HALIFAX

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Item No. 12.1.1
Environment & Sustainability Standing Committee
February 4, 2016

TO: Chair and Members of Environment & Sustainability Standing Committee

SUBMITTED BY: Original Signed by

Bruce Zvaniga, Director, Transportation & Public Works

DATE: January 6, 2015

SUBJECT: **Organics Processing and Management**

ORIGIN

January 14, 2014 staff provided Halifax Regional Council with the Final Solid Waste Strategy Review recommendations. As per recommendation #2, Council directed staff to initiate development of a business case for the source separated organics program to introduce an Anaerobic Digestion processing capability and other program changes to improve system cost performance and compost quality and return to Regional Council with a revised plan by June 30, 2014.

LEGISLATIVE AUTHORITY

Under the HRM Charter, Section 79, Halifax Regional Council may expend money for municipal purposes. Administrative Order #35, the Procurement Policy, requires Council to approve the award of contracts for sole sources exceeding $50,000 or $500,000 for tenders and RFP's. See Charter Sections 79(1) and 322(3).

RECOMMENDATION

The Environment and Sustainability Standing Committee recommends to Halifax Regional Council to:

1. Direct staff to initiate the process to identify a service provider for organics management and processing as per the scope of work and requirements included as Attachment A to this report and to return to Halifax Regional Council to award the organics management and processing contract.

BACKGROUND

On September 20, 2011 Halifax Regional Council directed staff to advance the 'next steps' in order to achieve a more fiscally sustainable delivery of the Halifax solid waste system. On June 18, 2013 staff presented the Stantec Waste Resource Strategy Report ("the Stantec Report") to Halifax Regional Council. The Stantec Report included recommendations on how to evolve the Solid Waste program for Halifax. Subsequent to this report staff returned to Council, after community consultations, with recommendations for Council's considerations. With regards to organic management on January 14, 2014 Council approved recommendations 2, 3 and 5:

Recommendation 2 - Direct staff to initiate development of a business case for the source separated organics program to introduce an Anaerobic Digestion processing capability and other program changes to improve system cost performance and compost quality and return to Regional Council with a revised plan by 30 June, 2014;

Recommendation 3 - Initiate By-law amendments to improve organics collection, processing and finished compost product quality for residential source separated organics by:

a. removing boxboard as a mandated green bin product (while still permitted as a kitchen scrap material catcher);
b. mandating use of kraft paper bags for separate collection of leaf and yard waste; and,
c. banning grass clippings from collection;

Recommendation 5 - Initiate By-law amendments to:

a. mandate clear bags (with one nested opaque bag) for residential collections; and,
b. reduce garbage bag limits from 6 to 4;

On February 3, 2015 Council adopted By-law S608 requiring:

a. removing boxboard as a mandated green bin product (while still permitted as a kitchen scrap material catcher);
b. mandating use of kraft paper bags for separate collection of leaf and yard waste;
c. banning grass clippings from collection; and
d. mandating clear bags (with one privacy bag) for residential collections;

The By-law became effective August 1, 2015.

This report is intended to address the above Recommendation 2 as approved by Regional Council on January 14, 2014.

DISCUSSION

Currently Halifax has contracts with two operators to process source separated organics (SSO) generated from the residential and industrial, commercial, and institutional (IC&I) sectors. The two facilities are:

- New Era Technologies Limited (New Era) compost facility located at 61 Evergreen Place, Goodwood, Nova Scotia
- Miller Waste Systems Inc. (Miller) compost facility located at 80 Gloria McCluskey Avenue, Dartmouth, Nova Scotia

Miller operates under a long-term design-build-finance-operate (DBFO also known as BOOT) contract with Halifax. Halifax will take ownership of the Miller facility no later than 2019 with the completion of the long term contract. On December 1, 2015 as part of a settlement agreement Halifax purchased the New Era facility. New Era will continue to operate the site until September 2016. At this point, Halifax will assume site operations. As Halifax's organics management infrastructure has aged, investments are needed to sustain and expand the system to meet future needs. As such, staff has evaluated future organics processing needs by assessing current infrastructure and options to build new facilities.

Each compost facility was evaluated in terms of:

- Building condition
- Equipment condition
- Compliance and process review; in particular the ability to meet the 2010 Nova Scotia Environment (NSE) Composting Facility Guidelines (2010 NSE Guidelines)

An engineering consultant, GHD, formerly Conestoga-Rovers & Associates (CRA), was retained to complete the majority of the evaluation and assessment work, while Machinex Industries Ltd. (Machinex) was retained to complete the assessment of material handling equipment.

Building assessments included a review of the structure, exterior building envelope, mechanical/electrical systems, life support systems, and roof. Upgrades/repairs were identified that are needed to be implemented over the next five years to improve the condition of the facility(s) and potentially extend the life for another 10-15 years, post 2019.

Equipment assessments were completed by Machinex and consisted of reviewing the condition of material handling equipment (e.g., conveyors, shredders, and magnets).

Compost processing reviews identified requirements to bring each facility into compliance with the 2010 NSE Guidelines, identified any general process improvements, and evaluated the options of increasing and decreasing the capacity of the facility. Both composting facilities were originally constructed and began operation in the late 1990s (1998/99) and were designed in accordance with NSE requirements that specified meeting compost quality in accordance with the 1996 Canadian Council of Ministers of the Environment (CCME) Guidelines for Compost Quality. Since that time, NSE has adopted the most recent 2005 CCME Guidelines for Compost Quality (2005 CCME Guidelines) and has required composting facilities in Nova Scotia be in compliance by the fall of 2019. The primary challenge for compost facilities to achieve compliance with the 2005 CCME Guidelines is that there is a more stringent maturity requirement for the organics.

The above evaluations and assessments were used to develop an Organics Management Business Case (GHD, October 2015). Based on input from staff, options were developed with regards to existing infrastructure and new facilities. The overall objective of the business case was to evaluate these options in terms of cost, compatibility with feedstock, and risk as examples. The business case summarizes the potential cost implications and advantages and disadvantages of each option. Within the business case, various processing technologies were considered for additional processing capacity. These included aerobic composting technologies, similar to the technologies currently used at the Goodwood and Dartmouth facilities, and anaerobic digestion including the use of on-farm anaerobic digesters.

The following sections of this report provide an overview of the assessment work completed at each facility, a summary of procurement considerations, and findings of the business case.

Overview of Goodwood Composting Facility (New Era) Assessments and Studies

Building Condition

The Goodwood facility was found to be in fair to poor condition with complete replacement of the Screening Building (i.e. replace fabric walls/roofing and steel trusses and further assessment of existing foundation prior to re-using it) required and localized repairs and maintenance required for the other two buildings (CRA, April 2015). The total cost to repair and maintain the facility over the five year investment horizon of the study is $697,500. It is GHD’s opinion, that with continued regular maintenance (such as the repairs recommended in the April 2015 assessment report) and no substantial change in the use of the facility, the buildings should have an estimated remaining useful life of 10-15 years.

Mechanical Equipment

Machinex (February, 2015) completed a review of equipment and identified that an infeed conveyer would likely need to be replaced. Overall material handling equipment predominantly used to process incoming material was in good condition. A cost estimate to complete the work was not provided.

Compliance and Process Review

CRA (GHD) completed a Compliance and Process Review for the New Era facility in June 2015 to evaluate if and how the facility will meet the 2010 NSE Guidelines. Based on the review, the following will be required at the Goodwood facility, at a minimum:

- Continued practice of no recirculation of leachate (zero capital cost, net operational savings with respect to leachate management).
- Additional bulking amendment (zero capital cost item, potential of $8-16 per tonne of SSO increase in operating costs).
- Additional curing area and/or more frequent turning of the curing pile (i.e., increased aeration) ($400,000 - $1,500,000 of capital for additional curing area and/or new windrow turning equipment).

In addition, GHD noted that the Stinnes-Enerco composting container system is nearing the end of its remaining useful life. New containers can no longer be purchased from Stinnes-Enerco (as they are no longer in business). An alternate composting system would be required to expand or replace the existing container system at this facility.

Recommendation for the Site Up to March 31, 2019

Provided that there are no plans to continue operating the facility post 2019, the Goodwood facility should continue to operate with no building or process improvements, with the exception for items effecting health and safety and to meet applicable codes, laws, and regulations. Based on the Building Assessment (CRA, April 2015), several items may need to be implemented prior to 2019, such as potentially replacing the screening building (as noted above), and making potential repairs and improvements to the Receiving Building (e.g., replace base angles, horizontal members, replace siding, corrosion protection, etc.).

Recommendation for the Site Post March 31, 2019

GHD concluded that the Goodwood facility is not ideal for considering further investment to upgrade operations to bring it into compliance with the 2010 NSE Guidelines. In 2019, when the 2010 NSE Guidelines will apply to the facility, it is recommended that Halifax replace the existing facility with alternate organics processing capacity to meet Halifax's organics processing needs for the subsequent 20-year period. Therefore, it was recommended that the Goodwood facility be decommissioned in 2019.

With respect to process improvements or modifying the capacity of the facility, the primary constraints are:

- Age and condition of existing equipment and buildings (including that the composting container system is nearing the end of its remaining useful life).
- Characteristics of feedstock materials (e.g., porosity, moisture, and carbon to nitrogen ratios) and challenges in sourcing suitable bulking amendment to mix with the feedstock material to make it more compatible with the processing technology.
- Incompatibility between the existing organics processing technology (static aerated floor container system) with Halifax SSO material (particularly wetter IC&I materials).

Associated Cost/Savings With Recommendation

GHD estimated to continue operating the Goodwood facility for the first 5 years of operation past 2019 would cost Halifax $5-17 million more of capital and operating costs as compared to a more efficient organic processing capacity. In addition, the 61 Evergreen Place property is zoned for processing of solid waste (organics) and is owned by Halifax. The site is 33 acres with approximately 20 acres undeveloped. There is sufficient space to construct a new facility around the existing facility while maintaining the Goodwood operation during a transition period.

Overview of Dartmouth Composting Facility (Miller) Assessments and Studies

Building Condition

The Dartmouth facility was found to be in fair condition with localized repairs and maintenance required (CRA, May 2015). The total cost to repair and maintain the facility over the five year investment horizon of the study is $491,000. It is GHD's opinion, that with continued regular maintenance (such as the repairs recommended in the May 2015 assessment report) and no substantial change in the use of the facility, the building should have an estimated remaining useful life of 10-15 years.

Mechanical Equipment

Machinex (February, 2015) completed a review of equipment and identified that an infeed conveyer requires replacement at a cost of $115,950. Overall material handling equipment predominantly used to process incoming material was in good condition.

Compliance and Process Review

GHD completed a Compliance and Process Review for the Miller facility in July, 2015 to evaluate if and how the facility will meet the 2010 NSE Guidelines. Based on the review, it was recommended that the Dartmouth facility continue operating at its current capacity beyond 2019 with some building repairs and equipment replacement, and the implementation of one of the following options to meet the 2010 NSE Guidelines for compost maturity requirements as of 2019:

- Option 1: Increased aeration during curing by forced aeration including the addition of a roof structure over screener bunkers and compost loading area, as piloted and proposed by Miller ($1.5 - 2.2 million capital expenditure by 2019).
- Option 2: Increased aeration during curing with turning equipment ($3.8 - 6.0 million capital expenditure by 2019).
- Option 3: Increased outdoor curing area (off-site) ($0.4 – 1.5 million capital expenditure by 2019, excluding the cost of land and does not consider the annual operating costs with respect to trucking compost to a curing facility).
- Option 4: Partial implementation of Miller's proposal to implement forced aeration throughout the curing area and additional outdoor curing of materials at the site ($0.5 – 1.0 million capital expenditure by 2019).

GHD concluded that overall, the existing Ebara in-vessel composting process at the Dartmouth facility is generally effective at producing compost from Halifax's residential SSO and IC&I organics. An increase in capacity at this facility would require a significant expansion to the compost facility, which may not be approved as per the 2010 NSE Guidelines separation distance requirement of at least 500 metres from the nearest residential or institutional building. The separation distance between the existing composting building and the neighbouring Central Nova Scotia Correctional Facility is less than 250 metres.

This site may also be able to accommodate a new organics management facility with a technology other than composting (i.e. anaerobic digestion), as the land is owned by Halifax and the site already contains an Approval to Operate as a compost facility. In addition the site has been approved by the Province for a 2 MW (mega watt) COMFIT agreement.

Recommendation for the Site Up to March 31, 2019

Continue operating the Dartmouth facility and implement the recommendations outlined in the Building Assessment (CRA, May 2015) and Machinex (February, 2015) reports.

Recommendation for the Site Post March 31, 2019

Continue operating the facility as a 25,000 tonnes per year composing facility. Implement one of the options identified in the Compliance and Process Review (GHD, July 2015), such that compost quality that is produced from the facility is in compliance with the 2010 NSE Guidelines.

Associated Cost/Savings With Recommendation

Capital expenditures to allow the facility to produce compost that is in compliance with the 2010 NSE Guidelines will likely cost $0.5 - 2.2 million provided that either Options 1 or 4, as noted above, are implemented. In addition, approximately $600,000 will be required in equipment and building repairs to maintain the facility. Further, additional capital investment will be required to extend the remaining useful life of the existing composting facility infrastructure and equipment to the full 20 year planning period post 2019.

Business Case Results

On January 14, 2014 Regional Council directed staff to initiate development of a business case for the source separated organics program to introduce an Anaerobic Digestion processing capability and other program changes to improve system cost performance and compost quality and return to Regional Council. In order to provide a more comprehensive analysis of organics system changes and their impact to Halifax, additional processing methods were also reviewed.

GHD (October 2015) prepared an Organics Management Business Case to evaluate organic material management options available to Halifax to meet processing capacities for the next 15 to 20 years, post 2019 (attached). Through discussions with Halifax, options were developed with regards to existing infrastructure and new facilities. The overall objective of the business case was to evaluate these options in terms of cost, compatibility with feedstock, and risk as examples.

In developing options, the following were identified as key considerations:

- Minimizing capital and operating costs, including reducing current processing costs
- Meeting the 2010 NSE Guidelines for compost post 2019
- Increasing organics processing capacity from 50,000 tonnes to 60,000 tonnes per year, with the option to increase to 75,000 tonnes per year in the future

Table 1 as attached (Attachment C) summarizes the options that have been considered for this assessment. Note that all options provide for a total of 60,000 tonnes per year organics processing capacity with the option to increase to 75,000 tonnes per year in the future. The options are split into three basic categories:

- Option 1: utilize the Dartmouth compost facility with one new organics processing facility for 35,000 tonnes/year.
- Option 2: utilize the Dartmouth compost facility with two new organics processing facilities for 10,000 – 25,000 tonnes per year each. This option was created to explore partially repurposing the Waste Stabilization Facility (WSF) and utilizing on-farm anaerobic digestion facilities that have COMFIT agreements. The WSF and on-farm facilities have limited capacity to accept Halifax organics.

- Option 3: one new organics processing facility for the full 60,000 tonnes per year.

Processing technologies that were considered for new processing capacity included aerobic composting and anaerobic digestion including the use of on-farm anaerobic digesters.

In addition to economic evaluation criteria, the following criteria were also scored in a decision matrix:

- Facility footprint
- Compatibility with Feedstock
- Planning and Approvals Risk
- Process and Technical Risk
- Odour and Noise
- Process Water and Stormwater
- End Products and Byproducts
- Phasing and Transition
- Overall Schedule
- Future Regulations (i.e. current regulations, guidelines or standards currently under review)

The decision matrix was created to compare the different siting configurations with each option, using criteria to rank the various options and a weighting factor to weight the significance of each criterion noted above. The decision matrix was used to develop a score for each option, with a maximum total possible score of 100.

The weighting values used by GHD were determined in cooperation with Halifax staff. They represent the priorities of Halifax for developing a new organics processing facility based on the over 15 years of experience in managing two organics processing facilities. The primary priorities identified were:

- Cost (Weighting 20/100)
- Odour and Noise (Weighting 20/100)
- Compatibility with Feedstock (Weighting 15/100)
- Overall Schedule (Weighting 10/100)

Scores were tabulated in two different ways, namely:

- Total Score: sum of the weighted scores for each option, higher scores are better
- Value for Money: calculated[1] as an adjusted total score divided by Equivalent Annual Cost and represents a relative points per dollar score

The options are sorted by Equivalent Annual Cost (lowest to highest) in Table 2 below to compare the results of the top scores. The top three options under each column in the below table are highlighted.

The top scores all involved existing sites.

Table 2 - Evaluation Results Summary

	Option	Equivalent Annual Cost[2] ($/tonne) (Rank)	Total Score (Rank)	Value for Money (Rank)
2b	Existing Dartmouth Facility (25,000 tonne/year) & 2 New On-Farm Anaerobic Digestion Facilities (~20,000 tonne/year each)	**$148**	67 (5)	**31.4 (3)**
3a	New 60,000 tonne/year Compost Facility at an Existing Site	**$155**	56 (9)	23.5 (11)
1a	Existing Dartmouth Facility (25,000 tonne/year) & New Compost Facility (35,000 tonne/year) at an Existing Site	**$159**	59 (8)	25.5 (7)
2a	Existing Dartmouth Facility (25,000 tonne/year) & New Compost (10,000 tonne/year) and Anaerobic Digestion (25,000 tonne/year) Facilities at an Existing Site	$184	62 (6)	25.3 (8)
1b	Existing Dartmouth Facility (25,000 tonne/year) & New Anaerobic Digestion Facility (35,000 tonne/year) at an Existing Site	$191	72 (4)	30.1 (5)
3b	New 60,000 tonne/year Anaerobic Digestion Facility at Goodwood Site	$209	**82 (1)**	**33.5 (1)**
3b	New 60,000 tonne/year Anaerobic Digestion Facility at Dartmouth Site	$209	**79 (2)**	**32.3 (2)**
3b	New 60,000 tonne/year Anaerobic Digestion Facility at New Site	$209	**77 (3)**	31.1 (4)

The lowest cost option, based on an Equivalent Annual Cost basis, over a 20 year lifecycle, was determined to be the option that utilized the existing Dartmouth composting facility assets in combination with two new on-farm anaerobic digestion facilities (Option 2b). The on-farm anaerobic digestion facilities do not require significant additional capital expenditures for Halifax. This is based on the assumption that existing COMFIT revenues for renewable energy received by these farms will offset capital expenditures for the farms, savings which will in turn be passed on to Halifax (i.e., they will build the facilities regardless if Halifax supplies them with feedstock). This option also represents the third best value for money. However, it has a low score compared with some of the other options primarily due to the uncertainty of relying on on-farm third-party processors for the bulk of Halifax's organics processing needs; this resulted in Option 2b only scoring well in one of the four priority evaluation criteria. Establishing agreements with multiple farms can help mitigate this risk to an extent. Also, ensuring contractual arrangements that would provide Halifax with performance guarantees and penalties would be critical to ensuring reliability of processing capacity.

Options involving new compost facilities at existing site(s) (e.g., Goodwood site; Options 1a and 3a) represent the next lowest cost option. These options have relatively low scores and represent poor value for money; in this case, primarily due to the issues surrounding the suitability of composting the feedstock

[1] Value for Money = 100 x (Total Score - Equivalent Annual Cost Score)/ Equivalent Annual Cost
[2] Equivalent Annual Cost (EAC) = NPV / $A_{t,r}$ + annual operating cost; where NPV is Net Present Value and annualization factor $A_{t,r}$ is the inverse of a loan repayment factor (PMT in Excel) for a period t (20 years) and a cost of capital r (4%).

material (i.e., wetter IC&I organics). An external bulking amendment would be required in greater quantities to effectively compost Halifax's co-mingled residential and IC&I organics. This is considered a significant obstacle to producing a quality compost product for sale under the 2010 NSE Guidelines. As such, it will be difficult to produce compost that can be marketed directly for a good price; and continued bulk sales to third-party landscaping companies, as an example, for low prices will likely continue to be the extent of the marketability of the product.

Options 1b and 3b, which involve the construction of a new anaerobic digestion facility generally scored the highest and represent the best value for money; but are the highest cost options as well. The options involving a new 60,000 tonnes per year facility at the Dartmouth or Goodwood sites (Option 3b) scored high in three of the four priority evaluation criteria and high in all of the other evaluation criteria. Anaerobic digestion is better suited for the nature of the materials generated within Halifax given the mandatory inclusion of IC&I organics. Anaerobic digestion facilities offer many benefits over composting in large urban centers, as they are able to be sited closer to the areas where the organics are generated and have smaller footprints.

For the purposes of the business case, it was assumed that COMFIT revenues for renewable energy would not be available for new anaerobic digestion facilities due to a current program freeze in Nova Scotia. If a long term COMFIT contract could be secured this could decrease the Equivalent Annual Cost by roughly $25-40/tonne down to $169-184/tonne; which would result in a more cost competitive option albeit still a higher cost over the long term as compared to composting.

The Goodwood facilities and site are owned by Halifax. They are not encumbered with a lease agreement and therefore have the potential to be immediately developed. The Dartmouth facilities are owned by Miller. The land is owned by Halifax and is leased to Miller. These lands are encumbered and not accessible to other proponents until 2019. Therefore developing the Dartmouth site may not be feasible for other operators unless a joint venture or purchase of the facilities can be achieved.

Overall, based on the evaluation criteria and weighting utilized, GHD is of the opinion that the development of anaerobic digestion capacity to process at a minimum part of Halifax's SSO will offer many long-term benefits including addressing the processing of wetter IC&I organics. It will also allow existing composting capacity at the Dartmouth site, should Halifax elect to keep it operational past 2019, to operate more effectively by allowing Halifax to selectively divert only drier residential organics to it that are mixed with some leaf and yard waste materials.

Each of the above options has its advantages and disadvantages. An option for Halifax to consider as a next step would be to move forward with a competitive bid process that is technology neutral to allow compost and anaerobic digestion technology centered bids to compete against each other. As well, Halifax could allow bids that utilize centralized transfer and pre-processing of materials as components (ensuring that proposals received adequately address all potential risks) such that off-site processing options such as on-farm AD could be available for potential organics capacity. A two stage procurement process where technology vendors and suppliers are pre-qualified based generally on technical merit first and then on their full business case proposal second is a viable procurement model.

FINANCIAL IMPLICATIONS

In the event that funding is required within 2015/16 there is approximately $75,000 available in consulting services (R321-6303). If these funds are not required they will become surplus for 2015/16. The majority of the cost is anticipated to be within the proposed 2016/17 project budget CW000004 Organics Management. This project has $500,000 currently proposed to fund the prequalification/RFQ development and RFP development, review and scoring, technical assessment and analysis of proposals, community consultations and engagement, legal, contract negotiations, a fairness monitor and other related project costs.

COMMUNITY ENGAGEMENT

After a proponent is selected by Council, and prior to the signing of a contract there will be a community consultation campaign in order to provide information and engage residents.

ALTERNATIVES

1. ESSC recommends that staff return to the committee with a recommendation on a specific organics processing methodology and technology for approval.

2. ESSC recommends that only 61 Evergreen Place, Goodwood and 80 Gloria McCluskey Avenue, Dartmouth be considered as sites for future organics processing, transferring and management within the Halifax Regional Municipality.

ATTACHMENTS

The following are reference materials for this report:

A. Procurement Scope of Work and Requirements
B. Project Delivery Methods for Organics Processing Capacity
C. Table 1 - Evaluated Organics Processing Options
D. GHD Organics Management Business Case, Halifax Regional Municipality, October 28, 2015
E. CRA Process Review of New Era Technologies Limited Compost Facility, June, 2015
F. GHD Process Review of Miller Waste Compost Facility, July, 2015
G. CRA Building Assessment Composting Facility – New Era Technologies, April, 2015
H. CRA Building Assessment Composting Facility – Miller Waste, May, 2015

A copy of this report can be obtained online at http://www.halifax.ca/commcoun/index.php then choose the appropriate Community Council and meeting date, or by contacting the Office of the Municipal Clerk at 902.490.4210, or Fax 902.490.4208.

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ATTTACHMENT A - Procurement Scope of Work and Requirements

It is not recommended that staff develop a predefined and predetermined solution to managing organic material; but instead allow market innovation to assist in procuring the most capable and cost effective solution to manage this stream. Proponents may utilize existing assets, facilities and sites in their proposals. By allowing the market to develop organics management and processing options it provides for alternative methods to be proposed which may or may not have been analyzed by staff.

Based on the data and information as noted throughout the report, staff believe that the procurement process should:

1. Allow the market to provide Halifax with an organics management and processing solution which:

    a. Minimizes capital and operating costs, including reducing current processing costs,
    b. Minimizes impact to the community (odors, noise etc.)
    c. Meets the 2010 NSE Guidelines for compost post 2019,
    d. Increases organics processing capacity from 50,000 tonnes to 60,000 tonnes per year, with the option to increase to 75,000 tonnes per year in the future.

2. Staff will issue a Request for Qualification (RFQ). Proponents will be assessed on a Pass/Fail basis and those who have passed will be invited to the RFP stage. The entire process will be open to different organics management and processing technologies and processes. If qualifications are deemed to be too restrictive staff may issue another RFQ with modified criteria.

   The RFQ may require such things as, but not limited to:

   a. The vendor being a capable contractor (or joint venture) with similar experience in organics processing facility development and successful track record of implementing projects of similar size and for a similar feedstock.
   b. The vendor having a minimum number of similar successful processing operations operating for a minimum number of years.
   c. The processing technology or method is demonstrated with reference projects and with successful operational facilities and some accessible facilities to be reviewed by Halifax.
   d. The demonstrated financial capability of the proponent to undertake the scope of work and requirements for this project and their organizational structure and financial resources.
   e. Proponent to provide information on the technology rights (if applicable), description of process technology, technical reliability, process controls, and attributes of their proposed solution including the proposed processing operations, the output(s), product(s), byproduct(s), and information on use of energy, water, etc. and generation of residues, wastewater, etc. from the process.
   f. An outline of the proponent's and staff's qualifications and experience (design, construction and operations), references, project management, operational successes, etc.
   g. The siting and regulatory process for the organics processing facility development and detail on the site or type of site being considered.

3. Within the RFQ, Halifax may include information such as but not limited to:

   a. Current operational plans for New Era Technologies and Miller Waste organics processing sites,
   b. Stantec Waste Resource Strategy Update,
   c. Machinex equipment review and assessment for New Era Technologies and Miller Waste organics processing sites,
   d. GHD Organics Management Business Case,
   e. CRA Process Review of New Era Technologies Limited Compost Facility,
   f. GHD Process Review of Miller Waste Compost Facility,
   g. CRA Building Assessment Composting Facility – New Era Technologies,
   h. CRA Building Assessment Composting Facility – Miller Waste,
   i. Scope of Work and Project Requirements,
   j. Organics Program Parameters and Expected Tonnage,
   k. System Requirements
   l. Proposed Project Schedule and Timelines,
   m. Proponent Eligibility,
   n. Expected Proponent Qualifications and Experience,
   o. Proponent's Responsibilities,
   p. Proponent Submission Requirements,
   q. Proponent's Expected Financial and Project Management Capabilities,

4. Staff intend to invite those who have passed the prequalification phase to the RFP stage. This stage allows staff to review in greater detail the proposed organics management and processing technologies and methods as well as the financial implications based on the various proponents' RFP responses. The procurement model staff intend to proceed with is a Build, Own, Operate with the option to transfer at the end of the operating term. After review, an evaluation committee will make a recommendation to Regional Council. It will be Council's decision which proposal is selected as the procurement method will be through a directed non-binding RFP. A non-binding RFP will provide Council options and flexibility in the award. Council will then be asked to direct staff to enter into community consultations as well as negotiations with the proponent, concluding in an agreement with a vendor.
5. Staff recommends allowing the service provider to use the existing approved compost processing sites located at 61 Evergreen Place, Goodwood or 80 Gloria McCluskey Avenue, Dartmouth. The service provider may have an alternate site within or surrounding the Halifax Regional Municipality that could also be used. These sites however would likely require the use of Evergreen Place or Gloria McCluskey Ave as a staging or transfer area (depending on distance). As indicated in the report, Halifax owns both properties. There is however a lease on Gloria McCluskey Ave which currently expires March 31, 2019 that may prohibit or limit its use until this time.

ATTACHMENT B - Project Delivery Methods for Organics Processing Capacity

GHD was requested to provide advice with respect to the project delivery methods available to Halifax in meeting its future organics processing needs. GHD advises that there are a number of traditional and emerging project delivery models available to owners or project sponsors. Each infrastructure project is unique with varying complexity, and should be evaluated individually to determine the optimal project delivery method. Similar to other infrastructure types, there is not a single best project delivery method that applies to all organics processing facility projects. Each organics processing project should be evaluated on its own merits based on the key considerations outlined herein; together with any owner or project specific considerations that may apply. This section summarizes the project delivery options available, key considerations for selecting a preferred method, and provides examples of the methods applied to other organics processing facilities in Canada.

There is an abundance of publicly available literature on the subject of infrastructure delivery methods with varying terminology. The following terminology and definitions will be used herein.

'Design-Bid-Build' (DBB) is a project delivery method in which the owner contracts with separate entities for the design and construction of a project. Operations and maintenance are contracted separately or completed by the owner. Capital financing is secured by the owner. This method is also known as design-tender, traditional method, and hardbid. This is the most common type of project delivery method in general, however, GHD is unaware of any organics processing facilities constructed using this approach in Canada.

'Design-Build' (DB) is a turnkey project delivery method in which the owner contracts with a single entity, known as the design-builder or the design-build contractor, to design and build a project. Operations and maintenance are contracted separately or completed by the owner. Capital financing is secured by the owner.

Example:

- City of Edmonton is currently employing a variation on the DB model, in which the anaerobic digestion and combined heat and power (CHP) unit (generator) technologies are being selected under separate procurement processes. The construction contractor will be procured as a Design-Build-Construction Management (DBCM) contractor to integrate the selected anaerobic digestion and CHP systems into the overall facility design and lead the construction. A DBCM is a variation of a DB in which a construction manager is involved in the project from design to commissioning.

'Design-Build-Operate' (DBO) is a turnkey project delivery method in which the owner contracts with a single entity to design, construct, operate, and maintain capital infrastructure. Operations and maintenance are for a defined period of time, after which control and operation of the facility is transferred back to the owner or subsequent operator. This method is also known as Design-Build-Operate-Maintain (DBOM), Build-Operate-Transfer (BOT), and Design-Build-Operate-Transfer (DBOT). Financing can be secured by the owner or by the contractor; if financing is secured by the contractor this approach is sometimes referred to as Design-Build-Finance-Operate (DBFO); which is sometimes treated as a subset of DBO but for the purposes of this discussion is considered a variation of the Build-Own-Operate-Transfer (BOOT) method defined below.

Examples:

- City of Toronto Disco Road SSO Anaerobic Digestion Facility (3-year base operating agreement + two 1-year optional extensions)
- City of Guelph SSO Composting Facility (10-year base operating agreement + two 5-year optional extensions)
- City of Hamilton SSO Composting Facility (4-year base operating agreement + two 1-year optional extensions)

- City of Calgary SSO Composting Facility (10-year operating agreement)

'Build-Own-Operate-Transfer' (BOOT) is a turnkey project delivery method in which the owner contracts with a single entity to design, construct, finance, own, operate, and maintain capital infrastructure for an agreed upon period of time and then transfer ownership and operations back to the owner at the end of that period in a specified condition. This method is also sometimes referred to as Design-Build-Finance-Operate (DBFO). The specified condition of the facility (e.g. major processing equipment must have a remaining useful life of 10 years) at the end of the contract will have a direct impact on the quality of equipment and materials utilized in the initial design of the project and thus will have a significant influence on the capital cost of the project.

Examples:

- Halifax Composting Facilities (5-year base operating agreement + one 5-year extension + two 5-year optional extensions)

'Build-Own-Operate' (BOO) is turnkey project delivery method similar to BOOT except the contractor retains ownership, including any residual value, of the infrastructure following the agreed upon contract period. This method is also known as Design-Build-Own-Operate (DBOO).

Examples:

- Walker Composting Facility servicing Region of Niagara SSO (20-year agreement)
- Orgaworld and Lafleche Composting Facilities servicing Region of York SSO (15-year agreement)
- Orgaworld Composting Facility servicing City of Ottawa (20-year agreement)

These are the key types of project delivery methods that will be used for the purposes of the discussion herein. There are a number of variations and hybridizations between these options that can and should also be considered. As indicated above, there is no single best approach to implementing an infrastructure project, each project is unique and may require a unique delivery method.

Public-Private Partnerships (PPP or P3) are increasing in popularity as demand for infrastructure upgrades and spending outpaces available public funds (particularly at the municipal level) for capital expenditures. The list of project delivery methods above is in order of increasing private sector involvement. DBB is a public ownership model. BOO is a private ownership model. The approaches in-between represent public-private partnerships. A P3 project is also a specific project delivery method endorsed by the Government of Canada that is a requirement to obtain some federal infrastructure funds.

The Government of Canada has created a federal crown corporation called PPP Canada. The PPP Canada website states, "PPP Canada acts as a leading source of expertise on P3 matters through knowledge development and sharing. Specifically, we provide expertise and advice in assessing and executing P3 opportunities at the federal level as well as leveraging greater value for money from Government of Canada investments in provincial, territorial, municipal and First Nations infrastructure through the P3 Canada Fund."

Summary of Halifax's Experience with Existing Organics Processing Contracts

Approximately 17 years ago, Halifax initiated a SSO program that included the construction of two new organics processing facilities. These facilities were constructed using a form of the BOOT project delivery method defined above. The contract between the owner and the contractor was based on a 5-year base contract period with one 5-year extension and two optional 5-year extensions in which the processing fee was renegotiated with each new contract extension (based on the actual operating costs of the facilities). The ownership of the facility is transferred to Halifax at the end of 20 years and the contract included buy-out options after the first 5-year extension period. Capital upgrades and expenditures were the responsibility of the contractor and were amortized over the remaining duration of the 20-year contract.

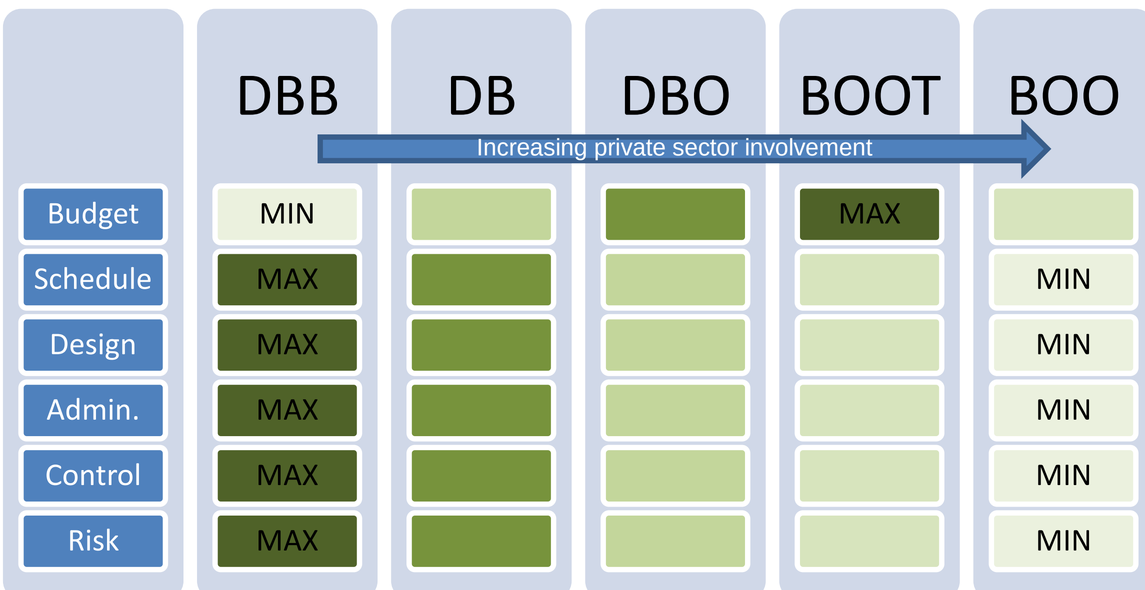
Breaking up the long-term contract in this manner avoided replacement and upgrade costs at the beginning of the contract but resulted in higher replacement and upgrade costs towards the end of the contract as required replacements were amortized over a shorter period. The renewal and renegotiating process was also often prolonged and expensive for Halifax.

Halifax owns the properties on which the facilities are located and leases the land to each of the respective contractors (New Era and Miller).

Key Considerations in Selecting a Project Delivery Method

This section discusses key considerations in deciding the project delivery method for an organics processing facility project. Figure 1 below summarizes which project delivery method provides the greatest and least benefit for the owner for each key consideration (see notes for Figure 1). Each consideration is discussed in detail following Figure 1.

Figure 1: Key Considerations for Project Delivery Methods



1. Notes: DBB = Design-Bid-Build
2. DB = Design-Build with separate private or public operator
3. DBO = Design-Build-Operate, financing through owner or contractor
4. BOOT = Build, Own, Operate, Transfer
5. BOO = Build, Own, Operate
6. In the case of Budget in Figure 1, DBB is considered to minimize the overall cost to the owner.
7. In the case of Schedule in Figure 1, the length of the project is increased due to the multiple steps with DBB while the BOO approach typically has the shortest turn-around time as the private sector is able to deliver the project in a completely private manner to achieve a set of performance specifications only.
8. In the case of Design in Figure 1, DBB typically requires more resources and design input and risk by the owner.
9. In the case of Administration in Figure 1, administration effort is the highest for the DBB approach which involves the greatest number of partners and associated contracts.
10. In the case of Control in Figure 1, there is less control of project details with the BOO approach.
11. In the case of Risk in Figure 1, the BOOT and BOO approaches intend to transfer more risk from the owner to the contractor.

Budget

For the purposes of this discussion, budget means project lifecycle capital and operational expenditures, including consultants, but does not include internal owner costs for project management and contract administration. Actual project lifecycle costs are difficult to compare directly for infrastructure projects as each project and project environment is unique. However, in general, the traditional DBB method is considered to be the lowest overall cost for an owner; this is offset by the level of direct involvement required by the owner to maintain multiple contracts with consultants, design firm(s), and contractor(s). A BOOT approach, while relatively simple for the owner to administer, can be expensive as financing costs are typically less favorable for a special purpose entity newly created for the purposes of a BOOT project as compared to a large municipality and are typically marked-up further by the contractor. The specified condition of equipment at the end of the contract can also have a significant impact on the cost of the facility.

In addition, for the DBB, DB and DBO methods, capital expenditures are paid directly by the owner as they are incurred during the design and construction phases of the project through their capital budget. This approach is typically cheaper over the longer term for a municipality but access to capital may be an impediment for a municipality at the time. In DBFO, BOOT, and BOO models (P3 approaches), capital expenditures are amortized through the processing fees after the project is successfully commissioned and after specific milestones are achieved.

Schedule

The DBB approach requires multiple procurement steps completed in sequence. For example, the design engineer must be procured first and the design completed before the tender process for the contractor can be initiated. Thus, the DBB approach tends to require additional time as compared with the other approaches that reduce the number of procurement steps. The BOO approach typically has the shortest turn-around time as the private sector is able to deliver the project in a completely private manner to achieve a set of performance specifications only.

In addition, schedule risk is reduced for the owner in the DBO, BOOT, and BOO approaches. The contractor agrees to schedule milestones with penalties for missed deadlines.

Design

The design effort and responsibility by the owner and the owners' consultants also varies for each project delivery method. DBB typically requires more design input and risk by the owner. DBO, BOOT, and BOO approaches are appropriate where the owner is primarily concerned with key performance criteria and less concerned with how the performance criteria are satisfied. DBO and BOOT approaches do require a minimum level of design input by the owner, whereas BOO projects can be executed without any significant design effort.

Administration

Administration effort is the highest for the DBB approach which involves the greatest number of partners and associated contracts that need to be initiated, administered and possibly renewed at defined intervals. Minimizing the number of contracts required minimizes the administration effort required by the owner. In addition, minimizing the design and performance specifications in the agreement also minimizes the administration effort required by the owner, or the owner's consultant.

Control

Transferring increased project risk to a contractor results in less control over the project details. Increased private sector involvement results in less control by the owner, apart from controls built into a single long-term contract. The importance of a good contract increases as the number of contracts decreases and the length of the contract term increases.

Risk

Increased risk transference from the owner to the contractor is the primary reason for increasing private sector involvement in a public infrastructure project. In order to be able to effectively assume risk, one's exposure to that risk must be fully understood. In construction, issues of risk are closely tied to the status of the local construction market, on-site safety, schedule, and budget. Contractors typically better manage construction related risks and are typically better able to manage and mitigate these risks if they have more input into the project from its inception.

It is possible to transfer a portion or all of the financial, schedule, insurance, and performance risk of a project to the private sector. This does come at a cost to the owner as the contractor will pass on any additional direct insurance costs or buffer their budgets to account for any items they view as being a risk to successful outcome of the project. The primary benefit to the owner in minimizing risk exposure is minimizing the likelihood of incurring unanticipated costs in the future.

Other Considerations

Insurance requirements do not typically change significantly with the project delivery method. However, ensuring proper and sufficient coverage among all project delivery partners becomes increasingly difficult with increased project delivery complexity.

Technology Selection

Proven organics processing technology options in Canada are limited to anaerobic digestion and composting, or aerobic digestion. While compost-based organics processing systems have historically tended to be cheaper than anaerobic digestion based systems, the technology options available in the Canadian marketplace for anaerobic digestion have changed significantly in the last few years. It is recommended that the procurement be open to both anaerobic digestion and compost based solutions. Only those anaerobic digestion systems that are cost competitive with composting options will likely respond.

Halifax has received inquiries from entities interested in engaging with the local farm community and (future) available on-farm anaerobic digestion capacity to process a significant portion of Halifax's organics. The primary benefit to Halifax is that these on-farm facilities have secured a significant additional revenue source in the form of a 20-year Nova Scotia Community Feed-In-Tariff (COMFIT) agreement for electricity sales, which could significantly offset capital and/or operating expenditures for Halifax. Another benefit is that the digestate from the on-farm anaerobic digestion facility could be directly land applied to that farm without the need for further composting. The risk to Halifax is that the farm operators have little to no experience handling or treating SSO or commercial organics in an anaerobic digestion facility. This risk can be mitigated somewhat by pre-processing the SSO at a central location (e.g. existing Dartmouth or Goodwood sites) and sending a clean organic pulp to the farms for digestion. Other risk mitigation measures include redundancy in on- and off-farm systems, clear contracts with the farm operators and a pre-determined contingency plan should an on-farm system fail to ensure no interruption in organics diversion.

This 'on-farm partnership' approach would require significant staff resources to develop, implement, administer, and maintain the necessary partnerships and agreements. Direct staff involvement with each individual participating farm would be required, at least initially, to protect Halifax's reputation in neigbouring communities and ensure necessary due diligence. Relying on a single contractor to manage this type of unique and innovative approach would be less staff resource intensive from a long-term contract administration perspective, but may result in reputational issues if staff are too hands-off.

No other large municipality in Canada relies on on-farm organics processing capacity for a significant portion of their organics diversion. If Halifax were to pursue this option, it would be a unique model and the first of its kind in Canada – particularly for an on-farm anaerobic digestion based system.

The COMFIT program mentioned above is currently suspended while it undergoes a program review. Further information on the future of the COMFIT program is expected sometime in the fall of 2015. COMFIT, or a similar renewable electricity procurement program, could potentially be a significant additional source of revenue for an anaerobic digestion facility. This is another reason for leaving the procurement process open to both anaerobic digestion and composting as it will allow those firms with COMFIT agreements, for example or any other competitive advantage, to offer the more expensive anaerobic digestion option at a more competitive price compared to composting.

Opening up the procurement to all technologies, will require a thorough evaluation of the technology types to ensure that the proposed technology is suitable for Halifax's organic materials. Anaerobic digestion and composting systems are known to both be effective.

Procurement Schedule

Anticipated procurement schedules for each of the project delivery methods are provided below.

DBB Schedule

- Design contractor procurement including request for proposal (RFP) development and contract signing: 4-8 months
- Design including tender document preparation and permitting: 8-12 months
- Construction contractor procurement: 6-8 months
- Construction and commissioning: 16-20 months
- Total: 34-48 months

DB, DBO Schedule

- DB/DBO contractor procurement including RFP development and contract signing: 10-16 months
- Design, permitting, construction and commissioning: 18-24 months
- Total: 28-40 months

BOOT, BOO Schedule

- BOOT/BOO contractor procurement including RFP development and contract signing: 6-12 months depending on time required to develop RFP and negotiate agreement(s)
- Design, permitting, construction and commissioning: 18-24 months
- Total: 24-36 months

There are 38 months between February 2016 and April 1, 2019 (i.e. end of current contract). Staff recommend proceeding with a form of the BOOT or BOO procurement approach to ensure new organics processing capacity is operational by April 1, 2019. Utilizing a DBB, DB or DBO approach requires more front end engineering design work than a BOOT or BOO approach.

Siting the facility at a site that is zoned and permitted for waste management will expedite the permitting process and remove the need for a public siting exercise. The Goodwood and Dartmouth sites are both considered good locations to site a future organics processing facility. The Dartmouth site could not be used for an expanded composting based facility due to proximity of neighboring institutional land uses but could be used for an anaerobic digestion facility. Use of an existing site may be advantageous to help meet the required April 1, 2019 deadline and will also save on overall project capital expenditures.

Siting the facility at an existing Halifax-owned site would require ownership of the facility to transfer back to Halifax at the end of the agreement (i.e. BOOT method) to ensure the Halifax-owned site and any assets continues to be available for Halifax's future waste management needs.

The current agreements for organics processing were structured as 20 year agreements with an initial 5-year fixed term plus a five year extension term and two optional 5-year terms. Each of the additional five year terms required fees to be re-negotiated based on the actual costs of operating the facility over the previous period. The re-negotiating process has proven to be time intensive for Halifax staff and requires significant legal and financial resources to complete. Moving forward, it is recommended that a single long-term operating agreement of 20 years, with specific handover requirements at the end of the 20-year operating period prior to transfer of ownership of a facility to Halifax, be negotiated with a single BOOT contractor. This will save Halifax significant contract administration time by staff and consultants.

ATTACHMENT C - Table 1 - Evaluated Organics Processing Options

Option No.	Facility 1	Facility 2	Facility 3
Option 1a	**Existing Dartmouth Compost Facility**	**New Compost Facility**	**NA**
Capacity	25,000 tonnes/year	35,000 tonnes/year	
Potential Sites		- Goodwood Compost Facility - New site	
Option 1b	**Existing Dartmouth Compost Facility**	**New Anaerobic Digestion Facility**	**NA**
Capacity	25,000 tonnes/year	35,000 tonnes/year	
Potential Sites		- Goodwood Compost Facility - Dartmouth Compost Facility - New site	
Option 2a	**Existing Dartmouth Compost Facility**	**New Compost Facility**	**New Anaerobic Digestion Facility**
Capacity	25,000 tonnes/year	10,000 tonnes/year	25,000 tonnes/year
Potential Sites		- Goodwood Compost Facility - Waste Stabilization Facility (WSF) at Otter Lake Site (partially repurpose facility) - New site	- Goodwood Compost Facility - Dartmouth Compost Facility - New site
Option 2b	**Existing Dartmouth Compost Facility**	**New On-Farm AD Facility**	**New On-Farm AD Facility**
Capacity	20,000 tonnes/year	20,000 tonnes/year	20,000 tonnes/year
Potential Sites		- On-farm site	- On-farm site
Option 3a	**New Compost Facility**	**NA**	**NA**
Capacity	60,000 tonnes/year		
Potential Sites	- Goodwood Compost Facility - New site		
Option 3b	**New Anaerobic Digestion Facility**	**NA**	**NA**
Capacity	60,000 tonnes/year		
Potential Sites	- Goodwood Compost Facility - Dartmouth Compost Facility - New site		

Attachment D

Organics Management Business Case

Halifax Regional Municipality, Nova Scotia

Halifax Regional Municipality

45 Akerley Boulevard Dartmouth Nova Scotia B3B 1J7

071855 | Report No 5 | October 28 2015

Executive Summary

GHD has prepared this organics management business case to evaluate organic material management options available to Halifax Regional Municipality (Halifax) to meet processing capacities for the next 15 to 20 years, post 2019. As Halifax's organics management infrastructure has matured, investments are needed to sustain and expand the system to meet future needs. Through discussions with Halifax, options have been developed with regards to existing infrastructure and new facilities. The overall objective of the business plan is to evaluate these options in terms of cost, compatibility with feedstock, and risk as examples. The findings of the business plan will help Halifax understand the cost implications and advantages and disadvantages of each option.

In developing options, the following were identified as key considerations:

- Minimizing capital and operating costs, including reducing current processing costs.
- Meeting the 2010 Nova Scotia Environment (NSE) Composting Facility Guidelines (2010 NSE Guidelines) post 2019.
- Increasing organics processing capacity from 50,000 tonnes to 60,000 tonnes per year, with the option to increase to 75,000 tonnes per year in the future.

The following table summarizes the options evaluated.

Option No.	Facility 1	Facility 2	Facility 3
Option 1a	**Existing Dartmouth Compost Facility**	**New Compost Facility**	**NA**
Capacity	25,000 tonnes/year	35,000 tonnes/year (may be increased to 50,000 tonnes/year)	
Potential Sites		- Goodwood Compost Facility - New site	
Option 1b	**Existing Dartmouth Compost Facility**	**New Anaerobic Digestion Facility**	**NA**
Capacity	25,000 tonnes/year	35,000 tonnes/year (may be increased to 50,000 tonnes/year)	
Potential Sites		- Goodwood Compost Facility - Dartmouth Compost Facility - New site	
Option 2a	**Existing Dartmouth Compost Facility**	**New Compost Facility**	**New Anaerobic Digestion Facility**
Capacity	25,000 tonnes/year	10,000 tonnes/year (may be increased to 25,000 tonnes/year)	25,000 tonnes/year

Option No.	Facility 1	Facility 2	Facility 3
Potential Sites		- Goodwood Compost Facility - Waste Stabilization Facility (WSF) at Otter Lake Site (partially repurpose facility) - New site	- Goodwood Compost Facility - Dartmouth Compost Facility - New site
Option 2b	**Existing Dartmouth Compost Facility**	**New On-Farm AD Facility**	**New On-Farm AD Facility**
Capacity	20,000 tonnes/year	20,000 tonnes/year	20,000 tonnes/year
Potential Sites		- On-farm site	- On-farm site
Option's 3a	**New Compost Facility**	**NA**	**NA**
Capacity	60,000 tonnes/year (may be increased to 75,000 tonnes/year)		
Potential Sites	- Goodwood Compost Facility - New site		
Option's 3b	**New Anaerobic Digestion Facility**	**NA**	**NA**
Capacity	60,000 tonnes/year (may be increased to 75,000 tonnes/year)		
Potential Sites	- Goodwood Compost Facility - Dartmouth Compost Facility - New site		

The following list ranks the options in terms of overall Equivalent Annual Cost, based on 4 percent interest for 20 years, from lowest to highest:

- $148/tonne: Option 2b (Dartmouth Facility, On-Farm Anaerobic Digestion).
- $155/tonne: Option 3a (New 60,000 tonne/year Compost Facility).
- $159/tonne: Option 1a (Dartmouth Facility, New Compost Facility).
- $184/tonne: Option 2a (Dartmouth Facility, New Compost Facility, New Anaerobic Digestion Facility).
- $191/tonne: Option 1b (Dartmouth Facility, New Anaerobic Digestion Facility).
- $209/tonne: Option 3b (New 60,000 tonne/year Anaerobic Digestion Facility).

In addition to economic evaluation criteria, the following criteria were also scored in a decision matrix:

- Facility footprint
- Compatibility with Feedstock
- Planning and Approvals Risk
- Process and Technical Risk
- Odour and Noise

- Process Water and Stormwater
- End Products and Byproducts
- Phasing and Transition
- Overall Schedule
- Future Regulations (i.e. current regulations, guidelines or standards currently under review)

The decision matrix was created to compare the different siting configurations with each option, using criteria to rank the various options and a weighting factor to weight the significance of each criterion noted above. The decision matrix was used to develop a score for each option, with a maximum total possible score of 100.

The weighting values were determined in cooperation with Halifax staff. They represent the priorities of Halifax for developing a new organics processing facility based on the over 15 years of experience in managing two organics processing facilities. The primary priorities identified were:

- Cost (Weighting 20/100)
- Odour and Noise (Weighting 20/100)
- Compatibility with Feedstock (Weighting 15/100)
- Overall Schedule (Weighting 10/100)

Scores were tabulated in two different ways, namely:

- Total Score: sum of the weighted scores for each option, higher scores are better.
- Value for Money: calculated[1] as an adjusted total score divided by Equivalent Annual Cost and represents a relative points per dollar score.

The options are sorted by Equivalent Annual Cost (lowest to highest) in the table below to compare the results of the top scores. The top three options under each column in the below table are highlighted. The top scores all involved existing sites.

Evaluation Results Summary

	Option	Equivalent Annual Cost ($/tonne) (Rank)	Total Score (Rank)	Value for Money (Rank)
2b	Existing Dartmouth Facility (25,000 tonne/year) & 2 New On-Farm Anaerobic Digestion Facilities (~20,000 tonne/year each)	**$148**	67 (5)	**31.4 (3)**
3a	New 60,000 tonne/year Compost Facility at an Existing Site	**$155**	56 (9)	23.5 (11)
1a	Existing Dartmouth Facility (25,000 tonne/year) & New Compost Facility (35,000 tonne/year) at an Existing Site	**$159**	59 (8)	25.5 (7)

[1] Value for Money = 100 x (Total Score - Equivalent Annual Cost Score)/ Equivalent Annual Cost

	Option	Equivalent Annual Cost ($/tonne) (Rank)	Total Score (Rank)	Value for Money (Rank)
2a	Existing Dartmouth Facility (25,000 tonne/year) & New Compost (10,000 tonne/year) and Anaerobic Digestion (25,000 tonne/year) Facilities at an Existing Site	$184	62 (6)	25.3 (8)
1b	Existing Dartmouth Facility (25,000 tonne/year) & New Anaerobic Digestion Facility (35,000 tonne/year) at an Existing Site	$191	72 (4)	30.1 (5)
3b	New 60,000 tonne/year Anaerobic Digestion Facility at Goodwood Site	$209	**82 (1)**	**33.5 (1)**
3b	New 60,000 tonne/year Anaerobic Digestion Facility at Dartmouth Site	$209	**79 (2)**	**32.3 (2)**
3b	New 60,000 tonne/year Anaerobic Digestion Facility at New Site	$209	**77 (3)**	31.1 (4)

The lowest cost option, based on an Equivalent Annual Cost basis, over a 20 year lifecycle, was determined to be the option that utilized the existing Dartmouth composting facility assets in combination with two new on-farm anaerobic digestion facilities (Option 2b). The on-farm anaerobic digestion facilities do not require significant additional capital expenditures for Halifax. This is based on the assumption that existing Nova Scotia Community Feed-In Tariff (COMFIT) revenues for renewable energy received by these farms will offset capital expenditures for the farms, savings which will in turn be passed on to Halifax (i.e., they will build the facilities regardless if Halifax supplies them with feedstock). This option also represents the third best value for money. However, it has a low score compared with some of the other options primarily due to the uncertainty of relying on on-farm third-party processors for the bulk of Halifax's organics processing needs; this resulted in Option 2b only scoring well in one of the four priority evaluation criteria. Establishing agreements with multiple farms can help mitigate this risk to an extent. Also, ensuring contractual arrangements that would provide Halifax with performance guarantees and penalties would be critical to ensuring reliability of processing capacity.

Options 1b and 3b, which involve the construction of a new anaerobic digestion facility generally scored the highest and represent the best value for money; but are the highest cost options as well. The options involving a new 60,000 tonnes per year facility at the Dartmouth or Goodwood sites (Option 3b) score high in three of the four priority evaluation criteria and high in all of the other evaluation criteria. Anaerobic digestion is better suited for the nature of the materials generated within Halifax given the mandatory inclusion of industrial, commercial, and institutional (IC&I) organics. Anaerobic digestion facilities offer many benefits over composting in large urban centers, as they are able to be sited closer to the areas where the organics are generated and have smaller footprints.

For the purposes of the business case, it was assumed that COMFIT revenues for renewable energy would not be available for new anaerobic digestion facilities due to a current program freeze in Nova Scotia. If a long term COMFIT contract could be secured for the Goodwood or Dartmouth sites, this could decrease the Equivalent Annual Cost by roughly $25-40/tonne down to $169-184/tonne; which would result in a more cost competitive option albeit still a higher cost over the long term as compared to composting.

Overall, based on the evaluation criteria and weighting utilized in this report, GHD is of the opinion that the development of anaerobic digestion capacity to process at a minimum part of Halifax's source separated organics (SSO) will offer many long-term benefits including addressing the processing of wetter IC&I organics. It will also allow existing composting capacity at the Dartmouth site, should Halifax elect to keep it operational past 2019, to operate more effectively by allowing Halifax to selectively divert only drier residential organics to it that are mixed with some leaf and yard waste materials.

Each of the above options has its advantages and disadvantages. An option for Halifax to consider as a next step, would be to move forward with a competitive bid process that is technology neutral to allow compost and anaerobic digestion technology centered bids to compete against each other. As well to allow bids that utilize on-farm infrastructure coupled with centralized transfer and pre-processing components; ensuring that proposals received adequately address all potential risks with partnering with one or more local farm businesses. This allows those firms with COMFIT agreements, for example or any other competitive advantage, to potentially offer the more expensive anaerobic digestion option at a more competitive price compared to composting.

However, in a public procurement process with pre-defined scoring, when the technology is not pre-determined prior to going out to tender, the owner must be willing to accept any technology that receives a passing score or cancel the procurement completely. One approach to mitigate this is a two stage procurement process where technology vendors and suppliers are pre-qualified based on technical merit first and then on their full business proposal second. This is similar to the approach currently being used by the City of Edmonton to find partners to provide a high-solids anaerobic digestion facility for their SSO.

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Table Index

1. Introduction

GHD has prepared this organics management business case to evaluate organic material management options available to Halifax Regional Municipality (Halifax) to meet processing capacities for the next 15 to 20 years, post 2019. As Halifax's organics management infrastructure has matured, investments are needed to sustain and expand the system to meet future needs. Through discussion with Halifax, options have been developed with regards to existing infrastructure and new facilities. The overall objective of the business plan is to evaluate these options in terms of cost, compatibility with feedstock, and risk as examples. The findings of the business plan will help Halifax understand the cost implications and advantages and disadvantages of each option.

In developing options, the following were identified as key considerations:

- Minimizing capital and operating costs, including reducing current processing costs
- Meeting the 2010 Nova Scotia Environment (NSE) Composting Facility Guidelines (2010 NSE Guidelines) post 2019
- Increasing organics processing capacity from 50,000 tonnes to 60,000 tonnes per year, with the option to increase to 75,000 tonnes per year in the future

Currently, source-separated organics (SSO) collected from residential and industrial, commercial and institutional (IC&I) haulers from within Nova Scotia are processed at either the New Era Technologies (New Era) composting facility, located at 61 Evergreen Place, Goodwood, Nova Scotia, or the Miller Waste Systems Inc. (Miller) Dartmouth composting facility, located at 80 Gloria McCluskey Avenue, Dartmouth, Nova Scotia. The 20-year long term design-build-operate contracts for both facilities will be completed in 2019, with Halifax taking ownership of the facilities, and terminating the lease of the properties. Each facility processes approximately 25,000 tonnes of organic materials per year. Although Halifax has established a number of policies and practices to reduce organic matter within the waste stream (e.g., green carts, clear bags), organic materials are still present within the residential and IC&I waste streams. This organic material is processed and disposed of at the Otter Lake Waste Processing & Disposal Facility (Otter Lake Site) through the Waste Stabilization Facility (WSF) located at exit 3 off Highway 103 in Halifax, Nova Scotia.

GHD considered the use of both existing organics processing sites under contract with Halifax, the Otter Lake Site, and the option of finding new sites for this evaluation. With respect to technology, in consultation with Halifax, GHD looked at proven organics treatment processes that have a demonstrated track record of being used to divert organics from landfills in Canada; namely composting and anaerobic digestion.

2. Existing Halifax Organics Management Facilities

As discussed in Section 1.0, organic material collected within Halifax is currently processed at three separate facilities on land owned by Halifax:

- Goodwood composting facility (SSO from residential and IC&I haulers).
- Dartmouth composting facility (SSO from residential and IC&I haulers).

- Otter Lake (organic material mixed with residential and IC&I waste).

GHD has considered how each of these sites could potentially contribute to Halifax's need for organics management post 2019. A brief description of each site and potential options for future organics processing is provided in the following subsections.

2.1 Goodwood Composting Facility

GHD completed a compliance and process review of the Goodwod composting facility (CRA[2], June 2015), and it was concluded that the facility is not ideal for considering further investment to upgrade operations to bring into compliance with the 2010 NSE Guidelines or to increase or decrease capacity. In 2019, when the 2010 NSE Guidelines will apply to the facility, it was recommended that Halifax replace the existing facility with alternate organics processing capacity to meet Halifax's organics processing needs for the subsequent 20-year period. With respect to process improvements or modifying the capacity of the facility, the primary constraints are:

- Age and condition of existing equipment and buildings.
- Characteristics of feedstock materials (e.g., porosity, moisture, and carbon to nitrogen ratios) and challenges in sourcing suitable bulking amendment to mix with the feedstock material to make more compatible with the processing technology.
- Incompatibility between the existing organics processing technology (static aerated floor/container) with Halifax SSO material (particularly IC&I materials). This is related to the feedstock issues identified above and the inability to easily address this incompatibility through changes to feedstock materials or composition.

In addition to the primary constraints, GHD estimated to continue operating the facility for the first 5 years of operation past 2019 would cost Halifax $5-17 million of capital and operating costs as compared to more efficient organic processing capacity.

Therefore, it was recommended that the Goodwood composting facility be decommissioned by 2019. A new organics management facility with a different technology could be constructed at this site, as the land is owned by Halifax and the site already contains an Approval to Operate as a compost facility. There is also the potential to utilize some existing equipment or infrastructure as part of a new processing facility.

2.2 Dartmouth Composting Facility

GHD completed a compliance and process review of the Dartmouth compost facility (CRA, July 2015). Overall, the existing Ebara in-vessel composting process is generally effective at producing compost from Halifax's residential SSO and IC&I organics.

It was recommended that the Dartmouth compost facility continue operating at its current capacity beyond 2019 with some building repairs and equipment replacement and the implementation of one of the following options to meet the 2010 NSE Guidelines for compost maturity requirements as of 2019:

[2] Conestoga-Rovers and Associates (CRA) has since changed its name to GHD

- Option 1: Increased aeration during curing by forced aeration including the addition of a roof structure over screener bunkers and compost loading area, as piloted and proposed by Miller ($1.5 - 2.2 million capital expenditure by 2019).
- Option 2: Increased aeration during curing with turning equipment ($3.8 - 6.0 million capital expenditure by 2019).
- Option 3: Increased outdoor curing area (off-site) ($0.4 – 1.5 million capital expenditure by 2019, excluding cost of land and does not consider annual operating costs with respect to trucking compost).
- Option 4: Partial implementation of Miller's proposal to implement forced aeration throughout the curing area and additional outdoor curing of materials at the site (0.5 – 1.0 million capital expenditure by 2019).

An increase in capacity would require a significant expansion to the facility, which may not be approved given the separation distance requirement of at least 500 metres from the nearest residential or institutional building in as per the 2010 NSE Guidelines. The separation distance between the existing composting building and the neighbouring Central Nova Scotia Correctional Facility is less than 250 metres.

This site may also be able to accommodate a new organics management facility with a technology other than composting (i.e., anaerobic digestion), as the land is owned by Halifax and the site already contains an Approval to Operate as a compost facility.

2.3 Otter Lake Waste Processing & Disposal Facility

The Otter Lake Site contains a Front End Processor (FEP) and WSF commissioned to remove recyclable materials and hazardous materials prior to landfill disposal, and stabilize any putrescible materials to reduce potential for landfill nuisance factors (e.g., odours, leachate, and vectors and vermin). Mirror Nova Scotia is the contractor operating the Otter Lake Site under a long-term 25-year design-build-operate contract. The majority of the solid waste taken to the Otter Lake Site is processed through the FEP. Approximately 27,000 tonnes per year of residential and IC&I residual solid waste materials less than 150 mm are processed through the WSF for stabilization with the intent of biodegrading organics, after being processed through the FEP. The WSF has the capacity to process approximately 49,000 tonnes per year of material. The facility contains 14 channels where materials are aerobically composted for 15-21 days, and then the resulting materials are sent to the landfill for disposal.

The WSF composting channels could potentially be transformed to allow for composting of residential SSO and IC&I organics. The following are examples of items that would require careful consideration to complete this:

- The indoor building air quality resulting from the positive aeration of the WSF channels is a significant concern that would need to be addressed. An option would be to implement negative aeration through the piles within the channels to improve indoor air quality.
- Creating a barrier over the channels to collect and treat the process air whether it be negative or positive aeration.
- Running a two-phased composting operation whereby half of the channels are used for primary composting and the other half are used for curing.

- The WSF is integral to the Otter Lake Site approval (i.e., approval was conditional on the WSF) and re-purposing it would involve a significant amendment to the Otter Lake Site approval.

There are a number of unknowns with this option that require further evaluation, such as building condition, other retrofit requirements, contractual constraints, approval conditions, and any impact this option may have on overall landfill operations. It is anticipated that amending permits for the Otter Lake Site would be much more onerous and expensive than for the development of a new site for an organics processing facility.

3. Evaluation Considerations

3.1 Feedstock Considerations

Based on discussions with Halifax, GHD developed organics processing options for an anticipated generation rate of 60,000 tonnes per year, with the option to expand to 75,000 tonnes per year if required to address current and future processing capacity requirements.

On August 1, 2015 Halifax implemented a clear bag program for residential garbage collection to improve the participation in their source separation programs for recyclables and organics. Halifax expects this program, based on results observed in other municipalities in Nova Scotia and Ontario, will significantly increase residential organics collection. Halifax also implemented a ban on grass clippings from residential collection, encouraging residents to "grasscycle", which will reduce the amount of organics collected as grass clippings as they were previously permitted in the green bins.

As of August 1, 2015 the following items were permitted in the green cart for collection:

- Fruit & vegetable peelings
- Table scraps, meat, fish, bones
- Dairy products
- Cooking oil & fat
- Bread, rice, pasta
- Coffee grounds, filters, tea bags
- Eggshells
- Food napkins
- Kitchen paper towels and soiled paper
- Excess leaves, brush and plants
- Sawdust and wood shavings

Plastic of any kind, including compostable bags or bin liners, was not permitted in the green carts. Boxboard is also permitted from the residential sector but is also allowed in the paper recycling stream effective August 1, 2015. The material accepted in Halifax's program is generally typical of SSO in other Canadian jurisdictions that do not permit plastic, pet waste or diapers. The relative quantities of residential and IC&I organics is summarized in Table 3.1 below.

Table 3.1 Organics Collected 2012 to 2014

Year	Leaf and Yard Waste[1] (tonne)	Residential (tonne)	IC&I (tonne)	Total (tonne)	% IC&I	Precipitation[2] (mm)
2012	2,210	33,349	16,233	49,581	32.7%	1,328
2013	2,348	33,365	16,453	49,818	33.0%	1,370
2014	3,559	33,002	17,353	50,355	34.5%	1,592
% Change		-1.0%	+6.9%	+1.6%	+5.3%	
Average		33,239	16,679	49,918	33.4%	1,388[3]

Notes:

1. Leaf and yard waste collected separately from residential organics, includes Christmas trees; shown for reference, not included in Total Organics as this material is not managed at the Goodwood or Dartmouth composting facilities
2. Source: http://halifax.weatherstats.ca/charts/precipitation-25years.html
3. Annual Historical Average from above-noted source.

The total amount of organics received at the two existing composting sites increased by 1.6 percent from 2012 to 2014. This is not a significant increase particularly when precipitation is factored in. IC&I tonnages increased by 6.9 percent from 2012 to 2014, however the operating staff at both the Goodwood and Dartmouth facilities commented that 2014 was a wet year and they noted the IC&I material specifically was coming in wetter than normal that year. Precipitation data over that time period confirms that 2014 was a wetter than average year; whereas 2012 and 2013 were both drier than normal years. IC&I collection containers are more exposed to the elements than residential green carts as they are more often stored outside and not always covered. Thus, it was assumed that the amount of organics collected over the three most recent years remained relatively constant at approximately 50,000 tonnes/year. The relative amount of IC&I organics is also assumed to be relatively stable at one third of the total.

A key challenge to future processing infrastructure is the ability to handle the wetter IC&I organics. Both the Goodwood and Dartmouth facilities have challenges to manage this material due to difficulty in sourcing reliable and cost effective bulking amendments (i.e., woodchips).

While the residential clear bag policy is expected to increase the total quantity of organics collected, the relative amounts of residential and IC&I organics is not expected to change significantly. A 15 percent (5,000 tonnes) increase in residential organics, with no change in IC&I quantities, would decrease the relative amount of IC&I organics from 33 to 30 percent. Thus, the feedstock porosity and moisture challenges currently experienced at both the Goodwood and Dartmouth facilities would remain an operational issue into the future. An external bulking amendment would still be required in greater quantities to effectively compost Halifax's co-mingled residential and IC&I organics. This is considered a significant obstacle to producing a quality compost product for sale under the 2010 NSE Guidelines. If an appropriate compost feedstock recipe cannot be achieved (i.e., C:N ratio, porosity, pH, etc) it will be difficult to produce a compost that can be marketed directly from the facility for a good price; and continued bulk sales to third-party landscaping companies, as an example, for low prices will likely continue to be the extent of the marketability of the product.

The moisture content and resulting lack of porosity or free air space of the SSO are generally conducive to creating anaerobic conditions in the material. One option is to work with the moisture in the material, not against it, and treat at least a portion of the organics in an anaerobic digestion facility. Halifax's residential and IC&I organics could be treated in an anaerobic digestion facility without the addition of external amendment materials.

3.2 Aerobic Versus Anaerobic Digestion

There are generally two processes utilized for organic material processing: aerobic composting and anaerobic digestion. Both are engineered biochemical conversion processes involving the decay of organic materials, but involve different conditions and produce different outputs, and have differing cost factors and revenue potential. Aerobic composting of SSO is the predominant means of processing SSO in Canada and the United States, while anaerobic digestion is relatively limited and may be dependent on energy pricing for biogas utilization as a revenue stream.

3.2.1 Aerobic Digestion/Composting

Aerobic composting occurs in the presence of oxygen, and uses naturally occurring microorganisms to break down complex organics into carbon dioxide, water, nitrates, and sulphates. In addition to these compounds, the aerobic process produces stable end-products (i.e., compost) and heat. Appropriate equipment selection and controlling process conditions such as moisture content and carbon to nitrogen ratio are key to minimizing odours and guaranteeing the quality of the end-product.

There are three main techniques used in aerobic composting: static piles, aerated static piles, and in-vessel systems. In its simplest form, composting is achieved using static piles called windrows, which are turned periodically using mobile equipment to aerate the material. These are simple outdoor piles that are exposed to the elements, and the level of overall process control is quite low.

Aerated static piles incorporate vented floors or perforated pipes into the windrows. Oxygen is introduced using pressure to push, or a vacuum to pull, air through the piles. There is a greater potential for odours using these techniques, so they are usually conducted indoors, or under a specially designed cover system. Introduction of controlled airflow accelerates the composting process and allows for more even and consistent distribution of oxygen within the organic mass, which is a prime consideration for composting.

More sophisticated systems include in-vessel composting plants which use mechanical means to introduce oxygen and aerate the material in enclosed, controlled environments. The most common systems include: beds or bays with mechanical agitation, horizontal basin reactors, modular tunnels/biocells with or without aeration, and vertical reactors. At this level of technology, process control is advanced, reducing composting times, environmental emissions, and producing high quality compost.

One of the key features of composting systems is the process air. In any composting regime, oxygenation of the material, either through mechanical turning or active aeration, is required. The air that has passed through and contacted the composting material thus contains odorous compounds that are then typically treated prior to release to the atmosphere. The treatment of process air in composting tends to be the single most challenging aspect of this type of operation.

The footprint required for an in-vessel composting facility is generally larger than an anaerobic digestion facility, mainly due to the size requirements for the processing vessels/tunnels and the area necessary for curing.

Composting is a proven technology for waste streams similar to Halifax's organics waste stream that includes residential and IC&I material. Generally, composting requires bulking amendment material to provide some structure within the compost piles during processing which allows air flow through the piles. Halifax's residential organic waste stream includes some leaf and yard waste that provides some bulking characteristics to the feedstock. The IC&I organic material does not contain leaf and yard waste and has a higher moisture content than the residential organic waste stream.

3.2.2 Anaerobic Digestion

Anaerobic digestion occurs in the absence of oxygen, and uses naturally occurring microorganisms to break down complex organics with the addition of heat. The outputs from this process include significant amounts of methane and carbon dioxide, other gases such as ammonia and hydrogen sulfide, and digestate which can be further composted using aerobic processes. A key advantage with anaerobic digestion is that a significant amount of energy can be recovered with the capture and utilization of the methane.

Anaerobic digestion processes are described as either wet or dry, or low vs. high solids, depending on the ratio of solids to moisture in the feedstock. Anaerobic digestion technologies are also distinguished by the number of stages (single or two-stage), operating temperature (mesophilic or thermophilic), process flow (continuous or batch), and the mixing regime (completely mixed, plug flow, or static). Anaerobic digestion facilities are more complex and capital intensive to operate than aerobic composting facilities, and require minimum tonnages and a continuous supply of material to make them feasible, in addition to some reasonable expectation of energy revenue over the long-term.

As opposed to composting, anaerobic digestion does not generate specific process air streams, as the odorous compounds are captured in the biogas produced in the unaerated environment. From an environmental emissions standpoint, this can be a significant benefit, especially when locating facilities in proximity to neighbours.

As noted, anaerobic digestion still produces an organic digestate that may be able to be directly land applied or it can be dewatered and composted. There may also be a wastewater/leachate end product that may require pre-treatment prior to discharge to the sewer or trucking off-site, and a residuals stream that is typically landfilled. The processing fees included in this business case account for some wastewater disposal/treatment or the hauling of digestate that is not dewatered for land application.

Water is a key consideration in planning an anaerobic digestion facility. The Dartmouth and Halifax sites are not connected to a sanitary sewer system and therefore wastewater generated would have to be trucked off-site for treatment or disposal. GHD recommends that Halifax carefully consider water and wastewater costs when evaluating anaerobic digestion options. High solids AD systems that minimize the amount of water required in the process should be included as part of the evaluation. High solids AD systems are less common in North America than wet AD systems but have been successfully implemented at a commercial scale at a number of locations, including in Richmond, British Columbia.

Anaerobic digestion is a proven technology for waste streams similar to Halifax's organics waste stream that includes residential and IC&I material. For example, the cities of Toronto, Richmond, and Orlando utilize anaerobic digestion to process a portion of their organic materials. Anaerobic digestion does not require the bulking amendment material that composting does, and as the IC&I organic material does not contain leaf and yard waste and has a higher moisture content than the residential organic waste stream, the IC&I material may be the most suitable organic waste stream for anaerobic digestion in Halifax.

The methane generated from the anaerobic digestion process can be captured and used to provide electricity and heat to the facility to offset electricity and propane requirements, or it can be exported from the facility and sold for additional revenues. Given that the Nova Scotia Community Feed-In Tariff (COMFIT) program is currently on hold, there are no incentive programs currently in Nova Scotia that offer premium prices and guaranteed long-term contracts for the generation and sale of renewable electricity or natural gas. As such, this business case assumes that no revenue will be realized from the sale of electricity from anaerobic digestion facilities; other than at third-party private on-farm anaerobic digestion facilities with existing COMFIT contracts. Revenues and on-farm anaerobic digestion facilities are discussed in detail below. COMFIT is further discussed in Section 3.5.1.

However, if a COMFIT or similar program does become available again in time for consideration, electricity revenue could be a significant source of revenue. The previous COMFIT price for combined heat and power was 17.5 cents per kWh. The amount of biogas and energy produced at anaerobic digestion facility varies depending on the feedstock and the process but at 17.5 cents per kWh, electricity sales could offset processing costs by approximately $25-40 per tonne of SSO[3].

If anaerobic digestion is selected as the preferred organics processing technology, a review of the inclusion of excess leaves, brush, and plants in the green carts should be reviewed with the technology provider. Certain leaf and yard materials can be digested under the right conditions but may not be compatible with all digestion technologies.

3.3 Siting – Existing Versus New

Halifax has the option to utilize existing organics management facility sites to develop new organics management facilities, to modify existing facilities, or to consider new sites in order to meet future processing capacity demands.

Siting criteria generally used to evaluate the suitability of a site for the purpose of constructing and operating an organics management facility are summarized below:

Location: in relation to waste-shed and other solid waste facilities.

Environmental: Air quality, noise, odour, terrestrial, aquatic, surface water, groundwater, agricultural.

Social: Sensitive receptors, land use/zoning, transportation, visual.

Cultural: Archaeological, heritage.

Technical: Permitting/approvals, safety, utility and services, suitability, flexibility.

[3] Assumes: 2 kWh/m^3 biogas, 90–130 m^3 biogas/tonne SSO and 10-20 percent engine downtime

Economic: Land purchase price and development costs.

Legal: Land acquisition, agreement.

Existing waste processing or disposal sites owned by Halifax have already gone through a siting exercise to address a set of siting criteria similar to the list above. The existing two composting sites and the Otter Lake Site are currently permitted for waste processing and/or disposal. Utilizing existing sites to expand the organics program in Halifax is a significant benefit in terms of site development cost savings and project development timelines. Environmental permits will need to be amended but a zoning amendment process can be avoided.

Halifax will need the existing organics processing capacity to be unaffected during the construction of any new facility. In other words, an existing facility may not be demolished to make room for a new facility until after the new facility is operational. A new facility constructed at an existing site must be constructed alongside an existing facility. Depending on the size of the new facility, and the staging area required for its construction, this may be a constraint for an existing site that may prevent its use or increase the time and cost required for construction.

The Goodwood composting facility is approximately 14 hectares while the Dartmouth composting facility is approximately 6 hectares. Co-locating a new anaerobic digestion facility at the Dartmouth site may be a challenge depending on its size and the ability to share or repurpose portions of the existing facility like the receiving hall, scale, and administration offices. There is approximately 2 hectares of usable space (accounting for 30 m buffers along the property boundary) at the Dartmouth site if the existing facility continues to operate. The Dartmouth site would not be an option to implement a new composting technology (if selected) due to setback requirements from neighboring institution. The Goodwood site is a good size for either composting or anaerobic digestion at the scales contemplated in this business case, namely 10,000 to 60,000 tonnes per year of SSO.

This business case does not evaluate sites based on the above-noted criteria other than to:

1. Differentiate between an existing site permitted and zoned for organic waste processing and a new site without requisite zoning or permits; for the purposes of this study GHD assumed that development costs for new organics processing capacity at all existing sites would be similar to developing a new site. This is a conservative estimate with regards to the cost of implementing new organics processing capacity at existing sites.
2. Eliminate the Dartmouth site as a potential site for additional composting capacity due to setback distances from the neighbouring institution.

3.3.1 On-Farm Anaerobic Digestion

There is also the potential to take advantage of available on-farm anaerobic digestion capacity to provide additional processing capacity as part of Halifax's organics management future plan. A number of farms have successfully obtained 20-year COMFIT agreements (refer to Section 3.5.1 for details on the COMFIT program) to sell electricity to the grid at a premium price (17.5 cents per kWh) and are in the process of constructing anaerobic digestion facilities. The actual status of these projects could not be confirmed and would need to be explored further. There is no known on-farm anaerobic digester processing residential SSO in the vicinity of Halifax that GHD is aware of. GHD is aware of on-farm anaerobic digesters processing agricultural and IC&I organics in Nova Scotia.

Table 3.2 summarizes the pros and cons of partnering with local farms for organics processing, specifically anaerobic digestion of SSO.

Table 3.2 Evaluation of On-Farm Organics Processing

Pros	Cons
COMFIT revenues decrease reliance on tip fees to finance capital expenditures. Deals with farms would need to be negotiated but there is a potential that this could save on processing fees for Halifax.	Reliability: Will on-farm facilities provide reliable processing capacity with minimal downtime? This depends on a number of factors including: - Operator skills and experience - Capacity redundancy, contracting with multiple farms with spare capacity - Agreement with facilities, ensure contracts contain necessary performance guarantees, consider contracting directly with farms to ensure Halifax can address any contract issues directly
Digestate can be stored on-farm and directly land applied at the farm, minimizing dewatering and transportation costs of digestate management.	An agricultural operation is not a waste processing operation. While some organics pre-processing can be done well on-farm, for cleaner IC&I organics for example, Halifax should exercise due diligence to ensure that any contracted farm is able to reliably deal with any residues generated by their process, or any wastes generated during a process upset. This can be mitigated by pre-processing the organics at a central location and delivering a clean pulp to the farms. Note: pre-processing systems need to be compatible with the anaerobic digestions systems, for example some anaerobic digestion systems are more sensitive to grit in the digester.
Provide local farms with additional electricity and tip fee revenues by supplying organics to support their project and their farm business.	GHD is not aware of any municipality of a similar size to Halifax in Canada that relies on on-farm partners for their organics processing requirements.
Reduced permitting requirements, particularly in comparison to a new industrial site.	
Halifax currently pays to transport and treat additional leachate generated by the composting facilities. An on-farm anaerobic digestion facility could minimize or eliminate the need for leachate transport or further treatment if the pulp is not dewatered prior to sending to the farms.	

GHD recommends Halifax pre-process the organics and supply the farm facility with a clean pulp suitable for their anaerobic digestion system. This will allow Halifax to retain control of and properly manage any residues at their own facilities or at facilities run by professional waste management companies. This business case assumes a central pre-processing facility for the on-farm processing option.

Grit removal is a key consideration in organics pre-processing ahead of an anaerobic digestion system. If grit enters the digester, or any storage tanks prior to the digester, it will settle out and accumulate at the bottom of the digester. Eventually, that digester will need to be shutdown, emptied and cleaned of grit. One hundred percent grit removal is not realistic and some grit accumulation is normal and anticipated, but it should be minimized to the extent possible; particularly for on-farm anaerobic digestion facilities. Most anaerobic digestion systems rely on pre-processing systems to remove grit, but some anaerobic digestion systems provide for grit and other contaminant removal within the digestion tank. Thus, a pre-processing system designed for an anaerobic digestion tank that includes built-in contaminant removal systems is not necessarily compatible with an anaerobic digestion system that does not include any built-in contaminant removal system.

Partnering with local farms would provide Halifax with a very unique model in Canada of returning food waste back to agricultural soils in a very local context. This could potentially be a very innovative and positive social benefit of this type of approach that could also provide Halifax with real economic benefits as well. That being said, this approach is untested and is considered risky from a processing capacity reliability perspective and should be considered carefully.

3.4 Regulatory Considerations

The regulatory framework for an organics processing facility in Nova Scotia can generally be thought of in two stages: facility development and operations, and end-product quality. The development and operation of the facility may require various approvals at the provincial and municipal level, while the quality requirements tied to the end-product govern its ability to be distributed into the marketplace.

A brief overview of the regulatory requirements for an organics facility is provided in the sections that follow. However, it is important to note that a number of different regulations and approvals may apply depending on the type of processing technology selected. In addition, if a site is selected that already has existing approvals in place, only amendments may be necessary. As a result, a review of the applicable regulatory requirements should be undertaken once the preferred processing approach and location have been selected.

3.4.1 Facility Development and Operations

As part of any siting process, it is important to highlight appropriate legislative framework that may apply to the development of the facility and ultimately, operations. Applicable Nova Scotia legislation includes:

1. Environment Act, administered by Nova Scotia Environment (NSE)
    - Solid Waste-Resource Management Regulations
    - NSE Compost Facility Guidelines (2010 NSE Guidelines)
    - Environmental Assessment Regulations
2. Fire Prevention Act, administered by the Department of Labour and Advanced Education
    - Fuel Safety Regulations

These Acts, along with the Regulations and Guidelines under it, are used to establish and detail the authority and responsibility of the province as well as the legal requirements for proponents of various proposals.

Environment Act

Solid Waste-Resource Management Regulations

Solid Waste-Resource Management Regulations (Section 27) made under Section 102 of the Environment Act states that a Municipal Waste Approval: Solid Waste from NSE is required prior to construction of a composting or anaerobic digestion facility.

NSE Compost Facility Guidelines

The 2010 NSE Guidelines state that applications to NSE to construct, operate, expand or modify a composting facility must be accompanied by a letter from the municipal unit where the facility is to be located stating that the facility meets zoning, planning restrictions and such other by-laws as may exist.

General information on facility design and operations is located within Part IV and Part VII of the Compost Facility Guidelines (i.e. receiving and tipping area, composting area, curing area, leachate management, surface water management, groundwater management, odour control systems, and separation distances).

Environmental Assessment Regulations

The Nova Scotia Environmental Assessment Regulations made under Section 49 of the Environment Act promote sustainable development by evaluating the potential environmental effects of major developments before they are constructed. The regulation applies to the following types of waste management facilities:

1. A facility for storing, processing, treating or disposing of waste dangerous goods that were not produced at that facility, other than facilities operated by, or on behalf of, a municipality or Provincial agency for waste dangerous goods collected only from residential premises (Class 1).
2. A facility for treating, processing or disposing of contaminated materials that is located at a site other than where the contaminated materials originated (Class 1).
3. A facility for the incineration of municipal solid waste (Class 2).

Based on the waste management facility categories above, a new composting or anaerobic digestion facility is not anticipated to be required to complete an Environmental Assessment, however, the Minister has the authority to apply an environmental assessment to any undertaking. In addition, elements of an environmental assessment (e.g., siting evaluation for items such as traffic, noise and odour; and some form of public consultation) will be required for significant amendments to existing Municipal Waste Approvals or in obtaining new approvals.

Fire Prevention Act

The Fuel Safety Regulations made under Section 3 of the Fire Prevention Act requires that any digester gas utilization project requires a Digester Gas/Landfill Gas Equipment Approval, issued by the Department of Labour and Advanced Education.

Other Approvals

Aside from the NSE, requirements under the following authorities and standards may also be applicable for the site works:

- Ministry of Natural Resources
- Ministry of Transportation
- Nova Scotia Building Code
- Occupational Health and Safety Act
- Nova Scotia Fire Code
- Standard municipal approvals (i.e. building permits and site plan approvals)

3.4.2 End Product Quality

The 2010 NSE Guidelines are used to identify whether compost may be categorized as Category A or B compost, and finished compost is classified in accordance with the criteria identified in the Canadian Council of Ministers of the Environment (CCME) document "Guidelines for Compost Quality" dated October 2005 as amended. Finished compost at both the existing Dartmouth and Goodwood composting facilities will be required to meet these criteria as of 2019 at the end of the current contracts. It has been well documented that the primary challenge for source-separated organic compost facilities, including the Dartmouth and the Goodwood compost facilities; to achieve compliance with the 2010 NSE Guidelines is the more stringent maturity requirement.

The sale and importation of compost products is regulated by the Canadian federal government under the Fertilizers Act and Regulations (T-4-120 - Regulation of Compost under the Fertilizers Act and Regulations), administered by the Canadian Food Inspection Agency (CFIA).

It should be noted that that the end product might not necessarily be compost and that depending on the technology ultimately selected, other end products may be produced. Products may also be generated to be sold as a registered or regulated fertilizer under the federal Fertilizers Act. Any such fertilizer product would have a label with a guaranteed analysis and instructions for use that have been reviewed by the CFIA to ensure that the product, if used as directed, will not be detrimental to vegetation, domestic animals, public health or the environment.

3.5 Cost Considerations

Table 3.3, attached, and summarizes the capital and operating costs for a number of different sized organics processing facilities. The size and type of facility correspond with the options analysis presented in Section 4. These numbers were developed based on capacity factoring and professional judgement from existing facilities where capital and operating costs or processing fees were known. These costs are used in the options evaluation in Section 5. The facilities ranked from lowest to highest Equivalent Annual Cost[4] are as follows:

1. $135/tonne: 20,000 tonne/year on-farm anaerobic digestion facility
2. $154/tonne: 60,000 tonne/year composting facility

[4] Equivalent Annual Cost (EAC) = NPV / At,r + annual operating cost; where NPV is Net Present Value and At,r is the inverse of a loan repayment factor (PMT in Excel) for a period t (20 years) and a cost of capital r (4%).

3. $175/tonne: 35,000 tonne/year composting facility
4. $184/tonne: 10,000 tonne/year composting facility
5. $209/tonne: 60,000 tonne/year anaerobic digestion facility
6. $230/tonne: 25,000 – 35,000 tonne/year anaerobic digestion facility

Land purchase price was not included in the capital cost estimates and is therefore not included in the Equivalent Annual Cost numbers above.

3.5.1 Nova Scotia Community Feed-In Tariff (COMFIT)

The COMFIT program is part of Nova Scotia's 2010 Renewable Electricity Plan available through the Nova Scotia Department of Energy, and encourages community-based, local renewable energy projects by guaranteeing a rate per kilowatt-hour for the energy the project feeds into the province's electrical distribution grid. This program is currently on pause, but an announcement regarding an update to the program status is anticipated to be made in the fall of 2015. The majority of the programs currently receiving COMFIT or in the application process involve renewable energy produced from wind, biomass, tidal, hydro, and combined heat and power (CHP). Any COMFIT status announcement that includes changes to agricultural digester approvals and requirements for the acceptance of SSO at farms may have an effect on the outcome of this business case.

Miller is currently listed as having an approved COMFIT agreement as of February 25, 2015 for a biomass CHP facility located at the Dartmouth composting facility for 2 megawatts. There are also a number of farms in the vicinity of Halifax that have COMFIT agreements, which may be beneficial for on-farm anaerobic digestion projects.

As stated previously, as there is no current active COMFIT program or other renewable energy incentive program in-place at present in Nova Scotia, the sale of electricity was assumed to be negligible as part of this business case analysis. COMFIT, or similar, premium electricity prices are a significant source of additional revenue for an anaerobic digestion facility and would improve the overall economics of the project significantly; on the order of $25–40 per tonne of SSO at a price of 17.5 cents per kWh.

3.6 Wastewater Considerations

The existing composting facilities generate a significant amount of process wastewater that is required to be hauled to an off-site wastewater treatment facility at significant expense. In 2014, the Dartmouth composting facility generated 3.7 million litres of leachate or 159 litres per tonne of organics processed. This material is a relatively high strength material and requires surcharges to be treated at third-party wastewater treatment facilities. Halifax Water can no longer accept this material into the sanitary sewer system, even with a surcharge agreement, due to its high strength.

A new composting facility could be designed to minimize leachate generation by utilizing covered biofilters for example. However, due to the wet nature of the organics in Halifax a certain amount of leachate is expected and will vary with the amount of precipitation in a year.

A SSO wet anaerobic digestion facility will also generate significant amounts of wastewater if solids are separated from the digestate for composting or land application. Wastewater volumes can vary from 500 litres of treated (to sewer use criteria) effluent per tonne of organics processed to over 1,100 litres of untreated effluent per tonne of organics process that would also require sewer use surcharges or additional tipping fees to be applied to the effluent. The amount and strength of the wastewater varies by facility and can vary over time. Managing wastewater is a significant part of the cost of an anaerobic digestion facility.

Table 3.4 summarizes Toronto and Halifax sewer use bylaw limits compared to wastewater quality data taken from the City of Toronto's anaerobic digestion organics processing facilities. The Dufferin Organics Processing Facility material is generally a lower strength wastewater compared with the wastewater from the Disco Road Organics Processing Facility because the Dufferin facility utilized more fresh water than the Disco Road facility.

Table 3.4: Anaerobic Digestion Wastewater Quality

Parameter	Toronto Sewer Use ByLaw Limit (mg/L)	Halifax Sewer Use ByLaw Limit (mg/L)	Disco Road Organics Processing Facility (mg/L)	Dufferin Organics Processing Facility (mg/L)
TKN	100	100	3133	1829
TSS	350	300	1583	3366
TP	10	10	119	74
BOD	300	300	7649	3690

Provided the wastewater treatment facility is sized appropriately, there are a number of proven wastewater treatment options for treating organics processing facility wastewater to meet sewer use discharge criteria, including biological treatment systems such as Sequencing Batch Reactors (SBR) or Membrane BioReactor (MBR) systems; among others. GHD has completed a number of wastewater treatment studies for source separated organics wastewater treatment facilities and is confident that treating to sewer use surcharge limits is readily attainable. The type and size of wastewater treatment system can vary significantly depending on the volume and characteristics of the wastewater.

The capital and operating costs compiled for this study include a conservative amount for treating and hauling wastewater utilizing either an on-site treatment system or off-site treatment facility. GHD reviewed the wastewater management costs for a number of facilities, and included a conservative estimate for wastewater management for a new organics processing facility in Halifax.

Another option for addressing wastewater at an anaerobic digestion facility is to not separate out the digester solids from the digestate and manage the digestate as a liquid soil amendment or fertilizer directly. The liquid digestate would need to be stored between land application windows but could otherwise be directly land applied in a liquid form. This may require additional permits for the agricultural operation.

3.7 Assumptions

The following assumptions have been applied to this analysis:

1. The Goodwood composting facility will be shut down as of 2019, as per GHD's recommendation.
2. The Dartmouth compost facility cannot be expanded for additional compost-based capacity due to regulated setbacks (see Section 2.2) from neighbouring sensitive receptors.

3. The 2010 NSE Guidelines will be applied to all existing and new facilities as of 2019.

4. COMFIT will likely not provide funding for new projects and no incentivized pricing for electricity or renewable natural gas sales will be available as a conservative estimate. COMFIT pricing only considered where known COMFIT contracts have been awarded and will be constructed regardless of the availability of Halifax organics, such as in the instance of a number of on-farm sites in Nova Scotia[5]. GHD is aware that Miller has secured a COMFIT agreement for the Dartmouth site in anticipation of participating in a future biogas project (as noted in Section 3.5.1 above). As there is no agreement between Miller and Halifax regarding a future biogas project in the existing COMFIT agreement, it was assumed that Halifax would not be able to utilize the COMFIT agreement independently of Miller. Therefore COMFIT pricing was included with the on-farm anaerobic digestion options, but not in the options that include the development of a new anaerobic digestion facility.

5. The cost of acquiring new land has not been included in this assessment as it has been assumed that new land would serve as a new asset to Halifax and not a cost associated with a new organics processing facility.

6. The financial impact of increasing the total capacity from 60,000 tonnes to 75,000 tonnes has not been included in the analysis; however, it may be worthwhile to Halifax to complete a similar analysis when the total capacity increase is required to ensure that the most cost effective options are selected at that time.

7. Cost estimates include a conservative estimate for disposing of or treating process and waste water generated at an organics processing facility. The estimate provides for some combination of on-site wastewater treatment, potential off-site wastewater treatment, and haulage. One option for addressing excess process water for anerobic digestions options may be to manage it with the digestate (i.e., not separate the solids from the digestate).

4. Organic Material Management Options

Table 4.1 summarizes the options that have been considered for this assessment. Note that all options provide for a total of 60,000 tonnes per year organics processing capacity with the option to increase to 75,000 tonnes per year in the future. The options are split into three basic categories:

- Option 1: utilize the Dartmouth Compost Facility with one new organics processing facility for 35,000 tonnes/year, scalable to 50,000 tonnes per year
- Option 2: utilize the Dartmouth Compost Facility with two new organics processing facilities for 10,000 – 25,000 tonnes per year each. This option was created to explore partially repurposing the WSF and utilizing on-farm anaerobic digestion facilities that have COMFIT agreements. The WSF and on-farm facilities have limited capacity to accept Halifax organics.
- Option 3: one new organics processing facility for the full 60,000 tonnes per year

The 'a' and 'b' sub-options under each main option generally differentiate between a compost-based process and an anaerobic digestion based process.

[5] COMFIT Project Status Table (as of August 14, 2015) http://energy.novascotia.ca/sites/default/files/files/Comfit%20Status%20as%20of%20August%2015%2C%202015.pdf

Table 4.1 Evaluated Organics Processing Options

Option No.	Facility 1	Facility 2	Facility 3
Option 1a	**Existing Dartmouth Compost Facility**	**New Compost Facility**	**NA**
Capacity	25,000 tonnes/year	35,000 tonnes/year (may be increased to 50,000 tonnes/year)	
Potential Sites		- Goodwood Compost Facility - New site	
Option 1b	**Existing Dartmouth Compost Facility**	**New Anaerobic Digestion Facility**	**NA**
Capacity	25,000 tonnes/year	35,000 tonnes/year (may be increased to 50,000 tonnes/year)	
Potential Sites		- Goodwood Compost Facility - Dartmouth Compost Facility - New site	
Option 2a	**Existing Dartmouth Compost Facility**	**New Compost Facility**	**New Anaerobic Digestion Facility**
Capacity	25,000 tonnes/year	10,000 tonnes/year (may be increased to 25,000 tonnes/year)	25,000 tonnes/year[1]
Potential Sites		- Goodwood Compost Facility - WSF at Otter Lake Site (partially repurpose facility) - New site	- Goodwood Compost Facility - Dartmouth Compost Facility - New site
Option 2b	**Existing Dartmouth Compost Facility**	**New On-Farm AD Facility**	**New On-Farm AD Facility**
Capacity	20,000 tonnes/year	20,000 tonnes/year	20,000 tonnes/year
Potential Sites		- On-farm site	- On-farm site
Option's 3a	**New Compost Facility**	**NA**	**NA**
Capacity	60,000 tonnes/year (may be increased to 75,000 tonnes/year)		
Potential Sites	- Goodwood Compost Facility - New site		
Option's 3b	**New Anaerobic Digestion Facility**	**NA**	**NA**
Capacity	60,000 tonnes/year (may be increased to 75,000 tonnes/year)		
Potential Sites	- Goodwood Compost Facility - Dartmouth Compost Facility - New site		

Notes:

1. The uneven split between Facility 2 and Facility 3 for Option 2a was to provide sufficient capacity in the anaerobic digestion facility for all or nearly all of the wetter IC&I organics and to also provide a minimum size to take advantage of economies of scale as anaerobic digestion facilities are generally more expensive than composting facilities

5. Evaluation of Options

The cost estimate for different sized organics processing facilities shown in Table 3.3 were utilized to calculate the estimated total capital and processing costs associated with new organics processing capacity for each option shown in Table 4.1. Table 5.1, attached, shows the budget comparison of each option, including an overall Equivalent Annual Cost, based on 4% interest for 20 years. The budget comparison includes forecasting all capital and operating costs to process 60,000 tonnes per year of SSO.

The following list ranks the options in terms of overall Equivalent Annual Cost (as shown in Table 5.1), from lowest to highest:

- $148/tonne: Option 2b (Dartmouth Facility, On-Farm Anaerobic Digestion).
- $155/tonne: Option 3a (New 60,000 tonne/year Compost Facility).
- $159/tonne: Option 1a (Dartmouth Facility, New Compost Facility).
- $184/tonne: Option 2a (Dartmouth Facility, New Compost Facility, New Anaerobic Digestion Facility).
- $191/tonne: Option 1b (Dartmouth Facility, New Anaerobic Digestion Facility).
- $209/tonne: Option 3b (New 60,000 tonne/year Anaerobic Digestion Facility).

In addition to economic evaluation criteria, the following criteria were also scored in a decision matrix summarized in Table 5.2:

- Facility Footprint: anaerobic digestion facilities have a smaller footprint than composting facilities.
- Compatibility with Feedstock: anaerobic digestion is generally more suitable for the nature of the Halifax materials, in particular with the wetter IC&I organics and does not require the addition of bulking amendment materials.
- Planning and Approvals Risk: Existing sites are already zoned and approved for solid waste activities. New sites will need to be sited, apply for a zoning amendment and apply for new approvals.
- Process and Technical Risk: Compost and anaerobic digestion of food waste are both proven technologies in Canada, throughout North America and throughout Europe. On-farm anaerobic digestion is not proven in Canada.
- Odour and Noise: given proximity of sites to developed areas of Halifax.
- Process Water and Stormwater: the existing Goodwood and Dartmouth composting facilities have known water management issues. It is assumed that a new site would be designed to better address water management issues.

- End Products and Byproducts: the existing Goodwood and Dartmouth compost facilities have struggled to generate quality compost from the available feedstock material. Anaerobic digestion would provide better treatment of the food waste which would result in a higher quality solid or liquid agricultural soil amendment.
- Phasing and Transition: Halifax requires the existing composting operations to remain in operation until one or more new facilities are constructed; this may impact suitability of the Dartmouth site for those options that require a large footprint and cannot be accommodated within the available space.
- Overall Schedule: with respect to permitting requirements, construction phasing, etc.
- Future Regulations: it is known that the 2010 NSE Guidelines are currently being reviewed and may be revised in the near future. In Ontario, compost quality standards have recently been created that are more onerous than the 2005 CCME Guidelines and this has resulted in a number of operations being unable to generate certified compost any more. There is a risk that the new Nova Scotia guidelines may mimic Ontario standards as jurisdictions typically look to other jurisdictions for examples.

The decision matrix was created to compare the different siting configurations with each option, using criteria to rank the various options and a weighting factor to weight the significance of each criterion in Table 5.2. The decision matrix was used to develop a score for each option, with a maximum total possible score of 100.

The weighting values were determined in cooperation with Halifax staff. They represent the priorities of Halifax for developing a new organics processing facility based on the over 15 years of experience in managing two organics processing facilities. The primary priorities identified were:

- Cost (Weighting 20/100): Fiscal responsibility is always a priority for public projects.
- Odour and Noise (Weighting 20/100): In order to locate the facilities as close as possible to the urban centres where the organic waste is generated, the facility may not generate nuisance odours or noise.
- Compatibility with Feedstock (Weighting 15/100): Halifax's SSO program has changed over time and the existing composting facilities have had difficulty composting a wetter organics feedstock.
- Overall Schedule (Weighting 10/100): Halifax must have the new organics process facility operational before the expiry of the current Goodwood and Dartmouth composting facilities operating agreements in 2019.

These four priority criteria represent nearly two-thirds of the Total Score. In order to score well overall, an option needed to score relatively well in 3-4 of these four priority items for Halifax.

Scores were tabulated in Table 5.2 in two different ways, namely:

- Total Score: sum of the weighted scores for each option, higher scores are better, top five scores are summarized in Table 5.3 below.
- Value for Money: calculated[6] as an adjusted total score divided by Equivalent Annual Cost and represents a relative points per dollar score, top five scores are summarized in Table 5.3 below.

[6] Value for Money = 100 x (Total Score - Equivalent Annual Cost Score)/ Equivalent Annual Cost

The options are sorted by Equivalent Annual Cost (lowest to highest) in Table 5.3 below to compare the results of the top scores calculated in Table 5.2. The top three options under each column in Table 5.3 are highlighted. The top scores all involved existing sites.

Table 5.3 Evaluation Results Summary

	Option	Equivalent Annual Cost ($/tonne) (Rank)	Total Score (Rank)	Value for Money (Rank)
2b	Existing Dartmouth Facility (25,000 tonne/year) & 2 New On-Farm Anaerobic Digestion Facilities (~20,000 tonne/year each)	**$148**	67 (5)	**31.4 (3)**
3a	New 60,000 tonne/year Compost Facility at an Existing Site	**$155**	56 (9)	23.5 (11)
1a	Existing Dartmouth Facility (25,000 tonne/year) & New Compost Facility (35,000 tonne/year) at an Existing Site	**$159**	59 (8)	25.5 (7)
2a	Existing Dartmouth Facility (25,000 tonne/year) & New Compost (10,000 tonne/year) and Anaerobic Digestion (25,000 tonne/year) Facilities at an Existing Site	$184	62 (6)	25.3 (8)
1b	Existing Dartmouth Facility (25,000 tonne/year) & New Anaerobic Digestion Facility (35,000 tonne/year) at an Existing Site	$191	72 (4)	30.1 (5)
3b	New 60,000 tonne/year Anaerobic Digestion Facility at Goodwood Site	$209	**82 (1)**	**33.5 (1)**
3b	New 60,000 tonne/year Anaerobic Digestion Facility at Dartmouth Site	$209	**79 (2)**	**32.3 (2)**
3b	New 60,000 tonne/year Anaerobic Digestion Facility at New Site	$209	**77 (3)**	31.1 (4)

Only two of the options, namely Option 2b and 1b are in the top five for all three columns in Table 5.3. None of the options are in the top three for all three columns. Three of the options, namely Option 2b, Option 3b (Goodwood Site), and Option 3b (Dartmouth Site), are in the top three for two of the three columns.

The lowest cost option, based on an Equivalent Annual Cost basis, over a 20 year lifecycle, was determined to be the option that utilized the existing Dartmouth composting facility assets in combination with two new on-farm anaerobic digestion facilities (Option 2b). The on-farm anaerobic digestion facilities do not require significant additional capital expenditures for Halifax. This is based on the assumption that existing COMFIT revenues for renewable energy received by these farms will offset capital expenditures for the farms, savings which will in turn be passed on to Halifax (i.e., they will build the facilities regardless if Halifax supplies them with feedstock). This option also represents the third best value for money. However, it has a low score compared with some of the other options primarily due to the uncertainty of relying on on-farm third-party processors for the bulk of Halifax's organics processing needs; this resulted in Option 2b only scoring well in one of the four priority evaluation criteria. Establishing agreements with multiple farms can help mitigate this risk to an extent. Also, ensuring contractual arrangements that would provide Halifax with performance guarantees and penalties would be critical to ensuring reliability of processing capacity.

Options involving new compost facilities at existing site(s) (e.g., Goodwood site; Options 1a and 3a) represent the next lowest cost option. These options have relatively low scores and represent poor value for money; in this case, primarily due to the issues surrounding the suitability of composting the feedstock material (i.e., wetter IC&I organics). An external bulking amendment would be required in greater quantities to effectively compost Halifax's co-mingled residential and IC&I organics. This is considered a significant obstacle to producing a quality compost product for sale under the 2010 NSE Guidelines. As such, it will be difficult to produce compost that can be marketed directly for a good price; and continued bulk sales to third-party landscaping companies, as an example, for low prices will likely continue to be the extent of the marketability of the product.

Options that involve the continued operation of the existing Dartmouth compost facility will also need to account for the replacement of major components over the 15-20 year planning horizon. Replacement costs for the existing Dartmouth facility are factored into Table 5.1 and assume replacement with an equivalent compost facility. Repair costs, based on separate inspection reports, for the Dartmouth facility required to keep the facility in service past the end of the current operations agreement are also included. The $500,000 included in Table 5.1 for the Dartmouth facility for options that do not include its continued operation is to account for decommissioning costs.

Options 1b and 3b, which involve the construction of a new anaerobic digestion facility generally scored the highest and represent the best value for money; but are the highest cost options as well. The options involving a new 60,000 tonnes per year facility at the Dartmouth or Goodwood sites (Option 3b) score high in three of the four priority evaluation criteria and high in all of the other evaluation criteria. Anaerobic digestion is better suited for the nature of the materials generated within Halifax given the mandatory inclusion of IC&I organics. Anaerobic digestion facilities offer many benefits over composting in large urban centers, as they are able to be sited closer to the areas where the organics are generated and have smaller footprints.

For the purposes of the business case, it was assumed that COMFIT revenues for renewable energy would not be available for new anaerobic digestion facilities due to a current program freeze in Nova Scotia. If a long term COMFIT contract could be secured for the Goodwood or Dartmouth sites, this could decrease the Equivalent Annual Cost by roughly $25-40/tonne down to $169-184/tonne; which would result in a more cost competitive option albeit still a higher cost over the long term as compared to composting.

Overall, based on the evaluation criteria and weighting utilized in this report, GHD is of the opinion that the development of anaerobic digestion capacity to process at, a minimum, part of Halifax's SSO will offer many long-term benefits including addressing the processing of wetter IC&I organics. It will also allow existing composting capacity at the Dartmouth site, should Halifax elect to keep it operational past 2019, to operate more effectively by allowing Halifax to selectively divert only drier residential organics to it that are mixed with a portion of the leaf and yard waste materials.

Options involving new sites, with their potential permitting issues, scored lower overall for both Total Score and Value for Money when compared against the same option implemented at one of the existing Goodwood or Dartmouth sites.

Each of the above options has its advantages and disadvantages. An option for Halifax to consider as a next step would be to move forward with a competitive bid process that is technology neutral to allow compost and anaerobic digestion technology centered bids to compete against each other. As well to allow bids that utilize on-farm infrastructure coupled with centralized transfer and pre-processing components; ensuring that proposals received adequately address all potential risks with partnering with one or more local farm businesses. This allows those firms with COMFIT agreements, for example or any other competitive advantage, to potentially offer the more expensive anaerobic digestion option at a more competitive price compared to composting.

However, in a public procurement process with pre-defined scoring, when the technology is not pre-determined prior to going out to tender, the owner must be willing to accept any technology that receives a passing score or cancel the procurement completely. One approach to mitigate this is a two stage procurement process where technology vendors and suppliers are pre-qualified based on technical merit first and then on their full business proposal second. This is similar to the approach currently being used by the City of Edmonton to find partners to provide a high-solids anaerobic digestion facility for their SSO.

6. Closure

The findings of the business plan include:

- The lowest cost option, based on an Equivalent Annual Cost basis, over a 20 year lifecycle, was determined to be the option that utilized the existing Dartmouth composting facility assets in combination with two new on-farm anaerobic digestion facilities (Option 2b) to provide a combined total of 60,000 tonnes per year of organics processing capacity. The lower cost is a result of the assumption that Halifax would not be required to contribute to the capital expenditures of the on-farm facilities (i.e., they will build the facilities regardless if Halifax supplies them with feedstock). This option is considered high risk as no other municipality in Canada has attempted to rely on an on-farm anaerobic digestion facility for the majority of its organics processing needs.
- Options which involve the construction of a new anaerobic digestion facility generally scored the highest and represent the best value for money; but are the highest cost options as well. The options involving a new 60,000 tonnes per year facility at the Dartmouth or Goodwood sites (Option 3b) score high in three of the four priority evaluation criteria and high in all of the other evaluation criteria.
- Overall, based on the evaluation criteria and weighting utilized in this report, GHD is of the opinion that the development of anaerobic digestion capacity to process at a minimum part of Halifax's SSO will offer many long-term benefits including addressing the processing of wetter IC&I organics. It will also allow existing composting capacity at the Dartmouth site, should Halifax elect to keep it operational past 2019, to operate more effectively by allowing Halifax to selectively divert only drier residential organics to it that are mixed with some leaf and yard waste materials.

All of Which is Respectfully Submitted,

GHD

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Table 3.3

Preliminary Budget Estimate for New Composting and Anaerobic Digestion Facilities
Organics Management Business Case
Halifax Regional Municipality
Nova Scotia

New Facility Processing Capacity (1000 tonnes)	2015 Capital Expenditure Estimate per Tonne	2015 Capital Expenditure Estimate (millions)	2015 Processing Fee Estimate per Tonne SSO [2]	2015 Processing Fee Estimate [2] (millions)	Equivalent Annual Cost (EAC)[3] (4%, 20yr)
New Composting Facility Costs					
10	$1,200	$12.0	$95	$1.0	$184
35	$1,150	$40.3	$90	$3.2	$175
60	$1,000	$60.0	$80	$4.8	$154
New Anaerobic Digestion Facility Costs					
25	$1,350	$33.8	$130	$3.3	$230
35	$1,350	$47.3	$130	$4.6	$230
60	$1,200	$72.0	$120	$7.2	$209
On-Farm Anaerobic Digestion Facility					
20	$0	$4.0	$120	$2.4	$135

Notes:

1. This capital cost estimate is a Class 5 cost estimate developed as defined by recommended practices of the Association for the Advancement of Cost Engineering (AACE) and is to be used for concept screening or feasibility assessment only. The methodology used to develop this cost estimate was based on capacity factoring and judgment estimating methods and should be considered to have an accuracy range of -30 percent to +50 percent. All estimates in Canadian dollars. Effects of capital and operating costs based on potential sites have not been included in these estimates.

2. Revenue from electricity generation is factored into the processing fee estimate for the on-farm anaerobic digestion facility. Revenue from electricity generation is assumed to be negligible for other anaerobic digestion facilities.

3. Equivalent Annual Cost (EAC) = NPV / $A_{t,r}$ + annual operating cost; where NPV is Net Present Value and At,r is the inverse of a loan repayment factor (PMT in Excel) for a period t (20 years) and a cost of capital r (4%).

4. The capital expenditure and processing fee estimate for the on-farm anaerobic digester accounts for revenues from electricity revenues and assumes they will be used to offset a portion of the capital expenditures. This was done in order to account for the potential benefit of the additional revenue and compare the on-farm option to the other options that do not include revenue from electricity generation as a conservative assumption. The capital expenditure estimate also accounts for a central processing facility located at a Halifax owned organics or waste processing site.

Table 5.1

Budget Comparison of Options
Organics Management Business Case
Halifax Regional Municipality
Nova Scotia

Technology /Facility	**Existing Dartmouth Compost Facility[2]**			**New Compost Facility**			**New Anaerobic Digestion Facility**			**Total for All Facilities**					
Option [1]	**Processing Capacity** (thousand tonnes)	**Capital Expenditure Estimate** (millions)	**Processing Fee Estimate [3]** (millions)	**Processing Capacity** (thousand tonnes)	**Capital Expenditure Estimate** (millions)	**Processing Fee Estimate** (millions)	**Processing Capacity** (thousand tonnes)	**Capital Expenditure Estimate** (millions)	**Processing Fee Estimate [4]** (millions)	**Processing Capacity** (thousand tonnes)	**Capital Expenditure Estimate** (millions)	**Capital Expenditure Estimate per Tonne**	**Processing Fee Estimate [4]** (millions)	**Processing Fee Estimate [4] per Tonne**	**Equivalent Annual Cost (EAC)[5]** (4%, 20yr)
Option 1a	25	$16.0	$2.3	35 (option for expansion to 50)	$40.3	$3.2				60	$56.2	$937	$5.4	$90	**$159**
Option 1b	25	$16.0	$2.3				35 (option for expansion to 50)	$47.3	$4.6	60	$63.2	$1,054	$6.8	$113	**$191**
Option 2a	25	$16.0	$2.3	10 (option for expansion to 25)	$12.0	$1.0	25	$33.8	$3.3	60	$61.7	$1,029	$6.5	$108	**$184**
Option 2b	20	$16.0	$2.4				40	$6.4	$4.8	60	$22.4	$373	$7.2	$120	**$148**
Option 3a		$0.5		60 (option for expansion to 75)	$60.0	$4.8				60	$60.5	$1,008	$4.8	$80	**$155**
Option 3b		$0.5					60 (option for expansion to 75)	$72.0	$7.2	60	$72.5	$1,208	$7.2	$120	**$209**

Notes:

1. This capital cost estimate is a Class 5 cost estimate developed as defined by recommended practices of the Association for the Advancement of Cost Engineering (AACE) and is to be used for concept screening or feasibility assessment only. The methodology used to develop this cost estimate was based on capacity factoring and judgment estimating methods and should be considered to have an accuracy range of -30 percent to +50 percent. All estimates in Canadian dollars. Effects of capital and operating costs based on potential sites have not been included in these estimates.
2. Assumed partial completion of forced aeration throughout the curing area and additional outdoor curing of materials at the site, provided an amendment to permit curing outdoors can be obtained ($0.5 – 1.0 million capital expenditure by 2019); with building repairs and equipment replacement costs of $606,950.
3. Revenue from electricity generation is not considered other than for on-farm options.
4.

Equivalent Annual Cost (EAC) = NPV / $A_{t,r}$ + annual operating cost; where NPV is Net Present Value and At,r is the inverse of a loan repayment factor (PMT in Excel) for a period t (20 years) and a cost of capital r (4%), in thousands.

Table 5.2

Evaluation Matrix
Organics Management Business Case
Halifax Regional Municipality
Nova Scotia

Option		Equivalent Annual Cost (EAC) ($/tonne)	Equivalent Annual Cost (EAC) Score[1]	Facility Footprint[2]	Compatibility with Feedstock[3]	Planning and Approvals Risk[4]	Process and Technical Risk[5]	Odour and Noise[6]	Process Water & Stormwater[7]	End Products and Byproducts[8]	Phasing and Transition[9]	Overall schedule (approvals, infrastructure)[10]	Future Regulations (ie. compost standards)[11]	Total Score	Value for Money[12]	Rank - Total Score	Rank - Value for Money
	Weighting		**20**	**5**	**15**	**5**	**5**	**20**	**5**	**5**	**5**	**10**	**5**	**100**			
1a	Existing Dartmouth Compost Facility & New Compost Facility																
	Goodwood, or	$159	19	0.5	3	4.5	4	14	0.5	2	3	8	1	59	25.5		
	New Site	$159	19	0.5	3	1.5	4	14	2.5	2	5	4	1	56	23.6		
1b	Existing Dartmouth Compost Facility & New Anaerobic Digestion Facility																
	Goodwood, or	$191	14	2.5	9	4.5	4	16	2.5	4	4	8	3	72	30.1	4	5
	New Site	$191	14	2.5	9	1.5	4	16	3.5	4	5	4	3	67	27.5	5	
2a	Existing Dartmouth Compost Facility, New Compost Facility & New Anaerobic Digestion Facility																
	Goodwood and Dartmouth, or	$184	15	2.5	7	3.5	4	14	0.5	3	2	8	2	62	25.3		
	Goodwood and New Site, or	$184	15	2.5	7	2.5	4	14	2.5	3	4	4	2	61	24.7		
	New Site and Goodwood/Dartmouth, or	$184	15	2.5	7	2.5	4	10	2.5	3	3	4	2	56	22.0		
	New site for both	$184	15	2.5	7	1.5	4	10	3.5	3	5	2	2	56	22.0		
2b	Existing Dartmouth Compost Facility, 2 New On-Farm Anaerobic Digestion Facilities																
	New On-Farm Sites	$148	20	2.5	9	2.0	1	10	5.0	3	4	6	4	67	31.4	5	3
3a	New Compost Facility																
	Goodwood, or	$155	19	0.5	3	4.5	4	10	0.5	2	3	8	1	56	23.5		
	New Site	$155	19	0.5	3	1.5	4	10	2.5	2	5	4	1	53	21.6		
3b	New Anaerobic Digestion Facility																
	Goodwood, or	$209	12	5.0	15	4.5	4	18	2.5	4	4	8	5	82	33.5	1	1
	Dartmouth, or	$209	12	5.0	15	4.0	4	18	2.5	4	2	8	5	79	32.3	2	2
	New Site	$209	12	5.0	15	1.5	4	18	3.5	4	5	4	5	77	31.1	3	4

Notes
1. EAC Score calculated as: Weighting x (1 - (EAC - Lowest EAC)/Lowest EAC))
2. Smallest footprint (anaerobic digestion) assigned score of 5, largest footprint (composting) assigned score of 0.5, combination of anaerobic digestion and composting assigned score of 2.5
3. Anaerobic digestion is better suited to Halifax's wet SSO material which includes IC&I organics. Compost only options given the lowest score and options that involve a combination of anaerobic digestion and compost technologies given an intermediate score.
4. Existing sites with existing approvals scored highest, new sites (assumed to have no approvals) scored lowest. Options involving both existing and new sites score in the middle.
5. Anaerobic digestion and compost are both proven technologies in Canada, North America and globally. Anaerobic digestion of SSO in an on-farm anaerobic digestion system is less proven and more dependent on operators not experienced with food waste or wastewater treatment.
6. Odours at an anaerobic digestion facility are generally easier to mitigate and manage than at a composting facility. The on-farm option was scored low due to less stringent on-farm regulations for odour mitigation and unknown site location.
7. Anaerobic digestion and compost options assumed to have similar water issues. Existing sites have known issues. New sites assumed to be designed to address concerns better. Water from on-farm option can be directly land applied with no additional trucking.
8. Generating a quality compost has historically been challenging for existing compost facilities. Utilizing digestion is assumed to improve the treatment level of the SSO and the quality of the resulting end products, whether solid or liquid.
9. Halifax requires existing compost facilities remain operational during construciton of new facility. A new site will make this easier than phasing construction on an existing site. The larger Goodwood site offers more room for the phasing and transition than the Dartmouth site.
10. Existing sites provide significantly reduced development timelines compared with new sites. Additional time for phasing of construction on existing sites is incorporated into the scores.
11. It is known that the compost standards are currently being reviewed. Recent Ontario regulation changes have left many SSO compost facilities unable to produce certified compost.
12. Value for Money calculated as: (Total Score - EAC Score) / EAC * 100

Attachment E

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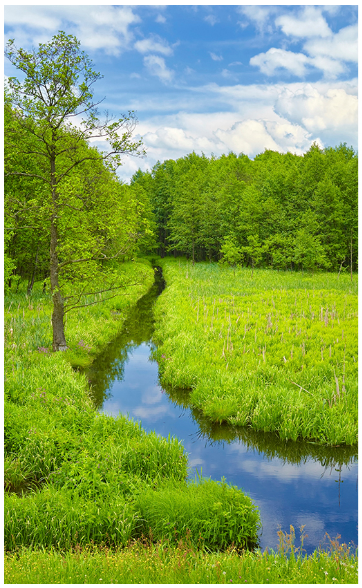

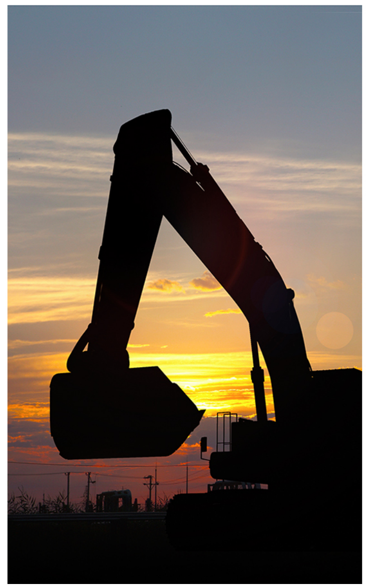

Process Review of New Era Technologies Limited Compost Facility

Prepared for: Halifax Regional Municipality

Conestoga-Rovers & Associates
45 Akerley Boulevard
Dartmouth, Nova Scotia B3B 1J7

June 1, 2015 • 071855 • Report No. 3

Partners in Sustainability

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Executive Summary

Conestoga-Rovers & Associates (CRA) completed a compliance and process review of the New Era Technologies Limited (NETL) compost facility located at 61 Evergreen Place Goodwood, Nova Scotia. The facility is operated under a long-term design-build-operate contract with Halifax Regional Municipality (Halifax). In 2019, the 20-year contract term will be completed, with Halifax taking ownership of the facility and terminating the lease of the property and having multiple options for the succession of the facility including entering into a new long-term arrangement to operate and upgrade the facility (including increasing or decreasing capacity) or shutting down the facility.

The objectives of the process review were therefore to:

- Identify requirements to bring the NETL facility into compliance with the 2010 Nova Scotia Environment (NSE) Composting Facility Guidelines (2010 NSE Guidelines)
- Identify facility process improvement opportunities
- Evaluate options to both increase and decrease the capacity of the facility

Following a site visit and review of historical reports, it was found that to generate compost from the NETL facility that is fully compliant with the 2010 NSE Guidelines will require, at a minimum:

- Continued practice of no recirculation of leachate (zero capital cost, net operational savings with respect to leachate management).
- Additional bulking amendment (zero capital cost item, potential of $8-16 per tonne of source separated organics increase in operating costs).
- Additional curing area and/or frequent turning (i.e., increased aeration) of the curing pile ($400,000 - $1,500,000 of capital for additional curing area and/or new windrow turning equipment).
- Elmsdale Landscaping Ltd. is not an approved composting facility and therefore would not be able to act as a secondary curing facility for the NETL facility, if required, unless it obtains approval.
- The NETL facility will require additional signage to provide normal operating hours, emergency contact information and the types of acceptable materials at the site entrance.
- Foreign matter levels in the compost are a concern and may require new or additional screening equipment. The screen size can likely be reduced if the compost maturity is improved. The efficacy of the existing equipment will need to be re-evaluated when the compost maturity has improved to an acceptable level (it was difficult to evaluate this from the material present during CRA's site visit).

- The NETL facility must increase the frequency of compost sampling as they are currently not in compliance with their Approval to Operate (NSE Approval #2008-062534). For the years 2012-2014 the operator was just short of this requirement. Testing is required for every 1,000 tonnes of compost or every 3 months; see Table 3.1. The 2010 NSE Guideline requirement is the same as the sampling frequency in the Approval to Operate.
- Condition 13(b) of the Approval to Operate requires overs to be disposed of at an approved landfill site unless written permission for an alternative is received from the NSE. This condition should be clarified by consulting with NSE to ensure that New Era is meeting the requirements of the Approval to Operate. Currently, New Era tests larger size compost material (coarse compost) prior to shipping according to the CCME Guidelines for every 1,000 tonnes generated and ships the material to Elmsdale Landscaping for further processing and curing.

The NETL facility is not ideal for considering further investment to upgrade operations to bring into compliance with the 2010 NSE Guidelines or to increase or decrease capacity. In 2019, when the 2010 NSE Guidelines will apply to the NETL facility, it is recommended that Halifax replace the existing facility with alternate organics processing capacity to meet Halifax's organics processing needs for the subsequent 20-year period. With respect to process improvements or modifying the capacity of the facility, the primary constraints are:

- Age and condition of existing equipment and buildings
- Porosity, moisture, pH and C:N ratios of feedstock materials and challenges in sourcing suitable bulking amendment
- Incompatibility between the existing organics processing technology (static aerated floor/container) with Halifax source separated organics (particularly Institutional, Commercial and Industrial materials). This is related to the feedstock issues identified above and the inability to easily address this incompatibility through changes to feedstock materials or composition. Thus, a different technology is recommended for the long-term organics processing needs of Halifax past 2019.

To continue operating the existing NETL facility for the first 5 years of operation past 2019, as compared to more efficient organic processing capacity, will cost Halifax $5-17 million of capital and operating costs or approximately $1.0-3.4 million annually. This assumes that the existing composting system (static aerated floor/container) will last until 2025.

Potential wastewater volume and disposal cost fluctuations are the primary reason for the large variation in potential savings. Under a worst case scenario, where the existing system is maintained and leachate and process water volumes are not significantly reduced and the current disposal option is no longer able to accept the NETL wastewater, the additional cost in wastewater treatment could exceed $1.4 million annually.

Section 1.0 Introduction

Conestoga-Rovers & Associates (CRA) has prepared this compliance and process review of the New Era Technologies Limited (NETL) compost facility located at 61 Evergreen Place, Goodwood, Nova Scotia. The facility is operated under a long-term design-build-operate contract with Halifax Regional Municipality (Halifax). In 2019, the 20-year contract term will be completed, with Halifax taking ownership of the facility and terminating the lease of the property and having multiple options for the succession of the facility including entering into a new long-term arrangement to operate and upgrade the facility (including increasing or decreasing capacity) or shutting down the facility. In reviewing these options, Halifax must consider the financial investment needed to continue operating the facility. The objectives of the process review were therefore to:

- Identify requirements to bring the NETL facility into compliance with the 2010 Nova Scotia Environment (NSE) Composting Facility Guidelines (2010 NSE Guidelines)
- Identify facility process improvement opportunities
- Evaluate options to both increase and decrease the capacity of the facility

The NETL facility was designed in the late 1990s in accordance with NSE requirements that specified meeting compost quality in accordance with the 1996 Canadian Council of Ministers of the Environment (CCME) Guidelines for Compost Quality. Since that time, NSE has adopted the most recent 2005 CCME Guidelines for Compost Quality (2005 CCME Guidelines) and has required composting facilities in Nova Scotia be in compliance by the fall of 2015. CRA understands that NSE may grant Halifax permission to meet this requirement by 2019 for the NETL facility to coincide with the end of the 20-year contract term.

In addition to the current study, CRA recently completed a building assessment of the NETL facility (submitted under separate cover in April 2015). Overall, the facility was found to be in fair to poor condition with capital expenditures of $698,000 required over a five year investment horizon to maintain the facility for a remaining useful life of 10-15 years.

Section 2.0 NETL Compost Process

Mr. Andrew Philopolous and Mr. Mike Muffels of CRA toured the site on April 28, 2015 and met with the Plant Manager, Mr. Darren Evans. Observations documented from the site visit are incorporated into the appropriate sections below.

The NETL facility consists of a receiving hall, office, Stinnes-Enerco containerized composting system, curing building, and a screening building. It is located at 61 Evergreen Place in

Goodwood, Nova Scotia on a piece of property owned by Halifax. The NETL facility site layout is shown on Figure 2.1. The NETL facility composting process flow is illustrated on Figure 2.2.

Feedstock is received in the receiving hall, where it is loaded onto a conveyor belt. The feedstock passes through a manual sort station staffed with 3-4 people on a part-time basis with a large magnet to remove metal for recycling. Recyclable materials collected are sold. The conveyor belt drops the sorted feedstock material into a shredder or grinder with an 8 inch screen size. The ground feedstock is mixed with screening overs and any other available bulking amendment in the receiving hall using a front end loader.

The facility is based on the Stinnes-Enerco containerized composting process. The primary composting stage is completed in one of 24 aerated and sealed containers. The composting containers are located outdoors. Material is typically left in the container for 7-10 days. The containers are controlled by a central control system that monitors air temperature and air flow. The primary compost process can be controlled by adjusting the air flow rate and the recirculation of leachate. No leachate is currently recirculated due to high moisture levels in the feedstock materials.

The containers are tipped in the curing building and the material placed onto the aerated curing floor. The compost remains in the curing building for 2.5 to 3.0 months. The material in the curing hall is only turned when it is moved down the curing floor using front end loaders towards the screening building as it matures.

The matured compost is screened (25 mm openings) and stored in the screening building. The screening equipment includes a vacuum blower to collect light film plastic. Roughly 40 percent of incoming organics are converted into compost at the NETL facility. Screening overs (>25 mm) are used as bulking amendment for the composting process. Overs not used back in the composting process are sent to Elmsdale Landscaping.

The fines or compost are transported in bulk to Elmsdale Landscaping for little revenue. Elmsdale Landscaping further cures the material and uses it for their landscaping products. The compost exported from the NETL facility does not have the quality or consistency to generate a higher price due to low maturity level (high moisture, low pH).

All process and building air is mechanically ventilated and treated through biofilters located either behind the receiving hall or beside the curing building. The facility does receive occasional odour complaints.

All process water and leachate is collected, stored and trucked off-site to a wastewater treatment facility. The leachate storage pump is located between the biofilters and compost containers behind the receiving hall. Approximately 5 million liters of leachate are generated annually. The process water storage tank and pump out is located in the northeast corner of the paved area. Approximately 3.8 million litres of process water are transported off-site each year for treatment.

Section 3.0 Compliance with 2010 NSE Composting Facility Guidelines

CRA completed a review of the NETL facility and the 2010 NSE Guidelines to identify compliance concerns. CRA understands that the NETL facility will not be required to comply with the 2010 NSE Guidelines until the end of the current contract with NETL in 2019. The results of this review are summarized in Table 3.1 following the text. It has been well documented that the primary challenge for source-separated organics (SSO) compost facilities, including the NETL facility, to achieve compliance with the 2010 NSE Guidelines is the more stringent maturity requirement. The compost maturity guideline is the primary non-compliance concern. This is discussed in more detail in Sections 3.1 and 3.2 below.

Other 2010 NSE Guideline non-compliance and potential non-compliance items include:

- Elmsdale Landscaping Ltd. is not an approved composting facility and therefore would not be able to act as a secondary curing facility for the NETL facility, if required, unless it obtains approval.
- The NETL facility will require additional signage to provide normal operating hours, emergency contact information and the types of acceptable materials at the site entrance.
- Foreign matter levels in the compost are a concern and may require new or additional screening equipment to meet Section 3.3 the 2005 CCME Guidelines. The screen size of 25 mm is relatively large for a screening a finished compost and this will have an impact on the level of contamination in the compost. The screen size can likely be reduced if the compost maturity is improved as discussed in Section 3.2 below. The efficacy of the existing equipment will need to be re-evaluated when the compost maturity has improved to an acceptable level (it was difficult to evaluate this from the material present during CRA's site visit).
- The NETL facility must increase the frequency of compost sampling as they are currently not in compliance with their Approval to Operate (NSE Approval #2008-062534). The 2010 NSE Guideline requirement is the same as the sampling frequency in the Approval to Operate.
- Condition 13(b) of the Approval to Operate requires overs to be disposed of at an approved landfill site unless written permission for an alternative is received from the NSE. This condition should be clarified by consulting with NSE to ensure that New Era is meeting the requirements of the Approval to Operate. Currently, New Era tests larger size compost

material (coarse compost) prior to shipping according to the CCME Guidelines for every 1,000 tonnes generated and ships the material to Elmsdale Landscaping for further processing and curing.

3.1 Current Compliance with Maturity Requirement

Mature compost is material in which biological activity has slowed after most of the easily degraded molecules have been broken down into humus, leaving the complex organic material behind. In this state, it is difficult to identify the original feedstock materials. A fine texture, dark colour, and a rich earthy smell characterize mature composts.

The 2010 NSE Guidelines require that the resulting compost meet the 2005 CCME Guidelines. The compost maturity requirements in Section 3.4 of the 2005 CCME Guidelines are as follows:

> *Compost shall be mature and stable at the time of sale and distribution. To be considered mature and stable, a compost shall be cured for a minimum of 21 days and meet one of the following three requirements:*
>
> *a. the respiration rate is less than, or equal to, 400 milligrams of oxygen per kilogram of volatile solids (or organic matter) per hour [400 mg O_2/kg VS/h]; or,*
>
> *b. the carbon dioxide evolution rate is less than, or equal to, 4 milligrams of carbon in the form of carbon dioxide per gram of organic matter per day [4 mg CO_2/g OM/d]; or,*
>
> c. *the temperature rise of the compost above ambient temperature is less than 8^oC.*

Dr. Paul Arnold of Bio-Logic Environmental Systems completed a technical memorandum, dated May 11, 2014 for New Era Technologies evaluating the process performance and respiration rate (2014 Bio-Logic Study). The measured respiration rates, after 80-90 days, reported in this memorandum were approximately an order of magnitude higher (3,500 - >10,000 mg O_2/kg VS/h) than the 2010 NSE Guideline limit of 400 mg O_2/kg VS/h. Full-scale trials involving no leachate recirculation and increased bulking amendment were not able to reduce the measured respiration result significantly.

Over 2010 and 2011, CBCL Limited (CBCL Study) collected 4 batches of compost samples from the NETL facility (as well as the Miller and Elmsdale facilities). While the respiration rates, after 120 days, were significantly lower (409 – 2,830 mg O_2/kg VS/h) than the results measured in the 2014 Bio-Logic Study, they were still above the 2005 CCME Guideline threshold.

Section IV.4(d)&(e) of the 2010 NSE Guidelines allows for immature compost to be transferred to an approved composting facility in order to complete the maturation process. In addition:

> *For immature compost to be transported to a secondary curing area, it must achieve one of the following requirements:*
>
> i. *cured for at least 21 days and must not reheat above 20^{o}C;*
> ii. *cured for at least 21 days and organic matter is reduced by at least 60% by weight; or*
> iii. *able to germinate 90% of cress seed vs control and has a plant growth rate of compost/soil at least 50% of control.*

The 2014 NETL Annual Report confirms that the compost generated at the NETL facility is currently able to consistently meet the cress seed germination and plant growth rate requirement. Thus, utilization of a secondary curing facility at an approved composting facility will be an option following the implementation of the 2010 NSE Guidelines for the NETL facility in 2019.

3.2 Feedstock and Process Considerations to Achieve Maturity Requirement

The rate at which maturity is attained is dependent primarily on how well the material is aerated during both the compost and curing stages. For a facility that relies on static aeration for both the compost and curing stages, this is ultimately dependent upon the structure and porosity of the feedstock. Manipulating air flow rates through a compost heap will only have a significant impact if the compost has adequate porosity or free air space to permit the air to flow through the heap. Porosity is a function of the range of particle sizes in the material, moisture content and homogeneity of the material (i.e., well mixed). Achieving maturity in a timely fashion also requires other material quality parameters such as C:N ratio, nutrients and pH to be maintained within certain bounds.

Process change options in 2019 to increase aeration include:

- Increased bulking amendment
- Increased turning/aeration at the primary and/or curing stages
- Increased curing times (requires additional capacity)

Previous work has been completed to improve the maturity of the compost at the NETL facility. The 2014 Bio-Logic Study separately measured the impact of additional bulking amendment (and cessation of leachate recirculation) and the impact of increased turning/aeration during the curing phase. In the study, Dr. Arnold was able to demonstrate, in a bench-scale test, that increased aeration during curing could achieve a respiration rate of below 1,000 mg O_2/kg VS/h in as little as 40 days despite the fact that the curing material was wetter than optimal curing conditions (60 percent actual vs 45-55 percent optimal). This was the best respiration result achieved in the study.

The study also demonstrated that only ceasing leachate recirculation or combining no leachate recirculation with a drier bulking agent (with no changes to curing process) was not sufficient to achieve the new maturity requirement on its own. The study did not examine the combined impact of no leachate recirculation, additional bulker and increased curing aeration.

At the time the 2014 Bio-Logic Study was completed leachate was still being recirculated back into the compost process; a practice which was terminated in May 2014 largely as a result of the 2014 Bio-Logic Study. Mr. Evans noted during the site visit that the compost quality has improved noticeably in the year since as a result.

Table 3.2, attached, summarizes the compost quality data from the 2012-2014 Annual Reports. There have been only two compost maturity samples collected since August 2014 and these results are within the range of values measured prior to August 2014. Thus, the cessation of leachate recirculation does not appear to have had any immediately measurable impact on compost maturity; but it is still too premature to draw any conclusions. It could take a number of compost cycles to progressively dry out the overs, in turn drying out the feedstock mixture, until a new seasonal process equilibrium is reached.

Figure 3.1, attached, illustrates the available compost C:N ratio, pH and moisture data compiled from the 2012-2014 Annual Reports. If leachate recirculation was terminated in May 2014, the first batches of compost generated without leachate addition would be screened in early August 2014 (grey dashed vertical line). There is not enough data yet available to draw any firm conclusions, but qualitatively comparing the compost moisture data before and after August 2014, it does appear that the moisture content in the compost may have dropped somewhat as a result of not adding leachate back to the composting process. This supports Mr. Evans' initial observations. There are no readily apparent trends in the available pH or C:N data.

Table 3.3, below, summarizes available moisture, pH and C:N ratio levels in the feedstock and compost compared against industry standard optimal ranges. From Table 3.3, the NETL facility compost C:N ratio was within the recommended range, however the moisture content and pH were not. C:N ratio data was not available for the feedstock materials, it is suspected that the C:N ratio of the mixed feedstock materials entering the compost containers is below 25:1. Typical values for municipal organics have been provided for reference. The NETL facility uses very little external bulking amendment and relies heavily on screening overs to bulk up the material. The low pH is also retarding the rate of composting and curing. The data in Table 3.3 suggests that the compost process is incomplete and ineffective based on current lack of external bulking amendment and compost and curing processes.

Table 0.3

Available Compost Quality Parameters

	Feedstock		*Compost*	
Parameter	***NETL*[1]**	***Optimal*[2]**	***NETL*[3]**	***Optimal*[2]**
Moisture (%)	56-61	55-65	50 (45-59)	40-45
C:N Ratio	Food Waste: 15:1 Green Grass: 10:1 Leaves: 55:1 Wood Chips: 200:1	25:1 – 30:1	16:1 (12:1-19:1)	15:1 – 20:1
pH	4.3-6.0	6.5-8.0	5.3 (4.5-6.1)	6.5-8.0
Bulk Density (kg/m³)		475-590	Not available	
Nutrients	Not available		Not available	

Notes:

1. Source: Moisture and pH values from 2014 Bio-Logics Study. Measured feedstock C:N ratio data not available; typical values taken from Environment Canada 2013 Technical Document on Municipal Solid Waste Organics Processing.
2. Source: Average, minimum and maximum values taken from Environment Canada 2013 Technical Document on Municipal Solid Waste Organics Processing.
3. Source: 2012-2014 NETL Annual Reports – see Table 3.1.

The material exported from the NETL facility does consistently meet previous cress seed germination and plant growth rate maturity requirements. This indicates that some level of treatment or composting is occurring but is likely limited due to a limiting factor such as low pH, high moisture, a nutrient deficiency or time; or a combination thereof.

The retention time of the primary compost containers is considered to be insufficient, particularly given the moisture content of the material and lack of suitable bulking amendment. This is a primary capacity constraint of the NETL facility. The containers must first dry the material before proper composting can begin. Seven to ten days is not considered enough time to dry, pasteurize and compost the wet, low pH SSO materials being received at the site, particularly given the lack of suitable bulking amendment. Thus, in effect, the curing area is also performing the function of a secondary composting area; which impacts that available curing capacity of the facility.

In 2019, the composting containers will be 20 years old and this is considered the end of their remaining useful life. The containers appear to have been reasonably well maintained and repaired over the past 15 years considering that they have been moved, tipped, lifted, dropped 25-30 times per year. They are however starting to exhibit signs of their age. The container walls are developing new holes at an increasing rate and an increasing number of patches are required according to Mr. Evans. The containers are expected to need replacing in 5-10 years to ensure reliable operation past 2019.

New containers can no longer be purchased from Stinnes-Enerco to expand the existing system as they are no longer in business. An alternate composting system would be required to expand or replace the existing container system. Adding additional capacity via another composting system, for example another compost container supplier or an in-vessel system (similar to HotRot system), would result with a facility that employs two different composting systems of two different vintages. As the existing system will be at or very near the end of its remaining useful life in 2019, it is recommended that it be replaced with a new organics processing system that is better suited to the quantity and quality of feedstocks anticipated to be received in the future.

To extend the life of the existing containers, without expansion, as long as possible past 2019, it is possible to utilize a portion of the curing area as a secondary composting area. This is essentially what is already occurring but should be done with more active management, including increased turning of the materials in the first part of the hall where active composting is occurring. Use of curing area for secondary composting will therefore require additional curing area (as a result of the reduced area available due to the secondary composting).

Additional bulking amendment material would improve the porosity, pH, moisture and C:N ratio of the feedstock material. Procurement of wood chips, a common and effective bulking agent, has been a challenge for the NETL facility. There is a strong local demand for wood chips for power generation driving up the price. Mr. Evans indicated that the local price for bulk mulch is too expensive at $15-18 per yard to utilize at the facility. Assuming a bulk density of approximately 250 kg/m^3 and a bulker:organics ratio of between 1:5 and 1:3 (volume basis), the cost of purchasing a mulch amendment could range between $8 and over $16 per tonne of SSO processed. At a bulker:organics ratio of 1:4 (volume basis), approximately 9,000 m^3 or 2,500 tonnes of well- structured bulking amendment would be required to process 25,000 tonnes of SSO.

The NETL does occasionally receive mulch from smaller suppliers as it is available. This is primarily used to replenish the biofilters on-site. Spent mulch from the biofilters is used as an amendment in the composting process as it becomes available (not continual).

Compounding the problem of the lack of bulking amendment is the increase in the amount of ICI organics being delivered to the facility. As with all municipal organics processing facilities, the quantity and quality of the material is dependent on the program participants and varies seasonally and over time. Table 3.4 summarizes the amounts of residential and ICI material received at the NETL facility from 2012 to 2014.

Table 0.4

Summary of ICI and Residential Tonnages Received at NETL Facility

Year	*Residential*	*ICI*	*Total*	*Percent ICI*
2012	15,900	8,159	24,059	33.9%
2013	15,684	8,659	24,343	35.6%
2014	14,873	9,354	24,227	38.6%

Source: 2012-2014 NETL Annual Reports

This increase in the relative amount of ICI SSO received at the facility increases the amount of bulking amendment required for adequate composting in a static aerated container composting system. The lack of bulking amendment availability compounds the unsuitability of the static aerated containers for this type of material. It is very difficult to first dry and then compost the material in this style of composting.

3.2.1 Increased Curing Area

The 2012 CBCL Study demonstrated that only the compost from the Elmsdale facility that had cured for 12 months consistently met the maturity and other compost quality criteria, including pathogen reduction. Thus, without any other significant improvements to the quality of fines exported from the NETL facility, an option to meet the 2010 NSE Guidelines would be to provide sufficient area for an additional 12 months of passive windrow curing. Table 3.5 summarizes the calculations for the approximate additional curing area required.

Table 0.1

Estimate of Additional Curing Area

Item	*Value*	*Units*
Mass to be Cured (110% of 2014 annual compost quantity)	12,500	tonne
Assumed Bulk Density of Immature Compost	500	kg/m^3
Volume to Cured	25,000	m^3
Stockpile Width	16	m
Stockpile Height	8	m

Item	***Value***	***Units***
Stockpile Cross-Sectional Area (triangle)	64	m^2
Stockpile Length	400	m
Stockpile Footprint	6,400	m^2
Allowance for Equipment Access and Work Areas (100%)	6,400	m^2
Allowance for Water Management (50%)	3,200	m^2
Approximate Total Additional Curing Area (-50%/+25%)	16,000 1.6 4.0	m^2 hectares acres

It is not clear how effective the existing curing hall is with the existing quality of material being cured. The air channels in the floor become completely clogged and must be cleaned each time material is moved down the curing hall. Therefore, it is not recommended that a new aerated curing hall be constructed as it would be required to be covered with mechanical ventilation and odour treatment.

The cost to develop an additional 1.6 hectares (4.0 acres) for a curing pad will depend on a number of factors but could vary from several hundred thousand dollars to over a million dollars depending on the site. Locating the additional curing pad at an existing serviced facility with an existing scale, a loader, staff and surface water management will greatly reduce the required capital investment and ongoing operational costs. The site may require NSE approval or an amendment to an existing approval to operate.

Increasing the curing area/time does nothing to address the quality of the compost currently produced at the NETL facility, the effectiveness of the existing composting equipment, or condition of existing infrastructure, which will be 20 years old in 2019.

3.2.2 Increased Aeration

Simply forcing more air through the existing feedstock materials or curing piles will not be successful in increasing aeration without suitable external bulking amendment. This approach has been attempted with little to no success multiple times by the operator within the bounds of the current blower fan capacities. For the NETL facility, increased aeration effectively implies additional turning of the curing pile, as additional turning of the primary compost containers is not possible. Additional turning of the curing pile will require additional labour, additional equipment and/or additional space.

The interior dimensions of the curing building are approximately 135 m long by 20 m. The aerated floor is approximately 120 m (container tipper is located at front of curing building) by 14 m. On the day of the site visit the curing pile spilled over at least 2 m past the end of the aerated floor making the pile approximately 16 m wide at its base. On the day of the site visit the curing pile was approximately 3.1 m (10 feet) high, but Mr. Evans indicated that normally he would prefer to keep it at approximately 2.4 m (8 feet) high. Based on these dimensions and the shape of the curing pile, it was calculated to have a cross sectional area that varied between 35 and 45 m^2.

The length of the floor is almost never entirely covered as space is always needed to add new material. It is estimated that currently the floor is approximately 80 percent full on average. On the day of the site visit the curing area was 50-67 percent full, but Mr. Evans indicated that he was clearing some space in the curing building to facilitate an inspection and possible repairs to the tipping floor area. Thus, on average the curing building contains roughly 3,400 – 4,300 m^3 of unscreened material for curing.

Additional turning using a front end loader could be accomplished with minimal additional space (if any) but with significant additional labour. In order for a front end loader to move and turn approximately 3,400 – 4,300 m^3 of material twice per week, allowing for at least three days before a material is turned and working on a 5-day work schedule, would require the turning to be completed in approximately 1.5 working days (Monday to Tuesday morning, and Thursday afternoon to Friday) or 11 hours. This implies moving 300 - 390 m^3/hr or 60 to 195 bucket loads per hour (1-3 bucket loads per minute) depending on the size of the bucket. This will likely require 2-3 loaders to complete depending on the amount of material and size of bucket. Operating three loaders in this tight and foggy space in a safe manner would need to be evaluated. This is very labour intensive regardless of the number of loaders required and may require an additional loader and operator to what currently exists at the facility.

Alternatively, a specialized compost turner could be utilized. It could be used to both turn the piles and move the piles down the hall towards the screening building if well planned. A single compost turner could potentially turn 4,300 m^3 in less than half a day.

Most compost turners are designed for outdoor windrow use and as such require a prohibitive amount of space for turning and between windrows. This space would result in significant reductions in the capacity of the curing building. As compost turners generally move the pile backwards during the turning process, they would need to move in the same direction for the majority of turns in the curing building, generally from back to front (oldest to newest material) to ensure the material is continually moved towards the screening building. This would require a dedicated extra wide aisle to move the machine from one end of the building to the other between rows. Most large self-propelled turners also do not fit through doors that are less than 6 m wide. Smaller turners would result in much smaller windrows and curing capacity.

CRA found one potential suitable compost turner:the ECO 5003 model from neuson ecotec; an Austrian firm with a distributer in Quebec (Agritibi R.H. Inc.). It can process up to 2,800 m^3/hr. The website link is:

http://www.neuson-ecotec.com/index.php?id=40&L=1

The ECO 5003 is specifically designed for tight spaces and indoor use. It does not require space between windrows and requires minimal turning area at the end of each windrow. The front rotor unit, which comes in 4 or 5 m widths, is attached with a quick-hitch system and with the front rotor unit removed; the machine is 3.65 m (12 feet) wide. This may allow the machine to enter and exit the building for maintenance without modifications to the doors (to be confirmed).

Figure 0.2: Photo of neuson-ecotec ECO 5003 (Source: neuson-ecotec website)

The 5 m wide rotor can manage a 10 m^2 trapezoidal – triangle pile that is 5 m (16 feet) at its base and 2.5 m (8 feet) high. No space is required between windrows; in fact they can be overlapped by 1.5 m, so three windrows would require as little as 12-15 m. The curing building is approximately 20 m wide. Three windrows would provide room for the machine to travel from one end of the building to the other to move all three windrows in the same direction. Three windrows provides approximately 30 m^2 total cross sectional area (less if the windrows are overlapped).

This type of compost turner would result in drier material at the NETL facility. The aeration channels would require less frequent cleaning, at least in the back half of the building. This would allow less of the area to be kept offline at any one time for cleaning. However, this is offset by the additional turning area required for the machine, roughly 6 m at each end of the building. It was assumed that with this machine, the curing hall would remain approximately 80 percent full on average. Thus, the total curing volume capacity would be approximately 2,800 m^3 or 65-82 percent of the current capacity.

Use of a compost turner of this type, combined with forced aeration, would reduce the amount of curing time required. Material is currently cured for 75-90 days (2.5 – 3.0 months). It is reasonable to expect that with the effective use of a turner such as this (turning 2-3 times per week), that the maturity requirement under the 2005 CCME Guidelines can be achieved in less than 65 percent of the current curing time (i.e., in less than 50 days) from a material generated from 7-10 days in the primary compost containers (without leachate recirculation and without additional amendment). This will need to be confirmed with a field trial as outlined in Section 3.2.3.

CRA is not aware of any facilities in Canada using the ECO 5003. This unit is expected to cost several hundred thousand dollars but would replace at least one front end loader and possibly one laborer as much less time will be spent in the curing hall moving materials around.

3.2.3 2010 NSE Guidelines Compliance Summary

To generate compost from the NETL facility that is fully compliant with the 2010 NSE Guidelines and applicable 2005 CCME Guidelines on compost quality will require, at a minimum:

- Continued practice of no recirculation of leachate (unless required to maintain minimum moisture requirements if a compost turner is utilized, for example) (zero capital cost, net operational savings with respect to leachate management)
- Additional bulking amendment (zero capital cost item, $8-16/tonne SSO received)
- Additional curing area and/or frequent turning (i.e., increased aeration) of the curing pile (several hundred thousand dollars to over a million dollars of capital for additional curing area or new windrow turning equipment)
- Potentially new or additional screening equipment (not fully operational during site visit therefore could not fully assess)

This is in addition to the approximately $698,000 in building repairs required over the next 5 years identified in the building assessment completed by CRA, submitted under separate cover (CRA, April 2015). This does not account for the age of the existing equipment and the expected requirement to replace the existing composting system within 5 years past 2019.

Given that the existing containers will be at the end of their remaining useful life in 2019, their unsuitability for the type of wet, low pH SSO material being received at the NETL facility, and the lack of suitable bulking amendment, it is not recommended to purchase additional primary composting capacity to improve the retention time of the existing containers to achieve the maturity requirement. If the existing composting system is operated past 2019, it is recommended that a portion of the curing area be utilized for the additional composting capacity as it is unknown how long past 2019 the existing containers will be serviceable.

If the decision is made to continue operating the existing composting system past 2019, it is recommended to complete a pilot-scale trial in the curing building (on the aerated floor) of the impact of increased turning of the curing pile. If possible a small windrow turner should be rented to complete the trial. An area at the back-end of the curing building (adjacent to the screening building) should be used for the trial to ensure that any of the leachate from the other compost does not impact the trial.

Section 4.0 Process Improvement Assessment

As part of CRA's operational review, a process improvement assessment was to be completed. The assessment was to identify process improvements that could result in better compost quality, throughput, and use of space in addition to process improvements required to meet the 2010 NSE Guidelines. Based on the on the findings outlined in Section 3.0 and the building condition assessment completed previously, investing in further process improvements to the existing Stinnes-Enerco containerized composting system is not recommended as it will need to be replaced by 2019 or shortly thereafter. In 2019, when the 2010 NSE Guidelines will apply to the NETL facility, it is recommended that Halifax replace the existing facility with alternate organics processing capacity to meet Halifax's organics processing needs for the subsequent 20-year period.

Based on the findings to bring the facility into compliance with the 2010 NSE Guidelines, the cost to implement these upgrades are in the order of several hundred thousand dollars (for a new turner) to over a million (for a new secondary curing area). This is in addition to the approximately $698,000 in building repairs required over the next 5 years identified in the building assessment completed by CRA, submitted under separate cover (CRA, April 2015).

This is also in addition to replacement costs for the existing compost containers with new composting equipment. If the compost equipment is replaced, it is not clear based on the characteristics of the SSO being received at the facility, namely it's high moisture content, low

C:N ratio and low pH, that composting the material is the most cost effective processing option. It is recommended that Halifax explore multiple organics processing options when considering replacement of the existing composting system at the NETL facility.

In addition to these capital expenditure upgrades, the following operational considerations are significant:

1. Due to the increased amounts of ICI organics to the feedstock material, the static aerated container composting technology is no longer ideal for composting the material currently being received at the facility. This is addressed in Section 3.2.
2. The process is labour intensive. The NETL facility employs 10-11 staff. Other more modern SSO composting facilities of a similar scale can operate with less full time staff; the number depends on the type of technology used but as few as 7 full time staff. Many composting facilities do not include a manual sorting step, apart from separation of large items observed by tip floor loader operator. This is an area for potential process improvement.
3. Halifax is paying to truck 5.0 million liters of leachate and 3.8 million litres of process water per year. Currently, this is costing Halifax approximately $0.08/litre for trucking and disposal, however, in the past it has been over $0.22/litre. The wastewater had been permitted to be trucked to a nearby Halifax Water sanitary sewer inlet, at a cost of $0.165/litre; however Halifax Water encountered difficulty processing the wastewater and could no longer accept the material. At the current price of $0.08/litre, Halifax is paying $704,000 annually to manage the leachate and process water at the site. Measures have been taken to minimize the amount of leachate generated at the facility (no leachate recirculation) and therefore the quantity is expected to decrease. No plans have been identified to cover the outdoor biofilters (further discussed below) to reduce the quantity of process water.

The uncovered outdoor biofilters could be covered to reduce the amount of process water generated at the NETL facility. The curing building biofilter is approximately 1,760 m^2. Halifax has an average annual rainfall of approximately 1,400 mm. Assuming that 50 percent of the precipitation that falls on the biofilter will eventually pass through it to be collected and stored, covering the biofilter will result in a reduction of approximately 1.2 million litres of process water per year or an approximate savings of $100,000 per year in disposal costs at the current price of $0.08/litre. Installing a fixed cover over the biofilter would cost between $0.8-1.5 million and would require disruption to existing operations to install as space is limited around the biofilter. Assuming the facility will only remain operational for 5 years, it is not recommended to cover the biofilters as the capital upgrade and disruption of operations is not justified based on the potential savings.

A temporary biofilter cover is an alternate option. However, assuming the facility will only remain operational for 5 years, the additional capital and operating costs are not justified. Managing exhaust air from the biofilter and the media moisture levels will be more difficult. If not managed properly, a temporary cover could result in increased odours. Additional costs considerations include the temporary cover system and labour and equipment to roll the cover on and off the biofilter to refresh the media and control the moisture levels.

In summary, the following costs, summarized in Table 4.1 attached, will be incurred by Halifax to keep the NETL facility operating past 2019 using the existing composting system:

- $698,000 in building repairs are required to continue to operate the existing facility.
- $400,000 - $1,500,000 for additional curing area and/or equipment.
- Potential costs associated with new screening equipment.
- Reduced tip fees from $200/tonne (which includes leachate and process water disposal costs): CRA's April 1, 2015 memorandum to Mr. Matthew Keliher at Halifax's Solid Waste Resources estimates tip fees for a composting facility to currently be approximately $175/tonne based on fees at other existing facilities. The Miller facility currently charges HRM $146/tonne. A new, more efficient facility with reduced tip fees and reduced wastewater disposal costs would save Halifax $0.6-1.4 million annually.
- Wastewater disposal costs included in the above $200 tip fee are currently lower than they have been in the past several years. Historically, leachate and process water disposal costs have been up to 3 times higher than the current cost of $704,000 annually; or approximately $2 million.
- Additional bulking amendment at $8-16 per tonne of SSO received. Taking a conservative assumption that a new composting system will still require some bulking amendment, the savings to Halifax is estimated to be $100,000 annually in additional bulking material.

In total, to continue operating the existing NETL facility for the first 5 years of operation past 2019, as compared to more efficient organic processing capacity, will cost Halifax approximately $5-17 million more in capital and operating costs or approximately $1.0-3.4 million annually. This assumes that the existing composting container system will last until 2025.

Potential wastewater volume and disposal cost fluctuations are the primary reason for the large variation in potential savings. Under a worst case scenario, where the existing system is maintained and leachate and process water volumes are not significantly reduced, and the current disposal option is no longer able to accept the NETL wastewater, the additional cost in wastewater treatment could exceed $1.4 million annually.

Section 5.0 Future Operational Capacity Scenarios

Halifax requested CRA evaluate three future capacity scenarios, namely:

1. Status Quo: 25,000 tonnes per year
2. Capacity increase: 40,000-45,000 tonnes per year
3. Capacity reduction: 10,000-15,000 tonnes per year

As discussed in Sections 3.0 and 4.0, the NETL facility, CRA does not recommend operating the NETL facility at its current capacity beyond 2019. The same rationale applies to both the capacity increase and decrease scenarios. The existing Stinnes-Enerco composting containers and associated ancillary equipment are expected to need replacing in 2019 or shortly thereafter. The system cannot be relied upon for another 15-20 years of operation past 2019. In addition, the static aerated container/floor system is not ideally suited for the nature of Halifax's organics due to the challenge in procuring a cost effective bulking amendment.

For both the status quo and capacity increase scenarios, scenarios 1 and 2 above, CRA recommends replacement of the existing composting system with alternate organics processing capacity. The existing system is not expected to be able to meet the 2005 CCME Guidelines for maturity at the existing or any increased material throughput without significant upgrades to infrastructure and/or equipment.

With respect to scenario 3, decreased capacity, for long-term robust organics processing capacity, CRA does not recommend relying on continuing operation of the NETL facility well past 2019; even at a reduced throughput. However, CRA expects that at a reduced throughput of roughly half the current throughput of 25,000 tonnes annually, that no further investment (beyond investment in building repairs to reach 2019) in the NETL facility would be required to achieve the 2010 NSE Guidelines, including the 2005 CCME Guidelines for maturity. Operating at a reduced capacity will reduce the labour required (7-8 staff), reduce the leachate and process water generated significantly and generate a finished saleable compost. Halifax should not rely on operating the NETL facility at half capacity past 2019 for an extended period of time but it could be operated in this manner possibly for a number of years if it is operated with some care.

Section 6.0 Conclusions and Recommendations

To generate compost from the NETL facility that is fully compliant with the 2010 NSE Guidelines and applicable 2005 CCME Guidelines on compost quality will require, at a minimum:

- Continued practice of no recirculation of leachate (unless required to maintain minimum moisture requirements if a compost turner is utilized, for example) (zero capital cost, net operational savings with respect to leachate management).
- Additional bulking amendment (zero capital cost item, potential of $8-16 per tonne of source separated organics increase in operating costs).
- Additional curing area and/or frequent turning (i.e., increased aeration) of the curing pile (several hundred thousand dollars to over one million of capital for additional curing area or new windrow turning equipment).
- Elmsdale Landscaping Ltd. is not an approved composting facility and therefore would not be able to act as a secondary curing facility for the NETL facility, if required, unless it obtains approval.
- The NETL facility will require additional signage to provide normal operating hours, emergency contact information and the types of acceptable materials at the site entrance.
- Foreign matter levels in the compost are a concern and may require new or additional screening equipment to meet Section 3.3 the 2005 CCME Guidelines. The screen size can likely be reduced if the compost maturity is improved as discussed in Section 3.2 above. The efficacy of the existing equipment will need to be re-evaluated when the compost maturity has improved to an acceptable level (it was difficult to evaluate this from the material present during CRA's site visit).
- The NETL facility must increase the frequency of compost sampling as they are currently not in compliance with their approval to operate from NSE. For the years 2012-2014 the operator was just short of this requirement. Testing is required for every 1,000 tonnes of compost or every 3 months; see Table 3.1. The 2010 NSE Guideline requirement is the same as the sampling frequency in NSE Approval #2008-062534.
- Condition 13(b) of the Approval to Operate requires overs to be disposed of at an approved landfill site unless written permission for an alternative is received from the NSE. This condition should be clarified by consulting with NSE to ensure that New Era is meeting the requirements of the Approval to Operate. Currently, New Era tests larger size compost material (coarse compost) prior to shipping according to the CCME Guidelines for every 1,000 tonnes generated and ships the material to Elmsdale Landscaping for further processing and curing.

The NETL facility is not ideal for considering further investment to upgrade operations to bring into compliance with the 2010 NSE Guidelines or to increase or decrease capacity. In 2019, when the 2010 NSE Guidelines will apply to the NETL facility, it is recommended that Halifax replace the existing facility with alternate organics processing capacity to meet Halifax's organics processing needs for the subsequent 20-year period. With respect to process improvements or modifying the capacity of the facility, the primary constraints are:

- Age and condition of existing equipment and buildings
- Porosity, moisture, pH and C:N ratios of feedstock materials and challenges in sourcing suitable bulking amendment
- Incompatibility between the existing organics processing technology (static aerated floor/container) with Halifax SSO (particularly the Institutional, Commercial and Industrial source separated organics). This is related to the feedstock issues identified above and the inability to easily address this incompatibility through changes to feedstock materials or composition. Thus, a different technology is recommended for the long-term organics processing needs of Halifax past 2019.

To continue operating the existing NETL facility for the first 5 years of operation past 2019, as compared to more efficient organic processing capacity, will cost Halifax $5-17 million of capital and operating costs or approximately $1.0-3.4 million annually. This assumes that the existing composting container system will last until 2025.

The 61 Evergreen Place property is zoned for processing of solid waste (organics) and is owned by Halifax. The site is 33 acres with approximately 20 acres undeveloped. There is sufficient space to construct a new facility around the existing facility while maintaining its operations.

Section 7.0 Closure

We trust that this report meets your present requirements. Please do not hesitate to contact us, if any questions arise.

Original signed by

Original signed by

Mike Muffels, M.Sc., P. Eng.

Tej Gidda, Ph.D., P. Eng.

Origional signed by

Andrew Philopoulos, M.Sc., P. Eng.

Aerial Imagery Source: DigitalGlobe, Halifax_CA_V2, captured 8/6/2011, accessed via ESRI World Imagery service.
Coordinate System: NAD 1983 UTM Zone 17N

figure 2.1

SITE LAYOUT
NEW ERA TECHNOLOGIES LTD. FACILITY
61 EVERGREEN PLACE, GOODWOOD
Halifax Regional Municipality

071855-02(002)GIS-WA001 August 28, 2015;

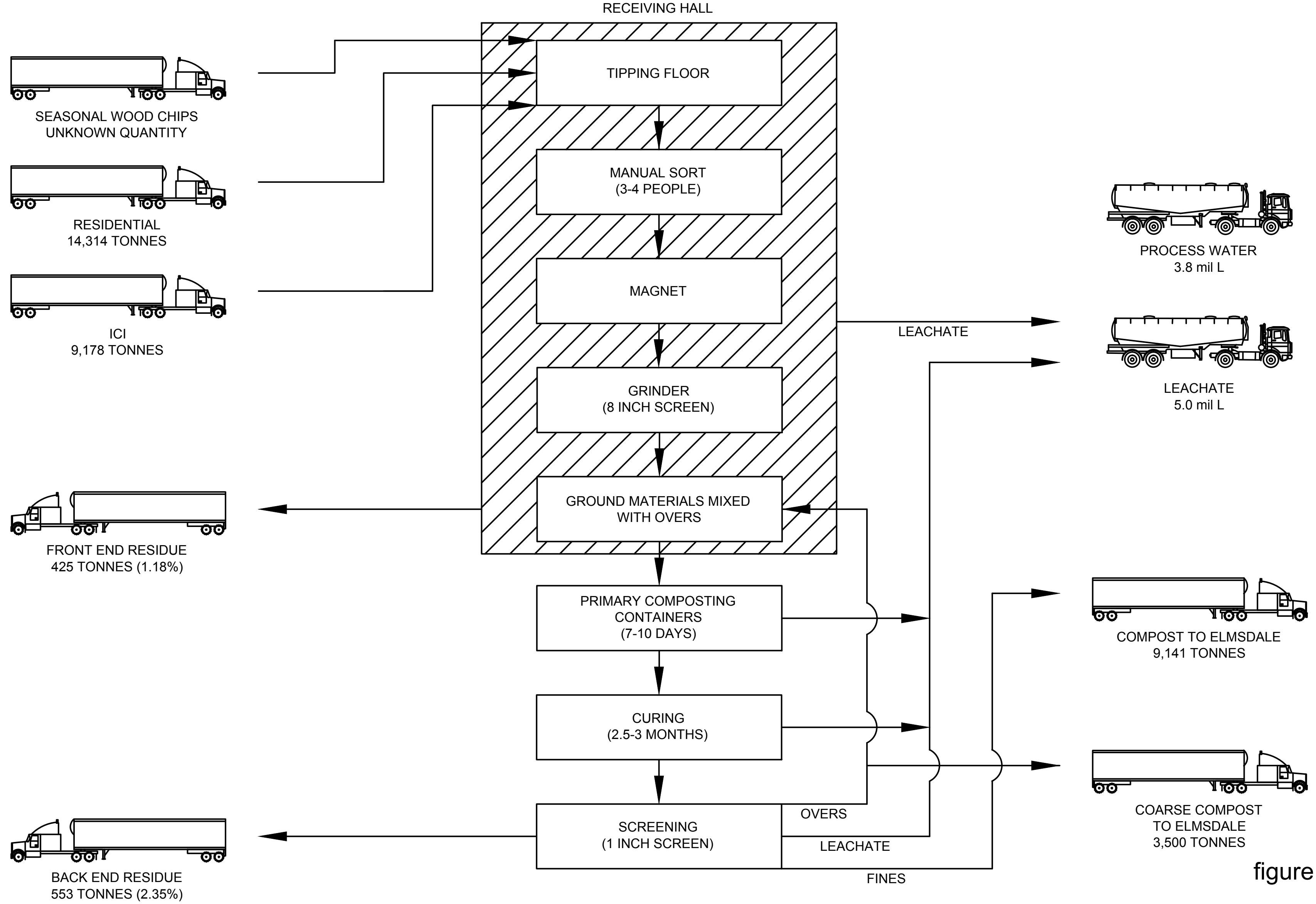

figure 2.2

PROCESS FLOW DIAGRAM
NEW ERA TECHNOLOGIES LTD. FACILITY
61 EVERGREEN PLACE, GOODWOOD
Halifax Regional Municipality

NOTE:
TONNAGES FROM HRM FISCAL 2014

71855-001(PRES001)GN-WA001 AUG 28/2015

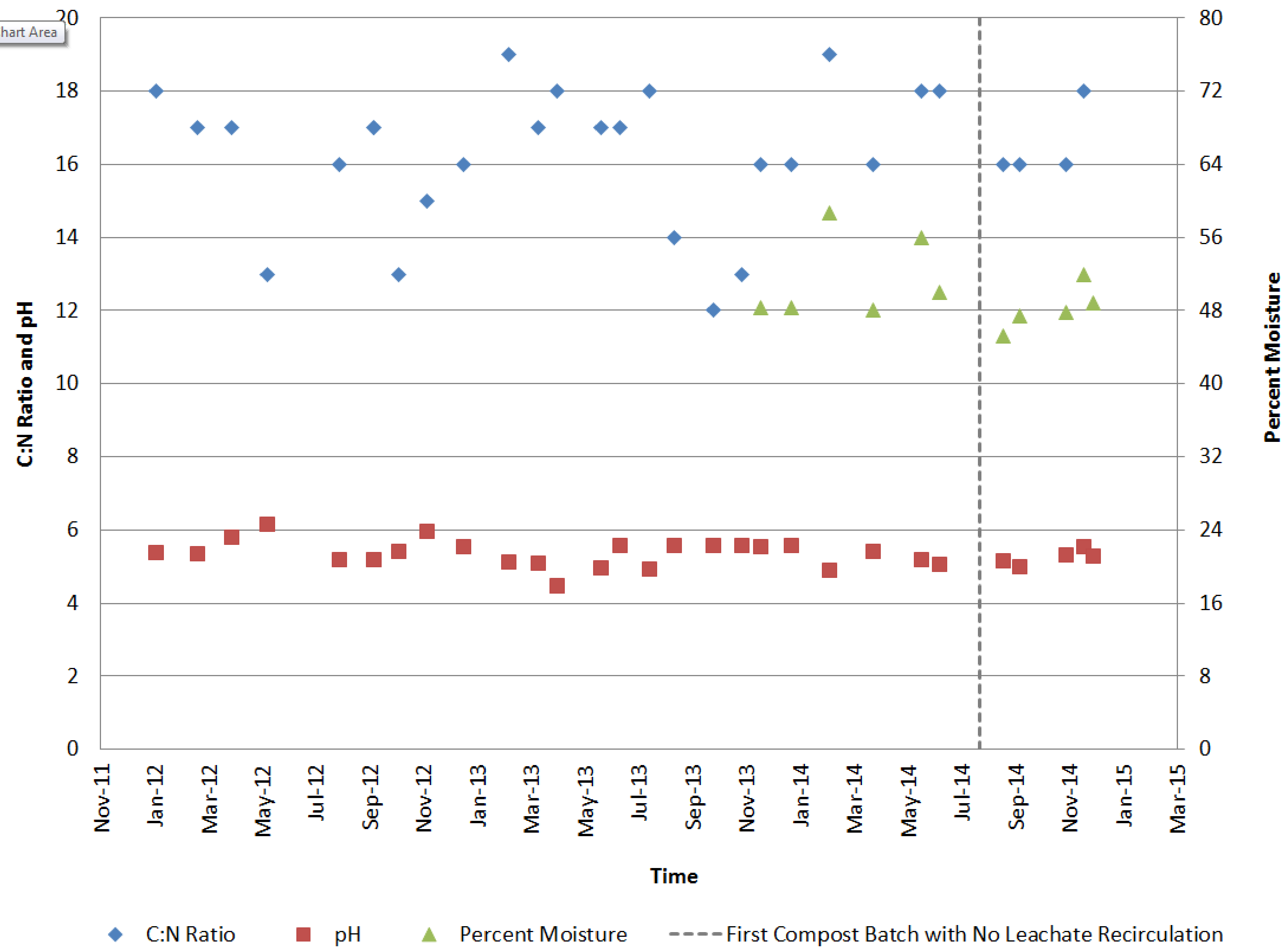

figure 3.1
COMPOST QUALITY
NEW ERA TECHNOLOGIES LTD. FACILITY
61 EVERGREEEN PLACE, GOODWOOD
Halifax Regional Municipality

CONESTOGA-ROVERS
& ASSOCIATES

TABLE 3.1

2010 NOVA SCOTIA ENVIRONMENT COMPOSTING FACILITY GUIDELINES COMPLIANCE SUMMARY
NEW ERA TECHNOLOGIES LIMITED (NETL) FACILITY PROCESS REVIEW
61 EVERGREEN PLACE, GOODWOOD, NOVA SCOTIA
HALIFAX REGIONAL MUNICIPALITY

Section	*Guideline Requirement*	*Compliant (Y/N)*	*Notes*
I & II	*General & Application for Approvals*		
I.3.(a) II.1.(a)	No person shall construct, operate, expand or modify a facility which can process compost without obtaining approval from the Minister.	Y	NSE Approval #2008-062534 Expires June 19, 2019
III	*Leaf and Yard Waste Composting Facilities under 10 000 tonnes*	*NA*	
IV.	*In-Vessel Composting Facilities*		
IV.2.(a)	The receiving and tipping area shall be underlain by an impermeable pad, the surface of which shall be concrete or asphalt. All drainage from the impermeable pad shall be collected for treatment or for return to the process.	Y	Receiving and tipping areas have concrete floor. Leachate collected and transported off-site for treatment. Leachate recirculation to process discontinued in May 2014.
IV.2.(b)	The receiving and tipping area shall be in an enclosed structure.	Y	
IV.3.(a)	The composting area shall be designed to fully contain the compostable organic material and all leachate which may be generated.	Y	Composting conducted in enclosed containers on outdoor concrete pad.
IV.3.(b)	The containment system shall be impermeable, the surface of which shall be constructed of concrete, asphalt, steel or other material as approved by the Department.	Y	Composting containers are steel on outdoor concrete pad.
IV.3.(c)	All drainage from the composting area shall be collected for treatment or for return to the process.	Y	Leachate collected from composting containers and transported off-site for treatment. Leachate recirculation to process discontinued in May 2014.
IV.4.(a)	The curing area shall be underlain by an impermeable pad, the surface of which shall be concrete, asphalt or other material as approved by the Department.	Y	Curing area has concrete floor.
IV.4.(b)	All drainage from the impermeable pad shall be collected for treatment or for return to the process.	Y	Leachate collected and transported off-site for treatment. Leachate recirculation to process discontinued in May 2014.
IV.4.(c)	All curing areas shall utilize permanent roof structures and/or proven management techniques to control moisture and minimize odour and leachate generation.	Y	Curing area enclosed in cover-all type building.

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61 EVERGREEN PLACE, GOODWOOD, NOVA SCOTIA
HALIFAX REGIONAL MUNICIPALITY

Section	Guideline Requirement	Compliant (Y/N)	Notes
IV.4.(d)	Where space limitations prevent the production of mature finished compost at in-vessel composting facilities, immature compost may be transferred to an approved composting facility in order to complete the maturation process.	N	Immature (per 2010 NSE Guidelines) compost is currently transferred to Elmsdale Landscaping Ltd. Elmsdale is not listed on the NSE list of Organic Composting Facilities in Nova Scotia.
IV.4.(e)	For immature compost to be transported to a secondary curing area (i.e. secondary site), it must achieve one of the following requirements: i) cured for at least 21 days and must not reheat above 20^{o}C; ii) cured for at least 21 days and organic matter is reduced by at least 60% by weight; or iii) able to germinate 90% of cress seed vs control and has a plant growth rate of compost/soil at least 50% of control.	Y	Refer to NETL facility Annual Reports. The fines or compost generated at the NETL complies with requirement iii).
IV.5	A leachate management system shall be developed which consists of infrastructure and monitoring systems designed to collect, monitor, control, and treat leachate prior to being discharged into the surrounding environment. The system shall: (i) have a leachate collection and removal network in the active area; (ii) function year round; and (iii) have a means of monitoring all treated leachate discharges.	Y	Leachate collected, stored and transported off-site for treatment.
IV.6	The applicant shall submit for approval from the Department, a surface water monitoring program.	Y	Compliance documented in annual reports reviewed by NSE.
IV.7	The applicant shall submit for approval from the Department, a groundwater monitoring program.	Y	Compliance documented in annual reports reviewed by NSE.
IV.8.(a)	Mechanical ventilation shall be provided for the composting area, areas for the storage of compostable organic feedstock and any other area containing readily putrescible materials such as the storage room for residuals.	Y	Mechanical ventilation is provided for all active areas.
IV.8.(b)	All areas referred to in clause (a) shall be under negative atmospheric pressure in order to avoid the escape of odours.	Y	On the day of CRA's site visit (April 28, 2015), inward air flow through open overhead and man doors was observed.
IV.8.(c)	All ventilation air shall be subject to a treatment system designed to remove odours prior to release into the environment.	Y	Ventilation air treated through organic media biofilters.

TABLE 3.1

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NEW ERA TECHNOLOGIES LIMITED (NETL) FACILITY PROCESS REVIEW
61 EVERGREEN PLACE, GOODWOOD, NOVA SCOTIA
HALIFAX REGIONAL MUNICIPALITY

Section	*Guideline Requirement*	*Compliant (Y/N)*	*Notes*
IV.9	Separation distance[2] between active area and: Nearest residential or institutional building is at least 500 metres Nearest commercial or industrial building is at least 250 metres	 Y Y	 ~860 metres ~225 metres, approved by NSE as permitted by IV.9.(f)
IV.9 (cont.)	Nearest property boundary is at least 100 metres, or 30 metres where it can be demonstrated that particular equipment will not release odours generated from the composting process Nearest watercourse or water body, including salt water, be at least 30 metres	Y Y	~10 metres, approved by NSE as permitted by IV.9.(f) 135 metres
V.	*Open Windrow Composting Facilities*	*NA*	
VI.	*Secondary Curing Areas*	*NA*	
VII.	*Composting Facility Operation*		
VII.1.(b)	The objective of all composting facilities shall be to incorporate all compostable organic feedstock into the composting process the same day that it is delivered to the site. If some feedstock is not incorporated into the process in the same day, except leaf and yard waste feedstocks only, then it shall be stored in an enclosed area with a mechanical ventilation system for the capture and treatment of odorous emissions.	Y	Mr. Evans confirmed that feedstock is generally processed and loaded into composting containers on the same day it arrives. On the day of CRA's site visit (April 28, 2015), it was observed that some of the SSO feedstock on the tipping floor looked as if it had been stored longer than 1 day, but unable to confirm. Receiving area and tipping floor is an enclosed area with mechanical ventilation for the capture and treatment of odorous emissions.
VII.1.(c)	The composting facility shall have constant supervision during the hours that the facility is open.	Y	On the day of CRA's site visit (April 28, 2015), Mr. Evans indicated that the facility is staffed with 10-11 full-time staff.
VII.1.(d)	The composting facility shall accept only feedstock identified in the approval.	Y	Not raised by HRM staff as a known issue. On the day of CRA's site visit (April 28, 2015), CRA did not observe any unapproved feedstock materials.

TABLE 3.1

2010 NOVA SCOTIA ENVIRONMENT COMPOSTING FACILITY GUIDELINES COMPLIANCE SUMMARY
NEW ERA TECHNOLOGIES LIMITED (NETL) FACILITY PROCESS REVIEW
61 EVERGREEN PLACE, GOODWOOD, NOVA SCOTIA
HALIFAX REGIONAL MUNICIPALITY

Section	Guideline Requirement	Compliant (Y/N)	Notes
VII.1.(e)	Any residual products associated with the composting operation shall be disposed of in a manner acceptable to the Department.	Y	Compost residuals are taken to an approved landfill for disposal in accordance with Condition 13.c) of NSE Approval #2008-062534.
VII.1.(f)	Litter shall be controlled on the entire site.	Y	On the day of CRA's site visit (April 28, 2015), no litter was observed.
VII.1.(g)	Exposed areas shall be stabilized to prevent erosion and sedimentation.	Not Assessed	On the day of CRA's site visit (April 28, 2015), snow still covered areas of the site not under concrete. Not a significant concern for the purposes of this study.
VII.1.(h)	Dust shall be controlled to Department requirements for particulate emissions.	Not Assessed	It rained and snowed on the day of CRA's site visit (April 28, 2015). Dust is not specifically addressed in NSE Approval #2008-062534. Not a significant concern for the purposes of this study.
VII.1.(i)	Vectors shall be controlled in accordance with a control plan approved by the Department.	Y	NSE Approval #2008-062534
VII.1.(j)	Signs shall be placed at the entrance to the site indicating the name of the facility, hours of operation, emergency contact, and the materials acceptable at the site.	N	Sign at front entrance does not indicate hours of operation, emergency contact and materials acceptable at the site
VII.2	An Operation and Maintenance Manual shall be submitted for review from the Department. The Operation and Maintenance Manual shall be left on site at all times and shall be available for inspection during operating hours.	Y	Operation and Maintenance Manual reviewed by NSE as part of NSE Approval #2008-062534
VII.3	The applicant shall provide contingency plans addressing problems associated with vectors, groundwater contamination, equipment failure, and odour generation and complaints.	Y	Contingency Plan prepared as part of NSE Approval #2008-062534
VII.4	Reports and Records	Y	Reports and records provided to NSE as required in NSE Approval #2008-062534. CRA received copies of 2012-2014 Annual Reports.

TABLE 3.1

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NEW ERA TECHNOLOGIES LIMITED (NETL) FACILITY PROCESS REVIEW
61 EVERGREEN PLACE, GOODWOOD, NOVA SCOTIA
HALIFAX REGIONAL MUNICIPALITY

Section	Guideline Requirement	Compliant (Y/N)	Notes
VIII.	*Compost Classification and Use*		
VIII.1.(a)	All compost will be classified in accordance with the criteria identified in the 2005 CCME Guidelines. The compost must meet all criteria as established for foreign matter, maturity, pathogens and trace elements.	N	Regular testing compiled in Annual Reports and CBCL Study demonstrate that NETL compost consistently meets trace elements and pathogen reduction requirements. A significant amount of foreign matter >25mm was visible during CRA's site visit on April 28, 2015. This appeared to be primarily film plastic. The plastics vacuum on the screening equipment was disconnected at the time of CRA's site visit. Mr. Evans indicated that due to the high moisture content in the compost this winter, the film plastic was too heavy for the vacuum blower. Screening equipment upgrades, including a smaller screen opening to 10 mm, may be required to meet 2005 CCME Guidelines for A and B compost for foreign matter. NETL compost has been consistently unable to meet 2005 CCME Maturity requirements. Refer to Section 4.1 of this report for detailed discussion on maturity.

TABLE 3.1

2010 NOVA SCOTIA ENVIRONMENT COMPOSTING FACILITY GUIDELINES COMPLIANCE SUMMARY
NEW ERA TECHNOLOGIES LIMITED (NETL) FACILITY PROCESS REVIEW
61 EVERGREEN PLACE, GOODWOOD, NOVA SCOTIA
HALIFAX REGIONAL MUNICIPALITY

Section	*Guideline Requirement*	*Compliant (Y/N)*	*Notes*
VIII.1.(b)	Testing of the compost quality shall be completed for every 1000 tonnes of compost produced or every three months and conducted in accordance with the minimum testing procedures identified in Section 4 of the 2005 CCME Guidelines.	N	See table below. **Note: This is a non-compliance with condition of 11.b).(iii) of the NSE Approval #2008-062534.**

	Compost (tonnes)	*No. of Samples*	*No. per 1000 tonnes*
'12	8,723	8	0.92
'13	10,890	11	1.01
'14	11,226	10	0.89
Sum	30,839	29	0.94

Notes:
1. Condition or efficacy of infrastructure or systems such as concrete pads, containment systems, tanks, etc. not inspected or assessed as part of this compliance review. Scope restricted to a presence/absence determination.
2. Separation distances confirmed using exploreHRM online mapping tool. Printouts from exploreHRM included as Appendix A.
3. List of Organic Compost Facilities in Nova Scotia found at: http://www.novascotia.ca/nse/waste.facilities/facilities.organic.composting.php

TABLE 3.2

COMPOST QUALITY DATA
NEW ERA TECHNOLOGIES LIMITED (NETL) FACILITY PROCESS REVIEW
61 EVERGREEN PLACE, GOODWOOD, NOVA SCOTIA
HALIFAX REGIONAL MUNICIPALITY

Date	*C:N*	*pH*	*Moisture*	*Dewar (Heating Test)*	*Compost Stability Index*	*Repiration CO_2-C/g OM/day*	*Repiration CO_2-C/g TS/day*
25-Jan-12	18	5.39		IV	8	0.10	<0.01
12-Mar-12	17	5.34					
19-Apr-12	17	5.80		V	8	0.70	0.50
30-May-12	13	6.14					
20-Aug-12	16	5.18		IV	3	11.40	6.60
27-Sep-12	17	5.19					
25-Oct-12	13	5.42		IV	4	8.50	5.30
27-Nov-12	15	5.95					
8-Jan-13	16	5.53		IV	3	11.70	8.20
28-Feb-13	19	5.12		IV	5	7.90	6.10
2-Apr-13	17	5.10		V	8	<0.01	<0.01
23-Apr-13	18	4.47		IV	8	1.50	1.30
12-Jun-13	17	4.97		IV	5	6.30	5.10
4-Jul-13	17	5.58		V	8	0.60	0.40
6-Aug-13	18	4.94					
3-Sep-13	14	5.57		V	8	0.90	0.90
17-Oct-13	12	5.58					
19-Nov-13	13	5.58					
10-Dec-13	16	5.54	48.3	V	5	7.00	4.80
14-Jan-14	16	5.57	48.3				
26-Feb-14	19	4.90	58.7				
16-Apr-14	16	5.42	48.0	IV	5	7.60	6.10
11-Jun-14	18	5.18	56.0				
30-Jun-14	18	5.04	50.0	III	7	3.90	2.60
11-Sep-14	16	5.15	45.2	IV	6	4.50	2.90
30-Sep-14	16	4.99	47.4				
21-Nov-14	16	5.32	47.8	IV	4	8.40	5.60
11-Dec-14	18	5.54	51.9				
22-Dec-14	17	5.29	48.9				
Mean	16	5.34	50.0				
Minimum	12	4.47	45.2				
Maximum	19	6.14	58.7				

Notes:

Maturity Index

3	Active compost; fresh ingredients, requires intensive oversight and management
4	Compost in medium or moderately active stage of decomposition; needs on-going management
5	Compost is moving past the active phase of decomposition and ready for curing; reduced need for intensive handling
6	Curing; aeration requirement reduced; compost ready for piling; significantly reduced management requirements
7	Well matured, aged compost, cured; few limitations for usage
8	Inactive, highly mature compost, very well aged, possibly over-aged, like soil; no limitations on usage

Stability Index

III	Material still decomposing; active compost
IV	Maturing; Moderately stable; Curing compost
V	Very mature stable, well-aged compost, Finished compost

TABLE 4.1

SUMMARY OF COSTS TO KEEP NEW ERA FACILITY OPERATIONAL FOR 5 YEARS
NEW ERA TECHNOLOGIES LIMITED (NETL) FACILITY PROCESS REVIEW
61 EVERGREEN PLACE, GOODWOOD, NOVA SCOTIA
HALIFAX REGIONAL MUNICIPALITY

				Annual Costs		*5-Year Window (2019-2024)*	
	Quantity		*Years*	*Low*	*High*	*Low*	*High*
Building repairs[1]						698,000	698,000
Additional curing pad off-site or additional curing equipment[2]						400,000	1,500,000
Screening Equipment (unknown, assume zero)						-	-
Risk of additional wastewater costs if price increases[3]	8,800,000	litres	5	-	1,232,000	-	6,160,000
Additional bulking amendment[4]	12,500	tonnes	5	100,000	200,000	500,000	1,000,000
Difference in Tip Fees							
New Era Tip Fees ($200/tonne)	25,000	tonnes	5	5,000,000	5,000,000	25,000,000	25,000,000
Alternate Facility Tip Fees ($146-175/tonne)	25,000	tonnes	5	3,650,000	4,375,000	18,250,000	21,875,000
Difference			5	625,000	1,350,000	3,125,000	6,750,000
Total						4,723,000	16,108,000
Corrected for 2019 dollars (2%, 4 years)			5	**$ 1,000,000**	**$ 3,400,000**	**$ 5,000,000**	**$ 17,000,000**

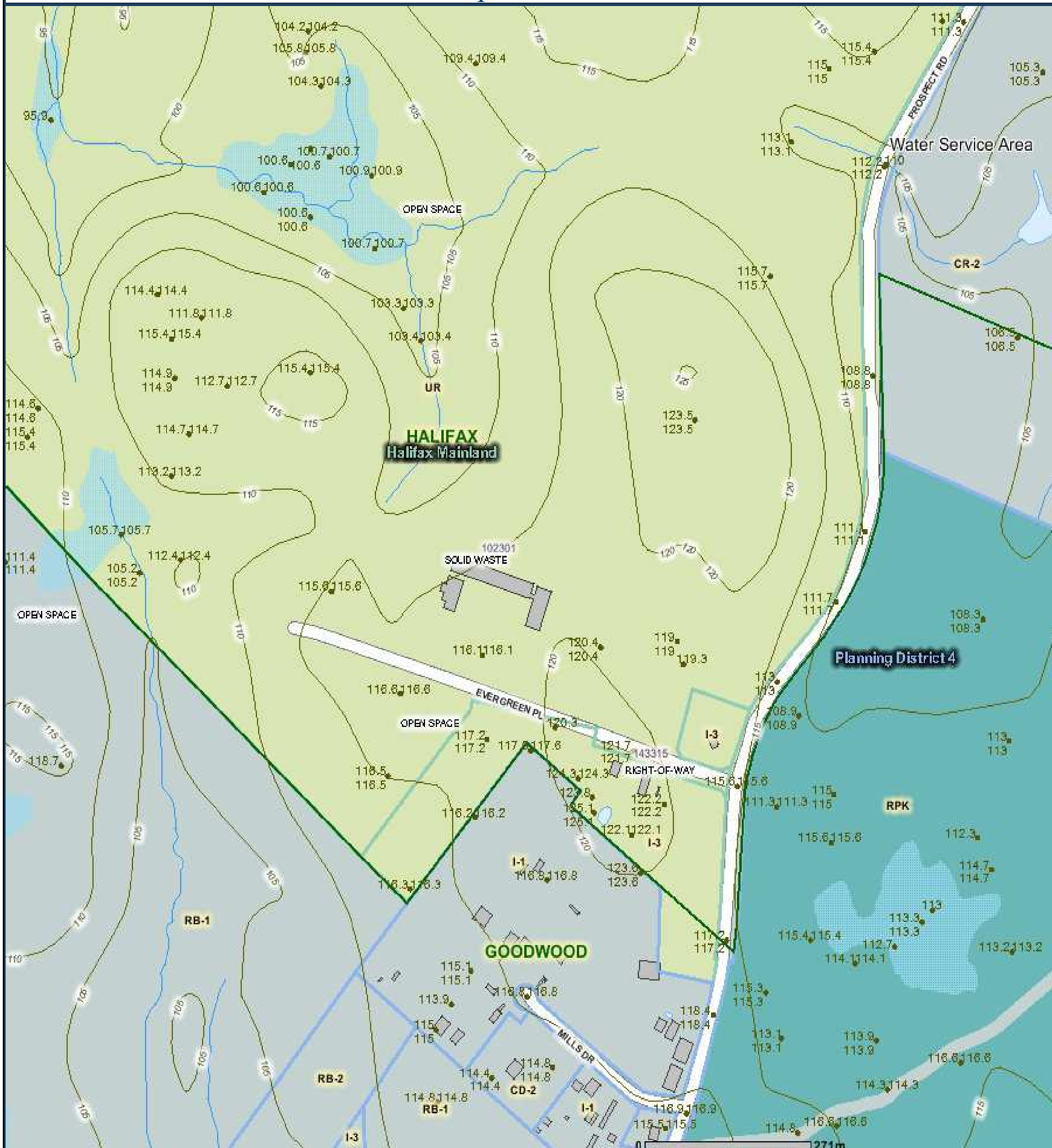
Notes:

1. Building repair cost estimate taken from New Era building assessment
2. Curing pad costs estimated from similar previous projects CRA is familiar with. Worst case costs assumes significant site development costs including electrical servicing.
3. Wastewater costs ranged from 0-14 cents per litre based on historical ranges of wastewater surplus costs from agreement with New Era Technologies Limited.
4. Additional bulking amendment based on $8-16/tonne for mulch.

Appendix A

Halifax Regional Municipality Maps

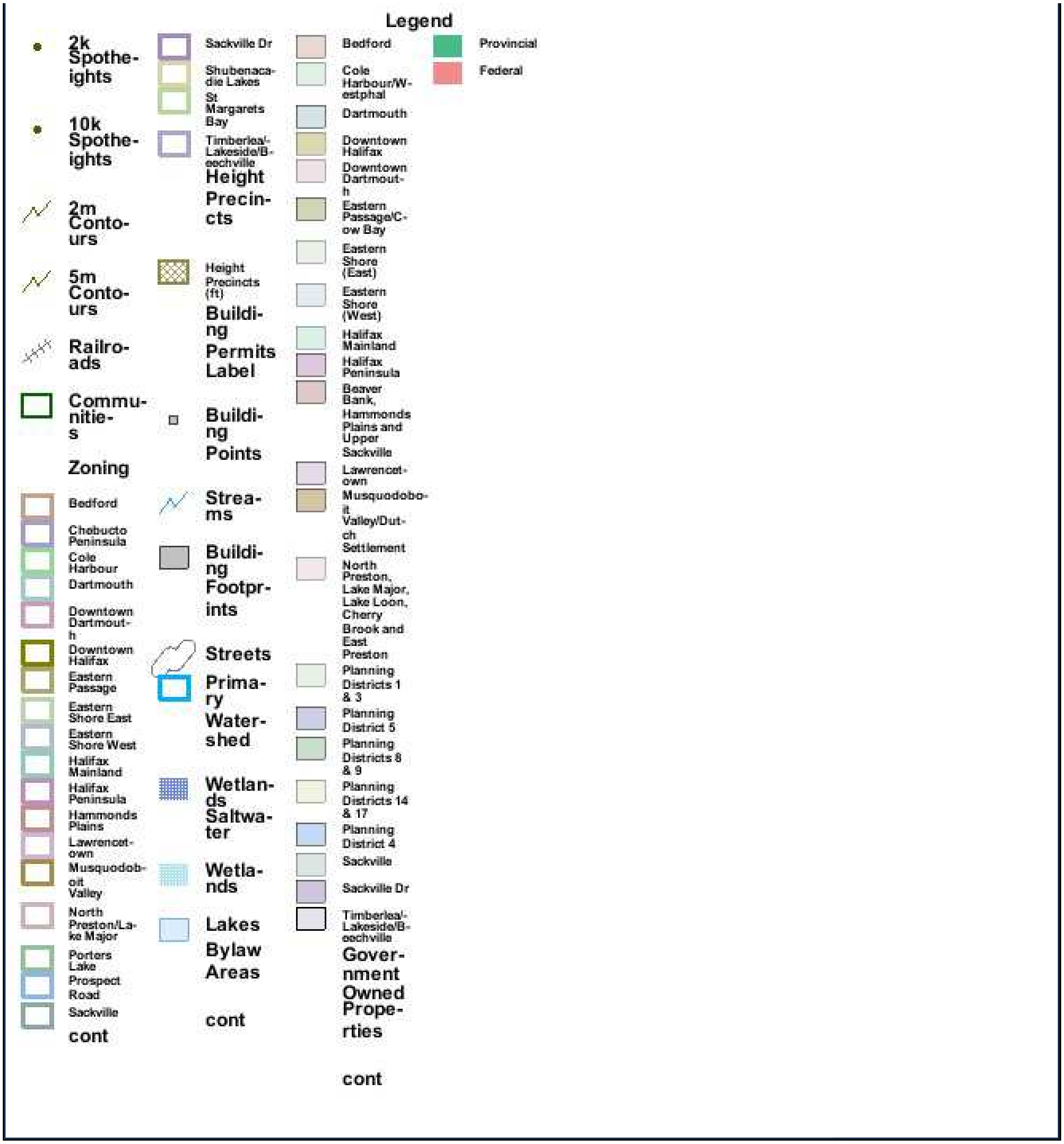
Explore HRM!



exploreHRM

Halifax Regional Municipality makes no representations, express or implied, as to the accuracy, completeness and timeliness of the information and data contained on this plot. This plot is for informational purposes only and should not be used for legal, engineering, or surveying purposes. This data is for the user's own internal business and personal purposes. Halifax Regional Municipality assumes no responsibility for its use.

Data accuracy concerns should be addressed to ExploreHRM@halifax.ca


Legend
2k Spotheights
10k Spotheights
2m Contours
5m Contours
Railroads
Communities
Zoning
Bedford
Chebucto Peninsula
Cole Harbour
Dartmouth
Downtown Dartmouth
Downtown Halifax
Eastern Passage
Eastern Shore East
Eastern Shore West
Halifax Mainland
Halifax Peninsula
Hammonds Plains
Lawrencetown
Musquodoboit Valley
North Preston/Lake Major
Porters Lake
Prospect Road
Sackville
cont
Sackville Dr
Shubenacadie Lakes
St Margarets Bay
Timberlea/Lakeside/Beechville
Height Precincts
Height Precincts (ft)
Building Permits Label
Building Points
Streams
Building Footprints
Streets
Primary Watershed
Wetlands Saltwater
Wetlands
Lakes
Bylaw Areas
cont
Bedford
Cole Harbour/Westphal
Dartmouth
Downtown Halifax
Downtown Dartmouth
Eastern Passage/Cow Bay
Eastern Shore (East)
Eastern Shore (West)
Halifax Mainland
Halifax Peninsula
Beaver Bank, Hammonds Plains and Upper Sackville
Lawrencetown
Musquodoboit Valley/Dutch Settlement
North Preston, Lake Major, Lake Loon, Cherry Brook and East Preston
Planning Districts 1 & 3
Planning District 5
Planning Districts 8 & 9
Planning Districts 14 & 17
Planning District 4
Sackville
Sackville Dr
Timberlea/Lakeside/Beechville
Government Owned Properties
cont
Provincial
Federal

Explore HRM!

exploreHRM

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Legend
Railroads
HRM Core Boundary
Communities
Property Boundaries
Building Points
Streams
Building Footprints
Streets
Primary Watershed
Wetlands Saltwater
Wetlands
Lakes

<u>UR (URBAN RESERVE) ZONE</u> (RC-Jun 25/14;E-Oct 18/14)

61AA(1) The following uses shall be permitted in any UR Zone:

(a) Single family dwellings, on existing lots or lots approved pursuant to Section 38 of the Subdivision By-law provided that a private on-site sewage disposal system and well are provided on the lot
(b) Passive recreation uses
(c) Uses accessory to the foregoing uses

61AA(2) No person shall in any UR Zone use or permit to be carried out, any development for any purpose other than one or more of the uses set out in subsection (1).

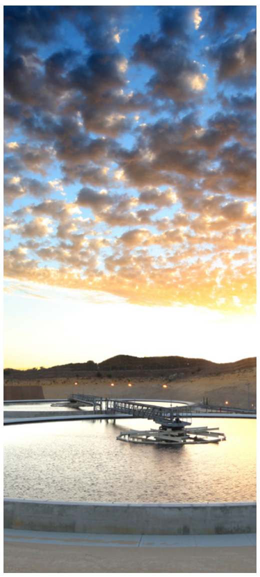
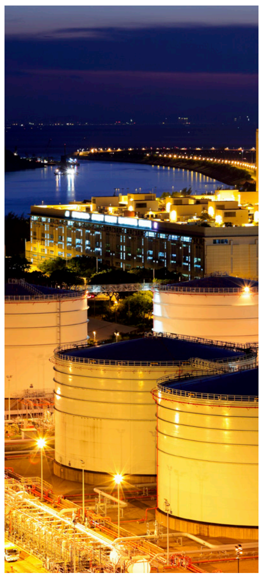
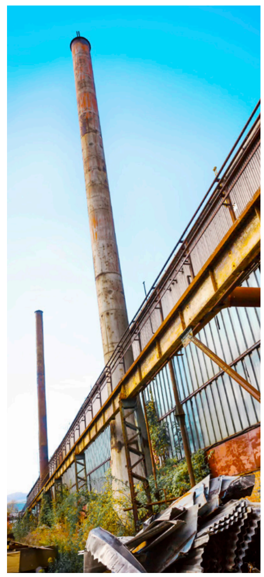
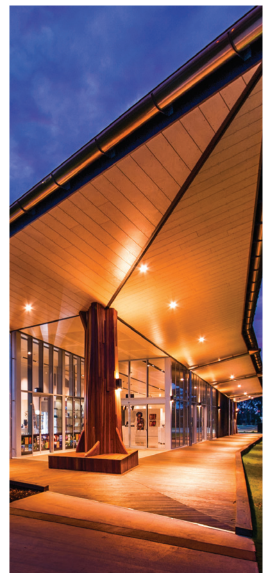
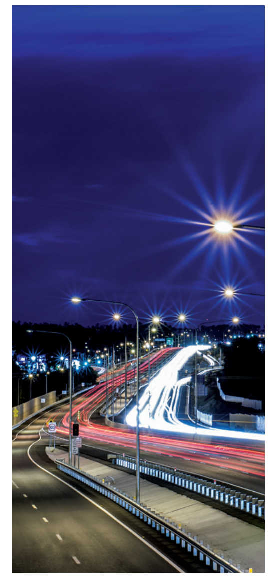
61AA(3) No person shall in any UR Zone use or permit to be used any land or building in whole or in part for any purpose other than one or more of the uses set out in subsection (1).

REQUIREMENTS

61AA(4) Buildings erected, altered or used for UR uses in a UR Zone shall comply with the following requirements:

Minimum Front or Flankage Yard:	**9.1m**
Minimum Side Yard:	**2.5m**
Minimum Rear Yard:	**2.5m**
Maximum Lot Coverage:	**35%**
Maximum Height of Main Building:	**11m**

ATTACHMENT F

Compliance and Process Review

Composting Facility – Miller Waste
80 Gloria McCluskey Avenue
Dartmouth, Nova Scotia

Halifax Regional Municipality

45 Akerley Boulevard Dartmouth Nova Scotia B3B 1J7

071855 | Report No 4 | July 08 2015

Executive Summary

GHD completed a compliance and process review of the Miller Waste Systems Inc. (Miller) compost facility located at 80 Gloria McCluskey Avenue, Dartmouth, Nova Scotia. The facility is operated under a long-term design-build-operate contract with Halifax Regional Municipality (Halifax). In 2019, the 20-year contract term will be completed, with Halifax taking ownership of the facility and terminating the lease of the property and having multiple options for the succession of the facility including extending the operations contract with Miller or entering into a new long-term arrangement to operate and upgrade the facility (including operating at status quo capacity, or increasing or decreasing capacity) or shutting down the facility.

The objectives of the process review were therefore to:

- Identify requirements to bring the Miller compost facility into compliance with the 2010 Nova Scotia Environment (NSE) Composting Facility Guidelines (2010 NSE Guidelines).
- Identify facility process improvement opportunities in terms of improving throughout and compost quality.
- Evaluate options to both increase and decrease the capacity of the facility.

Following a site visit and review of historical reports, generating compost from the Miller compost facility that is fully compliant with the 2010 NSE Guidelines will require consideration of the following:

- Elmsdale Landscaping Ltd. is not an approved composting facility and therefore would not be able to act as a secondary curing facility for the Miller compost facility, if required, unless it obtains approval.
- The Miller compost facility will require additional signage to provide normal operating hours, emergency contact information and the types of acceptable materials at the site entrance.
- Additional bulking amendment and/or diversion of the wetter industrial, commercial and institutional (IC&I) organic waste would improve the final compost product.
- The Miller compost facility must increase the frequency of compost sampling to ensure compliance with the Approval to Operate (i.e., NSE Approval #2000-017965-R01) as in 2014 they met the sampling requirements but in 2012 and 2013 only half of the required number of tests were completed. The 2010 NSE Guideline requirement is the same as the sampling frequency in the Approval to Operate.
- The Approval to Operate references the CCME 2005 Guidelines[1] and not the CCME 1996 Guidelines[1]. This is a discrepancy between the New Era Technologies Ltd. approval and the Miller approval. The reason for the discrepancy is unknown. GHD recommends consulting with the NSE and clarifying this requirement; and obtaining an amendment if necessary.
- Condition 14(b) of the Approval to Operate requires overs to be disposed of at an approved landfill site unless written permission for an alternative is received from the NSE. This condition should be clarified by consulting with NSE to ensure that Miller is meeting the requirements of the Approval to Operate. Currently, Miller tests larger size compost material (coarse compost)

[1] 1996 and 2005 versions of the Canadian Council of Ministers of the Environment (CCME) Guidelines for Compost Quality

prior to shipping according to the CCME Guidelines for every 1,000 tonnes generated and ships the material to Elmsdale Landscaping for further processing and curing.

- The following are options available to meet maturity requirements:
  - Option 1: Increased aeration during curing by forced aeration including the addition of a roof structure over screener bunkers and compost loading area, as piloted and proposed by Miller ($1.5 - 2.2 million capital expenditure by 2019).
  - Option 2: Increased aeration during curing with turning equipment ($3.8 – 6.0 million capital expenditure by 2019).
  - Option 3: Increased outdoor curing area (off-site); this option would require significant annual operating costs with respect to the trucking of immature compost to a secondary curing facility ($0.4 – 1.5 million capital expenditure by 2019, excluding the cost of land).
  - Option 4: Partial implementation of Miller's proposal to implement forced aeration throughout the curing area and additional outdoor storage/polishing of compost at the site ($0.5 – 1.0 million capital expenditure by 2019). This option should be piloted prior to applying for an amendment to the Approval to Operate.

Overall, the existing Ebara in-vessel composting process is generally effective at producing compost from Halifax's residential source separated organic (SSO) and IC&I organics. In 2019, when the 2010 NSE Guidelines will apply to the Miller compost facility, GHD recommends as a viable option that Halifax continue to operate the existing facility to meet Halifax's organics processing needs by incorporating one of the options to improve the maturity of the composted materials as outlined above.

It should be tested now to confirm whether or not compost maturity can be obtained within the facility such that part of the Miller proposal can be implemented with the exclusion of the roof structure over the screener bunkers and compost loading area (approximately 66.7% of the cost of Option 1). This would produce an unrestricted use product that can be stored on-site for further curing as a polishing stage prior to sale for increased revenue, and would cost approximately $0.5 to $1.0 million capital expenditure by 2019 (i.e., Option 4). If odours pose a problem with this option, then implementing the Miller proposal (Option 1) to produce mature compost and selling directly after curing is the next recommended option as all activities can be completed on-site, at approximately $1.5 to $2.2 million capital expenditure by 2019.

GHD did not identify significant additional process improvements at the facility during this assessment, as the process appears to be operating relatively efficiently. There is the option to further investigate the effectiveness of the manual sorting line in terms of glass removal, and to move the overs material inside the building instead of requiring a loader and labour to constantly move the overs material from outside to back inside the building. These process improvements will have little impact on the overall operational cost of the facility.

Building repairs and equipment replacement needs will cost Halifax $606,950 over the next 5 years based on GHD's building assessment (submitted under separate cover in May 2015) and an assessment of the equipment by Machinex Industries Ltd. (dated May 13, 2015).

GHD recommends operating the Miller compost facility at its current capacity beyond 2019, as an increase in capacity to 40,000 - 45,000 tonnes per year would require a significant expansion to the facility, which may not be approved as per Section IV.9.a of the NSE 2010 Guidelines separation distance requirement of at least 500 metres from the nearest residential or institutional building. The separation distance between the existing composting building and the neighbouring Central Nova Scotia Correctional Facility is less than 250 metres.

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(following text)

Appendices

1. Introduction

GHD has prepared this compliance and process review of the Miller Waste Systems Inc. (Miller) compost facility located at 80 Gloria McCluskey Avenue, Dartmouth, Nova Scotia. The facility is operated under a long-term design-build-operate contract with Halifax Regional Municipality (Halifax), and processes organic materials collected by residential and commercial haulers. In 2019, the 20-year contract term will be completed, with Halifax taking ownership of the facility and terminating the lease of the property and having multiple options for the succession of the facility including extending the operations contract with Miller or entering into a new long-term arrangement to operate and upgrade the facility (including operating at status quo capacity, or increasing or decreasing capacity) or shutting down the facility. In reviewing these options, Halifax must consider the financial investment needed to continue operating the facility. The objectives of the process review were therefore to:

- Identify requirements to bring the Miller compost facility into compliance with the 2010 Nova Scotia Environment (NSE) Composting Facility Guidelines (2010 NSE Guidelines).
- Identify facility process improvement opportunities in terms of improving throughout and compost quality.
- Evaluate options to both increase and decrease the capacity of the facility.

The Miller compost facility was originally constructed and began operation in 1998, designed in accordance with NSE requirements that specified meeting compost quality in accordance with the 1996 Canadian Council of Ministers of the Environment (CCME) Guidelines for Compost Quality. Since that time, NSE has adopted the most recent 2005 CCME Guidelines for Compost Quality (2005 CCME Guidelines) and has required composting facilities in Nova Scotia be in compliance by the fall of 2015. GHD understands that NSE may grant Halifax permission to meet this requirement by 2019 for the Miller compost facility to coincide with the end of the 20-year contract term, and therefore it is assumed for this assessment that 2019 will be the year when the 2010 NSE Guidelines will be applied to the site.

In addition to the current study, GHD recently completed a building assessment of the Miller compost facility (submitted under separate cover in May 2015). Overall, the facility was found to be in fair condition with localized repairs and maintenance requirements; capital expenditures of $491,000 are required over a five year investment horizon to maintain the facility for a remaining useful life of 10-15 years, assuming continued regular maintenance and no substantial change in the use of the facility. In addition, Machinex Industries Ltd. conducted an assessment of equipment replacement needs for the facility (dated May 13, 2015) and found that the infeed conveyor requires replacement at a cost of $115,950. Building repairs and equipment replacement needs will therefore cost Halifax $606,950 over the next 5 years to maintain the facility.

2. Miller Compost Process

Mr. Andrew Philopoulos and Mr. Mike Muffels of GHD toured the site on June 16, 2015 and met with the Operations Analyst, Mr. Sean Hagan. Observations documented from the site visit are incorporated into the appropriate sections below.

The Miller compost facility consists of one building split into three sections: a Receiving Hall, Vessel Area, and Curing Hall. It is located at 80 Gloria McCluskey Avenue, Dartmouth, Nova Scotia on a piece of property owned by Halifax. The Miller compost facility site layout is shown on Figure 2.1. The Miller compost facility process flow is illustrated on Figure 2.2.

Residential and industrial, commercial and institutional (IC&I) organic wastes are accepted at the facility. Leaf and yard waste is accepted with the organic waste collection. Feedstock is received in the receiving hall, where trucks back up and dump onto the receiving hall located a few feet down from the truck door elevation. The doors remain open when the trucks are dumping but the receiving hall is separated from the processing areas by a wall to keep odours in the receiving hall to a minimum. Feedstock is loaded into a hopper by a front-end loader, which is then conveyed via an inclined conveyor belt to the sorting line. The feedstock passes through a manual sort station staffed with 3 – 4 people with a large magnet to remove metal for recycling. The conveyor belt drops the sorted feedstock material into a shredder with a 2.5 inch screen size. There is no additional bulking amendment material to mix in with the shredded feedstock as leaf and yard waste is collected and shredded with the organic material as incoming feedstock.

Miller also operates a green cart exchange program with some of their IC&I customers. As part of this program, cleaned carts are exchanged for full carts at the customer location. The full carts are taken directly to the facility for dumping. The carts are then rinsed out and returned to the customers as cleaned carts with the next collection period. A cart tipping machine is used to empty the carts onto the tip floor. The carts are manually rinsed with a high pressure washer. Leachate is collected and transferred to leachate collection tanks located underground outside the facility building.

The facility is based on the Ebara in-vessel composting process. The primary composting stage is completed in one bunker style vessel with a paddle turning system. The vessel is located indoors and is 62.5 m (205 feet) long and 21.3 m (70 feet) wide. It has a slotted floor that is elevated 0.46 m (18 inches) off the bottom of the bunker to provide a plenum for the forced negative aeration system; this was a later addition to the facility. The material is typically left in the bunker for 30 days. The paddle system turns the material and moves the material forward approximately 2 m per day, in 0.4 m (15 inch) increments, which allows for the addition of new material at the back end of the vessel. The paddle mixer is typically operated once per day, but occasionally less if not required and only operated at night when there are no personnel in the building. Leachate is introduced onto the material in the bunker as needed.

The material from the vessel is placed onto either an aerated or non-aerated floor area in the Curing Hall. The aerated static pile (ASP) curing area was set up as a pilot in 2011 to improve the curing process and overall maturity of the compost product. The compost cures for 3 to 4 weeks. The material cured on the non-aerated floor portion of the curing area is turned daily. Leachate is collected and stored in an above-ground leachate tank located in the curing area used for recirculating liquid back onto the curing compost if needed.

The cured compost is screened using a star screener and stored in the covered screening area just outside of the building. The star screen produces screened compost and an overs material pile also located outdoors in a covered area. Roughly 50 to 60 percent of incoming organics are converted into compost at the Miller compost facility. The fine and coarse compost is transported in bulk to Elmsdale Landscaping. Elmsdale Landscaping further cures the material, screens it and uses it in their landscaping products.

Condition 14(b) of the Approval to Operate (i.e., NSE Approval #2000-017965-R01) requires overs to be disposed of at an approved landfill site unless written permission for an alternative is received from the NSE. This condition should be clarified by consulting with NSE to ensure that Miller is meeting the requirements of the Approval to Operate. Currently, Miller tests larger size compost material (coarse compost) prior to shipping according to the CCME Guidelines for every 1,000 tonnes generated and ships the material to Elmsdale Landscaping for further processing and curing.

The composting hall building and process air is mechanically ventilated, humidified, and treated through an organic-media biofilter located to the north of the primary composting vessel hall. The Curing Hall air is mechanically ventilated and treated through a second biofilter located to the north of the Curing Hall. The Curing Hall building air is not humidified prior to exiting through the biofilter. The facility is maintained at a negative pressure and does receive occasional odour complaints.

All compost leachate and biofilter water is collected, stored and trucked off-site to a wastewater treatment facility. The biofilter water storage is located to the north of the receiving hall and the leachate storage tanks are located to the south of the receiving hall, all underground and outdoors. There is also one above-grade leachate tank located in the Curing Hall that is used for leachate recirculation.

Approximately 3.7 million liters of leachate and biofilter water was transported off-site in 2014 for treatment, which is an increase from 2.7 million in 2013 and 1.1 million in 2012. Mr. Hagan indicated that 2014 was a wet year and the organic material came in noticeably wetter, which contributed to additional leachate volumes in that year. The precipitation data summarized in Table 2.1 below confirms that Halifax received more precipitation in 2013 and 2014 than 2012.

Table 2.1 Halifax Annual Precipitation Data

Years	Precipitation (mm)	Leachate (L)
2012	1,328	1,100,000
2013	1,370	2,700,000
2014	1,592	3,700,000
Annual Historical Average	1,388	

Source: http://halifax.weatherstats.ca/charts/precipitation-25years.html

3. Compliance with 2010 NSE Composting Facility Guidelines

GHD completed a review of the Miller compost facility and the 2010 NSE Guidelines to identify compliance concerns. GHD understands that the Miller compost facility will not be required to comply with the 2010 NSE Guidelines until the end of the current contract with Miller in 2019. The results of this review are summarized in Table 3.1 following the text. It has been well documented that the primary challenge for source-separated organics (SSO) compost facilities, including the Miller compost facility, to achieve compliance with the 2010 NSE Guidelines is the more stringent maturity requirement. The compost maturity guideline is the primary non-compliance concern. This is discussed in more detail in Sections 3.1 and 3.2 below.

Other 2010 NSE Guidelines non-compliance and potential non-compliance items include:

- Elmsdale Landscaping Ltd. is not an approved composting facility and therefore would not be able to act as a secondary curing facility for the Miller compost facility, if required, unless it obtains approval.
- The Miller compost facility will require additional signage to provide normal operating hours, emergency contact information, and the types of acceptable materials at the site entrance.
- In 2012 and 2013, only half of the required compost testing was completed. In 2014, the composting testing frequency met the requirement of at least 1 sample per 1,000 tonnes of compost (not including overs). The 2010 NSE Guidelines requirement is the same as the sampling frequency in NSE Approval to Operate #2000-017965-R01. It is recommended that the compost sampling frequency be closely monitored in the future to ensure compliance with the Approval to Operate, as well as the 2010 NSE Guidelines.

3.1 Current Compliance with Maturity Requirement

Mature compost is material in which biological activity has slowed after most of the easily degraded molecules have been broken down into humus, leaving the complex organic material behind. In this state, it is difficult to identify the original feedstock materials. A fine texture, dark colour, and a rich earthy smell characterize mature composts.

The 2010 NSE Guidelines require that the resulting compost meet the 2005 CCME Guidelines. The compost maturity requirements in Section 3.4 of the 2005 CCME Guidelines are as follows:

Compost shall be mature and stable at the time of sale and distribution. To be considered mature and stable, a compost shall be cured for a minimum of 21 days and meet one of the following three requirements:

a. *the respiration rate is less than, or equal to, 400 milligrams of oxygen per kilogram of volatile solids (or organic matter) per hour [400 mg O_2/kg VS/h]; or,*

b. *the carbon dioxide evolution rate is less than, or equal to, 4 milligrams of carbon in the form of carbon dioxide per gram of organic matter per day [4 mg CO_2/g OM/d]; or,*

c. *the temperature rise of the compost above ambient temperature is less than 8^{o}C.*

Over 2010 and 2011, prior to and during the startup of the aerated static pile curing pilot, CBCL Limited (CBCL Study) collected 4 batches of compost samples from the Miller compost facility (as well as the New Era Technologies and Elmsdale Landscaping facilities). While the sample taken on November 8, 2011 indicated that the compost was moving past the active phase of decomposition and ready for curing based on the re-heat test result of 0-10 degrees Celsius (as compared to the 2005 CCME Guidelines for Type A compost of less than 8 degrees Celsius), the respiration rates (ranging from 436 to 1,360 mg O_2/kg VS/h) and the carbon dioxide (CO_2) evolution rates (ranging from 7.10 to 13.00 mg CO_2/g OM/d), after 120 days, were still above the 2005 CCME Guideline threshold for all four samples.

Section IV.4(d)&(e) of the 2010 NSE Guidelines allows for immature compost to be transferred to an approved composting facility in order to complete the maturation process. In addition:

For immature compost to be transported to a secondary curing area, it must achieve one of the following requirements:

i. cured for at least 21 days and must not reheat above 20^{o}C;

ii. cured for at least 21 days and organic matter is reduced by at least 60% by weight; or

iii. able to germinate 90% of cress seed vs control and has a plant growth rate of compost/soil at least 50% of control.

The 2014 Miller compost facility Annual Report confirms that the compost generated at the Miller compost facility is currently able to meet the requirement for not reheating above 20^{o}C. Thus, utilization of a secondary curing facility at an approved composting facility will be an option following the implementation of the 2010 NSE Guidelines for the Miller Compost Facility in 2019.

3.2 Feedstock and Process Considerations to Achieve Maturity Requirement

The feedstock processed at the Miller compost facility consists of a mix of residential and IC&I material. As there is currently no bulking amendment material mixed with the incoming organic material, the feedstock is not considered ideal for composting. The residential organics include some leaf and yard waste but this is limited to the spring through fall months, and the IC&I organic waste does not contain any appreciable bulking amendment material. Overs are only returned to the compost process over winter. Amendment material is important to the overall composting process for food waste as it allows for a more effective C:N ratio, increases the porosity of the material, and it provides more nutrients to the process.

No recent data on the feedstock materials was available. It is assumed to be similar to material received at the New Era Facility which was generally consistent with typical values published in the literature. Thus, it was assumed that the Miller feedstock material had a high moisture content, lower pH and lower C:N ratio than is considered ideal according to the Environment Canada 2013 Technical Document on Municipal Solid Waste Organics Processing; which recommends the following feedstock quality parameters:

- Moisture: 55 – 65 percent
- C:N Ratio: 25:1 – 30:1
- pH: 6.5 – 8.0
- Bulk Density: 475 – 590 kg/m^3

Additional bulking amendment would improve the porosity, moisture, C:N ratio, and bulk density of the feedstock material, resulting in an improved final compost product. The daily turning of the primary compost vessel by the Ebara paddle wheel and of the non-aerated curing piles by front end loader does minimize, but not eliminate, the requirement for bulking amendment for porosity considerations. However, efficient and complete composting of food waste does require a minimum amount of amendment material. The amount of amendment material required varies depending on the nature of the feedstock material, which in the case of Halifax organic waste is seasonal due to the inclusion of leaf and yard waste in the SSO residential collection bins. The leaf and yard waste does provide required amendment for food waste composting. Overs are used during the winter when there is no leaf and yard waste being collected and the incoming material is wet. The suitability of the overs as a bulking amendment is dependent on the quality of the feedstock at the start of the process. Less bulking amendment at the start of the process means there will be less suitable bulking amendment in the overs at the end of the process. Thus, the overs produced from a compost that is generated from food waste with minimal additional leaf and yard material have limited amendment value.

Additional bulking amendment materials, such as wood chips, are difficult and expensive to source in the Halifax region due to competing demands for the material. As the Miller facility is able to achieve the current compost quality requirements, including maturity, the expense of additional bulking amendment is difficult to justify for Miller under their current operating contract. In reality, achieving an ideal compost recipe with food waste, particularly IC&I organics, is often difficult to achieve and the compost process is often adapted to compensate.

Given the difficulty in securing bulking amendment, removing the relatively wet IC&I incoming organics from the process would be another means of improving the overall feedstock quality for composting. The residential SSO co-mingled with the leaf and yard waste will compost much better without additional amendment if the IC&I material was managed separately. However, this would require another processing option for the IC&I organics in order to continue to divert this significant quantity of organics from landfill. A wet processing or treatment option may be more suitable for this type of material, such as anaerobic digestion or hydrolysis.

The rate at which maturity is attained through the curing process is dependent primarily on how well the material is aerated during the curing stage. Manipulating air flow rates through a compost heap will only have a significant impact if the compost has adequate porosity or free air space to permit the air to flow through the heap. Porosity is a function of the range of particle sizes in the material, moisture content and homogeneity of the material (i.e., well mixed). Achieving maturity in a timely fashion also requires other material quality parameters such as C:N ratio, nutrients and pH to be maintained within certain bounds.

Potential process/facility changes that may aid in the production of mature compost at the Miller compost facility in 2019 are discussed in the following subsections, including:

- Option 1: Increased aeration during curing by forced aeration (as piloted and proposed by Miller).
- Option 2: Increased aeration during curing with turning equipment.
- Option 3: Increased outdoor curing area (off-site).
- Option 4: Additional outdoor curing of materials at the facility.

3.2.1 Option 1: Increased Aeration During Curing by Forced Aeration

This option is one that was proposed by Miller in a letter proposal to Halifax entitled "Miller Composting Dartmouth Certificate of Approval Compliance", dated April 11, 2014. Process change options as recommended by Miller in this proposal to bring the Miller compost facility into compliance with the updated maturity standards (and maintaining the same processing capacity and footprint) are outlined below:

- Changes to the loading floor and vessel configuration to remove free standing liquid (previously implemented).
- Increased aeration in the curing area to bring all curing materials under aeration (proposed future works):
  - Installation of a roof structure over the compost loading area and screen bunkers.
  - Installation of an additional ventilation fan and scrubber to the secondary biofilter.
  - Installation of a foundation collection liner along the north side of the Curing Hall.
  - Installation of aeration piping in the south west corner of the Curing Hall.
  - Moisture addition system to deliver liquid to the Curing Hall.

Miller's proposal includes the addition of a ventilation fan and scrubber to the secondary biofilter to accommodate the increase in air flow (31.6 m^3/min or 1,117 cfm per 230 m^3 of material) and to maintain the overall negative pressure in the building. Miller's proposal also includes the installation of aeration piping in the south west corner of the Curing Hall. This area is currently used for curing and storage, and by installing a new concrete slab with aeration piping, the material stored in this area for curing can be aerated.

The approach of forcing more air through the curing piles was demonstrated during a pilot program to test the results of increasing the aeration within the curing materials and providing additional moisture as required. Table 3.2, following the text, summarizes available sampling results from the aerated static pile (ASP) pilot program.

Limited data from the ASP pilot program was made available for review to draw conclusions with any degree of certainty. However, the three maturity tests completed do indicate that the compost finished over the aerated floor met the 2005 CCME Guidelines for maturity, namely a respiration or carbon evolution rate of less than 4 mg CO_2-C/g Organic Matter/day, at least once in 2011, 2012 and 2013. Moisture levels measured in 2011 were above 40 percent; which is the current Ontario requirement for curing (Ontario Compost Quality Standards, 2012). Moisture content results since 2011 were not available. The temperatures in the curing piles were in the thermophilic range (approximately 40-60 degrees Celsius). This is an indication that the material leaving the primary composting vessel has not been completely composted. The curing area is effectively being managed as a secondary composting process area. That being said, there is no available data to suggest that the compost generated from the pilot ASP program was not meeting the 2005 CCME Guidelines for maturity.

In 2014, Miller provided a cost estimate of $1.445 million for converting the remainder of the curing floor area to ASPs and enclosing the star screen bunkers. Correcting for 1 year of inflation (approximately 2%) and adding a 10 percent contingency, the budgetary cost estimate is revised to $1.7 million. GHD reviewed the estimate and it is considered reasonable; it is recommended that the cost estimate be considered accurate to -10% / +25% ($1.5 – 2.2 million).

Forcing more air through the curing piles may be successful at meeting maturity requirements for the composted materials (based on available data), however, the addition of suitable external bulking amendment to the feedstock would also increase the effectiveness of any additional aeration efforts and may also decrease energy requirements for forced aeration through the curing piles to reach compost maturity.

Similar to Option 4 presented below, it may not be necessary to cover the screener bunkers and compost loading area if the forced aeration is fully implemented in the Curing Hall. Eliminating the roofing requirement would reduce the cost of Option 1 by 66.7%. Refer to discussion in Option 4. Phasing the implementation of Option 1 by first fully implementing the forced aeration system would allow for the evaluation of odours. Expanding the building envelope to enclose the screener bunkers could be implemented pending odour monitoring results, as needed.

3.2.2 Option 2: Increased Aeration During Curing with Turning Equipment

An alternative to increasing aeration (Option 1) is to mechanically turn the curing piles. The non-aerated areas of the Curing Hall were generally turned daily by a front end loader and the resulting compost did not meet the new maturity requirement within the 3 – 4 week curing period as demonstrated by the 2012 CBCL Study. Employing a purpose built compost turning machine will not provide any significant improvement over the same 3 – 4 week curing period given that the material was already turned daily. There is no opportunity at the Miller facility to improve the maturity of the compost by mechanically turning the curing compost within the space available.

The primary constraints to curing at the Miller compost facility are the stage in which the compost leaves the primary compost vessel and the space available for curing. The minimum length of time to cure blended feedstock material that has been fully composted is 3 - 4 weeks, however, if the material is not fully composted due to feedstock quality issues, the same feedstock quality issues (i.e., lack of suitable bulking amendment) will further inhibit the curing process. The curing area will need to be used to both finish the composting process and cure the less than ideal material. Assuming the current feedstock blend will not change in 2019, mechanical turning of the curing piles will not result in compost that complies with the 2010 NSE Guidelines within the space available.

Significant additional curing floor space will be required to cure the compost if mechanical turning will continue to be utilized past 2019. Table 3.3 summarizes the calculation for the estimated additional indoor curing area required. The calculation assumes 4 months of indoor curing capacity will be adequate and this is based on the assumption that the curing material will be turned at least twice a week with a dedicated compost turning machine, which is less labour intensive than turning with a front end loader.

Table 3.3 Estimate of Additional Indoor Curing Area for Mechanical Turning

Item	Value	Units
Mass to be Cured (110% of 4 months' worth of 2014 annual compost quantity)	5,200	tonnes
Assumed Bulk Density of Immature Compost	500	kg/m3
Volume to be Cured	10,400	m3
Stockpile Width	16	m
Stockpile Height	8	m
Stockpile Cross Sectional Area (triangle)	64	m2
Stockpile Length	163	m
Stockpile Footprint	2,600	m2
Allowance for Equipment Access and Work Areas (50%)	1,300	m2
Approximate Total Curing Area	3,900	m2
Subtract Existing Curing Area	-1,820	m2

Table 3.3 Estimate of Additional Indoor Curing Area for Mechanical Turning

Item	Value	Units
Additional Area to Enclose Screening Piles	620	m2
Approximate Additional Building Area (+/- 25%)	2,700	m2

Cost estimate to continue with mechanical turning of the curing piles and to meet the 2010 NSE Guidelines:

- New 2,700 m^2 curing building: $4,000,000
- Additional compost turning equipment: $500,000 (assuming new compost turning equipment)
- New biofilter: $300,000
- Total: $4.8 million (+/- 25%)
- Range: $3.8 – 6.0 million

3.2.3 Option 3: Increased Outdoor Curing Area (Off-site)

The 2012 CBCL Study demonstrated that only the compost from the Elmsdale facility that had cured outdoors for 12 months consistently met the maturity and other compost quality criteria, including pathogen reduction. Thus, without any other significant improvements to the quality of fines exported from the Miller compost facility, an option to meet the 2010 NSE Guidelines would be to provide sufficient area for an additional 12 months of passive windrow curing, or potentially sufficient area for 6 months of passive windrow curing which would require further testing to ensure maturity requirements can be met. It is important to note that Elmsdale also cured immature compost from the New Era composting facility. Table 3.4 summarizes the calculations for the approximate additional outdoor curing area required assuming maturity could be achieved in an additional 6 months. This option is similar to current operations at the site, with additional curing at Elmsdale, however, this would provide Halifax with the option of utilizing an already-approved site for outdoor curing and storage.

Table 3.4 Estimate of Additional Outdoor Curing Area

Item	Value	Units
Mass to be Cured (110% of 6 months' worth of 2014 annual compost quantity)	7,820	tonnes
Assumed Bulk Density of Immature Compost	500	kg/m3
Volume to be Cured	15,640	m3
Stockpile Width	16	m
Stockpile Height	8	m
Stockpile Cross Sectional Area (triangle)	64	m2
Stockpile Length	244	m
Stockpile Footprint	3,910	m2
Allowance for Equipment Access and Work Areas (100%)	3,910	m2
Allowance for Water Management (50%)	1,960	m2
Approximate Total Additional Curing Area (-50% / +25%)	9,780	m2
	1.0	hectares
	2.4	acres

The cost to develop an additional 1.0 hectares (2.4 acres) for a curing pad will depend on a number of factors but could vary from $0.4 to $1.5 million depending on the site (excluding the cost of land).

Locating the additional curing pad at an existing serviced facility with an existing scale, a loader, staff and surface water management will greatly reduce the required capital investment and ongoing operational costs. The site may require NSE approval or an amendment to an existing approval to operate. Immature compost will need to be trucked to the off-site curing area if this option is selected which will add significant annual operating cost.

Increasing the curing area/time will likely address the maturity issues of the compost currently produced at the Miller compost facility. The overall operation of the facility appears to be effective at producing compost from the available feedstock and amendments with the exception of the maturity levels.

3.2.4 Option 4: Additional Outdoor Curing of Materials at the Facility

There is currently an old outdoor storage pad already at the site that is approximately 3 hectares. Currently, odour concerns due to the close proximity of neighbours prevent Miller from storing the compost they currently generate, which is an unrestricted use product, outdoors. Odour is a significant concern. GHD is not familiar with the history of the site and odour complaints that resulted from compost being stored outdoors at the Miller compost facility. Odour risk is a factor that Halifax will need to consider based on the history of the facility.

If the Curing Hall was converted to a forced aeration system, as outlined in Miller's proposal (Option 1) and an unrestricted use product could be generated within the current building footprint, it may be possible to store the compost outdoors for a period for final polishing or curing within the current site approval. Presumably compost that complies with the more stringent maturity requirements will be less odorous, thus possibly opening up the option of outdoor on-site compost storage again. This could be tested immediately as part of the pilot program. If successful, this option would eliminate the need to cover the screener bunkers and compost loading area (though a smaller extension may be desired for the back-end residues loading). The roof structure was $1 million of the $1.5 million total proposed cost by Miller. Providing additional curing on top of what was proposed may also result in a higher value compost that would not require lengthy storage at a landscaping yard. This option requires further testing to ensure that odours will not be an issue but would be expected to cost between $0.5 and $1.0 million; and is potentially the cheapest option. Outdoor curing of the compost will also require increased labour and a loader to move and turn the materials.

On the day of GHD's site visit, Miller was working to convert a significant portion of the outdoor compost storage area into a vegetated filter area for storm water. If the vegetated filter area system is successful, then the option to convert this area into an outdoor curing area may no longer be an option.

3.2.5 2010 NSE Guidelines Compliance Summary

To generate compost from the Miller compost facility that is fully compliant with the 2010 NSE Guidelines and applicable 2005 CCME Guidelines on compost quality will require, at a minimum one of the following options:

- Option 1: Increased aeration during curing by forced aeration.
  - $1.5 - 2.2 million capital expenditure by 2019.

  - Additional operational costs to operate the new ventilation fan and scrubber and moisture addition system.
- Option 2: Increased aeration during curing with turning equipment.
  - $3.8 – 6.0 million capital expenditure by 2019.
  - Additional operational costs to operate the turner from fuel usage and labour.
- Option 3: Increased outdoor curing area (off-site).
  - $0.4 – 1.5 million capital expenditure by 2019 (excluding the cost of land).
  - Additional operational costs to operate the loader from fuel usage and labour.
- Option 4: Additional outdoor curing of materials at the facility.
  - Odour concerns may prevent this option.
  - $0.5 – 1.0 million capital expenditure by 2019.
  - Additional operational costs to operate the loader from fuel usage and labour.

By incorporating additional bulking amendment and/or removing (a portion of) the IC&I organic waste, especially during the winter months when leaf and yard waste is at a minimum within the collected residential organic materials, the composting process will benefit from a C:N ratio that is more suitable for producing mature compost. This should be confirmed through obtaining appropriate laboratory data.

This is all in addition to the approximately $491,000 in building repairs required over the next 5 years identified in the building assessment completed by GHD, submitted under separate cover (CRA/GHD, May 2015). Based on equipment replacement needs for the facility according to an assessment conducted by Machinex Industries Inc. dated May 13, 2015, the infeed conveyor requires replacement at $115,950; for a total additional cost of $606,950.

Overall, the existing Ebara in-vessel composting process is generally effective at producing compost from Halifax's residential SSO and IC&I organics that is close to achieving maturity.

4. Process Improvement Assessment

As part of GHD's operational review, a process improvement assessment was to be completed. The assessment was to identify process improvements that could result in better compost quality, throughput, and use of space in addition to process improvements required to meet the 2010 NSE Guidelines. Based on the findings outlined in Section 3.0 and the building condition assessment completed previously, investing in the facility to produce mature compost and to complete the building maintenance and equipment replacement is recommended. In 2019, when the 2010 NSE Guidelines will apply to the Miller compost facility, it is recommended that Halifax consider continuing to operate the existing facility to meet Halifax's organics processing needs.

GHD did not identify many additional process improvements at the facility during this assessment as the process appears to be operating efficiently. There is the option to further investigate the effectiveness of the manual sorting line in terms of glass removal. As Elmsdale has expectations of no glass in the compost material, there may be a more effective way of removing the glass from the material at the facility. Currently, if glass is observed on the manual sorting line, all material is removed and discarded as a waste. There are screening technologies (e.g. ballistic separators) that would increase glass removal from the processed material either before or after curing at the Site. One other potential improvement could be to move the overs material inside the building instead of requiring a loader and labour to constantly move the overs material from outside to back inside the building. These process improvements will have little impact on the overall operational cost of the facility.

5. Future Operational Capacity Scenarios

Halifax requested GHD evaluate three future capacity scenarios, namely:

1. Status Quo: 25,000 tonnes per year
2. Capacity increase: 40,000 – 45,000 tonnes per year
3. Capacity reduction: 10,000 – 15,000 tonnes per year

As discussed in Sections 3.0 and 4.0, GHD recommends operating the Miller compost facility at its current capacity beyond 2019. The status quo scenario with the incorporation of Miller's proposal to increase forced aeration during curing is likely the best option moving forward past 2019 from an operational and cost standpoint.

For the increase in processing capacity to 40,000 - 45,000 tonnes per year scenario, the facility is currently not large enough to accommodate an increase in processing capacity. The existing Ebara composting unit currently has difficulty fully composting the current feedstock amounts. Increasing the processing capacity of the facility will require a significant expansion to the facility, including new building(s) for primary composting and compost curing at a minimum. Section IV.9.a of the NSE 2010 Guidelines require that the separation distance between the active area of an in-vessel compost facility and the nearest residential or institutional building be at least 500 metres.

The separation distance between the existing composting building and the neighbouring Central Nova Scotia Correctional Facility, which was constructed over 1999 to 2001, is less than 250 metres. Thus, in order to increase capacity at the site significantly, a special request will need to be made of the NSE to waive the setback requirement of 500 metres for an expansion of an existing facility. GHD recommends consulting with NSE first regarding expansion and the setback requirements before considering this option further.

It was assumed that expanding the Miller facility to 45,000 tonnes per year would require installing a second mostly parallel system rated for 15,000 – 20,000 tonnes per capacity. Based on the costs to construct other similar sized composting facilities (15,000 to 20,000 tonnes per year), taken from GHD's memorandum regarding Preliminary Budget Estimate for a Source Separated Organics Processing Facility dated April 1, 2015, it is estimated that the additional structures and equipment required would cost approximately $14 – 17 million. While the expansion does not have the same site development costs, it will have additional costs associated with a retrofit of an existing operation.

The capacity reduction scenario is possible, and should be considered if the current status quo scenario with the recommended changes is not successful at producing mature compost to meet the 2005 CCME Guidelines past 2019. Reducing capacity will allow for more overs to be recirculated in the composting process, improving the overall compost quality. However, as the facility, with minimal upgrades, appears to be able to meet the NSE 2010 Guidelines, it is recommended that the Miller facility be operated at its original design capacity to maximize the benefit from the existing asset.

GHD would like to reiterate that the commercial organic material currently accepted at the Site is not ideally suited for this type of composting process, as it lacks bulking amendment material. GHD recommends that Halifax and Miller consider the addition of bulking amendment to increase the overall operations of the facility and potentially also increase the quality if the end product. Alternatively, reducing or eliminating the IC&I organic waste will also have a noticeable impact on the resulting compost quality.

6. Conclusions and Recommendations

Overall, the existing Ebara in-vessel composting process is generally effective at producing compost from Halifax's residential SSO and IC&I organics that is close to maturity. To generate compost from the Miller compost facility that is fully compliant with the 2010 NSE Guidelines and applicable 2005 CCME Guidelines on compost quality will require consideration of the following:

- Elmsdale Landscaping Ltd. is not an approved composting facility and therefore would not be able to act as a secondary curing facility for the Miller compost facility, if required, unless it obtains approval.
- The Miller compost facility will require additional signage to provide normal operating hours, emergency contact information and the types of acceptable materials at the site entrance.
- Additional bulking amendment and/or diversion of the wetter IC&I organic waste would improve the final compost product.
- The Miller compost facility must increase the frequency of compost sampling to ensure compliance with the Approval to Operate as in 2014 they met the sampling requirements but in 2012 and 2013 only half of the required number of tests were completed. The 2010 NSE Guideline requirement is the same as the sampling frequency in NSE Approval #2000-017965-R01.
- NSE Approval #2000-017965-R01 references the CCME 2005 Guidelines[2] and not the CCME 1996 Guidelines[1]. This is a discrepancy between the New Era Technologies Ltd. approval and the Miller approval. The reason for the discrepancy is unknown. GHD recommends consulting with the NSE and clarifying this requirement; an obtaining an amendment if necessary.
- Condition 14(b) of the Approval to Operate requires overs to be disposed of at an approved landfill site unless written permission for an alternative is received from the NSE. This condition should be clarified by consulting with NSE to ensure that Miller is meeting the requirements of the Approval to Operate. Currently, Miller tests larger size compost material (coarse compost) prior to shipping according to the CCME Guidelines for every 1,000 tonnes generated and ships the material to Elmsdale Landscaping for further processing and curing.

[2] 1996 and 2005 versions of the Canadian Council of Ministers of the Environment (CCME) Guidelines for Compost Quality

- The following are options are available to meet maturity requirements:
  - Option 1: Increased aeration during curing by forced aeration including the addition of a roof structure over screener bunkers and compost loading area, as piloted and proposed by Miller ($1.5 - 2.2 million capital expenditure by 2019).
  - Option 2: Increased aeration during curing with turning equipment ($3.8 – 6.0 million capital expenditure by 2019).
  - Option 3: Increased outdoor curing area (off-site); this option would require significant annual operating costs with respect to the trucking of immature compost to the secondary curing facility ($0.4 – 1.5 million capital expenditure by 2019, excluding the cost of land).
  - Option 4: Partial implementation of Miller's proposal to implement forced aeration throughout the curing area and additional outdoor storage and polishing of compost at the site ($0.5 – 1.0 million capital expenditure by 2019). This option should be piloted prior to applying for an amendment to the Approval to Operate.

It should be tested now to confirm whether or not compost maturity can be obtained within the facility such that part of the Miller proposal can be implemented with the exclusion of the roof structure over the screener bunkers and compost loading area (approximately 66.7% of the cost of Option 1). This would produce an unrestricted use product that can be stored on-site for further curing as a polishing stage prior to sale for increased revenue, and would cost approximately $0.5 to $1.0 million capital expenditure by 2019 (i.e., Option 4). If odours pose a problem with this option, then implementing the Miller proposal (Option 1) to produce mature compost and selling directly after curing is the next recommended option as all activities can be completed on-site, at approximately $1.5 to $2.2 million capital expenditure by 2019.

In 2019, when the 2010 NSE Guidelines will apply to the Miller compost facility, GHD recommends that Halifax consider the continued operation of the existing facility to meet Halifax's organics processing needs by incorporating one of the options to improve the maturity of the composted materials as outlined above, at its current capacity. Increasing the processing capacity of the facility may not be possible due to the proximity (<500 metres) of the Central Nova Scotia Correctional Facility. NSE should be consulted prior to pursuing expansion at the site further.

GHD did not identify significant additional process improvements at the facility during this assessment, as the process appears to be operating relatively efficiently. There is the option to further investigate the effectiveness of the manual sorting line in terms of glass removal, and to move the overs material inside the building instead of requiring a loader and labour to constantly move the overs material from outside to back inside the building. These process improvements will have little impact on the overall operational cost of the facility.

7. Closure

We trust that this report meets your present requirements. Please do not hesitate to contact us, if any questions arise.

All of Which is Respectfully Submitted,

GHD

Original signed by

Mike Muffels, M.Sc., P. Eng.

Original signed by

Tej Gidda, Ph.D., P. Eng.

Original signed by

Andrew Philopoulos, M.Sc., P. Eng.

Source: Source:ESRI World Imagery Service, Accessed May 2015 (Not the capture date)

0 25 50 75
Meters
Coordinate System:
NAD 1983 UTM Zone 20N

HALIFAX REGIONAL MUNICIPALITY
80 GLORIA MCCLUSKY AVENUE, DARTMOUTH
HALIFAX SOURCE SEPARATED COMPOSTING FACILITY

SITE LAYOUT

071855
Jul 6, 2015

FIGURE 2.1

GIS File: Q:\GIS\PROJECTS\71000s\71855\Layout\004\071855-02(004)GIS-WA001.mxd

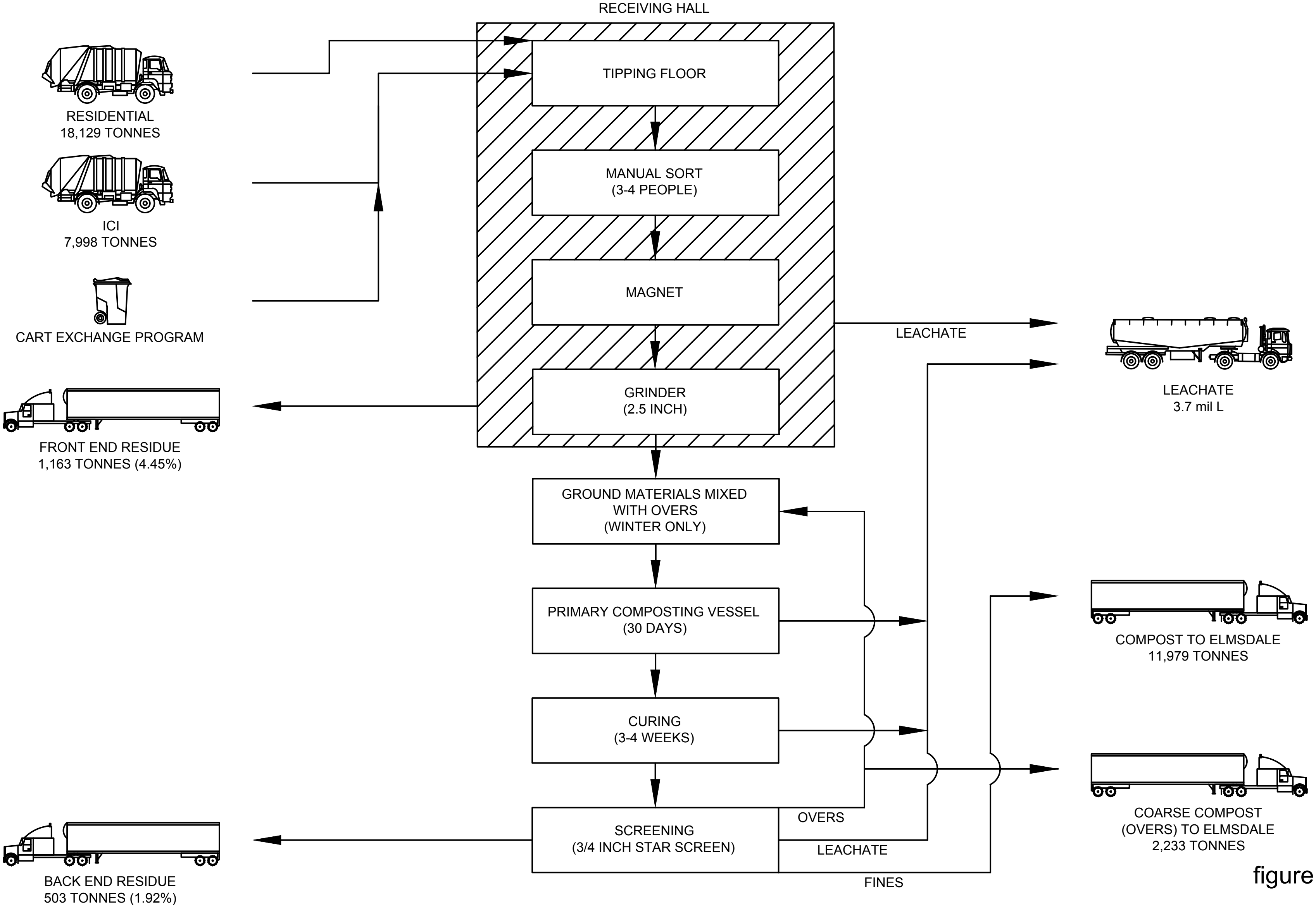


figure 2.2

PROCESS FLOW DIAGRAM
HALIFAX SOURCE SEPARATED COMPOSTING FACILITY
80 GLORIA MCCLUSKEY AVENUE, DARTMOUTH
Halifax Regional Municipality

NOTE:
TONNAGES FROM HRM CALENDAR 2014

71855-001(004)GN-WA001 AUG 28/2015

Table 3.1

2010 Nova Scotia Environment Composting Facility Guidelines Compliance Summary
Compliance And Process Review, Composting Facility, Miller Waste
80 Gloria McCluskey Avenue, Dartmouth, Nova Scotia
Halifax Regional Municipality

Section	Guideline Requirement	Compliant (Y/N)	Notes
I & II	General & Application for Approvals		
I.3.(a) II.1.(a)	No person shall construct, operate, expand or modify a facility which can process compost without obtaining approval from the Minister.	Y	NSE Approval #2000-017965-R01 Expires March 31, 2022
III	Leaf and Yard Waste Composting Facilities under 10 000 tonnes	NA	
IV.	In-Vessel Composting Facilities		
IV.2.(a)	The receiving and tipping area shall be underlain by an impermeable pad, the surface of which shall be concrete or asphalt. All drainage from the impermeable pad shall be collected for treatment or for return to the process.	Y	Receiving and tipping areas have concrete floor. Leachate collected and transported off-site for treatment or returned to the process.
IV.2.(b)	The receiving and tipping area shall be in an enclosed structure.	Y	
IV.3.(a)	The composting area shall be designed to fully contain the compostable organic material and all leachate which may be generated.	Y	Composting conducted in enclosed building with concrete floor.
IV.3.(b)	The containment system shall be impermeable, the surface of which shall be constructed of concrete, asphalt, steel or other material as approved by the Department.	Y	Composting conducted in enclosed building with concrete floor and foundation liner.
IV.3.(c)	All drainage from the composting area shall be collected for treatment or for return to the process.	Y	Leachate collected from composting process and transported off-site for treatment or returned to the process.
IV.4.(a)	The curing area shall be underlain by an impermeable pad, the surface of which shall be concrete, asphalt or other material as approved by the Department.	Y	Curing area has concrete floor. The section of aerated floor is underlain with a concrete floor with a leachate collection system.
IV.4.(b)	All drainage from the impermeable pad shall be collected for treatment or for return to the process.	Y	Leachate collected and transported off-site for treatment or returned to the process.
IV.4.(c)	All curing areas shall utilize permanent roof structures and/or proven management techniques to control moisture and minimize odour and leachate generation.	Y	Curing area enclosed in building.
IV.4.(d)	Where space limitations prevent the production of mature finished compost at in-vessel composting facilities, immature compost may be transferred to an approved composting facility in order to complete the maturation process.	N	Immature (per 2010 NSE Guidelines) compost is currently transferred to Elmsdale Landscaping Ltd. Elmsdale is not listed on the NSE list of Organic Composting Facilities in Nova Scotia.

Table 3.1

2010 Nova Scotia Environment Composting Facility Guidelines Compliance Summary
Compliance And Process Review, Composting Facility, Miller Waste
80 Gloria McCluskey Avenue, Dartmouth, Nova Scotia
Halifax Regional Municipality

Section	Guideline Requirement	Compliant (Y/N)	Notes
IV.4.(e)	For immature compost to be transported to a secondary curing area (i.e., secondary site), it must achieve one of the following requirements: i) Cured for at least 21 days and must not reheat above 20^{o}C. ii) Cured for at least 21 days and organic matter is reduced by at least 60% by weight. iii) Able to germinate 90 percent of cress seed vs control and has a plant growth rate of compost/soil at least 5 percent of control.	Y	Refer to facility Annual Reports. The fines or compost generated at the facility complies with requirement i).
IV.5	A leachate management system shall be developed which consists of infrastructure and monitoring systems designed to collect, monitor, control, and treat leachate prior to being discharged into the surrounding environment. The system shall: (i) Have a leachate collection and removal network in the active area. (ii) Function year round. (iii) Have a means of monitoring all treated leachate discharges.	Y	Leachate collected, stored and transported off-site for treatment.
IV.6	The applicant shall submit for approval from the Department, a surface water monitoring program.	Y	Compliance documented in annual reports reviewed by NSE.
IV.7	The applicant shall submit for approval from the Department, a groundwater monitoring program.	Y	Compliance documented in annual reports reviewed by NSE.
IV.8.(a)	Mechanical ventilation shall be provided for the composting area, areas for the storage of compostable organic feedstock and any other area containing readily putrescible materials such as the storage room for residuals.	Y	Mechanical ventilation is provided for all active areas.
IV.8.(b)	All areas referred to in clause (a) shall be under negative atmospheric pressure in order to avoid the escape of odours.	Y	On the day of GHD's site visit (June 16, 2015), slight inward air flow through open overhead and man doors was observed. Overhead doors for trucks must remain open while trucks unloaded. Overhead door at cart washing area was left open for an extended period of time during the visit.

Table 3.1

2010 Nova Scotia Environment Composting Facility Guidelines Compliance Summary
Compliance And Process Review, Composting Facility, Miller Waste
80 Gloria McCluskey Avenue, Dartmouth, Nova Scotia
Halifax Regional Municipality

Section	Guideline Requirement	Compliant (Y/N)	Notes
IV.8.(c)	All ventilation air shall be subject to a treatment system designed to remove odours prior to release into the environment.	Y	Ventilation air treated through organic media biofilters. The compost building air is pre-humidified prior to the biofilter. The curing building air is not pre-humidified.
IV.9	Separation distance[2] between active area and: Nearest residential or institutional building is at least 500 metres Nearest commercial or industrial building is at least 250 metres	 Y Y	 ~450 metres ~130 metres, approved by NSE as permitted by IV.9.(f)
IV.9 (cont.)	Nearest property boundary is at least 100 metres, or 30 metres where it can be demonstrated that particular equipment will not release odours generated from the composting process Nearest watercourse or water body, including salt water, be at least 30 metres	Y Y	~50 metres, approved by NSE as permitted by IV.9.(f) ~800 metres
V.	Open Windrow Composting Facilities	NA	
VI.	Secondary Curing Areas	NA	
VII.	Composting Facility Operation		
VII.1.(b)	The objective of all composting facilities shall be to incorporate all compostable organic feedstock into the composting process the same day that it is delivered to the site. If some feedstock is not incorporated into the process in the same day, except leaf and yard waste feedstocks only, then it shall be stored in an enclosed area with a mechanical ventilation system for the capture and treatment of odorous emissions.	Y	Mr. Hagan confirmed that feedstock is generally processed and loaded into composting vessel on the same day it arrives. Receiving area and tipping floor is an enclosed area with mechanical ventilation for the capture and treatment of odorous emissions.
VII.1.(c)	The composting facility shall have constant supervision during the hours that the facility is open.	Y	On the day of GHD's site visit (June 16, 2015); Mr. Muffels observed at least 8 staff.
VII.1.(d)	The composting facility shall accept only feedstock identified in the approval.	Y	Not raised by HRM staff as a known issue. On the day of GHD's site visit (June 16, 2015); GHD did not observe any unapproved feedstock materials.
VII.1.(e)	Any residual products associated with the composting operation shall be disposed of in a manner acceptable to the Department.	Y	Compost residuals are taken to an approved landfill for disposal in accordance with Condition 13.c) of NSE Approval

Table 3.1

2010 Nova Scotia Environment Composting Facility Guidelines Compliance Summary
Compliance And Process Review, Composting Facility, Miller Waste
80 Gloria McCluskey Avenue, Dartmouth, Nova Scotia
Halifax Regional Municipality

Section	Guideline Requirement	Compliant (Y/N)	Notes
			#2000-017965-R01.
VII.1.(f)	Litter shall be controlled on the entire site.	Y	On the day of GHD's site visit (June 16, 2015), no litter was observed.
VII.1.(g)	Exposed areas shall be stabilized to prevent erosion and sedimentation.	Y	Erosion and sedimentation a concern. On the day of GHD's site visit (June 16, 2015), staff were hydro-seeding an exposed area.
VII.1.(h)	Dust shall be controlled to Department requirements for particulate emissions.	Y	NSE Approval #2000-017965-R01
VII.1.(i)	Vectors shall be controlled in accordance with a control plan approved by the Department.	Y	NSE Approval #2000-017965-R01
VII.1.(j)	Signs shall be placed at the entrance to the site indicating the name of the facility, hours of operation, emergency contact, and the materials acceptable at the site.	N	Sign at front entrance does not indicate hours of operation, emergency contact and materials acceptable at the site
VII.2	An Operation and Maintenance Manual shall be submitted for review from the Department. The Operation and Maintenance Manual shall be left on site at all times and shall be available for inspection during operating hours.	Y	Operation and Maintenance Manual reviewed by NSE as part of NSE Approval #2000-017965-R01
VII.3	The applicant shall provide contingency plans addressing problems associated with vectors, groundwater contamination, equipment failure, and odour generation and complaints.	Y	Contingency Plan prepared as part of NSE Approval #2000-017965-R01
VII.4	Reports and Records	Y	Reports and records provided to NSE as required in NSE Approval #2000-017965-R01. GHD received copies of 2012-2014 Annual Reports.

Table 3.1

2010 Nova Scotia Environment Composting Facility Guidelines Compliance Summary
Compliance And Process Review, Composting Facility, Miller Waste
80 Gloria McCluskey Avenue, Dartmouth, Nova Scotia
Halifax Regional Municipality

Section	Guideline Requirement	Compliant (Y/N)	Notes
VIII.	Compost Classification and Use		
VIII.1.(a)	All compost will be classified in accordance with the criteria identified in the 2005 CCME Guidelines. The compost must meet all criteria as established for foreign matter, maturity, pathogens and trace elements.	N	Regular testing compiled in Annual Reports demonstrate that compost consistently meets trace elements and fecal coliform requirements. Available salmonella results (2012 CBCL Report and additional analysis conducted by Miller, attached to this report) confirm salmonella has not been detected historically. With respect to maturity, the Miller facility, as originally designed and constructed has been unable to consistently meet 2005 CCME Maturity requirements. Compost cured in the ASP pilot area has been demonstrated to comply with the 2005 CCME Maturity requirements. Refer to Section 3.2 of this report for detailed discussion on maturity.

Table 3.1

2010 Nova Scotia Environment Composting Facility Guidelines Compliance Summary
Compliance And Process Review, Composting Facility, Miller Waste
80 Gloria McCluskey Avenue, Dartmouth, Nova Scotia
Halifax Regional Municipality

<table>
<tr><th>Section</th><th>Guideline Requirement</th><th>Compliant (Y/N)</th><th>Notes</th></tr>
<tr><td>VIII.1.(b)</td><td>Testing of the compost quality shall be completed for every 1000 tonnes of compost produced or every three months and conducted in accordance with the minimum testing procedures identified in Section 4 of the 2005 CCME Guidelines.</td><td>N</td><td><table><tr><th></th><th>Compost[4] (tonnes)</th><th>No. of Samples</th><th>No. per 1000 tonnes</th></tr><tr><td>2012</td><td>13,917</td><td>8</td><td>0.57</td></tr><tr><td>2013</td><td>12,415</td><td>6</td><td>0.48</td></tr><tr><td>2014</td><td>11,979</td><td>13</td><td>1.09</td></tr><tr><td>Sum</td><td>38,311</td><td>27</td><td>0.70</td></tr></table>
Note: 2012 and 2013 testing was not in compliance with condition of 12.b).(iii) of the NSE Approval #2000-017965-R01.</td></tr>
</table>

Notes:

1. Condition or efficacy of infrastructure or systems such as concrete pads, containment systems, tanks, etc. not inspected or assessed as part of this compliance review. Scope restricted to a presence/absence determination.
2. Separation distances confirmed using exploreHRM online mapping tool. Printouts from exploreHRM included as Appendix A.
3. List of Organic Compost Facilities in Nova Scotia found at: http://www.novascotia.ca/nse/waste.facilities/facilities.organic.composting.php.
4. Compost tonnage does not include overs.

Table 3.2

Summary of Results of Curing Area Aerated Static Pile Pilot Program
Compliance and Process Review, Composting Facility, Miller Waste
80 Gloria McCluskey Avenue, Dartmouth, Nova Scotia
Halifax Regional Municipality

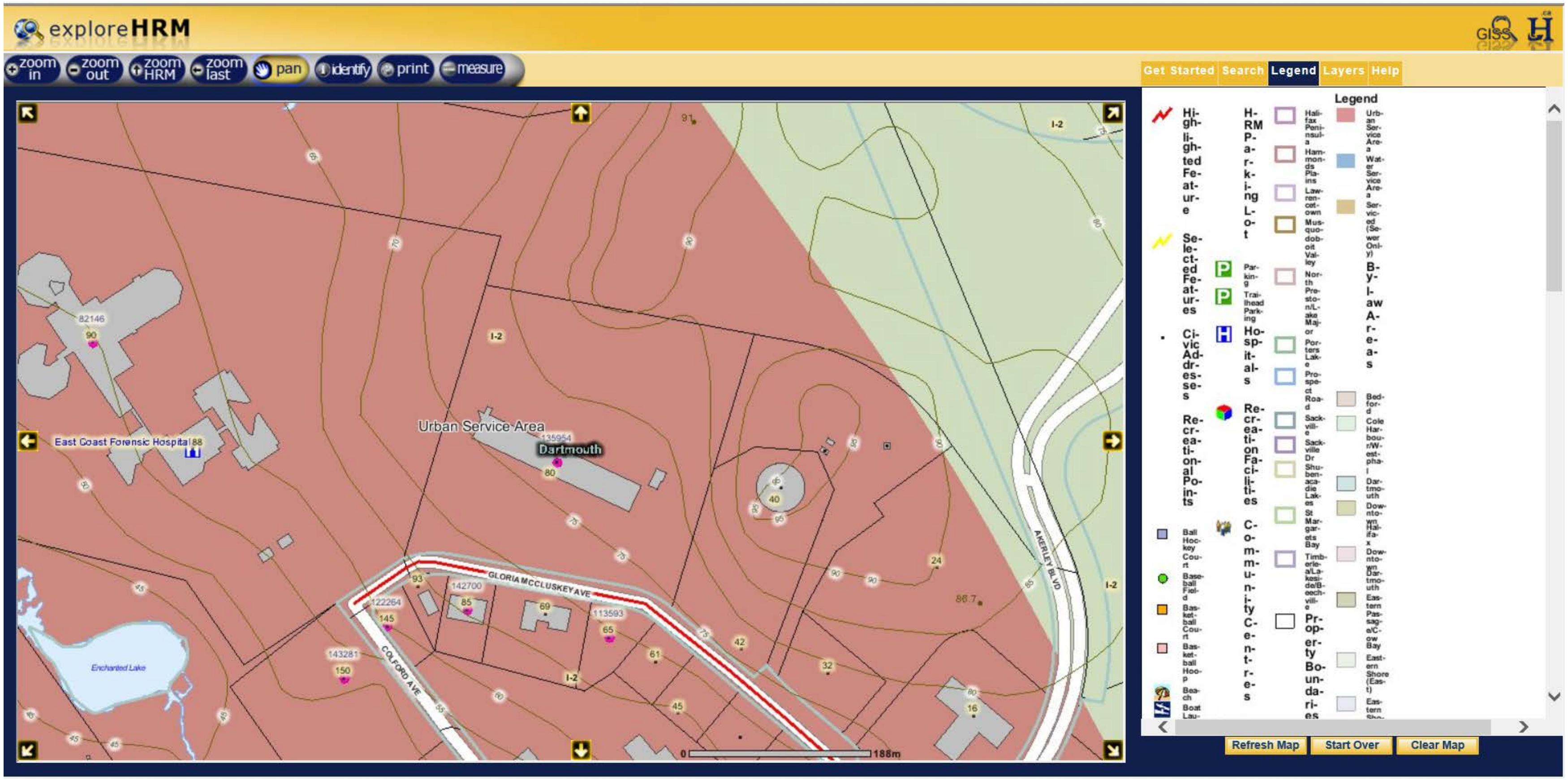
	2005 CCME Guidelines	21-Oct-11	26-Oct-11	9-Nov-11	23-Feb-12	8-Aug-13	27-Aug-13
Sample Location	**Screened Compost**	**Screened Compost**	**Curing Pile Prior to Screening**	**Curing Pile Prior to Screening**	**Screened Compost**	**Curing Pile Prior to Screening**	**Screened Compost**
Temperature range of curing pile at 4 ft. depth (°C)							
Front			60.0	61.5		57.5	
Middle			62.0	61.0		63.5	
End			64.0	63.0		47.5	
Oxygen range of curing pile (%)						20.4 - 20.8	
Compost Stability Index		7			7		7
Moisture content (%)		55.9	55.0	53.0			
C:N Ratio		21:1					
Maturity (Respiration - CO2-C/g OM/day)	≤ 4.00	2.90			3.20		3.20
Organic Matter (%)		80.28					

Note:

OM - organic matter

Appendices

Appendix A
Halifax Regional Municipality Maps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Help
Urban Service Area
Dartmouth
East Coast Forensic Hospital
Enchanted Lake
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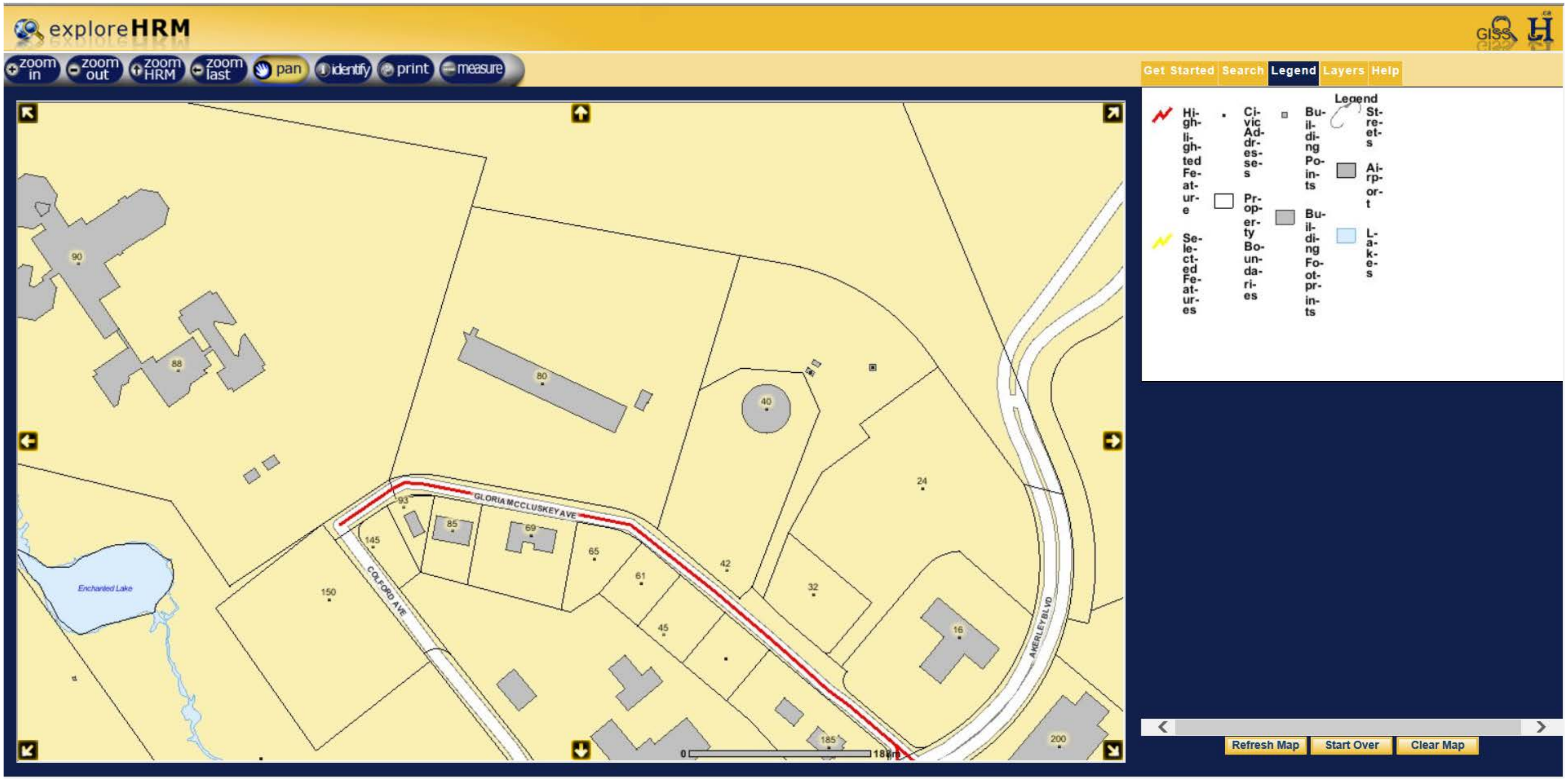

explore HRM
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measure
Get Started
Search
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Layers
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Highlighted Feature
Selected Features
Civic Addresses
Property Boundaries
Building Points
Building Footprints
Streets
Airport
Lakes
GLORIA MCCLUSKEY AVE
COLFORD AVE
AKERLEY BLVD
Enchanted Lake
Refresh Map
Start Over
Clear Map

ATTACHMENT G

CONESTOGA-ROVERS & ASSOCIATES

www.CRAworld.com

Final

Building Assessment

Composting Facility – New Era Technologies
61 Evergreen Place
Goodwood, Nova Scotia

Prepared for: Halifax Regional Municipality

Conestoga-Rovers & Associates
45 Akerley Boulevard
Dartmouth, NS B3B 1J7

Partners in Sustainability

April 2015 • 071855-01 • Report No. 1

Executive Summary

The services of Conestoga-Rovers & Associates (CRA) were retained by the Halifax Regional Municipality (HRM) to provide an engineering assessment of the structure, exterior building envelope, mechanical/electrical systems, life support systems and the roofs for the composting facility located at 61 Evergreen Place in Goodwood, Nova Scotia (Property or Facility). The Facility is currently occupied and operated by New Era Technologies (New Era) and processes organic materials collected by residential and commercial haulers.

The Facility consists of three buildings:

- The Receiving Building, constructed in 1998, is a one storey, steel frame structure, measuring approximately 1,200 sq.m (12,900 sq.ft) in area with a small office area attached at the front of the building.
- The Curing Building, constructed in 1998, is a one storey, arched steel truss, fabric covered building measuring approximately 2,975 sq.m (32,000 sq.ft) in area. The Curing Building had the entire fabric structure (including steel trusses) and concrete floor replaced in 2012. Localized concrete repairs have also been conducted to the concrete foundations over various years.
- The Screening Building, constructed in 2001, is also a one storey, arched steel truss, fabric covered building measuring approximately 1,485 sq.m (16,000 sq.ft) in area.

Overall, the Facility was found to be in fair to poor condition with complete replacement of the Screening Building required and localized repairs and maintenance required for the other two buildings. The total cost to maintain the facility over the five year investment horizon of the study is $697,500 as detailed in the Capital Expenditure Table located in Appendix B. It is CRA's opinion, that with continued regular maintenance (such as the repairs recommended in this report) and no substantial change in the use of the Facility, the buildings should have an estimated Remaining Useful Life (RUL) of 10-15 years.

The following actions are required immediately:

- None.

The following additional investigations are recommended:

- Prior to the application of corrosion protection for the steel trusses in the Curing Building, it is recommended that ultrasonic thickness (UT) measurements confirm the wall thicknesses have not been compromised from the corrosion and that spot repairs are not required prior to application of the corrosion protection product.

The following actions will be required over the five year investment horizon of this study:

- The steel wall girts in the Receiving Building at low elevations, which are closer to the process floor, have experienced heavy corrosion and loss of section. It is estimated that 20 girts will require replacement.
- The base angle, located at the top of the concrete strip wall in the Receiving Building, which serves to secure the bottom of the exterior cladding panels, is also heavily corroded or even missing for the majority of the building's perimeter. The base angle will require replacement. The west wall at the south end (along gridline 1 between gridlines C and D on the original structural drawings) of the Receiving Building is a braced bay that has had the lower level of cross-bracing removed. Bracing is an integral part of the structures' lateral force resisting system and requires replacement. In addition, several column bases and anchor rods throughout the building have surface corrosion with the base plate at Gridline H1 delaminating in a localized area. It is recommended to provide corrosion protection to these column bases to further extend the Remaining Useful Life (RUL) of the columns.
- Significant corrosion was noted in the siding of the Receiving Building, particularly in the areas adjacent to the steel girts. In several locations along the east elevation and in the southwest corner of the building the siding has corroded through the full material thickness creating holes and gaps in the siding and causing the siding to become detached from the girts in localized areas. It is recommended that the metal siding for this building be completely replaced, except for the office portion, which is in good repair.
- The fabric covering (walls and roofing) for the Screening Building was noted to be in fair to poor repair at the time of our site visit. According to the manufacturer this fabric building has an expected useful life (EUL) of 15-20 years provided it is properly maintained and not subjected to harsh environmental conditions. This building is currently 14 years of age so is nearing the end of its EUL. In addition, several sections of the fabric walls and roof appeared in poor repair with several holes noted, particularly in the areas where it is attached to the roof trusses. The fabric covering for the entire building will require replacement in the near future. However, according to the manufacturer they no longer manufacture fabric coverings for the type of steel truss system utilized in this building therefore the only option for repairs is complete replacement of the fabric and the steel trusses. The new fabric building should be able to be attached to the existing foundations but an inspection of the foundations, by a qualified structural engineer, after removal of the existing structure is recommended.
- Assuming the Screening Building will be replaced, the harsh environmental conditions warrant special measures for corrosion protection of the new steel structure. It is recommended that the new structure be protected with a corrosion control product such as Stayflex®. This system has had several case studies specific to the

environments of composting facilities with good results in obtaining the maximum EUL of the structure.

- Generally, the Curing Building structural steel trusses, which are only two years of age, are in fair to good repair. The majority of trusses were covered in a layer of saturated organic material. A roughened surface indicative of surface corrosion was exposed beneath the accumulated organic material. Similar to the Screening Building, special measures of corrosion protection are warranted. The Stayflex® corrosion control product is recommended to protect the structural steel of the Curing Building.
- The slab-on-grade in the Screening Building was in fair to poor repair with a section of concrete slab, approximately 80’ x 80’ in size, near the screening equipment that was in various stages of disrepair. It is recommended that this section of floor be completely replaced with a new 6” reinforced concrete slab that is treated with a concrete sealer and concrete hardener, suitable for the building operations, to increase slab durability. A budget to conduct this work has been provided in Year 3 of the attached cost table.
- There are two metal man doors in metal frames located along the north and east elevations of the Receiving Building that were found to be in poor condition due to corrosion of the doors and frames. There are also two metal man doors in metal frames for the Screening Building that were found to be in poor condition due to corrosion of the doors and frames. A budget to replace these doors has been provided in Year 2 of the attached cost table.
- The overhead and sliding bay doors in the Receiving and Curing buildings appeared in fair to good repair. It is anticipated that only routine maintenance, such as replacement of chains, switches, tracks and other hardware, should be required during the investment horizon of this study for these doors. A maintenance allowance for repairs has been provided in Years 3-5 of the attached cost table.
- The HVAC unit that services the office area is reported to be original to the building and thus is 17 years of age. Typically, HVAC units have an EUL of 20 years provided they are regularly maintained and serviced. Therefore, the HVAC unit is approaching the end of its EUL and will require replacement within the next 3-5 years. It was also reported by New Era representatives that recent air quality testing has indicated that the existing unit may not be sized properly to maintain proper air quality for the office space, which has been renovated with additional walls and rooms since the original installation of the HVAC unit. The New Era representative also indicated that they are planning to replace the existing 6-ton HVAC unit with a larger 10-ton unit and upgrade interior ducting and controls during the HVAC replacement to meet air quality standards in the office space. Review of air quality test results were not part of the scope of this current mandate and therefore were not requested for review. However, given this information and the fact that the existing HVAC unit is nearing the end of its EUL, a budget for a replacement of the existing unit has been provided in Year 4 of the attached cost table.

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List of Appendices

Section 1.0 Introduction

1.1 Scope of Work

The services of Conestoga-Rovers & Associates (CRA) was retained by the Halifax Regional Municipality (HRM) to provide an engineering assessment of the structure, exterior building envelope, mechanical/electrical systems, life support systems and the roof for the composting facility located at 61 Evergreen Place in Goodwood, Nova Scotia (Property or Facility). As part of the work, CRA has provided upgrade/repair options which could be required over the next five years to improve the condition of the Facility and extend the life for another 10-15 years. The scope of work included the assessment of the building structure, roof, exterior siding and flashing, windows, exterior doors, electrical/mechanical systems and life support systems for each of the three buildings. Rough order-of-magnitude cost estimates have also been provided for all upgrade/repair construction options proposed.

The particular physical components of the Property which are addressed in this assessment are as follows:

Building Structure:

- Foundations, Structural Steel Frame
- Slab-on-Grade

Building Envelope:

- Exterior Walls
- Windows, Doors, Loading Docks and Overhead Doors
- Roofing Systems, visible Waterproofing Membranes and Flashing Details

Electrical and Mechanical Systems:

- Main Heating and Ventilation Systems
- Electrical (Service Entry, Distribution Panels and Lighting Systems)

Fire Protection and Alarm Systems:

- Fire Suppression Systems (Sprinklers, Extinguishers and Hose Cabinets)
- Fire Alarm Systems (Alarm Panel, Flow Detectors)

1.2 Definition of Terms

The following terms and their respective definitions are used to describe the condition of the building systems:

Excellent:	The system or equipment was found to be in new or nearly new condition with no deficiencies or damages.
Good:	The system or equipment was found to be in satisfactory condition with no recommendations for repairs or improvements.
Fair:	The system or equipment was found to be in satisfactory condition with recommendations to correct minor deficiencies. May indicate that immediate attention is required to minor deficiencies.
Poor:	The system or equipment was found to be in unsatisfactory condition and must be replaced or repaired in the short term.

The following terms are commonly used in a Building Condition Assessment to describe the state of the building and the appropriate maintenance strategies for the required repairs:

Walkthrough Investigation	Non-intrusive, visual observations of the subject Property, survey of readily accessible, easily visible components and systems of the subject Property. A walkthrough investigation is not technically exhaustive, and excludes concealed physical deficiencies and other Out of Scope Issues. Observations of the building (exterior and interior) are limited to vantage points that are on-grade, from readily accessible balconies, rooftops, platforms, etc.
Remaining Useful Life (RUL)	A subjective estimate of the number of remaining years that an item, component or system will be able to function in accordance with its intended purpose before warranting replacement.
Expected Useful Life (EUL)	The average amount of time in years that an item, component or system is estimated to function when installed new and assuming routine maintenance is practised.
Immediate Costs	Costs that will be incurred due to 1) existing or potential unsafe conditions, 2) fire hazards, 3) condition that, if left un-remedied,

	can result in a critical failure of a system within one year, or result in a significant escalation of remedial costs.
Capital Expenditures	Future budgetary recommendations for items, components or systems based on their respective Remaining Useful Life (RUL).
Regular Building Maintenance	Maintenance that can be carried out by building staff without requiring specialised sub-contractors, equipment, or any significant interruptions to the building's use. These items will generally be of minor expense, and can often be carried out in phases over long periods of time.

Definitions of additional selected Building Science and maintenance terms can be found in the "*Glossary of Selected Terms"* included in Appendix C.

1.3 Cost Estimates

The estimated costs associated with the deficiencies and conditions reported herein are presented in the Capital Expenditure Tables, included in the appendices. The term "Capital Expenditure" as it pertains to the Capital Expenditure Tables, means the cost to replace defective elements of the building or to fully repair the deficient elements within a given building system at a specified point during the investment horizon.

Items that are deemed to be deficient, but not significant in terms of importance, cost or their effect on the overall building condition will be considered to lie within the scope of regular building maintenance.

Cost estimates for repairs and system replacements presented in this report are not derived from quantity surveys or detailed engineering calculations. The costs and unit rates provided are based on the following information sources:

- Our experience with contractors specialising in the fields in question
- Direct inquiries to service contractors involved with the Property
- Industry-accepted costing tools including, but not limited to, "Hanscomb's Yardsticks for Costing Cost Data for the Canadian Construction Industry", published by the R.S. Means Company

These estimates are intended only for global budgeting purposes; they should be used as a guide only, as costs may vary according to the time of year, quality of materials used, volume of work, actual observed conditions, etc. Note that the estimates do not include applicable taxes.

Section 2.0 Building Condition Assessment

2.1 Capital Expenditure Parameters

Rough order-of-magnitude cost estimates have been provided, in the Capital Expenditure Table included in Appendix B, for all upgrade/repair construction options proposed. For the purpose of this report, any item having a cost estimate of less than $2,000.00 will be considered to be within the scope of regular building maintenance, as defined in Section 1.2. With respect to the Capital Expenditure Table provided in Appendix B, the recommended repairs will be scheduled appropriately over a five year period. All of the prices quoted are in Canadian (year 2015) dollars.

2.2 Procedures and Conditions

All of the reasonably accessible areas were examined during the assessment of the Property. Selected photographs are enclosed in Appendix A.

Our mandate did not include non-destructive or destructive testing, opening of roofing systems, wall assemblies or other enclosures, or testing of mechanical, electrical or life-safety systems. The assessment of the mechanical and electrical systems was strictly visual to determine the type of system, age and visual condition. Operating conditions of the actual equipment were determined through a review of available logbooks, interviews with Property contacts and maintenance personnel. No physical testing or intrusive investigative techniques were used. A review of the National Building and Fire Codes or compliance of the Property to these codes was not completed. Only code issues that were reported, or were readily apparent during the “walkthrough” are indicated in this report. During the on-Site assessment, construction drawings (if available) were consulted strictly for the purpose of locating specific systems. No verification or analyses concerning design loads or design details was carried out.

The Site visit for this engineering assessment was conducted by, Mr. Mike Gallahue, P. Eng. and Mr. Matthew Mittrovich, P. Eng. of CRA on March 26, 2015, under partly cloudy skies and an average outdoor temperature of approximately -5oC. Mr. Gallahue and Mr. Mittrovich were accompanied during the inspection by Mr. Darren Evans of New Era.

2.3 Site and Building Contacts

The following personnel were contacted during the investigation and research periods:

Person	Company	Position	Phone
Mr. Barry Nickerson	HRM	Waste Resources Engineer	902-490-7172
Mr. Darren Evans	New Era Technologies	Plant Manager	902-876-5185

The following service contractors were identified during the Site visits and research periods:

Item	Service Contractor	Contact	Phone
Fabric Buildings	Treeline Project Management Ltd.	John Lawrence	902-665-2598
Electrical	Ainsworth	N/A – Inspection Report provided	902-468-9193
Fire Alarm	Protectron Security Services/ Armstrong Communication Ltd.	N/A – Inspection Report provided	1-800-986-0000
Mechanical	Fader Agencies	N/A – Service Reports provided	902-466-2333

2.4 Property Use

The Facility is currently occupied and operated by New Era Technologies (New Era) and processes organic materials collected by residential and commercial haulers. The Facility consists of three buildings:

- The Receiving Building, constructed in 1998, is a one storey, steel frame structure, measuring approximately 1,200 sq.m (12,900 sq.ft) in area with a small office area attached at the front of the building.
- The Curing Building, constructed in 1998, is a one storey, arched steel truss, fabric covered building measuring approximately 2,975 sq.m (32,000 sq.ft) in area. The Curing Building had the entire fabric structure (including steel trusses) and concrete floor replaced in 2012. Localized concrete repairs have also been conducted to the concrete foundations over various years.
- The Screening Building, constructed in 2001, is also a one storey, arched steel truss, fabric covered building measuring approximately 1,485 sq.m (16,000 sq.ft) in area.

2.5 Structure

General Description and Condition:

Foundations: The foundations for all three buildings are poured in-place reinforced concrete and consist of spread footings for the perimeter walls and interior pier footings to support columns and interior partitions. It should be noted that only the above-grade portions of the foundation walls were included in our assessment.

Frame: The Receiving Building is a clear span pre-engineered steel structure composed of tapered main frame beams and columns. Column bases are anchored to piers that are raised above the finished floor. The walls and roof are constructed of cold formed steel girts and purlins respectively and are exposed to the interior. Steel finishes vary from shop primed to shop primed and painted. Concentric cross-bracing consists of rod or cable bracing. Both the Curing and Screening Buildings are composed of fabric covered arched steel trusses with base plates anchored to concrete that is raised above the finished floor. Both truss styles are constructed of hollow structural sections (HSS). The steel finish of the Curing Building trusses is hot-dip galvanized. The steel finish of the Screening building trusses is hot-dip galvanized with an epoxy paint system. Concentric cross-bracing for both buildings is cable bracing.

Slab-on-Grade: The Receiving Building has a reinforced slab-on-grade over its entire footprint. The slab-on-grade was generally visible except in the office area, washrooms and lunch room. The two fabric buildings have reinforced slabs-on-grade over their entire footprint. The slabs for these two buildings were generally visible except in areas where piles of compost material were stored at the time of our site visit. During our site visit approximately 75% of the slab in the Screening Building was visible but only 25% of the Curing Building slab was visible due to a large pile of compost in the building. However, as noted above, the slab-on-grade for the Curing Building was replaced in 2012.

Observations and Recommendations:

1. No significant cracks or obvious deformations were noted in the structures or transferred to the interior finishes (including floors, walls and ceilings) that would indicate significant or ongoing structural movement. No serious, important or generalized defects that would imply a problem with groundwater or unstable soil conditions were noted.

2. Generally, the Receiving Building structural steel framing was found to be in fair to poor condition. Steel frames, purlins, and girts at higher elevations were dry at the time of inspection. Light surface corrosion in localized areas was present on the main frames with more surface corrosion present on cold formed sections. No loss of section was observed on steel at higher elevations from the roof to approximately half of the wall height. Girts at low elevations, which are closer to the process floor, have experienced heavy corrosion and loss of section. It is estimated that 20 girts will require replacement. The base angle, located at the top of the concrete strip wall, which serves to secure the bottom of exterior cladding panels, is also heavily corroded or even missing for the majority of the building's perimeter. The base angle will require replacement. The west wall at the south end (along gridline 1 between gridlines C and D on the original structural drawings) is a braced bay that has had the lower level of cross-bracing removed. Discussion with New Era staff revealed the brace was removed several years ago. Bracing is an integral part of the structures' lateral force resisting system and requires replacement. Several column bases and anchor rods throughout the building have surface corrosion with the base plate at Gridline H1 delaminating in a localized area. It is recommended to provide corrosion protection to these column bases to further extend the Remaining Useful Life (RUL) of the columns. A budget for this work has been included in the Year 1 of the Capital Expenditure Table.

3. Generally, the Screening Building structural steel trusses are in poor repair. At the time of inspection, the environment was at a moderate temperature with high humidity that was evident with condensed moisture on all steel trusses. The epoxy paint system has been compromised with cracks and has flaked off in localized areas at most joint locations. The exposed galvanized steel has visible surface corrosion. A small dent approximately 40 mm long and 10 mm deep was observed on the 6th truss from the north at the west side near the support. The epoxy paint system has peeled away at this location and surface corrosion was present. At the time of inspection, base plates were covered with a thick layer of organic material which allowed access to the two inside anchor rods only. The

epoxy paint system on base plates and anchor rods was mostly intact with minor surface corrosion on both base plates and anchor rods. Overall, the epoxy paint system has reached its EUL and requires replacement. Corrosion observed on truss components warrant ultrasonic thickness (UT) measurements to confirm the wall thicknesses have not been compromised prior to any refurbishment.

4. However, as described in detail in Section 2.6, due to the unavailability of replacement parts for this building, specifically the fabric covering, the majority of the structure including the steel trusses will require replacement. Assuming the building will be replaced, the harsh environmental conditions warrant special measures for corrosion protection of the new structure. It is recommended that the new structure be protected with a corrosion control product such as Stayflex®. This system consists of two parts, the first of which is a spray on polyurethane foam insulation and assists in keeping the temperature of the steel above the dew point. The second is a spray on water vapour barrier isolating the steel from the humid environment. This system has had several case studies specific to the environments of composting facilities with good results in obtaining the maximum EUL of the structure. A budget for this work has been included in Year 2 of the Capital Expenditure Table.

5. Generally, the Curing Building structural steel trusses, which are only two years of age, are in fair to good repair. At the time of inspection, the environment was at a moderate temperature with very high humidity that was evident with condensed moisture on all steel trusses. The majority of trusses were covered in a layer of saturated organic material. A roughened surface indicative of surface corrosion was exposed beneath the accumulated organic material. At the time of inspection, the interior of the HSS truss sections were inaccessible to determine if corrosion was present. Similar to the Screening Building, special measures of corrosion protection are warranted to ensure that the steel reaches it's maximum EUL. This is evident given that the steel in this building, which is only two years of age, is already experiencing surface corrosion. The Stayflex® corrosion control product is recommended to protect the structural steel of the Curing Building. Prior to the application of corrosion protection, it is recommended that UT measurements confirm the wall thicknesses have not been compromised. A budget for this work has been included in Year 1 of the Capital Expenditure Table.

6. Generally, the slab-on-grade in the Receiving Building was in fair repair with typical shrinkage cracking noted and localized areas of impact damage due to the operation of the building. The slab-on-grade in the Curing Building was noted to be in good repair and was completely replaced in 2012 as part of a major renovation to this building. The slab-on-grade in the Screening Building was in fair to poor repair with a section of concrete slab, approximately 80' x 80' in size, near the screening equipment that was in various stages of disrepair. This area of the building is exposed to continuous scraping from the bucket of the loader that is used to transport compost material to and from the screening equipment. The continuous scraping of the floor in this area has damaged the surface of the floor exposing aggregate and creating a rough uneven surface. It is recommended that this section of floor be completely replaced with a new 6" reinforced concrete slab that is treated with a concrete sealer and concrete hardener, suitable for the building operations, to increase slab durability. A budget to conduct this work has been provided in Year 3 of the Capital Expenditure Table.

2.6 Building Envelope

2.6.1 Exterior Walls

General Description and Condition:

The exterior walls of the Receiving Building are comprised of metal clad siding on steel framed walls with no insulation. The exterior walls of the Curing and Screening Buildings are comprised of stressed fabric coverings on steel trusses. At the time of our visit to the property, the exterior walls of the Curing Building were found to be in good condition while the condition of the exterior walls of the Receiving and Screening Buildings were found to be in poor condition with complete replacement being recommended for both buildings.

Observations and Recommendations:

1. The metal siding of the Receiving Building was noted to be in poor repair, except for the small office portion at the south entrance. Significant corrosion was noted in the siding, particularly in the areas adjacent to the steel girts. In several locations along the east elevation and in the southwest corner of the building the siding has corroded through the full material thickness creating holes and gaps in the siding and causing the siding to become detached from the girts in localized areas. In the worst areas, the building tenant has re-fastened the siding to different locations of the girts using oversized washers and metal pins but this

is a temporary repair only. It was also reported that a portion of the siding in the southwest corner was torn off during a previous wind storm due to the poor attachment caused by the corrosion. It is recommended that the metal siding for this building be completely replaced, except for the office portion, which is in good repair. A budget to conduct this work has been provided in Year 1 of the Capital Expenditure Table.

2. The fabric covering (walls and roofing) for the Screening Building was noted to be in fair to poor repair at the time of our site visit. According to the manufacturer this fabric building has an expected useful life (EUL) of 15-20 years provided it is properly maintained and not subjected to harsh environmental conditions. This building is currently 14 years of age so has reached the end of its EUL. In addition, several sections of the fabric walls and roof appeared in poor repair with several holes noted, particularly in the areas where it is attached to the roof trusses. Treeline Project Management Ltd. (Treeline) is the local representative for the fabric building manufacturer (Britespan Building Systems Inc.) and have conducted a visual inspection of the structure in the past 2 years. Treeline were contacted as part of our current mandate and indicated that based on their last inspection of this building, the fabric covering has reached the end of its EUL and will require replacement in the near future. However, according to the manufacturer they no longer manufacture fabric coverings for the type of steel truss system utilized in this building so the only option for repairs is complete replacement of the fabric and the steel trusses. New Era provided CRA with a cost quote from Treeline to supply and install a new fabric building, complete with new steel trusses, on top of the existing foundations. The cost quote is dated March 11, 2015 and the budget to conduct this work has been carried in Year 2 of the Capital Expenditure Table. The cost in the attached cost table also includes additional costing for demolition and removal of the existing structure. As discussed above in Section 2.5, installation of corrosion protection for the new trusses is also recommended to help ensure the new structure reaches it's EUL of 15-20 years. A budget for the installation of the corrosion protection has also been included in Year 2 of the Capital Expenditure Table. The new fabric building should be attachable to the existing foundations but an inspection of the foundations, by a qualified structural engineer, after removal of the existing structure is recommended.

3. The fabric covering for the Curing Building appeared in good repair and was installed new in 2012 during a major renovation conducted to this building. Due to its age and current condition it is not anticipated the fabric covering will require replacement during the investment horizon of this current assessment and with proper maintenance and care should not require any further major repairs or capital investment for the next 10-15 years. However, it should be noted that this type of structure typically only has an EUL of 15-20 years, therefore it is likely the building will require replacement or major improvements shortly after that time frame.

2.6.2 Windows and Doors

General Description and Condition:

The glazing serving the Receiving Building is comprised of double-pane, operable windows in vinyl frames, which serve the office area only. There are no windows in the remainder of the building. The windows were examined for deteriorated caulking, gaskets and broken glazing, as well as for condensation or rust in the air spaces between the glazing panels in the double-pane units, which would indicate possible broken thermal seals. Generally, the window units and the caulking were found to be in fair to good condition. There are no windows in either of the fabric covered buildings.

The main entrance to the Receiving Building (office area) has glass doors in a metal frame. There are two metal man doors in metal frames located along the north and east elevations of the building that are used as alternate entrances and emergency exits. The main entrance door was found to be in good repair while the metal man doors in the process area were found to be in poor condition. The man doors for the Curing Building consist of metal doors in metal frames are were found to be in good repair. There were two man doors in metal frames for the Screening Building and both were found to be in poor repair.

There are three vinyl overhead doors and one metal overhead door in the Receiving Building. The vinyl overhead doors appeared in good repair and the metal overhead door was noted to be in fair repair. The vinyl overhead doors are electric doors and it was reported that the metal overhead door is no longer used. There are two metal sliding doors located in the Curing Building, which were noted to be in good repair. There are two sliding doors located in the Screening Building, which were noted to be in fair to poor repair and will require replacement as part of the building replacement.

Observations and Recommendations:

1. The glazing serving the office area was noted to be in fair to good condition. There was no evidence of broken thermal seals or water infiltration noted. It is anticipated these windows will only require routine maintenance during the investment horizon of this study.

2. There are two metal man doors in metal frames located along the north and east elevations of the Receiving Building that were found to be in poor condition due to corrosion of the doors and frames. There are also two metal man doors in metal frames for the Screening Building that were found to be in poor condition due to corrosion of the doors and frames. A budget to replace these doors has been provided in Year 2 of the Capital Expenditure Table.

3. The overhead and sliding bay doors in the Receiving and Curing buildings appeared in fair to good repair. It is anticipated that only routine maintenance, such as replacement of chains, switches, tracks and other hardware, should be required during the investment horizon of this study for these doors. A maintenance allowance for repairs has been provided in Years 3-5 of the Capital Expenditure Table. The sliding bay doors in the Screening Building are in fair to poor repair and will require replacement as part of the Screening Building replacement. The cost for two new overhead doors is included in the budget for the Screening Building replacement referenced in Section 2.6.1 above.

2.7 Roofing

General Description and Condition:

The roof for the Receiving Building is a low slope peaked roof and consists of pre-finished metal roof cladding with fibreglass insulation and reinforced vinyl vapour barrier, supported by steel trusses and steel channels. The current roofing system was reported to be the original for this building. The roof inspection was conducted from ground level inside the building and from an aerial lift on the exterior of the building. It was reported by New Era representative that there have been no previous leaks in the roof system. There were no signs of historical or active leaks noted with the roof system during our site visit.

The roofs for the Curing and Screening buildings are dome or arch type roof/wall systems and are comprised of the stressed fabric covering attached to the steel trusses as described in Section 2.6.1 above.

Observations and Recommendations:

1. The roof for the Receiving Building appeared in fair to good repair at the time of our site visit. There was no visible corrosion on the surface of the standing seam metal panels and there were no signs or reports of active or historical roof leaks. It is anticipated the roofing for this building will only require routine maintenance during the investment horizon of this study.

2. Damage to the roof insulation was noted in localized areas of the Receiving Building, particularly in the southwest corner. It was reported by New Era that this insulation was damaged due to a rodent infestation experienced at the facility a number of years ago. The damaged insulation should be repaired as part of regular building maintenance.

3. The roof/walls of the Curing Building were installed new in 2012 and were noted to be in good repair.

4. As discussed in detail in Section 2.6.1 the stressed fabric walls/roofing for the Screening Building is in various stages of disrepair and will require replacement. A budget for the work has been carried in Year 2 of the Capital Expenditure Table.

2.8 Electrical and Mechanical Systems

The building's electrical and mechanical systems were visually examined, where possible, during a walkthrough inspection. The system components were randomly reviewed to assess their overall condition. Information concerning capacity, adequacy, efficiency and condition of the electrical and mechanical systems, where possible, was obtained through interviews with the service contractors, tenants and owners or their representatives and review of available maintenance and service records.

2.81 Electrical Systems

General Description and Condition:

Main Service:	The main electrical entrance is located in the main electrical room in the office area and is rated to provide 2000 Amps at 600 Volts. There are also two separate electrical rooms for the Curing and Screening Buildings, which are located in small, concrete block, exterior sheds located adjacent to these buildings and contain motor control centers (MCC) and fan distribution (VFD) panels.
Metering:	Power use is metered in the main electrical room.
Distribution:	Power is distributed to local panels located throughout the building via typical switchgear. Distribution panels are located in the main electrical room and the electrical sheds.
Interior Lighting:	Fluorescent lighting fixtures and metal halide lamps provide the general interior lighting for the buildings on site.
Exterior Lighting:	Wall-mounted HID lamps and pole mounted lamps provide the exterior lighting. It should be noted that the efficacy of the exterior lighting could not be verified as the assessment was carried out during daylight hours.

Observations and Recommendations:

1. No major deficiencies were noted or reported that would suggest any problem with the electrical systems or lighting systems.

2. Several of the lamps in the Screening Building were noted to have impact damage and missing fixtures. These lights should be repaired as part of regular building maintenance.

3. An electrical panel maintenance inspection utilizing an infrared thermal imaging camera was conducted by Ainsworth Inc. (Ainsworth) in January of 2012. The inspection report was provided to CRA by New Era and was reviewed. The inspection report included the main electrical entrance switch, main distribution

panel, all main electrical room panels, VFD's, MCC Panel for lighting and all panels in the exterior electrical sheds. There were no problems found during the inspection as per the report.

2.8.2 Heating, Ventilating and Air-Conditioning (HVAC)

General Description and Condition:

Heating:	The office area of the Receiving Building is heated by an electric fired HVAC unit, with supplemental heat being provided by electric baseboard heaters.
Cooling:	The office area of the Receiving Building is cooled by the electric fired HVAC unit.
Ventilation:	Ventilation for the Receiving Building is provided by the above mentioned HVAC unit and two exhaust units in the process area. There are 6 exhaust fans for the Curing Building that provide ventilation for that building and ventilation in the Screening Building is through natural air movement by opening doors and louvre vents in each end of the building.

Observations and Recommendations:

1. The exhaust units for the process area of the Receiving Building and the Curing Building appeared in good repair at the time of our site visit and no operating problems were reported. The exhaust units are inspected internally by New Era on a regular schedule through a preventative maintenance program and defective parts are replaced as required as part of regular building maintenance. The most recent servicing and repair work orders were provided by New Era for our review as part of this current study. According to the work orders reviewed several of the exhaust units had upgrades to the motors between 2011 and 2013. It is anticipated that only similar type repairs will be required for these fans, as part of regular building maintenance, during the investment horizon of this study.

2. The HVAC unit that services the office area is reported to be original to the building and thus is 17 years of age. Typically, HVAC units have an expected useful life (EUL) of 20 years provided they are regularly maintained and serviced. Therefore, the HVAC unit is approaching the end of its EUL and will require replacement within the next 3-5 years. It was also reported by New Era representatives that recent air quality testing has indicated that the existing unit may not be sized properly to maintain proper air quality for the office space, which has been renovated with additional walls and rooms since the original installation of the HVAC unit. The New Era representative also indicated that they are planning to replace the existing 6-ton HVAC unit with a larger 10-ton unit and upgrade interior ducting and controls during the HVAC replacement to meet air quality standards in the office space. Review of air quality test results were not part of the scope of this current mandate and therefore were not requested for review. However, given this information and the fact that the existing HVAC unit is nearing the end of its EUL a budget for a replacement of the existing unit has been provided in Year 4 of the Capital Expenditure Table. The attached costing assumes a 10-ton unit and includes an allowance for upgrading interior ducting and controls.

2.9 Fire Protection and Alarm Systems

General Description and Condition:

Sprinkler Systems: There is no sprinkler system for any of the buildings at this site.

Fire Alarm Systems: There is a smoke sensor in the office area of the Receiving Building that is wired in through the security alarm for the building. The alarm is monitored off-site 24 hrs/day.

Emergency Lighting: There is emergency lighting located throughout the building.

Observations and Recommendations:

1. This report did not include a review of the Fire Codes or compliance of the property to these codes. Only code issues that were reported are presented in this report.

2. All emergency lighting units and illuminated exit signs appeared in good working order at the time of our site visit.

Section 3.0 Closure

We trust that this report meets your present requirements. Please do not hesitate to contact us, if any questions arise.

Original signed by

Mike Gallahue, P.Eng.

Original signed by

Tim Morrison, P. Eng.

Original signed by

Matthew Mittrovich, P. Eng.

Appendix A

Selected Photographs

PHOTO 1 - SOUTH ELEVATION OF OFFICE AND RECEIVING BUILDING

PHOTO 2 - GENERAL OVERVIEW OF CURING BUILDING

PHOTOGRAPHIC LOG
BUILDING ASSESSMENT
COMPOSTING FACILITY - NEW ERA TECHNOLOGIES
61 Evergreen Place, Goodwood, Nova Scotia

CRA

PHOTO 3 - GENERAL OVERVIEW OF SCREENING BUILDING

PHOTO 4 - GENERAL OVERVIEW OF ROOF OF RECEIVING BUILDING

PHOTOGRAPHIC LOG
BUILDING ASSESSMENT
COMPOSTING FACILITY - NEW ERA TECHNOLOGIES
61 Evergreen Place, Goodwood, Nova Scotia

PHOTO 5 - INTERIOR OF RECEIVING AREA

PHOTO 6 - CORROSION OF METAL MAN DOOR AND FRAME IN RECEIVING BUILDING

PHOTOGRAPHIC LOG
BUILDING ASSESSMENT
COMPOSTING FACILITY - NEW ERA TECHNOLOGIES
61 Evergreen Place, Goodwood, Nova Scotia

PHOTO 7 - AREA ALONG EAST ELEVATION WHERE SIDING HAS COMPLETELY CORRODED IN AREAS ADJACENT TO WALL GIRTS AND HAS BEEN PINNED

PHOTO 8 - AREA IN SOUTHWEST CORNER WHERE SIDING HAD PREVIOUSLY BLOWN OFF AND HAS BEEN TEMPORARILIY PUT BACK IN PLACE USING PINS

PHOTOGRAPHIC LOG
BUILDING ASSESSMENT
COMPOSTING FACILITY - NEW ERA TECHNOLOGIES
61 Evergreen Place, Goodwood, Nova Scotia

PHOTO 9 - INTERIOR OF SOUTHWEST CORNER WHERE METAL SIDING THAT PREVIOUSLY BLEW OFF HAS BEEN TEMPORARILY PUT BACK IN PLACE WITH PINS

PHOTO 10 - TYPICAL CORROSION OF METAL SIDING IN AREAS ADJACENT TO WALL GIRTS

PHOTOGRAPHIC LOG
BUILDING ASSESSMENT
COMPOSTING FACILITY - NEW ERA TECHNOLOGIES
61 Evergreen Place, Goodwood, Nova Scotia

CRA

PHOTO 11 - RECEIVING BUILDING-BASE PLATE AND ANCHOR ROD CORROSION AND STEEL DELAMINATION AT GRIDLINE H1

PHOTO 12 - RECEIVING BUILDING-GIRT CORROSION DAMAGE AND LOSS OF SECTION

PHOTOGRAPHIC LOG
BUILDING ASSESSMENT
COMPOSTING FACILITY - NEW ERA TECHNOLOGIES
61 Evergreen Place, Goodwood, Nova Scotia

PHOTO 13 - RECEIVING BUILDING-MISSING X-BRACING IN BOTTOM HALF OF BRACED BAY

PHOTO 14 - RECEIVING BUILDING - TYPICAL ROOF INSULATION DAMAGE DUE TO PREVIOUS RODENT PROBLEMS

PHOTOGRAPHIC LOG
BUILDING ASSESSMENT
COMPOSTING FACILITY - NEW ERA TECHNOLOGIES
61 Evergreen Place, Goodwood, Nova Scotia

PHOTO 15 - RECEIVING BUILDING-TYPICAL BASE ANGLE CORROSION AND LOSS OF SECTION

PHOTO 16 - INTERIOR OF CURING BUILDING

PHOTOGRAPHIC LOG
BUILDING ASSESSMENT
COMPOSTING FACILITY - NEW ERA TECHNOLOGIES
61 Evergreen Place, Goodwood, Nova Scotia

PHOTO 17 - CURING BUILDING-ROUGHENED SURFACE INDICATIVE OF SURFACE CORROSION EXPOSED BENEATH ACCUMULATED ORGANIC MATERIAL

PHOTO 18 - CURING BUILDING-TYPICAL CORROSION ON TURNBUCKLE

PHOTOGRAPHIC LOG
BUILDING ASSESSMENT
COMPOSTING FACILITY - NEW ERA TECHNOLOGIES
61 Evergreen Place, Goodwood, Nova Scotia

PHOTO 19 - CURING BUILDING-TYPICAL ORGANIC MATERIAL ACCUMULATION

PHOTO 20 - INTERIOR OF SCREENING BUILDING

PHOTOGRAPHIC LOG
BUILDING ASSESSMENT
COMPOSTING FACILITY - NEW ERA TECHNOLOGIES
61 Evergreen Place, Goodwood, Nova Scotia

PHOTO 21 - TYPICAL CONDITION OF SCREENING BUILDING FABRIC COVERING

PHOTO 22 - TYPICAL INTERIOR OF FABRIC WALLS OF SCREENING BUILDING

PHOTOGRAPHIC LOG
BUILDING ASSESSMENT
COMPOSTING FACILITY - NEW ERA TECHNOLOGIES
61 Evergreen Place, Goodwood, Nova Scotia

PHOTO 23 - TYPICAL TEAR IN ROOF FABRIC NEAR TRUSS

PHOTO 24 - HOLE IN FABRIC ROOF COVERING OF SCREENING BUILDING

PHOTOGRAPHIC LOG
BUILDING ASSESSMENT
COMPOSTING FACILITY - NEW ERA TECHNOLOGIES
61 Evergreen Place, Goodwood, Nova Scotia

PHOTO 25 - TYPICAL CORROSION OF MAN DOORS AND FRAMES IN SCREENING BUILDING

PHOTO 26 - TYPICAL CONDITION OF CONCRETE FLOOR IN AREA ADJACENT TO SCREENING EQUIPMENT

PHOTOGRAPHIC LOG
BUILDING ASSESSMENT
COMPOSTING FACILITY - NEW ERA TECHNOLOGIES
61 Evergreen Place, Goodwood, Nova Scotia

PHOTO 27 - SCREENING BUILDING-DAMAGE TO BOTTOM CHORD OF 6TH TRUSS FROM NORTH AT WEST END NEAR THE SUPPORT

PHOTO 28 - SCREENING BUILDING-EPOXY PAINT CRACKED AND FLAKED OFF EXPOSING GALVANIZED STEEL WITH LOCALIZED AREAS OF CORROSION

PHOTOGRAPHIC LOG
BUILDING ASSESSMENT
COMPOSTING FACILITY - NEW ERA TECHNOLOGIES
61 Evergreen Place, Goodwood, Nova Scotia

Appendix B

Capital Expenditure Table

CAPITAL EXPENDITURE TABLE - DETAILS

61 Evergreen Place, Goodwood, NS

Reference: 071855-01

Item No.	Item	Condition	Estimated Capital Expenditures – Investment Horizon 2015 Year 1	2016 Year 2	2017 Year 3	2018 Year 4	2019 Year 5	Total Cost Years 1 to 5
2.5	**Building Structure**							
	Foundation Walls							$0
	Frame	Replacement of corroded girts in Receiving Building	$15,000					$15,000
		General Repairs for Receiving Building including: Base plate corrosion protection repair, replacement of base angle for metal siding attachment to foundation wall, replace bracing that has been removed and replacement of door jambs.	$20,000					$20,000
		Corrosion protection for all new trusses in new Screening Building		$60,000				$60,000
		Corrosion protection for all existing trusses in Curing Building	$74,000					$74,000
		Additional Study to confirm wall thickness of HSS members prior to corrosion protection repairs.	$12,000					$12,000
	Slab-on-Grade	Replace section of slab in the Screening Building			$100,000			$100,000
2.6	**Building Envelope**							
	Exterior Walls	Replace metal cladding for Receiving Building	$105,000					$105,000
		Replace Screening Building with new fabric building complete with trusses. Existing concrete foundations to remain.		$270,000				$270,000
	Windows and Doors	Replace 4 man doors and frames		$4,000				$4,000
	Overhead Doors	Maintenance allowance for overhead doors			$2,500	$2,500	$2,500	$7,500
2.7	**Roofing**							
								$0
2.8	**Electrical and Mechanical Systems**							
	Electrical							$0
	Mechanical	Replace HVAC unit for Office area and conduct proposed upgrades to interior ductwork				$30,000		$30,000
2.9	**Life Safety, Fire Protection Systems**							
	Fire Suppression Systems							$0
	Emergency Lighting							$0
		TOTALS	$226,000	$334,000	$102,500	$32,500	$2,500	**$697,500**

Appendix C

Glossary of Selected Terms

BUILDING SCIENCES

SELECTED GLOSSARY OF TERMS

Acoustical sealant: a sealant with acoustical properties used to seal joints in the construction of sound rated ceramic tile installations.
Alligator cracking: a series of inter-connecting cracks on an asphalt surface caused by failure of the asphalt under repeated traffic loading.

Backer rod: bar used to seal wide gaps and joints before caulk is applied, reducing unwanted air leakage.
Baluster: the small vertical supports in a balustrade.
Balustrade: a railing consisting of balusters and a top rail.
Baseboard: trim placed at the join of the floor and wall planes.
Batten: a continuous piece of square-sawn lumber to which sheet metal panels can be attached; also, a wood or metal covering strip, to conceal joints from view and from the weather.
Bearing plate: a flat plate, intended to spread load from a column to the foundation, to provide for fastening and to permit levelling of the column base.
Bleeding: the extrusion of adhesive, cement paste, creosote, or resins from building components.
Blisters: small rounded or elongated raised areas of roof membrane which are filled with air.
Bridging: blocking between joists used to distribute loads and stiffen frames.
Brick veneer: a facing of brick laid against a structural wall but not bonded to the wall and which bears no load other than its own weight.
Buckle: in structural terms, failure by deflection.
Bowing: longitudinal deflection of a piece of lumber, pipe, rod, or the like, usually measured at its center.

Caulk: to seal joints or cracks with a mastic material.
Camber: the upward curve of a surface or beam, usually invoked to offset deflection or induce drainage.
Casing; wood trim around doors and windows.
Chalking: oxidation of paint over time due to weather.
Cladding: a non-load-bearing skin forming an exterior wall.
Clear span: horizontal unsupported distance between bearings.
Control joints: see Expansion joints.
Compression: the state of being pressed or condensed by forces.
Condensation: the formation of water out of moisture vapour because of reduced temperature.
Conduit: a metal or plastic tube that allows wires to be threaded through construction systems.
Corrugate: to bend sheet material into a series of parallel folds to produce a regular pattern of furrows and ridges.
Course: a horizontal row of masonry units.
Creep: deformation of a material under stress.
Crazing: fine, random cracks or fissures caused by the shrinkage which may appear in a surface of plaster, cement paste, mortar, or concrete.
Cribbing: an assembly of heavy wooden members to retain earth.
Cutout: a piece removed to create a small opening.
Curtain wall: a non-load-bearing envelope wall hung on the external structural frame of a building.
Curing: maintenance of humidity and temperature of the freshly placed mortar or grout during some definite period following the placing or finishing, to assure satisfactory hydration.

Damp-proofing: the exclusion of water in its vapourized form.
Decking: system used to form a wood or metal horizontal platform.
Defect: a natural or machining fault that detracts from the serviceability or appearance of a piece of material.
Deflection: downward displacement of a beam or truss because of loading.
Delamination: the separation of layers of glued or bonded materials.
Dry rot: a type of wood decay caused by a fungus.
Durability: characteristics of materials that determines how long they will last under expected conditions of service.

Efflorescence: a powdery gray-white salt residue brought to the surface of masonry by the action of moisture.
Esthetic (aesthetic): having primarily to do with appearance.
Expansion joint: a location where construction systems are interrupted to permit movement of the building.
Epoxy adhesive: an adhesive system employing epoxy hardener portions.

BUILDING SCIENCES

SELECTED GLOSSARY OF TERMS

Face: the surface exposed to view.
Fieldstone: naturally occurring uncut blocks of stone.
Flagstone: large, thin, irregularly shaped pieces of slate or shale laid flat as paving stones.
Flange: the peripheral plates along the outermost edges of the central web of a steel beam.
Flashing, base: that part of the flashing system that connects the horizontal roof or waterproof membrane to the adjacent vertical wall or parapet.
Flashing, cap: a continuous piece of metal, snapped on to complete a weatherproof system at edges, ridges, or expansion joints in roof system.
Flue: a (usually) vertical duct or vent for hot gasses and smoke.
Flush: two components having surfaces lying within one plane.
Frieze: a decorative horizontal band on a building surface.

Gable: the upper triangle area formed by the sloping roof at the end of a building.
Girder: a horizontal or slightly inclined main beam.
Glazing : the process of securing glass panels into prepared door or window frames.
Grade beam: a horizontal foundation that transmits loads to vertical piles.
Grout: a mixture of cement, fine sand and water used to fill minor voids in concrete or masonry work.

Hanger: a metal or plastic device used to suspend building components.
Header: a masonry unit laid horizontally with its length perpendicular to the wall plane; also, the horizontal frame member at the top of an opening.
Heave: The localized upward bulging of the ground due to expansion or displacement caused by phenomena, such as frost or moisture absorption. May also occur due to the production of secondary sulphate based by-products due to the oxidation of pyrite present in granular fill.
HVAC: heating, ventilation, air-conditioning.

Insulation: any material that will not easily conduct energy in the form of heat, sound or electricity.

Jamb: the vertical side of any opening.
Joint: the point of contact between two components.
Joist: horizontal structural member supporting decks and floors.

Laminate: to apply a thin layer on the top of another.
Landing: an intermediate rest platform in a flight of stairs.
Lintel: a horizontal member used to distribute forces above an opening.
Longitudinal crack: a crack in asphalt surface that runs parallel to the “laydown” direction.
Louver: a slatted ventilation opening.

Mastic: oil-or cement-based paste used to fill minor holes and cracks in buildings.
Membrane: a thin pliable sheet or layer of (usually waterproof) material used as a liner in parts of buildings.
Mildew: a whitish fungal coating, often appearing on damp paper or plaster surface.
Molding: trim or ornamental cover.

Offset: a change in vertical plane.
Overhang: the distance a joist or chord extends beyond the bearing point.

Panel: a flat board, plate or pane inserted into a frame.
Parapet: a low wall projecting above the roof level.
Parging: a single application of masonry cement used to cover minor blemishes in concrete or masonry walls; also used to line brick chimney vents.
Parquet: small wood block flooring laid in basket-weave or other mosaic patterns.
Partition: a non-load bearing wall separating two areas of a building.
Peeling: the separation of adhesive from glued surfaces.
Permeability: ability to permit (or resist) the passage of water.
Pier: a vertical portion of wall between openings, also a free-standing short or stubby column.

BUILDING SCIENCES

SELECTED GLOSSARY OF TERMS

Pitch: slope or angle.
Plumb: vertical.
Ponding: the accumulation of water in low areas of nominally flat roof decks or paved areas.
Popping: the loosening of cover over concealed nail heads caused by thermal or moisture movement in framing.
Porous: a surface permeable by water or air.
Potholes: bowl shaped holes of various sized in an asphalt surface.
Precast unit: concrete formed, poured and cured in a location other than its final location.
Pyrite: a widespread iron sulphide mineral often associated with heaving and sulfatation of concrete due to the formation of sulphate based secondary by-products, on oxidation.

Ramp: an inclined plane.
Ridge: the uppermost edge of a roof plane; the upper apex between two adjoining roof planes.
Riser: the vertical component of a step, intended to prevent the feel from slipping beyond the tread.
Rout: to gouge with a cutting tool.

Scaling: pitting of surfaces after repeated exposure to freezing and thawing.
Sealants: products used to seal joints that have been packed with weatherproof materials.
Sealers: waterproof products used to coat or prepare surfaces or areas to inhibit moisture penetration.
Shear: the tendency of forces to cause a transverse fracture across a member.
Sheathing: usually rough wood or plywood boarding used to enclose a space and impart structural integrity to a wood or metal frames, such as a floor wall or roof.
Siding: overlapping long, narrow and thin boards of wood or metal attached horizontally or vertically to the outside of buildings to improve weather protection and appearance.
Sill: the lowest horizontal part of any opening through the wall.
Soffit: the exposed underside of any building surface.
Spalling: breaking away of surface in flakes or chunks.
Splits: tears that extend through roof membrane layers.
Step crack: a pattern of cracks in brick or concrete block veneer, often following mortar joints, which form as a result of foundation settlements.
Storey: the usable portion of a building between one floor and the one above it.
Strength: the characteristic of a material that determines its ability to resist or impart forces.
Substrate: the surface beneath a finishing layer or coating.

Tension: forces tending to stretch or elongate an object.
Terrazzo: a mixture of cement paste and marble chips, ground and polished after curing.
Thermographic scan: an infrared survey carried out on a roof system to determine areas of heat loss and potential roof leaks.
Threshold: see sill.
Topping: a thin layer of fine concrete laid on top of and bonded to a thicker substrate of structural concrete.
Transverse crack: a crack in an asphalt surface that runs across (perpendicular or diagonal to) the “laydown” direction.
Tread: the horizontal component of a step.
Trim: long, narrow strips of shaped and finished wood, metal, or plastic used to conceal joints of building components.
Truss: a structural frame, usually part of a roof structure.

Valley: the line where two inclined planes of a roof surface meet and to which water will be directed.
Vapor Barrier: material used to prevent the passage of vapour or moisture into a structure or another material, thus preventing condensation within them.
Veneer: a thin layer of wood, masonry, or metal applied for primarily cosmetic effect.

Warp: a significant and unwanted deviation from an intended true plane.
Waterproofing: the exclusion of water in its liquid form.
Web: the central vertical plate between outer beam flanges.
Weep holes: small spaces left in mortar joints or concrete walls to permit moisture escape.
Wythe: in masonry, width, usually the width of one brick, as is a wall or veneer one wythe thick.

ATTACHMENT H

CONESTOGA-ROVERS & ASSOCIATES

www.CRAworld.com

Final

Building Assessment

Composting Facility – Miller Waste
80 Gloria McCluskey Avenue
Dartmouth, Nova Scotia

Prepared for: Halifax Regional Municipality

Conestoga-Rovers & Associates
45 Akerley Boulevard
Dartmouth, NS B3B 1J7

May 2015 • 071855-01 • Report No. 2

Partners in Sustainability

Executive Summary

The services of Conestoga-Rovers & Associates (CRA) were retained by the Halifax Regional Municipality (HRM) to provide an engineering assessment of the structure, exterior building envelope, mechanical/electrical systems, life support systems and the roofs for the composting facility located at 80 Gloria McCluskey Avenue in Dartmouth, Nova Scotia (Property or Facility). The Facility is currently occupied and operated by Miller Waste Systems Inc. (Miller) and processes organic materials collected by residential and commercial haulers.

The compost facility at this site consists of one building split into three sections consisting of a Receiving Area, Vessel Area and Curing Area. The building is a combination of steel frame (Receiving Area and Vessel Area) and pre-cast tilt-up concrete panel (Curing Area) construction and was constructed in 1998.

Overall, the Facility was found to be in fair condition with localized repairs and maintenance required. The total cost to maintain the facility over the five year investment horizon of the study is $491,000 as detailed in the Capital Expenditure Table located in Appendix B. It is CRA's opinion, that with continued regular maintenance (such as the repairs recommended in this report) and no substantial change in the use of the Facility, the building should have an estimated Remaining Useful Life (RUL) of 10-15 years.

The following actions are required immediately:

- None.

The following actions will be required over the five year investment horizon of this study:

- Generally, the structural steel framing of the vessel area was found to be in fair to poor repair. The epoxy paint system has failed on the main frames and a roughened surface, indicative of surface corrosion was exposed beneath the failed epoxy paint. It is recommended to replace the failed epoxy paint system to ensure no further corrosion of the main frame structural steel.
- All girts on the south wall of the vessel area, totaling approximately 70, are recommended to be replaced due to surface corrosion and section loss that was observed on all accessible girts that were reviewed. A budget for this work has been included in Year 2 of the Capital Expenditure Table.
- It is recommended that the existing main frame structural steel and the new girts be protected with a corrosion control product such as Stayflex® due to the harsh environmental conditions in the building. This system has had several case studies specific to the environments of composting facilities with good results in obtaining the maximum EUL of the structure. A budget for installing corrosion protection on the existing main frames has been included

in Year 1 of the Capital Expenditure Table. An additional study has also been recommended below to verify that the plate thickness of the main frame members has not been compromised due to the corrosion, prior to the installation of the corrosion control product. The cost for installing the corrosion protection on the newly installed girts is included in the overall replacement budget for the girts, referenced above and provided in Year 2 of the Capital Expenditure Table.

- Generally, the structural steel framing of the Curing Area was found to be in fair repair. At the time of inspection, steel trusses and the underside of the roof deck varied from dry near the north wall to wet near the south wall. Surface corrosion was present but no significant section loss was observed. However, due to the harsh environmental conditions the trusses are subject to, it is recommended that the steel trusses be monitored every three years to confirm that section loss has not occurred. A budget for the additional monitoring has been included in years 2 and 5 of the Capital Expenditure Table.
- The concrete slab in the Receiving Area is in poor repair with aggregate and rebar showing in localized sections. The concrete floor in the west end of the Vessel Area is also in poor repair with aggregate showing in localized sections. Both of these slabs are exposed to corrosive leachate on a daily basis and constant scraping with the loader bucket as part of the composting operations. Both of these sections of concrete floor should be replaced. A budget to conduct this work has been included in Years 1 and 2 of the Capital Expenditure Table.
- The concrete slabs in the north and south aisles of the Vessel Area are in various stages of disrepair due to the constant presence of leachate in these areas. These slabs should be replaced during the investment horizon of this study and as such replacement budgets have been provided in Years 3 and 5 of the Capital Expenditure Table.
- The two man doors and frames along the south elevation of the Vessel Area and the door and frame near the sprinkler room along the north elevation are in poor repair due to corrosion and require replacement. A budget to conduct this work has been provided in Year 2 of the Capital Expenditure Table.
- The overhead doors appeared in fair to good repair at the time of our site visit. The latest preventative maintenance inspection report prepared by The Garage Depot indicated minor deficiencies with the doors that will require maintenance during the investment horizon of this study. A maintenance budget to conduct anticipated repairs to these doors has been included in Years 3 through 5 of the Capital Expenditure Table.

- The sprinkler system was last tested and serviced on April 22, 2014. The latest sprinkler inspection report did indicate several minor deficiencies, which should be corrected as part of regular building maintenance.

The following additional investigations are recommended:

- It is recommended to verify the existing main frame plate thicknesses through ultrasonic thickness (UT) measurements prior to the application of any corrosion control product on the main frames in the Vessel Area. This will ensure the plate thickness has not been compromised from the corrosion and that spot repairs are not required prior to application of the corrosion protection product. A budget for this additional study has been included in Year 1 of the Capital Expenditure Table.

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List of Appendices

Section 1.0 Introduction

1.1 Scope of Work

The services of Conestoga-Rovers & Associates (CRA) were retained by the Halifax Regional Municipality (HRM) to provide an engineering assessment of the structure, exterior building envelope, mechanical/electrical systems, life support systems and the roof for the composting facility located at 80 Gloria McCluskey Avenue in Dartmouth, Nova Scotia (Property or Facility). As part of the work, CRA has provided upgrade/repair options which could be required over the next five years to improve the condition of the Facility and extend the life for another 10-15 years. The scope of work included the assessment of the building structure, roof, exterior siding and flashing, windows, exterior doors, electrical/mechanical systems and life support systems. Rough order-of-magnitude cost estimates have also been provided for all upgrade/repair construction options proposed.

The particular physical components of the Property which are addressed in this assessment are as follows:

Building Structure:

- Foundations, Structural Steel Frame
- Slab-on-Grade

Building Envelope:

- Exterior Walls
- Windows, Doors, Loading Docks and Overhead Doors
- Roofing Systems, visible Waterproofing Membranes and Flashing Details

Electrical and Mechanical Systems:

- Main Heating and Ventilation Systems
- Electrical (Service Entry, Distribution Panels and Lighting Systems)

Fire Protection and Alarm Systems:

- Fire Suppression Systems (Sprinklers, Extinguishers and Hose Cabinets)
- Fire Alarm Systems (Alarm Panel, Flow Detectors)

1.2 Definition of Terms

The following terms and their respective definitions are used to describe the condition of the building systems:

Excellent:	The system or equipment was found to be in new or nearly new condition with no deficiencies or damages.
Good:	The system or equipment was found to be in satisfactory condition with no recommendations for repairs or improvements.
Fair:	The system or equipment was found to be in satisfactory condition with recommendations to correct minor deficiencies. May indicate that immediate attention is required to minor deficiencies.
Poor:	The system or equipment was found to be in unsatisfactory condition and must be replaced or repaired in the short term.

The following terms are commonly used in a Building Condition Assessment to describe the state of the building and the appropriate maintenance strategies for the required repairs:

Walkthrough Investigation	Non-intrusive, visual observations of the subject Property, survey of readily accessible, easily visible components and systems of the subject Property. A walkthrough investigation is not technically exhaustive, and excludes concealed physical deficiencies and other Out of Scope Issues. Observations of the building (exterior and interior) are limited to vantage points that are on-grade, from readily accessible balconies, rooftops, platforms, etc.
Remaining Useful Life (RUL)	A subjective estimate of the number of remaining years that an item, component or system will be able to function in accordance with its intended purpose before warranting replacement.
Expected Useful Life (EUL)	The average amount of time in years that an item, component or system is estimated to function when installed new and assuming routine maintenance is practised.
Immediate Costs	Costs that will be incurred due to 1) existing or potential unsafe conditions, 2) fire hazards, 3) condition that, if left un-remedied,

	can result in a critical failure of a system within one year, or result in a significant escalation of remedial costs.
Capital Expenditures	Future budgetary recommendations for items, components or systems based on their respective Remaining Useful Life (RUL).
Regular Building Maintenance	Maintenance that can be carried out by building staff without requiring specialised sub-contractors, equipment, or any significant interruptions to the building's use. These items will generally be of minor expense, and can often be carried out in phases over long periods of time.

Definitions of additional selected Building Science and maintenance terms can be found in the "*Glossary of Selected Terms"* included in Appendix C.

1.3 Cost Estimates

The estimated costs associated with the deficiencies and conditions reported herein are presented in the Capital Expenditure Tables, included in the appendices. The term "Capital Expenditure" as it pertains to the Capital Expenditure Tables, means the cost to replace defective elements of the building or to fully repair the deficient elements within a given building system at a specified point during the investment horizon.

Items that are deemed to be deficient, but not significant in terms of importance, cost or their effect on the overall building condition will be considered to lie within the scope of regular building maintenance.

Cost estimates for repairs and system replacements presented in this report are not derived from quantity surveys or detailed engineering calculations. The costs and unit rates provided are based on the following information sources:

- Our experience with contractors specialising in the fields in question
- Direct inquiries to service contractors involved with the Property
- Industry-accepted costing tools including, but not limited to, "Hanscomb's Yardsticks for Costing - Cost Data for the Canadian Construction Industry", published by the R.S. Means Company

These estimates are intended only for global budgeting purposes; they should be used as a guide only, as costs may vary according to the time of year, quality of materials used, volume of work, actual observed conditions, etc. Note that the estimates do not include applicable taxes.

Section 2.0 Level I Property Condition Assessment

2.1 Capital Expenditure Parameters

Rough order-of-magnitude cost estimates have been provided, in the Capital Expenditure Table included in Appendix B, for all upgrade/repair construction options proposed. For the purpose of this report, any item having a cost estimate of less than $2,000.00 will be considered to be within the scope of regular building maintenance, as defined in Section 1.2. With respect to the Capital Expenditure Table provided in Appendix B, the recommended repairs will be scheduled appropriately over a five year period. All of the prices quoted are in Canadian (year 2015) dollars.

2.2 Procedures and Conditions

All of the reasonably accessible areas were examined during the assessment of the Property. Selected photographs are enclosed in Appendix A.

Our mandate did not include non-destructive or destructive testing, opening of roofing systems, wall assemblies or other enclosures, or testing of mechanical, electrical or life-safety systems. The assessment of the mechanical and electrical systems was strictly visual to determine the type of system, age and visual condition. Operating conditions of the actual equipment were determined through a review of available logbooks, interviews with Property contacts and maintenance personnel. No physical testing or intrusive investigative techniques were used. A review of the National Building and Fire Codes or compliance of the Property to these codes was not completed. Only code issues that were reported, or were readily apparent during the “walkthrough” are indicated in this report. During the on-Site assessment, construction drawings (if available) were consulted strictly for the purpose of locating specific systems. No verification or analyses concerning design loads or design details was carried out.

The Site visit for this engineering assessment was conducted by, Mr. Mike Gallahue, P. Eng. and Mr. Matthew Mittrovich, P. Eng. of CRA on March 25, 2015, under clear skies and an average outdoor temperature of approximately 0^{o}C. Mr. Gallahue and Mr. Mittrovich were accompanied during the inspection by Mr. Sean Haggan of Miller. A second site visit by Mr. Gallahue to review the roof surface, which was covered in snow during the first visit, was conducted on May 19, 2015, under sunny skies and an average outdoor temperature of approximately 16 ^{o}C.

2.3 Site and Building Contacts

The following personnel were contacted during the investigation and research periods:

Person	Company	Position	Phone
Mr. Barry Nickerson	HRM	Waste Resources Engineer	902-490-7172
Mr. Sean Haggan	Miller Waste	Facility Manager	902-490-6640
Mr. Jeff Traver	Miller Waste	District Manager	902-468-3161

The following service contractors were identified during the Site visits and research periods:

Item	Service Contractor	Contact	Phone
Sprinkler System	Life Safety Systems	N/A – Inspection Report provided	902-468-7500
Overhead Doors	The Garage Door Depot	N/A – Inspection Report provided	902-482-0799
Fire Alarm	D & L Engineering Sales Ltd.	N/A – Inspection Report provided	902-429-3790
Mechanical	BJ Electric Motor & Control Ltd.	N/A – Service Reports provided	902-407-2277

2.4 Property Use

The property is currently occupied by Miller Waste as a composting facility to process streams of organic materials collected by the residential collection fleet and various commercial haulers and converting the material into compost. The compost facility at this site consists of one building split into three sections consisting of a Receiving Area, Vessel Area and Curing Area. The building is a combination of steel frame (Receiving Area and Vessel Area) and pre-cast tilt-up concrete panel (Curing Area) construction and was constructed in 1998.

2.5 Structure

General Description and Condition:

Foundations: The foundations for the building are poured in-place reinforced concrete and consist of spread footings for the perimeter walls and interior pier footings to support columns and interior partitions.

Frame: The building is a combination of clear span pre-engineered steel construction and steel roof trusses with tilt-up concrete wall panels. The pre-engineered portion comprises approximately 60% of the building in plan area. Main frames consist of tapered beams and columns with column bases anchored to piers that are raised above the finished floor. The roof is sloped at 1:12 with the ridge located at mid-span. The walls and roof are constructed of cold formed steel girts and purlins respectively and are exposed to the interior except where membrane systems have been installed. Membranes are present on both the walls and ceiling of the vessel area and on the ceiling of the receiving area. The steel truss portion approximately matches the pre-engineered portion in profile with a slightly lower eave. The steel trusses bear on tilt-up concrete wall panels and are composed primarily of angle and double angle members. The roof trusses have a membrane secured to the underside of the bottom chord in an effort to minimize humidity within the truss space.

Slab-on-Grade: There is a slab-on-grade over the entire building footprint. The slab-on-grade is generally a 6-inch thick reinforced slab except in the north and south aisles of the Vessel Area, which are 5-inch thick slabs and the recently re-poured east end of the Vessel Area which consists of a second 6 inch thick, lined, slab poured on top of the existing 6-inch slab. The slab for the perimeter of the Curing Area where composting material is stored is 12 inches thick because of a 6-inch thick wear slab in that area. The slab-on-grade was generally visible except in areas where organic materials were stored in piles (particularly in the Curing Area) as part of the composting process.

Observations and Recommendations:

1. No significant cracks or obvious deformations were noted in the structure or transferred to the interior finishes (including floors, walls and ceilings) that would indicate significant or ongoing structural movement. No serious, important or generalized defects that would imply a problem with groundwater or unstable soil conditions were noted.

2. Generally, the structural steel framing of the receiving area was found to be in fair repair. Steel frames, purlins, and girts in the Receiving Area were dry at the time of inspection. The epoxy paint system was intact on the vast majority of the receiving area structural steel. Small localized areas of surface corrosion were present where the epoxy paint system has failed. These locations were mostly on the main frame flanges, main frame braces and column bases. No loss of section was observed. Girts in this area were covered in a spray insulation. There was no evidence of corrosion bleeding through the insulation. Purlins in the Receiving Area are protected by a simple saver liner system which includes insulation and a vapour barrier between the steel and interior environment. The liner was opened and immediately repaired after observations were made. The cold formed z-shaped purlins were observed to be moist with galvanizing in good condition except at the edge of the flange where minor surface corrosion was present.

3. Generally, the structural steel framing of the Vessel Area was found to be in fair to poor repair. At the time of inspection, the environment was at a moderate temperature with high humidity that was evident with condensed moisture on all steel frames and membranes. Only the main frame steel is exposed on the interior whereas the purlins and girts are behind membranes. The majority of steel surfaces were covered in a thin layer of saturated organic material. The epoxy paint system has failed on the main frames. A thickened and bubbled surface was observed that could easily be peeled away. A roughened surface, indicative of surface corrosion was exposed beneath the failed epoxy paint. An investigation by Stantec in March of 2013 revealed that section loss due to corrosion was evident but minor in nature and did not warrant repairs or rehabilitation. Ultrasonic thickness (UT) measurements to measure the extent of section loss was beyond the scope of CRA's current mandate. However, the visual inspection did not reveal significant signs of section loss in the main frame structural steel at the time of the inspection. It is recommended to replace the failed epoxy paint system to ensure no further corrosion of the main frame structural steel. Girts on both side walls of the Vessel Area have been isolated by

a membrane installed on the interior of the building. Girts on the north side of the building were recently replaced in 2014 and as such, the membrane was not penetrated for observation. Girts on the south wall were accessible at a poorly fastened membrane location near the eave and by cutting two small penetrations near the bottom of the wall. Surface corrosion and section loss were observed on the accessible girts. All girts on the south wall of the Vessel Area, totaling approximately 70, are recommended to be replaced. A budget for this work has been included in Year 2 of the Capital Expenditure Table.

The harsh environmental conditions in the building warrants special measures for corrosion protection for both the existing main frame structural steel, which requires new corrosion protection to replace the failed epoxy paint system and for the recommended new girts on the south wall. It is recommended that the main frame structural steel and the new girts be protected with a corrosion control product such as Stayflex®. This system consists of two parts, the first of which is a spray on polyurethane foam insulation and assists in keeping the temperature of the steel above the dew point. The second is a spray on water vapour barrier isolating the steel from the humid environment. This system has had several case studies specific to the environments of composting facilities with good results in obtaining the maximum EUL of the structure. A budget for installing corrosion protection on the existing main frames has been included in Year 1 of the Capital Expenditure Table. The cost for installing the corrosion protection on the newly installed girts is included in the overall replacement budget for the girts, referenced above and provided in Year 2 of the Capital Expenditure Table. It is recommended to verify the existing main frame plate thicknesses through UT measurements prior to the application of any corrosion control product on the main frames. A budget for this additional study has been included in Year 1 of the Capital Expenditure Table.

4. Generally, the structural steel framing of the Curing Area was found to be in fair repair. At the time of inspection, the environment was at a moderate temperature with high humidity. A membrane has been installed on the interior side of the truss bottom chords. The membrane prevented access by boom lift however two small holes, one against the north wall and one against the south wall near the middle of the Curing Area, granted access to a camera for local observation near membrane holes. At the time of inspection, steel trusses and the underside of the roof deck varied from dry near the north wall to wet near the south wall. Surface corrosion was present and no section loss was observed. An investigation by Stantec in February of 2013 of the roof trusses indicated that

section loss due to corrosion was evident but only minor and did not represent a structural safety concern or warrant repairs/rehabilitation. However, due to the harsh environmental conditions the trusses are subject to, it is recommended that the steel trusses be monitored every three years to confirm that section loss has not occurred. In the event that monitoring concludes corrosion must be addressed, similar to the vessel area, it is recommended to apply a corrosion control product such as Stayflex®. A budget for the additional monitoring has been included in years 2 and 5 of the Capital Expenditure Table.

5. Generally, the slab on grade was in fair repair with typical shrinkage cracking noted and localized areas of impact damage due to the operation of the building. However, the concrete slab in the Receiving Area is in poor repair with aggregate and rebar showing in localized sections. The concrete floor in the west end of the Vessel Area is also in poor repair with aggregate showing in localized sections. Both of these slabs are exposed to corrosive leachate on a daily basis and constant scraping with the loader bucket as part of the composting operations. Both of these sections of concrete floor should be replaced. A budget to conduct this work has been included in Years 1 and 2 of the Capital Expenditure Table.

6. The concrete slabs in the north and south aisles of the Vessel Area are in various stages of disrepair due to the constant presence of leachate in these areas. The south aisle, which is exposed to more leachate due escaping leachate from the access doors located on the south side of the vessel, is in the worst condition with exposed aggregate noted in localized sections. These slabs should be replaced during the investment horizon of this study and as such replacement budgets have been provided in Years 3 and 5 of the Capital Expenditure Table.

2.6 Building Envelope

2.6.1 Exterior Walls

General Description and Condition:

The exterior walls of the building are comprised of a combination of pre-finished metal siding on steel framed walls with insulation (Receiving Area and Vessel Area) and pre-finished metal siding on 9-inch thick pre-cast concrete tilt-up wall panels (Curing Area). At the time of our visit to the Property, the exterior walls were generally found to be in fair to good condition with only minor impact damages noted.

Observations and Recommendations:

1. The exterior siding appeared in fair to good repair with only minor localized impact damages noted, which can be repaired as part of regular building maintenance. It is not anticipated the siding will require replacement during the investment horizon of this current assessment.

2. The wall at the junction of the high roof (Receiving and Vessel Area) and the low roof (Curing Area) was removed during the re-roof of the Curing Area roof and has not yet been re-installed. At the time of our site visit the wall was protected by Tyvek air barrier only, which is not a permanent solution for water tightness of the building envelope. Miller representatives indicated that new metal cladding will be installed on the wall within the next two months. Since this repair is already in Miller's budget for this year, no costing for this repair has been included in the Capital Expenditure Table for this assessment

2.6.2 Windows and Doors

General Description and Condition:

There is one window unit for this building. The unit is a double-pane, operable window in vinyl frame, which serves the mezzanine level. The unit appeared in fair repair at the time of our site visit.

There are metal man doors in metal frames located along the north and south elevations of the building that are used as entrances and emergency exits. Generally, the metal doors were found to be in poor condition.

There are six vinyl overhead doors for the building. The overhead doors are inspected on a regular basis by The Garage Depot as part of a preventative maintenance program. In general the overhead doors were found to be in fair to good condition.

Observations and Recommendations:

1. The two man doors and frames along the south elevation of the Vessel Area and the door and frame near the sprinkler room along the north elevation are in poor repair due to significant corrosion of the frames and lower portion of the doors. These will require replacement during the investment horizon of this current study. A budget to conduct this work has been provided in Year 2 of the Capital Expenditure Table.

2. The overhead doors appeared in fair to good repair at the time of our site visit. It was reported that the doors have been replaced since the original construction of the building. The latest preventative maintenance inspection report prepared by The Garage Depot was provided to CRA and reviewed as part of this current study. The report indicated minor deficiencies with the doors that will require maintenance during the investment horizon of this study. Suggested maintenance included replacement of tracks, lubing of bearings, replacement of chains, replacement of switches, replacement of wind bar rollers and replacement of safety edges. Some of the suggested maintenance items have already been completed per service records provided by Miller. However, a maintenance budget to conduct anticipated repairs to these doors has been included in Years 3 through 5 of the Capital Expenditure Table.

2.7 Roofing

General Description and Condition:

The roof is a low slope peaked roof and consists of a combination of pre-finished metal roof cladding with fibreglass insulation (Receiving and Vessel Areas) and a 2-ply modified bitumen membrane system (Curing Area). The metal clad roofing system was reported to be from the original construction while the modified bitumen roof system was installed new in 2012 to replace an existing EPDM (FleeceBack) roof membrane system. It was reported by Miller that a portion of the Curing Building roof blew off during a wind storm due to corrosion of the perimeter roof framing that allowed air to penetrate beneath the roof membrane system and cause a blow-off. As a result Miller decided to repair the perimeter framing, a portion of the steel decking and replace the existing EPDM (FleeceBack) roof with a 2-ply modified bitumen membrane roof system consisting of hot asphalt applied rigid insulation and a torched on membrane system. The roof inspection was conducted from ground level inside the building only during the March 25th visit due to significant snow load on the roof surface at the time of our site visit making a roof-top inspection unsafe. An additional site visit was conducted on May 19, 2015 to review the roof from the roof surface.

Observations and Recommendations:

1. The roof for the Receiving and Vessel areas showed no signs of active or historical roof leaks and no historical roof leaks were reported by Miller. No sign of corrosion of the roof panels was evident on the roof surface and it was noted that approximately 85% of the screws securing the metal roofing have been re-sealed with either a silicone or mastic based sealant. Metal roofing typically has an expected useful life (EUL) of 35-40 years provided it is maintained properly. It

is anticipated the metal roofing for this building will only require routine maintenance during the investment horizon of this study.

2. The roof for the Curing Area is only two years of age and showed no signs of active roof leaks and Miller reported that there have been no leaks since the new roof has been installed. The cap sheet membrane was examined at the surface for fishmouths, loose seams and de-granulation and was found to be in good repair. A 2-ply modified bitumen roof membrane system typically has an EUL of 20 years. If maintained properly during the 20 years a modified bitumen roof system also allows for a new cap sheet membrane to be installed on top of the existing cap sheet to extend the EUL of the roof system for another 10-15 years at a relatively low cost. Given, that the existing 2-ply system is only two years of age it is not anticipated the roofing for this area of the building will require any capital investment during the investment horizon of this study.

2.8 Electrical and Mechanical Systems

The building's electrical and mechanical systems were visually examined, where possible, during a walkthrough inspection. The system components were randomly reviewed to assess their overall condition. Information concerning capacity, adequacy, efficiency and condition of the electrical and mechanical systems, where possible, was obtained through interviews with the service contractors, tenants and owners or their representatives.

2.8.1 Electrical Systems

General Description and Condition:

Main Service: The main electrical entrance for the building is located in the main electrical room on the first floor in the Vessel Area and is rated to provide 1200 Amps at 600 Volts.

Metering: Power use is metered in the main electrical room.

Distribution: Power is distributed to local panels located throughout the building via typical switchgear.

Interior Lighting: Fluorescent lighting fixtures and metal halide lamps provide the general interior lighting.

Exterior Lighting: Wall-mounted HID lamps and pole mounted lamps provide the exterior lighting. It should be noted that the efficacy of the exterior lighting could not be verified as the assessment was carried out during daylight hours.

Observations and Recommendations:

1. No major deficiencies were noted or reported that would suggest any problems with the electrical systems or lighting systems.

2.8.2 Heating, Ventilating and Air-Conditioning (HVAC)

General Description and Condition:

Heating: The lab area located on the mezzanine level is heated by an electric HVAC unit, with supplemental heat being provided by electric baseboard heaters.

Cooling: The lab area is cooled by the electric HVAC unit.

Ventilation: Ventilation for the lab area is provided by the above mentioned HVAC unit and there are six ventilation fans for the remainder of the building.

Observations and Recommendations:

1. The roof-top HVAC unit for the lab area was installed in May of 2014. Typically, HVAC units have an expected useful life (EUL) of 20 years provided they are regularly maintained and serviced. Therefore, it is not anticipated that the HVAC unit will require any capital investment during the investment horizon of this current study.

2. The ventilation fans for the process area appeared in good repair at the time of our site visit and no operating problems were reported. The fans are inspected by BJ Electric Motor & Control Ltd. on a regular schedule through a preventative maintenance program and defective parts are replaced as required as part of regular building maintenance. The most recent inspection report, dated June 12, 2014, was provided by Miller for our review as part of this current study.

According to the inspection report only two of the fans were not functioning properly and required repairs. It was reported by Miller that both units have been re-built and are now working properly. It is anticipated that only routine maintenance and repairs will be required for these fans during the investment horizon of this study.

2.9 Fire Protection and Alarm Systems

General Description and Condition:

Sprinkler Systems: The building is 100% protected by a dry pipe sprinkler system. The system is controlled by a 4-inch dry pipe valve. The sprinkler system is serviced and tested yearly by Life Safety Systems. The sprinkler system is monitored for flow, tampering and pressure drop through a Cerberus Pyrotronics fire alarm panel located in the electrical room.

Fire-Extinguishers: The building is equipped with a standard supply of portable fire extinguishers located in utility rooms, common areas and hallways. The extinguishers are inspected yearly.

Emergency Lighting: There is emergency lighting located throughout the building.

Observations and Recommendations:

1. This report did not include a review of the Fire Codes or compliance of the property to these codes. Only code issues that were reported are presented in this report.

2. The sprinkler system was last tested and serviced on April 22, 2014. A copy of the sprinkler test report was provided to CRA for our review as part of this study. No major deficiencies with the sprinkler system were indicated in the inspection report. However, the sprinkler report did indicate several minor deficiencies such as storage too close to sprinkler heads, low fuel level in the diesel fire pump, additional protection required in localized areas and water motor not operating properly. These suggested improvements and repairs should be conducted as part of regular building maintenance.

3. In March of 2015 several corroded sprinkler heads were identified by Miller and Life Safety Systems were retained to replace the corroded heads. This repair work was confirmed through an invoice and work order from Life Safety Systems.

4. The Cerberus Pyrotronics fire alarm panel and associated siren alarms are inspected yearly and were last serviced and inspected in March of 2014 by D & L Engineering Sales Ltd. The inspection report was provided to CRA for our review as part of this study. No deficiencies with the fire alarm panel or alarm system were indicated in the inspection report.

Section 3.0 Closure

We trust that this report meets your present requirements. Please do not hesitate to contact us, if any questions arise.

Original signed by

Mike Gallahue, P.Eng.

Original signed by

Tim Morrison, P. Eng.

Original signed by

Matthew Mittrovich, P. Eng.

Appendix A

Selected Photographs

PHOTO 1 - GENERAL OVERVIEW OF NORTH ELEVATION

PHOTO 2 - GENERAL OVERVIEW OF SOUTH ELEVATION

PHOTOGRAPHIC LOG
BUILDING ASSESSMENT
COMPOSTING FACILITY - MILLER WASTE
80 Gloria McCluskey Avenue, Dartmouth, Nova Scotia

PHOTO 3 - INTERIOR OF RECEIVING AREA

PHOTO 4 - INTERIOR OF VESSEL AREA

PHOTOGRAPHIC LOG
BUILDING ASSESSMENT
COMPOSTING FACILITY - MILLER WASTE
80 Gloria McCluskey Avenue, Dartmouth, Nova Scotia

PHOTO 5 - TYPICAL CRACKING AND DAMAGE TO CONCRETE FLOOR IN RECEIVING AREA

PHOTO 6 - WATER PONDING ON FLOOR OF RECEIVING AREA DUE TO DAMAGED CONCRETE SLAB

PHOTOGRAPHIC LOG
BUILDING ASSESSMENT
COMPOSTING FACILITY - MILLER WASTE
80 Gloria McCluskey Avenue, Dartmouth, Nova Scotia

PHOTO 7 - CORROSION DAMAGE TO DOOR AND FRAME NEAR SPRINKLER ROOM IN VESSEL AREA

PHOTO 8 - CORROSION TO MAN DOOR AND FRAME ALONG SOUTH ELEVATION OF VESSEL AREA

PHOTOGRAPHIC LOG
BUILDING ASSESSMENT
COMPOSTING FACILITY - MILLER WASTE
80 Gloria McCluskey Avenue, Dartmouth, Nova Scotia

PHOTO 9 - TYPICAL RUTTING AND EXPOSED AGGREGATE IN CONCRETE FLOOR OF SOUTH AISLE

PHOTO 10 - WEST END OF VESSEL AREA

PHOTOGRAPHIC LOG
BUILDING ASSESSMENT
COMPOSTING FACILITY - MILLER WASTE
80 Gloria McCluskey Avenue, Dartmouth, Nova Scotia

PHOTO 11 - INTERIOR OF CURING AREA

PHOTO 12 - RECEIVING AREA-LOCALIZED AREAS OF CORROSION ON BOTTOM FLANGE OF MAIN FRAMES

PHOTOGRAPHIC LOG
BUILDING ASSESSMENT
COMPOSTING FACILITY - MILLER WASTE
80 Gloria McCluskey Avenue, Dartmouth, Nova Scotia

PHOTO 13 - VESSEL AREA-FAILED EPOXY PAINT SYSTEM AND ROUGHENED SURFACE INDICATIVE OF SURFACE CORROSION

PHOTO 14 - VESSEL AREA-SOUTH WALL GIRT NEAR EAVE EXHIBITING CORROSION AND SECTION LOSS

PHOTOGRAPHIC LOG
BUILDING ASSESSMENT
COMPOSTING FACILITY - MILLER WASTE
80 Gloria McCluskey Avenue, Dartmouth, Nova Scotia

PHOTO 15 - VESSEL AREA-SOUTH WALL GIRT NEAR FLOOR EXHIBITING SURFACE CORROSION AND SECTION LOSS

PHOTO 16 - VESSEL AREA-TYPICAL FAILURE OF EPOXY PAINT SYSTEM AND ASSOCIATED SURFACE CORROSION

PHOTOGRAPHIC LOG
BUILDING ASSESSMENT
COMPOSTING FACILITY - MILLER WASTE
80 Gloria McCluskey Avenue, Dartmouth, Nova Scotia

PHOTO 17 - VESSEL AREA-TYPICAL ACCUMULATION OF ORGANIC MATERIAL ON MAIN FRAME

PHOTO 18 - CURING AREA-TYPICAL SURFACE CORROSION ON TRUSSES

PHOTOGRAPHIC LOG
BUILDING ASSESSMENT
COMPOSTING FACILITY - MILLER WASTE
80 Gloria McCluskey Avenue, Dartmouth, Nova Scotia

PHOTO 19 - CURING AREA-SURFACE CORROSION ON TRUSSES

PHOTO 20 - OVERVIEW OF CURING AREA ROOF

PHOTOGRAPHIC LOG
BUILDING ASSESSMENT
COMPOSTING FACILITY - MILLER WASTE
80 Gloria McCluskey Avenue, Dartmouth, Nova Scotia

PHOTO 21 - GENERAL OVERVIEW OF RECEIVING AND VESSEL AREA ROOF

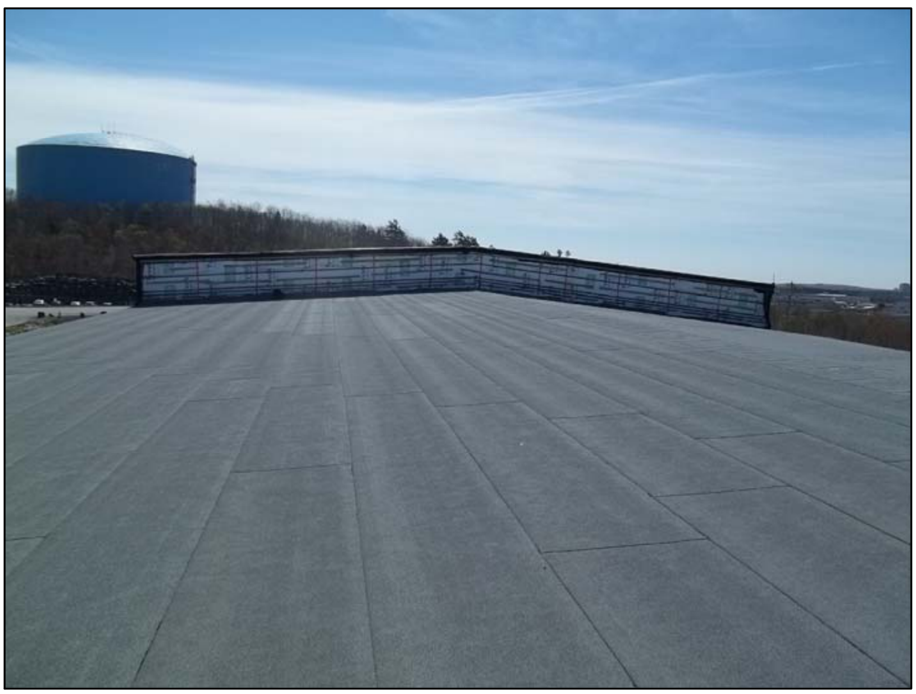

PHOTO 22 - WALL AT JUNCTION OF HIGH ROOF AND LOW ROOF WITH ONLY TYVEK AIR BARRIER

PHOTOGRAPHIC LOG
BUILDING ASSESSMENT
COMPOSTING FACILITY - MILLER WASTE
80 Gloria McCluskey Avenue, Dartmouth, Nova Scotia

PHOTO 23 - TYPICAL ROOF SCREW THAT HAS BEEN RE-SEALED

PHOTOGRAPHIC LOG
BUILDING ASSESSMENT
COMPOSTING FACILITY - MILLER WASTE
80 Gloria McCluskey Avenue, Dartmouth, Nova Scotia

Appendix B

Capital Expenditure Table

CAPITAL EXPENDITURE TABLE - DETAILS

Reference: 071855-01

80 Gloria McCluskey Avenue, Dartmouth, NS

Item No.	Item	Condition	Estimated Capital Expenditures Investment Horizon 2015 Year 1	2016 Year 2	2017 Year 3	2018 Year 4	2019 Year 5	Total Cost Years 1 to 5
2.5	**Building Structure**							
	Foundation Walls							$0
	Frame	Replacement of corroded girts on south elevation in Vessel Area (includes installation of corrosion protection for new girts)		$78,000				$78,000
		Corrosion protection for all main frames in Vessel Area	$130,000					$130,000
		Additional Study to confirm plate thickness of main frame members prior to corrosion protection repairs.	$12,000					$12,000
		Detailed Study & Monitoring of structural members in Curing Area		$12,000			$12,000	$24,000
	Slab-on-Grade	Replace slab in Receiving Area		$95,000				$95,000
		Replace slab in west end of Vessel Area	$60,000					$60,000
		Replace slab in south Aisle			$50,000			$50,000
		Replace slab in north Aisle					$30,000	$30,000
2.6	**Building Envelope**							
	Exterior Walls							$0
	Windows and Doors	Replace 3 man doors and frames		$3,000				$3,000
	Overhead Doors	Maintenance allowance for overhead doors			$3,000	$3,000	$3,000	$9,000
2.7	**Roofing**							
								$0
2.8	**Electrical and Mechanical Systems**							
	Electrical							$0
	Mechanical							$0
2.9	**Life Safety, Fire Protection Systems**							
	Fire Suppression Systems							$0
	Emergency Lighting							$0
		TOTALS	$202,000	$188,000	$53,000	$3,000	$45,000	**$491,000**

Appendix C

Glossary of Selected Terms

BUILDING SCIENCES

SELECTED GLOSSARY OF TERMS

Acoustical sealant: a sealant with acoustical properties used to seal joints in the construction of sound rated ceramic tile installations.
Alligator cracking: a series of inter-connecting cracks on an asphalt surface caused by failure of the asphalt under repeated traffic loading.

Backer rod: bar used to seal wide gaps and joints before caulk is applied, reducing unwanted air leakage.
Baluster: the small vertical supports in a balustrade.
Balustrade: a railing consisting of balusters and a top rail.
Baseboard: trim placed at the join of the floor and wall planes.
Batten: a continuous piece of square-sawn lumber to which sheet metal panels can be attached; also, a wood or metal covering strip, to conceal joints from view and from the weather.
Bearing plate: a flat plate, intended to spread load from a column to the foundation, to provide for fastening and to permit levelling of the column base.
Bleeding: the extrusion of adhesive, cement paste, creosote, or resins from building components.
Blisters: small rounded or elongated raised areas of roof membrane which are filled with air.
Bridging: blocking between joists used to distribute loads and stiffen frames.
Brick veneer: a facing of brick laid against a structural wall but not bonded to the wall and which bears no load other than its own weight.
Buckle: in structural terms, failure by deflection.
Bowing: longitudinal deflection of a piece of lumber, pipe, rod, or the like, usually measured at its center.

Caulk: to seal joints or cracks with a mastic material.
Camber: the upward curve of a surface or beam, usually invoked to offset deflection or induce drainage.
Casing; wood trim around doors and windows.
Chalking: oxidation of paint over time due to weather.
Cladding: a non-load-bearing skin forming an exterior wall.
Clear span: horizontal unsupported distance between bearings.
Control joints: see Expansion joints.
Compression: the state of being pressed or condensed by forces.
Condensation: the formation of water out of moisture vapour because of reduced temperature.
Conduit: a metal or plastic tube that allows wires to be threaded through construction systems.
Corrugate: to bend sheet material into a series of parallel folds to produce a regular pattern of furrows and ridges.
Course: a horizontal row of masonry units.
Creep: deformation of a material under stress.
Crazing: fine, random cracks or fissures caused by the shrinkage which may appear in a surface of plaster, cement paste, mortar, or concrete.
Cribbing: an assembly of heavy wooden members to retain earth.
Cutout: a piece removed to create a small opening.
Curtain wall: a non-load-bearing envelope wall hung on the external structural frame of a building.
Curing: maintenance of humidity and temperature of the freshly placed mortar or grout during some definite period following the placing or finishing, to assure satisfactory hydration.

Damp-proofing: the exclusion of water in its vapourized form.
Decking: system used to form a wood or metal horizontal platform.
Defect: a natural or machining fault that detracts from the serviceability or appearance of a piece of material.
Deflection: downward displacement of a beam or truss because of loading.
Delamination: the separation of layers of glued or bonded materials.
Dry rot: a type of wood decay caused by a fungus.
Durability: characteristics of materials that determines how long they will last under expected conditions of service.

Efflorescence: a powdery gray-white salt residue brought to the surface of masonry by the action of moisture.
Esthetic (aesthetic): having primarily to do with appearance.
Expansion joint: a location where construction systems are interrupted to permit movement of the building.
Epoxy adhesive: an adhesive system employing epoxy hardener portions.

BUILDING SCIENCES

SELECTED GLOSSARY OF TERMS

Face: the surface exposed to view.
Fieldstone: naturally occurring uncut blocks of stone.
Flagstone: large, thin, irregularly shaped pieces of slate or shale laid flat as paving stones.
Flange: the peripheral plates along the outermost edges of the central web of a steel beam.
Flashing, base: that part of the flashing system that connects the horizontal roof or waterproof membrane to the adjacent vertical wall or parapet.
Flashing, cap: a continuous piece of metal, snapped on to complete a weatherproof system at edges, ridges, or expansion joints in roof system.
Flue: a (usually) vertical duct or vent for hot gasses and smoke.
Flush: two components having surfaces lying within one plane.
Frieze: a decorative horizontal band on a building surface.

Gable: the upper triangle area formed by the sloping roof at the end of a building.
Girder: a horizontal or slightly inclined main beam.
Glazing : the process of securing glass panels into prepared door or window frames.
Grade beam: a horizontal foundation that transmits loads to vertical piles.
Grout: a mixture of cement, fine sand and water used to fill minor voids in concrete or masonry work.

Hanger: a metal or plastic device used to suspend building components.
Header: a masonry unit laid horizontally with its length perpendicular to the wall plane; also, the horizontal frame member at the top of an opening.
Heave: The localized upward bulging of the ground due to expansion or displacement caused by phenomena, such as frost or moisture absorption. May also occur due to the production of secondary sulphate based by-products due to the oxidation of pyrite present in granular fill.
HVAC: heating, ventilation, air-conditioning.

Insulation: any material that will not easily conduct energy in the form of heat, sound or electricity.

Jamb: the vertical side of any opening.
Joint: the point of contact between two components.
Joist: horizontal structural member supporting decks and floors.

Laminate: to apply a thin layer on the top of another.
Landing: an intermediate rest platform in a flight of stairs.
Lintel: a horizontal member used to distribute forces above an opening.
Longitudinal crack: a crack in asphalt surface that runs parallel to the “laydown” direction.
Louver: a slatted ventilation opening.

Mastic: oil-or cement-based paste used to fill minor holes and cracks in buildings.
Membrane: a thin pliable sheet or layer of (usually waterproof) material used as a liner in parts of buildings.
Mildew: a whitish fungal coating, often appearing on damp paper or plaster surface.
Molding: trim or ornamental cover.

Offset: a change in vertical plane.
Overhang: the distance a joist or chord extends beyond the bearing point.

Panel: a flat board, plate or pane inserted into a frame.
Parapet: a low wall projecting above the roof level.
Parging: a single application of masonry cement used to cover minor blemishes in concrete or masonry walls; also used to line brick chimney vents.
Parquet: small wood block flooring laid in basket-weave or other mosaic patterns.
Partition: a non-load bearing wall separating two areas of a building.
Peeling: the separation of adhesive from glued surfaces.
Permeability: ability to permit (or resist) the passage of water.
Pier: a vertical portion of wall between openings, also a free-standing short or stubby column.

BUILDING SCIENCES

SELECTED GLOSSARY OF TERMS

Pitch: slope or angle.
Plumb: vertical.
Ponding: the accumulation of water in low areas of nominally flat roof decks or paved areas.
Popping: the loosening of cover over concealed nail heads caused by thermal or moisture movement in framing.
Porous: a surface permeable by water or air.
Potholes: bowl shaped holes of various sized in an asphalt surface.
Precast unit: concrete formed, poured and cured in a location other than its final location.
Pyrite: a widespread iron sulphide mineral often associated with heaving and sulfatation of concrete due to the formation of sulphate based secondary by-products, on oxidation.

Ramp: an inclined plane.
Ridge: the uppermost edge of a roof plane; the upper apex between two adjoining roof planes.
Riser: the vertical component of a step, intended to prevent the feel from slipping beyond the tread.
Rout: to gouge with a cutting tool.

Scaling: pitting of surfaces after repeated exposure to freezing and thawing.
Sealants: products used to seal joints that have been packed with weatherproof materials.
Sealers: waterproof products used to coat or prepare surfaces or areas to inhibit moisture penetration.
Shear: the tendency of forces to cause a transverse fracture across a member.
Sheathing: usually rough wood or plywood boarding used to enclose a space and impart structural integrity to a wood or metal frames, such as a floor wall or roof.
Siding: overlapping long, narrow and thin boards of wood or metal attached horizontally or vertically to the outside of buildings to improve weather protection and appearance.
Sill: the lowest horizontal part of any opening through the wall.
Soffit: the exposed underside of any building surface.
Spalling: breaking away of surface in flakes or chunks.
Splits: tears that extend through roof membrane layers.
Step crack: a pattern of cracks in brick or concrete block veneer, often following mortar joints, which form as a result of foundation settlements.
Storey: the usable portion of a building between one floor and the one above it.
Strength: the characteristic of a material that determines its ability to resist or impart forces.
Substrate: the surface beneath a finishing layer or coating.

Tension: forces tending to stretch or elongate an object.
Terrazzo: a mixture of cement paste and marble chips, ground and polished after curing.
Thermographic scan: an infrared survey carried out on a roof system to determine areas of heat loss and potential roof leaks.
Threshold: see sill.
Topping: a thin layer of fine concrete laid on top of and bonded to a thicker substrate of structural concrete.
Transverse crack: a crack in an asphalt surface that runs across (perpendicular or diagonal to) the “laydown” direction.
Tread: the horizontal component of a step.
Trim: long, narrow strips of shaped and finished wood, metal, or plastic used to conceal joints of building components.
Truss: a structural frame, usually part of a roof structure.

Valley: the line where two inclined planes of a roof surface meet and to which water will be directed.
Vapor Barrier: material used to prevent the passage of vapour or moisture into a structure or another material, thus preventing condensation within them.
Veneer: a thin layer of wood, masonry, or metal applied for primarily cosmetic effect.

Warp: a significant and unwanted deviation from an intended true plane.
Waterproofing: the exclusion of water in its liquid form.
Web: the central vertical plate between outer beam flanges.
Weep holes: small spaces left in mortar joints or concrete walls to permit moisture escape.
Wythe: in masonry, width, usually the width of one brick, as is a wall or veneer one wythe thick.