July 31, 2014

DILLON
CONSULTING

137
Chain Lake Drive
Suite 100
Halifax
Nova Scotia
Canada
B3S 1B3
Telephone
(902) 450-4000
Fax
(902) 450-2008

GOVERNMENT OF NEWFOUNDLAND
AND LABRADOR
Department of Municipal Affairs
Confederation Building, West Block
P. O. Box 8700
St. John's, NL
A1B 4J6

ATTENTION: Frank Huxter, P.Eng.

Study of Options for Organic Waste Processing in the Province of Newfoundland and Labrador (Revised Final Report)

With reference to our recent discussions, Dillon Consulting Limited is pleased to submit the revised final version of the Study of Options for Organic Waste Processing in the Province of Newfoundland and Labrador. With a focus on the management of compostable organics and acknowledging a 30 year planning horizon, this document presents an analysis of seven candidate organics management scenarios for the island of Newfoundland.

It has been our pleasure to work with you and the Project Committee on this assignment and we hope to be of further service in the future.

Yours truly,

DILLON CONSULTING LIMITED

Scott D. Kyle, P.Eng.
Project Manager

SDK:jes
Attachment
Our File: 13-8097-8000

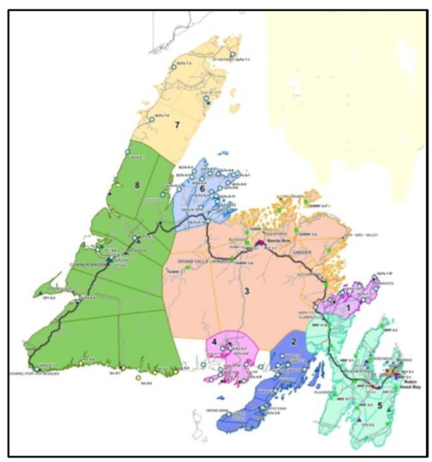
Dillon Consulting Limited

Executive Summary

Over the last several years, significant progress has been made within Newfoundland and Labrador in the area of progressive, sustainable solid waste management. Beginning in the mid-1990s with the establishment of the Multi-Materials Stewardship Board (MMSB) and progressing with the issuing of the Province's Waste Management Strategy in 2002 and an accompanying 2007 Implementation Plan, the Province has led the way to commission environmentally sustainable landfills and develop infrastructure and programs to reduce the quantity of materials requiring disposal. But in order to meet the Province's 50% diversion target, a more intensive analysis of options to effectively segregate and manage compostable organics must be completed.

In December 2012, with the objective of identifying a practical 30 year organics management strategy for the island of Newfoundland, the Department of Municipal Affairs (DMA) issued a Request for Proposals (RFP) entitled Study of Options for Organic Waste Processing in the Province of Newfoundland and Labrador. Following the completion of the proposal review process, Dillon Consulting Limited (Dillon) was selected by DMA as the preferred consultant, with the project initiation meeting being held in St. John's on July 3, 2013. Early in the assignment, several guiding principles were established to serve as the foundation for the remainder of the project; key principles included the following:

- The study area included the eight established waste management regions on the island of Newfoundland; 1) Discovery Regional Service Board (DRSB), 2) Burin Peninsula Regional Service Board (BPRSB), 3) Central Regional Service Board (CRSB), 4) Coast of Bays Waste Management Corporation (CBWMC), 5) Eastern Regional Service Board (ERSB), 6) Green Bay Waste Authority Inc. (BVGB), 7) Northern Peninsula Regional Service Board (NPRSB) and 8) Western Regional Service Board (WRSB).



- While the study was to incorporate the assessment of organic feedstocks from the industrial, agricultural and resource sectors, the focus for the identification of candidate organics processing programs within the eight management regions will be the diversion of traditional MSW organic materials from residential and industrial, commercial and institutional (ICI) generators.
- The provincial objective of reducing the amount of waste going to the landfill by 50% is an overall target (by weight) for Newfoundland and Labrador and is not to be applied on the individual regional, municipal or community level.
- In order to be considered a proven organics processing technology, for the purposes of this study, the following criteria will have to be met: 1) a minimum of five years of continuous, reliable operation; 2) use of similar MSW feedstocks and at a similar proposed throughput tonnage (e.g., within 25%), 3) confirmation of an ability to effectively control odour and leachate, 4) operation in a

climate similar to the proposed application location(s) and 5) reliable generation of a minimum Category B (restricted use) finished compost, as defined in CCME's Guidelines for Compost Quality.
- Forecasting of future island populations and associated waste and organics tonnages using available data from Statistics Canada, the Government of Newfoundland and Labardor, the MMSB and the study team's information resources.

Consolidation of current conditions information on Newfoundland's waste management programs involved direct engagement with representatives of the eight management regions. As part of this effort, a GIS-enabled base map of the island of Newfoundland was developed, to allow for the efficient identification of current and proposed facilities, the provincial road network and service area boundaries and to provide a foundation for the development of candidate management scenarios.

Beginning with the background information presented in MMSB's 2012 document *The Management of Organic Waste in Newfoundland and Labrador* and augmented with a significant amount of information held by members of the Dillon team, a "long list" of candidate organics management technologies was assembled. Following the preparation of the long list inventory, the next step was the definition of screening criteria to develop a "short list" of viable technologies relevant to the context of Newfoundland and Labrador. In consultation with DMA, a methodology was developed to identify a short list of preferred organics processing technologies for three sizes or scales of composting operations (from largest to smallest); Level I – Centralized/Regional, Level II – Sub-Regional and Level III – Community.

With reference to Dillon's original proposal for the assignment, the next step was to develop three candidate organics management scenarios with the following characteristics; 1) Use of regional, centralized processing facilities (e.g., Norris Arm and the St. John's Area), 2) Use of regional facilities augmented by sub-regional, multi-community processing operations and 3) A hybrid of Scenarios 2 and 3, including community-specific, small scale facilities for remote areas. Following the initial presentation of three draft version of these scenarios at a committee workshop meeting in September 2013, DMA requested that two more scenarios be included for analysis; 4) Use of a single processing facility for the island situated in Norris Arm with a maximum four hour one-way trailer transport haul distance and 5) Use of two processing facilities for the island; one located near St. John's and one in the Deer Lake area with a maximum three hour one-way trailer transport haul distance. Following the draft report presentation at a Committee meeting on December 16, 2013, DMA requested that two additional scenarios be included for analysis; 6) Scenario 4 expanded to accommodate 99.7% of the island's population, and 7) Scenario 5 expanded to accommodate 99.7% of the island's population.

With the boundary conditions and performance requirements for the seven candidate organics management scenarios established, the Dillon team defined system details allowing for the analysis of a) diversion performance (e.g., the amount of compostable organic material diverted away from landfill and b) the associated annualized and net present value costs. While the extent of provincial curbside service varies amongst the seven scenarios, all are assumed to share some key common features (note that these assumed common features were developed as part of this study. It is acknowledged that Regions and/or Municipalities are likely to make refinements (e.g., container collection size, collection frequency, etc.);

- Only those communities currently providing or intending to provide curbside collection service were included in proposed organics service areas.
- Residential curbside collection of organics will be achieved through the use of wheeled 240 L carts, similar to those used in jurisdictions throughout Atlantic Canada. Again with reference to a proven approach in other Atlantic Canadian communities, curbside collection of garbage and organics will occur on alternating weeks, thus maintaining the overall weekly service model currently envisioned for most island collection systems.
- ICI organics generators will be obliged to coordinate their own contracted collection services. Costs associated with ICI services for long-distance transfer and processing at regional facilities will be recouped through tip fees.
- To address concerns regarding a “carbon deficit” in the overall compost feedstock mix, generators will be directed to place boxboard, portions of yard waste and select food contaminated fibre materials in their collection carts. An annual operating cost allowance has also been included for each identified composting facility to maintain a stockpile (equivalent to 10% of the annual forecasted process tonnage) of a carbon bulking agent (e.g., wood chips).
- Existing/planned waste transfer stations will also be used for the bulking/transfer of organics materials, where required. Transfer will be facilitated through the use of contract hauled walking floor trailers or sealed roll-off containers (trailers/containers owned by the regions).
- The siting of new compost facilities will occur at existing or historic waste management facilities where practical.
- To address the concern of an initial “overbuild” of system infrastructure, it has been assumed that a moderate level of organics “capture success” from residential and ICI generators will be experienced in the first 10 years of operation (e.g., 2015 – 2024), with an anticipated improvement in the overall organics capture rate beginning in 2025 (remaining stable through to 2045). Should an actual capture rate improvement be documented in the later part of the initial 10 years of operation, capital expansion to existing processing facilities can be completed. Scenario costing as presented in this report assumes that this capture improvement and associated expenditure occurs.

Noting that costs for residential curbside collection remain relatively consistent whether or not an organics management system is established, a summary of the waste diversion performance and estimated NPV costs for the seven candidate scenarios (not including collection) is presented in Table E-1.

Table E-1 Seven Scenarios – Summary Results

Scenario	NPV Total (000s) @6%: 30 years ($2013)	Total Annual Cost (000s $2013)	% Waste Diversion Achieved				% of Population Served
			2015	2025	2035	2045	
Scenario 1	$117,691	$5,902	8	12	12	12	86.8
Scenario 2	$139,020	$6,972	9	14	14	14	99.7
Scenario 3	$134,476	$6,744	9	14	14	14	99.7
Scenario 4	$154,986	$7,772	9	13	13	13	95.0
Scenario 5	$125,434	$6,290	9	13	13	13	91.7
Scenario 6	$162,508	$8,148	9	14	14	14	99.7
Scenario 7	$137,769	$6,909	9	14	14	14	99.7

An additional analysis was conducted to consider the greenhouse gas and avoided landfill cost benefits of establishing the organics management program described under Scenario 1. Through this analysis, and considering the complete 30 year planning period (2015-2045) for both the Norris Arm and Robin Hood Bay Landfill sites, it was estimated that (as compared to the landfill-only alternative) implementation of Scenario 1 would result in a GHG generation reduction of over 1.7 million tonnes of carbon dioxide equivalent (CO_2e) and a landfill capital cost savings of approximately $33 million.

Following the submission of this report, it is recommended that the Province, the eight management regions and their member municipalities use this document as a basis to define the preferred organics system components and implementation schedule.

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List of Acronyms

3Rs	Reduce, Reuse and Recycle
ACES	Atlantic Canada Electronics Stewardship
AD	Anaerobic Digestion
C&D	Construction and Demolition
CCC	Composting Council of Canada
CCME	Canadian Council of Minister of the Environment
CBPPL	Corner Brook Pulp and Paper Limited
CBWMC	Coast of Bays Waste Management Corporation
CRD	Construction, Renovation and Demolition
CRSB	Central Regional Service Board
DEC	Newfoundland and Labrador Department of Environment and Conservation
DFA	Newfoundland and Labrador Department of Fisheries and Aquaculture
DMA	Newfoundland and Labrador Department of Municipal Affairs
DNR	Newfoundland and Labrador Department of Natural Resources
DRSB	Discovery Regional Service Board
EC	Environment Canada
EPRA	Electronic Products Recycling Association
ERSB	Eastern Region Service Board
FTE	Full Time Equivalent
GIS	Geographic Information System
BVGB	Baie Vert – Green Bay Region
HDPE	High Density Polyethylene
HHW	Household Hazardous Waste
HRM	Halifax Regional Municipality
ICI	Industrial, Commercial and Institutional
ISWM	Integrated Solid Waste Management
LSD	Local Service District
LDPE	Low Density Polyethylene
LYW	Leaf and Yard Waste
MMSB	Multi Materials Stewardship Board
MRF	Materials Recovery Facility
MSW	Municipal Solid Waste
NPRSB	Northern Peninsula Regional Service Board
NSE	Nova Scotia Environment
NFA	Newfoundland Federation of Agriculture
NL	Newfoundland and Labrador
OCC	Old Corrugated Cardboard
PAH	Polyaromatic Hydrocarbon
PAYT	Pay As You Throw

PET	Polyethylene Terephthalate
PP	Polypropylene
PROG	Paper, recyclables, organics and garbage
PVC	Polyvinyl Chloride
Res	Residential
RRFB	Resource Recovery Fund Board (Nova Scotia)
SSO	Source Separated Organics
SWANA	Solid Waste Association of North America
SWM	Solid Waste Management
TS	Transfer Station
USEPA	United States Environmental Protection Agency
WRF	Waste Recovery Facility
WDS	Waste Disposal Site
WRSB	Western Regional Service Board

Definitions

Anaerobic Digestion (AD) - A naturally occurring biological process that uses microorganisms to breakdown organic material in the absence of oxygen. In engineered AD systems, the breakdown takes place within specially designed reactors or chambers with the primary byproducts being a biogas (mainly CH_4 and CO_2), a semi solid residual called digestate and a liquid effluent.

Backyard Composting (BYC) - The transformation of organic kitchen and yard waste into a beneficial soil amendment on the property of the generating resident or business. Traditionally, backyard composting has been undertaken by allowing a pile of organic wastes to naturally degrade. However, pre-fabricated backyard compost units are widely available.

Best Practice - Strategies, activities, or approaches which have been shown through research and evaluation to be most effective.

Buffer Zone -The area between the property line of a waste management facility of a waste disposal site and the active reception, transfer, treatment and/ or waste disposal area.

Centralized Composting - The composting of organic wastes such as food, yard, and garden and select paper waste at a centralized facility. Composting at a central facility is generally undertaken through one of three types of processes: windrows (turned or static), aerated static pile or in-vessel.

Compostables - Materials that can undergo microbiological decomposition, resulting in a humus-like end product that is primarily used for soil conditioning.

Construction & Demolition (C&D) Debris - Waste materials from the construction, renovation and/or demolition of buildings, usually including wood and metal scrap, brick, block and concrete rubble, wire and packaging. In Newfoundland and Labrador, Appendix D of the General Environmental Standards Municipal Solid Waste Management Facilities/Systems define C&D debris as including *a) clean soil, b) landscaping waste such as root balls and organic mat, c) brick, mortar, concrete, d) drywall, plaster, windows, doors, glass, ceramic items, cellulose, fibreglass fibres, gyproc, unsalvageable metals, e) wood that has not been chemically treated (i.e. non-pressure treated and non-creosote wood), f) asphalt shingles and other roofing materials (no cans, drums or other containers, empty or otherwise) of roofing adhesives, tar or waterproofing compounds, g) siding, floor coverings and ceiling tile, wire, conduit, pipes, plastic films, and other building plastics and metals, h) other inert materials approved by the Department.*

Diversion - Any environmentally-sustainable initiative that decreases the quantity of waste that must be landfilled or otherwise disposed.

Enforcement - Administrative or legal procedures and actions to require compliance with legislation, regulations or limitations.

E-Waste – Broken, unrepairable or unwanted electrical or electronic equipment.

Extended Producer Responsibility - A waste management policy approach that identifies end-of-life management of products as the responsibility of producers.

Flow Control – Legal provisions that allow provincial and/or municipal governments to designate the locations where municipal solid waste (MSW) is taken for processing, treatment, or disposal.

4Rs – Originally, and with a focus on waste management activities, the 4Rs incorporated reduction, reuse, recycling and recovery (of energy). Dalhousie and other agencies and organizations now define the 4Rs as rethink, reduce, reuse, and recycle.

Green Programming - A comprehensive effort to incorporate responsible, diversion-based concepts and initiatives in the development of operational plans and policies.

HDPE - HDPE (High Density Polyethylene) refers to a plastic used to make bottles for milk, juice, water and laundry products. Unpigmented HDPE bottles are translucent and have good barrier properties and stiffness.

Household Hazardous Waste (HHW) - Materials commonly found in the home that may cause harm to human health or the environment.

Humus - Inert material produced by the biological decay of plant or animal matter.

Industrial Waste - Generally liquid, solid or gaseous wastes originating from the manufacture of specific products. Wastes are usually concentrated, variable in content and rate, and require more extensive or different treatment than municipal waste.

Industrial, Commercial and Institutional (ICI) Sector - Includes industries (e.g., manufacturing), businesses and institutions such as schools, universities and hospitals. Municipal waste is often categorized according to whether it is generated by the ICI sector or the residential sector.

Landfill - The disposal of solid wastes or sludges by placing on land, compacting and covering as appropriate with a thin layer of soil. These facilities often rely on bulldozers and compactors as their main piece of equipment for spreading, grading, and covering refuse.

LDPE - LDPE (Low Density Polyethylene) is a plastic used predominantly in film applications due to its toughness, flexibility and relative transparency. LDPE has a low melting point, making it popular for use in applications where heat sealing is necessary. Typically, LDPE is used to manufacture flexible films such as those used for plastic retail bags, garment dry cleaning and grocery bags.

Materials Recovery Facility (MRF) - A facility where materials are processed to separate and recover recyclable materials from the waste stream.

Mixed Waste (or) Mixed Residue - Discarded materials and products which have not been source-separated and therefore may contain compostable or recyclable materials which can be recovered for beneficial use.

Municipal Solid Waste (MSW) - Commonly referred to as garbage, this material is handled by municipal collection and/or disposal services. It includes two main types of solid waste: residential or domestic waste, and industrial, commercial and institutional waste. In Newfoundland and Labrador, Appendix D of the General Environmental Standards Municipal Solid Waste Management Facilities/Systems define municipal solid waste as; *garbage, refuse, rubbish, litter and other discarded materials resulting from residential, commercial, institutional and industrial activities which are commonly accepted at a municipal solid waste management facility, mixed or unmixed. This would generally exclude industrial processing waste and agricultural waste.*

Net Present Value (NPV) - The difference between the present value of cash inflows and the present value of cash outflows. NPV compares the value of a dollar today to the value of that same dollar in the future, taking inflation and returns into account and is a standard method for using the time value of money to appraise long-term projects.

Organics - Carbon and hydrogen-based materials that can be transformed into humus-like materials through microbiological processes (e.g., composting).

Pay As You Throw – A program where residents are charged for the collection of municipal solid waste based on the amount they throw away. Most North American communities with "PAYT" charge residents a fee for each bag or can of waste they generate.

PET - PET or PETE (Polyethylene Terephthalate) is a clear, tough plastic with good gas and moisture barrier properties. Some is used in PET soft drink bottles and other blow molded containers, although sheet applications are increasing. Cleaned, recycled PET flakes and pellets are utilized for spinning fibre for carpet yarns and producing fibrefill and geotextiles.

Public/Private Partnering - A process whereby the public sector and the private sector collaborate to finance and operate a project or program.

Product Stewardship - Action undertaken by industry, either voluntarily or as a result of a legislative/regulatory requirement, to provide the appropriate management of a product when it becomes a waste.

Recovery - Typically refers to the recovery of heat for electrical generation through the incineration of solid waste or select waste stream components.

Recyclables - Materials that can be separated from municipal solid waste and reprocessed into new products.

Recycle - When used as a noun, means reutilization of a secondary resource as a result of its inclusion in a manufacturing process. When used as a verb, means the act of recycling.

Residential Sector - Householders, including those who live in detached dwellings, row housing, condominiums and apartments.

Reuse - When used as a noun, means reutilization of a secondary resource without need of a manufacturing process. The term "reuse", when used as a verb, will be defined to mean the act of reuse.

Source Separation - Classifying and segregating waste/resource materials by category, usually separating various classes of recyclable vs. non-recyclable items, usually done by the generator at the collection or pick-up point (e.g., residences, offices or commercial facilities).

Sustainability - Sustainability can be defined as development that meets the needs of the present generation without compromising the ability of future generations to meet their needs. Sustainability is typically based upon three components: economic growth, social progress, and environmental protection.

Transfer Stations - Temporary storage facility for waste, used in circumstances where the landfill site is located far from the areas where waste is generated. Typically, waste is collected and loaded into large capacity trailers at the station for subsequent bulk transfer to vehicles at the landfill.

Waste Audit - A method of assessing the amount and type of waste generated by a specific organization or sector.

Waste Minimization - The reduction, to the extent feasible, of waste that is generated or subsequently treated, stored or disposed of. It may include any source reduction, reuse, recycling or composting activity undertaken by a generator that results in a reduction in the total quantity of waste, thus minimizing present and future threats to human health and the environment.

White Goods - Large, bulky metal items, usually durable household appliances such as refrigerators, stoves, washing machines and dryers.

Yard Waste - Discarded materials from residential yards and gardens, such as lawn clippings, leaves and prunings. These materials are generally compostable.

Zero Waste - A philosophy that encourages the redesign of resource life cycles so that all products are reused and quantities requiring disposal are minimized or eliminated.

1.0 Introduction

Over the last several years, significant progress has been made within Newfoundland and Labrador in the area of progressive, sustainable solid waste management. Beginning in the mid-1990s with the establishment of the Multi-Materials Stewardship Board (MMSB) and progressing with the issuing of the Province's Waste Management Strategy in 2002 and an accompanying 2007 Implementation Plan, the Province has led the way to commission environmentally sustainable landfills and develop infrastructure and programs to reduce the quantity of materials requiring disposal. But in order to meet the Province's 50% diversion target, a more intensive analysis of options to effectively segregate and manage compostable organics must be completed. To date, the Province has been proceeding on the assumption that the organics diversion goal could be met by establishing dedicated composting facilities at three regional management "hubs" (e.g., in the Western, Central and Eastern/Avalon Regions). But, acknowledging the remote nature of many Newfoundland communities, the practicalities of transporting small quantities of source-separated organics long distances to regional management facilities has come into question.

In December 2012, with the objective of identifying a practical 30 year organics management strategy, the Newfoundland and Labrador Department of Municipal Affairs (DMA) issued a Request for Proposals (RFP) entitled *Study of Options for Organic Waste Processing in the Province of Newfoundland and Labrador*. With a focus on the island of Newfoundland, the scope of this RFP incorporated a range of requirements, including the review and updating of relevant background information, direct consultation with representatives of the island's eight waste management boards/committees, identification of non-MSW candidate feedstocks, development of an island wide feedstock transportation model, preparation of a candidate technologies "short list" and detailed analysis of three primary organics management scenarios in consultation with DMA, including a cost/benefit assessment of composting vs. disposal at the Norris Arm and Robin Hood Bay sites.

Following the completion of the proposal review process, Dillon Consulting Limited was selected by DMA as the preferred consultant, with the project initiation meeting being held in St. John's on July 3, 2013. This report documents the scenario development and analysis process completed by Dillon, including a consolidation of existing conditions waste management information on the island of Newfoundland, a review of organics processing technology options and a forecast of compostable material quality and quantity over a 30 year planning horizon.

Following the Introduction (Section 1), the report is organized as follows:

- Section 2: Methodology
- Section 3: Existing Conditions and Future Needs Assessment
- Section 4: Review of Candidate Organics Processing Technologies

- Section 5: Proposed Candidate Organics Management Scenarios
- Section 6: Assessment of Candidate Organics Management Scenarios
- Section 7: Cost Benefit Analysis – Landfilling Versus Composting
- Section 8: Next Steps

2.0 Project Methodology

2.1 Objectives

Founded on the content of the RFP for this assignment and acknowledging information gathered during the early stages of the work program, the project objectives for this assignment are summarized as follows:

- Options developed must provide a higher level of environmental protection and enhancement when compared to present practices.
- Options developed must contribute to the Province's goal of 50% waste diversion (by weight) from landfill/disposal.
- Finished/cured material from recommended organics management systems should, but is not required to, have a beneficial use beyond the waste management system. For example, use of the end product as landfill cover is acceptable but would be considered less desirable as compared to incorporation into landscaping or soil amendment activities.

2.2 Guiding Principles

Based on team experience and information gathered during the initial stages of the study program, a set of guiding principles were developed to serve as boundary conditions for the remaining project tasks. In consultation with DMA, the following seven guiding principles were identified:

1. Study area scope
2. Program focus
3. Organics program consistency
4. Achieving 50% diversion
5. Candidate feedstocks
6. Proven technologies
7. Waste stream forecasting

Further discussion on each of these guiding principles is provided below.

2.2.1 Study Area Scope

The following eight regions were included for consideration in the Organic Waste Options assignment:

1. Discovery Regional Service Board (DRSB)
2. Burin Peninsula Regional Service Board (BPRSB)
3. Central Regional Service Board (CRSB)
4. Coast of Bays Waste Management Corporation (CBWMC)
5. Eastern Regional Service Board (ERSB)
6. Baie Verte – Green Bay Region (BVGB)*

7. Northern Peninsula Regional Service Board (NPRSB)
8. Western Regional Service Board (WRSB)

**: revised from Green Bay Waste Authority (GBWA) following the review of the draft report*

In terms of region-specific data (e.g., current services, costs and facilities as well as non-MSW organics sources), it is acknowledged that the Dillon team will be reliant on information provided by designated regional representatives consistent with the proposed schedule for the project.

Remote areas outside of the boundaries of these eight regions have not been incorporated into the review of organics management options for the island of Newfoundland.

2.2.2 Program Focus

While the incorporation of organic materials from agricultural, forestry and fisheries processing sources is being included in the evaluation of candidate management programs for the eight regions, it is acknowledged (consistent with most jurisdictions across Canada) that Province of Newfoundland and Labrador does not include these materials within the definition of "municipal solid waste" (MSW). As a result, residual material from these sources (as noted in information provided from MMSB) is not included in waste management system performance calculations (e.g., tonnes disposed, percentage diverted, etc.). Thus, the focus for the identification of candidate organics processing programs within the eight management regions will be the diversion of traditional MSW organic materials from residential and industrial, commercial and institutional (ICI) generators. The ability of a candidate program to also accommodate organic materials from agricultural, forestry and fisheries sources will be a secondary consideration.

2.2.3 Organics Program Consistency

For the purposes of the study, it has been assumed that the type and extent of organics material management services across the island and within individual regions can vary from community to community. This includes the potential of some portions of a region not having any defined compostable organics program (beyond individual on-site or backyard composting for non-meat and dairy materials).

2.2.4 Achieving 50% Diversion

The provincial objective of "reducing the amount of waste going to the landfill by 50%" (as stated in the 2007 Provincial Solid Waste Management Strategy Implementation Plan) is an overall target (by weight) for Newfoundland and Labrador and is not to be applied on the individual regional, municipal or community level. This approach acknowledges that higher levels of diversion (e.g., above 50%) may be feasible in select areas of higher population as compared to more remote portions of the province.

2.2.5 Candidate Feedstocks

With reference to the TOR for this assignment, and noting the comment regarding program focus under Section 2.2.2, the opportunity to include organic feedstocks/bulking agents from "non-MSW" sources (e.g., fish processing facilities, agricultural operations, fur farms, forestry operations) will be incorporated into the review of regional organic processing options.

2.2.6 *Proven Technologies*

In order to be considered a proven organics processing technology, for the purposes of this study, the following criteria (with documentable evidence) will have to be met:

- A minimum of five years of continuous, reliable operation.
- Use of similar MSW feedstocks and at a similar proposed throughput tonnage (e.g., within 25%).
- Confirmation of an ability to effectively control odour and leachate.
- Operation in a climate similar to the proposed application location(s) (e.g., coastal and/or interior Newfoundland).
- Reliable generation of a minimum Category B (restricted use) finished compost, as defined in CCME's Guidelines for Compost Quality (2005).

2.2.7 *Waste Stream Forecasting*

For the purposes of waste stream (organic feedstocks) forecasting, existing characterization (percent of overall waste stream) information for Newfoundland will be used, where available, with data from other relevant jurisdictions being utilized as necessary. In terms of the change in the quantity of material over the 30-year planning period (i.e., 2015 – 2045) per capita waste generation rates (based on latest available information from the MMSB) combined with regional population projection data from the Newfoundland and Labrador Department of Finance will be utilized. The projection effort will include assumptions about the annual change in the per capita waste generation rate. Projections on the quantity of organic feedstocks available from non-MSW sources (e.g., fisheries or agricultural waste) will be developed based on available information.

2.3 Project Tasks

Consistent with Dillon's original proposal, this assignment was undertaken through the completion of the following eight tasks;

Task 1 – Hold Kick Off Meeting
Task 2 – Conduct Interviews & Consolidate Background Information
Task 3 – Define Performance Requirements
Task 4 – Prepare Digitized Study Area Base Plan
Task 5 – Develop Long/Short List of Technology Options
Task 6 – Assemble Candidate Management Scenarios
Task 7 – Conduct Detailed Scenario Analyses
Task 8 – Prepare Project Report

During the course of the project, in consultation with DMA, some refinements were made to task descriptions. An overview of the project tasks as completed is presented below.

Task 1 - Hold Kick-off Meeting

The Kick-off Meeting for the Organic Waste Processing Options assignment was conducted in the Mount Pearl offices of the MMSB on July 3, 2013. In addition to Dillon team members, 11 representatives of provincial government departments and waste management regions were in attendance. Key objectives of the meeting included:

- Confirmation of the content of the work plan, with a specific emphasis on scope and schedule.
- Review of contract terms.
- Identification of key project contact coordinates for the Director, the regional waste management authorities, relevant provincial departments and Dillon.
- Identification of key background data held by the Director relevant to the assignment, including previous reports (beyond that provided in the RFP), scale/tonnage information and descriptions of current regional/municipal waste services programs.
- Initial discussion to identify primary generators of non-food/yard waste organics materials within Newfoundland (e.g., generators within the fisheries, forestry, agricultural/fur breeding sectors). Include the issue of a carbon deficiency in this feedstock discussion.
- Review of current/pending initiatives within the province that could impact upon project findings and recommendations (e.g., status of current organics pilot programs, political mood regarding waste management issues, recent discussions within DMA and the Department of Environment and Conservation (DEC)).
- Identification of the Director's key operational concerns and longer term performance expectations for the overall waste-resource diversion system (with a noted focus on organics) within the province.
- Definition of reporting mechanisms for the project.

Minutes of the meeting were prepared by Dillon, distributed to attendees and are provided in Appendix A.

Task 2 - Conduct Interviews & Consolidate Background Information

In July 2013, to augment data gathered during the kick-off meeting, the Dillon team initiated an information collection effort to confirm both current conditions and planned changes relevant to solid waste management activities across the island of Newfoundland. The collection of information was founded on telephone interviews held with a designated representative (as confirmed by DMA) of each of the island's regional waste management authorities. The interviews were preceded by an introductory call complete with the provision (via email) of a questionnaire to guide the conversation. The discussions, which extended into November 2013, acknowledged the variations in services and program specifics amongst the regions and their respective municipal units.

An interview questionnaire template is provided in Appendix B. A consolidation of information gathered during Task 2 is presented in Section 3.2 of this report.

Task 3 - Define Performance Requirements

Within the Terms of Reference for this assignment, the overall purpose of the study was clearly articulated; "*…to identify the most viable option(s) to address organic waste for the Province of Newfoundland and Labrador.*" In addition, the following three primary objectives, in order of priority, are defined:

1. Options presented must provide a higher level of environmental protection and enhancement when compared to present practices.
2. Options must contribute to the Provincial goal of 50% waste diversion from landfill/disposal.
3. Finished material should, if possible, have a beneficial use beyond incorporation into waste management system operations.

The study's purpose along with these objectives established the initial boundary conditions for the assignment. However, to allow for the efficient execution of the project work plan, some additional project assumptions required definition. In consultation with DMA, and as described previously in Section 2.2, seven guiding principles for the assignment were defined.

Task 4 - Prepare Digitized Study Area Base Plan

To support the cost evaluation of the transport of organics to centralized processing locations under the candidate management scenarios (see Task 7), it was necessary to develop a digitized GIS base plan of Newfoundland. Using information provided by both the Provincial and Federal governments, a transportation routing map of the island of Newfoundland was developed, complete with waste management service regional boundaries and approximate locations of existing and proposed waste management facilities.

Task 5 - Develop Long/Short List of Technology Options

Beginning with the background information presented in MMSB's 2012 document *The Management of Organic Waste in Newfoundland and Labrador* and augmented with a significant amount of information held by members of the Dillon team, a "long list" of candidate organics management technologies was assembled. Basic descriptive information for each technology was gathered, including process overview, infrastructure requirements, applicable feedstocks/bulking agents, feedstock preparation requirements, process control features, nuisance (e.g., odour) control features, manufacturers/suppliers, ranges of cost (capital and operational), end product characteristics and representative installations.

Following the preparation of the "long list" inventory, the next step was the definition of screening criteria to develop a "short list" of viable technologies relevant to the context of Newfoundland and Labrador. As presented in Appendix C, and in consultation with DMA, a methodology was developed to identify a "short list" of preferred organics processing technologies for three sizes or "scales" of composting operations (from largest to smallest); Level I – Centralized/Regional, Level II – Sub-Regional and Level III – Community. The technologies scoring and categorization effort is presented in Section 4 of this report.

Task 6 - Assemble Candidate Organics Management Scenarios

In Dillon's original proposal for this assignment it was recommended that the following three candidate organics management scenarios be developed for the island of Newfoundland (Scenarios 1, 2, 3):

1. Use of regional, centralized processing facilities
    - Transport of organics from a defined service region to planned processing facilities in either Norris Arm or Robin Hood Bay;
    - Consideration of sub-regional organics transfer stations (TSs) where applicable;
    - Definition of a minimum tonnage/population threshold for regional program participation; and
    - Limited inclusion of non-MSW organic feedstocks.

2. Use of regional facilities augmented by sub-regional, multi-community processing operations
    - Definition of a service boundary for planned processing facilities in Norris Arm and Robin Hood Bay;
    - Establishment of multi-community sub-regions, with a focus on remote areas;
    - Consideration of "lower-tech" processing technologies for sub-region facilities and using organics from non-MSW sources to enhance feasibility/sustainability; and
    - Definition of a minimum tonnage/population threshold for both regional and sub-regional program participation.

3. A hybrid of Scenarios 2 and 3, including community-specific, small scale facilities for remote areas.

    Preliminary descriptions (e.g., service areas, facility locations, approximate annual tonnage, haul routes) of these three scenarios were developed and presented at a 50% Project Review Meeting held in St. John's on September 24th and at a follow-up meeting held at the Earth Bound conference on September 26th (minutes are provided in Appendix D). Following these meetings, Dillon was asked to consider two additional organics management scenarios (Scenarios 4, 5).

4. Use of a single processing facility for the island situated in Norris Arm with a maximum four hour one-way trailer transport (e.g., from a TS) haul distance.

5. Use of two processing facilities for the island; one located near St. John's and one in the Deer Lake area with a maximum three hour one-way trailer transport (e.g., from a TS) haul distance.

    Analysis and results of the five scenarios were presented at the Draft Report Review Meeting held in St. John's on December 16th (minutes are provided in Appendix I). Following this meeting, Dillon was asked to consider two additional organics management scenarios (Scenarios 6 and 7).

6. Scenario 4 expanded to include 99.7% of the island's population.

7. Scenario 5 expanded to include 99.7% of the island's population.

Founded on these requirements, and as documented in Section 6 of this report, descriptions for seven candidate organics management scenarios were prepared. Scenario development included the definition of key system attributes, including:

System Governance/Management
Public Education and Awareness
Residential and ICI Collection
- Feedstock identification
- Source Separated Organics (SSO), leaf & yard, seasonal

Transfer
- Direct haul, TSs

Processing
- Facility type(s), sizes, and generalized locations

End Products
- Compost and residuals

Task 7 - Conduct Detailed Scenario Analyses
Following the completion of Task 6, the team commenced a detailed analysis of each option consistent with the areas highlighted in Section 3 of the Terms of Reference, namely;

- Consideration of a 30-year lifecycle;
- Estimation of capital and annual operating costs, as well the Net Present Value (NPV) cost, within a target range of ±30%;
- Identification of feedstock locations and projected quantities, including necessary bulking/carbon sources;
- Specific consideration of feedstock transportation requirements (routes, methods, infrastructure and cost), evaluated through the use of a computer/GIS-based transportation model;
- Identification of generator (residential and ICI) feedstock collection requirements;
- Identification of system user education and awareness requirements (initial and ongoing);
- End product usage opportunities, including revenue generation estimates;
- Estimation of diversion performance (% by weight) and contribution to overall provincial total;
- Specific cost/benefit evaluation (including GHG generation/carbon footprint implications) of establishing an organics management facility in proximity to St. John's and Norris Arm as compared to landfilling the materials at the same locations;
- Identification of recommended revisions to relevant provincial guidelines and regulations; and
- Discussion on potential opportunities to establish necessary organics management infrastructure, including ongoing operations, through the establishment of a public-private partnership(s).

Task 8 - Prepare Project Report

Upon the conclusion of Task 7, the assignment's objectives, assumptions, methodologies, findings and recommendations were assembled into a draft version of the Study for Options for Organic Waste Processing in the Province of Newfoundland and Labrador. Following the presentation of highlights of the Draft Report to the Project Committee at a meeting in St. John's and the identification of required revisions in consultation with DMA (including the addition of two new scenarios), a finalized version of the Project Report was prepared.

Following the issuing of the Final Project Report in March 2014, the Project Committee contacted Dillon to request that some additional revisions, including modification of Scenario 3, be incorporated into a revised version of the final study document. Based on a confirmed set of revisions developed in consultation with the Project Committee, a Revised Final Project Report was prepared and issued in July 2014.

3.0 Existing Conditions and Future Needs Assessment

3.1 Overview of Provincial Initiatives

3.1.1 Background

As mentioned in Section 1, the province released a Waste Management Strategy for Newfoundland and Labrador in 2002 and followed up with an implementation plan to the Strategy in 2007. One of the goals of the strategy is to divert 50% of the total waste generated from disposal (landfill/incineration). With approximately 30% of the total waste generated being comprised of organic materials, it is an obvious targeted material to find diversion programs for. The Strategy discussed implementing a disposal ban for organic materials.

The Strategy also defines the establishment of regional waste management systems as an action item with central composting facilities being part of the system. Assisting isolated and remote communities with economic and effective community composting operations is identified as an action item as well. Minimum requirements for two types of composting facilities (in-vessel and open windrow/static piles) were provided in the Strategy that were to be referred to until Guidelines were released (Guidelines released are discussed in Section 3.3).

In 2007, the provincial government announced the provision of $200 million to implement the actions in the Strategy. The government committed to covering 100% of the capital costs that could go towards implementing initiatives of the Strategies such as purchasing waste collection vehicles and procurement and construction of composting facilities. Operational costs will be covered through the users of the waste management system (e.g., communities, residents, businesses and industry).

Part of the MMSB mandate is to provide capacity building support to the regional waste management authorities to facilitate the implementation of the provincial Strategy. MMSB put forward the Strategic Plan (2011-2014) that discusses the goals and objectives in that three year period. An annual report is released that outlines their achievements in relation to the Strategic Plan goals. The most recent annual report was issued in July 2013 for the 2012-2013 fiscal year. In terms of organics management, the annual report provided updates on the community composting pilot projects and the curbside composting pilot program in the Burin Peninsula.

3.1.2 Current Programs

MMSB is providing the initial capital investment to establish community composting projects and to train operators of the programs. At the time of reporting, there were four pilot projects as follows: 1) Town of Holyrood, 2) Harbour Breton, 3) Town of Cape St. George and 4) Small Point-Broad Cove-Blackhead-Adam’s Cove. As mentioned above, MMSB is working with the Burin Peninsula Regional Service Board and the Town of Grand Bank to implement curbside collection of organic waste (food waste, fibres).

MMSB also established an Inter-Industry Organics By-Products Group that is comprised of federal and provincial government departments, agencies and stakeholders from the agriculture, aquaculture, forestry and fisheries industries to find solutions to manage industrial by-products.

3.2 Existing Municipal Infrastructure and Services

3.2.1 Overview

As listed in the adjacent text box, there are eight Regional Waste Management Authorities (RWMA) that operate on the island of Newfoundland. The RWMAs are responsible for designating, financing and operating regional waste management systems across the province. Each RWMA is operated by a board of directors and is represented by municipalities, local service districts (LSD) and/or unincorporated communities within the region.

Regional Waste Management Authorities

1. Discovery Region
2. Burin Peninsula
3. Central Region
4. Coast of Bays
5. Eastern Region
6. Baie Verte - Green Bay Region
7. Northern Peninsula

A questionnaire was developed by the Dillon team to gain an understanding of existing waste management services and infrastructure in each region. The questionnaire was divided into the following seven sections:

- Section A: General Information (e.g., roles and responsibilities, population served)
- Section B: Wastes/Garbage
- Section C: Recyclables
- Section D: Organics - Backyard Composting & Leaf and Yard Waste
- Section E: Organics - Food Waste
- Section F: Public Education and Stakeholder Engagement
- Section G: Other Information

A member of the Dillon team first called each RWMA representative to explain the purposes of the study and questionnaire and the timelines for completion and follow up questions. The questionnaires were then emailed to the contacts on July 11 and 12, 2013 and the majority of the information requested was provided from the RWMAs by mid-August. Seven of the RWMA participated in the questionnaire and follow up discussions. As of September 6, 2013, no response had been provided by Baie Verte – Green Bay Region. Follow up discussions with regional representatives were conducted throughout the course of the study.

The following provides a summary of the information gathered as part of this assignment on existing waste management services and infrastructure on the island of Newfoundland. Regional maps that show sub-regional boundaries and waste management infrastructure is also provided. Note that the numerical order used for the regions and sub-regions was one developed by the study team during the proposal preparation stage.

3.2.2 *Discovery Regional Service Board*

Discovery Regional Service Board (Discovery RSB, Error! Not a valid bookmark self-reference.) manages wastes generated in the north east part of Newfoundland as stated in the Discovery Regional Service Board Regulations (July 10, 2013). The Board is comprised of members representing municipalities, local service districts and unincorporated communities. According to Statistics Canada, Discovery RSB has a population of about 11,500 (2011 data). There are some portions of the region that are primarily tourist areas. In addition, some areas are unincorporated; very limited waste management system information was identified for these locations.

<u>Discovery RSB Sub-Regions</u>
1. Bonavista
2. 5 Coves
3. Trinity Bay North
4. King's Cove
5. Port Rexton
6. Charleston/Sweet Bay
7. Jamestown
8. Lethbridge
9. Musgravetown
10. Port Blandford

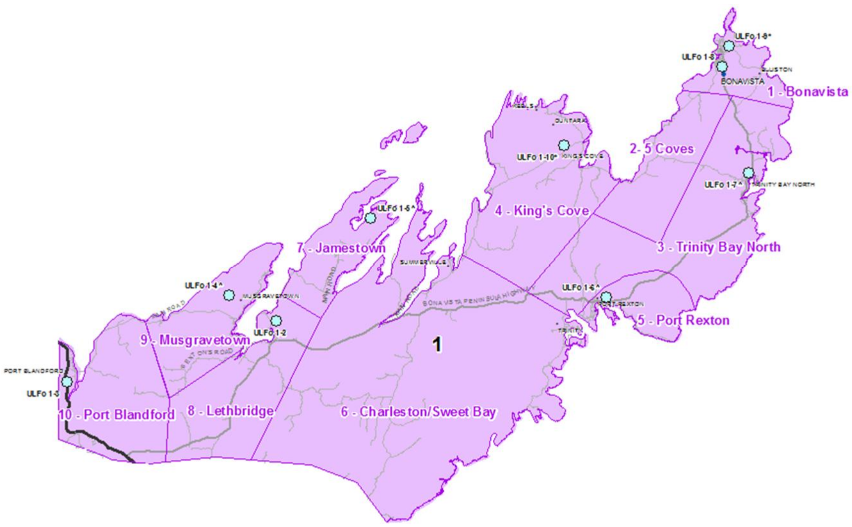


Figure 3-1 Map of Discovery RSB

Discovery RSB does not provide curbside collection of waste for its residents. Trinity Bay North and Bonavista share a contract for hauling of waste to landfills. Some communities offer a bi-annual bulk clean up service but the majority of residents self-haul to the unlined landfills.

There are nine unlined landfills located in the region. Sites are located at Lethbridge, Port Blandford, Musgravetown, Charleston/Southern Bay, Port Rexton, Trinity Bay North (Catalina), Bonavista, Newmans Cove and King's Cove, providing a disposal service to the region's 47 communities. Residents dump directly at the disposal site and in some cases waste is burned to reduce volume. The primary ICI waste generators are the two fish plants (which are permitted to dump at sea), one operational mink farm (currently uses the Lethbridge landfill) and a hospital in Bonavista (currently uses the Bonavista landfill).

Residents can drop off recyclables at the Green Depot in Bonavista. School children also collect recyclables and receive double the deposit (for fundraising efforts) when returned which reportedly has made it difficult for the Green Depot to be economical. Discovery RSB approximates that 200 backyard composters have been distributed to residents at a cost of $25 each. There are no other composting related programs currently in place.

In the future, Discovery RSB plans to consolidate the landfill sites into two regional Waste Recovery Facilities (WRFs) (Lethbridge and Bonavista) and provide curbside collection of garbage. The landfill sites are planned for closure within the next year. Residents can self-haul bulky waste, yard waste and construction and demolition (C&D) waste to the WRFs and garbage collected at the curbside will be hauled directly to the Clarenville TS (to be constructed) in Eastern Region. From there, it will be transported to and disposed at the Robin Hood Bay landfill site. The future plans for the curbside collection of organics and recycling are uncertain at this time. Disposal of household hazardous waste (HHW) will be offered through an annual mobile collection event.

There is interest in participating in a composting program as the lower volumes of garbage going to landfill will equate to less transportation costs for a region that is economically challenged. A barrier to implementation will be resident participation but with transparent rationale for a composting program, residents should see the benefits with such a program. For the tourist-intensive areas that are comprised of bed and breakfasts and restaurants, organic volumes will typically be higher in the summer months (3-5 months).

Potential sources of non-residential composting feedstock/bulking agents are two fish plants, a mink farm, hospital and restaurants.

Data received through contact with the local authority representative was a background document on public consultation and events to promote waste management.

3.2.3 Burin Peninsula Regional Service Board

Burin Peninsula Regional Service Board (Burin Peninsula RSB, Figure 3-2) manages wastes generated in the southeast portion of Newfoundland (west of Eastern Region). Waste is managed under the Waste Collection and Disposal Regulations (May 2012) which provides requirements for proper waste set out, unacceptable curbside collected materials, residential bulk collection, commercial bulk disposal and taxation. The Board is comprised of members representing designated sub-regions of Burin Peninsula. The General Manager oversees daily operations of the Grand Bank landfill site and communication with outside bodies such as municipalities, consultants, and provincial partners. There is a superintendent at the landfill who operates site scales, maintains volume records and separates organics for the composting program (more detail provided below). There is a heavy equipment operator who conducts site development and landfill maintenance. According to Statistics Canada, Burin Peninsula RSB has a population of about 18,400 (2011 data).

<u>Burin Peninsula RSB Sub-Regions</u>

1. Placentia West
2. Marystown Area
3. Town of Grand Bank
4. St. Lawrence Area
5. Garnish Area
6. Fortune Bay East
7. Town of Burin
8. Burin Exterior
9. Town of Fortune
10. Greater Lamaline Area

As of May 2013, Burin Peninsula RSB provides weekly collection of garbage to half of the region (approximately 5,000 households). Those residents currently have an eight bag limit. Bugden's Trucking and Excavation provides two collection vehicles and collects on a four-day schedule at an approximate annual cost of $600,000. Monthly bulky waste collection is available at most sites whereby residents call ahead to book this service.

Burin Peninsula RSB operates a landfill site in Grand Bank which services half of the region's population. There are seven active municipal waste disposal sites (WDSs) that are currently being operated by the Towns or by LSDs of Grand Le Pierre, Terrenceville, English Harbour East, Bay L'Argent, Monkstown, Rushoon and Marystown. These sites also have public drop-off areas and accept C&D waste and white goods (e.g., refrigerators, washers, dryers and stoves). Commercial customers can either pay $120 a year to have weekly collection of waste or pay tipping fees at the Grand Bank landfill (currently $80/tonne). Residents pay $120 per household per year. There are 11 landfill sites that are closed and awaiting environmental closure in Burin, Epworth-Great Salmonier, Fox Cove-Mortier, St. Lawrence, Lawn, Lord's Cove, Lamaline, Point May, Winterland, Garnish and Frenchman's Cove. Residents dump directly into the landfills and in some cases waste is burned to reduce volume. The primary ICI waste generators are Kiewit Energy in Marystown, Ocean Choice International in St. Lawrence, Burin Peninsula Health Care Centre, the College of the North Atlantic in Burin and Eastern School District locations throughout the region.

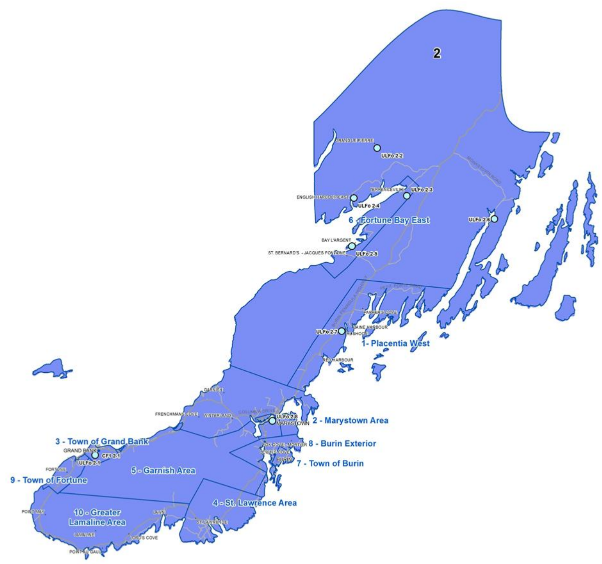


Figure 3-2 Map of Burin Peninsula RSB

Container recycling is provided through the two Green Depots located in Marystown and Fortune.

Approximately 1,200 households within the Town of Grand Bank have access to a pilot project where residents receive weekly collection of compostables (paper fibres, leaf and yard waste (LYW) and food scraps). Fibre products (e.g., paper, old corrugated cardboard) are collected in translucent green bags and food scraps and LYW are collected in compostable bags. The same contractor that collects garbage also collects organics from this pilot area using 60/40 split collection vehicles. The project initially was offered to 400 households and 200 households voluntarily participated along with ICI generators (fish plant, saw mill and grocery store). This voluntary program generated 120 tonnes of waste within the first year. The program was recently expanded to 1,200 households. Residents can also drop off organics at the Grand Bank landfill site. Burin Peninsula RSB is working with MMSB to integrate a local high school into the composting program. Organics are processed in a windrow composting facility at the Grand Bank landfill site. Burin Peninsula RSB believes some residents use backyard composters however the number of users is uncertain. LYW collection is collected monthly with bulk waste to about 5,000 households that Burin Peninsula RSB services (about half of the region). Some of the other municipalities provide leaf and yard collection. The Grand Bank landfill and all active municipal WDSs accept LYW and annual waste fees include access to these sites. LYW received at the Grand Bank landfill is chipped and composted in the windrow facility. The facility is designed to accommodate 1,000 tonnes per year. The finished compost meets BNQ and CCME Category “A” standards and is used locally among residents and community groups.

Burin Peninsula RSB conducts annual public information sessions for the composting pilot with MMSB. They have also gone door-to-door to provide hands on information to participating residents. The website is maintained and any service interruptions are broadcasted on the local radio station. Press events are held to announce significant developments in their operation. They are currently developing a regional email listing. Their current annual cost is $5,000 for the public education and information program.

Burin Peninsula RSB is planning to close the Grand Bank landfill site and will eventually send waste to Robin Hood Bay. The Placentia West and Fortune Bay East area WDSs may also be closed. Gradual expansion of the curbside composting service is being planned and potentially recyclables collected in a different coloured bag. Adding a bin service for C&D and bulky wastes at strategic locations around the region is also being considered. There have been plans to construct a TS and composting facility in either Frenchman’s Cove or Marystown but little investment has been made.

Burin Peninsula is pleased with the success of the voluntary compost collection program, the cost savings and the quality of compost produced through rudimentary means. It is believed that a voluntary program is unlikely to lead to high diversion rates therefore, in order to maximize the benefit of the program, participation must be made mandatory. Burin Peninsula RSP also believes that allowing more bags for segregated waste streams and less for residual waste is key to ensuring participating and maximizing diversion. Assuming that a reasonable level of user cost can be maintained, the local representative expected that residents would be supportive of enhanced diversion efforts in the region.

Potential future sources of non-residential composting feedstock/bulking agents that are currently contributing to the pilot composting program are White’s Sawmill in Burin, Ocean Choice International in St. Lawrence and Sobeys in Grand Bank. There are reportedly other candidate ICI sources that have not yet been integrated.

Data received through our consultation with the local authority representative were ICI statistics, the 2012 and 2013 (up to June 30) budget statement and a 2008 Waste Management Study.

3.2.4 Central Regional Service Board

Central Regional Service Board (Central RSB, Figure 3-3) manages wastes generated in the central part of Newfoundland. The Board is comprised of a Chairperson and 12 Board members. Central RSB

<u>Central RSB Sub-Regions</u>

1. Buchans Area
2. Point Leamington Area
3. New World Island/Twillingate
4. Fogo Island
5. Gander Bay
6. Indian Bay
7. Terra Nova
8. “Zone 8”

currently employs 32 people that include a manager, operations supervisor, finance, administration, scale house, TS and equipment operators and collection drivers. According to Statistics Canada, Central RSB has a population of about 72,000 (2011 data).

Central RSB provides weekly collection of garbage to most of the region (approximately 40,000 residents or 15,000 households) and collects approximately 10,000 tonnes per year. Central RSB received financial support from the Province to purchase ten 60/40 split compartment collection vehicles ($2.25 million investment). The current (2013) annual operating cost for the region's waste management system is about $5.8 million. Some local municipalities provide curbside collection of garbage. For residents that do not have curbside collection, they are required to either drive the waste directly to a TS or regional site or hire their own collection contractor. Bag limits, where they exist, are set by the local municipalities. C&D, HHW and bulky waste are accepted at the Region's waste management sites.

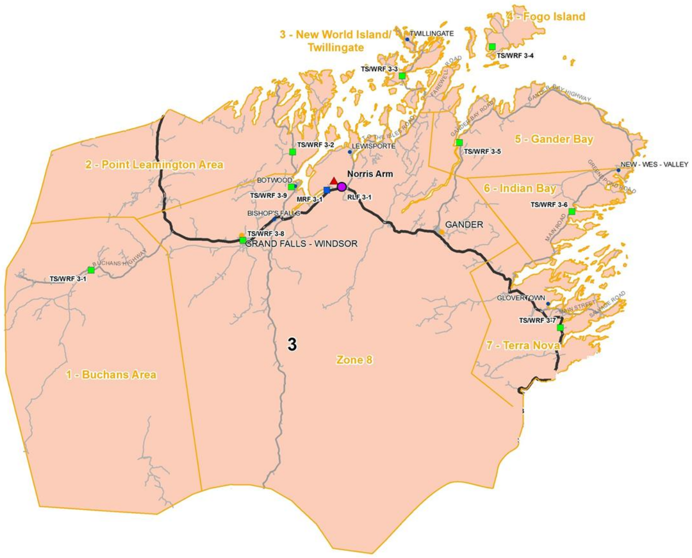


Figure 3-3 Map of Central RSB

Central RSB operates the Norris Arm Regional Waste Management Facility. The Facility, which opened in March 2012, includes an engineered, lined landfill with leachate treatment, a public drop-off area and a C&D material depot. International garbage from airports and seaports are deposited at the engineered landfill. A Materials Recovery Facility (MRF) is currently under construction at the Norris Arm site and is expected to be operational in late 2014. Central RSB oversees the operations of seven TSs that were constructed so that residents would not have to travel more than an hour to dispose of waste. These TSs are located in Buchans, Point Leamington, Twillingate, Fogo Island, Gander Bay, Indian Bay and Terra Nova. Central RSB estimates that 12,000 tonnes of garbage is received annually at these TSs. Transfer trailers, with walking floors, are used to move residential waste from the stations to the Regional Site. Tipping fees for garbage and mixed C&D wastes are $117 per tonne, C&D sorted waste and tires are $10 per tonne. The Towns of Grand Fall-Windsor and Botwood have their own Waste Recovery Facilities that accept C&D waste, metals and yard waste. Garbage collected in Botwood is hauled to the Point Leamington TS site, consolidated and then hauled to Norris Arm. Approximately 65% of the population has curbside collection of garbage primarily in "Zone 8" which includes Gander, Botwood, Grand Falls - Windsor which is hauled directly to Norris Arm. To date, 41 local dump sites have been closed. The primary ICI waste generators are schools, hospitals, shopping malls, restaurants, general contractors, aquaculture fisheries and government offices. Central RSB estimates that it received about 21,000 tonnes of garbage from the ICI sector in 2012.

There are 14 Green Depots in the region and curbside collection of recyclables is scheduled begin in late 2014 when the MRF is operational.

There is currently no curbside collection of organic waste in Central RSB. Residential and non-residential LYW is accepted at all eight sites in the Region at a cost of $10 per tonne. Non-residential sources of carbon-rich feedstock are sawmills, the forestry sector and from general contracting work (e.g., clean wood waste). Potential non-residential generators of composting feedstock/bulking agents are fisheries, agricultural operations, food processors and institutions.

Based on information provided by the regional authority representative, the Central RSB is in the process of implementing a three stream collection program with weekly organics collection and alternating bi-weekly single-stream recycling and bi-weekly garbage collection. Recyclable materials will go to the MRF and organic materials will go to the composting facility. The current focus is on implementing the recycling program and then to find ways to manage organics and garbage. The composting facility is Phase III of the regions' Waste Management Strategy (Phase I – construction of engineered landfill which is complete, Phase II – construction of MRF which is expected to open in late 2014). Western RSB may send their materials to the Regional Site and the composting facility may also receive organics from Coast of Bays and Green Bay.

Central RSB has a website, annual calendar and uses other marketing materials to promote waste management programs. Residents have been informed that the wet/dry system will be in effect by mid-2014 through the annual calendar and other media sources. The Regional Site has been marketed as a "Supersite" with all the required waste management services. Central RSB estimates that the approximate annual cost of the public education program is $100,000.

Data received through our consultation included estimated waste quantities, operational budgets, financial statements and staffing information.

3.2.5 Coast of Bays Waste Management Corporation

Coast of Bays Waste Management Corporation (Coast of Bays WMC, Figure 3-4) manages wastes generated in the southern central part of Newfoundland. The WMC has a Waste Management Coordinator who regularly provides updates to the mayors and councillors in the region. According to Statistics Canada, Coast of Bays WMC has a population of about 6,600 (2011 data).

Each municipality and LSD offers residential (approximately 2,800 households) and small commercial

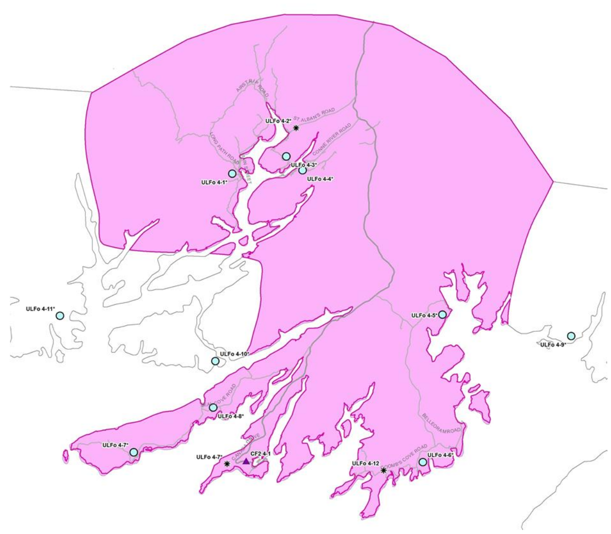


Figure 3-4 Map of Coast of Bays WMC

garbage waste collection services. The services (typically on a weekly basis) are provided either by town workers or through contractors engaged by the municipality.

Municipalities offer bulky waste collection at least twice a year which is brought to the landfill. The current annual cost per household ranges from $60 to $213.

There are 12 WDSs (WDSs) within the region identified as St. Jacques-Coombs Cove WDS, Conne River, Gaultois (remote site), Town of Harbour Breton, Hermitage-Sandyville WDS, Milltown/Head of Bay D'Espoire Site, Morrisville WDS, Pool's Cove Dump Site, Town of Rencontre East Landfill (remote site), Pass Island Road (Seal Cove), McCallam (remote site) and St. Alban's Municipal Disposal Site. These WDSs are open pit landfills where waste is dumped over the tipping face and covered two to four times a month. There are no tipping fees. There is a designated scrap metal receiving area at all sites where metals are stored and then picked up by a metals recycler approximately once a year. The primary ICI waste generators are the aquaculture industry, hospitals and clinics, community schools, Newfoundland and Labrador Hydro and automobile repair garages. Municipalities and/or private contractors collect from schools and garages.

There is one Green Depot in the region located in St. Alban's. Some communities provide for residential drop off of recyclables at municipal facilities that is later collected. Some schools also have drop off areas for recyclables since they get double the deposit returned through a provincial program. A Green Depot vehicle collects recyclables from these sources.

There is no curbside collection of organic waste in Coast of Bays WMC. Municipalities and the MMSB provide residents with the opportunity to purchase backyard composters. In addition, some communities sponsor composting seminars to residents and schools. Two elementary schools started their own vegetable gardens and composting program that uses the compost to fertilize the gardens. Reportedly, Coast of Bays WMC has received positive feedback from residents on the effectiveness of backyard composters and residents are becoming aware of the benefits of recycling and composting and how it reduces costs to manage garbage. There is a community composting operation in Harbour Breton that processes food scraps from grocery stores (no meats), sawdust from local sawmills and from residential sources. Town staff manages the facility and compost that is produced is either used in community projects or given away to the community. Non-residential sources of carbon-rich feedstock are sawmills (the local contact noted that limited quantities are generated).

Coast of Bays WMC uses the local newspaper to inform residents about updates to the regional waste management strategy, proper backyard composting techniques, environmental best practices and ways to reduce and reuse waste.

Coast of Bays WMC is looking into consolidating the landfill sites into three sub-regional TSs and closing all the landfills within the next two years. Each sub-regional facility (potentially to be located at Harbour Breton, St. Jacques-Coombs Cove and Milltown) will be sized to store residential and ICI waste, C&D waste, bulky waste and HHW. Three sub-regional zones will also be defined around the locations of the proposed TS facilities. The waste will be sent to the Norris Arm regional waste facility. Coast of Bays WMC is interested in finding a way to manage compost on the coast (e.g., increase use of backyard composters, community composting facilities) and could stockpile recyclables until sufficient quantities are collected for efficient transport to processors.

Data received through our consultation included a draft Solid Waste Management Strategy and current garbage collection costs per household.

3.2.6 Eastern Regional Service Board

Eastern Regional Service Board (Eastern RSB, Figure 3-5) manages wastes generated in the central part of Newfoundland which is governed through the Eastern Regional Service Board Regulations (92/11). The Board is comprised of a Chairperson and 19 Board members that represent sub-regions among the 163 communities. There are also sub-regional waste management committees that were established to develop landfill site closure options and to implement modern waste management practices in the local area with Eastern RSB. Based on 2011 Census information, the Eastern RSB has a population of approximately 266,000.

Eastern RSB Sub-Regions

1. Clarenville and Isthmus
2. Trinity Bay South and Isthmus East
3. Trinity Conception North
4. Bay Roberts
5. Large Metro
6. Small Metro
7. St. John's
8. Southern Shore
9. Southwest Avalon

Eastern RSB provides (through contractors) weekly collection of garbage to 18,000 households where the remaining households receive weekly collection through their municipality conducted by a mix of contractors and municipal staff. Bag limits vary between the municipalities from six to 10 bags. Residents can place bulky waste at the curbside for collection or drop off at a Waste Recovery Facility (WRF) or the residential drop-off site at Robin Hood Bay at no cost. No commercial waste is accepted at residential drop-off sites and WRFs. Schedule 1 of the Regulations list waste prohibited for collection (e.g., hazardous waste, pathological waste, HHW). Mobile HHW collection events occur throughout the year.

The City of St. John's operates the Regional Integrated Waste Management Facility at Robin Hood Bay. The facility includes a landfill, MRF and a permanent HHW facility. The landfill received over 200,000 tonnes of waste in 2012 from residential and commercial sources. Eastern RSB oversees the operations of six WRFs located in Placentia, St. Joseph's, Bay Bulls, Renews-Cappahayden, Old Perlican and Sunnyside. The 2012 operating budget for these facilities was just over $900,000.

There are currently 17 Green Depots in St. John's and throughout the region. Approximately 85% of residents (or 108,000 households) are provided with biweekly curbside collection of recyclables through different contractors. Recyclables are sorted into two streams (containers and paper products) and placed into separate clear blue recycling bags. It is estimated that 5,800 tonnes of recyclables were processed at the Robin Hood Bay MRF.

There is no curbside collection of organic waste in Eastern RSB. Residents can drop off LYW at WRFs and the Robin Hood Bay site. There are local, small scale composting operations in Holyrood, Riverhead and Harbour Grace.

Eastern RSB is planning to construct three additional WRFs, three of which (Cavendish, Harbour Grace, Whitbourne) are scheduled for completion in 2013 and a Request for Proposal to build a TS in Clarenville is currently (at the time of reporting) out for tender.

Eastern RSB publishes an annual Regional Services Guidebook that describes the waste collection programs, facilities and provides a waste collection calendar for six areas.

Data received through our consultation included quantities of waste managed at Robin Hood Bay, 2013 budget, 2007 City of St. John's Solid Waste Management Plan and the 2011 Eastern RSB Waste Management Plan.

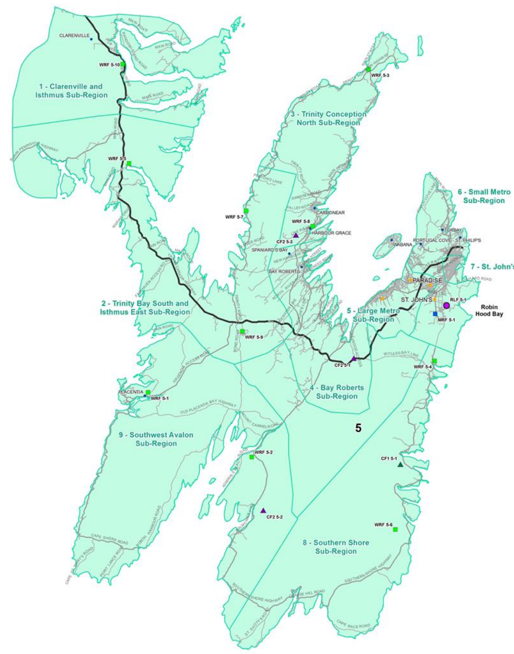


Figure 3-5 Map of Eastern RSB

3.2.7 *Baie Verte – Green Bay Region*

During July and August 2013, several attempts were made to contact with representatives in the Baie Verte – Green Bay Region to ask for their response to the questionnaire. As of September 6, 2013, no information had been provided. MMSB provided Dillon with a previous Waste Management Review for the Baie Verte Sub-Region and an overview of the Region. Based on 2011 Statistics Canada data, the Green Bay area (Figure 3-6) has a population of 12,900.

The following information about Baie Verte - Green Bay Region is taken from the files received from MMSB.

The Baie Verte - Green Bay Region is made up of 45 communities in the north central portion of Newfoundland. Within the Region, there are two sub-regions that have separate waste management programs: Baie Verte and Green Bay. The region was split into the two sub-regions based on a map showing the dividing line that was provided by DMA to Dillon in July 2014.

Baie Verte - Green Bay Sub-Regions

1. Green Bay
2. Baie Verte

Baie Verte sub-region has 22 communities and according to the 2011 Census, has a population of 5,520. There is one scrap metal site and 10 active landfills (Westport, Burlington, Seal Cove, Wild Cove, Baie Verte, Ming's Bight, Woodstock, Nipper's Harbour, Snook's Arm, La Scie). The landfills are permitted to conduct seasonal burning. An estimated 3,500 tonnes of garbage is landfilled annually with the majority

Figure 3-6 Map of Baie Verte - Green Bay Region

of it being disposed of at the Baie Verte and La Scie sites. There are two Green Depots in Baie Verte. The primary industries are fishing and forestry. The goal of the Waste Management Review for the Baie Verte Sub-Region (September 2009) was to investigate each WDS and develop potential options to consolidate disposal operations. The Provincial Solid Waste Management Strategy identified the Green Bay/Baie Verte region as an "undesignated" region where waste would be collected and hauled to a host facility. The Review suggested that in the long term (2016) that the Green Bay and Baie Verte sub-regions would each have its own TS and send waste to either Central or Western regional facilities.

Green Bay sub-region is made up of 23 communities and according to the 2011 Census, has a population of 7,343. Aside from the Little Bay Island community (population of approximately 150), Green Bay sub-region is serviced by the Green Bay Waste Authority Inc. (GBWA). GBWA owns a WDS in South Brook which has been identified as a regional WDS for the area. GBWA has been providing bi-weekly curbside collection of recyclables (beverage containers, paper fibre) to residents and businesses since 2003. Residents do not pay for this service and businesses pay $5 per pick up. Paper fibres are collected with an eight-tonne truck and they estimated about 520 tonnes of paper fibre are diverted annually. Deposit-bearing containers that are collected at the curbside are brought to one of three Green Depots in the sub-region. GBWA estimates household participation rates of between 50% and 60% and services approximately 60 businesses. It is estimated that the sub-region landfill 7,800 tonnes of garbage annually.

3.2.8 Northern Peninsula Regional Service Board

Northern Peninsula Regional Service Board (NorPen RSB, Figure 3-7) manages residential, commercial and industrial wastes generated in the northwest part of Newfoundland which is governed through the Northern Peninsula Regional Service Board Regulations (34/05). The Board is comprised of a Chair, Co-Chair, hired Coordinator and 10 elected officials that represent the four sub-regions. According to Statistics Canada, NorPen RSB has a population of 12,700 (2011 census).

NorPen RSB Sub-Regions

1. Sub-region 1
2. Sub-region 2
3. Sub-region 3
4. Sub-region 4

NorPen RSB provides weekly collection of garbage to all households (approximately 4,900 households) and ICI sources (provided their waste can fit in the collection vehicles) in the region. There are four collection zones and days where Norpen RSB staff collect garbage using compaction vehicles. Garbage is directly hauled to one of four regional landfill sites. In 2012, approximately 5,400 tonnes of garbage was collected. Customers can also drop-off waste at the four regional landfill sites for a fee based on the size of vehicle (fees posted on NorPen RSB website). There is an annual spring clean-up.

NorPen RSB has closed eight dump sites in the region and now all garbage is hauled and disposed at four regional landfill sites that are owned and operated by NorPen RSB. Sub-region 1 landfill is located near St. Anthony, Sub-region 2 (Bill's Pit) landfill is located near Roddickton, Sub-region 3 landfill is located near St. Barbe and Sub-region 4 landfill is located near Hawke's Bay. The estimated annual cost to operate the four landfill sites is $100,000. When the Provincial Waste Management Strategy is fully operational, there will be no landfills in the Northern Peninsula. All garbage will be hauled to the Norris Arm regional landfill.

The primary ICI waste generators are hospitals, commercial establishments, Ocean Choice International, hotels, construction companies, and schools. NorPen RSB estimates that the ICI sector generated about 28,000 cubic metres of garbage.

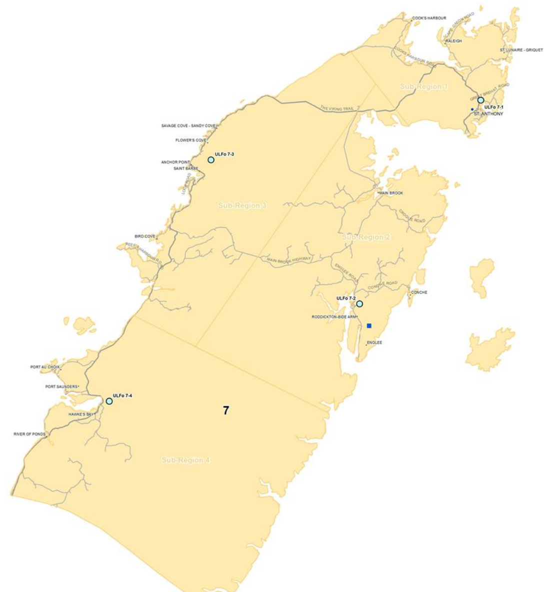


Figure 3-7 Map of Northern Peninsula RSB

There are three Green Depots in the region (St. Anthony, Port au Choix, Roddickton).

NorPen RSB estimates that 90 backyard composters have been distributed to date. The cost to purchase is $24.85 and NorPen RSB believes that most residents use them. Backyard composting is promoted through newspaper advertisements and their website. There is no organic collection program (leaf and yard or food scraps). NorPen RSB believes the advantages with having a composting program are: less waste going to landfills, reduced greenhouse gas emissions, lower disposal costs and ability for gardeners to have access to a safer product without the chemical fertilizers and pesticides. The primary challenge with implementing a program will be cost. They conducted a survey and 95% of the respondent said they would participate in a curbside collection program (preferred over a drop-off depot program). A potential non-residential generator of composting feedstock/bulking agent are shrimp shells.

NorPen RSB uses newsletters, the website, brochures and presentations to promote waste management programs. The estimated cost to run the public engagement program is $5,000. Other groups in the community that are interested in waste management are schools, hospitals and Northern Wellness.

Data received through our consultation included waste audit data, 2012 and project 2013 budgets and 2013 tipping fee structure.

3.2.9 Western Regional Service Board

Western Regional Service Board (Western RSB) manages wastes generated in the western part of Newfoundland which is governed through the Western Regional Service Board Order (10/13) under the Regional Services Board Act, 2012. The Board is comprised of a Chairperson and 11 elected officials that represent the sub-regions. Western RSB has a population of approximately 75,000 (2011 Census).

Western RSB does not currently provide any waste management services (e.g., collection, disposal) to residents. There are seven sub-regions within Western RSB and each sub-region has slightly different waste management programs however, most provide weekly garbage collection through compactor collection vehicles, pick-up trucks or trailers. Waste can also be dropped off at approved landfill sites or incineration facilities (located at remote and isolated communities).

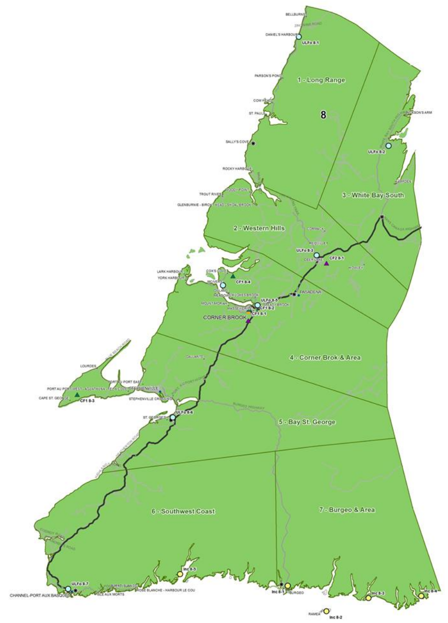


Figure 3-8 Map of Western RSB

Western RSB Sub-Regions

1. Long Range
2. Western Hills
3. White Bay South
4. Corner Brook & Area
5. Bay St. George
6. Southwest Coast
7. Burgeo and Area

There are currently seven active landfills (Portland Creek, Pollard's Point, Deer Lake, Wild Cove, McIver's (Corner Brook Area), St. Georges and Port au Basque) that will be closed when the future TSs are built in each sub-region. Two landfills (Trout River, Howley) were closed in July 2013. All landfill sites accept C&D waste. St. George's landfill and Port aux Basques have HHW depots and the MMSB conducts mobile collection events in the summer. Used paint is accepted by paint retailers and green depots. There were four low-temperature incinerators in Burgeo, Ramea, Grey River and Francois. Burgeo is now closed and there is a consolidation pilot project where waste collected at Grey River is being shipped to Burgeo which will eventually close the Grey River incinerator. Bulky waste collection varies among the communities with some having annual pick-ups and others having weekly collection with garbage. Some communities have by-laws regarding bag limits, bag size, curbside boxes, landfill bans on cardboard (e.g., Corner Brook) and some have LYW collection. There are 11 closed landfills within the region.

Small businesses have their waste collected with the residential waste. The larger ICI companies manage their own waste through private contractors. The primary ICI waste generators are commercial establishments (e.g., restaurants, grocery stores, shopping malls), institutions (e.g., hospitals, colleges, schools), Corner Brook Pulp and Paper and fish plants.

There are 11 Green Depots in the region (Burgeo, Burnt Islands, Codroy Valley, two in Corner Brook, Deer Lake, Pasadena, Port aux Basques, Rocky Harbour, Stephenville, Three Mile Rock). Most of these are operated by Scotia Recycling. The City of Corner Brook provides curbside collection of fibres. Some ICI companies backhaul cardboard and other fibres.

MMSB supports and promotes backyard composting through education and provision of subsidized composters to the community. Some municipalities (e.g., Corner Brook) provide curbside collection of LYW that is usually collected in the fall and at Christmas with regular garbage. There are a few composting facilities in the region including Memorial University Grenfell Campus (in-vessel system), Hi-Point organics (private facility known as Genesis Organics), MMSB runs compost projects in Cape St. George and Deer Lake (for LYW). Carbon-rich materials from non-residential sources may be challenging to obtain as Corner Brook Pulp and Paper Mill uses carbon-rich materials from its own operations, scrap wood from landfills, sawdust from Clarenville saw mill and debris from forestry operations for hog fuel. Potential ICI organic feedstock providers are from fish plants and grocery stores. There is currently no food waste collection within the region.

Western RSB uses newsletters, the website, brochures and presentations to promote waste management programs. The estimated annual cost to run the public engagement program is $5,000. Other groups in the community that are interested in waste management are schools, hospitals and Northern Wellness.

Within the next 24 months, Western RSB plans to take over several contracts for landfill operations and implement a cost per tonne tipping fee structure in some areas. By 2016, Western RSB plans to construct six TSs and at least three public drop-off depots. They are considering multi-stream collection with garbage being hauled from TSs to Central RSB's Norris Arm landfill site. A final plan to manage the recyclable and compostable materials has yet to be developed. The return distance from Corner Brook to Norris Arm is around 600 km. As a result, local representatives have concluded that the only way centralized organics processing would be feasible is if the facility would be able to backhaul marketable compost from the facility or if there was an advanced technology used to process compostables (e.g., in-vessel system). Western RSB's goal is to provide curbside collection of single stream recyclables and processing these materials at either Norris Arm or a local MRF. The remoteness of the Western RSB from the Central Region's site is viewed as a significant limiting issue in utilizing the proposed composting facilities at Norris Arm.

Waste management is promoted through a website and quarterly newsletter and an estimated $2,000 is spent on educational efforts. Potential interest groups include the Memorial University's Grenfell Campus, the College of the North Atlantic, schools and Western Health.

Data received through our consultation included 2012 tonnage information on the Wild Cove and St. George landfills, 2013 Executive Summary of the Solid Waste Management Plan and a map showing estimated waste quantities, population and distances from six sub-regions to the Central Norris Arm site.

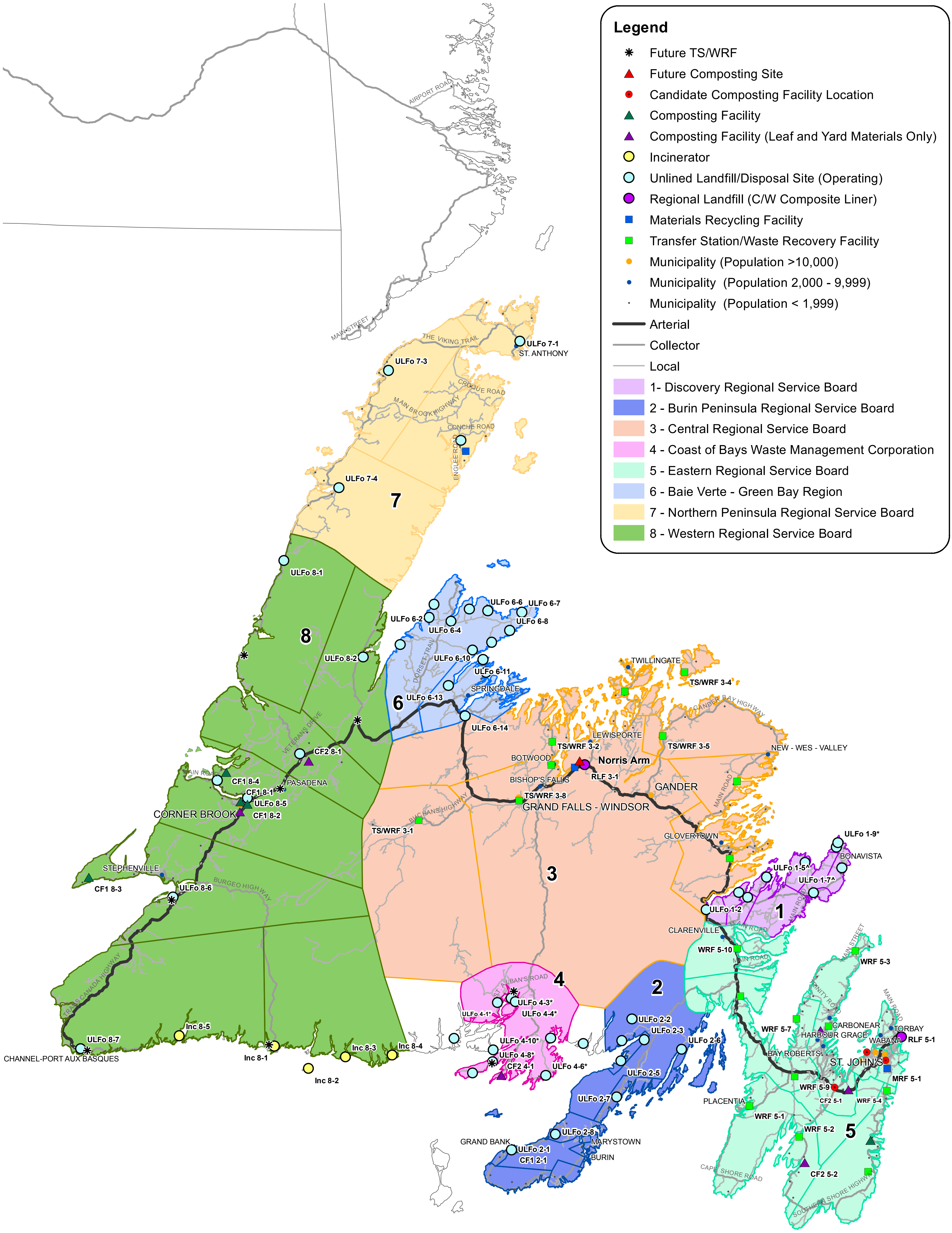
3.2.10 Summary of Current Services

Information received through interviews, questionnaires and review of background information provided an understanding of the current level of service in each of the eight regions. As mentioned by several regional authorities, some of the municipalities and LSDs within the regions manage and operate their own programs. The Regional representatives were only able to provide information that they knew about in the communities/municipalities outside of their jurisdiction.

Seven regions offer weekly collection of garbage (collection frequency may vary among municipalities and LSDs within region). There is a pilot organics collection program in one region and another region provides seasonal LYW collection (it is noted that many of the sub-regional and regional waste facilities accept public drop off of LYW). Two regions currently provide bi-weekly collection of recyclables (containers, fibres). One region does not have any curbside collection program in place.

Using all of the data received on existing and proposed waste management programs, a map was developed that presents the existing conditions (Figure 3-9). This map displays the eight waste management regions within the island of Newfoundland (each regional 'piece' was provided in the regional summaries above). Where applicable, each region was subdivided into sub-regions. Most of the regions define sub-regional boundaries but in the case of the Baie Verte – Green Bay Region, a division between two sub-regions was made based on information provided from DMA. Sub-regions were not defined for Coast of Bays. For Central Region, an eighth zone was created which captures the towns/areas that direct haul waste to Norris Arm (e.g., Grand Falls - Windsor, Gander).

The map also displays known existing waste facilities including landfills, TSs/WRFs, composting facilities and incinerators. Facilities have been symbolized based on the type of facility and have been assigned a unique code. This data is tied to a Geographic Information System (GIS) which will be used to analyze transportation routes and estimate hauling costs for the seven candidate scenarios.



GOVERNMENT OF NEWFOUNDLAND AND LABRADOR
STUDY OF OPTIONS FOR ORGANIC WASTE PROCESSING

FIGURE 3-9
STUDY AREA/WASTE MANAGEMENT FACILITIES MAP

MAP DRAWING INFORMATION:
DATA PROVIDED BY THE PROVINCE OF NEWFOUNDLAND AND LABRADOR

MAP CREATED BY: SLS
MAP CHECKED BY: AL
MAP PROJECTION: GCS_North_American_1983

0 5 10 20 km

DILLON CONSULTING

FILE LOCATION: I:\GIS\138097 50 NL Organics Options\Mapping

PROJECT: 13-8097 STATUS: REVISED FINAL DATE: 07/30/14

3.3 Regulations, Bylaws and Guidelines

3.3.1 Provincial Regulations

The following section presents a summary of the relevant provincial regulations.

3.3.1.1 Environmental Protection Act

As per the Environmental Protection Act, composting is referred to as *the treatment of waste and organic matter by aerobic decomposition and microbial action to produce a stable and inert material*. Under this act, the minister may designate a material that is to be banned, reduced, composted, recycled or restricted in use. Additionally, the Lieutenant-Governor in Council may make regulations that restrict, prohibit or enable the use or sale of products that may be composted.

Through a discussion with DEC staff, it was confirmed that an Environmental Assessment can be triggered for certain waste management systems by factors including proximity to major highways.

3.3.1.2 Waste Management Regulations

The 2003 Newfoundland and Labrador Waste Management Regulations define requirements for: 1) the Multi-Materials Stewardship Board (MMSB) which includes implementing and operating a waste management program approved by the minister and in accordance with the Waste Management Regulations, 2003; 2) the beverage container control program; and 3) used tire recycling.

As discussed earlier in this report, the Multi Materials Stewardship Board (MMSB) is a Crown Agency of the provincial government responsible for developing, implementing and managing waste diversion and recycling programs for specific waste streams designated by the province. MMSB provides guidelines and resources for backyard composting, community composting and vermi-composting.
http://www.mmsb.nf.ca/community-composting.asp

3.3.2 Provincial Guidance Documents

3.3.2.1 General Environmental Standards for Waste Management Facilities (July 2010)

This Guidance Document provides a general overview of standards applicable to all waste management facilities/systems that are part of the Provincial Waste Management Strategy which includes compost facilities. The Document refers readers to the other available standards that are specific to the type of waste management facility proposed (e.g., standards for MSW compost facilities).

Waste management facilities/systems are subject to registration in accordance with Part X of the Environmental Protection Act and in the Environmental Assessment Regulation. The legislative authority for establishment, development and operation is provided through the Environmental Protection Act Parts IV, V and XI and the Municipalities Act, Part XIII.1. The Guidance Document provides the following "non-exhaustive" list of municipal, provincial and federal legislation that also applies to waste management facilities/systems and sites.

Municipal requirements include:

- Zoning requirements and building codes as applicable.

Provincial legislation also includes:

- Occupational Health and Safety Act, Municipalities Act, and Water Resources Act.

Federal legislation includes:

- Canadian Environmental Protection Act and Regulations, Transportation of Dangerous Goods Act and Regulations, Fisheries Act, and National Fire Code.

Canadian Council of Ministers for the Environment (CCME) Guidelines are also enforceable under the Environmental Protection Act. These guidelines include:

- CCME Water Quality Guidelines for the Protection of Freshwater Aquatic Life, CCME Drinking Water Quality Guidelines, and CCME Compost Quality Guidelines.

Applications for a Certificate of Approval to construct and operate a waste management facility/system must be requested from DEC. This is further discussed in Section 3.3.2.2 below. The Guidance Document provides requirements for environmental standards, receiving materials, facility operations and design considerations, operations plans, records and reporting requirements, site security, environmental monitoring and decommissioning. In Section 8.0 (Reception of Materials), there is a sub-section that discusses “Unacceptable Materials” and that organic and compostable waste should be diverted wherever possible to an appropriate composting facility/operation.

3.3.2.2 Environmental Standards for MSW Compost Facilities (April 2010)

These standards apply to MSW which includes SSO, the “wet” component of wet/dry collection systems, other feedstocks and bulking agents added to MSW organic waste and co-composting of MSW with biosolids from various sources. They do not apply to generally-accepted agricultural practices and backyard composting, composting facilities that accept only leaf, brush and yard waste, composting of organic material only from non-municipal sources and composting of biosolids primarily.

Section 3.0 of the guidelines applies to MSW composting facilities that process more than 1,000 tonnes per year of organics. Although the standards state that in-vessel, windrow or static (passive or aerated) pile technologies can be used, in-vessel or covered facilities are recommended in the guidelines due to the wet weather conditions of Newfoundland and Labrador. Facilities handling over 2,500 tonnes per year of municipal organic waste are obliged to use in-vessel systems for the initial phases of composting with curing being completed using open windrow systems if space permits.

Terms and conditions for facility operation are site specific while compost product quality requirements are based on proposed end use.

A Certificate of Approval is required for the construction and operation of a composting facility. Requirements include:

- Public notification (if EA registration is not required, then public notification for the proposed facility, consisting of a positing in the local newspaper or notice by registered mail to occupiers of property within 1.6 km of proposed site is necessary).
- Posting of financial security upon request.
- Defined separation distances from the property boundary for the active composting area, Residential and ICI properties, right-of-way public roads, high water marks and drinking water supplies. Recommended separation distances are provided for:
    - In-vessel composting;
    - Windrow/static pile <1,000 tonnes food waste or <10,000 tonnes of total feedstock per year; and
    - Windrow/static pile >1,000 tonnes food waste or >10,000 tonnes of total feedstock per year.

An approved facility must have an approved site location, facility location and facility design. The facility is required to have a quality control/assurance program including an environmental sound design and performance. An odour management program which includes odour generation controls must be submitted prior to approval. Recommended practices are indicated to assess compost product quality and for the development of a sampling program. Finished compost must be tested for quality on a regular basis; at least every 1,000 tonnes of production every three months and prior to marketing any product. All finished compost is required to be in accordance with CCME Guidelines for Compost Quality. Additionally, compost must meet all criteria as established for foreign matter, maturity, pathogens and trace elements. Three months storage capacity for post-processing of compost is recommended with a quarter of the area for curing. However, the curing may be located at another site.

3.3.2.3 Environmental Standards for MSW Transfer Stations (July 2010)

The purpose of the standards is to define environmental standards to site, design, construct, operate and decommission MSW TSs and local waste management facilities that receive and transfer material from MSW streams. The guideline aids in the Certificate of Approval application process.

In terms of organics management, the TSs are limited to storing MSW destined for a composting facility (or a regional landfill) to two days in the summer and one week in the winter, unless there are outstanding circumstances that affect waste removal or transport (refer to Section 6.9.3 regarding recommended changes to storage time limits). During the facility design process space dedicated for the temporary storage of organic waste must be identified. Floors of containment areas must be designed to collect runoff and to prevent leachate from running off-site. Uncontained MSW cannot be stored outside at TSs to reduce the chance of precipitation in the waste causing leachate.

3.3.2.4 Municipal Solid Waste Management and Public Education Guidance Document (November 2007)

The Guidance Document outlines the requirements for and components of a public education plan for MSW management facilities. Certificate of Approval applications to construct and operate a waste management facility is to be accompanied by a public education plan. As per the Provincial Waste Management Strategy, the region will reduce waste sent for disposal and deliver public education programs to its residents, businesses and institutions. The Guidance Document states that that DEC requires each region to develop a public education plan that explains the regional waste management system (e.g., collection, transportation, storage, reuse, recycling, etc.). This plan can include an education centre focusing on recycling or composting programs, teaching garden, tours of various waste management facilities, school group tours and education materials distributed in print and online.

3.3.2.5 Regional/Municipal Bylaws

Regional Authorities are legal, incorporated entities that are authorized to operate waste management systems. The authorities are governed by a board of directors comprised of municipal, Local Service District and unincorporated community representatives. Within the Regions, some of the municipalities have their own waste management programs and corresponding bylaws. Table 3-1 provides an overview of existing municipal bylaws in Newfoundland that are documented on the Municipalities Newfoundland and Labrador (MNL) website.

Table 3-1 Municipal Bylaws in Newfoundland

Jurisdiction	Bylaw Name/ Number	Description of Bylaw
Burin Peninsula Municipal Service Delivery Corporation (Marystown excluded)	Waste Collection and Disposal Regulations	Provides requirements for proper waste set-out, unacceptable curbside collected materials, residential bulk collection, commercial bulk disposal and taxation.
Town of Marystown	Solid Waste Disposal Regulations	Pertains to litter management, requirements for proper waste set-out, containers and penalties.
Town of Gander	Garbage and Refuse Regulations	Provides requirements for proper waste (garbage, fibres) setout, restrictions, storage (garbage in receptacles impervious to animals), suitable containers, unacceptable materials, special clean-ups and vehicles carrying garbage and refuse.
Town of Grand Falls - Windsor	Garbage and Refuse Regulations	Provides requirements for proper waste (garbage, fibres) setout, restrictions, storage (garbage in receptacles impervious to animals), suitable containers, unacceptable materials, vehicles carrying garbage and refuse.

Jurisdiction	Bylaw Name/ Number	Description of Bylaw
City of St. John's Sanitation Regulations	By-law No. 985	Provides requirements for proper waste (garbage, paper) setout, container limits and suitable container types, unacceptable materials, vehicles carrying garbage and refuse, private collection.
City of Mount Pearl	Solid Waste Regulations	Provides fees for automated garbage collection from residential dwellings, procedures for requests for additional carts, proper cart setout, unacceptable materials, bulk collection, management of C&D waste, private contractor, recycling collection (fibres, containers) and penalties.
Town of Carbonear	Solid Waste Disposal Regulations	Provides requirements for proper waste (garbage, fibres) setout, unacceptable materials and enforcement.
Town of Clarenville	Garbage and Refuse Regulations	Contains requirements for days and times of collection, restrictions, storage (garbage in receptacles impervious to animals), suitable containers, proper waste setout, covering of garbage with a net, unacceptable materials, commercial garbage containers, spring clean-up, vehicles carrying garbage and refuse, fees, composting (backyard) and penalties.
Town of Conception Bay South	Waste Disposal and Property Regulations	Provides obligations for owners to keep properties clean and free from waste material and garbage.
Town of Portugal Cove - St. Philip's	Litter, Garbage and Refuse Regulations	Provides requirements for proper waste setout, litter management, providing proper number of authorized containers in buildings and penalties.
Town of Torbay	Garbage and Refuse Regulations	Provides requirements for proper waste setout, restrictions, storage (garbage in receptacles impervious to animals), suitable receptacles, unacceptable materials, spring clean-up, vehicles carrying garbage and refuse and penalties.
Town of Channel - Port aux Basques	Garbage and Refuse Regulations	Provides requirements for proper waste set out, unacceptable materials and restrictions, suitable containers, commercial garbage containers, storage (garbage in receptacles impervious to animals), covering of garbage with a net, spring clean-up, vehicles carrying garbage and refuse, fees, composting (backyard) and penalties.

Jurisdiction	Bylaw Name/ Number	Description of Bylaw
City of Corner Brook	Garbage and Refuse Regulations	Provides requirements for proper waste (garbage, fibres) setout, container limits, unacceptable materials, penalties for landfilling recyclable materials and sets tipping fees.

3.4 Waste Stream Characterization

3.4.1 Definition and Assumptions

Commonly referred to as garbage, MSW is material handled by municipal collection and/or disposal services. It includes two main types of solid waste: residential or domestic waste, and industrial, commercial and institutional (ICI) waste. In Newfoundland and Labrador, Appendix D of the General Environmental Standards Municipal Solid Waste Management Facilities/Systems defines MSW as:

> *Municipal solid waste (MSW) refers to garbage, refuse, rubbish, litter and other discarded materials resulting from residential, commercial, institutional and industrial activities which are commonly accepted at a municipal solid waste management facility, mixed or unmixed. This would generally exclude industrial processing waste and agricultural waste.*

> *Organics refers to carbon and hydrogen-based materials that can be transformed into humus-like materials through microbiological processes (e.g., composting).*

The MSW stream for a given area can be characterized by defining a percentage breakdown of specific material types, including organics. This definition of composition is essential as it allows (in concert with an overall waste stream quantity estimate) for the estimation of quantities of specific materials (e.g., organics, recyclables, non-divertible residuals) and the operational requirements for future infrastructure and related systems. As organics are the focal point of this study, the project team is primarily concerned with compostable organic material in the overall waste stream.

For the purposes of Dillon's analysis for the Newfoundland assignment, and as discussed in more detail in Sections 3.4.5 and 6.1.1, candidate feedstocks for the organics system are defined as food waste, LYW, indoor plant waste, boxboard, food-soiled OCC, paper towel and select "other" organics.

3.4.2 Composition and Primary Generators

3.4.2.1 Overall MSW Stream

For this study, projections of waste tonnage quantity were developed based on current waste tonnages, population data and waste generation rate forecasts. Current generated waste tonnages were obtained from Multi Materials Stewardship Board (MMSB). Information for the year 20111 provided to Dillon from MMSB indicates that 42.5% of the waste stream is domestic (i.e., residential) and 57.5% is non-domestic (i.e., ICI).

Using population forecast information for each Region, generators were categorized as follows:

Urban Municipalities (population density >75 persons/km^2)

- Residential (Res) generator: single and multi-family homes.
- ICI generator: e.g., businesses, hospitals, schools, manufacturing facilities, retail operations.

Rural Municipalities (population density $\leq$75 persons/km^2)

- Residential (Res) generator: single and multi-family homes.
- ICI generator: e.g., businesses, hospitals, schools, manufacturing facilities, retail operations.

Using these generator definitions, several data sources were reviewed in order to develop an approximate composition of the Newfoundland waste stream. No single ideal data source was identified to properly characterize the waste stream that is generated in Newfoundland. For example, the waste tonnage information for Newfoundland from the MMSB did not provide a detailed breakdown of the waste stream. In other cases, identified characterization studies were for disposed waste (e.g., after removal of recyclables and other divertible materials), not for generated waste. Thus, the project team used its best judgement to develop an approximate breakdown by material type for the Newfoundland waste streams. In order to develop an approximate composition of the Newfoundland waste stream, the waste tonnage data for Newfoundland was used in conjunction with waste audit data from municipalities with similar populations and geographic conditions.

The sources that were utilized were as follows:

- Waste management information including waste generation data for Newfoundland, provided by Gordon Murphy of the MMSB to the Dillon Team, 2011.
- 2011 and 2012 Waste Audit Data Spreadsheet for Nova Scotia, Otter Lake Landfill (Halifax) and Little Forks Landfill (Cumberland County), Resources Recovery Fund Board (RRFB), 2012.
- RRFB information on tires and redeemable beverage containers generated in Nova Scotia, provided by Jerome Paris (RRFB) to the Dillon Team, 2012.
- Reported waste quantities (recyclables, organics and mixed waste), Halifax Regional Municipality, 2011-12.

Figures 3-10 to 3-13 present the assumed waste stream percentage breakdowns, by material type and by weight percent, for the four generator categories: a) Urban Res, b) Urban ICI, c) Rural Res and d) Rural ICI. For the purposes of the Newfoundland Organics project, it has been assumed that the waste stream compositions (quality) will remain unchanged during the 30-year study period. However, as discussed below, the quantity of waste will change over time due to anticipated increases in per capita generation rate.

Figure 3-10 Assumed Waste Stream Percentage Breakdown - Urban - Residential

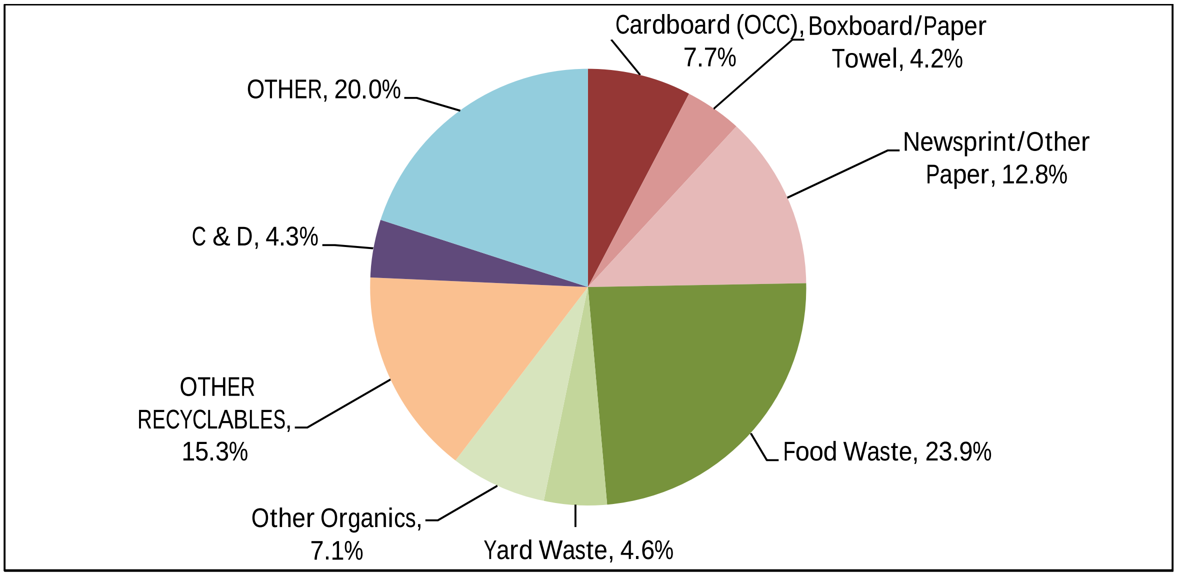


Figure 3-11 Assumed Waste Stream Percentage Breakdown – Urban - ICI

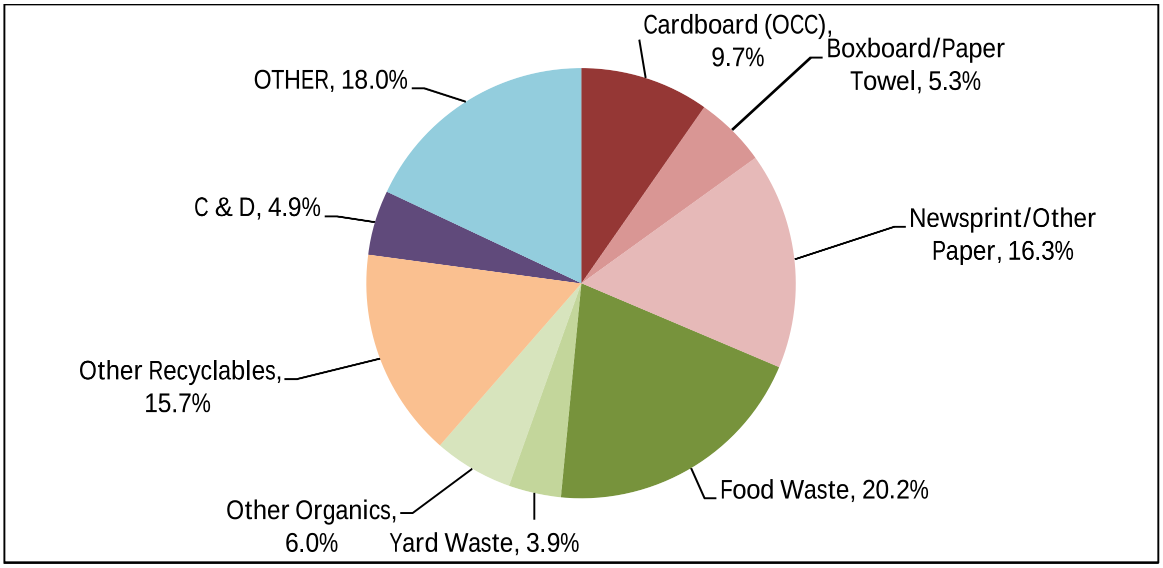


Figure 3-12 Assumed Waste Stream Percentage Breakdown – Rural - Residential

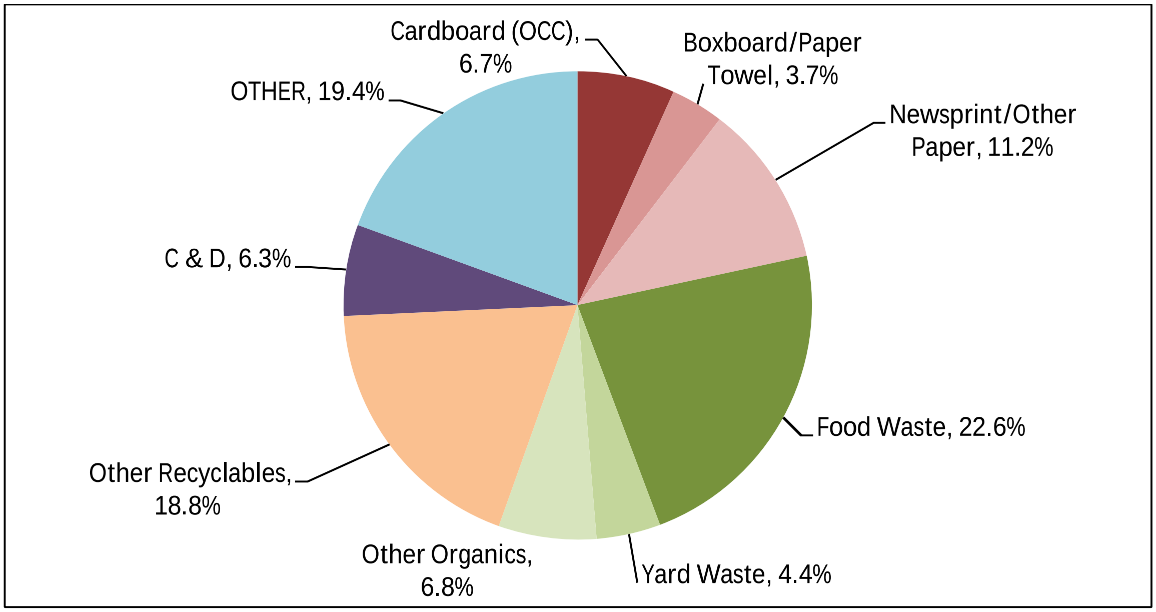
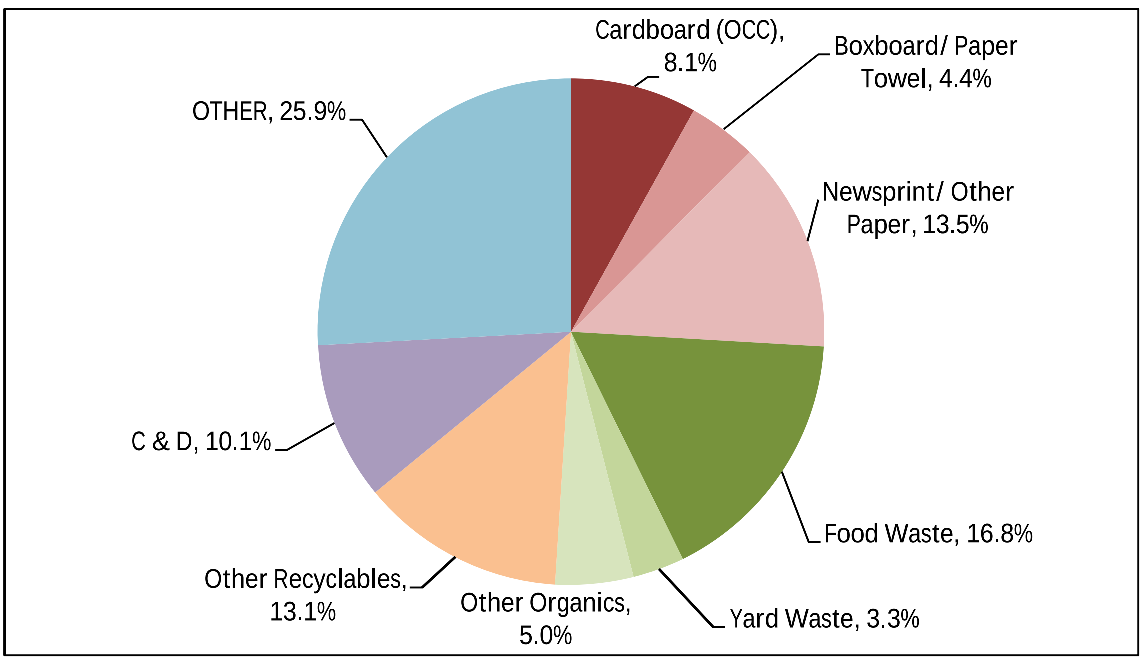


Figure 3-13 Assumed Waste Stream Percentage Breakdown – Rural - ICI



3.4.2.2 Compostable Organics

Organic material including food waste, LYW and agricultural waste is compostable. Boxboard, paper towel and a portion of the cardboard in the paper stream is also compostable.

3.4.2.2.1 Residential MSW Sources

The Residential sector contains single and multi-family homes. The Residential sector typically generates a higher percentage of organic material compared to the ICI sector. Table 3-2 highlights the compostable organic materials in the waste stream for the Residential sector. Organic material is predominantly food waste.

Table 3-2 Compostable Organics Percentage Breakdown by Generator Type (Residential)

	Urban Residential	Rural Residential
1. Paper	24.7%	21.6%
a. Cardboard	7.7%	6.7%
b. Boxboard/Paper Towel	4.2%	3.7%
c. Newsprint/Other Paper	12.8%	11.2%
2. Organics	35.7%	33.8%
a. Food Waste	23.9%	22.6%
b. Yard Waste	4.6%	4.4%
c. Other	7.1%	6.8%
3. Other Recyclables (plastic, glass, metal)	15.3%	18.8%
4. Construction & Demolition	4.3%	6.3%
5. Other	20.0%	19.4%

Note: Only a portion of the cardboard stream is compostable

3.4.2.2.2 ICI MSW Sources

The ICI sector includes businesses, restaurants, hospitals, schools, manufacturing facilities and retail operations. Typically, the ICI sector generates a higher percentage of paper and C&D material compared to the Residential sector. Table 3-3 highlights the compostable organic materials in the waste stream for the ICI sector. Organic material is predominantly food waste from restaurants, retail food outlets and kitchens in businesses.

Table 3-3 Compostable Organics Percentage Breakdown by Generator Type (ICI)

	Urban ICI	Rural ICI
1. Paper	31.4%	26.0%
a. Cardboard	9.7%	8.1%
b. Boxboard/Paper Towel	5.3%	4.4%
c. Newsprint/Other Paper	16.3%	13.5%
2. Organics	30.1%	25.1%
a. Food Waste	20.2%	16.8%
b. Yard Waste	3.9%	3.3%
c. Other	6.0%	5.0%
3. Other Recyclables (plastic, glass, metal)	15.7%	13.1%
4. Construction & Demolition	4.9%	10.1%
5. Other	18.0%	25.9%

Note: Only a portion of the cardboard stream is compostable

3.4.2.2.3 Industrial and Resource Sector Sources

As mentioned in Section 2.2.2, the feedstock of primary focus for this study is from traditional MSW generators (i.e., residential and ICI sources). However, the Dillon team reviewed the potential non-MSW sources from across the island of Newfoundland (e.g., from agricultural, aquaculture, forestry and fisheries industries) that could contribute to MSW composting facilities should the host jurisdiction choose to supplement with MSW sources. The following summary table (Table 3-4) is provided for information only and was not included in the defined development of the seven scenarios (i.e., organic waste quantities from industrial and resource sector sources are not included in the analysis).

While the opportunity to incorporate industrial and resource sector organics in municipal composting systems is intriguing, investigations conducted as part of this assignment (and as summarized in Appendix E) did not identify confirmed candidate contributors worthy (due to limited information and an inability to confirm the availability of the feedstock) of direct incorporation into the definition of the seven island-wide scenarios. It is anticipated that securing long-term feedstock from an industrial or resource sector generator will require direct negotiations, ideally as a component of the development of a detailed engineering/process design for a composting facility.

Table 3-4 Summary of Research on Non-MSW Organic Waste Generators

Agriculture Industry
• Over 500 farms in Newfoundland and Labrador (Newfoundland and Labrador Farm Guide) and a map showing locations of farms is provided in Appendix E. • Estimates provided on total organic waste generated from the poultry, dairy and mink sectors (farms with Certificates of Approval) only and not on total quantity of organic waste available as feedstock for organic processing facilities. • Types of organic waste generated are poultry litter, poultry mortalities, dairy manure, mink manure and mink carcasses.
Fisheries Industry
• Fish processing plants are located across the island (figure provided in Appendix E) with concentrated amount of plans on the Avalon peninsula. • Types of organic waste generated are shellfish, groundfish and pelagics. • Memorial University conducted a study that estimated that composition of fisheries waste with the majority (about 80%) being shellfish. • DFA provided estimates of organic waste generated in six of the regions (2012 Wild Harvest Production). • Much of the organic waste is currently dumped at sea by permit from Environment Canada if no viable land option is available. MMSB estimates that this waste could come ashore annually if these permits are revoked. • Some farmers may be composting organic waste.
Aquaculture and By-Products Industry
• There were approximately 145 aquaculture licenses in 2011-2012 (DFA) and a map is provided in Appendix E. • Industry is concentrated in two areas: Notre Dame Bay in the northeast and Connaigre Peninsula in the Coast of Bays. Fish offal is typically ocean dumped, with other management options including landfilling, feed for mink farms or feedstock for a fish meal facility. Mussel shells were used in one trial effort in the construction of a gravel parking area, but they are typically either directed to other market uses or ocean dumped. • Contingency capacity for mass mortalities should be considered (estimated at 6,000 tonnes per event). • Consideration for biosecurity is required. Aquaculture can be affected by disease requiring biosecurity protocols.
Forestry Industry
• A map provided in Appendix E shows the locations of active and inactive sawmills and estimates on sawmill and logging residue quantities generated and stockpiled (Provincial Inventory of Forest Biomass Residues, Memorial University, 2009 data). • Types of organic waste generated are logging residues, sawmill residues (stockpiled in mill yards) and pulp and paper mill residues (landfilled as black bark).

- Majority of in-forest residues and about half of the sawmill residues are diverted to the Corner Brook Pulp and Paper mill as hogfuel.

3.4.3 Population and Future Development Trends

Waste generation quantities are closely linked to changes in population and economic activity. Over the last several years, Newfoundland has experienced limited population growth, with noted decreases in some regions. Projected population growth information for the 30-year study period was obtained from *The Estimated Rural Secretariat Region Population Projection Data from 1986 to 2026* for each Region of the island of Newfoundland. The percentage population growth or decline for each Region per year is presented in Table 3-5.

Table 3-5 Change in Population per Year for Each Waste Management Region

	Region 1 (Discovery MSB)	Region 2 (Burin Peninsula)	Region 3 (Central)	Region 4 (Coast of Bays)	Region 5 (Eastern)	Region 6 (Green Bay)	Region 7 (Northern)	Region 8 (Western)
% Population Change per Year	-0.56%	-1.27%	-0.48%	-0.57%	0.41%	-0.98%	-0.75%	-0.18%

3.4.4 Future Waste Stream Forecast

As mentioned above, waste generation quantities are closely linked to changes in population and economic activity. With reference to an article presented in the June/July 2012 edition of Solid Waste and Recycling magazine (www.solidwastemag.com), the annual rate of change in the per capita solid waste generation rate for the last several decades has tracked closely with annual changes in the Gross National Product (GNP) and Gross Domestic Product (GDP). Using data available from www.tradingeconomics.com, over the last 25 years, the average rate of annual change for the Canadian GNP has been approximately 4.7% while the GDP value has been approximately 2.2%. For the purposes of this study, and in the interests of not “over-building” proposed system infrastructure (a noted Project Committee concern), the 2.2% value was selected as the assumed rate of annual growth in per capita waste generation.

It is acknowledged that this annual growth rate varies from a current MMSB forecasting value (~1% per year) brought to the attention of the study team following the issuing of the original final report. The difference in these rates points to the speculative nature of forecasting changes in the individual waste generation behaviours of residential and ICI generators. In the case of this particular study, it is noted that the use of regional provincial population projection information (acknowledging areas of both growth and decline within Newfoundland) as well as the proposed two-stage development of recommended facilities (see Section 6.1.1) helps to offset concerns associated with the over-building of organics management program infrastructure. And finally, consistent with typical best practice, a more in-depth analysis of capacity requirements will be necessary prior to completing detailed facility engineering designs.

Founded on the information presented in the preceding sections, Table 3-6 presents a waste generation forecast for the eight Newfoundland regions for the total amount of waste generated and the total amount of organics generated. For presentation purposes, values for 2015, 2025, 2035 and 2045 are presented and more detailed estimates are provided in Appendix F. This table serves as the foundation for the forecasting of organics tonnages in the regional model.

3.4.5 Targeted Materials for Composting

As identified in MMSB's March 2012 report *The Management of Organic Waste in Newfoundland and Labrador* as well as in the Terms of Reference for this assignment, there is a noted concern that composting facilities in Newfoundland could be subject to a "carbon deficit"; e.g., an inadequate amount of carbon-rich material to achieve an appropriate carbon to nitrogen (C:N) ratio in the feedstock mix. Noting that the overall municipal solid waste stream in Newfoundland will be somewhat similar to what exists in other locations in the Atlantic Region, information on composting facilities serving existing cart-based programs in Nova Scotia was reviewed. It was determined that the issue of a carbon deficit was an infrequent challenge due to the fact that residential and ICI generators were instructed to include select fibre materials (e.g., boxboard, paper towel, food-soiled OCC and newsprint) in their organics cart. In addition, dry leaves and other yard waste materials (either included in the cart or collected separately) also served to address carbon requirements for the overall facility process mix. Notwithstanding this assumption, an annual operating cost allowance has also been included for each identified composting facility to maintain a stockpile (equivalent to 10% of the annual forecasted process tonnage) of a carbon bulking agent (e.g., wood chips).

Based on the approach utilized in Nova Scotia, and with reference to Section 3.4.2, Dillon targeted traditional green cart items (e.g., food waste) as well as a select portion of LYW, food-soiled fibre and other organics. Further details on the assumed material mix with the collection carts (and arriving at the composting facilities) is presented in Section 6.1.1.

Table 3-6
Newfoundland Organics Options Study
Generated Waste Tonnage Projections

Waste Management Region	Generation Sector	Estimated Population	2015		2025		2035		2045	
			Total Waste Generated (Tonnes)	Organics Generated (Tonnes)	Total Waste Generated (Tonnes)	Organics Generated (Tonnes)	Total Waste Generated (Tonnes)	Organics Generated (Tonnes)	Total Waste Generated (Tonnes)	Organics Generated (Tonnes)
Region 1 - Discovery RSB	Residential		5,123	1,726	6,020	2,028	7,075	2,384	8,315	2,801
	ICI		6,654	1,658	7,820	1,949	9,190	2,290	10,800	2,692
	Total	11,500	11,777	3,384	13,840	3,977	16,265	4,674	19,115	5,493
Region 2 - Burin Peninsula	Residential		8,014	2,744	8,767	3,001	9,591	3,283	10,492	3,592
	ICI		10,508	2,761	11,496	3,020	12,576	3,304	13,757	3,615
	Total	18,394	18,523	5,505	20,263	6,022	22,167	6,588	24,250	7,207
Region 3 - Central	Residential		31,496	10,646	34,455	11,646	37,692	12,740	41,234	13,937
	ICI		40,908	10,268	44,752	11,233	48,956	12,288	53,556	13,443
	Total	71,840	72,404	20,913	79,207	22,878	86,649	25,028	94,790	27,380
Region 4 - Coast of Bays	Residential	6,602	2,878	973	3,149	1,064	3,444	1,164	3,768	1,274
	ICI		3,738	938	4,089	1,026	4,474	1,123	4,894	1,228
	Total	6,602	6,616	1,911	7,238	2,091	7,918	2,287	8,662	2,502
Region 5 - Eastern	Residential		114,876	40,111	125,669	43,880	137,477	48,002	150,393	52,512
	ICI		153,576	44,455	168,005	48,631	183,791	53,201	201,059	58,199
	Total	266,294	268,451	84,565	293,674	92,511	321,267	101,203	351,453	110,712
Region 6 - Green Bay	Residential		5,632	1,904	6,161	2,082	6,740	2,278	7,373	2,492
	ICI		7,315	1,836	8,002	2,009	8,754	2,197	9,577	2,404
	Total	12,863	12,947	3,740	14,164	4,091	15,494	4,475	16,950	4,896
Region 7 - Northern Peninsula	Residential		5,553	1,877	6,075	2,053	6,645	2,246	7,270	2,457
	ICI		7,212	1,810	7,890	1,980	8,631	2,167	9,442	2,370
	Total	12,699	12,765	3,687	13,965	4,034	15,277	4,413	16,712	4,827
Region 8 - Western	Residential		32,692	11,050	35,764	12,088	39,124	13,224	42,801	14,467
	ICI		42,463	10,658	46,452	11,660	50,817	12,755	55,591	13,953
	Total	74,571	75,155	21,708	82,217	23,748	89,941	25,979	98,392	28,420
TOTAL		474,763	478,638	145,414	524,567	159,352	574,978	174,647	630,324	191,436

4.0 Review of Candidate Organics Processing Technologies

The review and assessment of Organic Processing Technologies was conducted based on the identification of an initial "long list" of technology options, the development of a screening process to allow for analysis of technologies and finally application of the screening process to rank each technology. Further details on each of these key steps are provided in the following sub-sections.

4.1 Anaerobic Processing Technologies

During the project kick-off meeting, and as part of the project scope confirmation discussions, it was communicated to the Dillon project team that the Newfoundland Federation of Agriculture, as a follow up to an initial anaerobic digestion review (see Appendix E) had conducted a more detailed "Phase 2" study that included a feasibility assessment of the applicability of anaerobic digestion (AD) to a range of organic materials generated in Newfoundland. Reportedly, this study concluded that AD technologies were not currently practical for application in Newfoundland and Dillon was therefore directed by DMA (in consultation with MMSB) to exclude them from further consideration.

This report therefore excludes consideration of anaerobic technologies and relies on the previous analysis conducted by MMSB. Dillon attempted to acquire a copy of the Phase 2 AD document in September 2013, but it was reported that it was not yet ready for public release. As a result, it was not reviewed by the project team.

4.2 Aerobic Processing Technologies

The evaluation of aerobic processing technologies was conducted in three steps, as follows:

- Development of aerobic processing technology "long list";
- Development of a technology evaluation process; and
- Screening and evaluation of technologies.

Each of these steps is elaborated on in the following sections.

4.2.1 Development of Aerobic Processing Technology "Long List"

In order to identify organic processing technologies that are applicable to the context of Newfoundland, it was first necessary to identify the various technology options that have been proven to be feasible and commercially viable. A literature review was conducted and it was found that most references or databases on composting technologies have defined the same listing/categories of technology options. This list of options is elaborated on in most detail in the Environment Canada publication entitled *Technical Document on Municipal Solid Waste Organics Processing* (Environment Canada Technical Document). The technologies described within this reference were used as the "long list" from which an evaluation of the preferred technologies for deployment in Newfoundland would be completed.

The Environment Canada Technical Document defines the technological options for aerobic processing of organic waste which is summarized in Table 4-1:

Table 4-1 Aerobic Processing Technology Options

Organic Waste Processing Technology	Overview of Technology	Typical Scale of Installations *(tonnes per year of organic waste)*
Static Pile	Formation of large windrows in an outdoor setting and the process relies on passive aeration for composting. Windrows are not actively mixed/turned and are left for an extended period of time (e.g., 2-3 years) to allow for composting.	<10,000
Bunker	Outdoor composting method based on the use of three sided bunkers and passive aeration for composting. Three bunkers are typically used with the first bunker used for waste receipt, and the second and third for composting. Each bunker can be between 2 and 20 m³ in size.	<500
Windrow	Formation of large windrows outdoors, which are mechanically agitated (turned). This method relies on passive aeration and differentiated from Static Pile based on the windrow agitation	<50,000
Turned Mass Bed	Outdoor process that uses “beds” that are larger than windrows, with mechanical agitation. Process relies on passive aeration of material. Specialized equipment is used to allow for material turning	15,000 to 50,000
Passively Aerated Windrow	Similar to Static Pile, but windrows built outdoors upon perforated open-ended pipes that allow for greater diffusion of air within the piles.	<10,000
Aerated Static Pile (ASP) – Uncovered	Windrows built over an aeration system that uses a fan to either push air into the piles (positive aeration) or pull air out of the piles (negative aeration). There is no agitation of the windrows.	1,000 to >100,000
Aerated Static Pile (ASP) – Covered	Windrows built over an aeration system that uses a fan to aerate the piles. A fabric cover is placed over the windrows that allows for air exchange to the environment but prevents moisture from getting into the piles. Air can be extracted from the system and treated prior to discharge to the environment.	1,000 to >100,000

Organic Waste Processing Technology	Overview of Technology	Typical Scale of Installations *(tonnes per year of organic waste)*
Enclosed Aerated Static Pile (tunnel)	Aerated static piles within a fully enclosed building, with windrows typically built in tunnels. Air is captured from the head space above the windrows and can be treated prior to discharge to the environment.	1,000 to >100,000
Static Container (in-vessel composting)	Material is composted in composting vessels (e.g., shipping containers). Containers are attached to an aeration system that pumps air into the bottom of the vessels. Air removed from the top of the containers and can be treated prior to discharge to the environment.	300 to 30,000
Agitated Container (in-vessel composting)	Material is composted within a vessel, using active aeration and agitation. Typically a continuous-flow system using augers, conveyors etc. to move material in/out of and along the vessel.	100 to 15,000
Enclosed Channel	Windrows are built between parallel concrete walls within an enclosed building, with active aeration and mechanical agitation present. A specialized turning machine moves along the channels to agitate the material.	15,000 to 100,000
Agitated Bed	Similar to a Turned Mass Bed system, with a higher level of automation and also active aeration. Beds of material are enclosed within perimeter walls, with an in-floor aeration system.	15,000 to >100,000
Rotating Drum (in-vessel composting)	Material composted within a rotating drum, with an incline on the drum allowing for material to move along the system. Active composting may not be complete within the drum, so another composting method may be necessary for use in series with a drum system.	1,000 to >100,000

Further details on each of the technologies are provided in Table 1 of Appendix C – Technology Evaluation. Information summarized within Table 1 of Appendix C includes:

- Overview of the process;
- Infrastructure requirements;
- Applicable feedstocks;
- Feedstock preparation requirements;
- Typical capacity;
- Composting time;
- Flexibility/ seasonality;
- Level of moisture control;
- Vector (animal/bird) access;
- Electricity consumption;
- Fuel consumption;
- Quantity of liquid effluent requiring treatment;
- End product characteristics;
- Relative cost; and

- Process control features;
- Level of odour control;
- Example operations.

4.2.2 Technology Evaluation Process

In order to identify preferred composting technologies from the "long list", an evaluation process was developed. The evaluation process was developed in consultation with DMA and incorporated key criteria that were identified as important to technology selection and relevant to Newfoundland.

The key criteria that formed the basis of the evaluation process were as follows:

- *Modularity of Technology*: This criterion defines the relative modularity of a technology, to allow for development of facilities to be staged over time and thus reduce upfront capital cost out lay and also accommodate for potential changes in the assumed capture rate. Through consultation conducted as part of the study, several stakeholders raised concerns about building facilities to accommodate a 30-year planning timeline upfront, and potentially having unused composting capacity at the facility whilst still having to perform maintenance on the infrastructure. This criterion allows for incorporation of that feedback into the technology evaluation process.
- *Technology Flexibility (Feedstock Quality)*: This criterion is targeted at highlighting differences between technologies in handling the ranges of feedstocks expected from the MSW SSO stream in Newfoundland. Depending on the type of wastes being processed, some technologies may perform better than others and this criterion allows for consideration of this within the evaluation.
- *Environmental Nuisance Control*: Within composting facilities, one of the main risks to operations is the generation of environmental nuisances (e.g., odour impacts, dust impacts, vector concerns). Consideration of a technology's ability to manage environmental nuisances is critical in developing a strategy that is sensitive to the environment.
- *Capital Costs*: Composting technologies range from highly automated to very simplistic/low maintenance options. This results in a broad range of costs associated with project development. This criterion is focused on assessing the relative capital costs associated with the use of each technology.
- *Operating and Maintenance (O&M) Costs*: It is recognized that technology options that have low capital costs may in some instances have high O&M costs. Therefore consideration of both capital and O&M costs is important in the technology evaluation.

In recognition of the differences between deployment of a technology in a large-scale and small-scale operation, the evaluation process incorporated proposed facility sizing (tonnage) limits. These limits were selected based on the DEC's Environmental Standards for Municipal Solid Waste Compost Facilities (Environmental Standards Guideline). The Guideline defines different environmental permitting and technology requirements for three tiers of facility processing capacities. The Environmental Standards Guideline stipulates that facilities processing less than 1,000 tonnes per year of organics are exempted from permitting requirements and those processing over 2,500 tonnes per year of organics are to use in-vessel technologies. These two key requirements of the provincial guideline were the basis for defining the following "levels" of facility development:

- *Level I* – Facilities with processing capacities greater than 2,500 tonnes per year of SSO (note that Level I facilities are later further separated into Level Ia (>10,000 tonnes per year) and Level Ib (2,500 to 9,999 tonnes per year));
- *Level II* – Facilities with processing capacities between 1,000 and 2,499 tonnes per year of SSO; and,
- *Level III* – Facilities with processing capacities less than 1,000 tonnes per year of SSO.

The differences in merits of each technology when applied to each Level of deployment was incorporated into the evaluation process by applying weightings to each of the criteria, for each Level of technology deployment. The weightings used within the evaluation are provided in Table 4-2.

Table 4-2 Technology Evaluation Criteria and Weighting

Facility Sizing	Key Criteria	Weighting
Level I	Modularity of Technology	15%
	Technology Flexibility (Feedstock Quality)	15%
	Environmental Nuisance Control	40%
	Capital Costs	15%
	Operating & Maintenance Costs	15%
Level II	Modularity of Technology	10%
	Technology Flexibility (Feedstock Quality)	10%
	Environmental Nuisance Control	30%
	Capital Costs	25%
	Operating & Maintenance Costs	25%
Level III	Modularity of Technology	5%
	Technology Flexibility (Feedstock Quality)	5%
	Environmental Nuisance Control	20%
	Capital Costs	35%
	Operating & Maintenance Costs	35%

The evaluation process was based on scoring each technology using a scale of 1-3, against each of the criteria, and for each Level of deployment. Scoring was based on the performance of a technology relative to others. For each Level, the individual scores assigned to each technology were combined into a single overall score using the weightings presented above.

The rationale for the weightings assigned to each criterion is as follows:

Modularity of Technology
The necessity for a technology that is modular to allow for future growth based on increased capture rates is most relevant to Level I operations. These types of operations will be large, centralized facilities that are developed to service a large geographical area. As a waste management system develops and matures over time there, will be increased capture rates and therefore the necessity for more capacity at the centralized site. In such operations it is desirable to not have full capital expenditure upfront for a facility sizing that spans a 30-year planning timeline.

Level III operations represent small community-based operations, typically in rural settings, where long term SSO tonnage processing requirements will be limited by the local population growth. In such circumstances, it is expected that modularity of technology will be less relevant as the basic infrastructure required to manage the range of tonnages expected will be similar.

Technology Flexibility (Feedstock Quality)
The ability of a technology to manage variations in feedstock quality is important where material is being brought in from various sources. This is most relevant to Level I facilities, where organics would be captured from a diverse geographic area (multiple communities) and also from different types of residential sources (e.g., single family homes, multi-tenant housing).

Within a community scale operation (Level III), it can be expected that there would be greater consistency in the feedstock quality as the source of the organics would be local residential sources. With the small population, diversion efforts would likely bring in a more consistent organics stream. Also, in a Level II system it may be easier to identify and remove contamination and therefore manage feedstock quality.

Environmental Nuisance Control
The ability to manage nuisances would be critical to centralized composting facilities that service multiple communities, because of the large volumes of organics being managed. While siting of facilities can be completed to allow for some level of nuisance control, facilities also need to be located within a reasonable distance of the communities they service to minimize costs associated with transportation. The technology design and its ability to minimize odours, dust and access to vectors is therefore important.

In a community-based composting system (Level III), lower population densities and availability of open space makes nuisance management less critical than within a centralized (Level I) setting.

Capital Costs
Typically, Level III facilities will not have the benefit of a large financial resource base (e.g., tipping fees, municipal subsidies) to develop capital intensive operations. In comparison, Level I facilities will generally benefit from a greater resource base to fund development of operations and to also deploy advanced technologies.

Operating & Maintenance Costs
Similar to capital costs, it is expected that at Level III facilities the on-going operational costs (e.g., staff, equipment, fuel) will be a critical consideration. This is in contrast to a centralized application, where there may be a greater ability to absorb higher operational costs because of the presence of a larger financial resource base.

4.2.3 Technology Evaluation Assessment & Results

For each of the three Levels being assessed, technologies were screened prior to be taken through the evaluation process. Screening was done based on mandatory requirements as follows:

- *For Level I facilities – Does the technology meet the Environmental Standards Guideline requirements that in-vessel technologies be utilized?*
- *For all Levels – Is the technology capable of processing the waste tonnages defined for the Level?*

This screening component allowed for the evaluation process to focus on technologies that would have a better potential to meet regulatory requirements and are feasible. In addition, technologies were considered in the context of Newfoundland and only considered if they would be able to properly compost material within the wetter climate experienced locally.

For each Level, the evaluation process followed the ranking process described in Section 4.2 and was based on a relative comparison of technologies that were not screened out. The preferred technologies for each Level are presented in the following sub-sections. The detailed technology evaluation matrix is provided as Table 2 in Appendix C – Technology Evaluation.

Preferred Technologies – Level I Facilities
As discussed earlier, the Environmental Standards Guideline stipulates that facilities processing greater than 2,500 tonnes per year of organics should utilize in-vessel technologies for the initial stages of composting. Based on this requirement, the following technologies were screened out:

- Static pile;
- Bunker;
- Windrow;
- Turned mass bed;
- Passively aerated windrow; and
- Aerated static pile (ASP) - Uncovered.

The evaluation of the remaining technologies yielded four equally ranked options which are presented in Table 4-3 along with a description of their ranking.

Table 4-3 Preferred Level I Technologies

Preferred Technology Option	Rationale (comparative analysis of technologies)
Aerated Static Pile (ASP) – Covered	Highest ranked modularity Able to process feedstock types (SSO) Medium level environmental nuisance control Low capital costs Low O&M costs Cover over material allows for use in wetter climate
Enclosed Aerated Static Pile (Tunnel)	Medium level modularity Able to process feedstock types (SSO) Highest environmental nuisance control Medium level capital costs Medium level O&M costs Enclosed system allows for use in wetter climate
Static Container	Medium level modularity Able to process feedstock types (SSO) Highest environmental nuisance control Medium level capital costs Medium level O&M costs Enclosed system allows for use in wetter climate
Enclosed Channel	Medium level modularity Able to process feedstock types (SSO) Highest environmental nuisance control Medium level capital costs Medium level O&M costs Enclosed system allows for use in wetter climate

Within Level I facilities, those technologies that required a high level of automation were ranked as having lower modularity and also yielded higher costs. All technologies were considered appropriate to manage SSO and able to provide medium to high control of environmental nuisances.

Preferred Technologies – Level II Facilities
There are no regulatory requirements that would allow for screening out of technologies from consideration within the evaluation for Level II facilities. However, some technologies were screened out from consideration within the Level II assessment based on their defined capacities (capacities based on information presented in the Environment Canada Technical Document). For the Level II evaluation, the following technologies were screened out:

- Bunker (maximum capacity of 500 tonnes per year);
- Turned mass bed (minimum capacity of 15,000 tonnes per year);

- Enclosed channel (minimum capacity of 15,000 tonnes per year); and
- Agitated bed (minimum capacity of 15,000 tonnes per year).

The evaluation of the remaining technologies yielded four equally ranked options which are presented in Table 4-4 along with a description of their ranking.

Table 4-4 Preferred Level II Technologies

Preferred Technology Option	Rationale (comparative analysis of technologies)
Static Pile	Highest ranked modularity Able to process feedstock types (SSO) – if material processed for appropriate time period Lowest environmental nuisance control Lowest capital costs Lowest O&M costs Applicable to wetter climate only if protection is provided from precipitation during primary composting
Windrow	Highest ranked modularity Able to process feedstock types (SSO) – if material processed for appropriate time period Lowest environmental nuisance control Lowest capital costs Lowest O&M costs Applicable to wetter climate only if protection is provided from precipitation during primary composting
Passively Aerated Windrow	Highest ranked modularity Able to process feedstock types (SSO) – if material processed for appropriate time period Lowest environmental nuisance control Lowest capital costs Lowest O&M costs Applicable to wetter climate only if protection is provided from precipitation during primary composting
Aerated Static Pile (ASP) – Covered	Medium level modularity Able to process feedstock types (SSO) Highest environmental nuisance control Medium level capital costs Medium level O&M costs Cover over material allows for use in wetter climate

Within Level II facilities, technologies that required a high level of infrastructure (e.g., enclosed buildings, tunnels) were ranked as having lower modularity and also yielded higher costs. All technologies were considered appropriate to manage SSO. Enclosed technologies provided the highest level of environmental nuisance control but were associated with the highest costs (both capital and O&M).

Preferred Technologies – Level III Facilities

Similar to Level II facilities, there are no regulatory requirements that would allow for screening out of technologies from consideration within the evaluation for Level III facilities. However, technologies were screened out from consideration based on their defined capacities (capacities based on information presented in the Environment Canada Technical Document). For the Level III evaluation, the following technologies were screened out:

- Turned mass bed (minimum capacity of 15,000 tonnes per year);
- Aerated static pile – Uncovered (minimum capacity of 1,000 tonnes per year);
- Aerated static pile – Covered (minimum capacity of 1,000 tonnes per year);
- Enclosed channel (minimum capacity of 15,000 tonnes per year); and
- Agitated bed (minimum capacity of 15,000 tonnes per year).

The evaluation of the remaining technologies yielded four equally ranked options, which are presented in Table 4-5 along with a description of their ranking.

Table 4-5 Preferred Level III Technologies

Preferred Technology Option	Rationale (Comparative analysis of technologies)
Static Pile	Highest ranked modularity Able to process feedstock types (SSO) – if material processed for appropriate time period Lowest environmental nuisance control Lowest capital costs Lowest O&M costs Applicable to wetter climate only if protection is provided from precipitation during primary composting
Windrow	Highest ranked modularity Able to process feedstock types (SSO) – if material processed for appropriate time period Lowest environmental nuisance control Lowest capital costs Lowest O&M costs Applicable to wetter climate only if protection is provided from precipitation during primary composting

Preferred Technology Option	Rationale (Comparative analysis of technologies)
Passively Aerated Windrow	Highest ranked modularity Able to process feedstock types (SSO) – if material processed for appropriate time period Lowest environmental nuisance control Lowest capital costs Lowest O&M costs Applicable to wetter climate only if protection is provided from precipitation during primary composting
Aerated Static Pile (ASP) – Covered	Medium level modularity Able to process feedstock types (SSO) Highest environmental nuisance control Medium level capital costs Medium level O&M costs Cover over material allows for use in wetter climate

Within Level III facilities, technologies that required a high level of infrastructure (e.g., enclosed buildings, tunnels) were ranked as having lower modularity and also yielded higher costs. All technologies were considered appropriate to manage SSO. Enclosed technologies provided the highest level of environmental nuisance control but were associated with the highest costs (both capital and O&M).

5.0 Proposed Candidate Organics Processing Technologies

5.1 Overview

As described in Section 2.3, the development of candidate organics management scenarios for the island of Newfoundland was founded on seven selected servicing descriptions; three that were identified in Dillon's original proposal; two that resulted from discussions at the 50% Project Review Meeting and follow-up meeting at the Earth Bound conference in September 2013; and, two that resulted from discussions at the Draft Report Review Meeting in December 2013. Key assumptions guiding the scenario definition efforts are provided in this section.

Curbside collection of source separated organics from residential generators was only considered in waste management regions/sub-regions that currently provide curbside collection services or have expressed a desire to do so in the near term (e.g., less than three years). Where identified in individual scenarios, existing and proposed TSs/WRFs, as located by DMA and regional authority contacts, will be utilized for the transport of SSO. Typically, proposed locations for new composting facilities correspond with existing or planned sites for sub-regional transfer/waste recovery stations. In select instances, the identification of previously undeveloped sites for proposed scenario infrastructure was required. Acknowledging that a digitized map base presenting crown land ownership was not available to the team, it is emphasized that proposed locations are for planning/modelling purposes only. Detailed site evaluations would be required to confirm all necessary siting requirements were met, including those related to ownership.

A summary of the assumptions made for a future organics waste management program in Newfoundland for each regional authority is provided in Table 5-1. These assumptions are based on questionnaires completed by and through follow up discussions with the Regional Authorities and form the basis for organic waste collection, transfer and hauling to the composting facility(ies) for each of the seven options. Note that Scenario 3 was revised in July 2014 at the request of DMA to include one facility in Region 6 and one facility in Region 7. Not all Regions are serviced in every scenario and, in some cases, the assumptions vary for a Region based on the scenario. The number(s) in brackets after the assumption indicate which of the seven scenarios the assumption applies to.

Table 5-1 Assumptions on Regional Organics Waste Management Programs

Regional Authority	Assumptions on Organics Waste Management Program
1. Discovery RSB	• Organic waste will be curbside collected and hauled directly to the Clarenville TS (1, 2, 3, 4, 5, 6, 7)
2. Burin Peninsula RSB	• All organic waste will be curbside collected and hauled directly to Frenchman's Cove (2, 3, 4, 6, 7)

Regional Authority	Assumptions on Organics Waste Management Program
	• A composting facility will be constructed and located in Frenchman's Cove (2, 3) • A TS will be constructed and located in Frenchman's Cove (4, 6, 7)
3. Central RSB	• Organics will be collected curbside, transferred at TS3-1 to TS3-7 and then hauled to the Norris Arm site (1, 2, 3, 4, 5, 6, 7) • Organics received at TS3-9 (Botwood) will be hauled to TS3-2 (Point Leamington) and then transferred to the Norris Arm site (1, 2, 3, 4, 5, 6, 7) • Organics in "zone 8" will be curbside collected and directly hauled to Norris Arm (1, 2, 3, 4, 5, 6, 7) • A composting facility will be constructed at the Norris Arm Regional Waste Management Facility (1, 2, 3, 4, 6) • A TS will be constructed at the Norris Arm Regional Waste Management Facility (5, 7)
4. Coast of Bays WMC	• Organic waste will be curbside collected (1, 2, 3, 4, 6, 7) • Two TSs will be constructed and located in Milltown-Head of Bay D'Espoire, and Hermitage (1, 2, 4, 6, 7) • Organic waste from the two TSs will be collected and hauled together to Norris Arm (1, 2, 4, 6, 7) • A composting facility will be constructed and located in Milltown-Head of Bay D'Espoire (3)
5. Eastern RSB	• Part of sub-region 2 and sub-regions 3 through 8 will have organic waste curbside collected and hauled directly to Dog Hill (1, 2, 3, 4, 5, 7) • Sub-region 1 and part of sub-region 2 will have organic waste curbside collected and hauled to TS5-1 (Clarenville) (1, 2, 4, 5, 6, 7) • Sub-region 1 and part of sub-region 2 will have organic waste curbside collected and hauled directly to a composting facility to be constructed and located in Clarenville (3) • A composting facility will be constructed and located in Dog Hill (1, 2, 3, 5, 7) • A TS will be constructed and located in Dog Hill (4, 6)
6. Baie Verte – Green Bay	• Organic waste will be curbside collected (1, 2, 3, 4, 5, 6, 7) • Two TSs will be constructed and located in South Brook and Baie Verte (1, 2, 4, 5, 6, 7) • Organic waste from the two TSs will be collected and hauled together to Norris Arm (1, 2, 4, 5, 6, 7) • One composting facility will be constructed and located in Baie Verte (3)

Regional Authority	Assumptions on Organics Waste Management Program
7. Northern Peninsula RSB	• Organic waste will be curbside collected (2, 3, 6, 7) • Two composting facilities will be constructed and located in St. Anthony and Port au Choix (2) • One composting facility will be constructed and located in Port au Choix (3) • One TS will be constructed and located in St. Anthony (3) • Two TSs will be constructed and located in St. Anthony and Port au Choix (6, 7) • Organic waste from the two TSs will be collected and hauled together to Norris Arm (6, 7)
8. Western RSB	• Three composting facilities will be constructed and located in Rocky Harbour, St. George's and Channel-Port aux Basques and organics generated within sub-regions 1, 5 and 6 will be hauled directly from the curbside to the composting facilities (2) • TSs will be constructed and located in Wild Cove (TS8-1) and Hampden Junction (TS8-2). Organics collected at curbside in sub-regions 2, 3, and 4 will be hauled directly to the TSs and then hauled to Norris Arm (1, 2, 6) • TSs will be constructed and located in Rocky Harbour (TS8-3) and St. George's (TS8-4). Organics collected at curbside in sub-regions 1 and 5, respectively, will be hauled directly to the TSs and then hauled to Norris Arm (6) • Organic waste from Wild Cove (TS8-1), Hampden Junction (TS8-2) and St. George's (TS8-4) will be hauled together to Norris Arm (4) • A composting facility will be constructed and located in Wild Cove and will service sub-regions 1 through 6 via curbside collected organics being hauled to TSs in Rocky Harbour, Hampden Junction, St. George's, Channel-Port aux Basques and then hauled to the composting facility in Wild Cove (3) • A composting facility will be constructed and located in Deer Lake and service sub-regions 1 through 6 via curbside collected organics being directly hauled to TSs constructed and located in Rocky Harbour, Hampden Junction, St. George's and Channel-Port aux Basques (5, 7)

The Regional Authorities are either planning to (or would like to) implement curbside collection of organics in the near term however, most are waiting to see how the Province allocates funding before implementing/changing collection programs to accommodate the organics stream. It has been assumed that initial implementation and ongoing operation of proposed organics management infrastructure and programs as described under each of the seven scenarios would be led by the relevant Regional Authorities, with assistance from provincial entities including DMA and MMSB as required. Also, it has been assumed that the relevant Regional Authorities will lead public education and awareness requirements and incorporate the initial implementation and ongoing operation of proposed organics management programs into existing user engagement efforts. Observation and monitoring of participation rates/quantities captured will also be conducted by Regional Authorities and adjustments to public education programs will be made accordingly. Consistent with current practices, efforts at the regional level would be augmented by information provided by municipal and provincial entities.

As described in Section 3.4.4, future waste generation quantities are based on participation and capture rates and on population projections. It is assumed that in the first 10 years of the program (i.e., 2015-2024), capture efficiencies will be relatively low (which is typical of new programs) as it takes time for users to understand and/or participate in the program. During the initial years of the program, it is assumed that Regional Authorities will monitor participation rates and make adjustments to public education programs and/or enforcement options. After 2025, improvements in capture efficiencies will be realized and will stabilize over the remaining years. Under these assumptions, the estimated quantities of organics generated, by sub-region, were estimated and used to determine: 1) the quantities of organics to be received at TSs, and 2) the annual capacities of proposed composting facilities.

For the purpose of this study, it was assumed that curbside collection of residential organics will be facilitated through the use of a kitchen “mini-bin” and a 240 L wheeled cart, both provided by the host municipality/region. This is consistent with an approach that has been used successfully throughout Nova Scotia (as well as other Canadian jurisdictions) for more than 15 years. Organics and garbage would be collected in alternating weeks (e.g., Week 1 - organics, Week 2 - garbage) and recycling would be collected weekly. These assumptions on the general collection approach may be modified by regions and/or municipalities to suit individual curbside collection programs preferences and contractor capabilities. Depending on the scenario and sub-region, organics will either be directly hauled to a composting facility or to a transfer station. It has been assumed that organics will be transferred to composting facilities a minimum of once a week (i.e., organic materials will not be stored for longer than a week)[1].

The analysis assumes one of two ways to transport organics from TSs to composting facilities: 1) open-topped (with retractable cover) 53 foot walking floor trailers with a capacity of 25 tonnes per transfer trailer, and 2) 30-yard roll-off containers with a capacity of 10 tonnes per container. The type of transportation container depends on the estimated weekly quantity of organics generated. Areas that generate at least 25 tonnes per week, will transport organics via walking floor trailers. Areas that generate less than 25 tonnes per week will use roll-off containers. Aside from the major population centres in Newfoundland, the majority of sub-regions are assumed to use roll-off containers. The specialized walking floor trailers and roll-off containers will be owned and maintained by the host municipality/region, with the trucking service being provided through contract.

In order to transfer the organic materials from collection vehicles to the transfer trailer or roll-off container, an enclosed, grade-separated TS will be required. Noting that design details on the existing/proposed TSs throughout the eight management regions were not available to the Dillon team at the time of reporting, it

[1] As mentioned in Section 3.3.2.3, the Environmental Standards for MSW Transfer Stations (July 2010) recommends that MSW destined for a composting facility are stored for no longer than two days in the summer and one week in the winter. Suggested changes to the maximum storage durations in the Environmental Standard are provided in Section 6.9.3.

has been assumed that no significant changes/incremental costs to the stations as configured will be necessary to accommodate the acceptance of organics.

As described in Section 4, for the purposes of this study, composting facilities fall into one of four levels in terms of annual facilities capacities (see adjacent text box). As described in Section 6.1.1, the estimated quantities of organics captured are anticipated to increase over the planning period (2015-2045) as a result of increased capture efficiencies (between 2015 and 2025) and population growth. While details on forecasted facility tonnages are incorporated within Section 6, the following sections provide some sizing information (in terms of process tonnage and corresponding facility level) for proposed composting operations.

<u>Composting Facility Levels (tonnes per year)</u>

1. Level Ia: ≥10,000;
2. Level Ib: 2,500 to 9,999;
3. Level II: 1,000 to 2,499; and
4. Level III: less than 1000.

5.2 Scenario 1 – Two Regional Facilities – Central Region and Eastern Region

Scenario 1 includes the use of two regional/centralized composting facilities. The Central Region facility would be located at the Norris Arm Regional Waste Management Facility where there is an engineered landfill in operation and a MRF currently under construction and anticipated to be commissioned in 2014. For the siting of a central composting facility in Eastern Region, a few different locations were considered. Three were based on population mean, population median and on proximity to known buildings (e.g., households) thereby minimizing travel distances. During the 50% Project Review Meeting, a study that had been completed to locate a new landfill was identified as a potential resource to aid in the selection of an Eastern Regional site (part of the Greater Avalon Region, Solid Waste Management Plan - Phase 4 Final Report, Preferred Option by BAE Newplan Group). The preferred location was near an area referred to as Dog Hill which is located in the middle of the three other proposed locations. Therefore, the candidate location for the Eastern Region composting facility is close to the Dog Hill location identified in the siting study but moved closer to the existing access road (since the area requirement is considerably less than a landfill site).

The service areas for the two composting facilities were selected if the jurisdictions were within a three hour, one-way drive. The three hour time is to transport waste from the sub-regional facility (e.g., TS, WRF) to one of the two composting facilities. Using this criterion to define the service areas, the regions and/or sub-regions included in Scenario 1 and the estimated facility capacities are summarized in Table 5-2.

Table 5-2 Scenario 1 Composting Facilities

1.1 Eastern Region Facility (Dog Hill)	1.2 Central Region Facility (Norris Arm)
• Region 1 (all) • Region 5 (all)	• Region 3 (all) • Region 4 (all) • Region 6 (all) • Region 8 (sub-regions 2, 3, 4)

1.1 Eastern Region Facility (Dog Hill)	1.2 Central Region Facility (Norris Arm)
Annual facility capacity (Level Ia) = 27,200 tonnes (2015) to 52,100 tonnes (2045)	Annual facility capacity (Level Ia) = 12,100 tonnes (2015) to 22,800 tonnes (2045)

5.3 Scenario 2 – Two Regional Facilities with Sub-Regional Operations

Scenario 2 is similar to Scenario 1 in that the same two regional facilities apply (Dog Hill and Norris Arm) and services the same regions and sub-regions that are within a three hour, one-way drive. Scenario 2 is augmented with six sub-regional facilities in areas that were not included in Scenario 1.

In Burin Peninsula (Region 2), it is proposed to have one composting facility to service this region. Burin Peninsula staff recommended that the facility be located where existing landfills are and suggested either Frenchman's Cove or Marystown as potential locations. Frenchman's Cove was selected for the study.

For the Northern Peninsula (Region 4), two composting facilities were identified and located St. Anthony and in Port au Choix.

For the Western Region (Region 8), the northwestern and southern sub-regions were excluded in Scenario 1. Aside from sub-region 7 (remote communities of Burgeo, Rameo), three additional facilities are proposed in sub-regions 1, 5 and 6 and located in the population centres.

Table 5-3 summarizes the eight proposed composting facilities, the associated facility capacities and regions/sub-regions serviced for Scenario 2.

Table 5-3 Scenario 2 Composting Facilities

2.1 Eastern Region Facility (Dog Hill)	2.2 Central Region Facility (Norris Arm)	2.3 Burin (Frenchman's Cove)
• Region 1 (all) • Region 5 (all)	• Region 3 (all) • Region 4 (all) • Region 6 (all) • Region 8 (sub-regions 2, 3, 4)	• Region 2 (all)
Annual facility capacity (Level Ia) = 27,200 tonnes (2015) to 52,100 tonnes (2045)	Annual facility capacity (Level Ia) = 12,100 tonnes (2015) to 22,800 tonnes (2045)	Annual facility capacity* = 1,700 tonnes (Level II in 2015) to 3,200 tonnes (Level Ib in 2045)

2.4 Western I (Rocky Harbour)	2.5 Western II (St. George's)	2.6 Western III (Channel - Port aux Basques)
• Region 8 (sub-region 1) Annual facility capacity (Level III) = 300 tonnes (2015) to 540 tonnes (2045)	• Region 8 (sub-region 5) Annual facility capacity* = 1,600 tonnes (Level II in 2015) to 3,000 tonnes (Level Ib in 2045)	• Region 8 (sub-region 6) Annual facility capacity* = 850 tonnes (Level III in 2015) to 1,600 tonnes (Level II in 2045)
2.7 Northern I (St. Anthony)	**2.8 Northern II (Port au Choix)**	
• Region 7 (sub-region 2) Annual facility capacity (Level III) = 400 tonnes (2015) to 760 tonnes (2045)	• Region 7 (sub-regions 1, 3, 4) Annual facility capacity* = 740 tonnes (Level III in 2015) to 1,300 tonnes (Level II in 2045)	

** Composting facility capacity crosses levels during the study period. .*

5.4 Scenario 3 – Hybrid of Scenarios 1 and 2

Scenario 3 is a combination of Scenarios 1 and 2. Scenario 1 is modified by servicing areas that are within a two hour, one-way driving time instead of a three hour one-way driving time.

The Eastern Region facility in Dog Hill services all of Region 5 with the exceptions of sub-region 1 (Clarenville and Isthmus) and half of sub-region 2 (Trinity Bay South and Isthmus East). A composting facility is proposed in Clarenville which will service sub-region 1 and half of sub-region 2 in Eastern Region and all of Discovery Regional Service Board (Region 1).

The Central Region facility in Norris Arm services all of Region 3. Baie Verte – Green Bay Region will have one composting facility located in Baie Verte to service all of Region 6. Northern Region will have one composting facility located in Port au Choix to service all of Region 7 (note that distance between St. Anthony and Port au Choix is greater than two hours but at the request of DMA, only one composting facility was identified for Region 7). The Burin Peninsula composting facility location will be the same as in Scenario 2. A new facility is proposed in Coast of Bays (Region 4) in Milltown which will service all of Region 4.

Western Region (Region 3) falls outside of the two-hour driving time to Norris Arm and therefore has its own composting facility. Through discussions with Western Region, it was decided to site a Western regional facility in Wild Cove as it was identified as a cost efficient location for Western Region. The Western regional facility services six of the seven regional facilities (sub-region 7 - Burgeo and area is excluded as the driving distance exceeds the two hour one-way driving time criteria).

Table 5-4 presents a summary of the eight proposed composting facilities, the associated facility capacities and regions/sub-regions serviced for Scenario 3.

Table 5-4 Scenario 3 Composting Facilities

3.1 Eastern/Discovery (Clarenville)	3.2 Eastern Region Facility (Dog Hill)	3.3 Central Region Facility (Norris Arm)
• Region 1 (all) • Region 5 (sub-regions 1 and 50% of 2) Annual facility capacity (Level Ib) = 2,700 tonnes (2015) to 5,600 tonnes (2045)	• Region 5 (all except sub-regions 1 and 50% of 2) Annual facility capacity (Level Ia) = 24,500 tonnes (2015) to 45,500 tonnes (2045)	• Region 3 (all) Annual facility capacity* = 6,500 tonnes (Level Ib in 2015) to 12,200 tonnes (Level Ia in 2045)
3.4 Burin (Frenchman's Cove)	**3.5 Coast of Bays (Milltown)**	**3.6 Western Region (Wild Cove)**
• Region 2 (all) Annual facility capacity* = 1,700 tonnes (Level II in 2015) to 3,200 tonnes (Level Ib in 2045)	• Region 4 (all) Annual facility capacity* = 600 tonnes (Level III in 2015) to 1,100 tonnes (Level II in 2045)	• Region 8 (all except sub-region 7) Annual facility capacity* = 6,600 tonnes (Level Ib in 2015) to 12,400 tonnes (Level Ia in 2045)
3.7 Northern Region (Port au Choix)	**3.8 Baie Verte – Green Bay Region (Baie Verte)**	
• Region 7 (all) Annual facility capacity* = 1,140 tonnes (Level II in 2015) to 2,060 tonnes (Level Ib in 2045)	• Region 6 (all) Annual facility capacity (Level II) = 1,150 tonnes (2015) to 2,180 tonnes (2045)	

** Composting facility size crosses levels during the study period.*

5.5 Scenario 4 – One Regional Facility

Scenario 4 was added after the 50% Project Review Meeting and follow-up meeting at the MMSB Earth Bound conference in September 2013. Feedback received from attendees at both meetings indicated an interest in proposing one facility in Central Region (Norris Arm) for the island of Newfoundland that would service areas that were within a four hour one-way driving time. Areas outside of this area would not be serviced as part of Scenario 4.

Table 5-5 shows which regions/sub-regions are within a four hour, one-way drive of the proposed Norris Arm composting facility and therefore included as part of Scenario 4.

Table 5-5 Scenario 4 Composting Facilities

4.1 Regional Facility (Norris Arm)	
• Region 1 (all) • Region 2 (all) • Region 3 (all) • Region 4 (all)	• Region 5 (all) • Region 6 (all) • Region 8 (sub-regions 1 to 5)
Annual facility capacity (Level Ia) = 42,900 tonnes (2015) to 81,700 tonnes (2045)	

5.6 Scenario 5 – Two Regional Facilities

Scenario 5 was also added after the 50% Project Review Meeting and the follow-up meeting at the MMSB Earth Bound conference in September. The Eastern Region composting facility in Dog Hill remains the same as Scenario 1 in that the facility services all of Eastern Region and Discovery Regional Service Board.

Instead of the second regional facility being located at Norris Arm (i.e., Scenario 1), the composting facility is located in the Western Region. The rationale for this scenario is to take advantage of backhauling opportunities. Western Region will be sending garbage to the Norris Arm landfill site. Instead of empty trailers being transported back to Western Region, it is assumed that the Western Region vehicles haul organics generated within Central Region and haul it to the composting facility in Western Region. Organics generated within Central Region will continue to be hauled from the local TSs to Norris Arm, consolidated at a new Norris Arm TS and then backhauled to Western Region. It is assumed that organics generated in Baie Verte – Green Bay region will be hauled to the two transfer stations. Organics will be collected in Baie Verte and then the same truck would collect organics in South Brook and then be hauled to the Deer Lake facility.

Deer Lake was selected as the preferred location in Western Region as it is located closer to the Western/Central regional boundaries. Areas located within a three hour, one-way driving time of Deer Lake are serviced in Scenario 5. All of Green Bay (Region 6) and Central Region (Region 3) are serviced. All sub-regions within Western Region (Region 8) are serviced with the exception of sub-region 7 (Burgeo and Area).

Table 5-6 provides a summary of the two facilities and corresponding areas serviced for Scenario 5.

Table 5-6 Scenario 5 Composting Facilities

5.1 Eastern Region Facility (Dog Hill)	5.2 Western Region Facility (Deer Lake)
• Region 1 (all) • Region 2 (all)	• Region 5 (all) • Region 6 (all) • Region 8 (sub-regions 1 to 5)
Annual facility capacity (Level Ia) = 27,200 tonnes (2015) to 52,100 tonnes (2045)	Annual facility capacity (Level Ia) = 14,200 tonnes (2015) to 26,900 tonnes (2045)

5.7 Scenario 6 – Expansion of Scenario 4 Service Area

Scenario 6 was added after the Draft Report review meeting in December 2013. Feedback received from participants indicated an interest to remove the driving time limitation (i.e., in the case of Scenario 4, the four hour one-way drive) to include areas not previously serviced aside from Region 8; namely, sub-region 7 (Burgeo and Area) for the facility in Deer Lake. This enables 99.7% of the island's population to be included organics program service area.

Table 5-7 Scenario 6 Composting Facility

4.1 Regional Facility (Norris Arm)	
• Region 1 (all) • Region 2 (all) • Region 3 (all) • Region 4 (all)	• Region 5 (all) • Region 6 (all) • Region 7 (all) • Region 8 (sub-regions 1 to 6)
Annual facility capacity (Level Ia) = 44,800 tonnes (2015) to 85,400 tonnes (2045)	

5.8 Scenario 7 – Expansion of Scenario 5 Service Area

Scenario 7 was also added after the Draft Report review meeting in December 2013. Feedback received from participants indicated an interest to remove the driving time limitation (i.e., in the case of Scenario 5, the three hour, one-way drive) to include areas not previously serviced aside from Region 8; namely, sub-region 7 (Burgeo and Area). This enables 99.7% of the island's population to be included in the organics program service area.

There is no change to the service area of the Dog Hill facility.

Table 5-8 Scenario 7 Composting Facilities

5.1 Eastern Region Facility (Dog Hill)	5.2 Western Region Facility (Deer Lake)
• Region 1 (all) • Region 2 (all) Annual facility capacity (Level Ia) = 27,200 tonnes (2015) to 52,100 tonnes (2045)	• Region 5 (all) • Region 6 (all) • Region 7 (all) • Region 8 (sub-regions 1 to 6) Annual facility capacity (Level Ia) = 17,600 tonnes (2015) to 33,200 tonnes (2045)

6.0 Assessment of Candidate Organics Management Scenarios

With a focus on cost and diversion performance (e.g., the ability to direct material away from landfilling), Section 6 presents an analysis over the 30-year planning period of the seven candidate compostable organics management scenarios described in Section 5.

6.1 Assumptions

In order to develop estimates of the number of tonnes of compostable material captured by each scenario as well as the associated management costs, a number of key assumptions required definition. These assumptions are summarized below.

6.1.1 Capture Rate

Capture rate refers to the percentage of compostable material that is extracted from the overall quantity that is available in the MSW stream. For waste diversion systems that rely on source separation at the point of generation (e.g., segregating compostable organics in a designated container), the capture rate is often expressed as the product of two factors; *participation rate* and *user efficiency*.

Participation rate is the percentage of generators (e.g., private residents or business operators) who actively take part in the program. *User efficiency* addresses the fact that even generators who intend to participate in a diversion program will sometimes not meet program requirements; e.g., miss a collection day or put materials in the wrong container.

In the case of the Newfoundland analysis, and with reference to collection data from jurisdictions in Nova Scotia, it was assumed that the organics capture rate would evolve over two stages; 1) Developing system stage (2015 to 2024), and 2) Mature system stage (2025 to 2045). During the 10-year developing system stage, acknowledging that both residential and ICI generators will be on a learning curve adjusting to the new material segregation requirements, a reduced level of capture success, as compared to mature system, was assumed.

With reference to Table 6-1, organics capture values ranging from 114 to 164 kg/person/year (acknowledging contributions from both residential and ICI generators) were achieved in Halifax Regional Municipality (HRM) and the Town of Amherst during 2001 to 2011. It is noted that cart-based curbside organics collection programs, similar to that being proposed for the Newfoundland servicing scenarios, were in place in both Amherst and HRM during this time period. It is also acknowledged that a provincially legislated ban on the disposal of organic materials has been in place in Nova Scotia since 1997.

Table 6-1 Organics Capture Rates – SSO Cart Programs

Jurisdiction	Year	Years Since Program Initiation	Population[1]	#HH[1,2]	Compost Facility Tonnage[3]	Kg/ Person/ Year	Kg/ HH/ Year	Notes
HRM	2001	2	359,111	144,410	44,243	123	306	Provincial organics disposal ban
HRM	2006	7	372,679	155,125	42,666	114	275	Provincial organics disposal ban
HRM	2011	12	390,096	165,033	51,117	131	310	Provincial organics disposal ban
Amherst, NS	2011	9	9,717	4,403	1,590	164	361	Provincial organics disposal ban

Notes:
1. Data from Statistics Canada.
2. HH = Households; Private dwellings occupied by usual residents.
3. Includes source separated organics from residential and ICI generators.
4. HRM data from public sources; Amherst data courtesy CJSMA.

With reference to the kg/person/year rates achieved in Nova Scotia, as well as team member experience, the capture rate value was defined for each Newfoundland sub-region identified as providing an organics collection program. For the developing system stage (2015 – 2024), the capture rate was adjusted to achieve an annual organics recovery rate (for residential and ICI sources combined) of 100 kg/person per year. For the mature system stage (2025 to 2045), the capture rate was set based on an annual organics recovery rate of 150 kg/person/year. In actual fact, it is assumed that this improvement in recovery rate would occur linearly over the first 10 years of system operation, founded on sustained education and enforcement efforts by the region and province.

With reference to Section 3.4.5, materials targeted in the definition of the capture rate included traditional green cart items (e.g., food waste) as well as a select portion of LYW, food-soiled fibre and other organics. Noting that further details on captured tonnages are presented in Appendix F, the assumed average composition (by weight) of the material collected under the seven scenarios (e.g., "what's in the cart") is as follows;

- Food waste: 71%
- Boxboard and Paper Towel: 12%
- Leaf & Yard Waste: 8%
- Soiled OCC, Newsprint, Other Paper: 6%
- Other Organics: 3%

The use of this staged approach was adopted to address concerns expressed by participants during the September 2013 50% Project Review Meeting about the potential of "over-building" system infrastructure; in other words, building composting facilities that were larger than necessary based on overly optimistic organics capture rates. The proposed approach allows for the initial establishment of a transfer and processing system founded on a mid-range level of capture success during the initial 10 years of operation. As the initial stage comes to a completion, system managers can evaluate actual capture and throughput tonnage rates and make the determination if processing facility expansions to address the remaining 20 years of operation (as has been assumed for costing purposes in this section) are necessary.

6.1.2 Definition of Reference Facilities for Costing

Capital and operating costs were developed for each of the composting facilities and the new organics TSs (one in Scenarios 4 and 6 as well as 5 and 7) identified in the seven scenarios.

Estimated capital cost for the compost facilities were based on facilities constructed in Nova Scotia and Prince Edward Island and consisted of:

- A greenfield site;
- Covered primary composting for Level I, II and III;
- Covered receiving/processing area for Level I;
- Level II and III uncovered curing;
- Level Ia and Ib covered curing;
- Storage of green material (e.g., fall leaf collection, Christmas trees);
- Biofiltration of process air from the primary composting for Levels Ia and Ib;
- Staff space for offices, locker room , washroom and lunchroom;
- Mobile equipment (beyond that already available at the site);
- Scale and scalehouse for Levels Ia and Ib to handle inbound and outbound vehicle traffic (unless already provided at the site); and
- A dedicated road network.

Estimated capital costs for the organics TSs were based on similar facilities constructed in Nova Scotia that consisted of:

- A greenfield site;
- Pre-engineered steel building;
- Concrete tipping floor;
- Grade separation between the tipping floor and the transfer trailer floor;
- Staff space for offices, locker room , washroom and lunchroom;
- Sufficient space on the tipping floor to store approximately three days of MSW, while allowing incoming waste to be delivered and transferred into the transfer trailers;
- An exterior storage area for white goods, miscellaneous metals and other materials;

- Mobile equipment (beyond that already available at the site);
- A scalehouse and scale to handle inbound and outbound vehicle traffic (unless already provided at the site); and
- A dedicated road network.

Operational costs for the compost facilities and the organics TSs were based on:
- Anticipated staffing levels;
- Utilities;
- Maintenance;
- Insurance;
- Mobile equipment fuel; and
- Office operations.

The *Construction Cost Historical Index* as publish by *Engineering News-Record* was used to adjust the construction capital costs and the Consumer Price Index (CPI) was used to adjust the operating costs for the TSs and composts facilities into 2013 dollars.

Using these costed facilities as "reference templates", capital and annual operating costs for proposed compost facilities were estimated by using a tonnage scaling factor. For example, if a scenario required a cost for a 7,000 tonne/year (Level Ib) composting facility, the estimated capital and operating costs for the Level Ib reference template facility (10,000 tonnes/year) was used to determine the factor at which to apply to the facility in question. In this example, the template values were multiplied by a factor of 7,000/10,000 or 70%. While adequate for a province-wide, planning level evaluation, it is acknowledged that a more detailed level of analysis, acknowledging site/region specific issues, will be necessary to confirm long term budgetary requirements.

Further details related to capital and operating cost estimates, along with reference facility site layout plans developed for this project, are presented in Appendix G.

6.1.3 Determination of Transport/Haulage Costs

A Geographic Information System (GIS) program was used to determine the appropriate transportation route to move waste from the transfer locations to the appropriate processing facilities. The analysis was carried out using ESRI's Network Analyst, a GIS tool developed specifically for the purpose of assessing networks, such as roads. Digital copies of GIS layers were provided by the Province of Newfoundland and Labrador (the Department of Municipal Affairs and the Department of Transportation and Works) for the existing road network. Using the road network, Network Analyst was used to determine the shortest and most practical route along the road network from each transfer location to the appropriate processing facility. In some cases, the shortest route was not selected as the road/highway may not be suitable for transfer trailers and/or winter conditions. The length of each route was recorded. A number of base parameters were also included in the analysis in order to determine the overall transportation cost of transporting the waste to and from facilities. Table 6-2 summarizes the parameters used in the analysis.

Table 6-2 Transportation Analysis Parameters

Parameter	Assumption
Average Truck Speed	90 km/hour
Transport Capacity a) 53 foot Walking Floor Trailer b) 30 cubic yard Roll Off (covered)	 25 tonnes 10 tonnes
Trucking Cost* a) Semi-trailer Truck b) Roll-off Truck	 $95/hour $90/hour
Maximum Organics Storage Period at a Transfer Station	1 week
Load/Unload Time	1 hours each
Fogo Island Ferry Time (Region 3)	2 hours

Notes:
*Trucking services provided through contract; all costs in 2013 dollars.

Using the length of the route and an assumed average speed of the truck, it was then possible to determine the time it would take to transport the waste to and from the transfer locations for each of the scenarios. Next, using the assumed cost per hour to operate the vehicles, a total transportation cost to move the waste was determined.

6.1.4 Residential Curbside Collection Costs

As described in Section 5.1, only those regions/sub-regions of Newfoundland that are either currently providing or are planning on providing curbside residential collection services were identified as participating in one of the seven organics management scenarios. With regard to costs for residential curbside collection, several sources were investigated including several NS municipalities and data provided by the regional contacts.

A summary of the information gathered from several NS municipalities is presented in Table 6-3. As noted in the table, all the contacted municipalities provide garbage and organics (using a cart) curbside collection on an alternating week basis (e.g., garbage collection on week 1, organics collection on week

Table 6-3
Collection Cost Summary - Select Jurisdictions with Three/Four Stream Residential Collection

					Service Desciption									
Jurisdiction	Contact	2011 Population[1]	Service Area (km^2)	Population Density (persons/km^2)	Garbage	Recyclables	Fibre/Paper	Organics	Bulky	Approx # HH[1,2]	Annual Contract Value[3]	Annual Cost/HH	Notes	
Municipality of the District of Argyle (NS)	Amy Hilliard, Waste Check	8,252	1,528	5.4	Every 2nd wk[4], 140 kg max	Every 2nd wk[4]	Every 2nd wk[4]	245 or 130L Gcart, Every 2nd wk[4]	Twice per year	3,380	$306,646	$91	Use clear bags for garbage.	
Municipality of the County of Cumberland (NS)	Stephen Rayworth, CJSMA	31,353	4,272	7.3	4 bag max, every 2nd wk	Bbag, every non garbage or organics wk	Same as Recyclables, in separate bag	240L Gcart, every 2nd wk	One item every 2nd wk	8,582	$1,164,744	$136	Ten year contract. Also includes small ICI generators. Use clear bags for garbage.	
Municipality of the County of Colchester & Town of Stewiacke (NS)	Darlyne Proctor, Colchester County	52,406	3,646	14.4	Every 2nd wk with Organics	Every 2nd wk with Fibre/Paper	Every 2nd wk with Recyclables	240L Gcart, every 2nd wk with Garbage	Twice per year	22,293	$1,631,560	$73	Use clear bags for garbage. Collection of all materials occurs on the same week using two "split" trucks; one for organics/waste and one for recyclables/ fibre.	
Municipality of the District of Yarmouth (NS)	Amy Hilliard, Waste Check	10,105	586	17.2	Every 2nd wk	Weekly	Weekly	245 or 130L Gcart, Every 2nd wk[4]	Twice per year	4,200	$383,668	$91	Use clear bags for garbage.	"Rural" Avg. = $94 /HH
Town of Truro (NS)	Darlyne Proctor, Colchester County	12,059	38	317.3	Every 2nd wk with Organics	Every 2nd wk with Fibre/Paper	Every 2nd wk with Recyclables	240L Gcart, every 2nd wk with Garbage	Twice per year	5,756	$434,700	$76	materials occurs on the same week using two "split" trucks; one for organics/waste and one for recyclables/ fibre.	
Town of Yarmouth (NS)	Amy Hilliard, Waste Check	6,761	11	614.6	Every 2nd wk	Weekly	Weekly	240 or 130L Gcart, Every 2nd wk[4]	Monthly	3,145	$268,534	$85	Use clear bags for garbage.	
Town of Amherst (NS)	Stephen Rayworth, CJSMA	9,717	12	809.8	Every 2nd wk	Every 2nd wk with Organics	Every 2nd wk with Organics	240L Gcart, every 2nd wk	Once per year	3,158	$264,966	$84	Use clear bags for garbage. #HH as reported by CJSMA.	
Town of Antigonish (NS)	Nicole Havercort, Region 6 Solid Waste Reduction Coordinator	4,524	5	904.8	Every 2nd wk with Organics	Every 2nd wk with Fibre/Paper	Every 2nd wk with Recyclables	240L Gcart, every 2nd wk with Garbage	Twice per year	2,102	$211,335	$101	Use clear bags for garbage. 50 km direct haul from Town to organics and garbage management site. #HH as reported by local authority.	"Urban" Avg. = $87 /HH

Legend

1. Data from Statistics Canada
2. HH (Households) = Usually Occupied Residences + (Seasonal Residences x 0.5)
3. Most recently reported value, taxes extra
4. All streams collected at the same time.
5. "Rural" = persons/km^2 < 75, "Urban" = persons/km^2 $\geq$ 75.

Bbag: Blue Bag
Gcart: Green Cart

L:\PROJECTS\Draft\2013\138097 - Newfoundland Organics Options\Spread\NS Collection Cost Info\[Collection Cost Summary.xlsx]Nova Scotia

2, and so on). Recyclables collection varies from weekly to bi-weekly with some additional variation noted regarding pick up of bulky items.

Data from Regions 2, 3 and 5 was reviewed (see Table 6-4) to determine how current Newfoundland curbside collection costs compared to the NS values.

Table 6-4 Select Newfoundland Curbside Collection Costs

Region/Collection Area	Service Description	Approx. # HH	Reported Annual Cost/HH
Region 5 (Eastern) - Southern Shore	Weekly garbage, bi-weekly recyclables	3,218	$109[1]
Region 5 - Trinity Conception North	Weekly garbage, bi-weekly recyclables	2,690	$99[1]
Region 5 (Eastern) - Conception Bay South/Central	Weekly garbage, bi-weekly recyclables	2,609	$120[1]
Region 5 (Eastern) – Isthmus	Weekly garbage, bi-weekly recyclables	3,058	$87[1]
Region 3 (Central)	Weekly garbage	17,000	$74[2]
Region 2 (Burin)	Weekly garbage, bi-weekly paper for 1,200 HH	5,000	$120[2]

Notes:
1. Projected 2014 budget value.
2. Reported 2013 budget value.
HH: Households

As described in Section 5.1, and founded on the approach adopted by many municipalities in Nova Scotia, it is proposed that residential curbside collection services under all seven of the scenarios provide collection of garbage and organics (using a cart system) on alternating weeks, with recyclables (details of preferred collection approach to be defined by the region) collected every second week. Therefore, as compared to the number of "truck passes" under the current system in Region 5 (which collects both garbage and recyclables), there is no net change. While it is acknowledged that going from a weekly to a bi-weekly garbage collection service represents a significant change to the established practice in Newfoundland, experience in Nova Scotia has shown that opposition to alternating week collection tends to be founded more on reluctance to change as opposed to actual inconvenience. Clearly, effective and timely user education and enforcement will play a significant role in making the transition to new collection practices.

For the purposes developing scenarios cost for this assignment, and with reference to the reviewed information, it is recommended that a 2013 per HH collection cost of $90/year be assumed for sub-regions categorized as "urban" and $100/year for those designated as "rural". As discussed in Section

6.1.5, these forecasted residential collection costs have not been included as part of the Net Present Value (NPV) evaluation of the seven candidate scenarios.

6.1.5 Calculation of Annual and Net Present Value Costs

This section provides an overview of the assumptions employed to estimate the Net Present Value (NPV) and the annualized costs of both the seven candidate organics management scenarios (presented in Sections 6.2 to 6.6) and the residential curbside collection (presented in Section 6.7.1). There are three cost items that we included in the analysis:

- Capital costs are estimated for major equipment in three categories: building, process equipment and mobile equipment (e.g., walking floor trailers, residential carts and kitchen “mini-bins”). Each scenario includes capital expenditures allocated at the beginning of the program in 2015 (e.g., composting facilities, new organics transfer stations, walking floor trailers, curbside carts) with capital replacement at select times occurring at the end of operating life during the 30-year planning period. The operating life is 20 years for buildings and 10 years for both stationary process equipment and mobile equipment. When equipment reaches its end of life it is renewed based on this schedule. Major capital costs are assumed to be expended in the year before operation while capital replacement happens in the scheduled year of replacement. For buildings, if the waste stream forecast in a future period exceeds the assumed operational limit of a facility, an upgrade in size and hence expenditure occurs to accommodate the increased waste flow. Waste handling facilities are therefore not initially overbuilt to match a future peak waste flow, but expand in time as needed.

- Annual operating costs include curbside collection, transfer and processing. As mentioned above, annual curbside collection costs are provided in Section 6.7.1. All annual operating costs were estimated using an equivalent annual cost (EAC) which takes the NPV estimate and breaks down the costs into equal annual payments.

- Salvage values are residual values in remaining capital items at the end of life. These are expressed as negative costs in the analysis in the year of operation before the capital is replaced. Salvage values are only applied to mobile and process equipment, and not to buildings, due to the ongoing operation of the facility, and not to residential containers, given they are assumed to be fully exhausted at end of life with no alternative uses.

The following two items are not included in the analysis:

- Financing Costs. Consistent with public projects economic analysis, financing costs are not included in the analysis. A discount rate of 6% was used however to reflect the time value of money to express future costs in 2013 dollars.

proposed organic processing facilities will not serve as a revenue source. Due to current uncertainties in the marketability of the product, and to maintain a cautious, conservative position on system funding requirements, it was recommended that it be assumed that the final cured compost product be considered a "net-zero" (no revenue or cost implications) contributor to annual facility operation and maintenance cost estimates. This assumption is linked to the expectation that the final product will be utilized for public works applications (e.g., slope stabilization, surface revegetation), final landfill cover application (e.g., blending with final cover soil materials to enhance vegetation growth) or offered at no charge to area residents and/or businesses.

The two main indictors developed for collection costs (Section 6.7.1) and the seven candidate organics management scenarios (Sections 6.2 to 6.6) include both a NPV estimate and the total annualized costs of the stream of future costs for both residential collection and for each of the seven scenarios. For each scenario and for each of the regions serviced in each scenario, the following costs are estimated:

1. Net Present Value is the discounted stream of future capital and operating costs expressed in 2013 dollars. Capital costs are accounted for fully in the first year of operation and maintenance costs accrue in each year of operation. Replacement capital costs are accounted for in the year they are needed (capital end of life +1), while operating and salvage values are expressed as negative costs at the end of their life (mobile and process equipment).

2. Total annualized costs (TAC) takes the NPV estimate and breaks down the costs into equal annual payments for each of the seven management scenarios and the residential collection costs (Section 6.7.1). The TAC includes annualized capital costs added to annual operating and maintenance, less salvage values.

Table 6-5 below provides an overview of the assumptions and parameters used to calculate the NPV for the seven candidate organics management scenarios.

Table 6-5 Summary of Parameters Used in Costing Analysis

Parameter	Description	Value
Analysis Time Period	The timeframe in which the appraisal is conducted, covering at a minimum the life of the asset but more likely aligned with forecast changes in temperature variables	30 years: 2015 to 2045
Discount Rate for NPV Calculation	Given long-time frames, a lower discount rate is suggested to bring streams of costs and benefits back to the base year (2013). $\mathrm{NPV}(i,N) = \sum_{t=0}^{N} \frac{R_t}{(1+i)^t}$, where t is the years and r is the discount rate	r = 6% discount rate t = 30 years

Parameter	Description	Value
Equivalent Annual Cost (EAC)	Converts a present value of the total capital and operating costs into an annual cost over the specified time period, at a specified discount rate: $EAC = \frac{NPV}{A_{t,r}}$, where *A* is expressed as $\frac{1-1/(1+r)^y}{r}$, where r is the discount rate and y are the years.	r = 6% discount rate y = 30 years
Base Year for Pricing	The year in which the expenditures are anticipated.	2013 prices
Capital Costs	For buildings, process equipment and mobile equipment	-
Capital Life	For buildings, process equipment and mobile equipment	Buildings - 30 years Process, mobile, carts and bins - 10 years
Capital salvage value	The residual value of the capital at end of life, netted from the cost of capital replacement costs	10% of capital cost for process equipment and mobile equipment

6.2 Scenario 1 Results

Following the description of Scenario 1 in Section 5.2 and the assumptions stated above, a graphical representation of Scenario 1 is presented in Figure 6-1. This figure shows the locations of the proposed composting facilities and TSs, the associated regions/sub-regions serviced and the proposed transportation and organics hauling route.

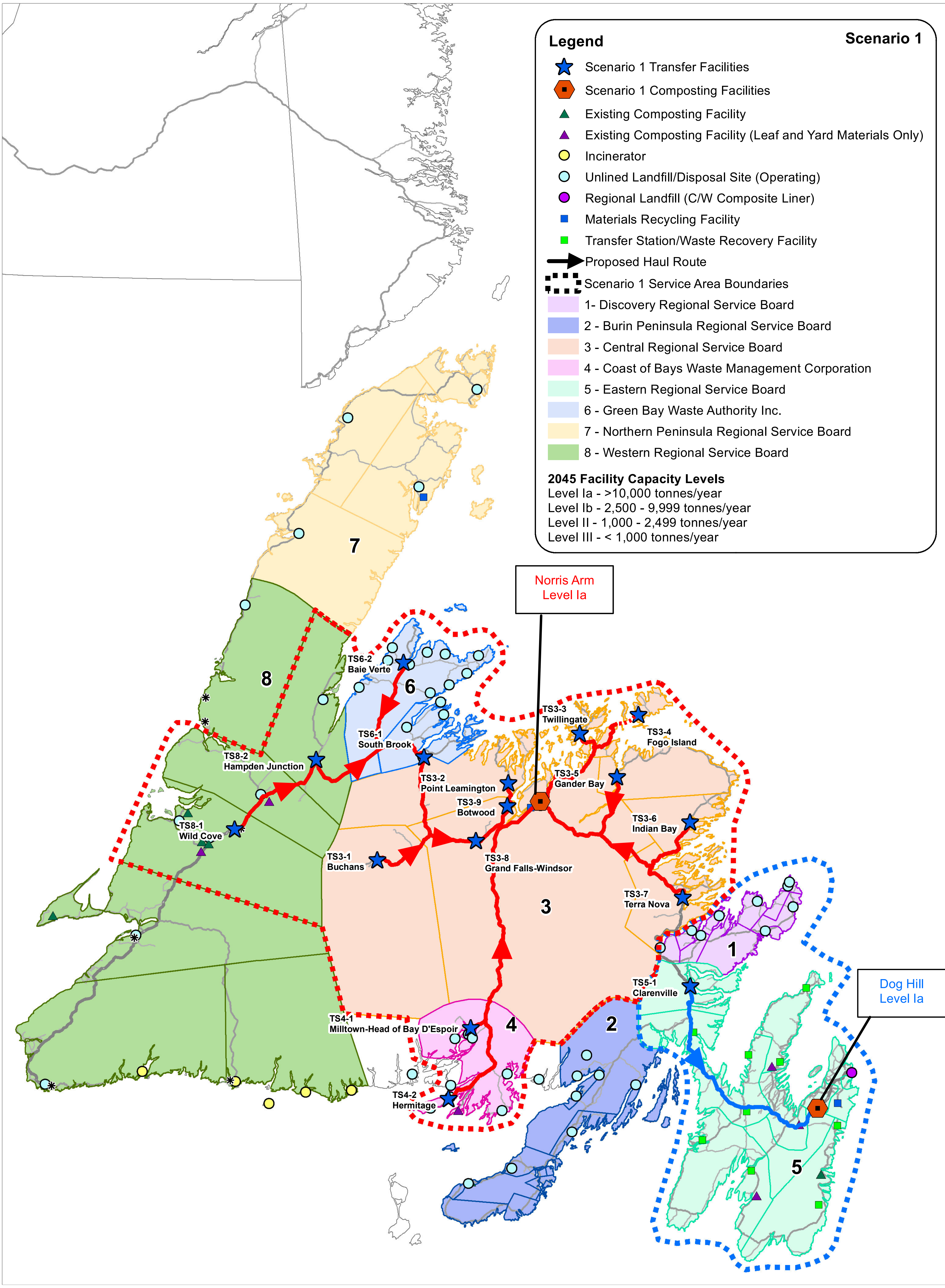
Scenario 1 diverts about 1.94 million tonnes over 30 years, with a NPV cost of $118 million. This is almost $5.9 million annually, with a cost per tonne of waste diverted of about $61. With an average of 170,700 households served annually in the scenario, annual costs are approximately $20.30 per household. Table 6-6 provides the NPV costs, including the distribution between ICI and residential (RES) and the annualized cost. The estimated quantities of waste diverted over the 30-year planning period (summarized into the following four years: 2015, 2025, 2035, 2045) are presented in Table 6-7.

Table 6-6 Estimated Costs for Scenario 1

Scenario 1	NPV (000s) @ 6%: 30 years ($2013)			Distribution of NPV	
	Total	Capital	O&M	ICI	RES
Region 1 – Discovery	$3,674	$2,298	$1,376	$1,617	$2,056
Region 2 – Burin Peninsula	$0	$0	$0	$0	$0
Region 3 – Central	$19,489	$11,648	$7,841	$8,327	$11,162
Region 4 – Coast of Bays	$2,202	$1,069	$1,133	$995	$1,207
Region 5 – Eastern	$74,162	$46,312	$27,850	$29,630	$44,531
Region 6 – Baie Verte - Green Bay	$4,066	$2,506	$1,560	$1,822	$2,244
Region 7 – NorPen	$0	$0	$0	$0	$0
Region 8 – Western	$14,098	$8,518	$5,580	$6,262	$7,836
Total	$117,691	$72,351	$45,340	$48,653	$69,036
	Annual Cost (000s $2013)			Distribution of Annual Cost	
	Total	Capital	O&M	ICI	RES
Region 1 – Discovery	$184	$115	$69	$81	$104
Region 2 – Burin Peninsula	$0	$0	$0	$0	$0
Region 3 – Central	$977	$584	$393	$418	$560
Region 4 – Coast of Bays	$111	$54	$57	$50	$61
Region 5 – Eastern	$3,719	$2,322	$1,397	$1,486	$2,233
Region 6 – Baie Verte - Green Bay	$204	$126	$78	$91	$112
Region 7 – NorPen	$0	$0	$0	$0	$0
Region 8 – Western	$707	$427	$280	$314	$392
Total	$5,902	$3,628	$2,274	$2,440	$3,462

Notes:

Indicates a region not serviced as part of the organics management scenario.



GOVERNMENT OF NEWFOUNDLAND AND LABRADOR

STUDY OF OPTIONS FOR ORGANIC WASTE PROCESSING

FIGURE 6-1
STUDY AREA/WASTE MANAGEMENT FACILITIES MAP
SCENARIO 1

MAP DRAWING INFORMATION:
DATA PROVIDED BY THE PROVINCE OF NEWFOUNDLAND AND LABRADOR

MAP CREATED BY: SLS
MAP CHECKED BY: AL
MAP PROJECTION: GCS_North_American_1983

0 5 10 20 km

N W E S

DILLON CONSULTING

FILE LOCATION: I:\GIS\138097 50 NL Organics Options\Mapping

PROJECT: 13-8097 STATUS: REVISED FINAL DATE: 07/30/14

Table 6-7
Scenario 1
Estimated Annual Total Waste Generation and Organics Diversion

	2015									2025								
Scenario 1	Total MSW Generated (tonnes)			Total Organics Diverted* (tonnes)			Total Organics Diverted* (% of total waste)			Total MSW Generated (tonnes)			Total Organics Diverted* (tonnes)			Total Organics Diverted* (% of total waste)		
Region	RES	ICI	TOTAL	RES	ICI	TOTAL	RES	ICI	TOTAL	RES	ICI	TOTAL	RES	ICI	TOTAL	RES	ICI	TOTAL
1	5,064	6,713	11,777	600	451	1,051	12%	7%	9%	5,951	7,889	13,840	911	877	1,788	15%	11%	13%
2	7,965	10,558	18,523	-	-	-	-	-	-	8,713	11,550	20,263	-	-	-	-	-	-
3	31,134	41,270	72,404	3,689	2,774	6,463	12%	7%	9%	34,059	45,148	79,207	5,214	5,018	10,232	15%	11%	13%
4	2,845	3,771	6,616	337	253	590	12%	7%	9%	3,112	4,126	7,238	466	459	925	15%	11%	13%
5	115,434	153,017	268,451	14,131	12,046	26,177	12%	8%	10%	126,280	167,394	293,674	19,965	21,533	41,498	16%	13%	14%
6	5,544	7,348	12,892	657	494	1,151	12%	7%	9%	6,065	8,039	14,104	928	893	1,821	15%	11%	13%
7	5,489	7,276	12,765	-	-	-	-	-	-	6,005	7,960	13,965	-	-	-	-	-	-
8	32,317	42,838	75,155	2,196	1,651	3,847	7%	4%	5%	35,353	46,864	82,217	3,105	2,988	6,093	9%	6%	7%
Total (Island of Newfoundland):	205,791	272,792	478,583	21,610	17,669	39,279	11%	6%	8%	225,538	298,970	524,508	30,589	31,768	62,357	14%	11%	12%

	2035									2045								
Scenario 1	Total MSW Generated (tonnes)			Total Organics Diverted* (tonnes)			Total Organics Diverted* (% of total waste)			Total MSW Generated (tonnes)			Total Organics Diverted* (tonnes)			Total Organics Diverted* (% of total waste)		
Region	RES	ICI	TOTAL	RES	ICI	TOTAL	RES	ICI	TOTAL	RES	ICI	TOTAL	RES	ICI	TOTAL	RES	ICI	TOTAL
1	6,994	9,271	16,265	1,071	1,030	2,101	15%	11%	13%	8,219	10,896	19,115	1,258	1,211	2,469	15%	11%	13%
2	9,532	12,635	22,167	-	-	-	-	-	-	10,428	13,823	24,250	-	-	-	-	-	-
3	37,259	49,390	86,649	5,704	5,489	11,193	15%	11%	13%	40,760	54,030	94,790	6,240	6,005	12,245	15%	11%	13%
4	3,405	4,513	7,918	521	502	1,023	15%	11%	13%	3,725	4,937	8,662	570	549	1,119	15%	11%	13%
5	138,145	183,122	321,267	21,840	23,556	45,396	16%	13%	14%	151,125	200,328	351,453	23,893	25,769	49,662	16%	13%	14%
6	6,634	8,795	15,429	1,016	977	1,993	15%	11%	13%	7,258	9,620	16,878	1,111	1,069	2,180	15%	11%	13%
7	6,569	8,708	15,277	-	-	-	-	-	-	7,186	9,526	16,712	-	-	-	-	-	-
8	38,675	51,266	89,941	3,396	3,268	6,664	9%	6%	7%	42,309	56,083	98,392	3,715	3,575	7,290	9%	6%	7%
Total (Island of Newfoundland):	247,213	327,700	574,913	33,548	34,822	68,370	14%	11%	12%	271,008	359,244	630,252	36,787	38,178	74,965	14%	11%	12%

**Note: Organics includesfood waste, leaf and yard waste and a portion of the fibre/paper stream as identified in Section 3.4 .*

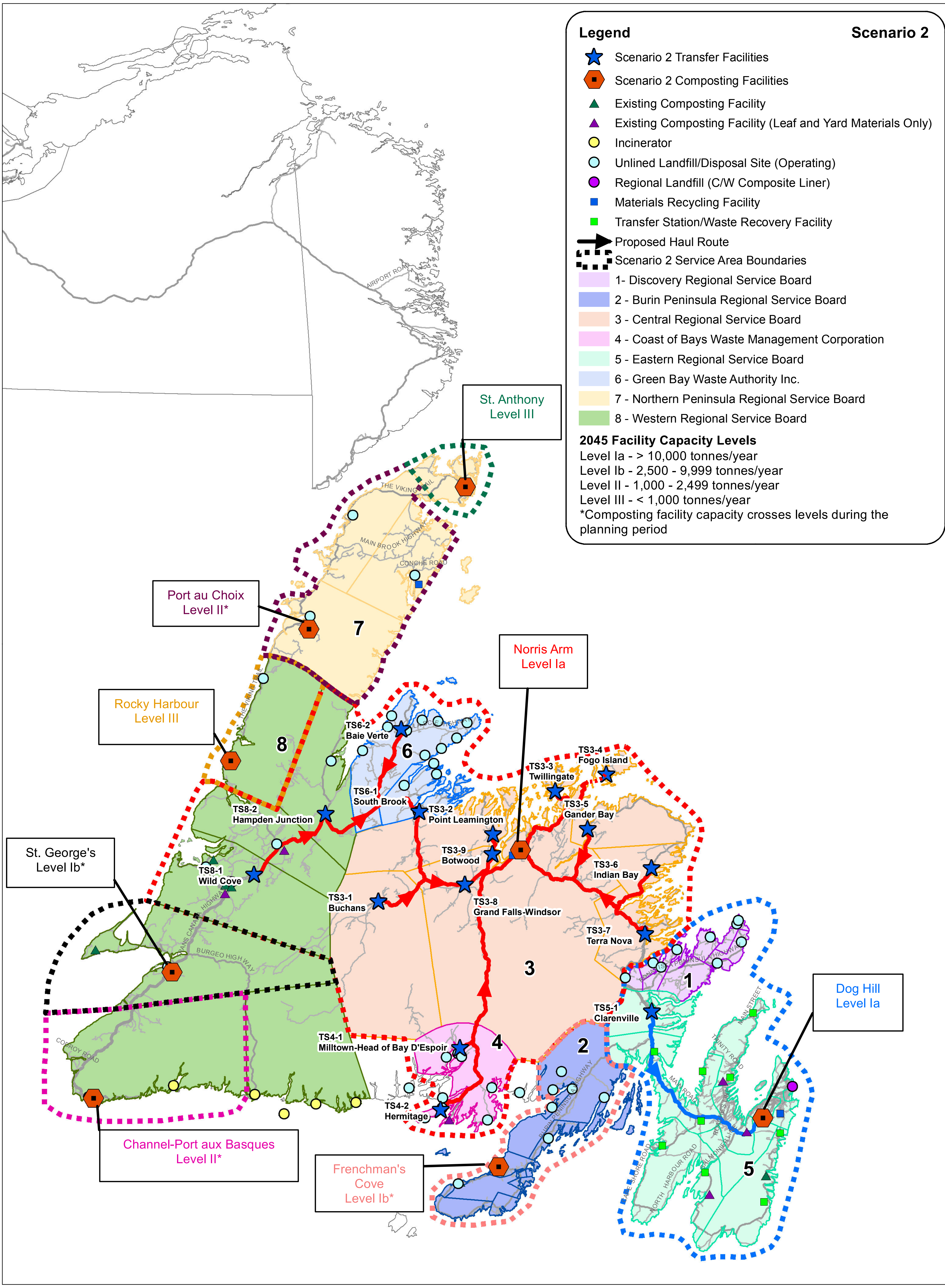
6.3 Scenario 2 Results

Following the description of Scenario 2 in Section 5.3 and the assumptions stated above, a graphical representation of Scenario 2 is presented in Figure 6-2. This figure shows the locations of the proposed composting facilities and TSs, the associated regions/sub-regions serviced and the proposed transportation and organics hauling route.

Scenario 2 indicates a diversion of about 2.2 million tonnes over 30 years, with a NPV cost of $139 million. This is $7 million annually, with a cost per tonne of waste diverted of $63. With an average of 193,500 households served annually, the household annual cost is $20.20. Table 6-8 provides the NPV costs, including the distribution between ICI and residential (RES) and the annualized cost. The estimated quantities of waste diverted over the 30-year planning period (summarized into the following four years: 2015, 2025, 2035, 2045) are presented in Table 6-9.

Table 6-8 Estimated Costs for Scenario 2

Scenario 2	NPV (000s) @ 6%: 30 years ($2013)			Distribution of NPV	
	Total	Capital	O&M	ICI	RES
Region 1 – Discovery	$3,707	$2,313	$1,394	$1,720	$1,987
Region 2 – Burin Peninsula	$6,534	$3,583	$2,951	$3,094	$3,440
Region 3 – Central	$19,489	$11,648	$7,841	$8,710	$10,778
Region 4 – Coast of Bays	$2,202	$1,069	$1,133	$1,047	$1,156
Region 5 – Eastern	$73,789	$46,296	$27,493	$30,774	$43,015
Region 6 – Baie Verte - Green Bay	$4,066	$2,506	$1,560	$1,914	$2,152
Region 7 – NorPen	$4,538	$2,502	$2,036	$2,190	$2,348
Region 8 – Western	$24,695	$14,491	$10,204	$11,543	$13,153
Total	$139,020	$84,408	$54,612	$60,992	$78,029
	Annual Cost (000s $2013)			Distribution of Annual Cost	
	Total	Capital	O&M	ICI	RES
Region 1 – Discovery	$186	$116	$70	$86	$100
Region 2 – Burin Peninsula	$328	$180	$148	$155	$173
Region 3 – Central	$977	$584	$393	$437	$541
Region 4 – Coast of Bays	$111	$54	$57	$53	$58
Region 5 – Eastern	$3,700	$2,321	$1,379	$1,543	$2,157
Region 6 – Baie Verte - Green Bay	$204	$126	$78	$96	$108
Region 7 – NorPen	$227	$125	$102	$110	$118
Region 8 – Western	$1,239	$727	$512	$579	$659
Total	$6,972	$4,233	$2,739	$3,059	$3,914



GOVERNMENT OF NEWFOUNDLAND AND LABRADOR
STUDY OF OPTIONS FOR ORGANIC WASTE PROCESSING

FIGURE 6-2
STUDY AREA/WASTE MANAGEMENT FACILITIES MAP SCENARIO 2

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MAP DRAWING INFORMATION:
DATA PROVIDED BY THE PROVINCE OF NEWFOUNDLAND AND LABRADOR

MAP CREATED BY: SLS
MAP CHECKED BY: AL
MAP PROJECTION: GCS_North_American_1983

FILE LOCATION: I:\GIS\138097 50 NL Organics Options\Mapping

PROJECT: 13-8097 STATUS: REVISED FINAL DATE: 07/30/14

Table 6-9
Scenario 2
Estimated Annual Total Waste Generation and Organics Diversion

	2015									2025								
Scenario 2	Total MSW Generated (tonnes)			Total Organics Diverted* (tonnes)			Total Organics Diverted* (% of total waste)			Total MSW Generated (tonnes)			Total Organics Diverted* (tonnes)			Total Organics Diverted* (% of total waste)		
Region	RES	ICI	TOTAL	RES	ICI	TOTAL	RES	ICI	TOTAL	RES	ICI	TOTAL	RES	ICI	TOTAL	RES	ICI	TOTAL
1	5,064	6,713	11,777	600	451	1,051	12%	7%	9%	5,951	7,889	13,840	911	877	1,788	15%	11%	13%
2	7,965	10,558	18,523	954	749	1,703	12%	7%	9%	8,713	11,550	20,263	1,348	1,350	2,698	15%	12%	13%
3	31,134	41,270	72,404	3,689	2,774	6,463	12%	7%	9%	34,059	45,148	79,207	5,214	5,018	10,232	15%	11%	13%
4	2,845	3,771	6,616	337	253	590	12%	7%	9%	3,112	4,126	7,238	466	459	925	15%	11%	13%
5	115,434	153,017	268,451	14,131	12,046	26,177	12%	8%	10%	126,280	167,394	293,674	19,965	21,533	41,498	16%	13%	14%
6	5,544	7,348	12,892	657	494	1,151	12%	7%	9%	6,065	8,039	14,104	928	893	1,821	15%	11%	13%
7	5,489	7,276	12,765	650	489	1,139	12%	7%	9%	6,005	7,960	13,965	919	885	1,804	15%	11%	13%
8	32,317	42,838	75,155	3,745	2,815	6,560	12%	7%	9%	35,353	46,864	82,217	5,293	5,093	10,386	15%	11%	13%
Total (Island of Newfoundland):	205,791	272,792	478,583	24,763	20,071	44,834	12%	7%	9%	225,538	298,970	524,508	35,044	36,108	71,152	16%	12%	14%

	2035									2045								
Scenario 2	Total MSW Generated (tonnes)			Total Organics Diverted* (tonnes)			Total Organics Diverted* (% of total waste)			Total MSW Generated (tonnes)			Total Organics Diverted* (tonnes)			Total Organics Diverted* (% of total waste)		
Region	RES	ICI	TOTAL	RES	ICI	TOTAL	RES	ICI	TOTAL	RES	ICI	TOTAL	RES	ICI	TOTAL	RES	ICI	TOTAL
1	6,994	9,271	16,265	1,071	1,030	2,101	15%	11%	13%	8,219	10,896	19,115	1,258	1,211	2,469	15%	11%	13%
2	9,532	12,635	22,167	1,475	1,477	2,952	15%	12%	13%	10,428	13,823	24,250	1,613	1,615	3,228	15%	12%	13%
3	37,259	49,390	86,649	5,704	5,489	11,193	15%	11%	13%	40,760	54,030	94,790	6,240	6,005	12,245	15%	11%	13%
4	3,405	4,513	7,918	521	502	1,023	15%	11%	13%	3,725	4,937	8,662	570	549	1,119	15%	11%	13%
5	138,145	183,122	321,267	21,840	23,556	45,396	16%	13%	14%	151,125	200,328	351,453	23,893	25,769	49,662	16%	13%	14%
6	6,634	8,795	15,429	1,016	977	1,993	15%	11%	13%	7,258	9,620	16,878	1,111	1,069	2,180	15%	11%	13%
7	6,569	8,708	15,277	1,006	923	1,929	15%	11%	13%	7,186	9,526	16,712	1,050	1,010	2,060	15%	11%	12%
8	38,675	51,266	89,941	5,790	5,572	11,362	15%	11%	13%	42,309	56,083	98,392	6,334	6,095	12,429	15%	11%	13%
Total (Island of Newfoundland):	247,213	327,700	574,913	38,423	39,526	77,949	16%	12%	14%	271,008	359,244	630,252	42,069	43,323	85,392	16%	12%	14%

**Note: Organics includesfood waste, leaf and yard waste and a portion of the fibre/paper stream as identified in Section 3.4 .*

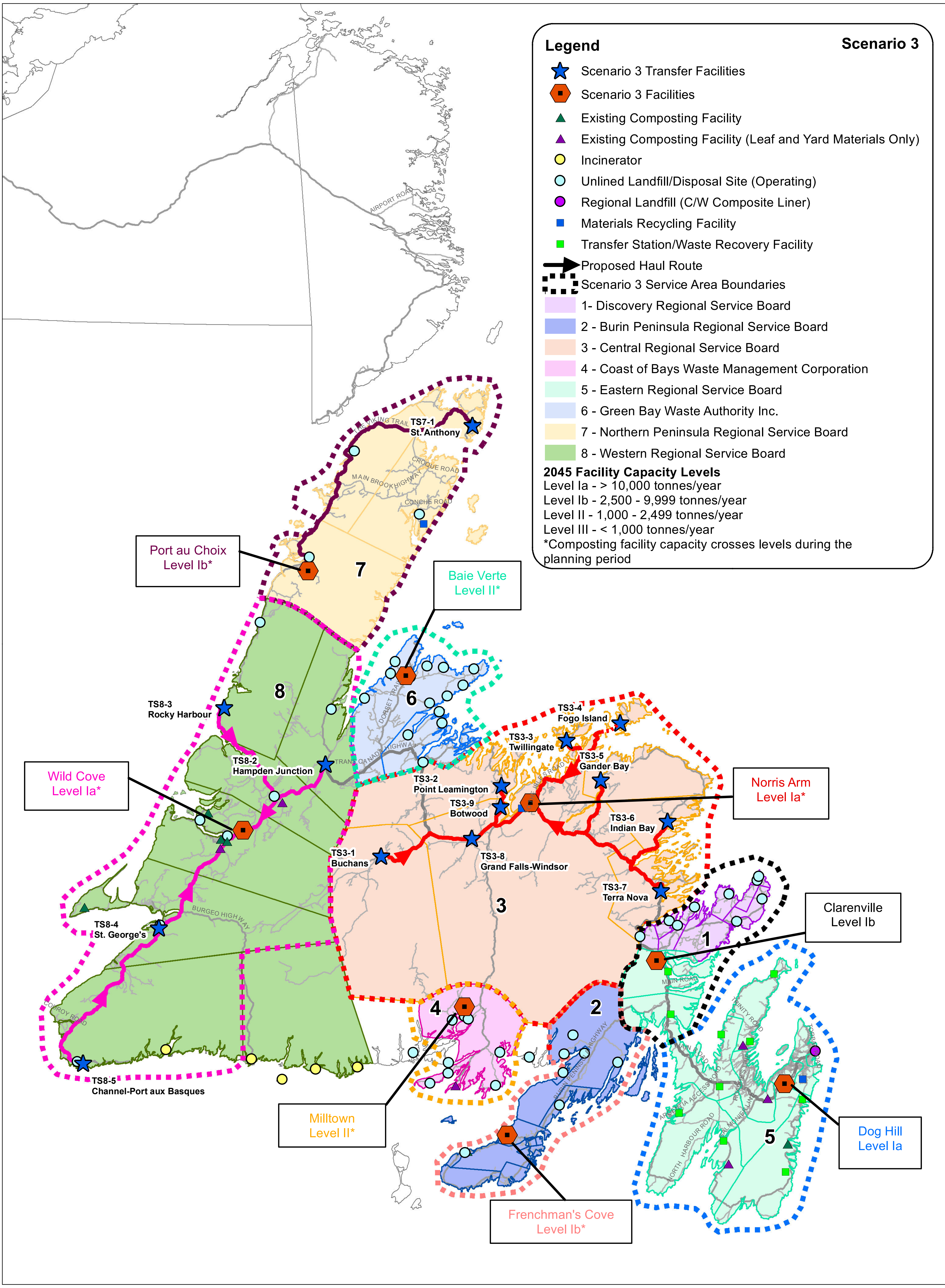
6.4 Scenario 3 Results

Following the description of Scenario 3 in Section 5.4 and the assumptions stated above, a graphical representation of Scenario 3 is presented in Figure 6-3. This Figure shows the locations of the proposed composting facilities and TSs, the associated regions/sub-regions serviced and the proposed transportation and organics hauling route.

Scenario 3 diverts about 2.2 million tonnes over 30 years, with a NPV cost of about $134 million. This is $6.7 million annually, with a cost per tonne of waste diverted of $60. With an average 193,500 households served annually, the household annual cost is $20.40. Table 6-10 provides the NPV costs, including the distribution between ICI and residential (RES) and the annualized cost. The estimated quantities of waste diverted over the 30-year planning period (summarized into the following four years: 2015, 2025, 2035, 2045) are presented in Table 6-11.

Table 6-10 Estimated Costs of Scenario 3

Scenario 3	NPV (000s) @ 6%: 30 years ($2013)			Distribution of NPV	
	Total	Capital	O&M	ICI	RES
Region 1 – Discovery	$4,244	$2,352	$1,892	$1,930	$2,314
Region 2 – Burin Peninsula	$6,534	$3,583	$2,951	$2,953	$3,581
Region 3 – Central	$19,485	$11,649	$7,836	$8,324	$11,160
Region 4 – Coast of Bays	$1,847	$1,088	$759	$805	$1,041
Region 5 – Eastern	$74,549	$46,703	$27,846	$29,848	$44,700
Region 6 – Baie Verte - Green Bay	$3,606	$2,114	$1,492	$1,576	$2,030
Region 7 – NorPen	$3,906	$2,124	$1,782	$1,742	$2,164
Region 8 – Western	$20,305	$12,643	$7,662	$8,635	$11,671
Total	$134,476	$82,256	$52,220	$55,813	$78,661
	Annual Cost (000s $2013)			Distribution of Annual Cost	
	Total	Capital	O&M	ICI	RES
Region 1 – Discovery	$213	$118	$95	$97	$116
Region 2 – Burin Peninsula	$328	$180	$148	$148	$180
Region 3 – Central	$977	$584	$393	$417	$560
Region 4 – Coast of Bays	$93	$55	$38	$40	$53
Region 5 – Eastern	$3,738	$2,342	$1,396	$1,497	$2,241
Region 6 – Baie Verte - Green Bay	$181	$106	$75	$79	$102
Region 7 – NorPen	$196	$107	$89	$87	$109
Region 8 – Western	$1,018	$634	$384	$433	$585
Total	$6,744	$4,125	$2,619	$2,799	$3,945



GOVERNMENT OF NEWFOUNDLAND AND LABRADOR

STUDY OF OPTIONS FOR ORGANIC WASTE PROCESSING

FIGURE 6-3
STUDY AREA/WASTE MANAGEMENT FACILITIES MAP
SCENARIO 3

MAP DRAWING INFORMATION:
DATA PROVIDED BY THE PROVINCE OF NEWFOUNDLAND AND LABRADOR

MAP CREATED BY: SLS
MAP CHECKED BY: AL
MAP PROJECTION: GCS_North_American_1983

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FILE LOCATION: I:\GIS\138097 50 NL Organics Options\Mapping

PROJECT: 13-8097 STATUS: REVISED FINAL DATE: 07/30/14

Table 6-11
Scenario 3
Estimated Annual Total Waste Generation and Organics Diversion

	2015									2025								
Scenario 3	Total MSW Generated (tonnes)			Total Organics Diverted* (tonnes)			Total Organics Diverted* (% of total waste)			Total MSW Generated (tonnes)			Total Organics Diverted* (tonnes)			Total Organics Diverted* (% of total waste)		
Region	RES	ICI	TOTAL	RES	ICI	TOTAL	RES	ICI	TOTAL	RES	ICI	TOTAL	RES	ICI	TOTAL	RES	ICI	TOTAL
1	5,064	6,713	11,777	600	451	1,051	12%	7%	9%	5,951	7,889	13,840	911	877	1,788	15%	11%	13%
2	7,965	10,558	18,523	954	749	1,703	12%	7%	9%	8,713	11,550	20,263	1,348	1,350	2,698	15%	12%	13%
3	31,134	41,270	72,404	3,689	2,774	6,463	12%	7%	9%	34,059	45,148	79,207	5,214	5,018	10,232	15%	11%	13%
4	2,845	3,771	6,616	337	253	590	12%	7%	9%	3,112	4,126	7,238	466	459	925	15%	11%	13%
5	115,434	153,017	268,451	14,131	12,046	26,177	12%	8%	10%	126,280	167,394	293,674	19,965	21,533	41,498	16%	13%	14%
6	5,544	7,348	12,892	657	494	1,151	12%	7%	9%	6,065	8,039	14,104	928	893	1,821	15%	11%	13%
7	5,489	7,276	12,765	650	489	1,139	12%	7%	9%	6,005	7,960	13,965	919	885	1,804	15%	11%	13%
8	32,317	42,838	75,155	3,745	2,815	6,560	12%	7%	9%	35,353	46,864	82,217	5,293	5,093	10,386	15%	11%	13%
Total (Island of Newfoundland):	205,791	272,792	478,583	24,763	20,071	44,834	12%	7%	9%	225,538	298,970	524,508	35,044	36,108	71,152	16%	12%	14%

	2035									2045								
Scenario 3	Total MSW Generated (tonnes)			Total Organics Diverted* (tonnes)			Total Organics Diverted* (% of total waste)			Total MSW Generated (tonnes)			Total Organics Diverted* (tonnes)			Total Organics Diverted* (% of total waste)		
Region	RES	ICI	TOTAL	RES	ICI	TOTAL	RES	ICI	TOTAL	RES	ICI	TOTAL	RES	ICI	TOTAL	RES	ICI	TOTAL
1	6,994	9,271	16,265	1,071	1,030	2,101	15%	11%	13%	8,219	10,896	19,115	1,258	1,211	2,469	15%	11%	13%
2	9,532	12,635	22,167	1,475	1,477	2,952	15%	12%	13%	10,428	13,823	24,250	1,613	1,615	3,228	15%	12%	13%
3	37,259	49,390	86,649	5,704	5,489	11,193	15%	11%	13%	40,760	54,030	94,790	6,240	6,005	12,245	15%	11%	13%
4	3,405	4,513	7,918	521	502	1,023	15%	11%	13%	3,725	4,937	8,662	570	549	1,119	15%	11%	13%
5	138,145	183,122	321,267	21,840	23,556	45,396	16%	13%	14%	151,125	200,328	351,453	23,893	25,769	49,662	16%	13%	14%
6	6,634	8,795	15,429	1,016	977	1,993	15%	11%	13%	7,258	9,620	16,878	1,111	1,069	2,180	15%	11%	13%
7	6,569	8,708	15,277	1,006	923	1,929	15%	11%	13%	7,186	9,526	16,712	1,050	1,010	2,060	15%	11%	12%
8	38,675	51,266	89,941	5,790	5,572	11,362	15%	11%	13%	42,309	56,083	98,392	6,334	6,095	12,429	15%	11%	13%
Total (Island of Newfoundland):	247,213	327,700	574,913	38,423	39,526	77,949	16%	12%	14%	271,008	359,244	630,252	42,069	43,323	85,392	16%	12%	14%

**Note: Organics includesfood waste, leaf and yard waste and a portion of the fibre/paper stream as identified in Section 3.4 .*

6.5 Scenario 4 Results

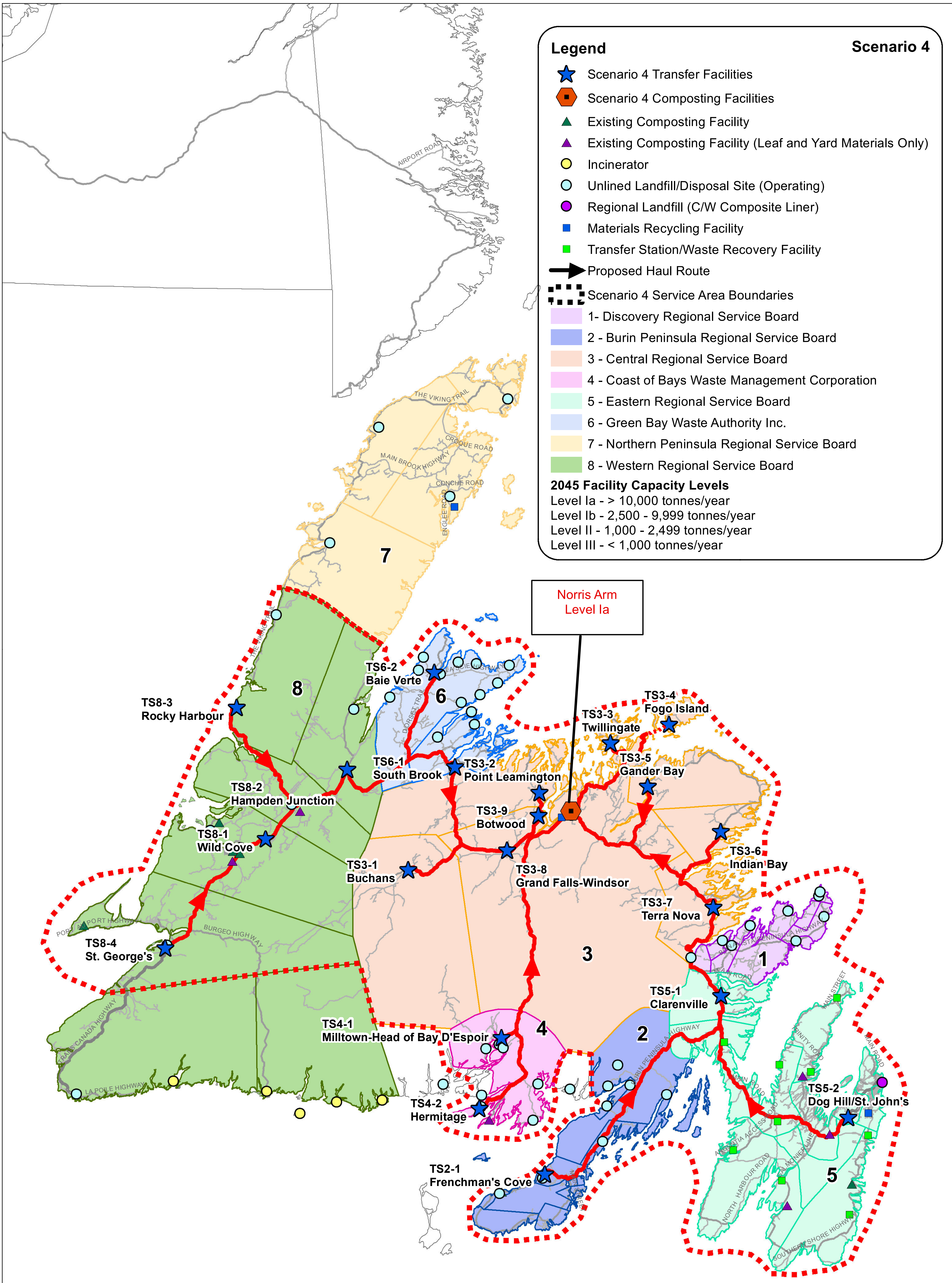
Following the description of Scenario 4 in Section 5.5 and the assumptions stated above, a graphical representation of Scenario 4 is presented in Figure 6-4. This figure shows the locations of the proposed composting facilities and TSs, the associated regions/sub-regions serviced and the proposed transportation and organics hauling route. Scenario 4 indicates a diversion of about 2.1 million tonnes over 30 years, with a NPV cost of $155 million. This is $7.8 million annually, with a cost per tonne of waste diverted of $73. With an average 185,300 households served annually, the household annual cost is $23.90. Table 6-12 provides the NPV costs, including the distribution between ICI and households (RES) and the annualized cost. The estimated quantities of waste diverted over the 30-year planning period (summarized into the following four years: 2015, 2025, 2035, 2045) are presented in Table 6-13.

Table 6-12 Estimated Costs of Scenario 4

Scenario 4	NPV (000s) @ 6%: 30 years ($2013)			Distribution of NPV	
	Total	Capital	O&M	ICI	RES
Region 1 – Discovery	$3,825	$2,344	$1,481	$1,697	$2,128
Region 2 – Burin Peninsula	$6,229	$3,517	$2,712	$2,777	$3,452
Region 3 – Central	$19,552	$11,730	$7,822	$8,359	$11,193
Region 4 – Coast of Bays	$2,204	$1,071	$1,133	$996	$1,208
Region 5 – Eastern	$97,203	$56,990	$40,213	$41,243	$55,960
Region 6 –- Baie Verte - Green Bay	$4,021	$2,463	$1,558	$1,799	$2,222
Region 7 – NorPen	$0	$0	$0	$0	$0
Region 8 – Western	$21,952	$12,558	$9,394	$9,802	$12,150
Total	$154,986	$90,673	$64,313	$66,673	$88,313
	Annual Cost (000s $2013)			Distribution of Annual Cost	
	Total	Capital	O&M	ICI	RES
Region 1 – Discovery	$192	$118	$74	$85	$107
Region 2 – Burin Peninsula	$312	$176	$136	$139	$173
Region 3 – Central	$980	$588	$392	$419	$561
Region 4 – Coast of Bays	$111	$54	$57	$50	$61
Region 5 – Eastern	$4,874	$2,858	$2,016	$2,068	$2,806
Region 6 – Baie Verte - Green Bay	$202	$124	$78	$90	$111
Region 7 – NorPen	$0	$0	$0	$0	$0
Region 8 – Western	$1,101	$630	$471	$492	$609
Total	$7,772	$4,547	$3,225	$3,343	$4,429

Notes:

Indicates a region not serviced as part of the organics management scenario.



GOVERNMENT OF NEWFOUNDLAND AND LABRADOR

STUDY OF OPTIONS FOR ORGANIC WASTE PROCESSING

FIGURE 6-4
STUDY AREA/WASTE MANAGEMENT FACILITIES MAP SCENARIO 4

MAP DRAWING INFORMATION:
DATA PROVIDED BY THE PROVINCE OF NEWFOUNDLAND AND LABRADOR

MAP CREATED BY: SLS
MAP CHECKED BY: AL
MAP PROJECTION: GCS_North_American_1983

0 5 10 20 km

DILLON CONSULTING

FILE LOCATION: I:\GIS\138097 50 NL Organics Options\Mapping

PROJECT: 13-8097 STATUS: REVISED FINAL DATE: 07/30/14

Table 6-13
Scenario 4
Estimated Annual Total Waste Generation and Organics Diversion

	2015									2025								
Scenario 4	Total MSW Generated (tonnes)			Total Organics Diverted* (tonnes)			Total Organics Diverted* (% of total waste)			Total MSW Generated (tonnes)			Total Organics Diverted* (tonnes)			Total Organics Diverted* (% of total waste)		
Region	RES	ICI	TOTAL	RES	ICI	TOTAL	RES	ICI	TOTAL	RES	ICI	TOTAL	RES	ICI	TOTAL	RES	ICI	TOTAL
1	5,064	6,713	11,777	600	451	1,051	12%	7%	9%	5,951	7,889	13,840	911	877	1,788	15%	11%	13%
2	7,965	10,558	18,523	954	749	1,703	12%	7%	9%	8,713	11,550	20,263	1,348	1,350	2,698	15%	12%	13%
3	31,134	41,270	72,404	3,689	2,774	6,463	12%	7%	9%	34,059	45,148	79,207	5,214	5,018	10,232	15%	11%	13%
4	2,845	3,771	6,616	337	253	590	12%	7%	9%	3,112	4,126	7,238	466	459	925	15%	11%	13%
5	115,434	153,017	268,451	14,131	12,046	26,177	12%	8%	10%	126,280	167,394	293,674	19,965	21,533	41,498	16%	13%	14%
6	5,544	7,348	12,892	657	494	1,151	12%	7%	9%	6,065	8,039	14,104	928	893	1,821	15%	11%	13%
7	5,489	7,276	12,765	-	-	-	-	-	-	6,005	7,960	13,965	-	-	-	-	-	-
8	32,317	42,838	75,155	3,264	2,454	5,718	10%	6%	8%	35,353	46,864	82,217	4,614	4,440	9,054	13%	9%	11%
Total (Island of Newfoundland):	205,791	272,792	478,583	23,632	19,221	42,853	11%	7%	9%	225,538	298,970	524,508	33,446	34,570	68,016	15%	12%	13%

	2035									2045								
Scenario 4	Total MSW Generated (tonnes)			Total Organics Diverted* (tonnes)			Total Organics Diverted* (% of total waste)			Total MSW Generated (tonnes)			Total Organics Diverted* (tonnes)			Total Organics Diverted* (% of total waste)		
Region	RES	ICI	TOTAL	RES	ICI	TOTAL	RES	ICI	TOTAL	RES	ICI	TOTAL	RES	ICI	TOTAL	RES	ICI	TOTAL
1	6,994	9,271	16,265	1,071	1,030	2,101	15%	11%	13%	8,219	10,896	19,115	1,258	1,211	2,469	15%	11%	13%
2	9,532	12,635	22,167	1,475	1,477	2,952	15%	12%	13%	10,428	13,823	24,250	1,613	1,615	3,228	15%	12%	13%
3	37,259	49,390	86,649	5,704	5,489	11,193	15%	11%	13%	40,760	54,030	94,790	6,240	6,005	12,245	15%	11%	13%
4	3,405	4,513	7,918	521	502	1,023	15%	11%	13%	3,725	4,937	8,662	570	549	1,119	15%	11%	13%
5	138,145	183,122	321,267	21,840	23,556	45,396	16%	13%	14%	151,125	200,328	351,453	23,893	25,769	49,662	16%	13%	14%
6	6,634	8,795	15,429	1,016	977	1,993	15%	11%	13%	7,258	9,620	16,878	1,111	1,069	2,180	15%	11%	13%
7	6,569	8,708	15,277	-	-	-	-	-	-	7,186	9,526	16,712	-	-	-	-	-	-
8	38,675	51,266	89,941	5,047	4,857	9,904	13%	9%	11%	42,309	56,083	98,392	5,522	5,313	10,835	13%	9%	11%
Total (Island of Newfoundland):	247,213	327,700	574,913	36,674	37,888	74,562	15%	12%	13%	271,008	359,244	630,252	40,207	41,531	81,738	15%	12%	13%

**Note: Organics includesfood waste, leaf and yard waste and a portion of the fibre/paper stream as identified in Section 3.4 .*

6.6 Scenario 5 Results

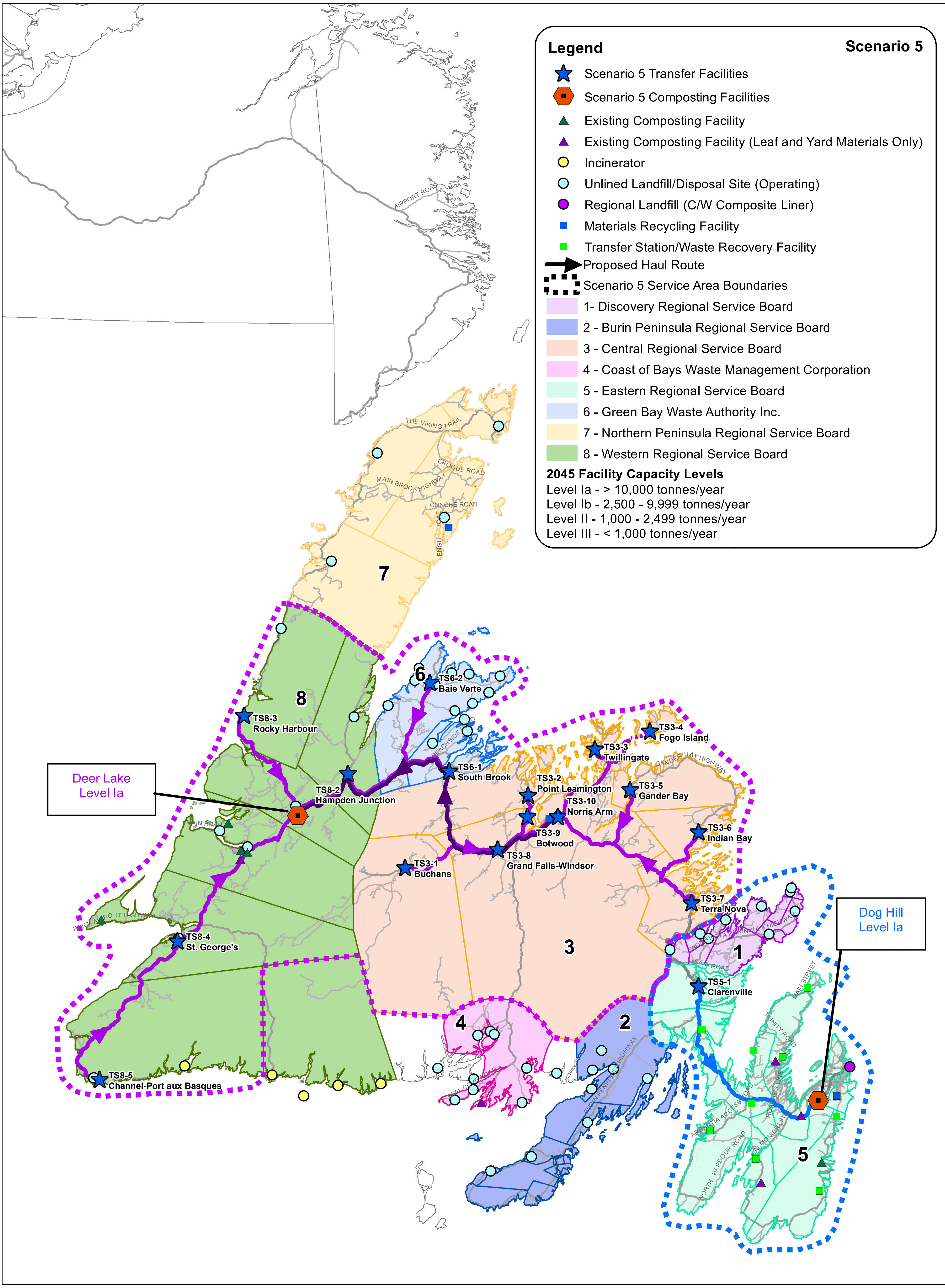
Following the description of Scenario 5 in Section 5.6 and the assumptions stated above, a graphical representation of Scenario 5 is presented in Figure 6-5. This figure shows the locations of the proposed composting facilities and TSs, the associated regions/sub-regions serviced and the proposed transportation and organics hauling route. Scenario 5 diverts about 2 million tonnes over 30 years, with a NPV cost of $125 million. This is $6.3 million annually, with a cost per tonne of waste diverted of $62. With an average 181,000 households served annually, the household annual cost is $20.30. Table 6-14 provides the NPV costs, including the distribution between ICI and households (RES) and the annualized cost. The estimated quantities of waste diverted over the 30-year planning period (summarized into the following four years: 2015, 2025, 2035, 2045) are presented in Table 6-15.

Table 6-14 Estimated Costs for Scenario 5

Scenario 5	NPV (000s) @ 6%: 30 years ($2013)			Distribution of NPV	
	NPV Total	Capital	O&M	ICI	RES
Region 1 – Discovery	$3,667	$2,310	$1,357	$1,613	$2,053
Region 2 – Burin Peninsula	$0	$0	$0	$0	$0
Region 3 – Central	$30,724	$17,620	$13,104	$14,394	$16,330
Region 4 – Coast of Bays	$0	$0	$0	$0	$0
Region 5 – Eastern	$73,136	$46,319	$26,817	$29,116	$44,020
Region 6 – Baie Verte - Green Bay	$4,125	$2,333	$1,792	$1,855	$2,270
Region 7 – NorPen	$0	$0	$0	$0	$0
Region 8 – Western	$13,782	$9,509	$4,273	$5,068	$8,714
Total	$125,434	$78,091	$47,343	$52,046	$73,387
	Annual Cost (000s $2013)			Distribution of Annual Cost	
	Total	Capital	O&M	ICI	RES
Region 1 – Discovery	$184	$116	$68	$81	$103
Region 2 – Burin Peninsula	$0	$0	$0	$0	$0
Region 3 – Central	$1,541	$884	$657	$722	$819
Region 4 – Coast of Bays	$0	$0	$0	$0	$0
Region 5 – Eastern	$3,668	$2,323	$1,345	$1,460	$2,207
Region 6 – Baie Verte - Green Bay	$207	$117	$90	$93	$114
Region 7 – NorPen	$0	$0	$0	$0	$0
Region 8 – Western	$691	$477	$214	$254	$436
Total	$6,290	$3,916	$2,374	$2,610	$3,680

Notes:

Indicates a region not serviced as part of the organics management scenario.



GOVERNMENT OF NEWFOUNDLAND AND LABRADOR

STUDY OF OPTIONS FOR ORGANIC WASTE PROCESSING

FIGURE 6-5 STUDY AREA/WASTE MANAGEMENT FACILITIES MAP SCENARIO 5

MAP DRAWING INFORMATION:
DATA PROVIDED BY THE PROVINCE OF NEWFOUNDLAND AND LABRADOR

MAP CREATED BY: SLS
MAP CHECKED BY: AL
MAP PROJECTION: GCS_North_American_1983

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FILE LOCATION: I:\GIS\138097 50 NL Organics Options\Mapping

PROJECT: 13-8097 STATUS: REVISED FINAL DATE: 07/30/14

Table 6-15
Scenario 5
Estimated Annual Total Waste Generation and Organics Diversion

Scenario 5	2015									2025								
	Total MSW Generated (tonnes)			Total Organics Diverted* (tonnes)			Total Organics Diverted* (% of total waste)			Total MSW Generated (tonnes)			Total Organics Diverted* (tonnes)			Total Organics Diverted* (% of total waste)		
Region	RES	ICI	TOTAL	RES	ICI	TOTAL	RES	ICI	TOTAL	RES	ICI	TOTAL	RES	ICI	TOTAL	RES	ICI	TOTAL
1	5,064	6,713	11,777	600	451	1,051	12%	7%	9%	5,951	7,889	13,840	911	877	1,788	15%	11%	13%
2	7,965	10,558	18,523	-	-	-	-	-	-	8,713	11,550	20,263	-	-	-	-	-	-
3	31,134	41,270	72,404	3,689	2,774	6,463	12%	7%	9%	34,059	45,148	79,207	5,214	5,018	10,232	15%	11%	13%
4	2,845	3,771	6,616	-	-	-	-	-	-	3,112	4,126	7,238	-	-	-	-	-	-
5	115,434	153,017	268,451	14,131	12,046	26,177	12%	8%	10%	126,280	167,394	293,674	19,965	21,533	41,498	16%	13%	14%
6	5,544	7,348	12,892	657	494	1,151	12%	7%	9%	6,065	8,039	14,104	928	893	1,821	15%	11%	13%
7	5,489	7,276	12,765	-	-	-	-	-	-	6,005	7,960	13,965	-	-	-	-	-	-
8	32,317	42,838	75,155	3,745	2,815	6,560	12%	7%	9%	35,353	46,864	82,217	5,293	5,093	10,386	15%	11%	13%
Total (Island of Newfoundland):	205,791	272,792	478,583	22,822	18,580	41,402	11%	7%	9%	225,538	298,970	524,508	32,311	33,414	65,725	14%	11%	13%

Scenario 5	2035									2045								
	Total MSW Generated (tonnes)			Total Organics Diverted* (tonnes)			Total Organics Diverted* (% of total waste)			Total MSW Generated (tonnes)			Total Organics Diverted* (tonnes)			Total Organics Diverted* (% of total waste)		
Region	RES	ICI	TOTAL	RES	ICI	TOTAL	RES	ICI	TOTAL	RES	ICI	TOTAL	RES	ICI	TOTAL	RES	ICI	TOTAL
1	6,994	9,271	16,265	1,071	1,030	2,101	15%	11%	13%	8,219	10,896	19,115	1,258	1,211	2,469	15%	11%	13%
2	9,532	12,635	22,167	-	-	-	-	-	-	10,428	13,823	24,250	-	-	-	-	-	-
3	37,259	49,390	86,649	5,704	5,489	11,193	15%	11%	13%	40,760	54,030	94,790	6,240	6,005	12,245	15%	11%	13%
4	3,405	4,513	7,918	-	-	-	-	-	-	3,725	4,937	8,662	-	-	-	-	-	-
5	138,145	183,122	321,267	21,840	23,556	45,396	16%	13%	14%	151,125	200,328	351,453	23,893	25,769	49,662	16%	13%	14%
6	6,634	8,795	15,429	1,016	977	1,993	15%	11%	13%	7,258	9,620	16,878	1,111	1,069	2,180	15%	11%	13%
7	6,569	8,708	15,277	-	-	-	-	-	-	7,186	9,526	16,712	-	-	-	-	-	-
8	38,675	51,266	89,941	5,790	5,572	11,362	15%	11%	13%	42,309	56,083	98,392	6,334	6,095	12,429	15%	11%	13%
Total (Island of Newfoundland):	247,213	327,700	574,913	35,421	36,624	72,045	14%	11%	13%	271,008	359,244	630,252	38,836	40,149	78,985	14%	11%	13%

**Note: Organics includesfood waste, leaf and yard waste and a portion of the fibre/paper stream as identified in Section 3.4 .*

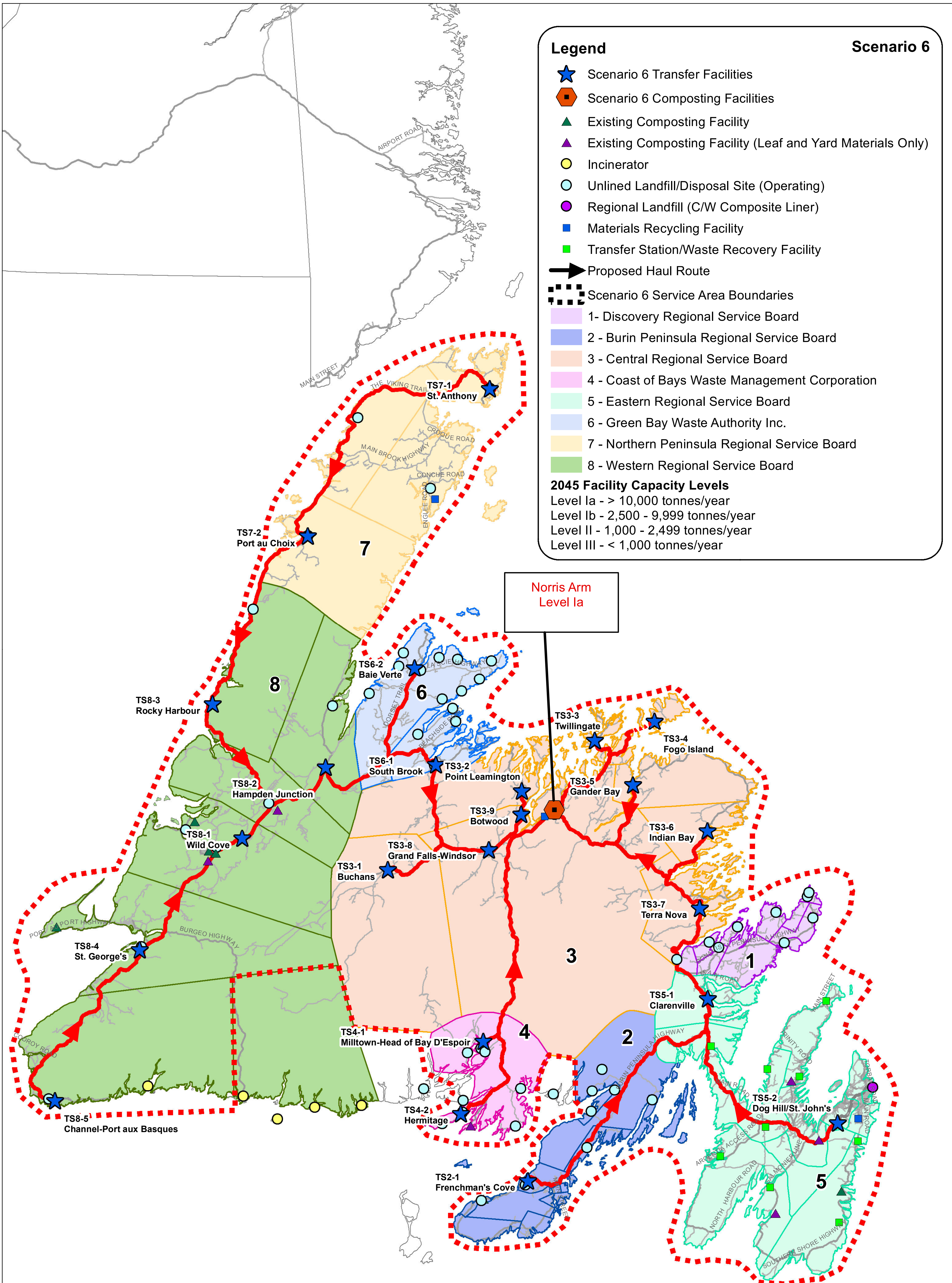
6.7 Scenario 6 Results

Following the description of Scenario 6 in Section 5.7 and the assumptions stated above, a graphical representation of Scenario 6 is presented in Figure 6-6. This figure shows the locations of the proposed composting facilities and TSs, the associated regions/sub-regions serviced and the proposed transportation and organics hauling route.

Scenario 6 diverts about 2.2 million tonnes over 30 years, with a NPV cost of $162 million. This is $8.1 million annually, with a cost per tonne of waste diverted of $74. With an average 193,500 households served annually, the household annual cost is $24.00. Table 6-16 provides the NPV costs, including the distribution between ICI and households (RES) and the annualized cost. The estimated quantities of waste diverted over the 30-year planning period (summarized into the following four years: 2015, 2025, 2035, 2045) are presented in Table 6-17.

Table 6-16 Estimated Costs for Scenario 6

Scenario 5	NPV (000s) @ 6%: 30 years ($2013)			Distribution of NPV	
	NPV Total	Capital	O&M	ICI	RES
Region 1 – Discovery	$4,906	$2,878	$2,028	$2,289	$2,616
Region 2 – Burin Peninsula	$6,229	$3,485	$2,744	$2,777	$3,452
Region 3 – Central	$19,553	$11,781	$7,772	$8,360	$11,193
Region 4 – Coast of Bays	$2,205	$1,083	$1,122	$996	$1,208
Region 5 – Eastern	$96,126	$55,616	$40,510	$40,685	$55,442
Region 6 – Baie Verte - Green Bay	$4,061	$2,450	$1,611	$1,819	$2,241
Region 7 – NorPen	$4,679	$2,368	$2,311	$2,157	$2,522
Region 8 – Western	$24,749	$14,316	$10,433	$11,004	$13,746
Total	$162,508	$93,977	$68,531	$70,087	$92,420
	Annual Cost (000s $2013)			Distribution of Annual Cost	
	Total	Capital	O&M	ICI	RES
Region 1 – Discovery	$246	$144	$102	$115	$132
Region 2 – Burin Peninsula	$313	$175	$138	$139	$173
Region 3 – Central	$981	$591	$390	$419	$561
Region 4 – Coast of Bays	$110	$54	$56	$50	$60
Region 5 – Eastern	$4,820	$2,789	$2,031	$2,040	$2,780
Region 6 – Baie Verte - Green Bay	$204	$123	$81	$91	$112
Region 7 – NorPen	$235	$119	$116	$108	$127
Region 8 – Western	$1,241	$718	$523	$552	$689
Total	$8,148	$4,712	$3,436	$3,514	$4,635



GOVERNMENT OF NEWFOUNDLAND AND LABRADOR

STUDY OF OPTIONS FOR ORGANIC WASTE PROCESSING

FIGURE 6-6 STUDY AREA/WASTE MANAGEMENT FACILITIES MAP SCENARIO 6

MAP DRAWING INFORMATION:
DATA PROVIDED BY THE PROVINCE OF NEWFOUNDLAND AND LABRADOR

MAP CREATED BY: SLS
MAP CHECKED BY: AL
MAP PROJECTION: GCS_North_American_1983

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FILE LOCATION: I:\GIS\138097 50 NL Organics Options\Mapping

PROJECT: 13-8097 STATUS: REVISED FINAL DATE: 07/30/14

Table 6-17
Scenario 6
Estimated Annual Total Waste Generation and Organics Diversion

2015

Scenario 6	Total MSW Generated (tonnes)			Total Organics Diverted* (tonnes)			Total Organics Diverted* (% of total waste)		
Region	RES	ICI	TOTAL	RES	ICI	TOTAL	RES	ICI	TOTAL
1	5,064	6,713	11,777	600	451	1,051	12%	7%	9%
2	7,965	10,558	18,523	954	749	1,703	12%	7%	9%
3	31,134	41,270	72,404	3,689	2,774	6,463	12%	7%	9%
4	2,845	3,771	6,616	337	253	590	12%	7%	9%
5	115,434	153,017	268,451	14,131	12,046	26,177	12%	8%	10%
6	5,544	7,348	12,892	657	494	1,151	12%	7%	9%
7	5,489	7,276	12,765	650	489	1,139	12%	7%	9%
8	32,317	42,838	75,155	3,745	2,815	6,560	12%	7%	9%
Total (Island of Newfoundland):	205,791	272,792	478,583	24,763	20,071	44,834	12%	7%	9%

2025

Scenario 6	Total MSW Generated (tonnes)			Total Organics Diverted* (tonnes)			Total Organics Diverted* (% of total waste)		
Region	RES	ICI	TOTAL	RES	ICI	TOTAL	RES	ICI	TOTAL
1	5,951	7,889	13,840	911	877	1,788	15%	11%	13%
2	8,713	11,550	20,263	1,348	1,350	2,698	15%	12%	13%
3	34,059	45,148	79,207	5,214	5,018	10,232	15%	11%	13%
4	3,112	4,126	7,238	466	459	925	15%	11%	13%
5	126,280	167,394	293,674	19,965	21,533	41,498	16%	13%	14%
6	6,065	8,039	14,104	928	893	1,821	15%	11%	13%
7	6,005	7,960	13,965	919	885	1,804	15%	11%	13%
8	35,353	46,864	82,217	5,293	5,093	10,386	15%	11%	13%
Total (Island of Newfoundland):	225,538	298,970	524,508	35,044	36,108	71,152	16%	12%	14%

2035

Scenario 6	Total MSW Generated (tonnes)			Total Organics Diverted* (tonnes)			Total Organics Diverted* (% of total waste)		
Region	RES	ICI	TOTAL	RES	ICI	TOTAL	RES	ICI	TOTAL
1	6,994	9,271	16,265	1,071	1,030	2,101	15%	11%	13%
2	9,532	12,635	22,167	1,475	1,477	2,952	15%	12%	13%
3	37,259	49,390	86,649	5,704	5,489	11,193	15%	11%	13%
4	3,405	4,513	7,918	521	502	1,023	15%	11%	13%
5	138,145	183,122	321,267	21,840	23,556	45,396	16%	13%	14%
6	6,634	8,795	15,429	1,016	977	1,993	15%	11%	13%
7	6,569	8,708	15,277	1,006	923	1,929	15%	11%	13%
8	38,675	51,266	89,941	5,790	5,572	11,362	15%	11%	13%
Total (Island of Newfoundland):	247,213	327,700	574,913	38,423	39,526	77,949	16%	12%	14%

2045

Scenario 6	Total MSW Generated (tonnes)			Total Organics Diverted* (tonnes)			Total Organics Diverted* (% of total waste)		
Region	RES	ICI	TOTAL	RES	ICI	TOTAL	RES	ICI	TOTAL
1	8,219	10,896	19,115	1,258	1,211	2,469	15%	11%	13%
2	10,428	13,823	24,250	1,613	1,615	3,228	15%	12%	13%
3	40,760	54,030	94,790	6,240	6,005	12,245	15%	11%	13%
4	3,725	4,937	8,662	570	549	1,119	15%	11%	13%
5	151,125	200,328	351,453	23,893	25,769	49,662	16%	13%	14%
6	7,258	9,620	16,878	1,111	1,069	2,180	15%	11%	13%
7	7,186	9,526	16,712	1,050	1,010	2,060	15%	11%	12%
8	42,309	56,083	98,392	6,334	6,095	12,429	15%	11%	13%
Total (Island of Newfoundland):	271,008	359,244	630,252	42,069	43,323	85,392	16%	12%	14%

**Note: Organics includesfood waste, leaf and yard waste and a portion of the fibre/paper stream as identified in Section 3.4 .*

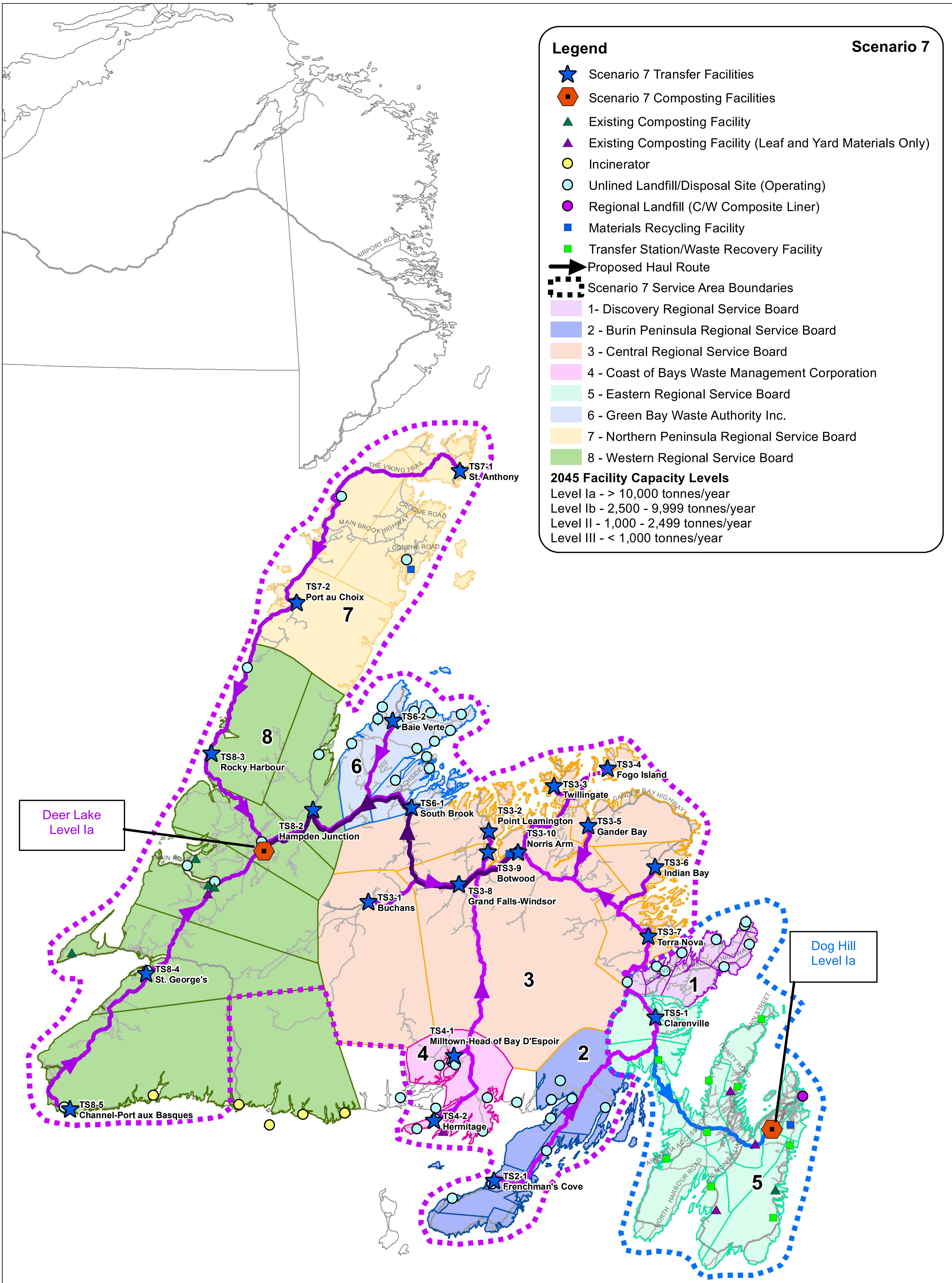
6.8 Scenario 7 Results

Following the description of Scenario 7 in Section 5.8 and the assumptions stated above, a graphical representation of Scenario 7 is presented in Figure 6-7. This figure shows the locations of the proposed composting facilities and TSs, the associated regions/sub-regions serviced and the proposed transportation and organics hauling route.

Scenario 7 diverts about 2.2 million tonnes over 30 years, with a NPV cost of $138 million. This is $6.9 million annually, with a cost per tonne of waste diverted of $62. With an average 193,500 households served annually, the household annual cost is $20.80. Table 6-18 provides the NPV costs, including the distribution between ICI and households (RES) and the annualized cost. The estimated quantities of waste diverted over the 30-year planning period (summarized into the following four years: 2015, 2025, 2035, 2045) are presented in Table 6-19.

Table 6-18 Estimated Costs for Scenario 7

Scenario 5	NPV (000s) @ 6%: 30 years ($2013)			Distribution of NPV	
	NPV Total	Capital	O&M	ICI	RES
Region 1 – Discovery	$4,113	$2,454	$1,659	$2,289	$2,616
Region 2 – Burin Peninsula	$5,755	$3,476	$2,279	$2,777	$3,452
Region 3 – Central	$30,852	$17,449	$13,403	$8,360	$11,193
Region 4 – Coast of Bays	$1,943	$1,078	$865	$996	$1,208
Region 5 – Eastern	$73,106	$46,340	$26,766	$40,685	$55,442
Region 6 – Baie Verte - Green Bay	$4,143	$2,380	$1,763	$1,819	$2,241
Region 7 – NorPen	$3,927	$2,357	$1,570	$2,157	$2,522
Region 8 – Western	$13,930	$9,453	$4,477	$11,004	$13,746
Total	$137,769	$84,987	$52,782	$70,087	$92,420
	Annual Cost (000s $2013)			Distribution of Annual Cost	
	Total	Capital	O&M	ICI	RES
Region 1 – Discovery	$206	$123	$83	$92	$114
Region 2 – Burin Peninsula	$288	$174	$114	$127	$162
Region 3 – Central	$1,547	$875	$672	$725	$822
Region 4 – Coast of Bays	$97	$54	$43	$43	$54
Region 5 – Eastern	$3,666	$2,324	$1,342	$1,460	$2,206
Region 6 – Baie Verte - Green Bay	$207	$119	$88	$93	$115
Region 7 – NorPen	$197	$118	$79	$88	$109
Region 8 – Western	$698	$474	$224	$258	$440
Total	$6,909	$4,262	$2,647	$2,887	$4,022



GOVERNMENT OF NEWFOUNDLAND AND LABRADOR

STUDY OF OPTIONS FOR ORGANIC WASTE PROCESSING

FIGURE 6-7 STUDY AREA/WASTE MANAGEMENT FACILITIES MAP SCENARIO 7

MAP DRAWING INFORMATION:
DATA PROVIDED BY THE PROVINCE OF NEWFOUNDLAND AND LABRADOR

MAP CREATED BY: SLS
MAP CHECKED BY: AL
MAP PROJECTION: GCS_North_American_1983

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FILE LOCATION: I:\GIS\138097 50 NL Organics Options\Mapping

PROJECT: 13-8097 STATUS: REVISED FINAL DATE: 07/30/14

Table 6-19
Scenario 7
Estimated Annual Total Waste Generation and Organics Diversion

	2015									2025								
Scenario 7	Total MSW Generated (tonnes)			Total Organics Diverted* (tonnes)			Total Organics Diverted* (% of total waste)			Total MSW Generated (tonnes)			Total Organics Diverted* (tonnes)			Total Organics Diverted* (% of total waste)		
Region	RES	ICI	TOTAL	RES	ICI	TOTAL	RES	ICI	TOTAL	RES	ICI	TOTAL	RES	ICI	TOTAL	RES	ICI	TOTAL
1	5,064	6,713	11,777	600	451	1,051	12%	7%	9%	5,951	7,889	13,840	911	877	1,788	15%	11%	13%
2	7,965	10,558	18,523	954	749	1,703	12%	7%	9%	8,713	11,550	20,263	1,348	1,350	2,698	15%	12%	13%
3	31,134	41,270	72,404	3,689	2,774	6,463	12%	7%	9%	34,059	45,148	79,207	5,214	5,018	10,232	15%	11%	13%
4	2,845	3,771	6,616	337	253	590	12%	7%	9%	3,112	4,126	7,238	466	459	925	15%	11%	13%
5	115,434	153,017	268,451	14,131	12,046	26,177	12%	8%	10%	126,280	167,394	293,674	19,965	21,533	41,498	16%	13%	14%
6	5,544	7,348	12,892	657	494	1,151	12%	7%	9%	6,065	8,039	14,104	928	893	1,821	15%	11%	13%
7	5,489	7,276	12,765	650	489	1,139	12%	7%	9%	6,005	7,960	13,965	919	885	1,804	15%	11%	13%
8	32,317	42,838	75,155	3,745	2,815	6,560	12%	7%	9%	35,353	46,864	82,217	5,293	5,093	10,386	15%	11%	13%
Total (Island of Newfoundland):	205,791	272,792	478,583	24,763	20,071	44,834	12%	7%	9%	225,538	298,970	524,508	35,044	36,108	71,152	16%	12%	14%

	2035									2045								
Scenario 7	Total MSW Generated (tonnes)			Total Organics Diverted* (tonnes)			Total Organics Diverted* (% of total waste)			Total MSW Generated (tonnes)			Total Organics Diverted* (tonnes)			Total Organics Diverted* (% of total waste)		
Region	RES	ICI	TOTAL	RES	ICI	TOTAL	RES	ICI	TOTAL	RES	ICI	TOTAL	RES	ICI	TOTAL	RES	ICI	TOTAL
1	6,994	9,271	16,265	1,071	1,030	2,101	15%	11%	13%	8,219	10,896	19,115	1,258	1,211	2,469	15%	11%	13%
2	9,532	12,635	22,167	1,475	1,477	2,952	15%	12%	13%	10,428	13,823	24,250	1,613	1,615	3,228	15%	12%	13%
3	37,259	49,390	86,649	5,704	5,489	11,193	15%	11%	13%	40,760	54,030	94,790	6,240	6,005	12,245	15%	11%	13%
4	3,405	4,513	7,918	521	502	1,023	15%	11%	13%	3,725	4,937	8,662	570	549	1,119	15%	11%	13%
5	138,145	183,122	321,267	21,840	23,556	45,396	16%	13%	14%	151,125	200,328	351,453	23,893	25,769	49,662	16%	13%	14%
6	6,634	8,795	15,429	1,016	977	1,993	15%	11%	13%	7,258	9,620	16,878	1,111	1,069	2,180	15%	11%	13%
7	6,569	8,708	15,277	1,006	923	1,929	15%	11%	13%	7,186	9,526	16,712	1,050	1,010	2,060	15%	11%	12%
8	38,675	51,266	89,941	5,790	5,572	11,362	15%	11%	13%	42,309	56,083	98,392	6,334	6,095	12,429	15%	11%	13%
Total (Island of Newfoundland):	247,213	327,700	574,913	38,423	39,526	77,949	16%	12%	14%	271,008	359,244	630,252	42,069	43,323	85,392	16%	12%	14%

**Note: Organics includesfood waste, leaf and yard waste and a portion of the fibre/paper stream as identified in Section 3.4 .*

6.9 Summary of Scenario Assessment Findings

6.9.1 Scenario Assessment Summary

With reference to information presented in Sections 6.2 through to 6.8, Table 6-20 presents key summary information resulting from the assessment of the seven candidate organics management scenarios.

Table 6-20 Summary Information for Seven Scenarios

Scenario	NPV Total (000s) @6%: 30 years ($2013)	Total Annual Cost (000s $2013)	% Organics Diversion Achieved				% of Population Served
			2015	2025	2035	2045	
Scenario 1	$117,691	$5,902	8	12	12	12	86.8
Scenario 2	$139,020	$6,972	9	14	14	14	99.7
Scenario 3	$134,476	$6,744	9	14	14	14	99.7
Scenario 4	$154,986	$7,772	9	13	13	13	95.0
Scenario 5	$125,434	$6,290	9	13	13	13	91.7
Scenario 6	$162,508	$8,148	9	14	14	14	99.7
Scenario 7	$137,769	$6,909	9	14	14	14	99.7

As mentioned in Section 6.1.4, it is assumed that all seven of the scenarios provide the same level of collection service (collection of garbage and organics (using a cart system) on alternating weeks, with recyclables (details of preferred collection approach to be defined by the region) collected every second week). Therefore, as compared to the number of “truck passes” under the current system in Region 5 (which collects both garbage and recyclables), there is no net change. However, the NPV and annual average costs for Regions to participate in organics collection were estimated and are summarized in Table 6-21.

Table 6-21 Residential Collection

Residential Collection	NPV (000s) @ 6%: 30 years ($2013)						
	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5	Scenario 6	Scenario 7
Region 1 – Discovery	$9,102	$9,102	$9,102	$9,102	$9,102	$9,102	$9,102
Region 2 – Burin Peninsula	$0	$12,924	$12,924	$12,924	$0	$12,924	$12,924
Region 3 – Central	$55,582	$55,582	$55,582	$55,582	$55,582	$55,582	$55,582
Region 4 – Coast of Bays	$4,853	$4,853	$4,853	$4,853	$0	$4,853	$4,853
Region 5 – Eastern	$205,482	$205,482	$205,482	$205,482	$205,482	$205,482	$205,482
Region 6 – Baie Verte - Green Bay	$9,350	$9,350	$9,350	$9,350	$9,350	$9,350	$9,350
Region 7 – NorPen	$0	$9,217	$9,217	$0	$0	$9,217	$9,217
Region 8 – Western	$33,653	$58,840	$58,840	$51,025	$58,840	$58,840	$58,840
Total	$318,022	$365,350	$365,350	$348,318	$338,356	$365,350	$365,350

	Annual Cost (000s $2013)						
	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5	Scenario 6	Scenario 7
Region 1 – Discovery	$456	$456	$456	$456	$456	$456	$456
Region 2 – Burin Peninsula	$0	$648	$648	$648	$0	$648	$648
Region 3 – Central	$2,787	$2,787	$2,787	$2,787	$2,787	$2,787	$2,787
Region 4 – Coast of Bays	$243	$243	$243	$243	$0	$243	$243
Region 5 – Eastern	$10,304	$10,304	$10,304	$10,304	$10,304	$10,304	$10,304
Region 6 – Baie Verte - Green Bay	$469	$469	$469	$469	$469	$469	$469
Region 7 – NorPen	$0	$462	$462	$0	$0	$462	$462
Region 8 – Western	$1,688	$2,951	$2,951	$2,559	$2,951	$2,951	$2,951
Total	$15,947	$18,320	$18,320	$17,466	$16,967	$18,320	$18,320

6.9.2 Implementation Considerations

6.9.2.1 Contribution to Provincial Diversion Target

As noted earlier in this section, and with reference to the total estimated amount of MSW generated on the island of Newfoundland, a range of waste diversion rates (e.g., 8% to 14%) are predicted through the implementation of the seven candidate organics management scenarios. It is acknowledged that the potential organics management programs only address a portion of the overall waste diversion effort; in order to achieve the Province's target of 50% waste diversion (by weight) away from landfill, robust programs targeting all materials in the waste stream will be required.

To illustrate the approximate degree of success that will be required from other material diversion programs to achieve the 50% target, a single consolidated version of the four sub-sector (e.g., Urban Residential, Urban ICI, Rural Residential and Rural ICI) waste stream characterizations was prepared (Table 6-22).

Table 6-22 Consolidated Island-Wide Waste Stream Characterization*

1	PAPER/FIBRE	25.9%
1a	Cardboard (OCC)**	8.0%
1b	Boxboard/Paper Towel**	4.4%
1c	Newsprint/Other Paper**	13.4%
2	ORGANICS**	30.3%
2a	Food Waste	20.3%
2b	Yard Waste	3.9%
2c	Other	6.1%
3	OTHER RECYCLABLES	15.6%
4	C & D MATERIALS	6.9%
5	OTHER	21.4%
	Total	100.0%

Notes:
*% of waste stream by weight.
**Materials included in assumed organics feedstock stream for scenario development.

Assuming an average organics diversion rate of 11% of the total MSW stream (and noting that a portion of that quantity is material from the fibre/paper category), the remaining 39% of the diversion target must be drawn out of the remainder of the "as generated" waste stream. With reference to diversion estimates developed in the evaluation of the candidate scenarios, the remaining materials percentages will be available in the waste stream following the implementation of the "11% success" organics program:

- Cardboard (OCC): 7.7%
- Boxboard/Paper Towel: 2.6%
- Newsprint/Other Paper: 12.9%
- Other Recyclables (e.g., beverage/food containers, packaging): 15.6%
- C&D Materials: 6.9%
- Other (e.g., furniture, HHW, textiles, tires, electronic waste, composite materials): 21.4%
- TOTAL REMAINING WASTE AVAILABLE: 67.1%

Therefore, to achieve a 50% overall diversion rate, the following capture rate is required for the remainder of the waste stream;

- Quantity of material required: 50% (target) - 11% (organics diversion) = 39%
- Quantity of remaining material available: 67.1%
- Required capture rate for remaining material: 39%/67.1% = 58%

In other words, all other waste diversion programs implemented on the island of Newfoundland (including those currently in place and future programs) must achieve a capture rate of approximately 58% of the remainder of the available waste stream. Noting that a significant portion of the available waste stream (after the diversion of organics) falls into the “Other” category (which includes problematic materials from a recycling/diversion standpoint), a high level of diversion success (built on progress made to date) will be required in the “Fibre”, “Other Recyclables” and “C&D Materials” categories to achieve the provincial target.

Information provided by MMSB, indicated that Newfoundland and Labrador was reportedly achieving a diversion rate of 29% in 2011, with the bulk of diverted tonnages being associated with activities in the private (as opposed to municipal) recycling sector. It is also noted that as of 2011, there were very limited diversion activities related to compostable organics underway in the province. Thus, with forecasted additional average diversion contribution of 11% from the implementation of a provincial organics management program combined with the planned expansion of curbside recyclables collection services to the majority of the island’s residents, the overall 50% goal appears to be an achievable, near term target.

6.9.2.2 Establishment of New Infrastructure

As described in Section 5, the seven management scenarios evaluated as part of this project all involve the establishment of new organics processing and/or organics transfer facilities. Some facilities, as in the case of a Level III (<1000 tonnes/year) composting operation have been identified as having relatively modest construction and capital/operating expenditure requirements. Other facilities, such as the larger and more complex Level I and II compost operations will require significant levels of funding for initial development and ongoing operation.

There are several models to establish and maintain ongoing operations of the proposed facilities, including the following;

1. Traditional Capital Procurement (Design-Bid-Build)
    - Following a competitive bidding process, the design and building aspects of an infrastructure asset are contracted out to the private sector at a fixed price that must meet public-sector performance standards. The government or public institution retains ownership. The public sector retains responsibility for ongoing management of the initiative, or may contract out these responsibilities separately. The initiative is funded from general government revenues or debt.

    <u>*Advantages*</u>
    - Historically and currently the most commonly used system to deliver public infrastructure projects.
    - Municipalities, Provincial and Territorial Government familiar with the process.
    - Significant level of owner control over design.

- Owner dictates performance requirements.
- Simple to add or subtract phases, or changes.
- Ability to accommodate change throughout design and construction process.

Disadvantages
- Can be cumbersome for large scale, multiphase assignments.
- Cost control and cost certainty is low.
- Does not allow innovative approaches to construction.
- Can be restrictive to proprietary technologies.

2. Design-Build (DB)
   - This model is similar to traditional capital procurement except that the design and build functions are combined within a single private-sector entity.

   Advantages
   - Accelerated design and construction schedule possible.
   - Contractor and designer work together, this can lead to cost savings for the Owner.
   - Less management required of the owner during construction (only one contract).
   - Provides avenue for proprietary and innovative technologies.
   - Minimizes risk of change orders during construction.

   Disadvantages
   - Extended procurement process.
   - New delivery system to some owners. Can be a lack of familiarity and confidence.
   - Operator has little or no influence on the design and final product.
   - Technologies/equipment used on project could be inconsistent with equipment familiar to operators.
   - Excludes smaller firms from bidding on work, and therefore could reduce competition on this and other projects.

3. Design-Build-Operate (DBO)
   - The private sector designs, builds and operates a new facility under an outsourcing arrangement. Ownership of the infrastructure asset and responsibility for financing remains with the public sector.
   - This model was utilized in the establishment and ongoing operation of the Otter Lake Waste Processing and Disposal Facility and two composting facilities that serve the 330,000 residents of the Halifax Regional Municipality.

Advantages

- Accelerated design and construction schedule possible.
- Possible Federal Funding under P3 Canada (see below).Less management during construction.
- Operation and maintenance contract causes the design build partners to look at optimizing life cycle costs.
- Minimizes the extent and impact of change orders during construction phase.

Disadvantages

- Extended procurement process.
- New delivery system in most Canadian jurisdictions.
- Significant costs in the set-up phase.
- Municipality has minimal or no control over design and operations.
- Excludes smaller firms from bidding on work, and therefore could reduce competition on this and other projects.

4. Design-Build-Finance-Operate (DBFO)
    - The private sector designs, builds and finances a new asset, typically under a long-term concession agreement. The private sector then operates the asset during the term of the agreement. A long-term lease may be used, with the private sector transferring ownership of the infrastructure asset to the government or the transfer partner at the end of the lease.

Advantages

- Accelerated design and construction schedule possible.
- Contractor, operator and designer work together, this can lead to cost savings for the Financer.
- Possible Federal Funding under P3 Canada (see below).
- Less management during construction.
- Provides avenue for proprietary and innovative technologies.
- Operation and maintenance contract causes the design build partners to look at optimizing life cycle costs.
- Minimizes the extent and impact of change orders during construction phase.
- Additional Oversight of Financer on capital and operating risk elements.

Disadvantages

- Extended procurement process.
- New delivery system for most Owners.
- Significant costs in the set-up.
- Higher borrowing costs than other options.
- Municipality has minimal or no control over design and operations.

- Excludes smaller firms from bidding on work, and therefore could reduce competition on this and other projects.
- Need for extensive requirement for external legal, financial, and procurement resources.

5. Design-Build-Own-Operate (DBOO)
   - The private sector designs, builds, finances, owns and operates an infrastructure asset indefinitely or for a fixed period.

   Advantages
   - Accelerated design and construction schedule possible.
   - Contractor, operator and designer work together, this can lead to cost savings for the Financer.
   - Possible Federal Funding under P3 Canada (see below).
   - Less management during construction.
   - Provides avenue for proprietary and innovative technologies.
   - Operation and maintenance contract causes the design build partners to look at optimizing life cycle costs.
   - Minimizes the extent and impact of change orders during construction phase.

   Disadvantages
   - Extended procurement process.
   - New delivery system in most Canadian jurisdictions.
   - Significant costs in the set-up phase.
   - Municipality has minimal or no control over design and operations.
   - Excludes smaller firms from bidding on work, and therefore could reduce competition on this and other projects.
   - Need for extensive requirement for external legal, financial, and procurement resources.

Methods 2 through 5 are typically described as Alternative Service Delivery (ASD) options and are often considered under the broad heading of "public-private partnerships" (P3). The term public-private partnership carries a specific meaning in the Canadian context. First, it relates to the provision of public services or public infrastructure. Second, it necessitates the transfer of risk between public and private sector partners.

PPP Canada, a federal Crown corporation, works with provincial, territorial, municipal, First Nations, federal and private partners to support greater adoption of public-private partnerships in infrastructure procurement. PPP Canada manages the P3 Canada Fund; a merit-based program, designed to encourage consideration of P3s in public infrastructure procurements, in order to achieve value for taxpayers and other public benefits. To be eligible for a P3 Canada Fund investment, the infrastructure project must be procured, and supported by a province, territory, municipality or First Nation (i.e., a public authority).

Methods 3, 4 and 5 are often referred to as Alternative Financing and Procurement (AFP) models. These approaches are typically considered most suitable for infrastructure projects with:

- An estimated capital cost of >$20M;
- A robust operations and/or maintenance component;
- Complex implementation requirements, including risks that the public sector might not be comfortable assuming; and
- A proven AFP delivery track record, with an acknowledgement of local performance history.

Therefore, referring to the estimated capital costs and ongoing operational requirements for the Level I and II compost facilities as well as the organics TSs included in Scenarios 4, 5, 6 and 7, the selection of an AFP model for the establishment of new infrastructure is worthy of consideration. It is acknowledged that Design Build procurement model is currently being utilized by the Department of Municipal Affairs for the development of the Clarenville MSW Transfer Station. With an estimated capital cost in the range of $2M to $3M, a DB model is an appropriate option. However, with some proposed facilities identified in the organics options analysis having estimated capital values exceeding $20M, the consideration of AFP procurement models should be seriously considered by municipal, regional and provincial representatives as they refine and finalize the details of an island-wide management program.

6.9.3 Suggested Revisions to Legislation and Guidelines

Section 3.3 provided a review of applicable legislation and guidelines to waste management systems which includes composting facilities, transfer stations and public education. The following presents suggested revisions to the current legislation and guidelines.

In the Environmental Standards for MSW Compost Facilities, there are suggested types of technologies that should be considered for certain facility capacities. Facilities processing over 1,000 tonnes per year of organics are recommended to be in-vessel or covered facilities and facilities processing over 2,500 tonnes per year are obliged to use in-vessel systems for the initial phases of composting. Section 4 of the report provided a detailed review and identified a more defined list of suitable technologies for the Newfoundland and Labrador environment. It is suggested to provide more direction on and expand the types of suitable composting technologies to consider in the province. The province could also consider setting recommendations for facilities processing more than 10,000 tonnes per year.

In the Environmental Standards for MSW Transfer Stations, the recommended storage time for MSW is two days in the summer and one week in the winter, unless there are outstanding circumstances that affect waste removal or transport. In the waste forecasting and transportation hauling analysis, it was recognized that some of the smaller communities will not generate/receive enough SSO to fill a transfer trailer (estimated capacity of 25 tonnes per trailer). To accommodate these many communities, a roll-off container with an estimated capacity of 10 tonnes per truck was assumed in these cases. However, it would still take a few days to fill a 10-tonne truck in some communities. Therefore, it is recommended to expand the SSO storage time to one week, all year round. Recommendations on storage requirements of SSO at the TSs could also be added to the guidelines.

Finally, it is recommended that in the future, the province consider banning organics from disposal. This has been an effective method to encourage participation in organics management programs in many provinces (e.g., Nova Scotia). Most recently, British Columbia is intending to ban organics from disposal in 2015. This has led to the jurisdictions and ICI in BC to develop their own organics collection and processing programs. Ontario is also moving towards banning organics from disposal. In any case, sufficient capacity to process banned materials must be in place prior to the ban.

7.0 Cost-Benefit Analysis – Landfilling Versus Composting

As requested in the Terms of Reference for this assignment, a cost-benefit analysis methodology was developed and conducted to assess the relative cost and greenhouse gas (GHG) implications of "*constructing/operating an organics management facility as compared to landfilling the same waste in one of the provinces two landfills at Robin Hood Bay or Norris Arm.*" Key assumptions used to allow for the completion of this analysis included the following;

- Scenario 1 as defined in this study would serve as the "base case" for the organics composting alternative. The analysis for the alternative approach (e.g., landfilling versus composting) would be based on landfilling the Scenario 1 organics in the Norris Arm and Robin Hood Bay landfills, with the 30 year tonnages for the respective facilities being equal to those presented in Section 6.2.
- Design and construction requirements for the landfills would be similar to those specified to date for the Norris Arm facility (drawing on Dillon's direct design experience at that site).
- Final capping of the Norris Arm and Robin Hood Bay Landfills would incorporate a membrane cover as well as a gas collection and flaring system.
- Requirements associated with curbside collection (either weekly garbage or alternating week garbage/organics) as well as long-distance transfer (same total mass of material requiring transport) would be the same for both alternatives and therefore not relevant to the comparison exercise.
- While the composting option will result in a reduction in the tonnage arriving at the disposal cell, differences in requirements (costs) associated with daily landfill operations (e.g., staffing, placement/covering, leachate management, stormwater management, gas management) will be marginal between the two alternatives. Instead, the focus for the analysis of the cost implications will be the reduction in landfill volume (e.g., landfill cell and cap construction) at the end of 30 year planning horizon for composting versus landfill.

7.1 Assessment of Differences in GHG Generation

The diversion of organics from landfill, and processing of this waste within an aerobic composting system, has the potential to generate greenhouse gas (GHG) reductions. This is as a result of the avoidance of methane production within the landfill that may otherwise be generated from the anaerobic decomposition of the organic waste.
Within an aerobic composting process, carbon dioxide (CO_2) is generated in place of methane. Since methane has a global warming potential (GWP) that is approximately 21 times higher than that of carbon dioxide, the avoidance of methane generates a net reduction in GHGs.

In order to assess the potential impact of organic waste diversion on GHGs for this project, the Environment Canada GHG Calculator for Waste Management (the Calculator) was utilized. The Calculator provides a defensible and industry accepted approach to quantify GHG emissions associated with changes in waste disposal. The Calculator is based on a life-cycle analysis of GHG impacts, and has been built upon the United States Environmental Protection Agency (USEPA) Waste Reduction Model (WARM) with Canadian specific content incorporated.

In order to gauge the GHG benefits from organic waste diversion in Newfoundland, total waste capture for a 30-year period (Scenario 1) was combined with the homogenized waste characterization that was developed under this project. An average capture rate was derived (average of urban and rural) and applied to the diverted tonnage of organics to allow for a determination of the tonnes of each component of the waste stream that was being composted.

The results of the waste tonnage calculations for the 30 year period are shown in Table 7-1, below.

Table 7-1 GHG-Contributing Material Tonnage Calculations

Waste Stream Components		Baseline Scenario All wastes sent to Landfill [tonnes]	Alternative Scenario – Waste Sent to Landfill [tonnes]	Alternative Scenario – Waste Sent to Compost Facilities [tonnes]
1	Paper	4,482,495	4,151,444	331,051
1a	*Cardboard (OCC)*	*1,393,260*	*1,299,365*	*93,895*
1b	*Boxboard/Paper Towel*	*761,299*	*524,143*	*237,156*
1c	Newsprint/Other Paper	2,327,936	2,327,936	0
2	Organics	5,252,810	3,648,859	1,603,951
2a	*Food Waste*	*3,519,038*	*2,107,716*	*1,411,322*
2b	*Yard Waste*	*683,973*	*545,551*	*138,422*
2c	*Other*	*1,049,799*	*995,592*	*54,207*
3	Other Recyclables	2,696,710	2,696,710	0
4	C & D	1,201,504	1,201,504	0
5	Other	3,708,539	3,708,539	0
	Total	17,342,059	15,407,057	1,935,002

From the data presented above, waste streams that were involved in composting were inputted into the Calculator. Streams that were not expected to change their end fate with the introduction of composting were excluded from the Calculator as they would have no impact on the analysis. The streams that were focused on are italicized in the table above. Assumptions incorporated into the Calculator were as follows:

- Landfill gas recovery exists at the site and the system operates at the Canadian average for system collection and destruction.

- Transportation emissions were not included in the assessment as they would be similar for both the baseline and alternative scenarios in the situation where a landfill was co-located with a composting facility.

- "Other organics" from within the waste stream was assumed to have decomposition characteristics more aligned with leaf and yard waste than food waste. This would provide a conservative estimation of the GHG reductions.

The default data input screen to the Calculator does not allow for consideration of cardboard and other paper products within the compost mix, noting that this is proposed for Newfoundland. Therefore the algorithms in the calculator were duplicated and revised to allow for consideration of these two waste types in the compost mix. Given the C:N ratio of paper and paper products, it was assumed that this material would behave similarly to food waste when treated in an aerobic composting system.
The results of the analysis are presented in Table 7-2, below.

Table 7-2 GHG Analysis Results

Material*	Baseline: Compost *[Tonnes of CO_2e]*	Baseline: Landfill *[Tonnes of CO_2e]*	Baseline: Total *[Tonnes of CO_2e]*	Alternative: Compost *[Tonnes of CO_2e]*	Alternative: Landfill *[Tonnes of CO_2e]*	Alternative: Total *[Tonnes of CO_2e]*	Change (Alternative Baseline) *[Tonnes of CO_2e]*
Cardboard	—	398,048	398,048	-21,807	371,223	349,415	-48,633
Other Paper	—	551,712	551,712	-55,080	379,846	324,766	-226,947
Food Scraps	—	2,807,877	2,807,877	-327,784	1,681,768	1,353,984	-1,453,893
Yard Trimmings	—	-284,605	-284,605	-44,739	-252,984	-297,723	-13,118
Total	—	3,473,032	3,473,032	-449,411	2,179,853	1,730,442	-1,742,591

Notes:
*Default waste types defined within the Calculator

The results show that there is a net life-cycle reduction in GHG emissions from the treatment of organic waste in an aerobic composting system (as opposed to landfilling). The estimated reduction of 1,742,591 tonnes of CO_2e is based on the Scenario 1, 30-year cumulative organic waste capture tonnage of 17,337,724 tonnes.

7.2 Assessment of Differences in Net Present Value

The diversion of organic material tonnage from a landfill to a composting facility will reduce the capital cost of the landfill over the 30 year planning period as less disposal space will be required. To determine the potential cost implications of this reduced landfilling requirement, and based on information held by Dillon on the current Norris Arm site and similar landfill sites, two landfills were conceptually designed; the first at Norris Arm and the second at Robin Hood Bay. Key assumptions were as follows:

- 30 year diverted organic tonnage based on Scenario 1;

- o Both landfills have identical infrastructure (i.e., roads, buildings, sedimentation ponds), so that the landfill cells were the only variable;
- Robin Hood Bay accepts material from Region 1 and Region 5;
- Norris Arm accepts generated waste from Region 3, 4, 6 and 8.2, 8.3 and 8.4;
- Waste delivered to the landfill over 30 years (see Section 3.4.4)
    - o Robin Hood Bay ~ 10, 020,000 tonnes
    - o Norris Arm ~ 4,385,000 tonnes
- Diverted 30 year organic material (see Section 6)
    - o Robin Hood Bay ~ 1,340,000 tonnes
    - o Norris Arm ~ 590,000 tonnes
- Landfill design based on:
    - o Density of 850 kg/m^3
    - o Ratio of waste to daily cover 6:1
    - o Landfill height 25 m
    - o Top slope 2%
    - o 3:1 side slopes
    - o 2 m deep excavation
    - o 1.5 m thick liner
    - o 1.0 m thick cap
    - o All cells in the landfill were the same size
    - o Capital cost to construct a landfill cell and to cap the cell of $2,000,000/ha based on the *Central Newfoundland Waste Management Technical Committee Meeting* of March 17, 2011, value of $183.00/$m^2$.

Based on the above assumptions, a conceptual landfill to accommodate the waste from Robin Hood Bay would be approximately 86 ha and have 14 cells over the 30 year planning period. The conceptual landfill at Norris Arm would be approximately 36 ha with 10 cells for the 30 year planning period.

<u>Estimate Avoided Capital Cost for a Landfill at Robin Hood Bay</u>

1. $86\ ha \times \$2{,}000{,}000 = \$172{,}000{,}000$

2. $86\ ha \div 14\ cells = 6.14\ ha$ / cell

3. $10{,}200{,}000\ tonnes \div 14\ cells = 718{,}000\ tonnes/cell$

4. $1{,}340{,}000\ tonnes\ of\ organic\ material$ / $718{,}000\ tonnes\ per\ cell = 1.87\ cells$

5. $6.14\frac{ha}{cell} \times 1.87\ cell\ \times \$2{,}000{,}000\ ha = \$\mathbf{22,960,000}$

Estimate of Avoided Capital Cost for a Landfill at Norris Arm

1. $36\ ha\ \times \$2{,}000{,}000\ = \$72{,}000{,}000$

2. $36\ ha\ \div 10\ cells = 3.60\ ha$ / cell

3. $4.385{,}000\ tonnes \div 10\ cells = 439{,}000\ tonnes/cell$

4. $590{,}000\ tonnes\ of\ organic\ material$ / $439{,}000\ tonnes\ per\ cell = 1.34\ cells$

5. $3.60\frac{ha}{cell} \times 1.34\ cell\ \times \$2{,}000{,}000\ ha = \$\mathbf{9,648,000}$

Through this analysis, and considering the complete 30 year planning period (2015-2045) for both the Norris Arm and Robin Hood Bay Landfill sites, it was estimated that (as compared to the landfill-only alternative) implementation of Scenario 1 would result in a landfill capital cost savings of approximately $33 million.

8.0 Next Steps

With specific reference to the analysis and findings presented in Section 6, Table 8-1 provides a series of recommended next steps for consideration of DMA in collaboration with Newfoundland's eight waste management regions. Item 3 is highlighted as being particularly critical (and potentially challenging); identifying the near term action items that are agreeable to the Province, the regions and their member municipalities.

Table 8-1 Recommended Next Steps

No.	Action	Led By	Timeline	
			Start	End
1	Hold Draft Report presentation with DMA/Study Committee	DMA/Dillon	December 16, 2013	December 16, 2013
2	Confirm Draft Report Revisions and Issue Finalized Report	DMA/Dillon	January 10, 2014	July 31, 2014
3	Identify/Detail a Preferred Course of Action (e.g., Scenario 1 through 5 or variation) and set Implementation Priorities and Timelines	DMA/Regional Authorities	August 2014	January 2015
4	Commence Implementation of Preferred Course of Action	DMA/Regional Authorities	February 2015	To be determined

Notes:

Indicates a completed action.

Appendix A
Kick-Off Meeting Minutes

Minutes of Meeting - Final

Date/Time	July 3, 2013 1:00pm – 3:30pm NST	**File no.**	13-8097
Location	MMSB boardroom; 6 Mount Carson Ave, Mount Pearl	**Prepared by**	Chris Boone
Subject	Study of Options for Organics Waste Processing Kick off Meeting		

Attendees

Chris Boone (CB) – Dillon
Scott Kyle (SK) – Dillon
Marilyn Butland (MB) – Subconsultant
Mike Samson (MS) – MMSB
Rob Locke (RL) - Service NL
Derrick Maddocks (DM) – ENVC
Tammy McDonald (TM) – ENVC
Allan Scott (AS) – CRSB
Jeff Saunders (JS) – CRSB
Don Downer (DD) – WRSB
Ed Grand (ED) – EWM
Kevin Power (KP) – EWM
Gordon Murphy (GM) – MMSB
Frank Huxter (FH) - DMA

Other Distribution Gary Ryan (GR) - MMSB
Attachment: Agenda, Attendees contact information

NOTE: These minutes shall be considered the official record of the meeting. Required follow up actions are identified in *bold italics*.

1. Introductions
2. Overview of Today's Session
   SK provided overview of the topics of discussion for the kickoff meeting covered in the agenda (distributed in advance of the meeting).
3. Contract Items Review
   a. SK discussed the agreement has been submitted to MA. FH stated that the signed agreement should be provide to Dillon soon.
   b. SK discussed the revisions to the Milestones/Schedule table shown in the Dillon proposal. The update milestone dates were identified as follows:

MILESTONES/DELIVERABLES:	DATE
Project Award	17-Jun-13
Task 1 - Hold Kick Off Meeting	3-Jul-13
Task 6 - Hold Scenario (50%) Review Meeting	25-Sep-13*
Task 8 - Submit Draft Project Report	15-Nov-13
Task 8 - Present Draft Project Report	25-Nov-13
Task 8 - Confirmation of Draft Report Revisions	10-Dec-13
Task 8 - Submit Final Project Report	17-Dec-13

*After the kickoff meeting it was decided that Task 6 – Hold Scenario (50%) Review Meeting should be changed from 17-Sep-13 to 25-Sep-13.

4. <u>Identification of Key Project Contact/Lines of Communication</u>
    a. It was confirmed that FH will be Dillon's main point of contact for the project and all Dillon invoices will be submitted to FH. FH will be kept informed on all communications during the project.
    b. FH confirmed that all the key government departments for the study were represented at this meeting.
    c. Other relevant Stakeholders were discussed, both Government and Private Industry. These included:
        i. Forestry
        ii. Fisheries
        iii. IBOG – *ACTION: GM to provide information on stakeholders contained in this group*
        iv. Paper Mill (Corner Brook)
        v. Lumber Association
        vi. Two new Waste Management Boards, Burin and Bonavista (Discovery) Peninsulas, were discussed. It was stated that Joe Pitman of the Burin board is very keen on providing input on this project. The Burin Peninsula currently has a pilot organic project in operation which they are very happy with. *ACTION: FH to provide Dillon with confirmed contact information.*
    d. SK discussed the submission of a questionnaire which will be distributed and then followed up with a telephone interview.
5. <u>Identification of Background Data/Reports</u>
    a. New reports include:
        i. 2011 Waste Management Report Card. *ACTION: GM to provide Dillon this document.*
        Report Card uses 1989 base line (1992 data used) and total mass diverted/mass produced.
6. <u>Discussion of primary non-MSW organics generators</u>
    a. Mink Industry – They are spread across the island. There are currently less farms with no known major developments in the industry in the near future. The Bay of Isles farm was discussed with regards to having its own compost facility. Catherine Moores was given as a contact. Largest producer is called "Viking".
    b. Fox Industry
    c. Chicken Industry – Country Ribbon.
    d. Fishery Industry – Currently organic waste is allowed to be dumped at sea. This is only one of three areas in the country where this is permitted. It is permitted as long as there is no viable land option. It is not known if future changes will occur to this policy. It was stated that a small amount of organic waste in the form of diseased fish and other special conditions does make its way to landfills. However this is rare.
    e. Forestry – Identified as a noted source of carbon feedstock. There exists a 2007 Inventory by department of Forestry and Agra Foods. Most of this waste comes from the lone pulp and paper mill in Corner Brook, however this mill is becoming more and

more active in reducing its waste. It was stated that the Corner Brook Mill may be looking at using the WRSB's waste trucks for back hauling of material from the Central area of the province. Other small producers include Sexton Lumber and Philpot's in central. Kevin Sexton was given as a contract for Sexton Lumber.

f. Other Carbon Sources – Peat Bog and paper/cardboard was discussed as examples. Peat Bog was further discussed and it was stated that large scale use will have environmental impacts and would most likely not be acceptable.

g. Other comments – Sunnyside hosts an existing organics waste site for industries in the adjacent area. It was noted that much of the byproduct waste which are organic go to other industries. For example chicken waste (feathers) is used by the Mink processors as feed.

h. Other Compost operators

    i. Grand Falls Windsor compost was discussed. They currently use clearing and grubbing and yard waste to obtain carbon.

    ii. New green house in the western region has been proposed. Clyde Simmons has produced a business plan for a 10 acre green house and has stated he is looking for as much compost material as possible.

    iii. Harbour Bretton has a community compost in the similar to Holyrood, Cape St. George and Deer Lake. They are leaf, yard and household organics (no meats and oils). It is used by 500 households.

    iv. The Hi-Point Industries (Genius) operation was discussed. They have a large windrow compost facility using fish waste (primarily aquaculture), bark and peat to produce class "A" compost. The site is located on an old mill dump site near wild cove landfill on the outskirts of Corner Brook and has access to large amount of decomposing wood byproducts. Bill Butler is a contract

7. <u>Current and Pending Provincial Initiatives</u>

    a. The Central Region currently allows septic waste to landfills. This activity is soon to be discontinued. Eastern and Western Regions have banned this practice and require this waste to be brought to processing facilities (e.g., lagoons).

    b. Pardy's Waste Management and Industrial Services (Pasadena) is looking to get into bio solids composting. Warren Pardy and Rob James are contracts with Pardy's.

    c. The public/political mood regarding composting was discussed.

        i. There has been a noticeable shift in the public that composting should be done and that some level of additional cost is acceptable. There is an apparent desire to get moving and show progress on this issue.

        ii. Illegal dumping is still an issue however it is not believed to be getting worse.

        iii. Public awareness is has improved significantly in recent years. Younger generations are more accepting of progressive waste management activities.

        iv. NGO's were discussed. The Newfoundland and Labrador Environmental Network (NLEN) is a major player. However most NGOs are essentially individuals.

8. <u>General Roundtable Discussion</u>

a. The Grendfell Campus composter is a copy of Concordia University.
b. Burin started their compost program to minimize transportation costs.
c. Robin Hood Bay was discussed as possible site for the Eastern Region. Based on information provided in the meeting, the Region does not see Robin Hood Bay as an appropriate location for an organic waste processing facility; it was suggested that another location on the Avalon Peninsula be considered.
d. The Sunnyside operation is hopeful that they will be considered as a possible management location for the Eastern Region. It was confirmed, however, that the current operation is not an engineered site.
e. End use of the compost material was discussed.
    i. NL has limited access to exports of this material because of CFIA restrictions on the export of NL soil due to the presence of a potato nematode.
    ii. There are challenges with nutrients
    iii. The cost of producing top class compost is concern as there is a concern that few people will want to "pay for dirt".
    iv. There is a bylaw to provide a minimum amount of topsoil (6") for new developments, but it is unclear whether this requirement is being enforced.
    v. Transportation of waste concerns were discussed for Burin/Bonivista and Western regions. The Western Region stated that return transportation to the Norris Arm location can be up to 14 hours. Ideally, the Western Region would like to see 3 to 4 smaller facilities in its region to reduce transportation requirements.
    vi. The liability of glass in the finished product was discussed.
    vii. FH stated that DMA's view on the project can be summarized as follows:
        1. They have no pre conceived solutions.
        2. They want to see functional composting facilities that are economically sustainable.
        3. Provide regional/local solutions.
        4. Provide a solution that will not have an unmanageable cost/household.
        5. DMA will cover the capital costs with each region covering the operating costs.
    viii. Backyard composting in Mount Pearl was discussed. They have had some bad experiences (rats/cats/flies) in the past and it is believed that backyard composting is looked upon unfavourably by municipal residents.
    ix. NL has compost guidelines.
    x. Not producing class "A" material will require more input from environment.
    xi. Environment stated that they see this process as producing one of two things, a product or a waste. If it is not a product that is used it will be considered waste and therefore must be handled.
    xii. DD asked the question. Will the operational costs include the cost of collection? SK stated that it would.

xiii. SK stated that multiple solutions will be presented, not one solution will fit all. It was agreed that solutions would need to be effective from both a performance and cost perspective, acknowledging the range of community contexts across the island.

xiv. GM stated that “NL community accounts” provides a wealth of information which is accessible online.

xv. GM stated that he will be made available to Dillon to provide information where possible.

9. Project Next Steps
    a. SK provided a review of the eight tasks presented in Dillon’s proposal.
    b. SK confirmed that Task 2 (Conduct Interviews and Consolidate Background Information), Task 3 (Define Performance Requirements) and Task 4 (Prepare Digitized Study Area Base Plan) would be the focus of the project team over the next few weeks.
    c. The next meeting for the overall committee is to occur in St. John’s at the completion of Task 6, currently scheduled for September 17.

The meeting adjourned at approximately 3:30 pm.
<END>

AGENDA

Study of Options for Organics Waste Processing

Kick Off Meeting – Confederation Building, St. John's NL

July 3, 2013

No.	Description	Led By	Start
1	Welcome/Introductions	DMA	1:00 pm
2	Overview of Today's Session	Dillon	1:10
3	Contract Items Review • Project Milestones	Dillon	1:15
4	Identification of Key Project Contacts/Lines of Communication • DMA, DEC, other government agencies • Regional Service Boards/Committees (to support Task 2)	Dillon	1:25
5	Identification of Background Data/Reports • Provincial and regional information • Existing system descriptions, tonnage reports	Dillon	1:45
6	Discussion of primary non-MSW organics generators • Fisheries, Mink, Forestry • Carbon deficiency concerns	Dillon	2:15
7	Current and Pending Provincial Initiatives • Grand Bank and Holyrood programs • Legislation and policy • Public/political mood	Dillon	2:40
8	General Roundtable Discussion • Key issues of interest/concern for the project	Dillon	3:05
9	Project Next Steps	Dillon	3:35
10	Adjournment	DMA	3:45 pm

Study of Options for Organics Waste Processing
Kick Off Meeting – 3 July 2013
Attendees

Name	Title	Affiliation	Telephone/Email
Allan Scott	Chair	Central Newfoundland Regional Service Board (CRSB)	T: 709-651-5920 E: allanscott@nf.sympatico.ca
Jeff Saunders	Chair Technical	CRSB	T: 709-489-0427 E: jsaunders@grandfallswindsor.com
Tammy McDonald	Senior Environmental Scientist	Department of Environment & Conservation (ENVC) – Pollution Prevention Division	T: 709-729-1810 E: TammyMcDonald@gov.nl.ca
Frank Huxter	Director (Acting) of Waste Management	Department of Municipal Affairs (DMA)	T: 709-729-7482 E: fhuxter@gov.nl.ca
Ed Grant	Chair	Eastern Waste Management (EWM)	T: 709-727-4030 E: egrant431@gmail.com
Derrick Maddocks	Director	ENVC – Pollution Prevention Division	T: 709-729-5782 E: dmaddocks@gov.nl.ca
Kevin Power	Manager of Waste Operations	EWM	T: 709-579-5330 E: kpower@easternwaste.ca
Gordon Murphy	Senior Program Development Officer	MMSB	T: 709-757-0782 E: gmurphy@mmsb.nl.ca
Mike Samson	CEO	Multi Materials Stewardship Board (MMSB)	T: 709-753-0972 E: msamson@gov.nl.ca
Rob Locke	Manager of Environmental Protection	Service NL	T: 709-729-3104 E: Rlocke@gov.nl.ca
Don Downer	Chair	Western Regional Service Board (WRSB)	T: 709-632-2202 E: wrwastemgmt@bellaliant.com / ddowner@swgc.mun.ca
Jason King	Western Coordinator	WRSB	T: 709-632-2922 E: wrwastemgmt@bellaliant.com / jking.wrwmc@gmail.com
Scott Kyle	Project Manager	Dillon Consulting Ltd.	T: 902-450-4000/709-754-2374 Ext. 5014 E: skyle@dillon.ca
Chris Boone	Project Engineer	Dillon Consulting Ltd.	T: 709-754-2374 Ext. 5512 E: cboone@dillon.ca
Marilyn Butland	Communications Subconsultant	Butland Communications	T: 709-746-0432 E: marilyn@butlandcommunications.com

Appendix B
Interview Questionnaire

Newfoundland Study of Options for Organics Waste Processing

Existing Waste Management Services and Infrastructure

Dillon Consulting Limited (Dillon) has been retained by the Government of Newfoundland and Labrador's Department of Municipal Affairs to undertake a study of options for organics waste processing for the island of Newfoundland (Department of Municipal Affairs contact is Frank Huxter, Manager, Municipal Engineering and Planning. email address: fhuxter@gov.nl.ca). The purpose of the study is to identify viable options to divert organics from landfill while acknowledging both the urban and remote rural character of Newfoundland.

This questionnaire was prepared to gain a clear understanding of existing waste management services and infrastructure in each region. The questionnaire is divided into the following seven sections:

Section A: General Information
Section B: Wastes/Garbage
Section C: Recyclables
Section D: Organics - Backyard Composting & Leaf and Yard Waste
Section E: Organics - Food Waste
Section F: Public Education and Stakeholder Engagement
Section G: Other Information

Please fill out the questionnaire as best as you can. We encourage you to seek input from colleagues and others involved in the management of waste within your region. Please email Betsy Varghese at bvarghese@dillon.ca the completed questionnaire by Friday, July 26, 2013. Betsy will call you during the week of July 29th to discuss the responses and seek clarification, if necessary. Dillon's objective is to assemble and confirm all of the existing conditions by the end of July.

Thank you for your participation in this important study!

Regional Waste Management Authority (RWMA): ____________________

Completed by:	____________	Date Completed:	____________
Title:	____________	Website:	____________
Tel. No.:	____________	Email:	____________

A. GENERAL INFORMATION

A.1 <u>RWMA Services</u>

a. Approximate population served: ____________

b. Brief overview of waste management services provided: ____________

c. Locations of public and private waste management facilities within RWMA (e.g. transfer stations, Green Depots, active & closed landfills, Material Recovery Facilities, composting facilities, construction & demolition waste facilities, household hazardous waste depots): ____________

d. Describe special material services (e.g., seasonal bulky waste collection): ____________

e. Are there any recent (e.g., within last five years) waste composition studies? If yes, please describe and attach.

f. Does the RWMA have specific by-laws or policies that address solid waste management requirements? If yes, please name and attach (or provide weblink). ____________

g. Describe roles and responsibilities of RWMA staff and contractors and attach organizational chart, if applicable.

h. 2012 Calendar Year Solid Waste Management Expenditures (attach detailed printout if available): ____________

i. 2013 Calendar Year Solid Waste Management Budget (attach detailed printout if available): ____________

j. Please identify and attach any other relevant reports and/or documents (e.g., annual reports): ____________

B. WASTES/GARBAGE

B.1 Residential

Collection

a. Does the RWMA provide curbside/roadside collection of residual waste? ***<If no, skip to B.1.k>*** ______

b. Frequency of curbside/roadside collection (i.e., weekly, biweekly): ______

c. Limits on garbage bag/container set out? Fees for extra garbage? ______

d. Approx. number of households served: ______

e. Are all areas within the RWMA serviced? If not, specify: ______

f. Provide the estimated annual quantities of residual wastes collected at curbside/roadside for the 2010-2012 calendar years:

______

______

g. Collection through contract or by RWMA forces? If by contract, provide contractor name. ______

______

h. Provide approximate annual value of collection contract: ______

i. Is garbage collected with another stream (i.e., organics or recyclables)? ______

j. General description of collection vehicle(s): ______

______

______

k. Describe method (e.g. vehicles used, frequency of trips) and costs associated with hauling waste to landfill(s): ______

______

______

Transfer / Hauling

l. Can residents drop wastes off at transfer stations and/or depots? ______

m. If yes, provide name and location of facility(ies): ______

______

______

n. Are there restrictions on what can be disposed at transfer stations and depots (e.g., weight limits): ______

______

o. What is the cost per tonne for wastes dropped off? ______

p. Provide the estimated annual quantities of wastes received at transfer stations and/or depots for the 2010-2012 calendar years

______

______

q. Describe method (e.g. vehicles used, frequency of trips) and costs associated with hauling waste from transfer stations/depots to landfill (if applicable): ______

______

______

Disposal (Landfilling)

r. Provide formal name/location of MSW landfill site(s) used by the RWMA: ______

______

______

s. Can residents drop wastes off directly at the landfill? ______

t. Are there restrictions on what can be disposed at the landfill (e.g., weight limits): ______

______

u. Are tipping fees applied at the site(s)? If yes, what is the cost per tonne: ______

v. Provide available approx. annual operating costs (including amortized capital costs) for the disposal site(s):

______

______

______

Other

w. Describe any planned upcoming changes to waste/garbage management program: ____________________

x. Any additional comments? ____________________

B.2 Industrial, Commercial and Institutional (IC&I)

a. Are wastes/garbage from IC&I sources collected as part of the RWMA system?

b. Approx. quantity of IC&I recyclables managed annually (i.e., tonnes): ____________________

c. Please describe and attach a list of the primary IC&I waste generators (name, location and suggested contact name) within the RWMA (i.e., schools, hospitals, malls, industries, etc.). ____________________

C. RECYCLABLES

C.1 Residential

Collection

a. Does the RWMA provide curbside/roadside collection of residual waste? ***<If no, skip to C.1.l.>***

b. Materials accepted (i.e., newsprint, cardboard, PET, HDPE, glass food containers, beverage containers, etc.)

c. Recycling program type (i.e., single stream, 2-stream, multi-stream):

d. Method of collection (i.e., blue bag, blue box, drop off depots):

e. Frequency of curbside/roadside collection (i.e., weekly, biweekly):

f. Approx. number of households served:

g. Are all areas within the RWMA serviced? If not, specify:

h. Collection through contract or by RWMA forces? If by contract, provide name of contractor:

i. General description of collection vehicles, if applicable:

j. Approx. quantity collected per year (i.e., tonnes):

k. Approx. annual collection cost (including amortized capital costs):

Transfer / Drop Off

l. Can residents drop recyclables off at transfer stations and/or depots?

m. If yes, provide name and location of facility(ies):

n. Are there Green Depots within the region? If so, please provide location(s):

o. Are customers charged to drop off recyclables? If so, what is the cost per tonne?

p. Provide the estimated annual quantities of recyclables received at transfer stations and/or depots for the 2010-2012 calendar years:

q. Describe method (e.g. vehicles used, frequency of trips) and costs associated with hauling recyclables from transfer stations/ depots to MRFs (if applicable):

r. Are there Green Depots within the RWMA? If so, provide location(s) of each:

Processing

s. Is processing undertaken through contract or by RWMA forces? If by contract, name contractor: ______

t. Provide formal name/location of the Materials Recovery Facility(ies) used by the RWMA: ______

t. Location of disposal facility to manage residual waste and method of transportation: ______

u. Approx. quantity processed per year - by material type if available (i.e., tonnes): ______

v. Approx. annual processing cost (including amortized capital costs): ______

Other

w. Describe any planned upcoming changes to the recycling program: ______

x. Describe any noted challenges in the recycling program (e.g., participation rates, contamination issues): ______

y. Any additional comments? ______

C.2 Industrial, Commercial and Institutional (IC&I)

a. Are recyclables from IC&I sources accepted (i.e., collected, processed, etc.) by the RWMA system?. If yes, describe (including fee arrangements): ______

b. Approx. quantity of IC&I recyclables managed annually (i.e., tonnes): ______

D. ORGANICS - Leaf & Yard and Backyard Composting

D.1 Residential - Backyard Composting

a. Approx. number of backyard composters (BYC) that have been distributed by the RWMA:

b. Approx. cost per composter to the RWMA:

c. Approx. cost per composter to the RWMA:

d. Recent participation estimates (% and year):

e. Are there any specific programs in place in the RWMA to promote backyard composting (i.e., master composter programs, demonstration sites, performance monitoring, etc.)? If yes, describe:

f. Any issues or concerns with backyard composting within the region?

D.2 Residential - Leaf and Yard Waste (L&YW)

a. Is curbside/roadside collection of L&YW provided to residents? ***<If no, skip to D.1.n>***

b. Method of collection (i.e., bags, carts):

c. Approx. number of households served:

d. Are all areas within RWMA serviced? If not, specify:

e. Frequency of collection, including seasonal variations (i.e., weekly, biweekly):

f. Provide the estimated annual quantities of L&YW collected at curbside/roadside for the 2010-2012 calendar years:

g. Describe method (e.g., vehicles used, frequency of trips) and costs associated with transporting L&YW to composting facility(ies):

Transfer / Drop Off

h. Can residents drop leaf and yard waste off at transfer stations, depots and/or seasonal locations (e.g., Christmas trees)?

i. If yes, provide name and location of facility(ies):

j. Are customers charged to drop off L&YW? If so, what is the cost per tonne?

k. Provide the estimated annual quantities of L&YW received at transfer stations and/or depots for the 2010-2012 calendar years:

l. Describe method (e.g. vehicles used, frequency of trips) and costs associated with hauling L&YW from transfer stations/ depots to composting facility(ies):

Processing

m. Describe processing/composting location, equipment, staff and procedures:

n. Does the facility currently hold a formal Provincial approval/registration?:

o. Is processing undertaken through contract or by RWMA forces?

p. Approx. quantity processed per year (i.e., tonnes):

q. Facility design capacity (i.e. maximum tonnes per year):

r. Approx. annual processing cost (including amortized capital costs):

s. Approximately annual rejected (oversize) material:

t. How is rejected material disposed (i.e., landfilled)?

u. At which site is material disposed?

v. How are residual materials shipped there? (vehicle type, frequency of shipping, contractor, cost, etc.):

Cured End Product (Compost)

w. Does end product meet "Category A" (unrestricted use) standard? If not, describe:

x. Describe end product quantities/markets/usage location(s):

y. How are materials shipped to end markets? (vehicle type, frequency of shipping, contractor, cost, etc.):

z. Cost/revenue per tonne charged/paid by end market (by material type, if applicable):

Other

aa. Describe any planned upcoming changes to leaf & yard/BYC programs:

ab. Are there any issues with contamination in the leaf & yard waste stream? If so, please describe:

ac. Any additional comments?

D.3 <u>Industrial, Commercial and Institutional (IC&I)</u>

a. Are leaf & yard organics from IC&I sources accepted (i.e., collected, processed, etc.) by the RWMA system, if yes, describe (including fee arrangements):

b. Approx. quantity of IC&I leaf & yard organics accepted annually (i.e., tonnes):

c. Identify potential sources of non-residential generators of carbon-rich feedstocks (e.g., forestry, lumber, paper mills):

E. ORGANICS - Food Waste

E.1 Residential

Collection

a. Is there a collection program for food scraps? ***<If no, skip to E.1.c>*** ____________________

b. If yes, please describe the program (e.g., how materials are collected, hauled, processed, end use, costs):

____

____

____

____

General Feedback on Potential Food Waste Composting Program

c. What are the potential advantages to a food waste composting program in the region? ____________________

____

____

____

____

d. What are the potential challenges and/or barriers to implemention? ____________________

____

____

____

____

e. Provide the RWMA's opinion on public acceptance: ____________________

____

____

____

____

f. Other suggestions and comments with respect to implementing a food waste composting program: ____________________

____

____

____

____

____

____

____

____

E.2 Industrial, Commercial and Institutional (IC&I)

a. Are organics from IC&I sources accepted (i.e., collected, processed, etc.) by the RWMA system?. If yes, describe (including fee arrangements): ____________________

____

____

____

____

____

b. Approx. quantity of organics managed annually (i.e., tonnes): ____________________

c. Identify potential non-residential generators of composting feedstock/bulking agents (e.g., fisheries, agricultural operations, food processors, institutions): ____________________

____

____

____

____

F. PUBLIC EDUCATION & STAKEHOLDER ENGAGEMENT

a. Describe the RWMA's solid waste management public education efforts (i.e., dedicated staff, newsletters, website, hot-line, promotional events, etc.)

b. What is the approximate annual cost of the RWMA's public education & information program?:

c. Identify individuals or groups in the community (including schools) with a noted interest in waste management:

G. OTHER INFORMATION

a. Other comments or information (attach if required):

Thank you for your assistance.

Appendix C
Technology Evaluation

Technology/Option	Process Overview	Infrastructure/ Space Requirements	Applicable Feedstock	Feedstock Preparation Requirements	Typical Capacity (tpy SSO)	Composting Time	Flexibility/ Seasonality	Process Control Features	Level of Odour Control	Water/Moisture Control Requirements	Vector (animal/ bird) Access	Electricity Consumption	Fuel Consumption	Quantity of Liquid Effluent Requiring Management	End Product Characteristics	Relative Cost	Example Operations
Aerobic Processing Technologies																	
Passively Aerated and Turned Composting Systems																	
Static Pile	Often used by small municipalities which are composting for the first time, or when an abundance of woody materials, space and time are available. Passive aeration, outdoor method. Method involves forming the organic feedstock into large windrows or piles which are allowed to decompose over an extended period (i.e., 2 to 3 years) with little or no mixing. Piles are built with the expectations that they will passively aerate themselves. Large piles should be limited to a height of 5 m (to reduce the potential for anaerobic conditions, spontaneous combustion, and odour issues).	High space requirements. Piles are built using front-end loaders, skid-steers, farm tractors, or excavators.	L&Y, high C:N ratio (greater than 40:1)	Shredding/mixing. Since passively aerated, materials need to be mixed well to provide sufficient FAS, and allow air to flow through the piles.	< 10, 000	2 to 3 years (with low rate of aeration and agitation)	Abundance of time and space is required for composting. Low to medium flexibility: outdoor method, may be difficult to compost during winter months	Remixing of static pile is required to re-establish porosity loss over time, maintain oxygen flow, and allow for piles to attain the required temperatures for composting. During remixing, dry areas are re-moistened to increase composting process and reduce likelihood of spontaneous combustion.	Odours constantly emitted from piles and agitated older materials release odours as well. There may be a need for a buffer zone between compost pile and adjacent properties, which in turn increases land requirements. This is not well suited for urban areas. To reduce odour, limit height of piles to 5 m.	Low water requirements/No moisture control	High	Not needed	Low to medium - to run mobile equipment	High quantity of effluent - Leachate is a mixture of higher-strength leachate from the piles and runoff from working pad. Due to large footprint, overall quantity of leachate is higher than from facilities using different composting methods.	Product is usually stable after 2-3 years	Low construction and O&M cost	1. City of Fort Saskatchewan 2. Community composting - 15 locations in NL 3. Envirem East River Compost Facility- Chester, NS 4. Most municipal L&Y waste facilities in Canada
Bunker	Passive aeration, outdoor method. Simple method for small feedstock quantities. Typical installation consists of three separate bunkers. The first bunker is used for receiving fresh materials daily. Once the first bunker is filled (2 to 3 weeks),the third bunker is emptied and refilled with material from the second bunker. Active composting takes place in the second and third bunkers. Individual bunkers can range in size from 2 - 3 m^3 to 20 m^3.	Medium to high space requirements. Bunkers are constructed from cast-in-place concrete, concrete lock-blocks, modular concrete barriers or even wood. Depending on location and climate, bunkers can be located outdoors, covered by a simple roof structure or fabric, or contained within a building. Material can be moved from bunker to bunker using a skid-steer or small front end loader. Bunker systems can be designed to match specific application and rate of feedstock generation. Large bunkers can be equipped with aeration systems to control odour.	L&Y, high C:N ratio, not suitable for much food waste, not suitable for large quantities of material	Shredding/mixing	< 500	8 to 12 months	Depends on location and climate. Low to medium flexibility: outdoor method, may be difficult to compost during winter months	Moving material from bunker to bunker to re-establish porosity. Large bunkers can be equipped with aeration systems to control odour.	Odours emitted, require larger buffer areas around site	Low water requirements/no moisture control unless covered	High	Not needed	Low to medium - equipment to move materials	Medium to high quantity of liquid effluent - Leachate production may be contained in bunker	Product is not a stable compost product, still needs a curing stage	Low construction and O&M cost	1. Acadia University, Wolfville, NS 2. Camrose Centra Cam Collection Depot - Compost Bunker
Windrow	Passive aeration and mechanical agitation, outdoor method. Suitable for a wide range of feedstock and facility capabilities. Method involves feedstock being formed into long, low piles (windrows). Windrows are regularly moved or turned. Composting time is reduced, and smaller quantity of material can be processed on a smaller footprint. Windrows are typically 1.5 to 3.5 m high and 3 to 6 m wide. Spacing between windrows ranges from 1 to 5 m.	Medium to high space requirements, low infrastructure requirements, includes long low piles, an outdoor working pad, access roads, accompanying ditches and a detention pond. Windrows are situated on a firm working pad composed of concrete, asphalt, cement-treated base or compacted gravel. Turning is done using mobile equipment such as a front-end loader, a skid steer, or a farm tractor and manure spreader. Several styles and sizes of specially designed windrow "turners" have also been developed specifically for this task.	L&Y, wood, food waste, high C:N ratio. Due to odour control, food waste is not recommended.	Shredding	< 50,000	6 to 12 months	9 to 12 months (during winter months or colder climates)	Removed first comment. Windrows are regularly moved or turned to re-establish porosity, break-up and blend material, introduce oxygen. Turning regularly (one to three times per week during active composting), maintain pile size (less than 3 m), and ensure FAS is maintained to increase rate of processing and reduce odour.	Low to medium- when windrow is turned, heat, water vapour and gases are released which can affect adjacent properties. Turn windrows in the morning or when wind is blowing away from adjacent properties.	Low to medium water requirements/no moisture control	High	Not needed	High	High quantity of liquid effluent - composting done outdoors where exposed to precipitation and can lead to runoff. Runoff must be collected and treated, or added to a batch of incoming feedstock to increase moisture content. Windrow composting is almost always done outdoors where it is exposed to precipitation. This can lead to runoff management problems. Any runoff created must be collected and treated, or added to a batch of incoming feedstock to increase its moisture content.	Product is not a stable compost product, still needs a curing stage	Low to medium construction and O&M cost	1. NuMink, Cox's Cove, NL 2. Greening's Dairy Farm, Musgravetown, NL 3. Carew Services, Cape Broyle Composting, Marystown, NL 4. Fundy Compost Inc. - Brookfield, NS: 9,000 tonnes/yr (uses compost turner) 5. Envirem Organics - Clarendon, NB (outdoor windrows): 150,000 tonnes/yr 6. City of Camrose- Alberta : 1500 tonnes, population 17,000
Turned Mass Bed	Variation/ improvement on the traditional windrow method. Passive aeration and mechanical agitation, indoor or outdoor method. A continuous-flow system that relies on a specialized windrow turner. Windrows are larger than the "windrow composting method" (i.e., 15 to 40 m wide)	Medium to high space requirements. Infrastructure includes working pad, turning equipment. To create mass bed, a windrow turner is modified by adding a horizontal cross-conveyer which allows for more processing of material.	L&Y, less suitable for materials with high oxygen demand such as food waste and biosolids	Shredding	15,000 to 50,000	6 to 12 months	Medium flexibility	Less surface area and lower level of passive aeration requires more turning (every two to four days) and higher level of monitoring. In-floor aeration system can be installed to increase oxygen concentration.	Low to medium	Low to medium water requirements/no moisture control unless covered	High if outdoors	Not needed	High- the cost of the specialized turning equipment is 50% to 100% higher than traditional windrow turner	Low to medium quantity of liquid effluent - Where windrows are exposed to precipiation, this can lead to runoff issues	Product is not a stable compost product, still needs a curing stage	Low to medium construction and O&M cost	1. Edmonton Composting Facility (note: uses different composting methods)
Passively Aerated Windrow (PAWs)	Cross between the static pile and aerated static pile (ASP) methods. Passive aeration and outdoor method. The mixture of materials to be composted is placed in long, low windrows which are constructed over a base network of perforated open-ended pipes. The open air pipes allow air to naturally diffuse through the windrow without the use of aeration fans.	High space requirements. Perforated HDPE or PVC pipe (4" or 6" diameter) is used when constructing passively aerated windrows. If perforated pipe is unavailable, standard sewer pipe can be used. In this case, holes would be drilled in the pipes manually. 100-mm diameter perforated pipes, placed every 30 to 45 cm along the length of the windrow, covered with 15 to 25 cm layer of compost or peat moss.	L&Y, high C:N ratio, not suitable for food waste, or large quantities of material	Shredding/mixing	<10,000	8 to 12 months	Low to medium flexibility: outdoor method, may be difficult to compost during winter months	Key process management parameters: perforated pipes allow for air to naturally diffuse through the windrow, layer of compost or peat moss helps discourage insects, increase moisture retention, manage odours. Amendments (i.e., straw and wood chips)are commonly used to achieve good structure of the material.	Low- use layer of peat moss to manage odours	Low water requirements/no moisture control	High	Not needed	Low to medium - to run mobile equipment	Low to medium quantity of liquid effluent	Product is not a stable compost product, still needs a curing stage	Low construction and O&M cost	1. Alymer, Ontario - Three Counties Recycling and Composting Inc 2. City of Port Townsend Biosolids Facility - Port Townsend, Washington 3. Eco City Farms (urban farm)- Prince George's County, Maryland

Technology/Option	Process Overview	Infrastructure/ Space Requirements	Applicable Feedstock	Feedstock Preparation Requirements	Typical Capacity (tpy SSO)	Composting Time	Flexibility/ Seasonality	Process Control Features	Level of Odour Control	Water/Moisture Control Requirements	Vector (animal/ bird) Access	Electricity Consumption	Fuel Consumption	Quantity of Liquid Effluent Requiring Management	End Product Characteristics	Relative Cost	Example Operations
Aerobic Processing Technologies																	
Actively Aerated Composting Systems																	
Aerated Static Pile - ASP (positive, negative, covered)	Aeration fans, outdoor method. Less exposed pile surface, less agitation, and higher level of odour control than static pile or windrow composting, especially if negative aeration used. Feedstock are mixed and piled. After material is removed from the ASP, materials are further cured in outdoor windrows. Positive ASP - blows air up through the pile Negative ASP - draws air down through the compost Covered ASP - tarp covers are used to protect the pile made from woven and nonwoven fabrics. The covers are perforated to allow air movement and leachate drainage. As an alternative to a tarp, feedstock is injected into tubes made of plastic film as they are unrolled. Aeration pipes are placed in the bottom of the tubes. When pods are filled, the ends are sealed and the pipes are connected to a positive aeration system. Once composting is complete, the tubes are cut open and material is removed.	Low to medium space requirements. No standard width of height for ASPs, size depends on site-specific requirements and land availability. Weights and straps are used to seal the edges of the covers in place.	L&Y, food waste, animal mortalities, animal manures, biosolids, and industrial composting Compost biosolids and feedstock of similar consistency, not great for composting SSO	Shredding/mixing, Blend feedstock with structural amendments to maintain porosity. Mixed well to ensure aerated and that no anaerobic areas develop in piles. Bulking agent: wood chips, shredded tires	1,000 to greater than 100,000	4 to 8 weeks	All year	Key process management parameters: remixed material halfway through active composting period to re-establish porosity, and ensure materials exposed to higher temperatures need to control pathogen and weed destruction, materials are remoistened during remixing step (tarp system). Tarp covers used to protect the pile from infiltration of precipitation, reduce evaporation loss of water, control odours and volatile organic compound emissions.	Medium (positive), Medium to high (negative and covered) Use negative aeration to minimize odour, Tarps contain a semi-permeable membrane to help air pas through and control odours.	Low to medium (positive and negative ASP), Low (covered ASP), Tarp covers used to protect the pile from infiltration of precipitation, reduce evaporation loss of water, control odours and volatile organic compound emissions.	Limited	Medium (positive and negative ASP), low to medium (covered ASP); aeration systems require three phase electrical supply	Medium	Medium (positive and negative ASP), low to medium (covered ASP) Low (positive ASP) quantity of liquid effluent	Product is not a stable compost product, still needs a curing stage	Medium construction and low to medium O&M cost	1. Greater Moncton Sewage Commission - NB: wastewater treatment/ bio-solids : 40,000 tonnes/yr, population 100,000 2. Edmonton Composting Facility 3. Norterra Organics Central Composting - Kingston Ontario 4. Atlantic County Compost- Afton, NS
Enclosed Aerated Static Pile (Tunnel)	Enclosed aerated static pile composting is simply a variation of the outdoor technology. Fully enclosed ASP, based on bunker style. Uses aeration fans (positively aerated composting system with below-floor aeration. During operation, process air is exhausted from the tunnel headspace). Provides a high degree of odour control. Corrosive process air is contained within the tunnel, so building damage is reduced. However, some enclosed facilities have proved to be inadequate with regard to corrosion protection, interior visibility, and indoor air quality. These problems are all related to low air exchange rates for the building interior. The composting process releases large amounts of heat, dust, and water vapour. These operating conditions are a particular concern for composting facilities in locations where winters are very cold.	Lower space requirements. Aeration floor and pile are housed within a long narrow tunnel. Tunnels are 3 to 6 m wide, 6 to 10 m high, and 50 m long. Tunnels are designed to allow front end loaders to drive in and out to load and remove materials. Custom airtight door system is used to seal the front of the tunnel during composting. Aeration system more complicated than in ASP system. Concrete is used to construct tunnels. Loading/unloading end of the tunnel and aeration fans at opposite ends are indoors, tunnel bays are outdoors????. Tunnel space requirements are similar to bunker style ASP.	L&Y, food waste	Shredding/mixing	1,000 to greater than 100,000	2 to 4 weeks	All year	Key process management parameters to monitor and control composting progress: some facilities remixing material half way through composting process, exhaust from the tunnel headspace helps control odours	Provides a high degree of odour control	Low water requirements/good moisture control	Limited	Medium to high	Medium	Low quantity of liquid effluent- leachate is contained	Product is not a stable compost product, still needs a curing stage	High construction and medium to high O&M cost	1. City of Guelph, ON - seven enclosed tunnels: 30,000 tonnes/yr, serves population of 125,000 2. City of Sydney, NS 3. City of Ottawa, ON - six enclosed tunnels: 10,000 tonnes/yr
Static Container (i.e., in-vessel composting)	In-vessel composting system, that relies on a number of discrete composting vessels. These containers are 40 cubic-yard roll-off containers, which are portable. Composting uses aeration fans, indoor. Containers are filled through sealable doors. Once filled, containers are moved to an outdoor concrete or asphalt pad and connected to a stationary aeration system which provides air to the system. Air is fed into the base of the containers and removed from the top. Exhaust air is passed through biofilters for treatment. After composting, the container is emptied (similar to a dump truck). In-vessel composting systems tend to be one of the most capital-intensive of the composting approaches available. The big advantage of these systems is that they take up less space, can be automated, and may be viable where others are not. What differentiates this system from the other aerobic composting system is that the composting process itself is conducted inside some type of sealed container, chamber or vessel, which enables the environment to be highly controlled, with access restricted.	Low to medium space requirements. Requires composting vessel (container), concrete or asphalt pad, stationary aeration system, and specialized trucks to move and unload containers. Each unit is equipped with forced aeration and mechanical mixing devices????? and equipment used to feed raw waste into the vessel and remove compost from it. The units include some type of monitoring system for at least temperature and oxygen content within the vessel.	L&Y, food waste	Shredding/mixing	300 to 30,000 (size limitation based on number of containers)	2 to 4 weeks	All year	Some in-vessel technologies are designed to have a continual flow of waste through the system, while others process one complete batch of compost at a time, and then are fully emptied before receiving a fresh batch. Odours are more easily managed with in-vessel systems, since all operations are sealed within the vessel, and exhaust air can be collected and passed through a biofilter.	High	Low water requirements/good moisture control	Low	Medium to high	Low-medium	Low quantity of liquid effluent- leachate is contained	Product is not a stable compost product, still needs a curing stage (done in separate windrow composting facility)	High construction and medium to high O&M cost	1. Brookfield, PE- 30,000 tonnes/yr., serves a population of 139,000 2. Halifax, NS- 25,000 tonnes/yr., serves a population of 150,000 3. Colchester Balefill Composting Facility - NS
Agitated Container (In-Vessel)	Generally stationary and operates on a continuous flow basis. Similar to static container, have smaller capacities and are modular. Well suited for smaller quantities and facilities that will be developed overtime. Aeration fans and mechanical agitation. Material handling is automated. In some units, a moving floor system slowly walks materials from the unit's inlet end to its discharge end. One or more sets of spinners may also be located along the length of the unit to agitate materials and break up clumps. Other systems use an auger that runs along the length of the vessel to move materials towards the unit's discharge end. The auger is driven by a motor and gear box situated outside of the processing chamber so it is readily accessible for maintenance.	Low to medium space requirements. Integrated control systems that monitor temperature and water addition, mixing and loading, and biofilter for treating exhaust air. Units vary in size.	L&Y, food waste	Shredding/mixing	100 to 15,000 (size limitation based on size of container)	2 to 4 weeks	All year	Positive aeration to avoid leachate building up in aeration manifold. To concentrate the process air to be treated for odours, some systems have plastic curtains around the perimeter of the bays ???(this reduces overall ammonia levels in the entire building, and contains moisture content in composting material)	High degree of odour control	Low water requirements/good moisture control	Low	Medium to high	Low	Low quantity of liquid effluent- leachate is contained	Shorter compositing time, so material is less stable and more possibly more odorous when removed, still needs a curing stage	High construction and medium to high O&M cost	1. Halifax, NS - 2.5 tonne/day demonstrator 2. Whistler, BC 3. Town of Yarmouth Compost Facility- NS
Enclosed Channel	Enclosed channel systems are essentially turned windrow piles which are placed inside of buildings. Aeration fans and mechanical agitation, indoor method. The windrows are situated between two long, parallel, concrete walls that are 1.8 to 2.4 m high, and spaced between 3 to 6 m. Raw material is loaded to one end of the channel and moved down its length over a period of two to four weeks by a turning machine that rides along the tops of the concrete walls. The turning machine sends the material down the channels, agitating during the process. The length of time the material is in the channels depends on channel length and how often the material is turned.	Low to medium space requirements. The turning machine has a conveyor/ rotating drum that lifts the compost and sends it down the channel. Several channels are used simultaneously. Channels are 30 to 75 m long. Building widths depend on number and width of channels (15 to 30 m longer to accommodate equipment)	L&Y, food waste	Shredding , only added at the in-feed end, must have proper blend and amendments requiring skilled operators.	15,000 to 100,000	2 to 4 weeks	All year	Oxygen and temperature control within each channel provided by aeration system in the floor of the channel.	High degree of odour control	Low water requirements/good moisture control	Low	Medium to high	Low	Low quantity of liquid effluent- leachate is contained	Product is not a stable compost product, still needs a curing stage	Medium to high construction and medium O&M cost	1. Edmonton Composting Facility (note: uses different composting methods)
Agitated Bed	Similar to a turned mass bed system, with a much higher degree of automation. Aeration fans and mechanical agitation, indoor method. Well suited for handling large volumes of material (e.g., more than 50 000 tpy). System consists of a large bed of composting material enclosed within perimeter walls. The wall around the bays allow for material depths between 2 to 3 m. The bays are equipped with an aeration system in the floor, similar to that used with ASP and tunnel systems. Both positive and negative aeration can be used (i.e., negative is more common). Material in each bay is turned every one to three days using an automated system. The materials are placed along the receiving side of the bay using front-end loaders or conveyor systems. The materials are moved down the length of the bed and is eventually discharged onto the floor or conveyor belt by the turner which follows a serpentine path from back-to-front.	Low space requirements. Infrastructure consists of large bed, enclosed within perimeter walls, an aeration system in the floor, a turner, and conveyor system. Dimensions of the bed range from 25 to 50 m long, and 10 to 75 m wide. The turner consists of an auger or flail, which is suspended from a bridge crane that spans the bay.	L&Y, food waste	Shredding. Proper preparation and mixing of feedstock and amendments is crucial (I don't think this is any different than what's required in other systems)	15,000 to greater than 100,000	3 to 4 weeks (depends on length of the bay and the turner design)	Lacks flexibility in dealing with feedstock peaks (requires increasing the turning schedule)	Capacity of the bed is a function of the depth of material and the bed width. Higher capacities can be achieved by installing several agitated beds in parallel. The turner is able to move along the length of the bay and agitate/ aerate all areas of the bed.	High degree of odour control since indoors, and the use of negative aeration	Low to medium water requirements/good moisture control	Low	Medium to high	Low	Low quantity of liquid effluent- leachate is contained	Product is not a stable compost product, still needs a curing stage	High construction and O&M cost since high degree of automation	1. Dartmouth, NS - 25,000 tonnes/yr serves population of 183,750 2. Lunenburg, NS - 10,000 tonnes/yr 3. Pictou, NS -
Rotating Drum (In-Vessel)	Uses aeration fans and mechanical agitation, indoor or outdoor. Drums are positioned on a slight incline (less than 5%) and rotate at between 0.5 to 5 rotations per minute. The incline and drum rotation results in materials tumbling in a corkscrew manner from in-feed end to discharge end. A drum's annual capacity depends on how much it is loaded and unloaded. Active composting is not completed in the drum and thus further treatment is required.	Must be used in tandem with other composting method. Medium to high space requirements. Consists of a steel drum with a diameter between 1.5 to 5 m. In small-scale systems, drums have a length of up to 10 m. In large-scale systems drums are from 30 to 80 m long. Depending on size of drums, they are driven by large ring-gears, rubber trunions, or sprockets and chains.	L&Y, food waste	Shredding	1,000 to greater than 100,000	1 to 7 days	All year	Air is injected into the drums at the discharge end. to meet air process requirements. Drums are loaded 65 to 85% of their total volume to ensure processing. Loading and unloading of drums introduces a higher degree of mechanical complexity and maintenance requirements.	Medium to high degree of odour control	Low water requirements/good moisture control	Low	High	Low	Low quantity of liquid effluent- leachate is contained	Shorter compositing time, so material has not completed active composting step and needs further treatment before the curing stage.	High construction and medium to high O&M cost	1. Rapid City, South Dakota - 55,000 tonnes, population 60,000 2. Nanaimo, BC -

Notes:

C:N - carbon to nitrogen ratio
FAS - free air space
L&Y - leaf and yard waste
N/A - not applicable
NL - Newfoundland & Labrador

O&M - operations and maintenance
Passive aeration requires free air space
SSO - source-separated organics
tpy - tonnes per year

Appendix C
Technology Evaluation Matrix

Level I Facility	Meets Provincial Standards for Municipal Solid Waste Facilities	—
	Applicability to Proposed Facility Sizing	—
	Modularity of Technology	15%
	Flexibility - Feedstock Quality	15%
	Environmental Nuisance Control	40%
	Capital Cost	15%
	O+M Cost	15%
	Applicability to the Climate of Newfoundland	—
Level II Facility	Meets Provincial Standards for Municipal Solid Waste Facilities	—
	Applicability to Proposed Facility Sizing	—
	Modularity of Technology	10%
	Flexibility - Feedstock Quality	10%
	Environmental Nuisance Control	30%
	Capital Cost	25%
	O+M Cost	25%
	Applicability to the Climate of Newfoundland	—
Level III Facility	Meets Provincial Standards for Municipal Solid Waste Facilities	—
	Applicability to Proposed Facility Sizing	—
	Modularity of Technology	5%
	Flexibility - Feedstock Quality	5%
	Environmental Nuisance Control	20%
	Capital Cost	35%
	O+M Cost	35%
	Applicability to the Climate of Newfoundland	—

Technology		Relative Analysis of Technologies Applied to a Level I Installation (> 2,500 tonnes per year)								
		Meets Provincial Standards for Municipal Solid Waste Facilities *Yes or No - based on requirements for Level I facilities to utilize in-vessel technologies*	*Applicability to Proposed Facility Sizing* *Yes or No - based on whether technology is capable of managing tonnages proposed*	*Modularity of Technology* *Ranking:* *1 Least Flexible* *3 Most Flexible*	*Flexibility - Feedstock Quality* *Ranking:* *1 Least Flexible* *3 Most Flexible*	*Environmental Nuisance Control (vectors, odour, etc.)* *Ranking:* *1 Least Control* *3 Highest Control*	*Capital Cost* *Ranking:* *1 Highest Cost* *3 Lowest Cost*	*O+M Cost* *Ranking:* *1 Highest Cost* *3 Lowest Cost*	*Applicability to the Climate of Newfoundland* *Yes or No - based on whether sufficient protection from elements can be built in*	Overall Score
Static Pile	Ranking	No								
	Rationale	Provincial guidelines stipulate the need for use of an enclosed technology for processing waste within Level I facilities								
Bunker	Ranking	No								
	Rationale	Provincial guidelines stipulate the need for use of an enclosed technology for processing waste within Level I facilities								
Windrow	Ranking	No								
	Rationale	Provincial guidelines stipulate the need for use of an enclosed technology for processing waste within Level I facilities								
Turned Mass Bed	Ranking	No								
	Rationale	Provincial guidelines stipulate the need for use of an enclosed technology for processing waste within Level I facilities								
Passively Aerated Windrow	Ranking	No								
	Rationale	Provincial guidelines stipulate the need for use of an enclosed technology for processing waste within Level I facilities								
Aerated Static Pile, ASP (positive or negative)	Ranking	No								
	Rationale	Provincial guidelines stipulate the need for use of an enclosed technology for processing waste within Level I facilities								
Aerated Static Pile, ASP (covered positive or negative)	Ranking	Yes	Yes	3	3	2	3	3	Yes	2.6
	Rationale	—	From 1,000 to> 100,000tpy	Additional piles easily added. Requires land and environmental monitoring designed to consider full capacity.	Able to process ranges of feedstock quality typical of SSO	Provides odour and vector control, but not as effective as fully enclosed systems	Low technology requirements	Low level of automation leads to low O+M costs	Material covered using appropriate fabric	
Enclosed Aerated Static Pile (Tunnel)	Ranking	Yes	Yes	2	3	3	2	2	Yes	2.6
	Rationale	—	From 10,000 to >100,000tpy	Tunnels can be added, however building and infrastructure to be sized for maximum throughput initially.	Able to process ranges of feedstock quality typical of SSO	Fully enclosed so best control	Mid-level requirements for infrastructure and technology	Mid-level O+M costs based on higher fuel and electricity requirements	Material within enclosed system	
Static Container (i.e., In-vessel composting)	Ranking	Yes	Yes	2	3	3	2	2	Yes	2.6
	Rationale	—	From 300 to 30,000tpy	Typically associated with smaller capacities and therefore limited in its applicability	Able to process ranges of feedstock quality typical of SSO	Fully enclosed so best control	Mid-level requirements for infrastructure and technology	Mid-level O+M costs based on higher fuel and electricity requirements	Material within enclosed system	
Agitated Container (i.e., In-vessel composting)	Ranking	Yes	Yes	2	3	3	1	1	Yes	2.3
	Rationale	—	From 100 to 15,000tpy	Typically associated with smaller capacities and therefore limited in its applicability	Able to process ranges of feedstock quality typical of SSO	Fully enclosed so best control	Highest requirements for infrastructure and technology	Agitation reduces need for active use of loader and/or turner to move material. Therefore less fuel costs, but higher electricity and maintenance costs	Material within enclosed system	
Enclosed Channel	Ranking	Yes	Yes	2	3	3	2	2	Yes	2.6
	Rationale	—	From 15,000 to 100,000tpy	Channels can be added, however building and infrastructure to be sized for maximum throughput initially.	Able to process ranges of feedstock quality typical of SSO	Fully enclosed so best control	Mid-level requirements for infrastructure and technology	Mid-level O+M costs based on higher fuel and electricity requirements	Material within enclosed system	
Agitated Bed	Ranking	Yes	Yes	1	3	3	1	1	Yes	2.1
	Rationale	—	From 15,000 to >100,000tpy	Level of mechanization means less modular	Able to process ranges of feedstock quality typical of SSO	Fully enclosed so best control	Highest requirements for infrastructure and technology	Agitation reduces need for active use of loader and/or turner to move material. Therefore less fuel costs, but higher electricity and maintenance costs	Material within enclosed system	
Rotating Drum (i.e., in-vessel composting)	Ranking	Yes	Yes	2	3	3	1	1	Yes	2.3
	Rationale	—	From 1000 to >100,000tpy	Units can be added to expand capacity	Able to process ranges of feedstock quality typical of SSO	Fully enclosed so best control	Highest requirements for infrastructure and technology	Agitation reduces need for active use of loader and/or turner to move material. Therefore less fuel costs, but higher electricity and maintenance costs	Material within enclosed system	

Technology		Relative Analysis of Technologies Applied to a Level II Installation (1,000 - 2,499 tonnes per year)								
		Meets Provincial Standards for Municipal Solid Waste Facilities *Yes or No - based on requirements for Level II facilities*	*Applicability to Proposed Facility Sizing* *Yes or No - based on whether technology is capable of managing tonnages proposed*	*Modularity of Technology* *Ranking:* *1 Least Flexible* *3 Most Flexible*	*Flexibility - Feedstock Quality* *Ranking:* *1 Least Flexible* *3 Most Flexible*	*Environmental Nuisance Control (vectors, odour, etc.)* *Ranking:* *1 Least Control* *3 Highest Control*	*Capital Cost* *Ranking:* *1 Highest Cost* *3 Lowest Cost*	*O+M Cost* *Ranking:* *1 Highest Cost* *3 Lowest Cost*	*Applicability to the Climate of Newfoundland* *Yes or No - based on whether sufficient protection from elements can be built in*	Overall Score
Static Pile	Ranking	N/A	Yes	3	3	1	3	3	Yes**	2.4
	Rationale	No specific requirements exist for Level II facilities that would exclude specific technologies	<10,000 tpy	Additional piles easily added. Requires land and environmental monitoring designed to consider full capacity.	Able to process ranges of feedstock quality typical of SSO	Limited control of vectors, odour, dust etc. due to limited or absence of enclosure	Low technology requirements	Low level of automation leads to low O+M costs	**- Assumes that appropriate cover is provided to allow for protection from the elements (e.g., rain, snow) to prevent saturation of material	
Bunker	Ranking	N/A	No							
	Rationale	No specific requirements exist for Level II facilities that would exclude specific technologies	Defined as most appropriate for installations that are <500tpy							
Windrow	Ranking	N/A	Yes	3	3	1	3	3	Yes**	2.4
	Rationale	No specific requirements exist for Level II facilities that would exclude specific technologies	<50,000 tpy	Additional piles easily added. Requires land and environmental monitoring designed to consider full capacity.	Able to process ranges of feedstock quality typical of SSO	Limited control of vectors, odour, dust etc. due to limited or absence of enclosure	Low technology requirements	Low level of automation leads to low O+M costs	**- Assumes that appropriate cover is provided to allow for protection from the elements (e.g., rain, snow) to prevent saturation of material	
Turned Mass Bed	Ranking	N/A	No							
	Rationale	No specific requirements exist for Level II facilities that would exclude specific technologies	Defined as most appropriate for installations that are between 15,000 and 50,00tpy							
Passively Aerated Windrow	Ranking	N/A	Yes	3	3	1	3	3	Yes**	2.4
	Rationale	No specific requirements exist for Level II facilities that would exclude specific technologies	<10,000 tpy	Additional piles easily added. Requires land and environmental monitoring designed to consider full capacity.	Able to process ranges of feedstock quality typical of SSO	Limited control of vectors, odour, dust etc. due to limited or absence of enclosure	Low technology requirements	Low level of automation leads to low O+M costs	**- Assumes that appropriate cover is provided to allow for protection from the elements (e.g., rain, snow) to prevent saturation of material	
Aerated Static Pile, ASP (positive or negative)	Ranking	N/A	Yes	2	3	2	2	2	Yes**	2.1
	Rationale	No specific requirements exist for Level II facilities that would exclude specific technologies	From 1,000 to 100,000 tpy	Additional piles easily added. Will require increased capacity of aeration system as expansion occurs	Able to process ranges of feedstock quality typical of SSO	Limited control of vectors, dust etc. due to limited or absence of enclosure. Some improved odour control if negative aeration used.	Mid-level requirements for infrastructure and technology	Mid-level O+M costs based on electricity and equipment maintenance	**- Assumes that appropriate cover is provided to allow for protection from the elements (e.g., rain, snow) to prevent saturation of material	
Aerated Static Pile, ASP (covered positive or negative)	Ranking	N/A	Yes	2	3	3	2	2	Yes	2.4
	Rationale	No specific requirements exist for Level II facilities that would exclude specific technologies	From 1,000 to 100,000 tpy	Additional piles easily added. Will require increased capacity of aeration system and more cover fabric as expansion occurs	Able to process ranges of feedstock quality typical of SSO	Cover provides management of vectors, odour, dust etc.	Mid-level requirements for infrastructure and technology	Mid-level O+M costs based on electricity and equipment maintenance	Material covered using appropriate fabric	
Enclosed Aerated Static Pile (Tunnel)	Ranking	N/A	Yes	1	3	3	1	2	Yes	2.1
	Rationale	No specific requirements exist for Level II facilities that would exclude specific technologies	From 1,000 to >100,000tpy	Least modular of Level II eligible technologies because of relatively high infrastructure and equipment requirements	Able to process ranges of feedstock quality typical of SSO	Enclosure provides managemet of vectors, odour, dust etc.	Highest requirements for infrastructure and technology	Mid-level O+M costs based on electricity and equipment maintenance	Material within enclosed system	
Static Container (i.e., In-vessel composting)	Ranking	N/A	Yes	1	3	3	1	2	Yes	2.1
	Rationale	No specific requirements exist for Level II facilities that would exclude specific technologies	From 300 to 30,000tpy	Least modular of Level II eligible technologies because of relatively high infrastructure and equipment requirements	Able to process ranges of feedstock quality typical of SSO	Enclosed nature of technology provides managemet of vectors, odour, dust etc.	Highest requirements for infrastructure and technology	Mid-level O+M costs based on electricity and equipment maintenance	Material within enclosed system	
Agitated Container (i.e., In-vessel composting)	Ranking	N/A	Yes	1	3	3	1	1	Yes	1.8
	Rationale	No specific requirements exist for Level II facilities that would exclude specific technologies	From 100 to 150,000tpy	Least modular of Level II eligible technologies because of relatively high infrastructure and equipment requirements	Able to process ranges of feedstock quality typical of SSO	Enclosed nature of technology provides managemet of vectors, odour, dust etc.	Highest requirements for infrastructure and technology	Agitation reduces need for active use of loader and/or turner to move material. Therefore less fuel costs, but higher electricity and maintenance costs	Material within enclosed system	
Enclosed Channel	Ranking	N/A	No							
	Rationale	No specific requirements exist for Level II facilities that would exclude specific technologies	Defined as most appropriate for installations that are between 15,000 and 100,00tpy							
Agitated Bed	Ranking	N/A	No							
	Rationale	No specific requirements exist for Level II facilities that would exclude specific technologies	Defined as most appropriate for installations that are between 15,000 and 100,00tpy							
Rotating Drum (i.e., in-vessel composting)	Ranking	N/A	Yes	1	3	3	1	1	Yes	1.8
	Rationale	No specific requirements exist for Level II facilities that would exclude specific technologies	From 1,000 to >100,000 tpy	Least modular of Level II eligible technologies because of relatively high infrastructure and equipment requirements	Able to process ranges of feedstock quality typical of SSO	Enclosed nature of technology provides managemet of vectors, odour, dust etc.	Highest requirements for infrastructure and technology	Agitation reduces need for active use of loader and/or turner to move material. Therefore less fuel costs, but higher electricity and maintenance costs	Material within enclosed system	

Technology		Relative Analysis of Technologies Applied to a Level III Installation (< 999 tonnes per year)								
		Meets Provincial Standards for Municipal Solid Waste Facilities *Yes or No - based on requirements for Level III facilities*	*Applicability to Proposed Facility Sizing* *Yes or No - based on whether technology is capable of managing tonnages proposed*	*Modularity of Technology* *Ranking:* *1 Least Flexible* *3 Most Flexible*	*Flexibility - Feedstock Quality* *Ranking:* *1 Least Flexible* *3 Most Flexible*	*Environmental Nuisance Control (vectors, odour, etc.)* *Ranking:* *1 Least Control* *3 Highest Control*	*Capital Cost* *Ranking:* *1 Highest Cost* *3 Lowest Cost*	*O+M Cost* *Ranking:* *1 Highest Cost* *3 Lowest Cost*	*Applicability to the Climate of Newfoundland* *Yes or No - based on whether sufficient protection from elements can be built in*	Overall Score
Static Pile	Ranking	N/A	Yes	3	3	1	3	3	Yes**	2.6
	Rationale	No specific requirements exist for Level II facilities that would exclude specific technologies	<10,000 tpy	Additional piles easily added. Requires land and environmental monitoring designed to consider full capacity.	Able to process ranges of feedstock quality typical of SSO	Limited control of vectors, odour, dust etc. due to limited or absence of enclosure	Low technology requirements	Low level of automation leads to low O+M costs	**- Assumes that appropriate cover is provided to allow for protection from the elements (e.g., rain, snow) to prevent saturation of material	
Bunker	Ranking	N/A	Yes	3	3	1	2	3	Yes**	2.3
	Rationale	No specific requirements exist for Level II facilities that would exclude specific technologies	<500tpy	Additional piles easily added. Requires land and environmental monitoring designed to consider full capacity.	Able to process ranges of feedstock quality typical of SSO	Limited control of vectors, odour, dust etc. due to limited or absence of enclosure	Low technology requirements	Low level of automation leads to low O+M costs	**- Assumes that appropriate cover is provided to allow for protection from the elements (e.g., rain, snow) to prevent saturation of material	
Windrow	Ranking	N/A	Yes	3	3	1	3	3	Yes**	2.6
	Rationale	No specific requirements exist for Level II facilities that would exclude specific technologies	<50,000 tpy	Additional piles easily added. Requires land and environmental monitoring designed to consider full capacity.	Able to process ranges of feedstock quality typical of SSO	Limited control of vectors, odour, dust etc. due to limited or absence of enclosure	Low technology requirements	Low level of automation leads to low O+M costs	**- Assumes that appropriate cover is provided to allow for protection from the elements (e.g., rain, snow) to prevent saturation of material	
Turned Mass Bed	Ranking	N/A	No							
	Rationale	No specific requirements exist for Level II facilities that would exclude specific technologies	Defined as most appropriate for installations that are between 15,000 and 50,00tpy							
Passively Aerated Windrow	Ranking	N/A	Yes	3	3	1	3	3	Yes**	2.6
	Rationale	No specific requirements exist for Level II facilities that would exclude specific technologies	<10,000 tpy	Additional piles easily added. Requires land and environmental monitoring designed to consider full capacity.	Able to process ranges of feedstock quality typical of SSO	Limited control of vectors, odour, dust etc. due to limited or absence of enclosure	Low technology requirements	Low level of automation leads to low O+M costs	**- Assumes that appropriate cover is provided to allow for protection from the elements (e.g., rain, snow) to prevent saturation of material	
Aerated Static Pile, ASP (positive or negative)	Ranking	N/A	No							
	Rationale	No specific requirements exist for Level II facilities that would exclude specific technologies	Defined as most appropriate for installations that are between 1,000 to 100,000 tpy							
Aerated Static Pile, ASP (covered positive or negative)	Ranking	N/A	No							
	Rationale	No specific requirements exist for Level II facilities that would exclude specific technologies	Defined as most appropriate for installations that are between 1,000 to 100,000 tpy							
Enclosed Aerated Static Pile (Tunnel)	Ranking	N/A	No							
	Rationale	No specific requirements exist for Level II facilities that would exclude specific technologies	Defined as most appropriate for installations that arefrom 1,000 to >100,000 tpy							
Static Container (i.e., In-vessel composting)	Ranking	N/A	Yes	2	3	3	2	2	Yes	2.3
	Rationale	No specific requirements exist for Level II facilities that would exclude specific technologies	From 300 to 30,000tpy	Requires additional equipment as installation is expanded	Able to process ranges of feedstock quality typical of SSO	Enclosed nature of technology provides managemet of vectors, odour, dust etc.	Mid-level requirements based on technology	Mid-level O+M costs based on fuel and electricity requirements	Material within enclosed system	
Agitated Container (i.e., In-vessel composting)	Ranking	N/A	Yes	1	3	3	1	1	Yes	1.5
	Rationale	No specific requirements exist for Level II facilities that would exclude specific technologies	From 100 to 150,000tpy	Requires highest level of technology addition to be able to expand	Able to process ranges of feedstock quality typical of SSO	Enclosed nature of technology provides managemet of vectors, odour, dust etc.	Highest level of technology requirements	Agitation reduces need for active use of loader and/or turner to move material. Therefore less fuel costs, but higher electricity and maintenance costs	Material within enclosed system	
Enclosed Channel	Ranking	N/A	No							
	Rationale	No specific requirements exist for Level II facilities that would exclude specific technologies	Defined as most appropriate for installations that are between 15,000 and 100,00tpy							
Agitated Bed	Ranking	N/A	No							
	Rationale	No specific requirements exist for Level II facilities that would exclude specific technologies	Defined as most appropriate for installations that are between 15,000 and 100,00tpy							
Rotating Drum (i.e., in-vessel composting)	Ranking	N/A	No							
	Rationale	No specific requirements exist for Level II facilities that would exclude specific technologies	Defined as most appropriate for installations that are between 1,000 to >100,000 tpy							

Appendix D
50% Project Review Meeting & Follow-up Meeting Minutes

Minutes of Meeting

Date/Time	September 24, 2013 1:00pm – 4:30pm NST	**File no.**	13-8097
Location	MMSB boardroom; 6 Mount Carson Ave, Mount Pearl	**Prepared by**	Chris Boone
Subject	Study of Options for Organics Waste Processing Task 6 "50%" Meeting		

Attendees	Chris Boone (CB) – Dillon Scott Kyle (SK) – Dillon Betsy Varghese (BV) – Dillon Gary Ryan (GR) - MMSB Rob Locke (RL) - Service NL Derrick Maddocks (DM) – ENVC Tammy McDonald (TM) – ENVC Allan Scott (AS) – CRSB	Jeff Saunders (JS) – CRSB Jason King (JK) - WRSB Don Downer (DD) – WRSB Ed Grant (EG) – EWM Gordon Murphy (GM) – MMSB Frank Huxter (FH) – DMA Ken Kelly (KK) - EWM
Other Distribution		
Attachments:	Task 6 "50%" Agenda, Task 6 Attendees contact information,	Task 6 Workshop Presentation.

NOTE: These minutes shall be considered the official record of the meeting. Required follow up actions are identified in *bold italics*.

MILESTONES/DELIVERABLES:	DATE
Project Award	17-Jun-13
Task 1 - Hold Kick Off Meeting	3-Jul-13
Task 6 - Hold Scenario (50%) Review Meeting	24-Sep-13
Task 8 - Submit Draft Project Report	15-Nov-13
Task 8 - Present Draft Project Report	25-Nov-13
Task 8 - Confirmation of Draft Report Revisions	10-Dec-13
Task 8 - Submit Final Project Report	17-Dec-13

Agenda items 2 through 9 were presented in a PowerPoint Presentation (see attached) completed by SK and BV.

1. Introductions
2. Overview of Today's Session
   SK provided an overview of the topics of discussion for the meeting covered in the agenda (distributed in advance of the meeting).
3. Project Guiding Principles
   a. SK discussed the guiding principles and stated that they were developed in consultation with DMA.

b. SK stated that the area shown white on study area map (page 2 of presentation) is not presently part of the study. It was then stated that some of this area has been absorbed into adjacent Service Boards.
c. As part of the program focus SK stated that 50% waste diversion does not include "non-MSW" wastes generated by industry (e.g., fish waste, resource or agriculture) and the goal is 50% diversion for the Island portion of the province as a whole and not for each community or Service Board.
d. GM brought up odour control as a concern. SK stated that appropriate facility setbacks, combined with sound operations, can help to reduce the potential of odour issues.
e. DD asked about the proposed grade of product. Reference was made to using Class B (or less) for landfill cover. SK stated Nova Scotia does not count landfill cover as diversion in their calculations. *ACTION: Dillon will carry forward the possibility of counting landfill cover towards diversion.*
f. SK stated that the local regulator must provide direction for what is the minimal compost grade acceptable to meet diversion. There was then some discussion about producing Class A & B where possible, with the potential option of making landfill cover with the stipulation that material used for landfill cover is not being used excessively (e.g., using 24 inches of cover when only 6 inches is required).
g. EG asked whether Class B material could be used for other applications such as highway ditch and embankment stabilization. (*Note: During the Earth Bound Conference Meeting the regulator stated they would be ok with this option. See Earth Bound Conference Meeting minutes.)*
h. SK noted that proper landfill cover material appeared to be in limited supply in Newfoundland. Therefore, there might be some potential to create a landfill cover product by blending native sandy/gravelly soil and a sub-Class B compost product.
i. GM stated the priority should be reducing the environmental impacts of organic waste if placed in an unprocessed state in a landfill in comparison to preparing a less contentious product.

4. Interviews and Background Information Collection
a. BV stated 7 of the 8 identified Solid Waste Service Boards/Corporations in Newfoundland took part in the questionnaire. *ACTION: GR stated that MMSB will provide Dillon the Green Bay data for the questionnaire.*
b. GM stated that the dairy farm located in the Discovery RSB service area no longer has its own composting facility.
c. It was stated that by the fall of 2013 the number of low temperature incinerators in the Western RSB should be reduced from four down to two. *ACTION: GM stated that the MMSB has industrial waste information and will provide to Dillon.*
d. SK reiterated that industrial organic waste is not part of the 50% diversion calculation.
e. SK stated that it is his experience that the industrial sector normally has their own composting or organics management facilities or they require unique processing methods for composting. Therefore, at this point in the assignment, he does not believe

there will be many opportunities for municipalities to collaborate directly with industry in the development of an organics management facility. SK added that collaborate opportunities are most likely to exist if a small isolated community could add MSW organics to an existing industrial composting operation.

5. Organic Material Forecast
    a. KK asked what typical number is Dillon using for waste generation. SK stated for this study, 2.42 kg/per/day has been adopted from MMSB's 2011 Waste Report Card. KK raised concerns with over estimating numbers that provide solutions that are oversized. SK stated that all numbers will be provided with information to make them defendable. *ACTION: GM stated MMSB will provide Dillon with waste generation data by sub-region, allowing for the definition of typical "rural" and "urban" per capita waste generation rates.*
    b. It was stated that rural areas tend to generate less waste per person than those residing in urban communities.
    c. SK stated that curing is a very important step in the organic composting process. He added that Halifax currently does not have room for curing at its two regional composting facilities and therefore loses out on potential finished product revenues because the compost is cured/sold by others.
    d. ED confirmed that Robin Hood Bay is a "nonstarter" as a location for a regional composting facility. It is however a possible location to use the composted landfill cover product.
    e. Dog Hill, a location previously identified as a candidate site for a regional landfill, was discussed as a possible location just outside of St. John's for a composting facility.
    f. GR stated that not many industries outside of the Corner Brook Pulp and Paper hog fuel burner in Corner Brook want carbon-rich materials. The agriculture industry is also looking for sources of carbon for use as bedding material.
    g. DD stated that it should not be assumed the Corner Brook Pulp and Paper mill will be available to accept carbon-rich material in the future.
    h. GR stated that carbon from cardboard is not a proven solution in all situations. It was noted that Halifax is trying to remove excess cardboard and boxboard from their organics collection system.
    i. DD brought up the issue of backhauling. For the Western Region this is a substantial concern for them noting the long haul distance to Norris Arm. Asked if opportunities to reduce backhauling impacts to the Western Region can be incorporated in the study.
    j. DD stated that the Western Region is questioning the practicality of hauling organic feedstock from Corner Brook to Norris Arm. He added that residents would understand why garbage had to be hauled to an engineered landfill site however, they may not agree with hauling compostable materials that could more easily be processed within the Region.
    k. SK presented a slide illustrating how a 64% capture rate (80% participation rate x 80% user efficiency) was required to achieve a 50% overall waste diversion rate. He

emphasized that such a capture rate could only be expected with a mature and well promoted waste management program. He added that such a capture rate would have to be achieved, as an average, throughout Newfoundland to achieve the 50% target.

l. Offshore dumping for fish processing plants was discussed. It was stated that this process is approved for non-farmed fish wastes in Newfoundland because there is no other readily available option. However, if a facility is available to process this material, the regulator may require the fish processors to transport its waste to the organic composting facilities.
m. It was discussed that accepting this material could be made based on premium tipping fees to address any additional operational costs.
n. It was confirmed by FH that MSW organics are the first priority and the Regions can decide if industry organics will be accepted as a secondary objective. *ACTION: GM/TM stated they can arrange a telephone meeting with industry and Dillon team representatives to discuss this study.*

6. Composting Technologies Review
    a. BV presented the approach to develop a long and short list of candidate organics processing technologies, acknowledging the range of community contexts across the island.
7. Refreshment Break
8. Candidate Management Scenarios – Preliminary Review
    a. Preliminary versions of the three candidate organics management scenarios were presented.
    b. GR asked if Dillon can look at one organics processing facility to serve the entire island.
    c. The potential of having Dillon develop a scenario based on a maximum 4 hour haul from a transfer station (as compared to a 3 hour limit in the preliminary version of Scenario 1) was discussed by the group.
    d. FH stated that if it makes sense to present additional scenarios, DMA will look at approving a scope change. *(Note: During the Earth Bound Conference Meeting, FH stated he will present Dillon with additional scenarios for scope change costing. See Earth Bound Conference Meeting minutes.)*
    e. The evaluation criteria of Capital Costs, Operating Costs, Operational Flexibility, Reliability and Resource Intensiveness was reviewed, discussed and ranked with half of the attendees (BV's group). SK's group focused on a review of the preliminary versions of the three candidate strategies, with potential variations on Strategy 3 being discussed.
    f. The resulting ranking of these criteria in order of most important was as follows; Relative Operating Costs, Operational Flexibility, Relative Capital Costs, Reliability and Resource Intensiveness.
    g. BV's group preferred Scenario 3. The perception of having SSO processing capabilities nearby is considered to be of benefit to the Regions.

9. Project Next Steps

a. With reference to the proposal work plan, SK reviewed remaining project tasks leading to the scheduled issuing of the final project report in late December.
b. SK confirmed that an informal roundtable meeting to discuss the organics options project would be held in the Columbus Room at the Sheraton @ 4 pm on Thursday, September 26 (following the conclusion of the Earth Bound conference sessions). Betsy Varghese, Ravi Mahabir, Chris Boone and Dr. Paul Arnold from the Dillon team will be in attendance.

The meeting adjourned at approximately 4:30 pm.
<END>

AGENDA

Study of Options for Organics Waste Processing

Task 6 “50%” Meeting – MMSB, Mount Pearl, NL

September 24, 2013

No.	Description	Led By	Start
1	Welcome/Introductions	DMA	1:00 pm
2	Overview of Today’s Session • Agenda review • Objectives	Scott K	1:10
3	Project Guiding Principles • As confirmed with DMA	Scott K	1:20
4	Interviews and Background Information Collection • Data collection process • Regional summaries • Island existing conditions base map • Remaining data gaps	Betsy V	1:35
5	Organic Material Forecast • Waste stream characterization • 30 year quantity forecast • Contribution to Provincial 50% goal	Scott K	2:05
6	Composting Technologies Review • Long and Short List Development	Betsy V	2:25
7	Refreshment Break	All	3:00

8	Candidate Management Scenarios – Preliminary Review
	• Three candidate scenarios
	• Preliminary review/discussion (break out groups)
	    o Facility locations/technologies
	    o Collection/transfer requirements
	    o Key attributes review
	• Carry-forward items
		Scott K	3:15

9	Next Steps	Scott K	4:20
10	Adjournment	DMA	4:30 pm

Study of Options for Organics Waste Processing
Task 6 “50%” Meeting – September 24 2013
Attendees

Name	Title	Affiliation	Telephone/Email
Allan Scott	Chair	Central Newfoundland Regional Service Board (CRSB)	T: 709-651-5920 E: allanscott@nf.sympatico.ca
Jeff Saunders	Chair Technical	CRSB	T: 709-489-0427 E: jsaunders@grandfallswindsor.com
Tammy McDonald	Senior Environmental Scientist	Department of Environment & Conservation (ENVC) – Pollution Prevention Division	T: 709-729-1810 E: TammyMcDonald@gov.nl.ca
Frank Huxter	Director (Acting) of Waste Management	Department of Municipal Affairs (DMA)	T: 709-729-7482 E: fhuxter@gov.nl.ca
Ed Grant	Chair	Eastern Waste Management (EWM)	T: 709-727-4030 E: egrant431@gmail.com
Derrick Maddocks	Director	ENVC – Pollution Prevention Division	T: 709-729-5782 E: dmaddocks@gov.nl.ca
Gordon Murphy	Senior Program Development Officer	MMSB	T: 709-757-0782 E: gmurphy@mmsb.nl.ca
Rob Locke	Manager of Environmental Protection	Service NL	T: 709-729-3104 E: Rlocke@gov.nl.ca
Don Downer	Chair	Western Regional Service Board (WRSB)	T: 709-632-2202 E: wrwastemgmt@bellaliant.com / ddowner@swgc.mun.ca
Jason King	Western Coordinator	WRSB	T: 709-632-2922 E: wrwastemgmt@bellaliant.com / jking.wrwmc@gmail.com
Ken Kelly	CAO	Eastern Waste Management (EWM)	T: 709-579-7960 E: KKelly@easternwaste.ca
Gary Ryan	Director	MMSB	T: 709-753-0899 E: gryan@mmsb.nl.ca
Scott Kyle	Project Manager	Dillon Consulting Ltd.	T: 902-450-4000/709-754-2374 Ext. 5014 E: skyle@dillon.ca
Chris Boone	Project Engineer	Dillon Consulting Ltd.	T: 709-754-2374 Ext. 5512 E: cboone@dillon.ca
Betsy Varghese	Project Engineer	Dillon Consulting Ltd.	T: 416-229-4647/709-754-2374 Ext. 2326 E: bvarghese@dillon.ca

Study of Options for Organic Waste Processing in Newfoundland

Task 6 “50%” Workshop

September 24, 2013

DILLON CONSULTING

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2) Overview of Today’s Session

- Project Guiding Principles
- Interviews and Background Information Collection
- Organic Material Forecast
- Composting Technologies Review/Categorization
- 15 minute break @ 3 pm
- Candidate Management Scenarios – Preliminary Review and Discussion
- Next Steps
- Adjournment @ 4:30 pm

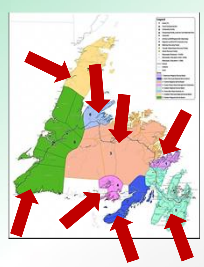
3) Project Guiding Principles

- Task 3 in the Proposal, developed in consultation with DMA
- Definition of “boundary conditions” for the project

1) Study Area Scope
2) Program Focus
3) Organics Program Consistency
4) Achieving 50% Diversion
5) Candidate Feedstocks
6) Proven Technologies
7) Waste Stream Forecasting

3) Project Guiding Principles

- Study Area Scope
  - Eight defined management regions in Newfoundland
  - Incorporation of sub-regions, if identified

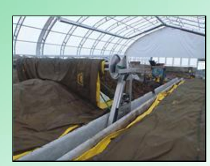


1) Discovery Regional Service Board
2) Burin Peninsula Regional Service Board
3) Central Regional Service Board
4) Coast of Bays Waste Management Corporation
5) Eastern Regional Service Board
6) Green Bay Waste Authority Inc.
7) Northern Peninsula Regional Service Board
8) Western Regional Service Board

3) Project Guiding Principles

- Program Focus
  - "Traditional" MSW organics from residential and ICI generators
  - Opportunities for agricultural/fisheries/forestry sector organic residuals a secondary consideration
- Organics Program Consistency
  - Can be variable throughout the province and regions
- Achieving 50% Diversion
  - To be considered at the Provincial level
  - 2015 target
- Candidate Feedstocks
  - In addition to traditional MSW organics
  - Organic residuals from fish processing, fur farming, agriculture and forestry

3) Project Guiding Principles



- Proven Technologies
  - $\geq$5 years of continuous, reliable operation
  - Similar tonnage throughput
  - Ability to control odour/leachate
  - Similar climate to Newfoundland
  - Minimum end product requirement = Class/Category "B" compost
- Waste Stream Forecasting
  - 30 year planning period (2013-2043)
  - Population data (current and projections) from Stats Can and NL Dept of Finance
  - Current tonnage and waste stream data from DNV, MMSB and the Regions

4) Interviews and Background Information Collection

- July 12 – Initial phone calls and questionnaire distribution
- July 26 – Deadline to submit completed questionnaire
- August 2 – Follow-up calls

- Participation Results
  - Seven of the eight Regions participated in the background review

- General Information
- Garbage
- Recycling
- Backyard Composting
- Leaf & Yard Waste
- Food Waste
- Public Education

Overview – Discovery RSB

- Majority of residents self-haul garbage to 1/10 unlined LFs
- Large influx of tourists in summer
- Recyclables dropped off at Green Depot or collected by students
- Have distributed ~200 backyard composters
- IC&I generators: fish plants, mink farm, hospital
- Dairy farm has its own composting facility

Future Plans

- Consolidate LFs to two regional TSs
- Provide uniform curbside collection of garbage, 2-S recycling and composting
- Garbage sent to Robin Hood Bay
- Recyclables to MRF in St. John's

Overview – Burin Peninsula RSB

- RSB provides weekly garbage collection to half the region
- RSB operates LF in Grand Bank (services ½ of the region)
- 7 municipal waste disposal sites operated by local gov'ts
- Containers to Green Depots
- L&YW collected monthly; pilot program for weekly organics (food waste and fibres) collection with garbage
- SSO processed at Grand Bank windrow composting facility (1,000 tpy capacity)
- IC&I generators: fish plant, energy sector, sawmill

Future Plans

- Operate a WDS and close northern WDSs
- Possibly build a composting facility and TS in Frenchman's Cove
- Gradually expand curbside SSO & potentially recyclables collection

Overview – Central RSB

- RSB provides weekly garbage collection to majority of region
- Some local gov'ts provide garbage collection. Other residents self-haul to a TS or hire their own contractor
- RSB operates Norris Arm WMF and oversees operations of 7 TSs – hauled to Norris Arm
- 14 Green Depots
- IC&I generators: aquaculture, forestry, food processors

Future Plans

- Wet/Dry collection system
- MRF under construction; curbside recycling
- Phase 3: composting facility at Norris Arm

Overview – Coast of Bays WMC

- Local gov’ts provides residential and small commercial collection of garbage (typically weekly)
- 12 WDSs including 3 remote sites
- One Green Depot and containers recycling drop off at municipal facilities and schools
- IC&I generators: aquaculture, energy sector, sawmills
- Community composting operation in Harbour Breton managed by Town staff; compost used locally

Future Plans

- Consolidate WDSs to three subregional TSs in next 2 years
- Send waste to Norris Arm WMF
- Interested in local solution for composting
- Could stockpile recyclables for transport to MRF

Overview – Eastern RSB

- RSB and local gov’ts provide weekly garbage and bi-weekly 2-stream recycling collection to majority of residents
- RSB operates Robin Hood Bay IWMF (LF, MRF, HHW) and oversees operation of 6 WRFs
- Leaf and yard waste can be dropped off at WRFs and at Robin Hood Bay
- Small-scale composting facilities in 3 areas
- 17 Green Depots

Future Plans

- Construct 3 additional TSs in 2013
- Construct 1 additional TS in Clarenville

Overview – NorPen RSB

- RSB provides weekly collection of garbage to residential and small IC&I sources
- Garbage is hauled to and residents can drop off at one of four regional LFs
- Three Green Depots
- Use of backyard composters
- IC&I generators: institutions, food processors

Future Plans

- Survey indicates 95% of residents in favour of curbside collection of organics (over drop off depot)

Overview – Western RSB

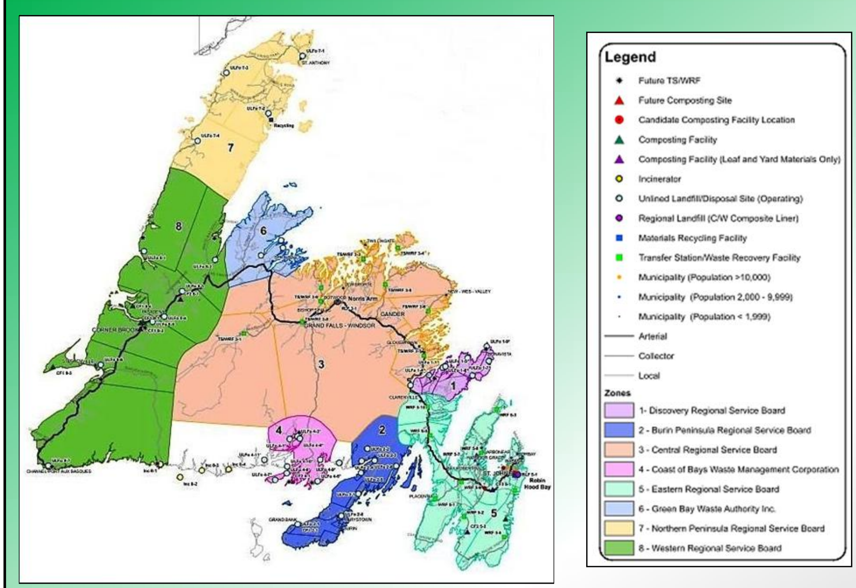
- Sub-regions provide weekly garbage collection to most residents (slightly different programs between sub-regions)
- Currently 7 active LFs and 4 low temperature incinerators
- 11 Green Depots; Corner Brook has curbside fibres collection
- Some sub-regions have leaf and yard collection; composting facilities in four locations
- IC&I generators: fish plants, pulp and paper sector, saw mill

Future Plans

- Take over several LF operations & implement tip fees
- Construct 6 TSs and ~3 public drop off depots
- Considering hauling garbage to Norris Arm IWMF
- SS recycling with processing at Norris Arm or local facility

Digitized Map

- Visual tool to see all existing and future planned WM facilities (numbered) and waste management subregions
- Population and household count data obtained from Statistics Canada Census (2011)
- Estimate quantity of SSO generated
- Will be used for transportation routing and costing



Remaining Data Gaps

- Industrial organic waste estimates
  - agriculture
  - fisheries
  - aquaculture
  - forestry
- Regional Zones

5) Organic Material Forecast

- Waste stream characterization
  - Traditional municipal solid waste (MSW)
  - What's in the waste stream?
    - Primarily interested in compostable materials (e.g., organics, select fibre/paper items)
    - But need to consider the entire waste stream for overall diversion estimates
  - "As-generated" (versus "As-disposed")
    - Disposed *and* diverted materials
  - Two generation contexts
    - "Urban" (> 75/persons/km^2)
    - "Rural" (< 75 persons/km^2)
  - Two generation sectors
    - Residential (homes, apartments)
    - Industrial, Commercial and Institutional

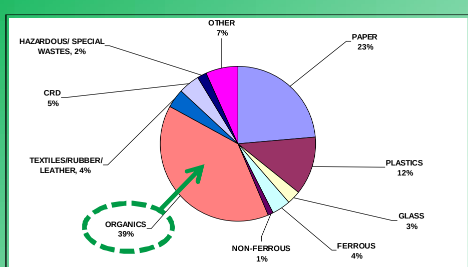
5) Organic Material Forecast

- Waste stream characterization
  - A requirement to “build” an approximate as-generated municipal waste stream breakdown for Newfoundland
  - Four separate approximated waste steam characterizations
  - All data not currently available from Newfoundland sources

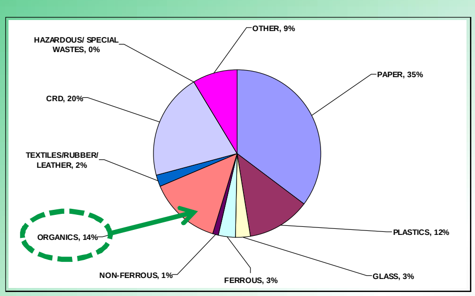
Urban – Residential	Rural – Residential
• MMSB 2012 St. John’s Audit	• RRFB 2012 Cumberland Audit
Urban – ICI	**Rural – ICI**
• RRFB 2012 HRM Audit	• RRFB 2012 Cumberland Audit

  - Currently getting diversion data to prepare finalized as-generated characterization estimates
  - But typically…

5) Organic Material Forecast

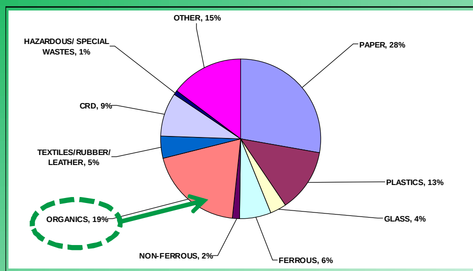


Urban – Residential

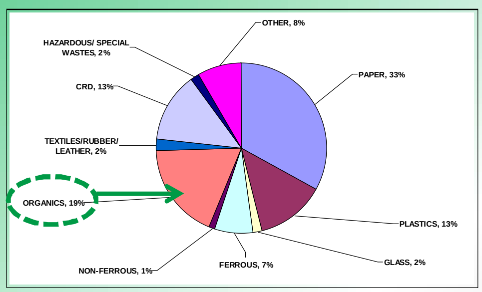


Urban – ICI

5) Organic Material Forecast



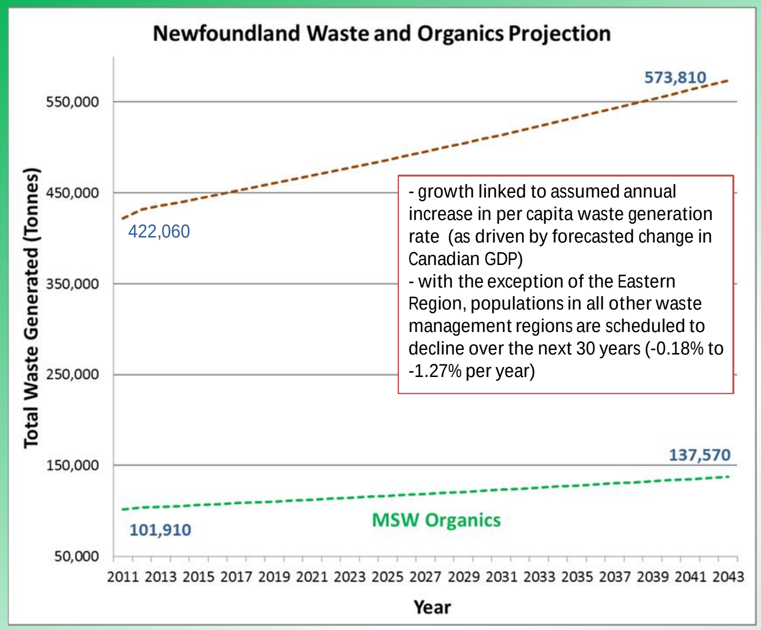
Rural – Residential



Rural – ICI

5) Organic Material Forecast

- 30 year quantity forecast
  - Regional population projection data from Dept of Finance
  - Per capita generation rates from MMSB data
  - Individual projections being prepared by sub-region



5) Organic Material Forecast

- Contribution to the 50% diversion goal
  - A mature, convenient (e.g., curbside) program can achieve 60-70% capture rates of recyclables and compostables

Capture rate = participation rate x user efficiency

64% = 80% x 80%

  - Typically, ~50% of the blended urban/rural waste stream is potentially recyclable (paper, containers, metals, C&D) or divertible (HHW/special waste)
  - And ~30% of the blended urban/rural waste stream is potentially compostable (food, leaf/yard waste)

Recyclables: 64% of 50% = 32% of waste stream
Compostables: 64% of 30% = 19% of waste stream

51%

6) Composting Technologies Review

- Development of Long-List of Composting Technologies

Aerobic (Passive)	Aerobic (Active)	Anaerobic
o Static Pile	o Aerated Static Pile	o High-Solids (Stackable)
o Bunker	o Enclosed Aerated Static Pile	o High-Solids (Slurry)
o Windrow	o Static Container	o Wet (low-solids)
o Turned Mass Bed	o Agitated Container	o Co-digestion in WWTP
o Passively Aerated Windrow	o Enclosed Channel	
	o Agitated Bed	
	o Rotating Drum	

6) Composting Technologies Review

- Compilation of data on composting technologies

o Process Overview	o Level of Odour Control
o Infrastructure Requirements	o Water / Moisture Control Requirements
o Applicable Feedstock	o Vector Access
o Feedstock Preparation Requirements	o Electricity & Fuel Consumption
o Typical Capacity	o Quantity of Liquid Effluent Requiring Management
o Composting Time	o End Product Characteristics
o Flexibility / Seasonality	o Example Operations
o Process Control Features	o Noted Manufacturers / Suppliers

Evaluation Criteria

- Relative Capital Cost – compare capital cost intensiveness of the technological options
- Relative Operational Cost – compare on the basis of their operating and maintenance costs
- Resource Intensiveness – relative supporting infrastructure requirements, including land, water/sewer servicing and energy
- Operational Flexibility – ability to manage varying quantities and qualities of organic feedstock.
- Reliability – reliability in managing nuisances (e.g., odour, dust), applicability to the climate of Newfoundland and ability to generate good quality product

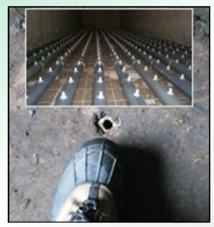
Candidate Scenarios

- Development of three scenarios
- Scenario 1 R
  - Use of regional, centralized processing facilities
- Scenario 2 SR
  - Use of regional, centralized facilities with sub-regional, multi-community processing operations
- Scenario 3 C
  - Hybrid of Scenarios 1 and 2 with small scale facilities for remote areas

R	I	>2,500 tpy
SR	II	100 to 2,499 tpy
C	III	<99 tpy

Enclosed Aerated Static Pile

- Based on bunker style – piles are housed within long narrow tunnels allowing for front-end loaders to access
- Aeration floor (passively aerated windrow)
- Provides high degree of odour control (custom air tight door system, process air is exhausted from tunnel)
- 1,000 to greater than 100,000 tpy SSO



R SR

Enclosed Channel

- Turned windrow piles between two long, parallel, concrete walls with turning machine on top of concrete walls
- Channels are 30 to 75 m long. Building widths depend on number and width of channels (15 to 30 m longer to accommodate equipment)
- Raw material is loaded to one end of the channel and moved down its length over a period of two to four weeks by turning machine
- Aeration system in floor of channels
- 15,000 to 100,000 tpy SSO

R SR

Static Container (in-vessel)

- Relies on number of discrete composting vessels (e.g.,40 yd^3 roll-off portable containers); takes up less space
- Highly controlled environment – containers filled through sealable doors, composting conducted in sealed container
- Containers connected to stationary aeration system
- Some systems designed for continual flow of waste, while others process one complete batch of compost at a time
- Exhaust air is passed through bio filters for treatment
- Monitoring system for temperature and oxygen control
- 300 to 30,000 tpy SSO

R SR

Agitated Container (in-vessel)

- Generally stationary and operates on a continuous flow basis
- Well suited for smaller quantities and modular system
- Units could have a moving floor system that slowly moves materials from the unit's inlet end to its discharge end
- Spinners could be located along length of unit to agitate materials and break up clumps
- Augers could be placed along length of vessel to move materials towards the unit's discharge end
- Positive aeration, high degree of odour control
- 100 to 15,000 tpy SSO

R

Agitated Bed

- Consists of large bed, enclosed within perimeter walls, turner (auger or flail – suspended by bridge crane that spans bay) and conveyor system
- Materials are moved down length of bed and discharged onto floor or conveyor belt by turner which follows a serpentine path from back-to-front
- High degree of automation - materials in bay are turned every one to three days using an automated system
- Aeration system in floor (both positive and negative aeration can be used)
- 15,000 to greater than 100,000 tpy SSO

Similarities of Technologies

- 2 to 4 weeks composting time
- Can manage leaf and yard waste and food waste
- Feedstock requires shredding and mixing
- Indoor operations allow for year round processing
- Requires curing stage
- High capital cost and medium to high O&M cost
- Low quantity of liquid effluent- leachate is contained
- Low/ limited vector (birds/animals) access
- Low water requirements/good moisture control
- High degree of odour control

Outdoor Windrow

- Feedstock being formed into long, low piles (windrows)
- Requires regular turning to re-establish porosity, break up and blend materials, introduce oxygen
- When turned, heat, water vapour and gases are released which can affect neighbouring properties
- High quantity of liquid effluent from precipitation and generation of runoff
- Requires working pad (e.g., concrete, asphalt), access roads, ditches and detention pond
- 6 to 12 months composting time
- < 50,000 tpy SSO

SR C

Turned Mass Bed

- Variation of traditional windrow that can be located indoors or outdoors
- Continuous-flow system that relies on specialized windrow turner which is modified by adding a horizontal cross-conveyer to allow for increased processing of materials
- Specialized equipment makes this option 50% to 100% more expensive than traditional windrow
- In-floor aeration system can be installed
- 6 to 12 months composting
- 15,000 to 50,000 tpy SSO

SR C

Aerated Static Pile

- Outdoor system that can use either positive, negative, or covered aeration
- Tarp covers used to protect pile from infiltration of precipitation, reduce evaporation, control odours
- Less exposed pile surface, less agitation, and higher level of odour control than static pile or windrow composting
- Material is remixed halfway through active composting period to re-establish porosity
- 4 to 8 weeks composting time
- 1,000 to greater than 100,000 tpy SSO

SR

Static Pile

- Feedstock is formed into large windrows or piles which decompose over extended period of time (e.g., 2-3 years)
- Passive aeration with little to no mixing
- Odours emitted from piles and agitated older materials release odours – may need buffer from adjacent properties
- Low water requirements, fuel consumption and capital and O&M costs
- Feedstock with high C:N ratio (e.g., LYW)
- Difficulty to compost in winter
- < 10, 000 tpy SSO

C

Bunker

- Simple method for small feedstock quantities
- Typical installation consists of 3 bunkers: first receives fresh materials. After first bunker is filled, third bunker is emptied and refilled with material from second bunker.
- Can be outdoor or indoor and aeration systems can be installed to control odours in large bunkers
- Low water requirements, low to medium energy consumption, low capital and O&M costs
- Feedstock with high C:N ratio (e.g., L&YW)
- 8 to 12 months composting time
- <500 tpy SSO

Passively Aerated Windrow

- Cross between static pile and aerated static pile
- Materials placed in long, low windrows constructed over base network of perforated open-ended pipes
- Open air pipes allow air to naturally diffuse through windrow without use of aeration fans
- May be difficult to compost during winter seasons
- 8 to 12 months composting time
- <10,000 tpy SSO

Similarities of Technologies

- Typically outdoor methods that require curing stage
- Passive aeration (note that bunkers can be equipped with aeration system)
- Suitable for L& Y waste (less suitable for food waste)
- Require shredding to prepare feedstock
- Low level of odour control
- High level of vector (birds and animal) access
- Medium to high space requirements
- Medium flexibility- outdoor method, therefore may be more difficult to use during colder months
- Low water requirements/no moisture control (unless covered), no electricity needed and low fuel consumption

C

7) Refreshment Break

- 15 minutes…

8) Candidate Management Scenarios – Preliminary Review

- Three Candidate Scenarios
  - As described in our proposal
  - "First cut" sizing based on 2011 service area population and waste estimate
  - To be validated/refined as part of Task 7, acknowledging comments gathered today

8) Candidate Management Scenarios – Preliminary Review

- Three Candidate Scenarios
  1. Use of regional, centralized processing facilities
     - Transport of organics from a defined service region to planned processing facilities in either Norris Arm or the St. John's Area
     - Consideration of sub-regional organics transfer stations where applicable
       - Acknowledging existing/planned facilities
     - Definition of a minimum tonnage/population and maximum haul distance threshold for regional program participation
     - Limited inclusion of non-MSW organic feedstocks

8) Candidate Management Scenarios – Preliminary Review

- Three Candidate Scenarios
  2. Use of regional facilities augmented by sub-regional, multi-community processing operations
     - Definition of a service boundary for planned processing facilities in either Norris Arm or the St. John's Area
     - Establishment of multi-community sub-regions, with a focus on remote areas not serviced under Scenario 1
     - Consideration of "lower-tech" processing technologies for sub-region facilities, considering organics from non-MSW sources to enhance feasibility/sustainability
     - Definition of a minimum tonnage/population and maximum haul distance threshold for both regional and sub-regional program participation

8) Candidate Management Scenarios – Preliminary Review

- Three Candidate Scenarios
  3. A hybrid of Scenarios 1 and 2
     - Maintaining two main regional processing facilities with refinement of service areas
     - Including community-specific, small scale facilities for remote areas

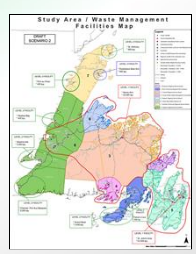
8) Candidate Management Scenarios – Preliminary Review

Sizing assumptions
- 2.42 kg / person / day
- Organics = 30% of waste stream
- 65% capture rate

- Assumptions for Scenario Development
  - Scenario 1
    - 3 hours maximum one way hauling time to one of two central composting facilities (Level I; ≥2500 tpy)
    - Requirement for a transport "hub" to generate ≥25 tonnes of organics (one transport trailer) per week
    - Curbside collection for identified service areas
  - Scenario 2
    - Scenario 1 plus identification of candidate areas for Level II (100 to 2500 tpy) and III (<100 tpy) composting facilities
    - Potential for user-delivery of organics in select locations
  - Scenario 3
    - 2 hour maximum one way hauling time to one of two central composting facilities – reduction of Scenario 1 service area
    - Definition of new sub-regional service hubs/facilities

8) Candidate Management Scenarios – Preliminary Review

- Group Exercise
  - Split into two groups (Betsy/Scott)
  - Review island maps with the three preliminary scenarios
  - Discuss layout assumptions, scenario attributes
  - Record comments and suggestions – incorporate into the preparation of the scenarios for detailed analysis
  - ~40 minutes, then reconvene to review highlights from the two groups



9) Project Next Steps

- Address remaining data gaps
  - Regional information
  - Industrial organics inventory & collaboration opportunities assessment
- Task 7 – Conduct Detailed Scenario Analyses
  - Finalize/refine three provincial servicing scenarios
  - Conduct analysis as described in the proposal
    - Feedstock sources and characteristics
    - Collection methods, facility types/locations
    - Regional transport routing
    - Capital and operation costs (transportation, facilities, processing)
    - Organics diversion forecast
    - End product market/revenue assessment
    - Composting vs. landfilling GHG comparison

9) Project Next Steps

- Task 8 – Prepare Project Report
  - Issue Draft Project Report; November 15
  - Draft Report Review Meeting; November 25
  - Submission of Final Report; December 17


Thanks for your participation!
DILLON
CONSULTING

Minutes of Meeting

Date/Time	September 26, 2013 4:00pm – 5:30pm NST	**File no.**	13-8097
Location	Columbus Suite; The Sheraton Hotel NL, 115 Cavendish Square, St. John's	**Prepared by**	Chris Boone
Subject	Study of Options for Organics Waste Processing Task 6 Earth Bound Conference Follow-up Meeting		

Attendees	Chris Boone (CB) – Dillon Ravi Mahabir (RM) – Dillon Betsy Varghese (BV) – Dillon Paul Arnold (PA) – Bio-Logic Gary Ryan (GR) - MMSB Rob Locke (RL) - Service NL Derrick Maddocks (DM) – ENVC Tammy McDonald (TM) – ENVC Ed Evans (EE) – CNWM Ken Anthony (KA) – LWRC Joe Pittman (JP) - BPWMC	Allan Scott (AS) – CRSB Boyd Wright (BW) – DMA Joe Dunphy (JD) - DMA Don Downer (DD) – WRSB Jason King (JK) - WRSB Frank Huxter (FH) – DMA Ken Kelly (KK) – EWM Deborah Barney (DB) – LSWMC Wilson Belbin (WB) – LSWMC Jonathan Kawaja (JKa) - DFA
Other Distribution	Ed Grant (EG) – EWM Jeff Saunders (JS) – CRSB	Gordon Murphy (GM) – MMSB Scott Kyle (SK) – Dillon
Attachment:	Task 6 Attendees contact information	

NOTE: These minutes shall be considered the official record of the meeting. Required follow up actions are identified in *bold italics*.

This meeting took place to provide a project update to individuals who attended the Earthbound Conference and to further discuss items discussed and the scenarios presented during the Task 6 "50%" meeting.

1. Introductions were made.
2. BV provided a summary of the Task 6 "50%" meeting making reference to the following:
    a. Dillon will use data from MMSB to update the waste generation rates based on region.
    b. Criteria which will be used for evaluating the scenarios include, but are not limited to: Relative Capital Cost, Relative Operating Costs, Operational Flexibility, Reliability and Resource Intensiveness. During the Task 6 50% meeting these criteria were debated resulting in a proposed ranking, starting from most important, as follows: Relative Operating Costs, Operational Flexibility, Relative Capital Costs, Reliability and Resource Intensiveness. This feedback will be considered in the final selection and ranking of criteria
    c. There is a possibility of adding another scenario which will be based on a 4hr haul distance (one way).

3. FH stated DMA is willing to approve a project scope change to add an additional scenario. FH asked the group if they would agree on adding one extra scenario based on a 4 hour haul distance.
4. A discussion on possible scenarios ensued.
    a. DD stated he did not see how scenario 1 was of benefit to the Western Region. Stated he would like to see a scenario with a facility located in the Western Region. Possibly a version where one facility is located in the Western Region which opens up the possibility for back hauling source separated organic waste generated in Central Region.
    b. It was stated one site should be considered.
    c. It was stated that back hauling opportunities should be considered in the study.
    d. It was stated that the 3 currently defined scenarios had to be taken through the assessment process to allow for one or more to be defined as less preferable. Removing a scenario without analysis could reduce the transparency of the process that is underway.
5. *ACTION: FH stated he will provide Dillon a description of the two additional scenarios and request a quote to add to the two options.*
6. It was stated that the outcome of this study could influence the Norris Arm facility process. Presently the Norris Arm facility is based on a “2 Stream System” (i.e., wet/dry), however it may be warranted to change this to a “3 Stream System” (i.e., garbage, organic waste, recyclables).
7. A discussion regarding “2 Stream” vs. “3 Stream” took place.
    a. PA stated he believes a “2 Stream” process will not produce a good compost product. Most facilities are “3 Stream” process.
    b. KK stated he does not see any value in a “2 Stream” process.

8. JP stated the Walter Termeer's Fundy Compost operation in NS is producing a Class A product for a low cost. The Walter Termeer’s Fundy Compost operation processes SSO for the municipal district of East Hants.
9. JP stated the Burin pilot program is going quite well. Further to this JP stated that material from the Burin windrow-based program has been analyzed and shown to meet all relevant CCME and BNQ standards for Category A compost.
10. It was stated that the bigger the facility typically the less cost per tonne of product produced. JP disagreed with this statement and referenced his system as well as the Walter Termeer's Fundy Compost operation. FH stated the Burin composting facility may still require additional items to meet environmental guidelines. PA clarified that costs per tonne and discusisons on technologies needed to consider household organic waste; some of the referenced facilities do not process significant quantities of household organic waste.
11. GR questioned the 64% capture rate based on 80% participation rate and 80% user efficiency. At this point he does not believe it is achievable. He is concerned about building something for a much larger volume then what will be supplied. There was discussion on planning around a 30-year timeline, and that 64% may be appropriate for that planning horizon and that it 64% was introduced into the study as an optimistic target. RM stated that Dillon will look at the 64% capture rate, and that rationale will be provided for the selected value. He also stated

oversizing is recognized as a potential issue, and that modularity of technologies could then be used as a key criteria in ranking/ assessing technologies.

12. FH stated that Dillon must not push back the planning timelines outlined in the RFP. Requested Dillon to review its generation and capture rate numbers but do not loosen the "Long Term Plan".
13. Dillon reiterated that the capture rate is based on a mature program and not on results in the short or mid-term.
14. PA was questioned on Nova Scotia's capture rate and the validity of the 64% capture rate. PA stated the NS capture rate is not as good as they had hoped and that the 64% capture rate was aggressive.
15. BV stated Dillon will review numbers and document all assumptions. She also stated that other jurisdictions have other policies/by-laws/programs in place to achieve their targets such as pay-as-you-throw and bi-weekly garbage collection.
16. FH stated that policies/ program/ regulations could be put into place in the Province to support the results of the study and overall long term planning. The existing regulatory framework could change, but current conditions need to be considered.
17. JKa of DFA discussed the aquaculture industry with regards to organic composting. Stated currently industry relies on municipal facilitates to dispose of their products, but are looking to develop their own solutions through private operators. He believes that mixing industry organic waste with municipal stream will produce a lower grade product, if a 2-stream municipal system were to be in place. He believes the agriculture industry requires a Class A product. Stated he believes it is too early for industry to be involved in the municipal organic composting process and that the municipal system should first be setup without industry involvement and then see where things go.
18. A short discussion took place at the end of the meeting with a few attendees still present. The outcome of this discussion was that the regulator stated they do not see any issues with the study considering that Class B compost could be sufficient for facilities as there are beneficial uses within N+L for this type of compost including, highway road construction.

The meeting adjourned at approximately 5:30 pm.
<END>

Study of Options for Organics Waste Processing
Task 6 "50%" Meeting – September 26 2013
Attendees

Name	Title	Affiliation	Telephone/Email
Allan Scott	Chair	CRSB	T: 709-651-5920 E: allanscott@nf.sympatico.ca
Joe Pittman	Manager	BPWMC	T: 709-891-1717 E: info@burinpenwaste.com
Tammy McDonald	Senior Environmental Scientist	ENVC – Pollution Prevention Division	T: 709-729-1810 E: TammyMcDonald@gov.nl.ca
Frank Huxter	Director (Acting) of Waste Management	Department of Municipal Affairs (DMA)	T: 709-729-7482 E: fhuxter@gov.nl.ca
Boyd Wright	Waste Management Coordinator	Department of Municipal Affairs (DMA)	T: 709-637-2769 E: bwright@gov.nl.ca
Derrick Maddocks	Director	ENVC – Pollution Prevention Division	T: 709-729-5782 E: dmaddocks@gov.nl.ca
Joe Dunphy	Senior Engineer Waste Management	Department of Municipal Affairs (DMA)	T: 709-729-2051 E: jdunphy@gov.nl.ca
Rob Locke	Manager of Environmental Protection	Service NL	T: 709-729-3104 E: Rlocke@gov.nl.ca
Don Downer	Chair	Western Regional Service Board (WRSB)	T: 709-632-2202 E: wrwastemgmt@bellaliant.com / ddowner@swgc.mun.ca
Jason King	Western Coordinator	WRSB	T: 709-632-2922 E: wrwastemgmt@bellaliant.com / jking.wrwmc@gmail.com
Ken Kelly	CAO	Eastern Waste Management (EWM)	T: 709-579-7960 E: KKelly@easternwaste.ca
Gary Ryan	Director	MMSB	T: 709-753-0899 E: gryan@mmsb.nl.ca
Deborah Barney	Board Member	Lab. South Waste Management Committee	T: 709-927-5573 E: fisher_barney@hotmail.com
Wilson Belbin	Chairperson	Lab. South Waste Management Committee	E: wbelbin57@hotmail.com
Ed Evans	Manager	CNWM	T: 709-653-2900 E: ed@cnwmc.com
Ken Anthony	Town of Wabush / Lab. West Regional Committee	CAO	T: 709-282-5696 E: kanthony@wabush.ca
Jonathan Kawaja	Aquaculture Dev. Env. Planner	DFA	T: 709-292-4101 E: jonathankawaja@gov.nl.ca
Ravi Mahabir	Project Engineer	Dillon Consulting Ltd.	T: 905-901-2912/709-754-2374 Ext. 3437 E: rmahabir@dillon.ca
Chris Boone	Project Engineer	Dillon Consulting Ltd.	T: 709-754-2374 Ext. 5512 E: cboone@dillon.ca
Betsy Varghese	Project Engineer	Dillon Consulting Ltd.	T: 416-229-4647/709-754-2374 Ext. 2326 E: bvarghese@dillon.ca
Paul Arnold	Consultant	Bio-Logic Environmental Systems	T: 902-449-6910 E: bio-logic@ns.sympatico.ca

Appendix E
Research on Non-MSW Organic Waste Generators

MEMO

TO: Betsy Varghese
FROM: Stephen Betts
CC: Scott Kyle, Ravi Mahabir

DATE: October 29, 2013

SUBJECT: Research on non-MSW Organic Waste Generators

PROJECT NO: 13-8097

This memo presents the results of research to date on non-MSW organics generators on the island of Newfoundland. Organics sources reviewed include agriculture, fisheries, aquaculture and forestry. One key challenge with estimating waste available for an organics facility is that some waste generated is used by other industries (e.g. sawmill residues used by Corner Brook Pulp and Paper). The distinction between waste 'generated' and waste 'available' has been made where possible.

Agriculture

The Department of Natural Resources publishes the Newfoundland and Labrador Farm Guide[1]. Relevant agricultural statistics from this guide include:

- Over 500 farms
- Approximately 11,400 cattle, 1,600 hogs, 3,100 sheep
- 214,700 mink pelts on 15 farms, 2,504 fox pelts on 8 farms
- 47 million litres of milk produced in 2011
- 359,000 chickens laid over 110 million eggs (increase of 60% since 2001). Production of poultry meat reached over 13 million
- Largest vegetable crops: potato, rutabagas, carrots and cabbage in 2010

The Newfoundland Federation of Agriculture commissioned an Anaerobic Digestion Feasibility Study (January 2013)[2]. Maps from the report showing farm locations in Newfoundland are attached to this memo.

Key information from the report's summary of farm sites in Newfoundland is included in Table 1. The table includes Newfoundland and Labrador Department of Environment data on the total organic waste generated from the poultry, dairy and mink sectors (farms with Certificate of Approval). According to the Department of Environment, the data does not represent hobby farms, mass mortality situations, nor is indicative of abattoirs or other processing facilities. It should also be noted that the data represents organic waste generated, not all of which may be available for an organics processing facility.

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[11] http://www.nr.gov.nl.ca/nr/publications/agrifoods/nl_farm_guide.pdf
[2] CH4 Biogas, "Newfoundland and Labrador Phase 1 Anaerobic Digestion Feasibility Study"

Table 1. Summary of Farm Locations and Organic Waste in Newfoundland[3]

Region	Poultry Litter [kg/day]	Poultry Mortalities [kg/day]	Dairy Manure [ft^3/day]	Mink Manure [ft^3/day]	Mink Carcasses [kg/yr]	Notes
Avalon	16,098	1,073	4,972	126	117,900	• Highest concentration of farm sites, including dairy farms, the largest chicken broiler farm in Canada (Country Ribbon), four egg producers (three located on one large site), and the largest mink farm in the province (Viking Fur) • Largest production of poultry wastes and second largest production of dairy and mink wastes.
Bonavista Bay	1,512	101	1,640	33	30,600	• Six small to medium-sized dairy farms, with mostly vegetable production on the remaining farms. Area is limited in terms of other organics sources.
Central NFLD (Grand Falls-Windsor and Gander)	3,966	264	0	129	114,300	• Three egg farms, several fur farms and a large concentration of vegetable farms. • Majority of salmonid aquaculture waste shipped through this region.
West Coast (Corner Brook)	0	0	6,330	230	216,000	• Large number of dairy farms in the Deer Lake area, several relatively large vegetable farms and the second largest mink farm (remote from other farms) • Southwest has the largest dairy producer in the province, who is currently undertaking biogas development, and several large vegetable farms

Notes:
According to the Chicken Farmers of Canada website[4], there are eight chicken farmers, all of which are on the Avalon Peninsula, producing 18 million kilograms of chicken each year. According to the same source, Country Ribbon Inc. grows 65% of "broilers", with the remaining 35% grown by independent contract grower farms.

[3] Summarized from Newfoundland and Labrador Phase 1 Anaerobic Digestion Feasibility Study, pp. 17-18.
[4] http://chicken.ca/blog/industry-notes/chicken-production-in-newfoundland-and-labrador

Fisheries

Dillon reviewed two key sources of information to understand potential organic waste for fisheries: the Newfoundland and Labrador Phase 1 Anaerobic Digestion (AD) Feasibility Study and personal communication with the Newfoundland Department of Fisheries and Aquaculture (DFA). As with agricultural waste sources, not all organic waste generated will be available for an organics processing facility (some is used as feed for fur farming, etc.). The DFA does not track where all waste ends up.

Fish processing plants are spread throughout the province, as shown in the figure that follows. The Government of Newfoundland and Labrador published a list of licensed processors in 2012[5], but the list does not include production or waste estimates for each plant.

The Newfoundland and Labrador Phase 1 AD Feasibility Study included several key conclusions about fisheries as an organics source:

- Highest density of processing plants on the Avalon peninsula
- Estimate that 30% of landed volume is waste
- Approximately 79% of waste by volume is shellfish; 21% is groundfish and pelagics, according to a study at Memorial University.
- Shellfish may not be suitable for digestion due to due to low digestibility of shells
- Large volume of groundfish and pelagic wastes go to the fur farming sector

The report included a 2010 estimate of Commercial Fisheries Landings, Processed Volumes and Waste (in tonnes). This information is summarized in Table 2 below, with more detailed information in the appendix to this memo.

Table 2 - NL Commercial Fisheries Landings, Processed Volumes and Waste (in tonnes)

Species/Fishery	Landed (Tonnes)	[a]Processed (Tonnes)	[b]Unutilized (Tonnes)
Ground Fish	39,639	15,137	25,938
Pelagics	83,456	64,486	18,891
[c]Molluscs	30,415	26,250	4,164
[d]Crustacean	168,083	108,882	57,915
Grand Total	321,593	191,058	105,962

Organic waste is currently dumped at sea by permit from Environment Canada if no viable land option is available. The Multi Materials Stewardship Board (MMSB) estimated that 52,000MT could come ashore annually if these permits are revoked.[6]

[5] http://www.fishaq.gov.nl.ca/licensing/license_holders_2012.pdf
[6] http://www.ccfi.ca/pdf/Murphy%20MMSB%20-%20Organics.pdf

Dillon contacted Bill Molloy, Resource Planning Supervisor – Processing Department at the DFA to obtain an estimate of organic waste generated from fish processing activities. A copy of correspondence received is included in the appendix to this memo.

Table 3 includes an estimate of organic waste generated based on 2012 Wild Harvest Production.

Table 3 – Summary of Organic Waste Based on 2012 Wild Harvest Production

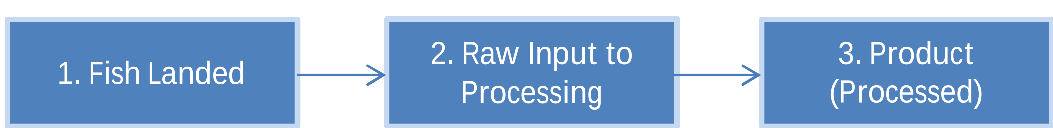
Waste Management Area	Estimated Tonnes (all species)
Burin Peninsula	2,700
Central	12,500
Discovery	2,200
Eastern	24,000
Northern Peninsula	17,200
Western	4,700
Total	63,300

Source: Bill Molloy, Newfoundland Department of Fisheries and Aquaculture. See notes below.

Fisheries and Aquaculture provided the following notes for the above data:

- Broad estimates as there is no exact means of tracking waste material
- Reflect a combination of Shellfish, Pelagic and Groundfish
- Reflect information based on 2012 operations and can vary year to year depending on quotas/landings and the areas where processing occurs
- It is suspected that the actual numbers may be somewhat higher than those indicated due to a discrepancy between pelagic landings and processed number. Some of this will be attributed to the production of fish meal, as well as direct shipment to fur breeders and direct use as bait. This data is not recorded by DFA.
- Some of the waste materials identified may already be going to some form of composting as anecdotal information suggests farmers are using various outputs for composting
- The data provided are broad estimates derived from production numbers provided to DFA by processors, utilizing a series of yield factors to convert to raw material. The organic waste is then determined by finding the differences in raw material and production. In shellfish species, estimates for amounts lost through process waster are also considered.

Dillon developed the following flow chart helps to understand the above fishery data provided by DFA:



- DFA has a good idea of 1. Fish Landed
- Processors report 3. Product Processed
- DFA calculated difference the between 1 and 3, and applied a yield factor for process loss (not all waste could be available for a composting facility – some is lost with process water, or cannot be recovered for various reasons)

Source: Newfoundland and Labrador Seafood Industry Year in Review 2012

Aquaculture

Information for this section was obtained primarily from Jonathan Kawaja, Aquaculture Environment Planner at the Newfoundland Department of Fisheries and Aquaculture, unless other sources are specified. The information includes an estimate of how much organic waste is generated, and also how much could be available to a composting facility, accounting for the current destinations of waste generated. Unlike the wild fishery, aquaculture products cannot be disposed of at sea. Any organics processing facility would compete with value-added processing, including feed and silage.

There were approximately 145 aquaculture licenses in 2011-2012[7], for a total production in 2012 of 21,228 metric tonnes. Expansion of the industry is expected to continue, from 12,000 MT to 50,000 MT by 2016, according to the MMSB[8]. As shown on the map that follows, the aquaculture industry is concentrated in two areas:

Northeast Coast (Notre Dame Bay)

- Blue mussel, yield is approximately 50-80%
- 2012 production of 4,400 MT
- Waste is undersized mussels and seaweeds
- Approximate waste generation for planning purposes of 2,000 Mt/yr in Western and Central Region overall.
- Approximately 12 grower operations; 3 main ones
- Several fish processors for the bulk of the material; one in Bay of Islands, others on the northeast coast
- Offal – shell used for gravel parking, some disposed as processing effluent, some at sea (unconfirmed), and some landfilled

Coast of Bays (Connaigre Peninsula)

- Salmonids produced year-round, with some seasonal variation. Most waste would come from fish processing plants.
- Served by three fish processing plants
- Stock mortality (routine die-offs) is a good estimate of how much would be landfilled in absence of higher value options (See Table 4 on next page). Compost would be top of the waste hierarchy for stock mortality.
    - 2013 estimate: 3,000 MT
    - 2017 estimate: 6,000 MT
- Some offal likely goes to landfill (e.g. routine quality control issue), but wouldn't suggest planning to send offal to compost, as offal is generally not treated as 'waste' – it is sent to mink farms as feed or to a fish meal facility.
- Should consider contingency capacity for mass mortalities. Estimated 6,000 MT event(s)
- Further details of estimates of organic waste from salmonids in the Coast of Bays area, as provided by the Department of Fisheries and Aquaculture, is included in Table 4.

[7] http://www.fishaq.gov.nl.ca/stats/aquaculture_2011-2012%20factsheet.pdf
[8] http://www.ccfi.ca/pdf/Murphy%20MMSB%20-%20Organics.pdf

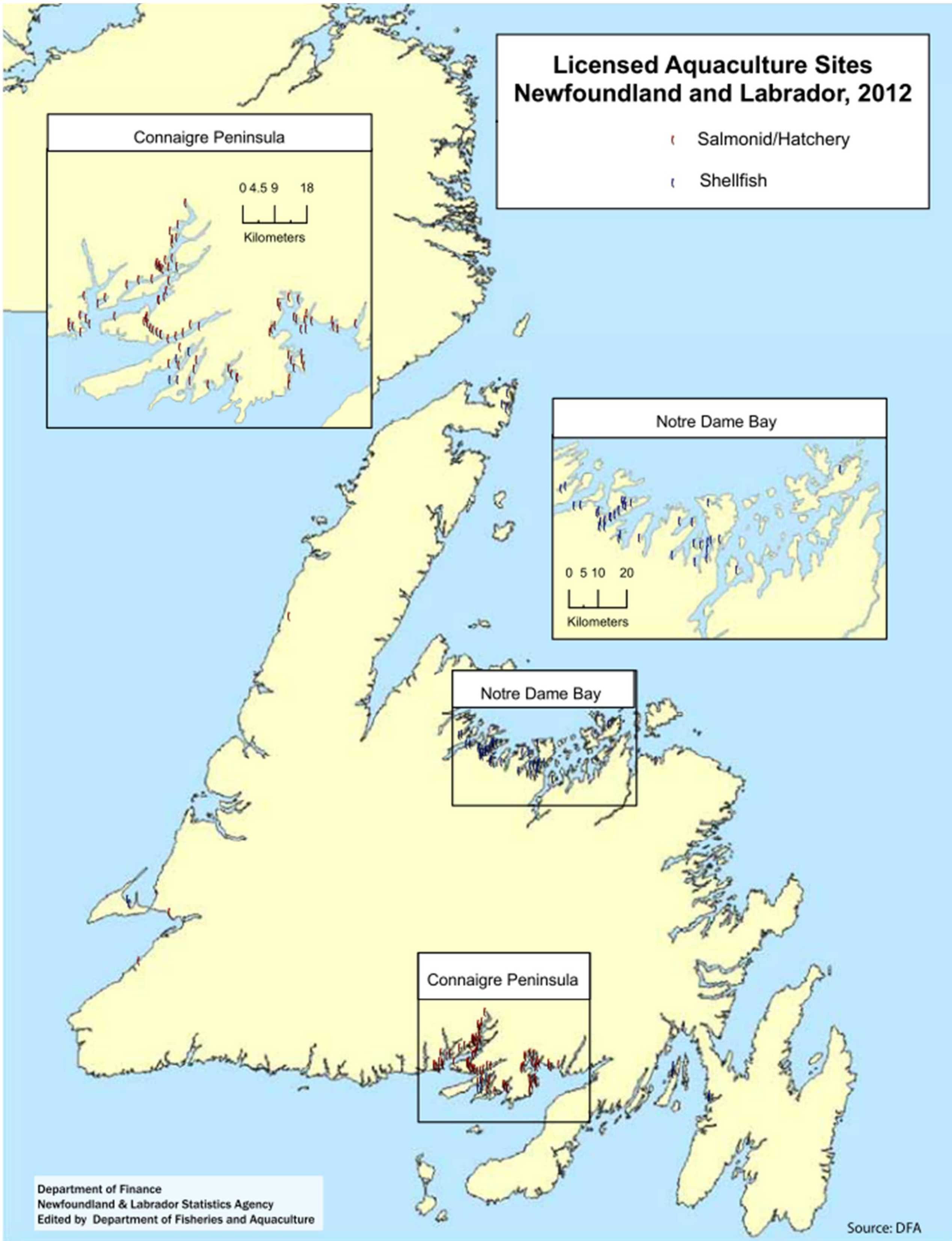
Table 4 – Summary of Historic and Projected Fish, Fish Bi-Product and Estimated Capacity Requirements in metric tonnes (MT)

Year	Industry Production (Farm-Gate)	Stock Mortality	Offal	Total Fish Parts	Estimated Mass Mortality assuming 6,000 MT event(s)
2006	7,300	876	1,869	2,745	7,300
2007	5,580	670	949	1,618	5,580
2008	9,697	1,164	2,327	3,491	9,491
2009	13,404	1,608	2,949	4,557	10,557
2010	14,945	1,793	3,288	5,081	11,081
2011	15,338	1,841	3,068	4,908	10,908
2012	19,126	2,295	4,735	7,030	13,030
2013	25,000	3,000	6,190	9,190	15,190
2014	32,5000	3,900	8,047	11,947	17,947
2015	40,000	4,800	9,904	14,704	20,704
2016	45,000	5,400	11,142	16,542	22,542
2017	50,000	6,000	12,380	18,380	24,380

Note: Shaded sections are projections extrapolated from current knowledge and assumptions. Data provided by Jonathan Kawaja, Newfoundland Department of Fisheries and Aquaculture

<u>Considerations</u>

- Marine grow-out produces bio-fouling that has to be removed from nets. Anti-foulant (copper-based) is used on nets that would have be dealt with in any organics processing facility
- Biosecurity considerations:
    - Aquaculture can be affected by disease, which requires biosecurity protocols. These protocols would encompass the entire chain of custody. The facility would need to meet containment, cleaning and disinfection requirements
    - In case of reportable diseases (e.g. Infectious Salmon Anemia), operating procedures would have to satisfy Canadian Food Inspection Agency (CFIA) at an organics facility. Not all compost facilities will necessarily be approved for this type of event
    - Standard Operating Procedures would require processes to monitor temperatures specific to inactivating pathogens of concern. Because of this, active, shorter duration processes such as in-vessel composting are preferred over passive processes such as static piles and windrow composting.



Source: Newfoundland and Labrador Seafood Industry Year in Review 2012

Forestry

Dillon spoke with Bill Clarke at Forestry and Agri-foods about potential feedstock from the forestry industry. Bill sent Dillon a report, "Provincial Inventory of Forest Biomass Residues", completed in 2011 at Memorial University (using 2009 data). The following presents key conclusions of this report:

- Largest sawmill owners and operators: Garland Forest Products, Sexton Lumber Company[9], Jamestown Lumber Company, Cottle's Island Lumber Company, Harold Sheppard Company Ltd, T & G WoodWorkers Ltd., Burtons Cove Logging and Lumber, Holson Forest Products Limited, Coates Lumber Company, S&N Wood Products, Inc., Strugnell Woodworks, Goose Bay Lumber and Sawmill Inc., Cashing's Pond Chipping Ltd., Rideout and Milley Ltd., Economix, Eastwood Forest Products, and Distinctive Mouldings Ltd.
- Annual 2008/2009 generation rates were:
    - o 24,414 BDT (Bone Dry Tonnes) of in-forest biomass residues
    - o 41,211 green t/y of sawmill residues
    - o 174,000 BDT/y of pulp mill residues
    - o 5,041 t/y of construction and demolition (C/D) waste
- CBPPL: The majority of in-forest residues and 55% of sawmill residues are diverted to the CBPPL (Corner Brook Pulp and Paper) as fuelwood
- Residues piles: in range of 131,000 and 773,000 green tonnes from active and inactive sawmills, respectively (2000-2009). Former Abitibi mill in Stephenville has residues of ash and sludge (645,290 square metres)
- Table 7.1 from the report (shown below) summarizes forest biomass residues stockpiled/landfilled by district. These numbers account for annual generation rates as well as use any waste (e.g. why there is only 29,000 BDT of pulp and paper residue…because most is used as hog fuel).

District	From 2009 operations				Operations between 2000 - 2009		
	Logging residues (BDT)	Sawmill residues[a] (green t)	Pulp and paper mill residues[b] (BDT)	Total	Active sawmills (green t)	Inactive sawmills (green t)	Total
1	871	1,095	-	1,966	7,098		7,098
2	3,490	4,320	-	7,810	67,037	58,251	125,288
5	4,840	0	-	4,840	2,495	5,904	8,399
8	4,896	0	-	4,896	2,971	698,504	701,475
12	3,992		-	3,992			
15			29,000	29,000			
16	2,258	0	-	2,258	6,800		6,800
18	3,226	1,915	-	5,141	37,033		37,033
21	840	256	-	1,096	7,382	10,744	18,126
Total	24,413	7,586	29,000	60,999	130,816	773,403	904,219

Notes: a – stockpiled on the mill yards, b – landfilled as black bark

[9] According to CBC news, the Sexton Lumber sawmill has been temporarily shut down, which is expected to affect dairy and poultry farms. http://www.cbc.ca/m/touch/canada/newfoundland/story/1.1894114

235 Yorkland Boulevard, Suite 800, Toronto, ON, M2J 4Y8 Phone: (416) 229-4647 Fax: (416) 229-4692

Figure 7.1 from the report, "Summary of annual generation and accumulation of forest biomass residues", is included below:

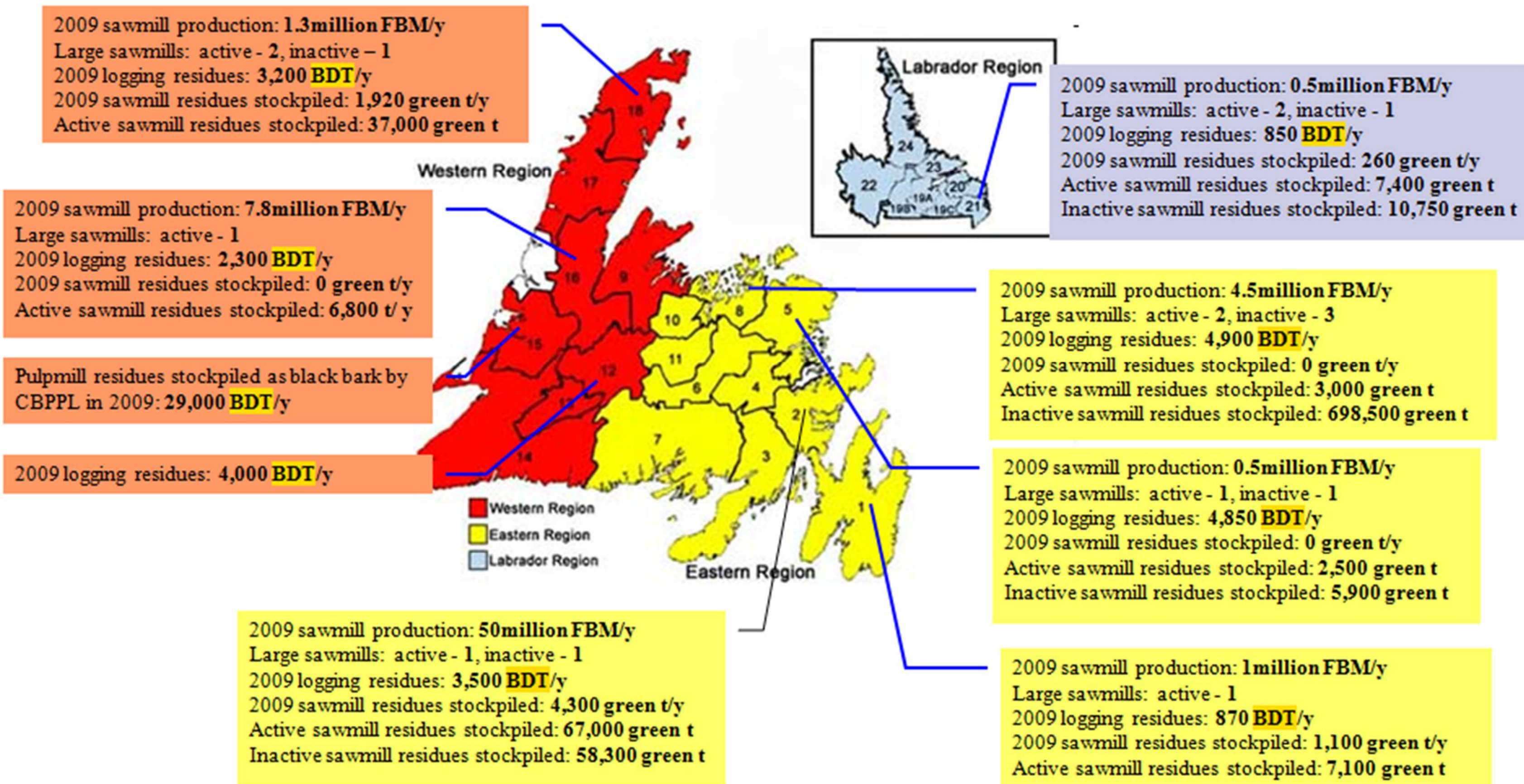


Figure 7:1: Summary of annual generation and accumulation of forest biomass residues

Appendix B:
Department of Environment
Agricultural Waste Production

Government of Newfoundland and Labrador
Department of Environment & Conservation

Pollution Prevention Division
(Environment)

November 26, 2012

Burke Consulting Inc.
C/O Brian Burke
7 Somerset Place
Conception Bay South, NL
A1W 4P3
bconsult@nl.rogers.com

Re: Agricultural Waste Volumes for the Province of Newfoundland and Labrador

The Department of Environment and Conservation are pleased to offer assistance to your research in biogas generation. We look forward in any research results that can be provided to us. Please accept, in the attached document, our contribution of agricultural waste volumes produced in the province based on farms only holding a valid and current Certificate of Approval through our Department. These figures do not represent hobby farms, mass mortality situations, nor are they indicative of abattoirs or other processing facilities.

The Department does not guarantee or warrant the accuracy of the information provided. If there is any conflict with interpretation of the results, please contact the undersigned at (709) 729-1810 or tammymcdonald@gov.nl.ca.

Sincerely,

Tammy McDonald, CPHI©
Senior Environmental Scientist

Cc Paul Connors, Federation of Agriculture
Hazen Scarth, Land Resource Stewardship, Dept. of Natural Resources

	Amount of Waste Generated by the Agriculture Sector					
	Poultry (Au)	**Dairy (AU)**	**Fur (Au)**	**Other (AU)**	**Total AU**	**Total All AU %**
Avalon	2683	2486	131	247	5547	52.00%
Clarenville	252	820	34	0	1106	10.40%
Gander	0	0	7	0	7	0.07%
GF-W	661	0	127	0	788	7.40%
Corner Brook	0	3165	240	0	3405	32.00%
Labrador			unknown			
Total	3596	6471	532	247	10,599	
Avalon AU %	75%	38.40%	24.60%	2.30%		
Clarenville AU%	7.00%	12.70%	6.30%			
Gander AU%	0	0	1.30%			
GFW AU %	18.40%	0	23.80%			
Corner Brook AU %	18.40%	49.00%	45.10%			
Total AU %	33.90%	61.10%	5.00%	2.30%		
	Poultry Litter + Farm Mortalities	**Dairy Manure**	**Mink Manure/Carcasses**			
Avalon	16,098 kg/day + 1,073.2 kg/day	4,972 cu ft/day	125.76 cu ft/day + 117,900kg/year			
Clarenville	1,512 kg/day + 100.8 kg/day	1,640 cu ft/day	32.64 cu ft/day + 30,600kg/year			
Gander			6.72 cu ft/day + 6,300kg/year			
GF-W	3,966 kg/day + 264.4 kg/day		121.92 cu ft/day + 114,300kg/year			
Corner Brook		6,330 cu ft/day	230.4 cu ft/day + 216,000kg/year			
Labrodor						
Total	21,576kg/day + 1438.4kg/day	12942 cu ft/day	517.44 cu ft/day + 485,100kg/year			

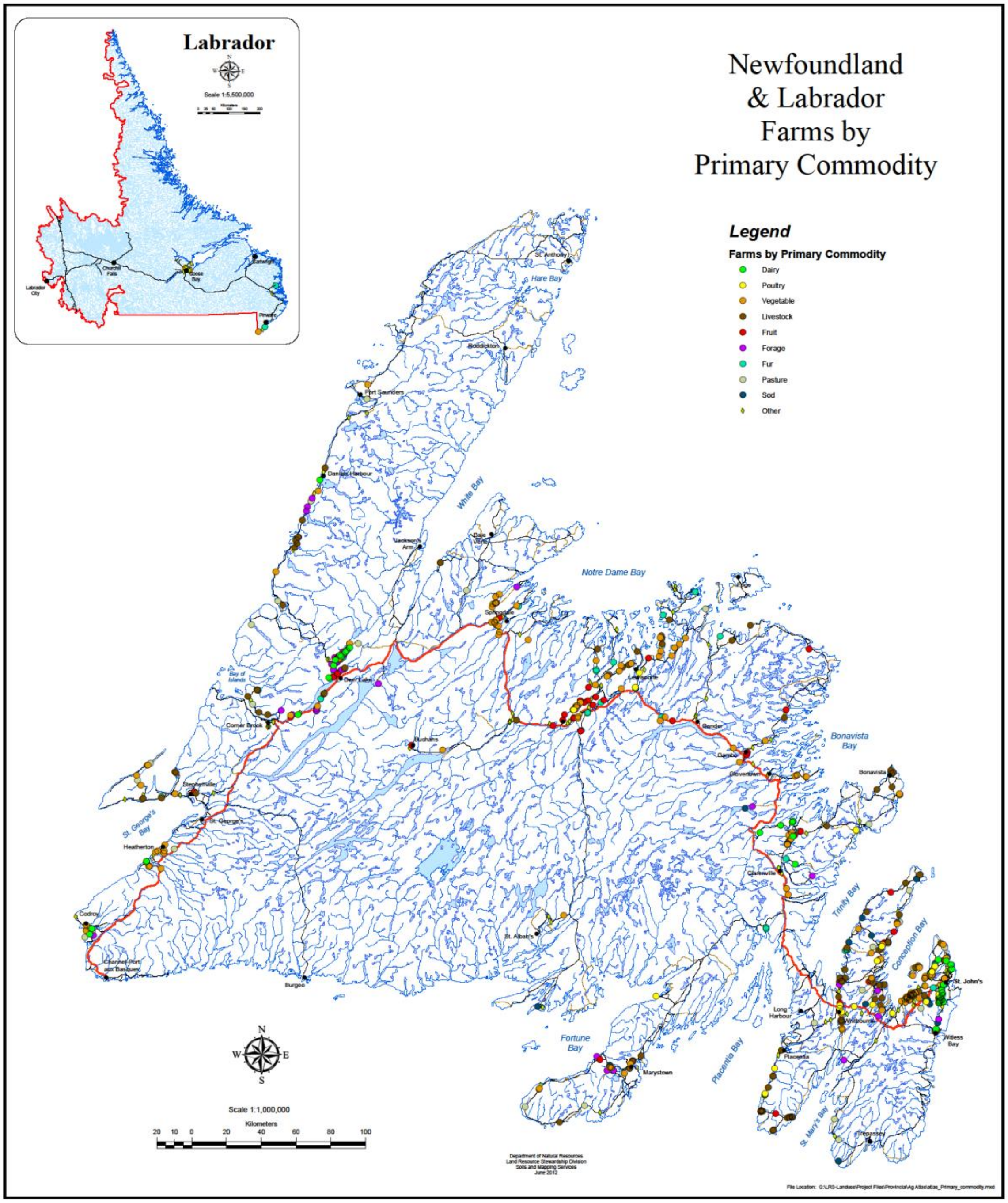


Figure 2: Agricultural Production throughout Newfoundland and Labrador

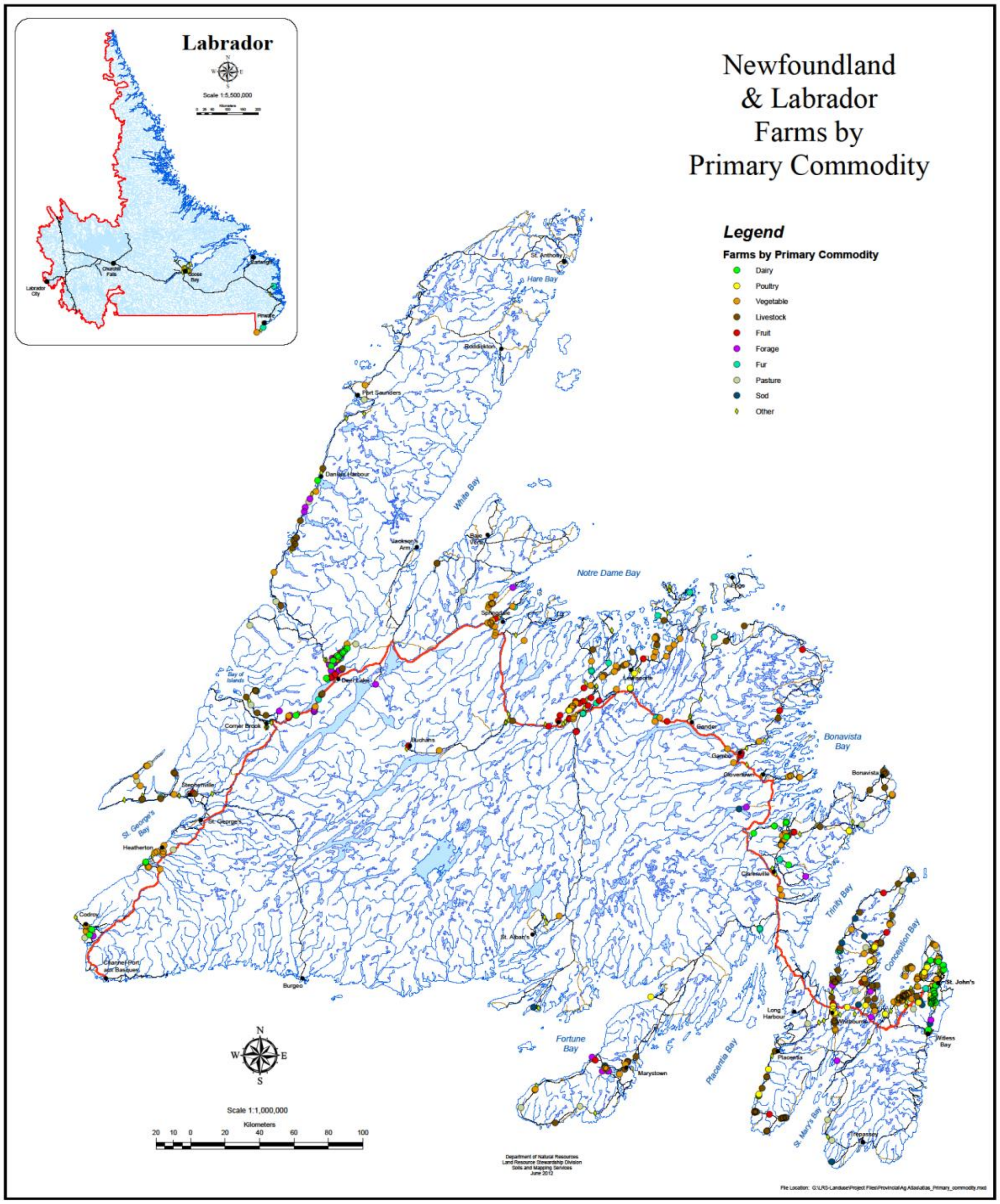


Figure 3: Agricultural Production, including Secondary Production in Newfoundland and Labrador

Appendix D:
PROVINCIAL FISHERY WASTE 2010

NL Commercial Fisheries Landings, Processed Volumes and Waste (in tonnes) for 2010

Species/Fishery	Landed (Tonnes)	[a]Processed (Tonnes)	[b]Unutilized (Tonnes)
Ground Fish			
Cod, Atlantic	12,209.00	4,884.26	7,324.75
Haddock	156.00	320.45	n/d
Redfish	2,583.00	187.63	2,395.37
Halibut	537.00	280.29	256.71
American plaice	1,674.00	363.22	1,310.78
Yellowtail flounder	8,079.00	2,472.26	5,606.74
Greysole/witch	757.00	1,039.88	n/d
Winter flounder	375.00	78.54	296.47
Turbot/Greenland halibut	11,579.00	3,480.91	8,098.09
Skate	351.00	75.55	275.45
Pollock	338.00	1,591.90	n/d
Hake, white	512.00	229.69	282.31
Monkfish (Am angler)	224.00	132.53	91.47
Subtotal	**39,639.00**	**15,137.10**	**25,938.13**
Pelagics			
Herring, Atlantic	26,032.00	15,914.80	10,117.21
Mackerel	33,106.00	30,051.41	3,054.59
Capelin	24,240.00	18,520.55	5,719.46
Subotal	**83,456.00**	**64,486.75**	**18,891.25**
Molluscs			
[c]Clams, Stimpsons surf	22,845.00	22,845.00	0.00
[c]Scallop, Sea	853.00	853.00	0.00
Whelks	5,510.00	2,436.65	3,073.35
Cockles	894.00	n/a	n/a
Scallop, Iceland	260.00	115.58	144.43
Sea Urchins	52.00	n/a	n/a
Subtotal	**30,415.00**	**26,250.23**	**4,164.77**
Crustacean			
Squid, Illex	91.00	190.08	n/d
Lobster	2,579.00	1,232.52	1,346.48
Crab, spider/toad	135.00	69.92	65.08
[d]Shrimp, Pandalus Borealis	111,666.00	72,578.66	39,087.34
Crab, Queen/Snow	52,228.00	34,811.56	17,416.44
Subtotal	**168,083.00**	**108,882.73**	**57,915.34**
Grand Total	**321,593.00**	**191,058.81**	**105,962.49**

[a]The data gaps in the processed column designated by n/a were either not available or could not be obtained.
[b]n/d = Some processors imported landings from other regions for processing, therefore the amount of unutilized product could not be determined (Source: personal communication with regional DFO office and provincial fisheries office).
[c]These values represent the volume of landed meats of species that are processed at sea and the by-product (i.e. shell waste) is discarded at sea.
[d]Landings include offshore and inshore shrimp. Processed volume includes shrimp sold shell on and cooked and peeled.

DILLON CONSULTING

Betts, Stephen <sbetts@dillon.ca>

Summary of Organic Waste - Wild Harvest by Waste Management Area

1 message

Molloy, Bill <billmolloy@gov.nl.ca> Fri, Oct 25, 2013 at 10:23 AM
To: "Betts, Stephen" <sbetts@dillon.ca>
Cc: "Rumboldt, Mark" <mrumboldt@gov.nl.ca>, "kawaja, jonathan" <jonathankawaja@gov.nl.ca>

Hi Stephen,

Attached you will find ***rough estimates*** of the organic waste from wild harvest fisheries by waste management area.The numbers provided are very rough as the Department of Fisheries and Aquaculture (DFA)does not collect that data directly and therefore the information provided is determined from estimates based on a series of conversion factors. To determine this information, we used 2012 production information. The following are some of the points you need to keep in your mind when using this data.

- the numbers are broad estimates as there is no exact means of tracking this waste material
- the numbers reflect a combination of shellfish, pelagics and groundfish
- the numbers are based on 2012 production and can vary year to year as a result of quota changes and landings
- it is suspected that the actual numbers may be a little higher as there appears to be a discrepancy between the amount of pelagics species landed and that processed. Some of this discrepancy may attributed to information we do not track including fish meal processing, material to fur breeders and material used directly as bait.
- it should be noted that some of the waste material identified may already be going to some form of composting as anecdotal information indicated some farmers are using various outputs for composting.
- these estimates are derived from production data provided to DFA by processors and utilizing a series of factors to convert the production back to raw material. The waste is then determined by finding the difference in the calculated raw material and the production. With regard to shellfish species, estimates for the amount of waste lost through process water are considered.
- DFA, as well as other industry and institutional partners, continue to work on finding alternatives for this waste material including uses such as chitin / chitosan, Omega 3 extracts, flavorings and colorants.
- for waste management areas not reported on, there was either no processing activity or too few active plants to allow reporting under DFA policy

Stephen, if you wish to discuss or gain clarification on any of these points, I can be reached at 709-729-1076.

Regards,
Bill

Summary of Organic Waste Sept 2013.xlsx
12K

Summary of Organic Waste Based on 2012 Wild Harvest Production

(Based on island portion of the Province only)

Waste Management Area	Estimated Tonnes (all species)
Burin Peninsula	2,700
Central	12,500
Discovery	2,200
Eastern	24,000
Northern Peninsula	17,200
Western	4,700
Total	***63,300***

Notes:
1)The numbers above are ***broad estimates*** as there is no exact means of tracking waste material.
2) The numbers above reflect a combination of Shellfish, Pelagic and Groundfish.
3) The numbers reflect information based on 2012 operations and can vary year to year depending on quotas/landings and the areas where processing occurs.
4) It is suspected that the actual numbers may be somewhat higher than those indicated due to a descrepency between pelagic landings and processed number. Some of this will be attributed to the production of fish meal (one meal plant operating plant in the province) as well as direct shipment to fur breeders, and direct use as bait. This data is not recoded by DFA.
5) It should be noted that some of the waste materials identified may already be going to some form of composting as ancedotal information suggest farmers are using various outputs for composting.

The data provided are broad estimates derrived from production numbers provided to DFA by processors and utilizing a series of yield factors to convert to raw material. The organic waste is then determined by finding the differences in raw material and the production. In shellfish species, estimates for amounts lost through process water are also considered.

Newfoundland and Labrador Organics Options Study (13-8097)
Dillon Consulting
Call and input from Jonathan Kawaja, Aquaculture Environmental Planner, Department of Fisheries and Aquaculture, Newfoundland and Labrador
Revised October 3, 2013

Subject: Aquaculture as a source for organics processing. Identify large potential sources of organics.

Note that there are two key aquaculture types operated in Newfoundland that would benefit from centralized organic management services:

1) Blue mussel (undersized mussels and seaweeds generated at the processing facility)
2) Salmonids (trimming and gut offal, as well as stock mortalities)
    a. Marine grow-out operations in the Coast of Bays is the primary generator of fish and fish bi-products
    b. Salmonid hatcheries/nurseries are more geographically separated, and do not produce commercially significant quantities of fish mortality, and thus not a significant consideration in strengthening the economics/business case for commercial organic management services
    c. Marine grow-out operations also produce biofouling (i.e., consisting of mussels and seaweeds, among other organisms) that must be removed from nets and disposed. Because nets are treated with copper based antifoulant, this material will contain antifoulant residues that impact organic management options.

- Aquaculture sources include Offal and Mortality sources
- Feedstock for organics processing would compete with other options to market material (feed, silage, etc.) (This season we experienced a clear compost service deficit as a result of the regular compost facility shutting down, and that is placing more demand on rendering services, as well as landfill. More valuable processing options require higher levels of quality control and assurance, and thus in this circumstance more pressure is on burial options when compost services are not available).
- Planning and projecting volumes is easier done for salmonids due to a the following:
    - Majority of material produced in one key geographical region (Coast of Bays)
    - Relatively constant volumes and predictable quality throughout the year
    - Further to this, although there may be seasonal variation, the industry production is year round

<u>Two types of Offal – access to different markets affects organics processing potential</u>

1. From filleting process
    a. Higher protein content
    b. Broader market opportunities (e.g. feed mink farming)

2. Head-on Gutted (HOG)
    a. Higher oil content
    b. Narrower market opportunities (higher potential for use in organics facility)

Two types of Mortality sources:

1. Operational Mortality
    a. Collected and retrieved from farms on a weekly basis. Easier to collect, manage and ship by truck than mass mortality
    b. Continuous mortality throughout the year with lower quality control may mean higher suitability for organics processing
    c. Limited composting capacity has meant industry has had to recognize new ways to render into fishmeal and oil extraction, or material ends up in landfill.
2. Mass Mortality
    a. Significant die-off at one time
    b. Better quality assurance, relative to routine stock mortality, opens more opportunities for processing
    c. Large volumes at once allow for less shipment frequency, via bulk transport by water opposed to road

Biosecurity considerations:

Disease management considerations can dictate the need for more rigours standard operating procedures at the farm, during transport, as well as at the organic management facility, and thus it is important to ensure the design of an engineered facility can accommodate cleaning, disinfection and containment in such a way that does not place an excessive operational burden on the facility relative to its standard practices. This consideration will affect the hierarchy of services available for organic management in a biosecurity contingency plan.

The next page provides a summary of the data we are looking for:

- Data organized geographically by Regional Waste Management Authorities (listed on next page) or more refined if possible.
- Locations and approx. number of large aquaculture businesses (source of organic material), description of material and amount of waste produced
- How this organic waste material is currently managed, estimated by management method

Data Request

Potential Organics Sources from Aquaculture Businesses

Regional Waste Management Authorities (or other geographic organization)	**Sub-Region / Company** *The key goal is to understand where the significant potential sources of industrial organic waste are and how much could be available to an organics processing facility. If data is readily available organized by company name and location, that would be ideal, but I understand it may not be. If available, we would like the data to be as disaggregated as possible to aid with our analysis.*	**Weight of organic waste produced** *Tonnes, include year (recent data and projection if possible),* *If data can be further refined to type (offal, etc.) that would be great.* *If not available, could you provide tonnes of total production, and we can apply a percentage of which is waste (25-30%?)*	**How currently managed** *Tonnes broken out by management method (dumped at sea, landfilled, composted, silage, fish meal, etc.)* *Location of management method (i.e. landfilled at <u>[name of landfill]</u> landfill site.*
Discovery Regional Service Board (Bonavista)			
Burin Peninsula Regional Service Board			
Central Regional Service Board	There is approximately a dozen mussel grower operations concentrated on the Northeast coast. Three companies generate the bulk of the product. There are several fish processors processing the majority of product: One on the West Coast (Bay of Islands); and several on the northeast coast. Sporadic processing may be done by smaller processors.	The quantity of organic material produced by the mussel sector is not quantified due to less consistency in volume and make-up from operation to operation. This variability in the result of different harvest practices as well as the extent to which a processor may process and extract value from farm-gate product. The yield can be from 50-80+%... 2012 market production was 4,400MT, thus the challenge. A very subjective planning number for the next 5 years would be 2,000Mt/a generated at multiple points in western and central region.	It's understood that offal is managed in a number of ways, and is quite variable from operation to operation. Some undersized mussels are marketed; some shell is used as a base for gravel parking areas, some disposed via processing effluent as well there is a likelihood some is disposed at sea (although unconfirmed), and some landfilled.
Coast of Bays Waste Management Corporation	There are five salmonid producers in the region serviced by three fish processing	See below	See Below

	plants. Net washing services also generate organic waste. There are several blue mussel operators in the region, but minimal mussel processing.		
Eastern Regional Services Board			
Green Bay Waste Authority, Inc.			
Northern Peninsula Regional Service Board			
Western Regional Service Board			

Aquaculture Organic Generation in the Coast of Bays region

Table 1 Summary of Historic and Projected Fish, Fish Bi-Product and Estimated Capacity Requirements in metric tonnes (MT) (Note that the shaded sections are projections extrapolated from current knowledge and assumptions)

Year	Industry Production (Farm-Gate)	Stock Mortality	Offal	Total Fish Parts	Estimated Mass Mortality Contingency assuming 6,000 MT Event(s)
2006	7,300	876	1,869	2,745	7,300
2007	5,580	670	949	1,618	5,580
2008	9,697	1,164	2,327	3,491	9,491
2009	13,404	1,608	2,949	4,557	10,557
2010	14,945	1,793	3,288	5,081	11,081
2011	15,338	1,841	3,068	4,908	10,908
2012	19,126	2,295	4,735	7,030	13,030
2013	**25,000**	**3,000**	**6,190**	**9,190**	**15,190**
2014	32,500	3,900	8,047	11,947	17,947
2015	40,000	4,800	9,904	14,704	20,704
2016	45,000	5,400	11,142	16,542	22,542
2017	50,000	6,000	12,380	18,380	24,380

Cannot say how much has gone to processing, but as a planning guide I would suggest that the 'stock mortality' tonnage is a good indicator of how much landfill capacity is required on an annual basis, in the absence of compost service or other soil amendment based solutions. Also, the 6,000 MT contingency is subjective, and is a planning consideration intended to ensure flexibility to address exceptional situations brought on by a fish health event. Experience has shown that this capacity is found through a combination of processing and landfill options. If the event is related to a pathogen or parasite, there will be more comprehensive biosecurity procedures that coincide with such an event. Thus, solutions such as composting as way of an example would need to accommodate the cleaning and disinfection (C&D) or equipment, and containment. As well, the ability to ensure a pathogen kill in an expedient fashion is advantageous in minimizing the overall operational costs of handling solids and liquids, as the C&D of equipment.

Additional comments related to Biosecurity Protocols

For reportable diseases (e.g., Infectious Salmon Anemia (ISA)) – in addition to an Certificate of Approval issued by The Department of Environment and Conservation (ENVC) standard operating procedures will have to satisfy the Canadian Food Inspection Agency (CFIA) at an organics facility (e.g., compost facility). Not all compost facilities will be necessarily approved for this type of an event.

Biosecurity procedures will encompass the entire chain of custody. The likelihood there will be multiple users, oppose to a single users, adds new risk factors that must be considered in managing the movement and containment of material prior to cleaning and disinfection.

Pathogens require different temperatures to achieve inactivation. The facility SOPs should reflect how they will monitor temperatures specific to the pathogen of concern and stipulate at what temperature they consider process finished. This will need to be recorded and auditable. In a scenario where demonstration of pathogen kill is required and the process is composting these considerations implies that more active processes that achieve and maintain target temperatures quickly (e.g., in-vessel) are more favourable than more passive processes that have extended process times (e.g., static piles/windrow composting). The active processes will support a shorter period of oversight, process monitoring, and small 'hot' zones; whereas, passive processes would require extended oversight, process monitoring, and extended maintenance of larger biosecurity 'hot' zones.

Appendix F
Population and Waste Generation Forecast Information

Table F-1
Newfoundland Organics Options Study
Generated Waste Tonnage Projections

Assumptions:

1	Waste generation rate growth estimate		2.20%
2	Waste generation rate per capita (tonnes/person/year)	Urban	0.96
		Rural	0.83
3	Waste Stream : Urban	Residential	42.50%
	Urban	ICI	57.50%
	Rural	Residential	43.50%
	Rural	ICI	56.50%

Waste Management Region	Sub-Region	Urban or Rural	Generation Sector	Estimated Population[2]	Estimated Population Change (%)[4]	Population Density (people/km^2)	Estimated Number of Households	Number of Occupied Dwellings	2015 Total Waste Generated (Tonnes)	2015 Organics Generated (Tonnes)	2025 Total Waste Generated (Tonnes)	2025 Organics Generated (Tonnes)	2035 Total Waste Generated (Tonnes)	2035 Organics Generated (Tonnes)	2045 Total Waste Generated (Tonnes)	2045 Organics Generated (Tonnes)
Region 1 - Discovery RSB	1. Bonavista	Rural	Residential	3,147	-0.56%	47.7	1,533	1,331	1,402	474	1,647	557	1,936	654	2,275	769
		Rural	ICI						1,821	457	2,140	537	2,515	631	2,955	742
	2 Five Coves	Rural	Residential	941		7.8	510	396	419	142	493	167	579	196	680	230
		Rural	ICI						544	137	640	161	752	189	884	222
	3 Trinity Bay North	Rural	Residential	2,638		8.9	1,411	1,137	1,175	397	1,381	467	1,623	549	1,907	645
		Rural	ICI						1,526	383	1,794	450	2,108	529	2,477	622
	4 King's Cove	Rural	Residential	781		3.1	619	348	348	118	409	138	481	162	565	191
		Rural	ICI						452	113	531	133	624	157	733	184
	5 Port Rexton	Rural	Residential	330		5.1	257	152	147	50	173	58	203	69	239	81
		Rural	ICI						191	48	224	56	264	66	310	78
	6 Charleston/Sweet Bay	Rural	Residential	1,987		2.7	1,485	842	885	299	1,040	352	1,222	413	1,437	486
		Rural	ICI						1,150	289	1,351	339	1,588	399	1,866	468
	7 Jamestown	Rural	Residential	144		1.6	93	61	64	16	75	19	89	22	104	26
		Rural	ICI						83	21	98	25	115	29	135	34
	8 Lethbridge	Rural	Residential	300		1.7	196	126	134	34	157	39	185	46	217	54
		Rural	ICI						174	44	204	51	240	60	282	71
	9 Musgravetown	Rural	Residential	734		6.1	393	307	327	111	384	130	452	153	531	179
		Rural	ICI						425	107	499	125	587	147	689	173
	10 Port Blandford	Rural	Residential	498		2.9	322	215	222	75	261	88	306	104	360	122
		Rural	ICI						288	72	339	85	398	100	468	117
			Total	11,500			6,819	4,915	11,777	3,384	13,840	3,977	16,265	4,674	19,115	5,493
Region 2 - Burin Peninsula	1 Placentia West	Rural	Residential	1,314	-1.27%	4.3	768	518	569	192	622	210	681	230	745	252
		Rural	ICI						739	185	808	203	884	222	967	243
	2 Marystown Area	Urban	Residential	2,040		76.5	923	823	874	312	956	341	1,046	373	1,144	408
		Urban	ICI						1,182	356	1,293	389	1,415	426	1,548	466
	3 Town of Grand Bank	Urban	Residential	2,221		81.8	1,076	986	951	340	1,041	372	1,139	406	1,246	445
		Urban	ICI						1,287	387	1,408	424	1,540	464	1,685	507
	4 St. Lawrence Area	Rural	Residential	1,402		7.1	729	546	615	208	672	227	736	249	805	272
		Rural	ICI						798	200	873	219	955	240	1,045	262
	5 Garnish Area	Rural	Residential	4,472		13.0	2,211	1,999	1,961	663	2,145	725	2,346	793	2,567	868
		Rural	ICI						2,547	639	2,786	699	3,048	765	3,334	837
	6 Fortune Bay West	Rural	Residential	1,279		10.6	762	535	561	190	613	207	671	227	734	248
		Rural	ICI						728	183	797	200	872	219	954	239
	7 Town of Burin	Rural	Residential	1,144		42.1	547	463	502	170	549	185	600	203	657	222
		Rural	ICI						651	164	713	179	780	196	853	214
	8 Burin Exterior	Rural	Residential	1,819		25.5	869	731	798	270	872	295	954	323	1,044	353
		Rural	ICI						1,036	260	1,133	284	1,240	311	1,356	340
	9 Town of Fortune	Rural	Residential	1,323		25.8	706	583	580	196	635	214	694	235	759	257
		Rural	ICI						753	189	824	207	902	226	986	248
	10 Greater Lamaline Area	Rural	Residential	1,380		3.4	767	578	605	205	662	224	724	245	792	268
		Rural	ICI						786	197	860	216	940	236	1,029	258
			Total	18,394			9,358	7,762	18,523	5,505	20,263	6,022	22,167	6,588	24,250	7,207

Table F-1
Newfoundland Organics Options Study
Generated Waste Tonnage Projections

Assumptions:

1	Waste generation rate growth estimate		2.20%
2	Waste generation rate per capita (tonnes/person/year)	Urban	0.96
		Rural	0.83
3	Waste Stream : Urban	Residential	42.50%
	Urban	ICI	57.50%
	Rural	Residential	43.50%
	Rural	ICI	56.50%

Waste Management Region	Sub-Region	Urban or Rural	Generation Sector	Estimated Population[2]	Estimated Population Change (%)[4]	Population Density (people/km^2)	Estimated Number of Households	Number of Occupied Dwellings	2015		2025		2035		2045	
									Total Waste Generated (Tonnes)	Organics Generated (Tonnes)	Total Waste Generated (Tonnes)	Organics Generated (Tonnes)	Total Waste Generated (Tonnes)	Organics Generated (Tonnes)	Total Waste Generated (Tonnes)	Organics Generated (Tonnes)
Region 3 - Central	1 Buchans Area	Rural	Residential	962	-0.48%	0.1	875	451	420	142	459	155	502	170	550	186
		Rural	ICI						545	137	596	150	652	164	714	179
	2 Point Leamington	Rural	Residential	2,599		0.7	2,434	1,113	1,140	385	1,247	421	1,364	461	1,492	504
		Rural	ICI						1,480	371	1,619	406	1,771	445	1,938	486
	3 New World Island / Twillingate	Rural	Residential	5,408		13.0	3,066	2,335	2,371	801	2,594	877	2,838	959	3,104	1,049
		Rural	ICI						3,080	773	3,369	846	3,686	925	4,032	1,012
	4 Fogo Island	Rural	Residential	2,747		7.2	1,561	1,167	1,204	407	1,318	445	1,441	487	1,577	533
		Rural	ICI						1,564	393	1,711	430	1,872	470	2,048	514
	5 Gander Bay	Rural	Residential	5,782		2.7	3,270	2,331	2,535	857	2,773	937	3,034	1,025	3,319	1,122
		Rural	ICI						3,293	826	3,602	904	3,940	989	4,311	1,082
	6 Indian Bay	Rural	Residential	4,827		3.8	2,759	1,922	2,116	715	2,315	783	2,533	856	2,771	936
		Rural	ICI						2,749	690	3,007	755	3,290	826	3,599	903
	7 Terra Nova	Rural	Residential	6,334		3.2	3,727	2,593	2,777	939	3,038	1,027	3,323	1,123	3,636	1,229
		Rural	ICI						3,607	905	3,946	990	4,317	1,083	4,722	1,185
	8 Zone 8	Rural	Residential	43,181		2.6	20,823	17,797	18,932	6,399	20,711	7,000	22,657	7,658	24,786	8,378
		Rural	ICI						24,590	6,172	26,901	6,752	29,428	7,386	32,193	8,080
			Total	71,840			38,515	29,709	72,404	20,913	79,207	22,878	86,649	25,028	94,790	27,380
Region 4 - Coast of Bays	1 Coast of Bays	Rural	Residential	6,602	-0.57%	2.2	3,055	2,620	2,878	973	3,149	1,064	3,444	1,164	3,768	1,274
		Rural	ICI						3,738	938	4,089	1,026	4,474	1,123	4,894	1,228
			Total	6,602			3,055	2,620	6,616	1,911	7,238	2,091	7,918	2,287	8,662	2,502
Region 5 - Eastern	1 Clarenville and Isthmus	Rural	Residential	12,285	0.41%	8.8	6,041	5,058	5,408	1,828	5,916	2,000	6,472	2,188	7,081	2,393
		Rural	ICI						7,025	1,763	7,685	1,929	8,407	2,110	9,197	2,308
	2 Trinity Bay South and Isthmus E	Rural	Residential	11,874		5.2	6,964	4,874	5,206	1,760	5,695	1,925	6,230	2,106	6,816	2,304
		Rural	ICI						6,762	1,697	7,397	1,857	8,092	2,031	8,853	2,222
	3 Trinity Conception North	Rural	Residential	17,431		19.6	8,634	7,171	7,642	2,583	8,361	2,826	9,146	3,091	10,005	3,382
		Rural	ICI						9,926	2,492	10,859	2,726	11,879	2,982	12,996	3,262
	4 Bay Roberts	Rural	Residential	20,586		25.0	10,712	8,127	9,026	3,051	9,874	3,337	10,802	3,651	11,816	3,994
		Rural	ICI						11,723	2,942	12,825	3,219	14,030	3,521	15,348	3,852
	5 Large Metro	Urban	Residential	85,188		344.9	35,401	33,285	36,491	13,027	39,920	14,251	43,671	15,590	47,774	17,055
		Urban	ICI						49,371	14,861	54,009	16,257	59,084	17,784	64,635	19,455
	6 Small Metro	Urban	Residential	93,843		178.1	41,182	38,328	40,199	14,351	43,976	15,699	48,108	17,174	52,628	18,788
		Urban	ICI						54,387	16,370	59,497	17,908	65,087	19,591	71,202	21,432
	7 St. John's	Urban	Residential	9,553		222.2	4,393	4,051	4,092	1,461	4,477	1,598	4,897	1,748	5,357	1,913
		Urban	ICI						5,536	1,666	6,057	1,823	6,626	1,994	7,248	2,182
	8 Southern Shore	Rural	Residential	7,747		4.0	4,174	3,211	3,397	1,022	3,716	1,118	4,065	1,224	4,447	1,338
		Rural	ICI						4,412	1,328	4,826	1,453	5,280	1,589	5,776	1,738
	9 Southwest Avalon	Rural	Residential	7,787		3.0	5,179	3,374	3,414	1,028	3,735	1,124	4,086	1,230	4,470	1,345
		Rural	ICI						4,434	1,335	4,851	1,460	5,307	1,597	5,806	1,747
			Total	266,294			122,680	107,479	268,451	84,565	293,674	92,511	321,267	101,203	351,453	110,712
Region 6 - Baie Verte - Green Bay	1 Green Bay	Rural	Residential	7,343	-0.98%	5.9	3,240	2,497	3,188	1,078	3,487	1,179	3,815	1,290	4,174	1,411
		Rural	ICI						4,141	1,039	4,530	1,137	4,955	1,244	5,421	1,361
	2 Baie Verte	Rural	Residential	5,520		1.6	3,480	2,796	2,420	818	2,648	895	2,896	979	3,168	1,071
		Rural	ICI						3,143	789	3,439	863	3,762	944	4,115	1,033
			Total	12,863			6,720	5,293	12,892	3,724	14,104	4,074	15,429	4,456	16,878	4,875

Table F-1
Newfoundland Organics Options Study
Generated Waste Tonnage Projections

Assumptions:

1 Waste generation rate growth estimate			2.20%
2 Waste generation rate per capita (tonnes/person/year)		Urban	0.96
		Rural	0.83
3 Waste Stream	Urban	Residential	42.50%
	Urban	ICI	57.50%
	Rural	Residential	43.50%
	Rural	ICI	56.50%

Waste Management Region	Sub-Region	Urban or Rural	Generation Sector	Estimated Population[2]	Estimated Population Change (%)[4]	Population Density (people/km^2)	Estimated Number of Households	Number of Occupied Dwellings	2015		2025		2035		2045	
									Total Waste Generated (Tonnes)	Organics Generated (Tonnes)	Total Waste Generated (Tonnes)	Organics Generated (Tonnes)	Total Waste Generated (Tonnes)	Organics Generated (Tonnes)	Total Waste Generated (Tonnes)	Organics Generated (Tonnes)
Region 7 - Northern Peninsula	1 Sub-Region 1	Rural	Residential	4,500	-0.75%	4.1	2,205	1,795	1,958	662	2,142	724	2,343	792	2,564	867
		Rural	ICI						2,543	638	2,782	698	3,044	764	3,330	836
	2 Sub-Region 2	Rural	Residential	2,245		0.8	1,255	873	984	333	1,077	364	1,178	398	1,289	436
		Rural	ICI						1,278	321	1,399	351	1,530	384	1,674	420
	3 Sub-Region 3	Rural	Residential	3,726		1.5	1,749	1,469	1,634	552	1,787	604	1,955	661	2,139	723
		Rural	ICI						2,122	533	2,321	583	2,539	637	2,778	697
	4 Sub-Region 4	Rural	Residential	2,228		0.5	1,384	944	977	330	1,069	361	1,169	395	1,279	432
		Rural	ICI						1,269	318	1,388	348	1,518	381	1,661	417
			Total	12,699			6,593	5,081	12,765	3,687	13,965	4,034	15,277	4,413	16,712	4,827
Region 8 - Western	1 Long Range	Rural	Residential	3,189	-0.18%	0.8	1,844	1,381	1,396	472	1,527	516	1,670	565	1,827	618
		Rural	ICI						1,813	455	1,983	498	2,169	545	2,373	596
	2 Western Hills	Rural	Residential	7,611		2.2	3,902	3,043	3,337	1,128	3,651	1,234	3,994	1,350	4,369	1,477
		Rural	ICI						4,334	1,088	4,741	1,190	5,187	1,302	5,674	1,424
	3 White Bay South	Rural	Residential	1,909		0.5	1,209	794	837	283	916	309	1,002	339	1,096	370
		Rural	ICI						1,087	273	1,189	299	1,301	327	1,423	357
	4 Corner Brook & Area	Rural	Residential	33,250		8.6	15,445	13,568	14,578	4,927	15,948	5,390	17,446	5,897	19,086	6,451
		Rural	ICI						18,935	4,753	20,714	5,199	22,660	5,688	24,789	6,222
	5 Bay St. George	Rural	Residential	17,610		3.3	8,749	7,602	7,721	2,610	8,446	2,855	9,240	3,123	10,108	3,417
		Rural	ICI						10,028	2,517	10,971	2,754	12,001	3,012	13,129	3,295
	6 Southwest Coast	Rural	Residential	9,354		1.3	5,398	4,041	4,101	1,386	4,487	1,516	4,908	1,659	5,369	1,815
		Rural	ICI						5,327	1,337	5,827	1,463	6,375	1,600	6,974	1,750
	7 Burgeo and Area	Rural	Residential	1,648		0.3	1,116	713	723	244	790	267	865	292	946	320
		Rural	ICI						938	236	1,027	258	1,123	282	1,229	308
			Total	74,571			37,663	31,142	75,155	21,708	82,217	23,748	89,941	25,979	98,392	28,420
	TOTAL			474,763			231,403	194,001	478,583	145,398	524,507	159,334	574,913	174,628	630,252	191,416

Notes:
(1) Generation rates based on current 2011 baseline values; assumes that rates will remain stable (e.g., not increase) as a result of waste reduction efforts.
(2) Per capita waste generation rates are from information provided by Gordon Murphy from MMSB, 2011.
(3) Split between residential and ICI waste from information provided by the MMSB
(4) Estimated Population Change from Rural Secretariat Region Population Projections Data, 1986-2026
Includes the total waste stream generated per year (residuals, organics, recyclables and CRD materials)

L:\PROJECTS\Final\2013\138097-Organics Options Study\For Client\Revised Final Draft\Revised Tables and Figures (July 31, 2014)\[Appendix F - Population & Tonnage Estimate Table (FINAL)_UPDATED JULY2014.xls]Pop & Tonnage Forecast

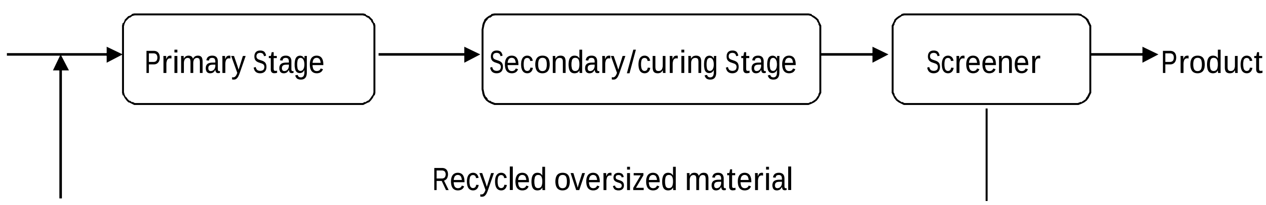
Appendix G
Reference Facility and Cost Estimate Information

Appendix G-1
Basic Compost Facility Footprint Requirements

The fundamental flow diagram of any compost process entails at least three process stages: a primary stage, a secondary or curing stage, and a screening stage that separates the final marketable product from the oversized, uncomposted woodier material typically associated more with leaf & yard waste. The amount of oversized material produced depends upon (at least) three conditions:

- the degree of shredding that takes place prior to processing,
- the efficacy of the compost process in reducing the coarse feedstock to a fine soil-like quality, and
- the screen settings which qualify the degree of refinement of the product.

Typically, the oversized material is returned to the front end of the process to serve as a bulking agent as well as a means to absorb excess moisture since the product is typically 15–20% drier than the feedstock. A typical process flow is provided below.

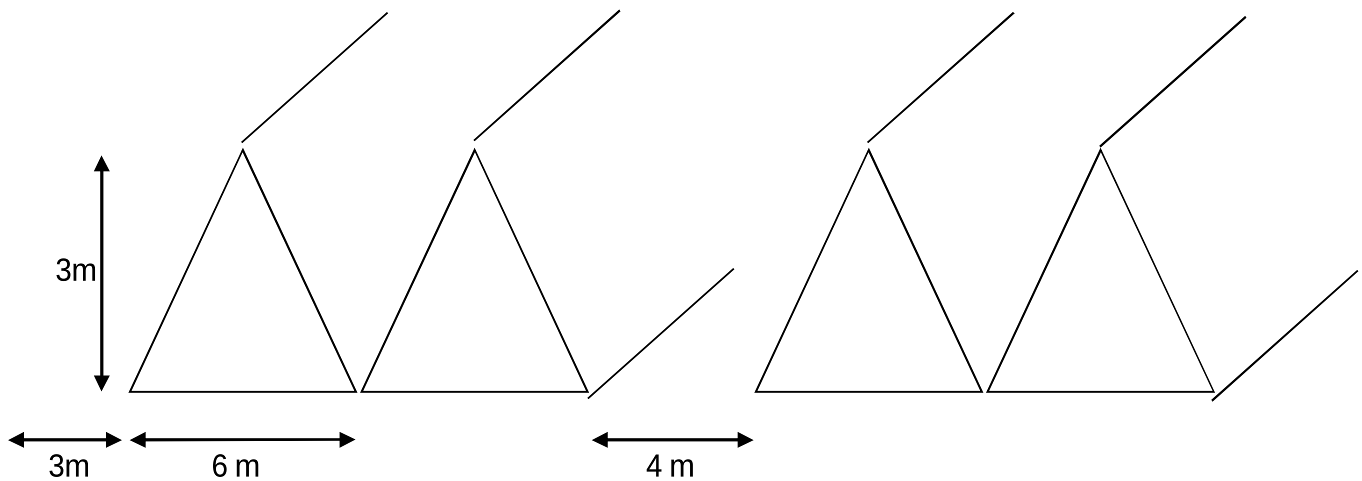


The assumed nature of the feedstock provided for composting in Newfoundland is decidedly high in food waste which implies a feedstock that is high in moisture, density and nitrogen—these three qualities create significant challenges to a process that requires an environment that is unsaturated, with a loose, porous and permeable structure consisting of a balance of nitrogen-rich (food) and carbon-rich (woody) ingredients. These concerns have previously been articulated in MMSBs March 2012 report, *The Management of Organic Waste in Newfoundland and Labrador* as well as in the Terms of Reference for this assignment.

The calculation of the footprint required to process the requisite tonnage of organic waste in Newfoundland is therefore based on a number of constraints and conditions:

- the feedstock consists of 70% food waste and 30% paper/leaf & yard waste by mass,
- the high food waste constituency requires a significant amount of drier, less dense, recycled oversized material to be returned to the front end of the process which is estimated to be 25% by mass of the total mass fed to the process, and
- the high moisture content of the feedstock requires (at least) the primary stage of the process to be covered to provide some degree of moisture control.

Typically, static piles of composting material are arranged in long triangular rows (windrows) that attempt to provide the composting mass with sufficient oxygen for decomposition, yet stack the material in a manner that reduces the facility footprint. Static windrows however require the material to be aerated/moved by a front-end loader or a specialized piece of turning equipment and therefore require additional space to maneuver on either side of the windrows. The basic windrow configuration was therefore predicated on the following design.



As the composting process employs the activity of microorganisms to consume fresh organic waste, there is a significant reduction in both volume and mass as the feedstock is refined and converted (in part) to carbon dioxide and water vapour. The degree of volume and mass reduction is accelerated with more frequent agitation and aeration over a longer period of time; for the purposes of this analysis which employs a moderate degree of aeration and mixing technology, it is assumed that:

- the primary stage experiences a 30% reduction in volume over one-quarter of a year of processing, and
- the secondary stage experiences a 20% reduction in volume over one-quarter of a year of processing.

Finally, it is imperative to maintain the composting mass in an unsaturated state over the decomposition process which is essentially controlled by the moisture content, which in turn is manifested in terms of density, the means by which tonnages are converted to volumes. For the calculated footprints provided, the following presumptions are applied:

- the density of the incoming food waste is 70%,
- the density of the incoming leaf & yard/paper waste is 40%,
- there is a 60% mass loss in the overall process,
- the density of the unscreened product is 56%,
- the density of the screened product is 63%, and
- the density of the recycled oversized material is 30%.

Consolidating the above design constraints that includes one-half year of total processing, windrow configurations with 10 m of aisle space (including 3 m on each side) and a 10% increase in footprint for contingencies, the required area for various feedstocks is presented in Table G-1-1.

Table G-1-1 Feedstock Area Requirements

Feedstock Rate (tonne/year)	Stage	Windrows (m^2)	Aisles (m^2)	10% Contingency (m^2)
1000	1^o	405	305	71
	2^o	286	305	59
2500	1^o	1013	305	132
	2^o	715	305	102
5000	1^o	2027	610	264
	2^o	1413	610	204
10000	1^o	4053	610	466
	2^o	2861	610	347

APPENDIX G-2
Level Ia Compost Facility - Capital Cost Estimate

Assumptions

1 Average Annual Tonnage 20,000
2 Based on CBRM Compost Facility, Sydney, NS. Christiaens "in-tunnel" technology.
3 http://www.solidwastemag.com/news/cape-breton-s-turn/1000217942/?&
4 Working days per year is (52 weeks x 5 days per week) minus 10 holidays = 250 days
5 Tonnages Daily 80 20,000
Weekly 400
6 Plant designed to handle 12 000 tonnes in 2005.
7 Budget costing from progress estimates.
8 Assume space requirements are based on CBRM site ~ 2.1 ha plus 25% or 2.6 ha.
9 All costs in 2013 dollars.

Item	Description	Units	Unit Price	Estimated Quantity	Budget
1	Site Selection Process	ls	$ 125,000	1	$ 125,000
2	Site Survey	ls	$ 25,000	1	$ 25,000
3	Site Entrance	ls	$ 7,000	1	$ 7,000
4	Access Road	m	$ 400	300	$ 120,000
5	Power Extension	m	$ 75	500	$ 37,500
6	Telephone	m	$ 30	500	$ 15,000
7	Clear and Grub	m^2	$ 5	30,000	$ 150,000
8	Site Grading	m^2	$ 10	30,000	$ 300,000
9	Office	m^2	$ 1,400	400	$ 560,000
10	Scale and Scalehouse	ls	$ 200,000	1	$ 200,000
11	Parking, Working Areas	m^2	$ 40	25,000	$ 1,000,000
12	Water/Septic	ls	$ 75,000	1	$ 75,000
13	Compost Facility	ls	$ 7,000,000	1	$ 7,000,000
14	Curing Facility	ls	$ 3,500,000	1	$ 3,500,000
15	Biofilter	ls	$ 350,000	1	$ 350,000
16	Wheel Loader	ls	$ 250,000	1	$ 250,000
17	Backhoe	ls	$ 100,000	1	$ 100,000
18	Site Pickup Truck	ls	$ 30,000	1	$ 30,000
19	Chipper Equipment	ls	$ 75,000	1	$ 75,000
20	Shredding Equipment	ls	$ 125,000	1	$ 125,000
21	Screening Equipment	ls	$ 475,000	1	$ 475,000
22	Material Storage Pad	ls	$ 20,000	1	$ 20,000
23	Sedimentation Pond	ls	$ 100,000	1	$ 100,000
24	Perimeter Drainage Ditching	m	$ 15	600	$ 9,000
25	Leachate Storage Tank	ls	$ 50,000	1	$ 50,000
26	Leachate Collection Transmission Line	m	$ 150	50	$ 7,500
27	Monitor Wells	each	$ 6,000	10	$ 60,000
28	Sediment Control Plan	each	$ 15,000	1	$ 15,000
29	Erosion Control Allowance	each	$ 15,000	1	$ 15,000
30	Material Testing Allowance	ls	$ 25,000	1	$ 25,000
31	Miscellaneous Allowance	each	$ 40,000	1	$ 40,000
			Subtotal		$ 14,861,000
			Engineering and Construction @ 10%	$	1,486,000
			Subtotal	$	16,347,000
			Contingency at 20%	$	3,269,000
			Total Estimated Budget		$ 19,616,000

APPENDIX G-3
Level Ia Compost Facility - Annual O&M Cost Estimate

Assumptions

1 Base costs are from Dillon 05-4369 project - Valley Waste-Resource Management Study (NS).
2 All costs in 2013 dollars.

Item	Description	Cost	
1	Salary	$ 697,000	see below
2	Benefits	$ 139,000	20%
3	Office Supplies	$ 5,000	Valley at 1.8k
4	Safety Equipment	$ 5,000	Valley at 2k
5	Insurance	$ 60,000	Valley at 21-23k
6	Staff Training and Development	$ 12,000	Valley at 3-4k
7	Telephone	$ 6,000	Valley at 3-4.5k
8	Electricity	$ 100,000	Valley at 12.5k
9	Snow/Ice Removal Supplies	$ 2,000	Valley at 1k
10	Janitorial	$ 4,000	Valley at 4k
11	Landscaping	$ 2,000	Valley at 500
12	Security	$ 2,000	Valley at 500
13	Gasoline and Diesel Fuel	$ 75,000	Valley at 21k
14	Mobile Equipment Rental	$ 10,000	Valley at 3k
15	Scale Maintenance	$ 2,000	Valley at 5k
16	Site and Building Maintenance	$ 20,000	Valley at 15k
17	Vehicle Registration	$ 2,000	Valley at 500
18	Miscellaneous	$ 50,000	
19	Miscellaneous Tools and Supplies	$ 3,000	
	Annual Budget	$ 1,196,000	

Employees		Salary
Scale House Operator	1	$ 47,000
Admin Staff	2	$ 42,000
Site Supervisor	2	$ 55,000
Supervisor/Equipment Operator/Worker	3	$ 42,000
Labourer	10	$ 33,000
Staff	18	
	$ 697,000	

APPENDIX G-4

Level Ib Compost Facility - Capital Cost Estimate

Assumptions

1 Average Annual Tonnage 10,000
2 Based on CBRM Compost Facility, Sydney, NS. Christiaens "in-tunnel" technology.
3 http://www.solidwastemag.com/news/cape-breton-s-turn/1000217942/?&
4 Working days per year is (52 weeks x 5 days per week) minus 10 holidays = 250 days
5 Tonnages Daily 40 10,000
Weekly 200
6 Plant designed to handle 12 000 tonnes in 2005.
7 Budget costing from progress estimates.
8 Assume space requirements are based on CBRM site ~ 2.1 ha plus 25% or 2.6 ha.
9 Does not include an allowance for electical, water or sewer servicing connections (site specific).
10 All costs in 2013 dollars.

Item	Description	Units	Unit Price	Estimated Quantity	Budget
1	Site Selection Process	ls	$ 125,000	1	$ 125,000
2	Site Survey	ls	$ 25,000	1	$ 25,000
3	Site Entrance	ls	$ 7,000	1	$ 7,000
4	Access Road	m	$ 400	300	$ 120,000
5	Power Extension	m	$ 75	500	$ 37,500
6	Telephone	m	$ 30	500	$ 15,000
7	Clear and Grub	m^2	$ 5	26,000	$ 130,000
8	Site Grading	m^2	$ 10	26,000	$ 260,000
9	Office	m^2	$ 1,400	300	$ 420,000
10	Scale and Scalehouse	ls	$ 200,000	1	$ 200,000
11	Parking , Working Areas	m^2	$ 40	20,000	$ 800,000
12	Water/Septic	ls	$ 60,000	1	$ 60,000
13	Compost Facility	ls	$ 5,000,000	1	$ 5,000,000
14	Curing Facility	ls	$ 1,000,000	1	$ 1,000,000
15	Biofilter	ls	$ 250,000	1	$ 250,000
16	Wheel Loader*	ls	$ 250,000	1	$ 250,000
17	Backhoe*	ls	$ 100,000	1	$ 100,000
18	Site Pickup Truck*	ls	$ 30,000	1	$ 30,000
19	Chipper Equipment	ls	$ 75,000	1	$ 75,000
20	Shredding Equipment	ls	$ 125,000	1	$ 125,000
21	Screening Equipment	ls	$ 475,000	1	$ 475,000
22	Material Storage Pad	ls	$ 20,000	1	$ 20,000
23	Sedimentation Pond	ls	$ 75,000	1	$ 75,000
24	Perimeter Drainage Ditching	m	$ 15	600	$ 9,000
25	Leachate Storage Tank	ls	$ 50,000	1	$ 50,000
26	Leachate Collection Transmission Line	m	$ 150	50	$ 7,500
27	Monitor Wells	each	$ 6,000	10	$ 60,000
28	Sediment Control Plan	each	$ 15,000	1	$ 15,000
29	Erosion Control Allowance	each	$ 15,000	1	$ 15,000
30	Material Testing Allowance	ls	$ 25,000	1	$ 25,000
31	Miscellaneous Allowance	each	$ 25,000	1	$ 25,000
			Subtotal		$ 9,806,000
			Engineering and Construction @ 10%		$ 981,000
			Subtotal		$ 10,787,000
			Contingency at 20%		$ 2,157,000
			Total Estimated Budget		$ 12,944,000

APPENDIX G-5

Level Ia Compost Facility - Annual O&M Cost Estimate

Assumptions

1 Base costs are from Dillon 05-4369 project - Valley Waste-Resource Management Study (NS).

2 All costs in 2013 dollars.

1	Salary	$ 576,000	see below
2	Benefits	$ 115,000	20%
3	Office Supplies	$ 5,000	Valley at 1.8k
4	Safety Equipment	$ 5,000	Valley at 2k
5	Insurance	$ 50,000	Valley at 21-23k
6	Staff Training and Development	$ 12,000	Valley at 3-4k
7	Telephone	$ 6,000	Valley at 3-4.5k
8	Electricity	$ 75,000	Valley at12.5k
9	Snow/Ice Removal Supplies	$ 2,000	Valley at 1k
10	Janitorial	$ 4,000	Valley at 4k
11	Landscaping	$ 2,000	Valley at 500
12	Security	$ 2,000	Valley at 500
13	Gasoline and Diesel Fuel	$ 75,000	Valley at 21k
14	Mobile Equipment Rental	$ 10,000	Valley at 3k
15	Scale Maintenance	$ 2,000	Valley at 5k
16	Site and Building Maintenance	$ 20,000	Valley at 15k
17	Vehicle Registration	$ 2,000	Valley at 500
18	Miscellaneous	$ 50,000	
19	Miscellaneous Tools and Supplies	$ 3,000	
	Annual Budget	$ 1,016,000	

Employees		Salary
Scale House Operator	1	$ 47,000
Admin Staff	2	$ 42,000
Site Supervisor	1	$ 55,000
Supervisor/Equipment Operator/Worker	3	$ 42,000
Labourer	8	$ 33,000
Staff	15	
	$ 576,000	

APPENDIX G-6
Level II Compost Facility - Capital Cost Estimate

Assumptions

1	Assumed annual tonnage	2,500	t
2	Primary Windrow Covered Area	1,013	m^2
3	Secondary Windrow Area	715	m^2
4	Does not include an allowance for electical, water or sewer servicing connections (site specific).		
5	All costs in 2013 dollars.		
6			
7			

Item	Description	Units	Unit Price	Estimated Quantity	Budget
1	Site Selection Process	ls	$ 75,000	1	$ 75,000
2	Site Survey	ls	$ 15,000	1	$ 15,000
3	Site Entrance	ls	$ 5,000	1	$ 5,000
4	Access Road	m	$ 300	400	$ 120,000
5	Power Extension	m	$ 50	500	$ 25,000
6	Telephone	m	$ 30	500	$ 15,000
7	Clear and Grub	m^2	$ 5	10,637	$ 53,000
8	Site Grading	m^2	$ 10	10,637	$ 106,000
9	Scale and Scalehouse	ls	$ 200,000	1	$ 200,000
10	Office and Storage Shed	m^2	$ 800	150	$ 120,000
11	Working Gravel Pad	m^2	$ 15	9,700	$ 146,000
12	Water/Septic	ls	$ 40,000	1	$ 40,000
13	Covered Outdoor Windrows	ls	$ 700	750	$ 525,000
14	Shredder	ls	$ 50,000	1	$ 50,000
15	Screener	ls	$ 75,000	1	$ 75,000
16	Compost Turner/Backhoe	ls	$ 100,000	1	$ 100,000
17	Site Pickup Truck	ls	$ 30,000	1	$ 30,000
18	Material Storage Pad	ls	$ 20,000	1	$ 20,000
19	Sedimentation Pond	ls	$ 50,000	1	$ 50,000
20	Perimeter Drainage Ditching	m	$ 15	450	$ 7,000
21	Leachate Storage Tank	ls	$ 25,000	1	$ 25,000
22	Leachate Collection Transmission Line	m	$ 150	50	$ 8,000
23	Monitor Wells	each	$ 6,000	10	$ 60,000
24	Sediment Control Plan	each	$ 10,000	1	$ 10,000
25	Erosion Control Allowance	each	$ 10,000	1	$ 10,000
26	Material Testing Allowance	ls	$ 10,000	1	$ 10,000
27	Miscellaneous Allowance	each	$ 25,000	1	$ 25,000
				Subtotal	$ 1,925,000
				Engineering and Construction @ 10%	$ 193,000
				Subtotal	$ 2,118,000
				Contingency at 20%	$ 424,000
				Total Estimated Budget	$ 2,542,000

APPENDIX G-7
Level II Compost Facility - Annual O&M Cost Estimate

Assumptions
1 Base costs are from Dillon 05-4369 project - Valley Waste-Resource Management Study (NS).
2 All costs in 2013 dollars.

Item No.	Description	
1	Salary	$ 107,000
2	Benefits	$ 21,000
3	Office Supplies	$ 500
4	Safety Equipment	$ 1,500
5	Insurance	$ 15,000
6	Staff Training and Development	$ 2,500
7	Telephone	$ 1,000
8	Electricity	$ 4,000
9	Snow/Ice Removal Supplies	$ 1,000
10	Janitorial	$ 500
11	Landscaping	$ 500
12	Security	$ 1,000
13	Gasoline and Diesel Fuel	$ 20,000
14	Mobile Equipment Rental	$ 3,000
15	Scale Maintenance	
16	Site and Building Maintenance	$ 5,000
17	Vehicle Registration	$ 500
18	Sewer Charges	
19	Water Charges	
20	Miscellaneous	$ 2,000
21	Miscellaneous Tools and Supplies	$ 2,000
	Annual Budget	$ 188,000

Employees			Salary
Scale House Operator			
Site Supervisor			
Supervisor/Equipment Operator/Worker	1		$ 48,750
Labourer	1.5		$ 39,000
Staff	2.5		
	$ 107,250		

APPENDIX G-8
Level III Compost Facility - Capital Cost Estimate

Assumptions

1	Assumed annual tonnage	1,000	t
2	Primary Windrow Covered Area	405	m^2
3	Secondary Windrow Area	286	m^2
4	Does not include an allowance for electical, water or sewer servicing connections (site specific).		
5	All costs in 2013 dollars.		

Item	Description	Units	Unit Price	Estimated Quantity	Budget
1	Site Selection Process	ls	$ 75,000	1	$ 75,000
2	Site Survey	ls	$ 10,000	1	$ 10,000
3	Site Entrance	ls	$ 5,000	1	$ 5,000
4	Access Road	m	$ 300	400	$ 120,000
5	Power Extension	m	$ 50	500	$ 25,000
6	Telephone	m	$ 30	500	$ 15,000
7	Clear and Grub	m^2	$ 5	7,392	$ 37,000
8	Site Grading	m^2	$ 10	7,392	$ 74,000
9	Office and Storage Shed	m^2	$ 800	100	$ 80,000
10	Working Gravel Pad	m^2	$ 15	6,800	$ 102,000
11	Covered Outdoor Windrows	ls	$ 700	500	$ 350,000
12	Water/Septic	ls	$ 40,000	1	$ 40,000
13	Shredder	ls	$ 50,000	1	$ 50,000
14	Screener	ls	$ 75,000	1	$ 75,000
15	Compost Turner/Backhoe	ls	$ 100,000	1	$ 100,000
16	Site Pickup Truck	ls	$ 30,000	1	$ 30,000
17	Material Storage Pad	ls	$ 20,000	1	$ 20,000
18	Sedimentation Pond	ls	$ 50,000	1	$ 50,000
19	Perimeter Drainage Ditching	m	$ 15	340	$ 5,000
20	Leachate Storage Tank	ls	$ 20,000	1	$ 20,000
21	Leachate Collection Transmission Line	m	$ 150	50	$ 8,000
22	Monitor Wells	each	$ 6,000	6	$ 36,000
23	Sediment Control Plan	each	$ 10,000	1	$ 10,000
24	Erosion Control Allowance	each	$ 10,000	1	$ 10,000
25	Material Testing Allowance	ls	$ 10,000	1	$ 10,000
26	Miscellaneous Allowance	each	$ 25,000	1	$ 25,000
			Subtotal		$ 1,382,000
			Engineering and Construction @ 10%		$ 138,000
			Subtotal		$ 1,520,000
			Contingency at 20%		$ 304,000
			Total Estimated Budget		$ 1,824,000

APPENDIX G-9

Level III Compost Facility - Annual O&M Cost Estimate

Assumptions

1 Base costs are from Dillon 05-4369 project - Valley Waste-Resource Management Study (NS).

2

Item No.	Description	
1	Salary	$ 87,750
2	Benefits	$ 17,550
3	Office Supplies	$ 500
4	Safety Equipment	$ 1,000
5	Insurance	$ 15,000
6	Staff Training and Development	$ 1,500
7	Telephone	$ 600
8	Electricity	$ 4,000
9	Snow/Ice Removal Supplies	$ 1,000
10	Janitorial	$ 250
11	Landscaping	$ 500
12	Security	$ 600
15	Gasoline and Diesel Fuel	$ 17,000
16	Mobile Equipment Rental	$ 3,000
17	Scale Maintenance	
18	Site and Building Maintenance	$ 5,000
19	Vehicle Registration	$ 500
20	Sewer Charges	
21	Water Charges	
22	Miscellaneous	$ 2,000
23	Miscellaneous Tools and Supplies	$ 2,000
	Annual Budget	$ 160,000

Employees			Salary
Scale House Operator			
Site Supervisor			
Supervisor/Equipment Operator/Worker	1		$ 48,750
Labourer	1		$ 39,000
Staff	2		
	$ 87,750		

APPENDIX G-10

Dog Hill Transfer Station - Capital Cost Estimate

Assumptions

1 Based on East Hants MSW/Organics Transfer Station (NS).

2 Does not include an allowance for electical, water or sewer servicing connections (site specific).

3 All costs in 2013 dollars.

4 Based on a facility to accommodate 46,000 tpy.

Item	Description	Units	Estimated Quantity	Unit Price	Budget
1	Site Selection Process	ls	1	$ 50,000	$ 50,000
2	Site Survey	ls	1	$ 15,000	$ 15,000
3	Site Entrance	ls	1	$ 5,000	$ 5,000
4	Access Road (two lane, gravel)	m	2500	$ 300	$ 750,000
5	Scale and Scalehouse	ls	1	$ 150,000	$ 150,000
6	Site Works	ls	1	$ 548,000	$ 548,000
7	Pre-Engineered Building	ls	1	$ 1,433,000	$ 1,433,000
8	Concrete	ls	1	$ 1,223,000	$ 1,223,000
9	Structural Fill	ls	1	$ 453,000	$ 453,000
10	Electrical	ls	1	$ 457,000	$ 457,000
11	Mechanical	ls	1	$ 92,000	$ 92,000
12	Power/Phone	ls	1	$ 30,000	$ 30,000
13	Water/Septic	ls	1	$ 40,000	$ 40,000
14	Site Backhoe	ls	1	$ 100,000	$ 100,000
15	Site Truck	ls	1	$ 30,000	$ 30,000
16	Material Storage Pad	ls	1	$ 20,000	$ 20,000
17	Sediment Pond	ls	1	$ 50,000	$ 50,000
18	Sediment Control	ls	1	$ 10,000	$ 10,000
19	Miscellaneous Allowance	ls	1	$ 10,000	$ 10,000
20	Material Testing Allowance	ls	1	$ 10,000	$ 10,000
	Subtotal				$ 5,476,000
	Engineering and Construction @10%				$ 548,000
	Subtotal				$ 6,024,000
	Contingency @ 20%				$ 1,205,000
	Total Estimated Budget				$ 7,229,000

Costs for the East Hants TS were from 2005
ENR Cost Index for Jan 2005 = 6160
ENR Cost index for Nov 2013 = 9666
=57% price increase

APPENDIX G-11
Dog Hill Transfer Station - Annual O&M Cost Estimate

Assumptions
1 Base costs are from Dillon 05-4369 project - Valley Waste-Resource Management Study (NS).
2 All costs in 2013 dollars.

Item No.	Description	
1	Salary	$ 261,000
2	Benefits	$ 53,000
3	Office Supplies	$ 3,000
4	Safety Equipment	$ 3,000
5	Insurance	$ 37,000
6	Staff Training and Development	$ 7,000
7	Telephone	$ 6,000
8	Electricity	$ 21,000
9	Snow/Ice Removal Supplies	$ 3,000
10	Janitorial	$ 5,000
11	Landscaping	$ 1,000
12	Security	$ 1,000
13	Gasoline and Diesel Fuel	$ 36,000
14	Mobile Equipment Rental	$ 5,000
15	Scale Maintenance	$ 3,000
16	Site and Building Maintenance	$ 20,000
17	Vehicle Registration	$ 1,000
18	Miscellaneous	$ 4,000
19	Miscellaneous Tools and Supplies	$ 3,000
	Annual Budget	$ 473,000

Employees		Salary
Scale House Operator	1	$ 47,000
Site Supervisor	1	$ 55,000
Supervisor/Equipment Operator/Worker	3	$ 42,000
Labourer	1	$ 33,000
Staff	6	
	$ 261,000	

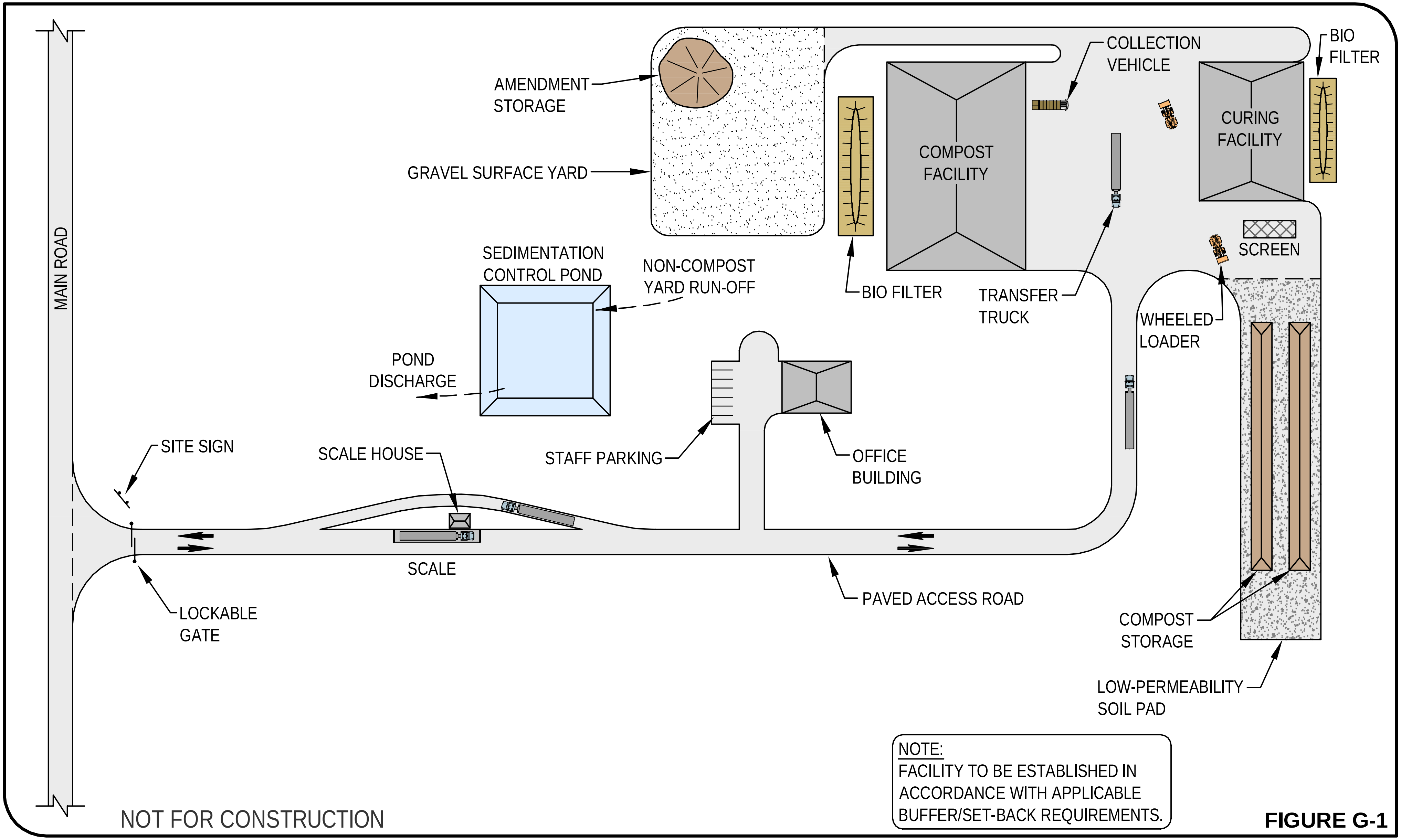
APPENDIX G-12
Norris Arm Transfer Station - Capital Cost Estimate

Assumptions

1 Based on East Hants MSW/Organics Transfer Station (NS).
2 Does not include an allowance for electical, water or sewer servicing connections (site specific).
3 All costs in 2013 dollars.
4 Based on a facility to accommodate 15,000 tpy.

Item	Description	Units	Estimated Quantity	Unit Price	Budget
1	Site Selection Process	ls	1	$ -	$ -
2	Site Survey	ls	1	$ 15,000	$ 15,000
3	Site Entrance	ls	1	$ -	$ -
4	Access Road	ls	1	$ 50,000	$ 50,000
5	Scale and Scalehouse	ls	1	$ -	$ -
6	Site Works	ls	1	$ 386,000	$ 386,000
7	Pre-Engineered Building	ls	1	$ 1,010,000	$ 1,010,000
8	Concrete	ls	1	$ 86,200	$ 86,000
9	Structural Fill	ls	1	$ 319,000	$ 319,000
10	Electrical	ls	1	$ 322,000	$ 322,000
11	Mechanical	ls	1	$ 65,000	$ 65,000
12	Power/Phone	ls	1	$ 10,000	$ 10,000
13	Water/Septic	ls	1	$ 25,000	$ 25,000
14	Site Backhoe	ls	1	$ 100,000	$ 100,000
15	Site Truck	ls	1	$ 30,000	$ 30,000
16	Material Storage Pad	ls	1	$ 20,000	$ 20,000
17	Sediment Pond	ls	1	$ 50,000	$ 50,000
18	Sediment Control	ls	1	$ 10,000	$ 10,000
19	Miscellaneous Allowance	ls	1	$ 10,000	$ 10,000
20	Material Testing Allowance	ls	1	$ 10,000	$ 10,000
	Subtotal				$ 2,518,000
	Engineering and Construction @10%				$ 252,000
	Subtotal				$ 2,770,000
	Contingency @ 20%				$ 554,000
	Total Estimated Budget				$ 3,324,000

Costs for the East Hants TS were from 2005
ENR Cost Index for Jan 2005 = 6160
ENR Cost index for Nov 2013 = 9666
=57% price increase



NOT FOR CONSTRUCTION

NOTE:
FACILITY TO BE ESTABLISHED IN ACCORDANCE WITH APPLICABLE BUFFER/SET-BACK REQUIREMENTS.

FIGURE G-1

GOVERNMENT OF NEWFOUNDLAND AND LABRADOR

STUDY OF OPTIONS FOR ORGANIC WASTE PROCESSING

LEVEL IA/B COMPOST FACILITY

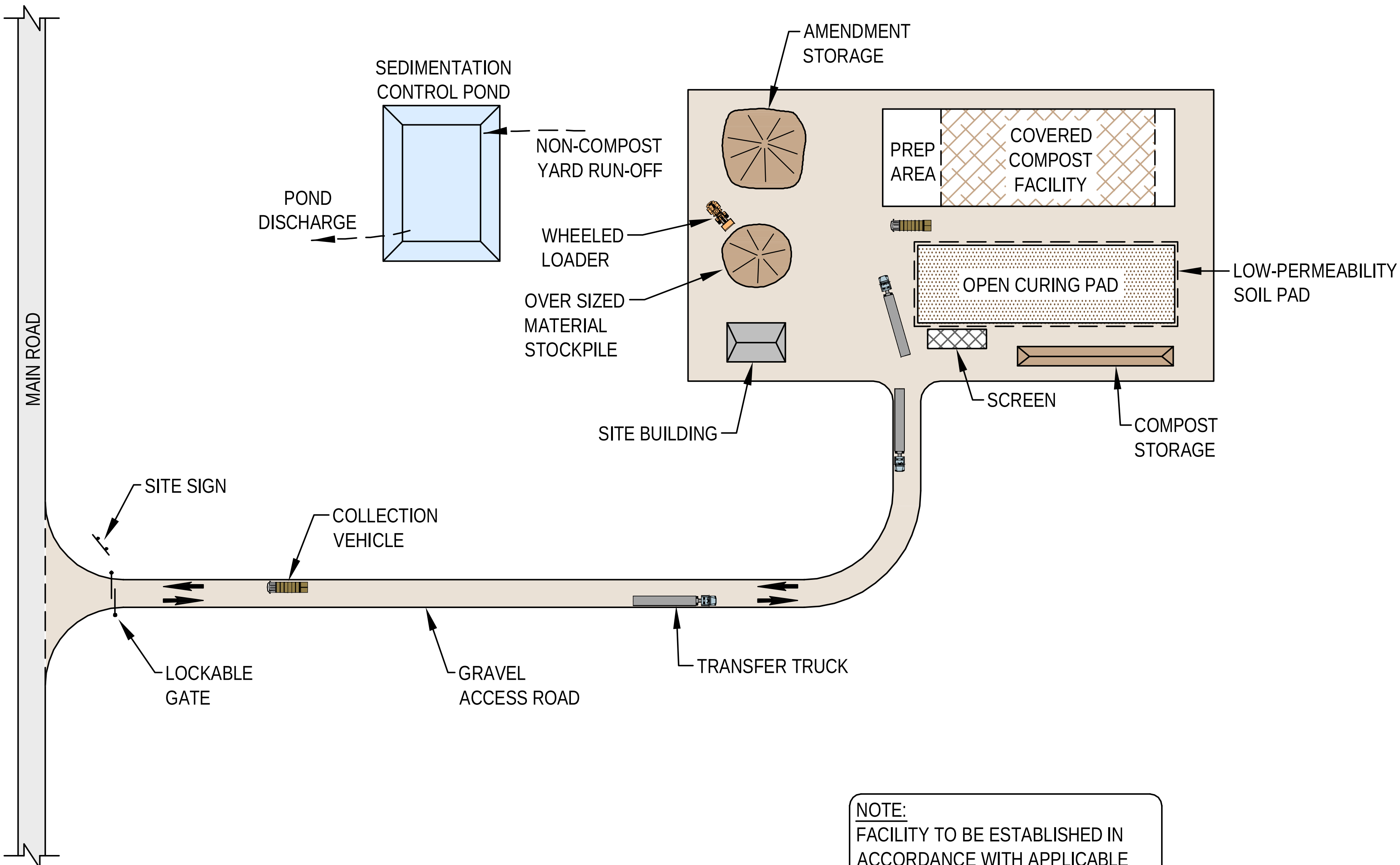
DILLON CONSULTING

CREATED BY: TLR
CHECKED BY: SDK
DESIGNED BY: CRS

File Location:
g:\cad\138097\00-general\03-reports\138097-00-site-figs.dwg July, 18, 2014 11:19 AM

0 10 20 30m
SCALE 1:150

PROJECT #: 13-8097 STATUS: REVISED FINAL DATE: 07/30/14



NOTE:
FACILITY TO BE ESTABLISHED IN ACCORDANCE WITH APPLICABLE BUFFER/SET-BACK REQUIREMENTS.

NOT FOR CONSTRUCTION

FIGURE G-2

GOVERNMENT OF NEWFOUNDLAND AND LABRADOR

STUDY OF OPTIONS FOR ORGANIC WASTE PROCESSING

LEVEL Ⅱ COMPOST FACILITY

DILLON CONSULTING

CREATED BY: TLR
CHECKED BY: SDK
DESIGNED BY: CRS

File Location:
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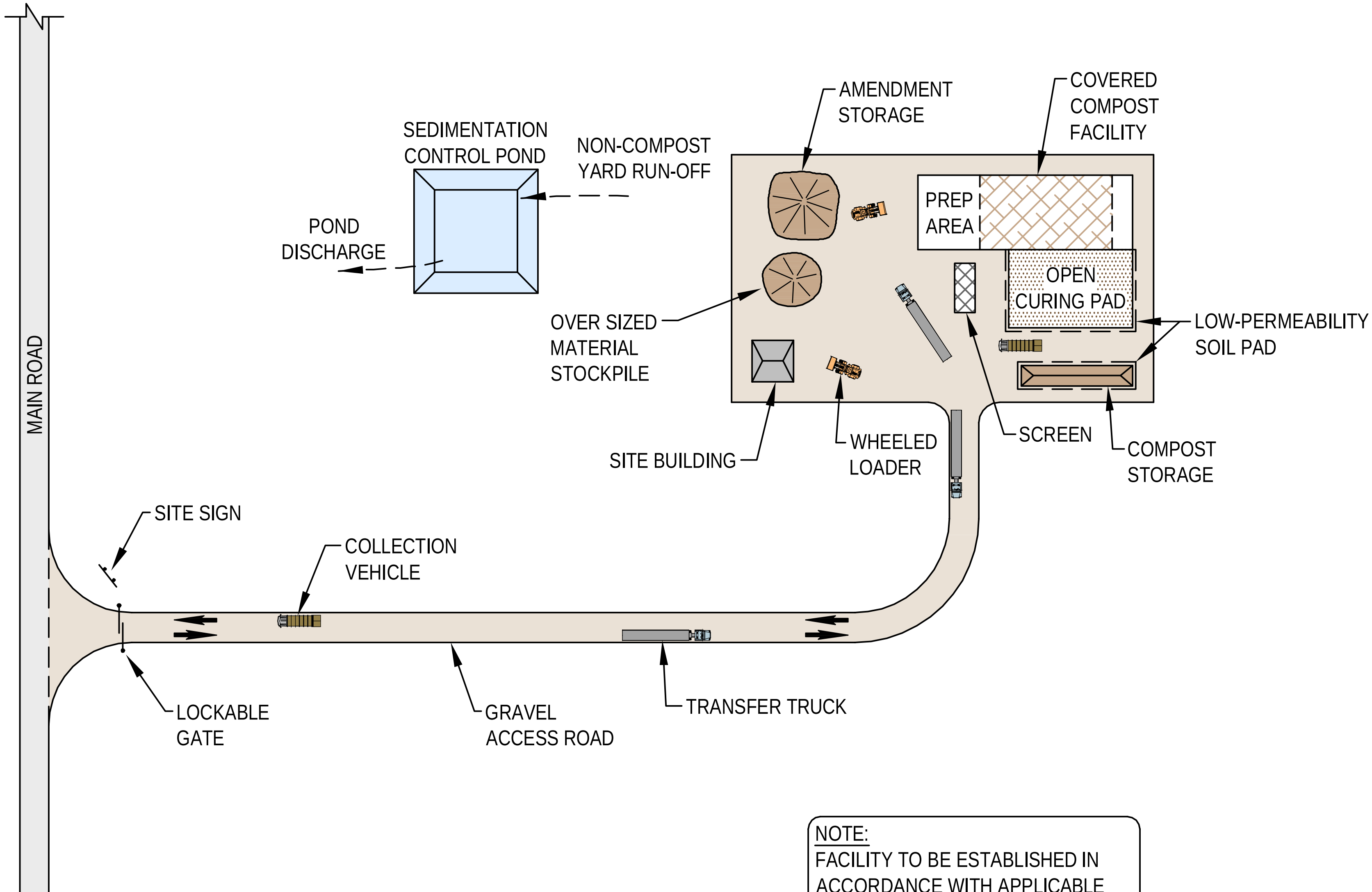

NOT FOR CONSTRUCTION

NOTE:
FACILITY TO BE ESTABLISHED IN ACCORDANCE WITH APPLICABLE BUFFER/SET-BACK REQUIREMENTS.

FIGURE G-3

GOVERNMENT OF NEWFOUNDLAND AND LABRADOR
STUDY OF OPTIONS FOR ORGANIC WASTE PROCESSING

LEVEL III COMPOST FACILITY

DILLON CONSULTING

CREATED BY: TLR
CHECKED BY: SDK
DESIGNED BY: CRS

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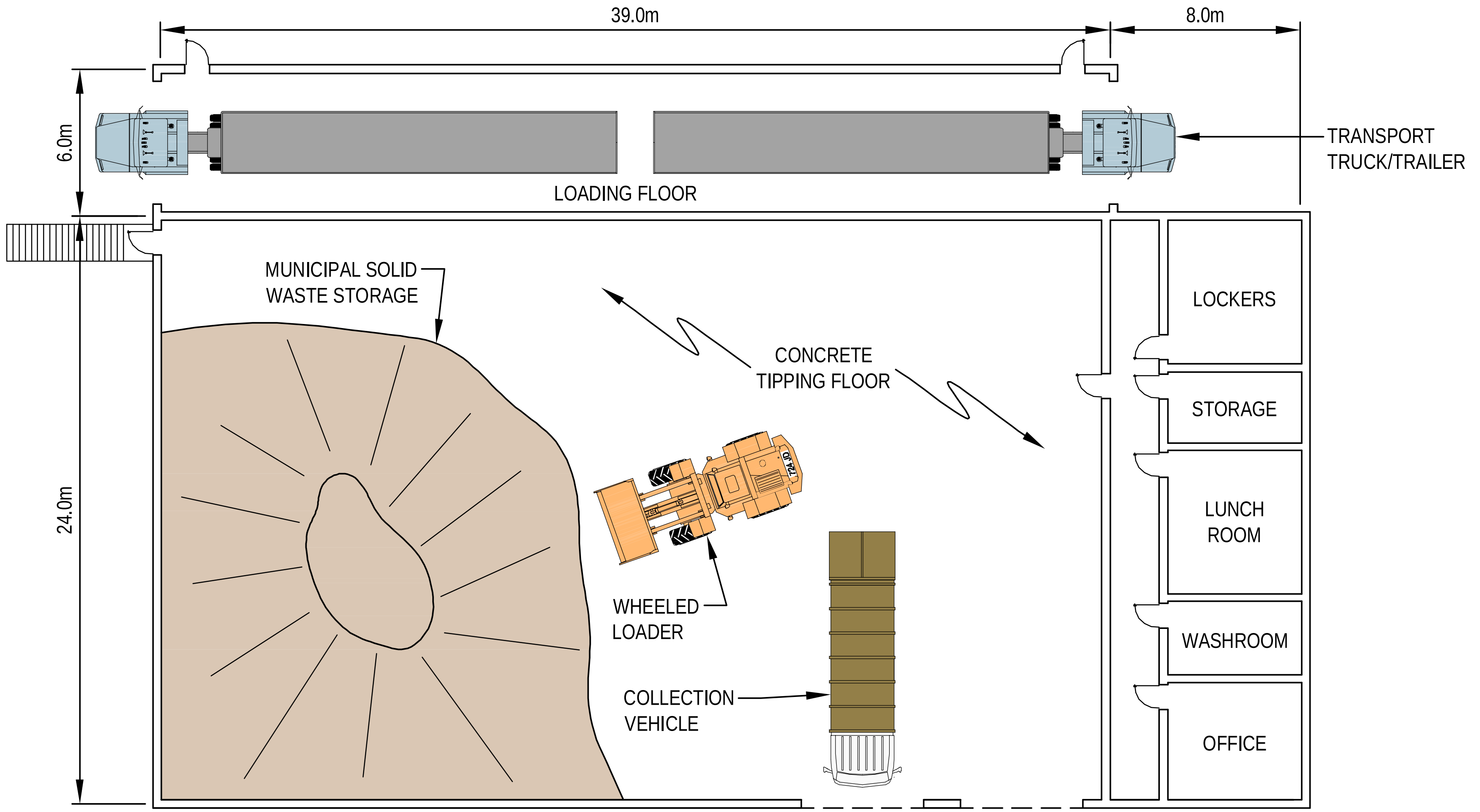

NOTE:
FACILITY TO BE ESTABLISHED IN ACCORDANCE WITH APPLICABLE BUFFER/SET-BACK REQUIREMENTS.

NOT FOR CONSTRUCTION

FIGURE G-4

GOVERNMENT OF NEWFOUNDLAND AND LABRADOR
STUDY OF OPTIONS FOR ORGANIC WASTE PROCESSING

NORRIS ARM
TRANSFER STATION - PLAN

DILLON CONSULTING

CREATED BY: TLR
CHECKED BY: SDK
DESIGNED BY: CRS

File Location:
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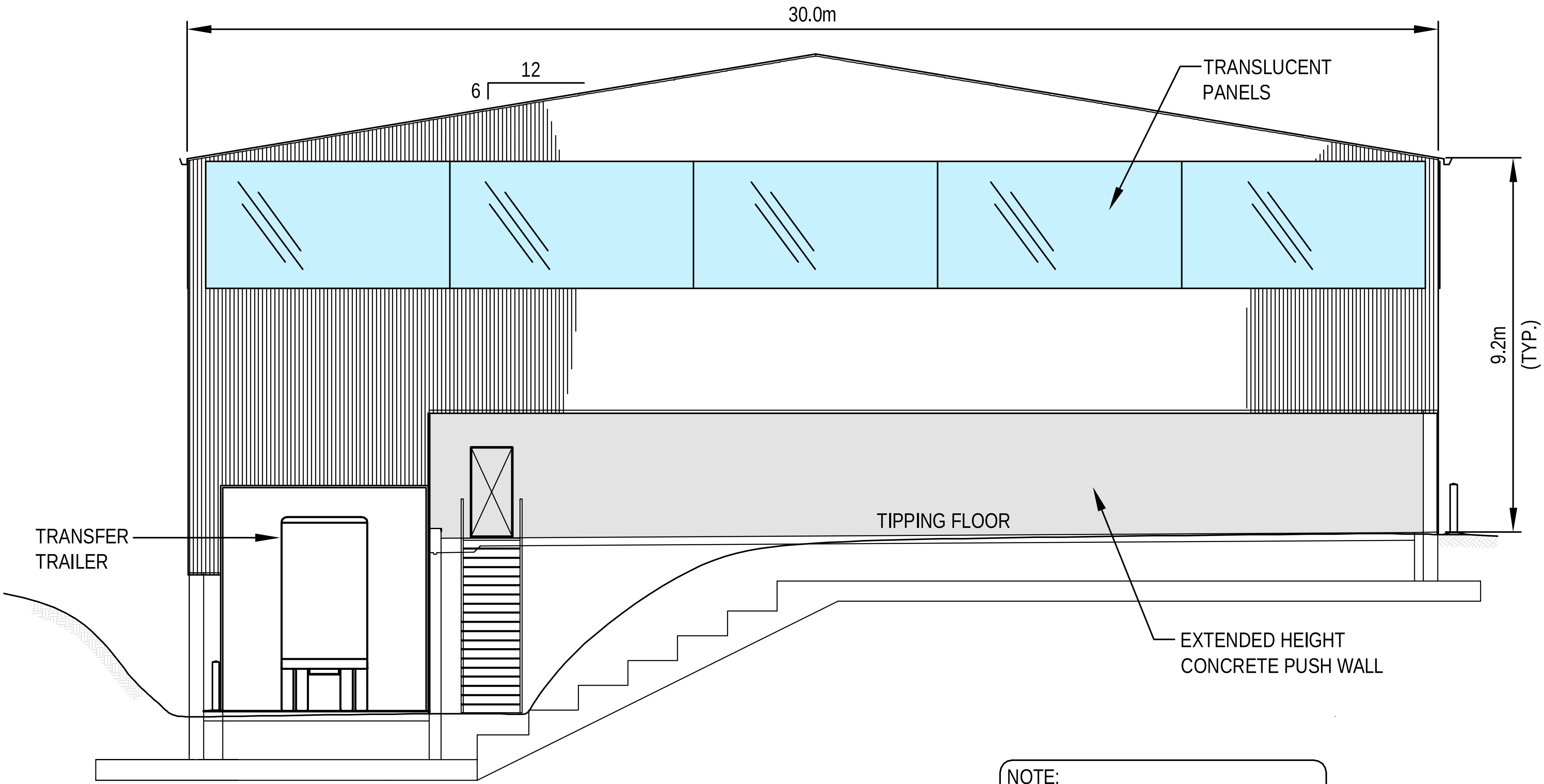

NOTE:
FACILITY TO BE ESTABLISHED IN ACCORDANCE WITH APPLICABLE BUFFER/SET-BACK REQUIREMENTS.

NOT FOR CONSTRUCTION

FIGURE G-5

GOVERNMENT OF NEWFOUNDLAND AND LABRADOR
STUDY OF OPTIONS FOR ORGANIC WASTE PROCESSING

NORRIS ARM TRANSFER STATION - SECTION

DILLON CONSULTING

CREATED BY: TLR
CHECKED BY: SDK
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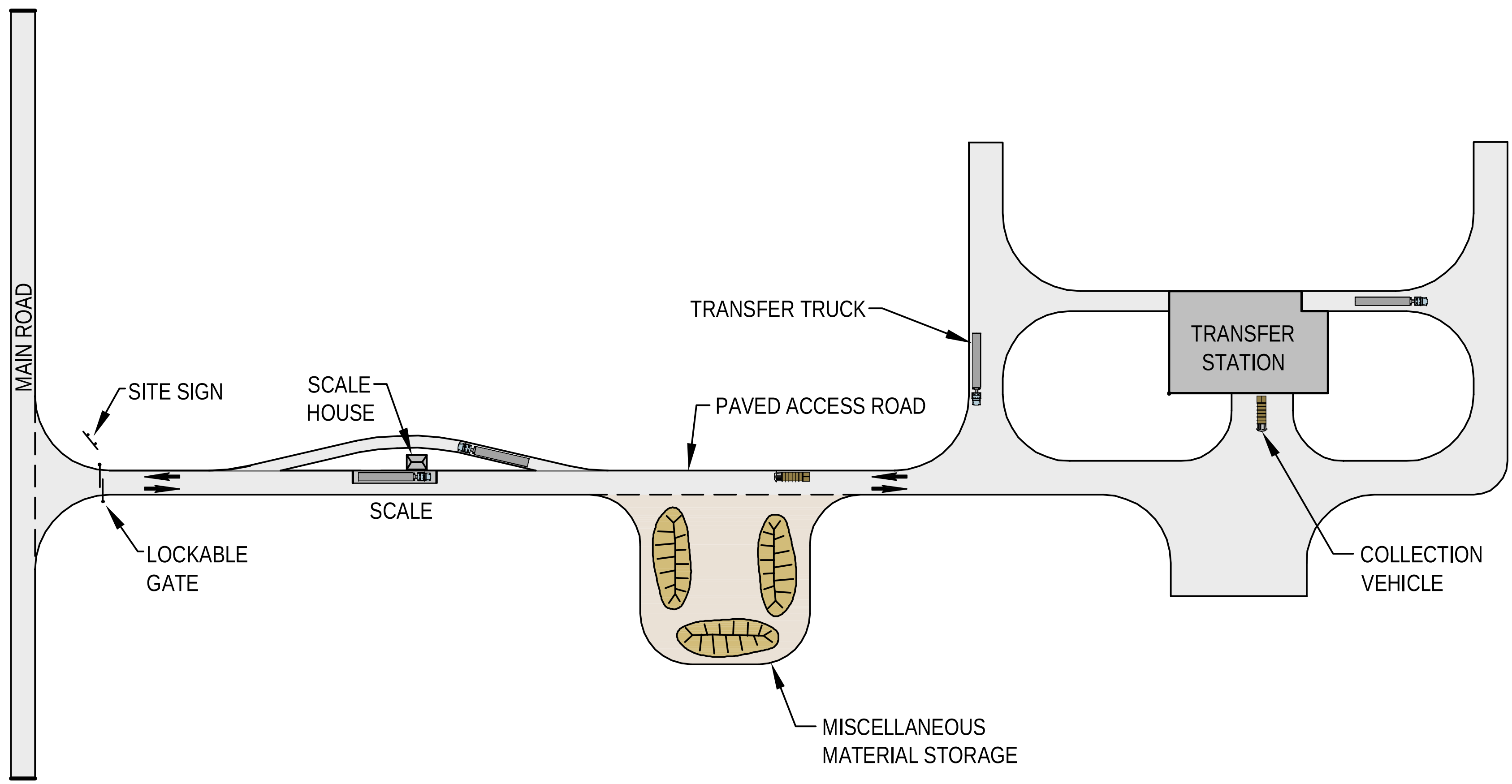

NOTE:
FACILITY TO BE ESTABLISHED IN ACCORDANCE WITH APPLICABLE BUFFER/SET-BACK REQUIREMENTS.

NOT FOR CONSTRUCTION

FIGURE G-6

GOVERNMENT OF NEWFOUNDLAND AND LABRADOR

STUDY OF OPTIONS FOR ORGANIC WASTE PROCESSING

NORRIS ARM TRANSFER STATION - LAYOUT

DILLON CONSULTING

CREATED BY: TLR
CHECKED BY: SDK
DESIGNED BY: CRS

File Location:
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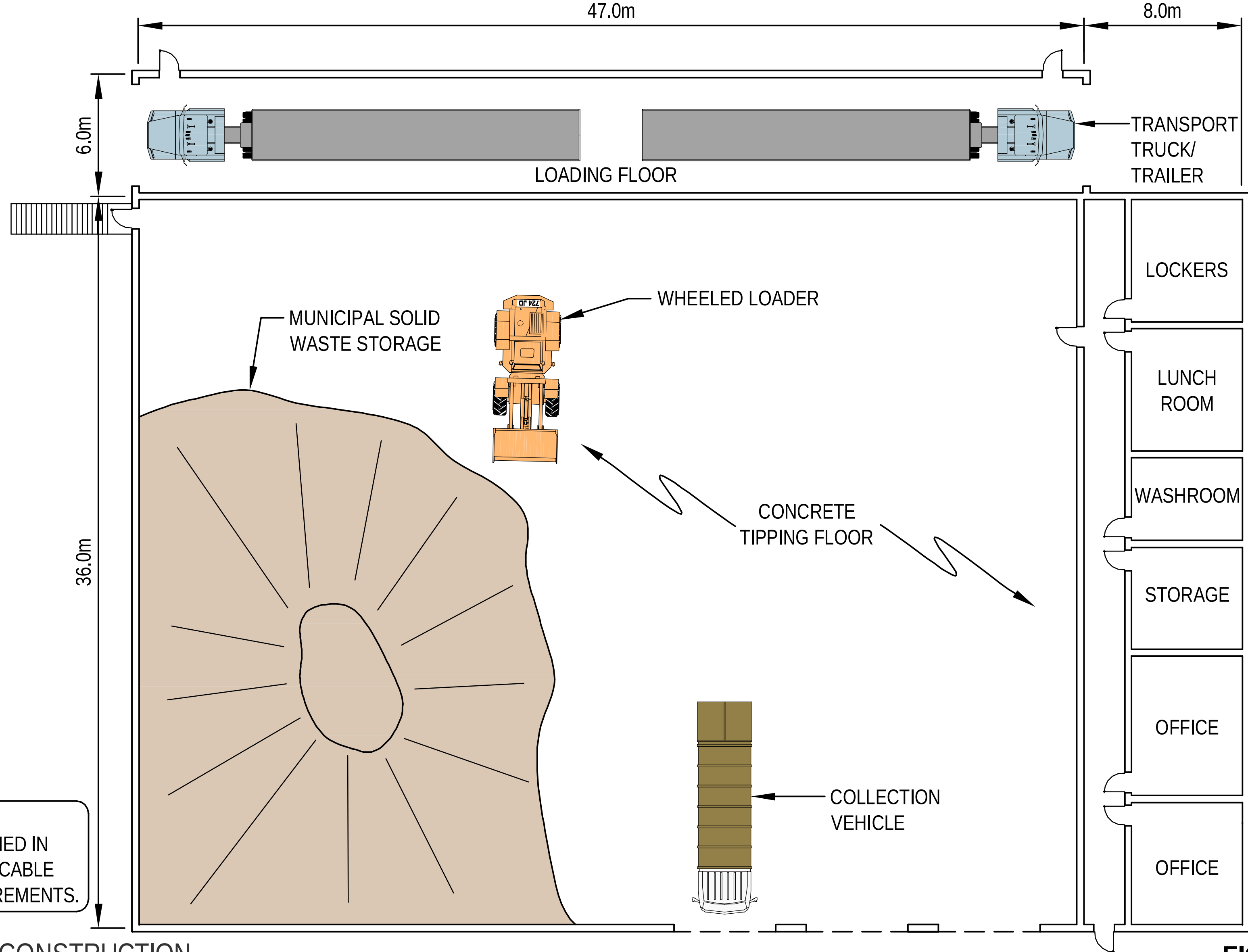

NOTE:
FACILITY TO BE ESTABLISHED IN ACCORDANCE WITH APPLICABLE BUFFER/SET-BACK REQUIREMENTS.

NOT FOR CONSTRUCTION

FIGURE G-7

GOVERNMENT OF NEWFOUNDLAND AND LABRADOR

STUDY OF OPTIONS FOR ORGANIC WASTE PROCESSING

DOG HILL TRANSFER STATION - PLAN

DILLON CONSULTING

CREATED BY: TLR
CHECKED BY: SDK
DESIGNED BY: CRS

File Location:
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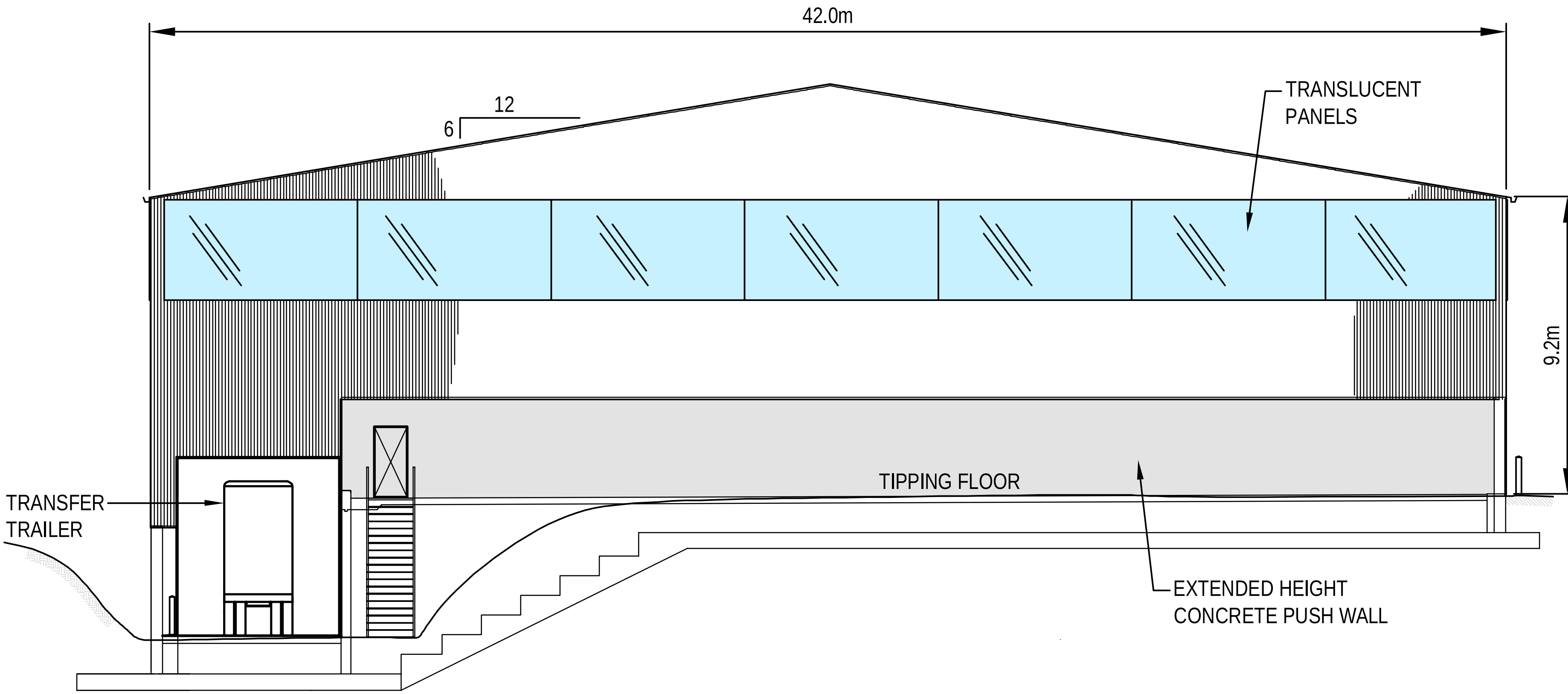

NOTE:
FACILITY TO BE ESTABLISHED IN ACCORDANCE WITH APPLICABLE BUFFER/SET-BACK REQUIREMENTS.

NOT FOR CONSTRUCTION

FIGURE G-8

GOVERNMENT OF NEWFOUNDLAND AND LABRADOR
STUDY OF OPTIONS FOR ORGANIC WASTE PROCESSING

DOG HILL TRANSFER STATION - SECTION

DILLON CONSULTING

CREATED BY: TLR
CHECKED BY: SDK
DESIGNED BY: CRS

File Location:
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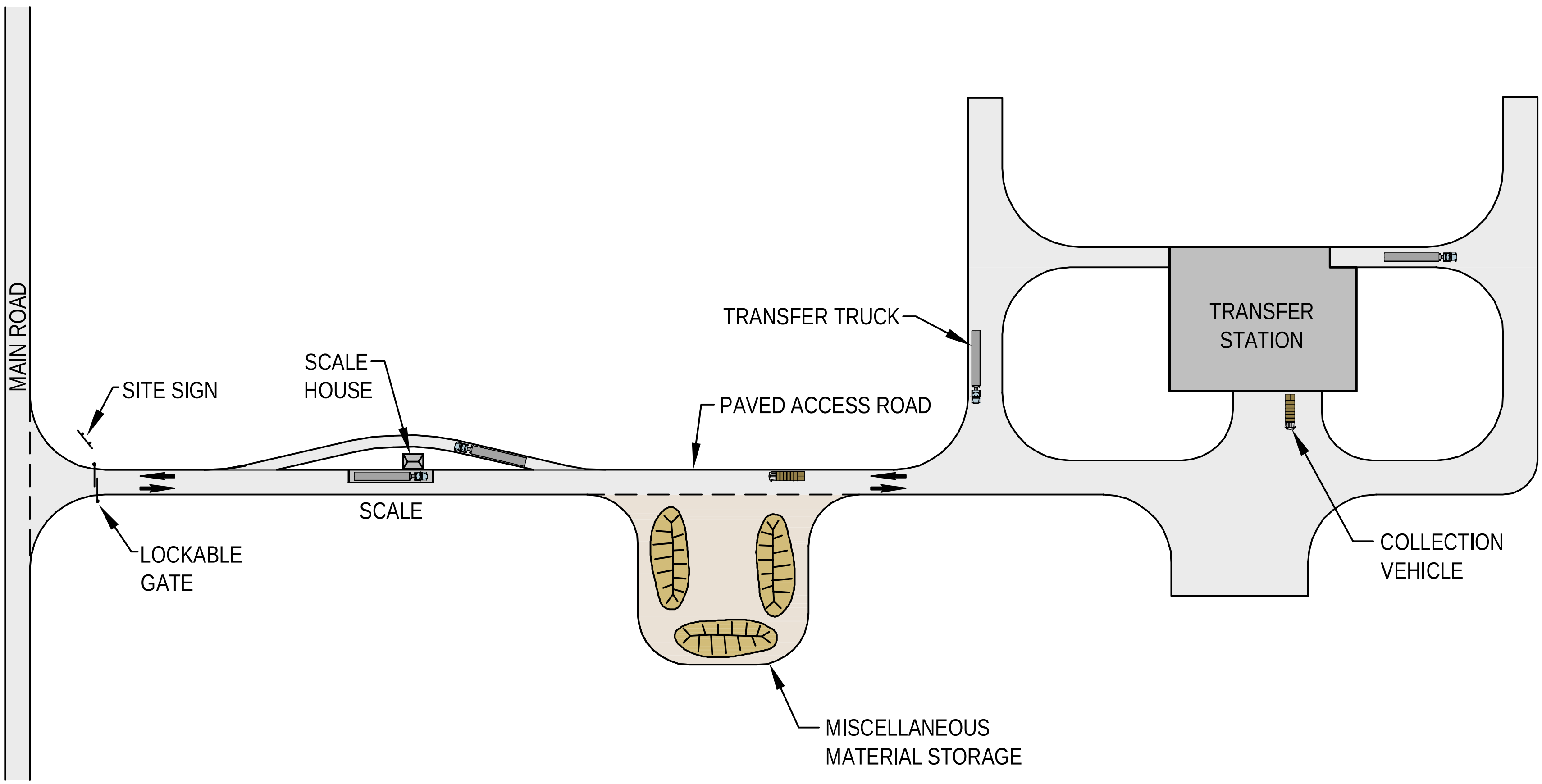

NOTE:
FACILITY TO BE ESTABLISHED IN ACCORDANCE WITH APPLICABLE BUFFER/SET-BACK REQUIREMENTS.

NOT FOR CONSTRUCTION

FIGURE G-9

GOVERNMENT OF NEWFOUNDLAND AND LABRADOR
STUDY OF OPTIONS FOR ORGANIC WASTE PROCESSING

DOG HILL TRANSFER STATION - LAYOUT

DILLON CONSULTING

CREATED BY: TLR
CHECKED BY: SDK
DESIGNED BY: CRS

File Location:
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PROJECT #: 13-8097 STATUS: REVISED FINAL DATE: 07/30/14

Appendix H
Greenhouse Gas Assessment

Appendix H-1-1
Estimation of GHG Impacts of Organics Diversion

Scen 1 Cumulative Waste Generation (Total) 17,337,724 tonnes of MSW (Robin Hood Bay & Norris Arm, 30 year total)

Homogenized Waste Characterization for NL

				Baseline (Landfill)	Alternative (Landfill)	Alternative (Composting)
1	*PAPER*	*26%*	*4,482,495*	*4,482,495*	*4,151,444*	*331,051*
1a	Cardboard (OCC)	8%	1,393,260	1,393,260	1,299,365	*93,895*
1b	Boxboard/Paper Tow	4%	761,299	761,299	524,143	*237,156*
1c	Newsprint/Other Pap	13%	2,327,936	2,327,936	2,327,936	0
2	*ORGANICS*	*30%*	*5,252,810*	*5,252,810*	*3,648,859*	*1,603,951*
2a	Food Waste	20%	3,519,038	3,519,038	2,107,716	1,411,322
2b	Yard Waste	4%	683,973	683,973	545,551	138,422
2c	Other	6%	1,049,799	1,049,799	995,592	54,207
3	*OTHER RECYCLABLES*	*16%*	*2,696,710*	*2,696,710*	*2,696,710*	*0*
4	*C & D*	*7%*	*1,201,504*	*1,201,504*	*1,201,504*	*0*
5	*OTHER*	*21%*	*3,708,539*	*3,708,539*	*3,708,539*	*0*
	Total	100%	17,342,059	17,342,059	15,407,057	1,935,002

Scen 1 Cumulative Organics Captured 1,935,970 tonnes

	Urban	Rural	Average	Organics (tonnes)
Food Waste	72.3%	73.5%	72.9%	1,411,322
Leaf and Yard	7.2%	7.1%	7.2%	138,422
Other Organics	2.8%	2.8%	2.8%	54,207
Boxboard and Paper Towel	12.7%	11.8%	12.3%	237,156
Cardboard and Other Paper	5.0%	4.7%	4.9%	93,895

Appendix I
Draft Report Review Meeting Minutes

Minutes of Meeting

Date/Time	December 16, 2013 1:00pm – 4:30pm NST	**File no.**	13-8097
Location	MMSB boardroom; 6 Mount Carson Ave, Mount Pearl	**Prepared by**	Chris Boone
Subject	Study of Options for Organics Waste Processing Draft Report Review		

Attendees

Chris Boone (CB) – Dillon
Scott Kyle (SK) – Dillon
Betsy Varghese (BV) – Dillon
Gary Ryan (GR) - MMSB
Rob Locke (RL) - Service NL
Derrick Maddocks (DM) – ENVC
Tammy McDonald (TM) – ENVC
Allan Scott (AS) – CRSB
Ed Evans (EE) – CRSB
Paul Arnold (PA) – Bio-logic
Jeff Saunders (JS) – CRSB
Jason King (JK) - WRSB
Don Downer (DD) – WRSB
Ed Grant (EG) – EWM
Gordon Murphy (GM) – MMSB
Frank Huxter (FH) – DMA
Ken Kelly (KK) – EWM
Chris Power (CP) – DMA
Cluney Mercer (CM) - DMA

Other Distribution

Attachments: -Draft Report Review Meeting Agenda, -Draft Report Review Meeting Attendees contact information, -Draft Report Presentation

NOTE: These minutes shall be considered the official record of the meeting. Required follow up actions are identified in *bold italics*.

Agenda items 2 through 9 were presented in a PowerPoint Presentation (see attached) completed by SK and BV.

1. <u>Introductions</u>
2. <u>Overview of Today's Session</u>
   a. FH spoke briefly about the Draft report and the purpose of this meeting. He made reference to his leaving DMA and CP taking over his responsibilities.
   b. SK provided an overview of the topics of discussion for the meeting covered in the agenda (distributed during the meeting).
3. <u>Highlights from September Meetings</u>
   a. BV reviewed the highlights of the Task 6 "50%" meeting and the Earth Bound Conference September meeting. Key items included the following:
      i. Concerns were raised with over-estimating waste generation quantities – Dillon has incorporated MMSB sub-regional waste generation data to estimate "rural" and "urban" per capita waste generation data. Rural rates based on $\leq$ 75 persons/km^2, Urban rates based on > 75 persons/km^2.
      ii. Two additional scenarios where added to the study.
      Scenario 4 – one facility (Central/Norris Arm) servicing areas with a 4-hour one-

way driving time.

Scenario 5 – two Facilities (Eastern, Western) with the Western/Central taking advantage of backhauling opportunities.

iii. Concerns were raised with oversizing facilities – Dillon added technology evaluation criteria “modularity of technologies” to prevent overcapacity of facilities and two-stage (initial and mature) capture rates.

4. Finalized Evaluation of Technologies
    a. BV presented the finalized evaluation of technologies.
        i. This was comprised of:
            1. The Long-List of Composting Technologies - Including Aerobic (Passive), Aerobic (Active) and Anaerobic categories.
            2. The Development of three levels of facility sizes – Including Regional/Centralized Facilities (Level I), Sub-Regional Facilities (Level II) and Small-Scale Facilities (Level III).
            3. The Evaluation Criteria and Weightings – Including Modularity of Technology (newly added), Technology Flexibility, Environmental Nuisance Control, Capital Costs and Operational & Maintenance Costs.
        ii. Resulting in the following preferred facilities for each size:
            1. Level I – Enclosed Aerated Static Pile and Static Container
            2. Level II – Windrow
            3. Level III - Windrow
5. Five Candidate Organic Management Scenarios
    a. BV presented the developed MSW waste compositions, the residential & ICI waste composition, future population growth and future waste stream forecast.
    b. BV presented the Industrial and Resource Sector Sources with conclusions. These sources included Agriculture, Fisheries, Aquaculture and Forestry. The ultimate conclusion presented was that organic waste quantities from non-MSW sources are not included in the analysis of this study.
    c. BV presented the five different study scenarios and discussed some of the assumptions for assembling the scenarios.
    d. EE stated that the central region has experienced a 7% increase in waste generation from last year. He stated that the population has remained relatively the same however there is less illegal dumping.
    e. DD stated that Scenario 1 as presented does not meet the expectations of the Western Region.
    f. FH stated that some of the assumptions for the locations of transfer stations are incorrect or have not yet been confirmed. FH also stated that given the some transfer stations locations are not finalized this may be an opportunity for waste and organic waste facilities to be combined. *ACTION: FH to provide information on which transfer stations are incorrect or have yet to be finalized.*

6. Scenario Analysis Assumptions

a. SK presented the 5 main categories including; capture rate, reference facilities for costing, determination of transfer/haulage costs, presentation of residential curbside collection costs, and calculation of annual and net present value.
b. SK presented the two stage capture rate which is based on Nova Scotia data. Stage 1 (2015 – 2024) 100 kg/person/year and Stage 2 (2025 – 2045) 150 kg/person/year.
c. KK voiced concerns with these numbers, believing they may be too large. SK stated Dillon will review the numbers further.
d. SK discussed the aspect of boxboard and paper towel in the organic waste. It is believed that 12% of the organic waste will be in this form and which will result in no chronic carbon deficiently levels for the composting process.
e. SK presented the reference facilities for costing. These included;
    i. Level Ia – 20,000 tpy (in-vessel/building system) – Existing PEI facility
    ii. Level Ib – 10,000 tpy (tunnel system) – Existing Sydney facility
    iii. Level II – 2,500 tpy (in-building windrow) – Existing Cumberland County, NS facility
    iv. Level III – 1,000 tpy (in-building windrow) – Existing Cumberland County, NS facility
f. SK presented schematic plans for each type of facility and showed an existing level I facility (Sydney) placed close to shopping centers.
g. PA stated that for all composting facilities it is very important to control moisture. Stated "If you do not control moisture you cannot control the process".
h. SK presented the methodology for producing the residential curbside collection costs. Presented that garbage collection and organics collection will occur on alternating weeks and therefore produce the same number of "truck passes" per year as a non-organics program.
i. The Western Region discussed that they are looking at doing weekly organics pickup, however the frequency of pickup will be the same as presented.
j. It was stated that Mount Pearl has had issues with cross contamination with split trucks in the past. It was also stated that the newer split trucks are better and should not cause this problem.
k. SK presented the calculation of Annual & Net Present Value Costs. It was assumed that transfer stations will already exist and therefore can also survey as organics transfer stations. It was discussed that the costs associated with mobile equipment should be reviewed to ensure that there are no redundancies (i.e., existing loaders for garbage transfer can be used for organics transfer). *ACTION: Dillon to review mobile equipment costs to ensure there are no redundancies.*

7. <u>Refreshment Break</u>
8. <u>Scenario Analysis Results</u>
    a. SK presented the financial results, % Organics Diversion Achieved and the % of Population Served for the 5 scenarios.

b. A discussion occurred regarding the fact that not all the solutions provided service to all (or almost all) the population. It was stated that the population not serviced will have to have organics still brought to a landfill.
c. It was stated that without composting of organic waste the 50% diversion will not be obtainable.
d. CM suggested he would like to see Scenario 1 and 5 to be modified to obtain 99.7% population served. *ACTION: FH stated DMA will evaluate and provide direction to Dillon regarding changes to the scenarios to obtain the 99.7%.*

9. Project Next Steps
    a. It was confirmed that all draft report comment are to go through FH.
    b. Referring to Section 8 in the Draft Report, SK presented a table with a proposed set of actions to establish an organics management program in Newfoundland. He confirmed that the proposed timeline was ambitious and would require a sustained level of communication and cooperation between the regions and the Province.

The meeting adjourned at approximately 4:30 pm.

<END>

Appendix J
Contacts

Contacts

Burke, Ashley. Business Development Officer, Multi Materials Stewardship Board, St. John's, NL. Tel: 709.753.0958, email: aburke@mmsb.nl.ca

Carlson, Matthew. Communications Officer, Newfoundland and Labrador Federation of Agriculture, St. John's, NL. Tel: 709.747,4830, email: mcarlson@nlfa.ca

Clarke, Bill. Ecosystem Manager, Department of Natural Resources, St. John's, NL. Tel: 709-729-0884, email: williamclarke@gov.nl.ca

Downer, Don. Chair, Western Regional Service Board, Corner Brook, NL. Tel: 709.632.2922, email: ddowner@swgc.mun.ca

Dunphy, Herb. Regional Coordinator, Coast of Bays Waste Management Corporation, Harbour Breton, NL. Tel: 709.885.2354, email: cobwma@gmail.com

Dunphy, Joe. Newfoundland and Labrador Department of Municipal Affairs, St. John's, NL. Tel: 709.729.5677, email: jdunphy@gov.nl.ca

Evans, Edward. Manager (soon-to-be CAO), Central Newfoundland Regional Service Board, Norris Arm, NL. Tel: 709.653.2900, email: ed@cnwmc.com

Hillyard, Amy. Waste Reduction Coordinator/Assistant Manager, Waste Check, Yarmouth, NS. Tel: 902.742.4404, email: amy@wastecheck.ca

Huxter, Frank. Director (Acting) Waste Management, Newfoundland and Labrador Department of Municipal Affairs, St. John's, NL. Tel: 709.729.7482, email: fhuxter@gov.nl.ca

Kawaja, Jonathan. Aquaculture Environment Planner, Department of Fisheries and Aquaculture, Grand Falls-Windsor, NL. Tel: 709.292.4104, email: jonathankawaja@gov.nl.ca

Kelly, Ken. CAO, Eastern Waste Management Committee, St. John's, NL. Tel: 709.579.7960, email: info@easternwaste.ca

Kenney, Bob. Solid Waste-Resource Analyst, Nova Scotia Environment, Halifax, NS. Tel: 902.424.2388, email: KENNEYBM@gov.ns.ca

King, Jason. Coordinator, Western Regional Service Board, Corner Brook, NL. Tel: 709.632.2922, email: wrwastemgmt@bellaliant.com

Lewis, Laurie. Diversion Planning Coordinator, Halifax Regional Municipality, Halifax, NS. Tel: 902.490.7176, email: lewisr@halifax.ca

Loveman, Lisa. Waste Management Coordinator, Green Bay Waste Authority Inc., South Brook, NL. Tel: 709.657.2233, email: info@greenbaywaste.com

MacDonald, Tammy. Senior Environmental Scientist, Newfoundland and Labrador Department of Environment and Conservation, St. John's, NL. Tel: 709.729.1810, email: TammyMcDonald@gov.nl.ca

Maddocks, Derrick. Director Pollution Prevention, Newfoundland and Labrador Environment and Conservation, St. John's, NL. Tel: 709.729.5782, email: dmaddocks@gov.nl.ca

Mills, Doug. Chair, Norpen Waste Management Authority, St. Anthony, NL. Tel: 709.454.3110, email: npwmc@yahoo.ca

Molloy, Bill. Resource Planning Supervisor - Processing. Department of Fisheries and Aquaculture, St. John's, NL. Tel. 709.729.3877, email: billmolloy@gov.nl.ca

Morgan, Sarah. Regional Coordinator, Bonavista Peninsula Regional Waste Management Committee, Port Union, NL. Tel: 709.468.8697, email: bprwmc@gmail.com

Murphy, Gordon. Senior Program Development Officer, Multi Materials Stewardship Board, Mount Pearl, NL. Tel: 709.757.0782, email: gmurphy@mmsb.nl.ca

Paris, Jerome. Director of Operations, Resource Recovery Fund Board NS, Truro, NS. Tel: 902.897.3265, email: jparis@rrfb.com

Pittman, Joe. Regional Coordinator, Burin Peninsula Waste Management Corporation, Burin Bay Arm, NL. Tel: 709.891.1717, email: info@burinpenwaste.com

Rayworth, Stephen. Solid Waste Manager, Cumberland Joint Services Management Authority, Amherst, NS. Tel: 902.667.5141, email: srayworth@cjsma.ns.ca

Ryan, Gary. Director of Programs - MMSB, Mount Pearl, NL. Tel: 709.753.0899, email: gryan@mmsb.nl.ca

Saunders, Jeff. Director of Engineering and Works, Town of Grand Falls-Windsor, Grand Falls-Windsor, NL. Tel: 709.489.0427, email: jsaunders@grandfallswindsor.com

Scott, Allan. Chairperson, Central Newfoundland Waste Management, Norris Arm, NL. Tel: 709.653.2900, email: allanscott@nfsympatico.ca

Short, Pat. President, Newfound Disposal Systems Limited, St. John's, NL. Tel: (709) 739-9302 x233, email: pshort@newfound.ca

Winter, Charmine. GIS Technician, Newfoundland and Labrador Department of Municipal Affairs, St. John's, NL. Tel: 709.729.6666, email: cwinter@gov.nl.ca

Appendix K
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