City of Sault Ste. Marie

Biosolids Management Study

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Executive Summary

Introduction

Waste water in the City of Sault Ste. Marie is treated at two separate sewage treatment plants; the East End and West End plants. The biosolids or sludge that is generated at these plants is dewatered and transported to the City of Sault Ste. Marie landfill for disposal. Historically approximately 10,000 tonnes of biosolids have been disposed of each year. The biosolids are approximately 25% solids and accounted for approximately 17% of the overall waste disposed of in 2013. The existing landfill is projected to have approximately 7.5 years of remaining disposal capacity (at the end of 2013).

Background

This Study was initiated in 2008, a public open house was conducted in December 2008 and a final Draft report was prepared in September 2009. The study completion was subsequently deferred at the request of technology vendors to allow them to make presentations and submissions to the City regarding the capabilities of their respective technologies. In addition the province of Ontario introduced new compost standards in July 2012 which impacted the evaluation of one of the alternatives. The evaluations and report have been updated to reflect the passage of time.

Problem/Opportunity

The City initiated this project to address the following problems/opportunities:

- The diversion of biosolids from disposal would enhance the projected longevity of the existing landfill.
- There may be an opportunity to further mitigate odours in transporting and managing the biosolids.
- There are challenges in managing the biosolids at the landfill due to its poor workability and high liquid content. This problem has been exacerbated with the significant reduction in fibrous materials landfilled (ie: increased diversion of paper type products) and the disposal of commercial waste in other sites.
- There is a shortage of earthen cover materials available at the landfill to meet future operational needs.

Class Environmental Assessment Process

Municipal infrastructure projects must be undertaken in accordance with the Environmental Assessment ("EA") Act. Municipal infrastructure projects of this type are not subject to a complete environmental assessment but are subject to a "Class" Environmental Assessment (“Class EA”). The Class EA process was developed to ensure that environmental concerns and public input are considered in the implementation of municipal infrastructure projects.

Under this process it is mandatory to consult with the public and relevant review agencies. Two pubic open houses were conducted to provide an opportunity for agencies, area residents and the general public to review and comment on the alternative solutions and design concepts being considered.

Input received through the public consultation process was considered in the planning and design of this project.

Biosolids Processing Alternatives

Alternative processing solutions were identified and assessed to address the identified problems/ opportunities. The biosolids processing alternatives included:

1. Do nothing – provides a basis for comparing the other alternatives.
2. Anaerobic Digestion – bacteria convert solids to a biogas (methane, carbon dioxide, hydrogen sulfide) in the absence of air.
3. Aerobic Digestion – air is introduced and dissolved oxygen and bacteria breakdown the solids and produce carbon dioxide and water.
4. Lime Stabilization – introduce an alkaline material and in some cases heat to raise the pH and reduce the microbiological population.
5. Geotube Freeze-Thaw – place biosolids in a geosynthetic “sock” and add polymers to allow water to drain by gravity over time.
6. Chemical and Heat Treatment – add chemicals and heat to lower the pH and reduce the microbiological population.
7. Enhanced Sludge Dewatering – reduced the liquid content through enhanced filtration and the introduction of heat.
8. Composting – an aerobic, self heating stabilization process requiring the introduction of an amendment to produce a suitable C:N ratio and improve porosity.
9. Pelletization – mixed with dust which coats the sludge granules and air dried to 80% solids content.
10. Incineration – combustion at temperatures in the range of 760°C to 870°C producing carbon dioxide and water.
11. Gasification – a high heat process (>700°C) in the absence of air to create a syngas.

A detailed evaluation of the alternatives was completed with due consideration of technical issues, natural and social environmental impacts and costs.

Preferred Processing Alternative

Based on the results of the evaluation there was a clear preference for **composting and alkaline stabilization**.

The principle reasons for selecting both processing alternatives are as follows:

- Both processes scored similarly in the evaluation and both eliminate the need for disposal of biosolids in the landfill.
- The processed material properties are similar to soil and are suitable for use as landfill cover or for other land application (eg. agriculture or forestry).
- The processed material is less odorous and safer to handle.
- No impacts to existing waste water treatment processes.
- Both are well established and reliable processes.

In addition to these processing alternatives, consideration was also given to the end use of the processed product and the location of a processing facility.

End Use Alternatives

Following the selection of a preferred processing strategy, three alternative end use applications were considered for the processed material:

1. Disposal in landfill.
2. Land application (agriculture or forestry).
3. Landfill cover.

An evaluation of these end uses was completed with due consideration of technical criteria, environmental benefits and costs.

Preferred End Use Alternative

Based on the results of the evaluation, the preliminary preferred end use for the processed material is landfill cover. The principle reasons for the selection of this alternative are as follows:

- Reduced land area requirements for application.
- No timing restrictions for application resulting in reduced storage area requirements.
- Less onerous administrative requirements.
- Lower costs and less potential for future liability.

The City also recognizes that Vendors may have an interest in marketing and distributing the processed material. Consideration of other end use alternatives will be permitted during the implementation phase.

Alternative Sites

Following the selection of preliminary preferred processing and end use alternatives, three alternative locations were considered for the proposed processing facility:

1. East End Sewage Treatment Plant;
2. West End Sewage Treatment Plant; and
3. The Municipal Landfill Site.

An evaluation of these sites was completed with due consideration of potential land use, transportation and nuisance impacts.

Preferred Site

Based on the results of the evaluation the preliminary preferred site selected to host the facility is the landfill.

The principle reasons for the selection of this site are as follows:

- Minimizes the total travel distance/time and related impacts.
- Will provide a means of mitigating biosolids odour issues at the landfill.
- Can be integrated with current operations.
- Vacant land is available on site.
- Lower density of sensitive uses in proximity to the site.

The City is also investigating upgrades to the trailers that are used to transport biosolids to the landfill site with the intent of mitigating odours during transport.

Conclusions and Recommendations

This project has been planned as a Schedule B undertaking under the Municipal Class EA process. A number of processing alternatives and facility locations were considered and evaluated. Two processing technologies – alkaline stabilization and composting received similar scoring and are capable of addressing the objectives that were established at the onset of the study. The City is encouraged to consider the following conclusions and recommendations:

- Construct a biosolids processing/management facility at the landfill site using a request for proposal process (RFP);
- The RFP should allow vendors that are capable of processing dewatered bisosolids using composting or alkaline stabilization technologies;
- The Terms of Reference (TOR) for the RFP should be developed to allow consideration of key performance criteria with particular emphasis on managing odours at the site and long term costs;
- The City should consider including, in the TOR, the service of transporting the biosolids to the landfill site from the two WPCPs with significant emphasis on managing odours enroute;
- Although the preferred end use of the processed biosolids is landfill cover, the TOR should provide adequate opportunity for qualified vendors to provide other end use management options;
- The on-site processed material storage facilities should consider a range of possible end use alternatives;
- The City should consider financing options for project implementation including potential funding from higher levels of government; and
- The City should consider various alternatives for implementation including conventional design and tender, design/build, design/build/operate and design/build/operate/finance.

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1. Introduction

The City of Sault Ste. Marie (the City) retained a consultant team comprising of AECOM and Dillon Consulting (“Dillon”) to assist in developing a Biosolids Management Plan. The Plan is intended to address the long term (20 years) management of biosolids generated at two water pollution control plants (WPCPs). The study was initiated in 2008 with a draft final report issued in September, 2009. The final completion of the study was subsequently delayed to allow consideration of unsolicited proposals from various technology vendors.

1.1 Current Management Practices

Wastewater in the City is treated at two WPCPs; the East End Water Pollution Control Plant (“EEWPCP”), and the West End Water Pollution Control Plant (“WEWPCP”). Biosolids from the City’s two WPCPs is currently disposed of in the City’s landfill. The landfill has an estimated 7.5 years of remaining disposal capacity[1] and in recent years the biosolids accounted for approximately 15% - 17% (by weight) of the overall waste disposed.

Each WPCP is described in the following subsections.

<u>East End Water Pollution Control Plant (EEWPCP)</u>

The EEWPCP is located at 2221 Queen Street East in the City’s east end. It was converted from a primary treatment facility to secondary treatment in 2006. It is a Biological Nutrient Removal (BNR) Plant and treated effluent is discharged to the St. Mary’s River.

The upgraded plant includes preliminary, primary and secondary treatment, followed by disinfection. Preliminary treatment consists of screening and grit facilities to remove large objects and heavy particles such as sand. Primary treatment consists of rectangular primary clarifiers to remove settleable solids. Secondary treatment consists of a continuous flow activated sludge process designed for BNR to provide biological phosphorus removal and nitrification/denitrification (removal of ammonia and nitrogen). The BNR process consists of bioreactors (large aerated tanks with multiple cells) and secondary clarifiers to remove suspended solids. In addition, a primary sludge fermenter provides the BNR process with the short chain volatile fatty acids required for biological phosphorus removal.

The secondary effluent from the BNR process is disinfected with ultraviolet (UV) lights installed in concrete channels. Following UV disinfection the final effluent is discharged to the river through a 1600 mm (64 inch) diameter sewer. Primary sludge from the primary clarifiers is thickened and fermented in the primary sludge fermenter. Waste activated sludge from the BNR process is mechanically thickened. The thickened primary sludge and waste activated sludge are mixed and dewatered using centrifuges prior to being trucked off site for disposal at the City’s landfill.

[1] *2013 Site Development and Operations Report, Sault Ste. Marie Municipal Landfill*

West End Water Pollution Control Plant (WEWPCP)

The WEWPCP is located at 55 Allen's Side Road in the City's west end. It is a conventional activated sludge treatment plant, approximately 28 years old. Treated effluent from the plant is discharged to the upper St. Mary's River southeast of Leigh Bay.

The treatment process at the WEWPCP includes preliminary, primary and secondary treatment, followed by disinfection. Preliminary treatment consists of screening and grit facilities to remove large objects and heavy particles such as sand. Primary treatment consists of rectangular primary clarifiers to remove settleable solids. Secondary treatment consists of large aerated tanks (activated sludge), phosphorus removal, and secondary clarifiers.

The secondary effluent from the treatment process is disinfected with gas chlorination, dechlorinated with sodium bi-sulphite and discharged to the river. A by-product of the process is a blended sludge comprising of raw (primary) sludge and waste activated sludge. Polymer is added to the sludge to aid in the dewatering process. The blended sludge is dewatered using plate filter presses prior to being trucked off site for disposal at the City's landfill.

A study was completed in 2014 to identify process improvements,future facility and equipment replacements at the WEWPCP. The study identified replacement of the plate and frame presses with centrifuges as a high priority need due to the age of the presses and the difficulties in sourcing replacement parts.

1.2 Study Objective

The objective of this study is to review alternative biosolids management strategies and develop a sustainable and effective strategy that reduces the impact on the City's landfill, more effectively manages nuisance odours, has wide public support and is cost effective and environmentally friendly.

The overall study process will be guided by the Municipal Engineers Association Class Environmental Assessment document (refer to Section 1.3 of this report) and the National Guide to Sustainable Municipal Infrastructure for Biosolids Management Programs. The latter document addresses best practices for biosolids management and has been developed to realize the following benefits:

- Compliance with regulatory requirements;
- Improved biosolids quality;
- Improved odour management;
- Improvements in safety;
- Wider public acceptance;
- Improved cost effectiveness; and
- Sustainability.

In order to achieve these objectives the following tasks/activities will be undertaken:

- Summarize the existing biosolids management practices;

- Identify alternative biosolids management strategies;
- Identify appropriate evaluation criteria that reflect the study objectives;
- Complete a thorough evaluation process;
- Solicit public and agency input; and
- Select a preferred long term biosolids management strategy.

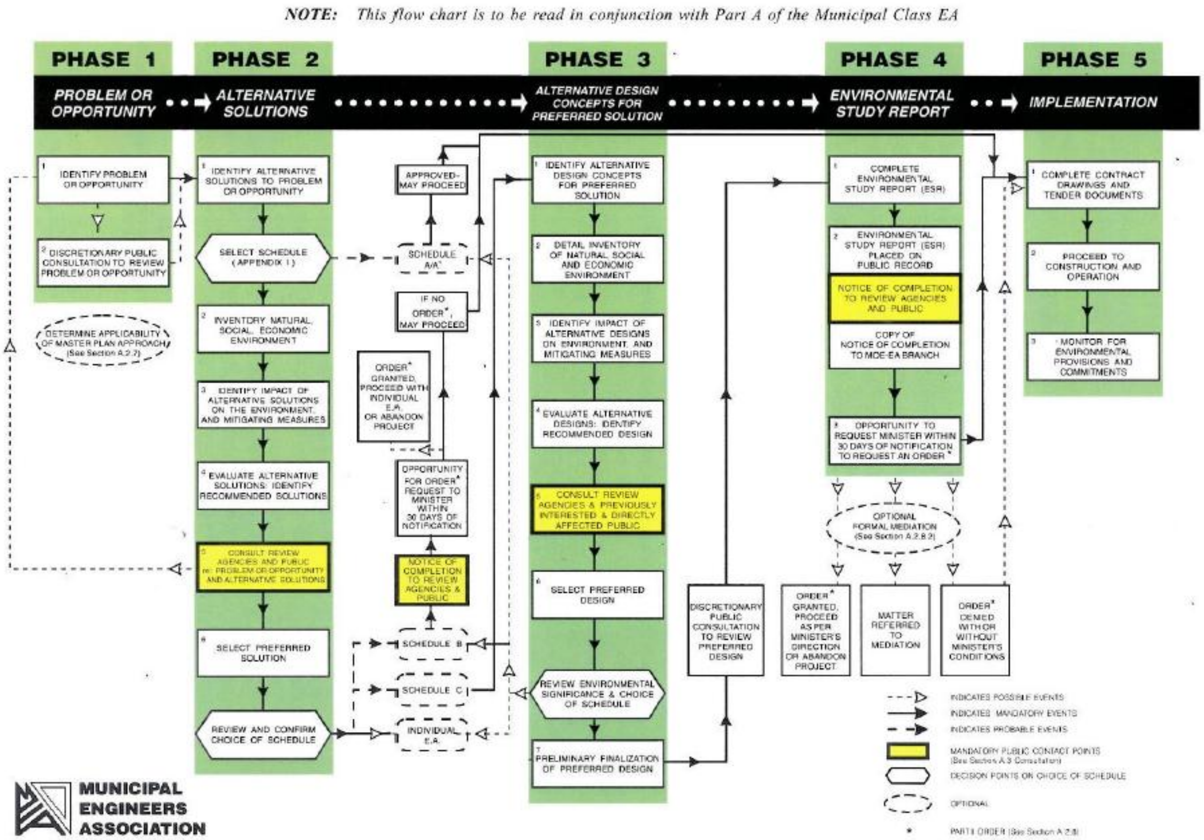
1.3 Municipal Class Environmental Assessment Process

This project is being undertaken in compliance with the Environmental Assessment Act ("EA Act"). The EA Act was enacted by the Province of Ontario to ensure that all reasonable alternatives and environmental impacts are identified and public input is solicited during the implementation of public undertakings.

Municipal wastewater undertakings are not subject to a full environmental assessment but are subject to a Class Environmental Assessment (Class EA). The Class EA process does not require formal ministerial approval provided the municipality complies with the activities and procedures set out in the pre-approved document entitled "Municipal Class Environmental Assessment - October 2000, as amended in 2007 and 2011" prepared by the Municipal Engineers Association (MEA). That document provides a planning framework that must be followed to ensure that Public and Agency concerns are properly addressed throughout the development of the proposed solutions and designs. The Municipal Class planning and design process is shown in Figure 1.3 (a).

Since impacts or potential impacts from a project can vary, projects are classified as Schedule A, A+, B or C. These schedules are fully described in the Municipal Class EA document but in general Schedule A projects are limited in scale, are expected to have minimal adverse impacts and are pre-approved without having to following the Class EA planning process, whereas Schedule C projects have the potential for significant environmental effects and therefore must proceed under the full planning process.

At the conclusion of the Alternatives solutions evaluation, this project was confirmed to be a Schedule “B” undertaking.



Source: Municipal Engineers Assosciation (October 2000 as amended in 2007 and 2011)

Figure 1.3(a): Municipal Class Planning and Design Process

1.4 Environmental Study Report ("ESR") and Part II Order Provisions

In general, the Environmental Study Report ("ESR") documents the Class EA planning and design process.

Following its completion, the ESR is placed in the public record for a review period of thirty calendar days. Copies of the ESR are also filed with the Ministry of the Environment and Climate Change (MOECC) and any other Agency that requests a copy. If there are no irreconcilable objections to the proposed undertaking during the mandatory thirty day review period, the project may proceed to final design and construction. If concerns are raised that cannot be resolved, the objector may request a Part II Order.

The Part II Order is a provision in the process for elevating the status of a project to a more rigorous Schedule (e.g. Schedule B to Schedule C or from a Class EA to an individual environmental assessment). This provision is necessary to allow for special treatment of those undertakings that may carry significant adverse environmental effects. Members of the public, interested groups, or government agencies may request a Part II Order for a specific project. The MOECC assesses any requests for a Part II Order and determines whether it is warranted.

1.5 Public Involvement

The Class EA process includes provisions for consultation with the general public and provincial and federal review agencies. Review agencies and the general public were invited to provide input at key milestones in the Class EA process.

2. Problems/Opportunities

This study was initiated to develop a sustainable, cost effective, long-term plan for managing biosolids generated at the two WPCPs. The specific problems/opportunities to be addressed within the context of the study are summarized as follows:

- Wastewater in the City is treated at two separate WPCPs; the EEWPCP and the WEWPCP. The biosolids are dewatered at each plant and transported to the City of Sault Ste. Marie landfill for disposal. Historically approximately 10,000 tonnes of biosolids have been disposed of each year. The biosolids accounted for approximately 15% to 17% of the overall waste disposed of in recent years. The existing landfill is projected to have approximately 7.5 years of remaining disposal capacity. The diversion of biosolids from disposal would enhance the projected longevity of the existing landfill.
- In accordance with the City's objectives of continual improvement there may be an opportunity to further mitigate odour generated in transporting and managing the biosolids.
- The biosolids are difficult to manage at the landfill site, due to their high liquid content (approximately 75% liquid) and poor workability. This problem has been exacerbated with the significant reduction in fibrous materials landfilled due to increased diversion of fibres.
- The manageability of the biosolids at the working face could become more problematic in the future with possible reductions in the quantity of residential and IC&I wastes disposed of at this landfill site. The City has committed its curbside residential waste stream to an energy-from-waste vendor and some of the IC&I waste may be diverted to waste disposal sites elsewhere.
- There is a shortage of earthen cover materials at the landfill site and there may be an opportunity to use processed biosolids or processing by-products as cover material.

These problems/opportunities are addressed within this study.

2.1 Projected Biosolids Quantities

The quantity of biosolids disposed of in the City’s landfill over the past five years is summarized in Table 2.1(a).

Table 2.1(a) HISTORICAL BIOSOLIDS QUANTITIES	
Year	Quantity (tonnes)[1.]
2009	10257
2010	10215
2011	10144
2012	9687
2013	9415
Average	9944

1. Quantities reflect "wet" dewatered tonnes (ie. approximately 25% solids).

Future quantities of biosolids will be dependent on population. The City's population peaked in the early 1980's, remained relatively stable (in the range of 80,000 to 83,000) for a period of approximately 15 years, declined through the 1990's and has been relatively stable since 2000. The historical decline in population is largely attributable to industry downsizing and its ripple effect in the service and retail sectors.

In 2008 the City Planning Division updated population and household projections. Their report suggests that the population will remain relatively stable near 75,000 through 2011 and grow at a modest rate to 82,500 by 2026 as the City's population ages and the community attracts new migrants to fill job vacancies.

For the purpose of this study, the 2006 and 2011 population was obtained from the census data and projections to 2026 were obtained from the City Planning Division report. The population projections are included in Table 2.1(b).

Table 2.1(b) POPULATION PROJECTIONS					
	2006	2011	2016	2021	2026
Sault Ste. Marie	74,948	75,141	77,594	80,047	82,500

Based on these projections, it is anticipated that the population may have a moderate impact on biosolids quantities over the next 20± years. The average annual quantity of biosolids landfilled between 2009 and 2013 has been used as a basis for this report. It has also been assumed that this quantity may increase moderately (i.e. 10%) throughout the 20 year planning period.

For the purposes of this study (i.e. comparison of the alternatives) we have assumed the annual quantity of dewatered biosolids that will require management is 10,000 tonnes. At the time of project implementation further consideration should be given to the required facility processing capacity.

3. Identification and Evaluation of Alternative Biosolids Processing and Management Solutions

The Class Environmental Assessment process requires the proponent to identify and evaluate all reasonable alternative solutions/designs to the identified problem/opportunity. The following alternative processing and management solutions have been identified and assessed within the context of the study:

Processing Alternatives (refer to Sections 3.1.1 to 3.1.9)

- Do Nothing
- Digestion Process
  - Anaerobic digestion
  - Aerobic digestion
- Alkaline stabilization
- Geotube freeze-thaw
- Chemical and heat treatment
- Enhanced sludge dewatering
- Composting
- Thermal Process
  - Incineration
  - Pelletization
  - Gasification

Management Alternatives (refer to Sections 3.2.1 to 3.2.4)

- Agricultural land application
- Non-agricultural land application
- Landfill cover
- Industrial re-use

3.1 Processing Alternatives

A range of processing alternatives has been considered in view of recent technical advances, scientific research and existing and evolving legislation. A brief description and the pros and cons of each processing alternative are presented in the following subsections.

3.1.1 Do Nothing

Under this alternative no changes to the current approach to managing the biosolids would be undertaken. The dewatered biosolids from each of the two plants would continue to be disposed of in the municipal landfill. This alternative has been included to provide a basis for comparing the other alternatives.

3.1.2 Digestion Process

Conventional digestion processes that can be used to allow direct land application of stabilized biosolids include:

- Mesophilic Anaerobic Digestion; and
- Aerobic Digestion.

Advanced digestion processes can be used to produce a better quality biosolids product, termed Class A biosolids under the U.S. Environmental Protection Act (EPA) Part 503 Rule. Advanced digestion processes include:

- Thermophilic Anaerobic Digestion;
- Staged Anaerobic Digestion which includes Staged Mesophilic Digestion, Staged Thermophilic Digestion, and Temperature Phased Anaerobic Digestion (TPAD);
- Autothermal Thermophilic Aerobic Digestion (ATAD or ATTAD);
- Vertad™ (Vertical ATAD); and
- Dual Digestion (Aerobic/Anaerobic).

3.1.2.1 Anaerobic Digestion

In the absence of air, anaerobic acid forming bacteria convert volatile solids present in sludge to simple organic acid molecules. The organic acids are converted by methanogenic bacteria to methane and carbon dioxide, i.e., biogas. The biogas contains approximately 65 to 75% methane, with the rest of the biogas consisting of carbon dioxide and small amounts of hydrogen sulfide. The methanogenic bacteria are slow growing microorganisms requiring stable environmental conditions for effective growth and volatile solids removal. The temperature for the anaerobic digester has to be kept above 30°C for efficient conversion of volatile solids to biogas. There are two temperature ranges for anaerobic digestion; mesophilic digestion process operating between 30 to 35°C and thermophilic digestion at 55°C. Typical digestion operation is in the mesophilic temperature range.

Typical anaerobic sludge digesters consist of a primary or heated digester followed by an un-heated secondary digester. In the primary digester most of the digestion process is completed while the secondary digester provides solids settling and separation from supernatant and storage with some additional sludge stabilization. The hydraulic retention time in the primary digester has to be in excess of 15 days as per the MOECC design guidelines. This will provide approximately 50% of volatile solids removal, i.e., sludge stabilization together with pathogenic organisms kill. The secondary digester has to be approximately twice the size of the primary digester. In the secondary digester, digested sludge is settled and stored and supernatant discharged. This supernatant contains high BOD, TSS, ammonia and phosphorus loads that have to be treated by the sewage treatment plant. To minimize the impact of additional contaminant loads on existing treatment capacity, digester supernatant may have to be pretreated together with centrate or filtrate produced during sludge dewatering. For example, in the presence of magnesium hydroxide, ammonia and phosphorus could form a precipitate that combines all three compounds as struvite. The chemistry could be adjusted such to maintain the optimum pH and ammonia to phosphorus to magnesium ratio to promote the formation of struvite precipitate. The precipitate could be captured by a clarifier and used as a fertilizer.

The recommended pre-treatment process may contain the following treatment steps:

- Chemical addition, such as ferric chloride or alum to precipitate out phosphorus.

- Coagulation and flocculation to enhance precipitate formation and solids removal. A polymer may be added to enhance solids separation and the solids content of collected sludge.
- Solids separation using a sludge blanket clarifier. This type of clarifier operates with a sludge blanket that acts as a filter thereby enhancing solids removal and solids content of settled sludge. As an alternative DensaDeg® process may be used. This proprietary technology would utilize the above treatment steps for solids removal and thickening of settled sludge.

The following anaerobic sludge digestion configuration may be used by the City:

- Waste activated sludge and primary sludge blending and thickening to a minimum of 4% solids content. This step will reduce the digester tank volume. Thickening technology may include conventional gravity thickening, gravity belt thickener and rotating drum thickener. For the mechanical thickening processes a polymer will have to be added to the raw sludge, while gravity thickening may not require any conditioning.
- Settled sludge from the secondary digester will be added to the digester feed to provide active biomass for sludge digestion.
- Feed to the digester will be heated to 33°C to achieve high volatile solids removal.
- The primary digester tank will be covered by a fixed cover and will have approximately 2000 m^3 of volume. The digester contents will be mixed to facilitate sludge digestion and prevent stratification in the reactor tank.
- The secondary digestion step will consist of 2 digester tanks, each with approximately 2,000 m^3 of volume. One of the secondary digesters will be covered with a floating cover to facilitate supernatant decanting and periodic sludge withdrawal. The digestion system will provide approximately 50 to 60 days of sludge storage.
- The digester system will be equipped with appropriate gas handling system, including a flare.
- Digested sludge would be removed from the digester and dewatered for landfilling or land application. In case of land application, additional storage for digested sludge will be expected to meet MOECC sludge storage best management practice of 280 days.
- The digested sludge will have a solids concentration of approximately 3.5% with a total estimated volume of 49,440 m^3/year. Because of the large volume, sludge will have to be dewatered before disposal.
- Sludge dewatering could be completed using existing dewatering system. It is estimated that the solids content of dewatered sludge would be similar to the existing sludge (ie. approximately 25% solids). It is estimated that the volume of waste sludge generated, following sludge dewatering, would be reduced to approximately 6200 m^3/year from estimated present rate of 10,000 m^3/year. This represents approximately 40% volume reduction as a result of anaerobic sludge digestion.
- The digestion process may produce approximately 1,500 m^3/d of biogas with a 200 MJ/d of heat and 130 kW of electricity recovery potential in a co-generator. The recovered heat could be used to heat the feed to the digester and the electricity to supplement power demand for the sewage treatment process. This feature may support an application for funding depending on the programs available at the time of implementation.

The digested sludge could be used as a soil amendment for land application or be disposed of at the landfill. The dewatered and digested sludge will not likely be suitable for use as day cover at the landfill as it would still have some residual odour as a result of the anaerobic digestion process.

The upgraded digesters at the Ravensview WWTP at Kingston, Ontario are operating at thermophilic temperatures. The implementation of a new anaerobic digester equipped with thermophilic capability (operating at 55°C instead of 35°C) helped Ravensview WWTP to surpass current biosolids management requirements. The process increased biogas production for the Cogeneration Facility and achieved a higher level of sludge stabilization and pathogen kill. The sludge produced through the upgraded digestion process meets the United States Environmental Protection Agency (US EPA) requirements for “Class A” biosolids, which have “virtual absence of pathogens” which can be land-applied with significantly less environmental restrictions.

Biosolids produced at the Burlington Skyway, Mid-Halton, Oakville South East and South West, Georgetown, and Acton WWTPs are stabilized on-site in anaerobic digestion processes prior to land application, landfilling, or haulage to off-site biosolids storage.

Other examples of anaerobic digestion facilities include:

- Region of Waterloo WWTPs, Ontario: Waterloo, Kitchener, Galt, Preston
- Annacis Island, Vancouver, BC

Advantages of Anaerobic Digestion:

- Well established process.
- Digested sludge is stable and will produce minimum odour during land application.
- The volume of sludge is reduced by approximately 40% as a result of the digestion process.
- Digested sludge is easy to dewater; the dewatering process presently applied may produce similar or slightly higher solids content at a reduced polymer dosage rate.
- Biosolids can be land applied for agricultural use.
- Volatile Suspended Solids (VSS) destruction of between 40 and 60%.
- Low net energy requirements.
- Low operational cost if the gas produced is utilized.
- Energy in the form of heat and electricity could be recovered that may support an application for funding.

Disadvantages of Anaerobic Digestion:

- Requires skilled operators.
- Recovers slowly from upsets.
- Foaming issues possible which can cause operation problems relating to poor settling sludge.
- Potential source of odour during digestion that needs to be mitigated using appropriate design approaches.
- Potential source of odour following processing which will likely prohibit the use of digested material as a day cover at the landfill.
- High capital cost.
- Sensitive system to temperature and pH fluctuations and to industrial contaminants such as heavy metals. The reported heavy metals content of waste sludge is below typical toxic levels for anaerobic digestion. Temperature and pH variations can be managed by appropriate engineering design.
- Supernatant contains high concentration of chemical oxygen demand (COD), biochemical oxygen demand (BOD), suspended solids and ammonia.
- Supernatant from digestion and centrate from sludge dewatering will have to be pretreated to minimize the return of contaminant loads from these sources to the sewage treatment process.
- Potential safety issue due to the presence of flammable gas (methane).

If the dewatered biosolids are to be disposed of by landfilling, some of the current challenges with management of biosolids at the landfill will still exist.

3.1.2.2 Aerobic Digestion

Sludge could be stabilized under aerobic conditions in an aerobic digester. Waste primary and activated sludge is sent to a digester tank that is equipped with an aeration system. Often the digester feed is thickened to minimize digester tank size. Thickener technology may include conventional gravity thickening, gravity belt thickener and rotating drum thickener. For the mechanical thickening processes a polymer will have to be added to the raw sludge, while gravity thickening may not require any conditioning. The aeration system provides oxygen for the biomass. Typically the aeration system used for sludge digestion is a coarse bubble system to prevent plugging of diffusers in a high solids environment. Bacteria in the presence of dissolved oxygen break down the volatile solids content of biomass. Approximately 50% of the volatile solids content of waste sludge could be removed following a 30 day digestion period. MOECC design guidelines require that the combined sludge age of the activated sludge and sludge digestion systems be at least 45 days. As a result of aeration, the supernatant and centrate generated during digested sludge dewatering will contain very little ammonia. However, as a result of the breakdown of volatile solids, significant amounts of phosphorus may be released from the BNR sludge generated by the east treatment plant as a result of digestion. Supernatant generated at the east plant will have relatively high phosphorus loads. The recommended pre-treatment process may contain the following treatment steps:

- Chemical addition, such as ferric chloride or alum to precipitate out phosphorus.
- Coagulation and flocculation to enhance precipitate formation and solids removal. A polymer may be added to enhance solids separation and the solids content of collected sludge.
- Solids separation using a sludge blanket clarifier. This clarifier type operates with a sludge blanket that acts as a filter thereby enhancing solids removal and solids content of settled sludge. As an alternative, DensaDeg® process may be used. This proprietary technology would utilize the above treatment steps for solids removal and thickening of settled sludge.

The following aerobic sludge digestion configuration may be used by the City:

- Waste activated sludge and primary sludge blending and thickening to a minimum of 4% solids content. This step will reduce the digester tank volume. Thickening technology may include conventional gravity thickening, gravity belt thickener and rotating drum thickener. For the mechanical thickening processes a polymer will have to be added to the raw sludge, while gravity thickening may not require any conditioning.
- Aerobic digester volume of approximately 4,000 m^3. The total digester volume will be divided into primary and secondary digestion compartments.
- Coarse bubble aeration system to provide approximately 4,700 kg/d of oxygen. This will require approximately 200 kW of blower capacity.
- Digested sludge would be removed from the digester and dewatered for landfilling or land application. In case of land application, additional storage for digested sludge will be expected to meet MOECC sludge storage best management practice of 280 days.
- The digested sludge will have a solids concentration of approximately 3.5% with a total estimated volume of 49,440 m^3/year. Because of the large volume, sludge will have to be dewatered before disposal. The existing sludge dewatering system may be used for sludge dewatering.

- The volume of sludge is reduced from approximately10,000 m^3/year to 6,200 m^3/year following dewatering, or by approximately 40% as a result of the digestion process.

The digested sludge could be used as a fertilizer for land application or be disposed of at the landfill. The dewatered and digested sludge will not likely be suitable for landfill cover due to potential for odour reformation over a short period of time.

Most extended aeration plants in Ontario utilize aerobic digestion. Several examples of Ontario facilities utilizing aerobic digestion include:

- Belle River WWTP in Essex County, Ontario
- Tillsonburg WWTP in Oxford County, Ontario
- New Hamburg WWTP in Waterloo, Ontario
- Trenton WWTP in Trenton, Ontario
- Hagersville WWTP in Hagersville, Ontario

Advantages of Aerobic Digestion:

- Well established process.
- Simpler safer operation as there is no potential for gas explosion.
- Digested sludge is stable and will produce minimum odour during land application.
- The volume of sludge is reduced by approximately 40% as a result of the digestion process.
- Digested sludge is easy to dewater; the dewatering process presently applied may produce higher solids content at a reduced polymer dosage rate.
- Capital cost is less than equivalent anaerobic digestion process.
- Less sensitive process than anaerobic digestion.

Disadvantages of Aerobic Digestion:

- Relatively large footprint required.
- Aerobic biosolids difficult to mechanically dewater.
- Reduced process efficiency in cold temperatures.
- Not able to produce biogas for energy production so not suitable for energy related funding.
- Potential source of odour during digestion that needs to be mitigated using appropriate design approaches.
- High operating cost.
- Supernatant from digestion and centrate from sludge dewatering will have to be pretreated to minimize the return of contaminant loads from these sources to the sewage treatment process.
- Lower solids concentration relative to anaerobic digestion.
- Biosolids have a lower nutrient value relative to anaerobically digested sludge.
- Processed sludge is not likely suitable for use as a day cover due to potential odour reformation over a short period of time.

3.1.3 Alkaline Stabilization

Alkaline stabilization processes utilize pH, sometimes in conjunction with elevated temperature, to stabilize biosolids. The source of the alkaline material may include hydrated lime [$Ca(OH)_2$, slaked lime, calcium hydroxide], quicklime (CaO), kiln dust (lime of cement), fly ash, carbide lime (CaC_2), and sodium or potassium hydroxide. There are a number of conventional and proprietary systems on the market using this type of sludge stabilization process such as:

- Wet Lime Stabilization;
- Dry Lime Stabilization;
- Alkaline Stabilization (N-Viro Process);
- In-vessel Lime Stabilization;
- Lystek; and
- Bioset.

The objective of this process is to reduce the microorganism content of waste sludge and produce an environment in the sludge matrix that prevents putrefaction and associated odour formation. Lime at a proper dosage rate, approximately 1 to 1.5 kg lime/kg of dry sludge, produces a high pH environment (approximately a pH of 11 to 12) and increases the sludge temperature above 50°C. The combination of high pH and temperature kills most of the microorganisms in the raw sludge. The sludge pH may stay at elevated levels, i.e., above 9, for several months, thereby preventing the re-growth of microorganisms. Consequently, the sludge remains stable with minimum odour emission for a long time.

In **wet lime stabilization**, lime slurry is mixed with liquid biosolids. The process is usually a batch process with a process time of at least two hours in the contact tank. The wet lime alkaline stabilization process is typically not used for pathogen elimination but rather pathogen reduction since heat requirements for pathogen destruction are typically not met.

In **dry lime stabilization**, the dry alkaline source is mixed with dewatered cake to elevate the pH to 12 or greater. If quicklime is used, the exothermic reaction of the lime with the water in the cake will elevate the temperature and complete pathogen destruction is possible.

The **N-Viro process** utilizes a combination of alkaline addition and heat drying to produce an essentially pathogen free product that meets the requirements and guidelines prescribed by the *Federal Fertilizer Act*. This allows the product to be applied with unrestricted use (e.g. public and private gardens). The main end use is typically in agriculture.

The **in-vessel lime pasteurization process** utilizes time, temperature, and pH to produce an essentially pathogen free product. The process varies from the traditional dry lime process in that external heat is added to the process and a reduced volume of lime is added.

The **Lystek process** was developed in Ontario and the rights to the process are owned by Lystek International Inc of Waterloo, Ontario. The Lystek process is used to convert dewatered cake into a stable liquid product through a combination of heat, alkali addition, and mechanical shearing. Heat is provided by injecting steam from a boiler, alkaline conditions are achieved through the addition of potassium hydroxide (KOH) and mechanical mixing is provided by a high speed mixer.

The **Schwing Bioset alkaline stabilization process** is owned by Schwing Bioset, Inc. This alkaline stabilization process uses time, temperature, and pH to produce an essentially pathogen free product as defined by USEPA. High levels of pH are maintained by adding lime and elevated temperatures are the result of the exothermal reaction of lime (quicklime) with the water in the biosolids dewatered cake feed. No additional heat sources are required for this stabilization process and an essentially pathogen free product is produced.

A typical alkaline stabilization process has the following treatment steps:

- Raw primary and waste activated sludge blending and dewatering. The existing dewatering system could be used for this process step.
- Dewatered sludge is blended with dehydrated lime in a mixing vessel. There are proprietary systems available that provide lime dosage control and blending.
- The mixing vessel may provide a minimum storage time of 30 minutes for the mixture. This step ensures that microorganisms are killed as a result of high pH and temperature. The treated mixture is cured for a few days to allow complete stabilization of sludge and a reduction of temperature.
- Stabilized sludge may be stored in an enclosed building in windrows until land application or other use.
- The treatment and storage facilities will be enclosed for odour control. Exhaust air from the building will have to be treated in a scrubber for odour control. The main odour concern for this process is ammonia smell as this compound is released from the sludge at high temperatures and pH.

The estimated volume of lime treated sludge would be 10,000 m^3/year, approximately the same volume as that produced under present operating conditions. However, as a result of lime addition and enhanced water evaporation at high mixture temperature, the solids content of the processed material will be in the range of 60% to 65%. The lime stabilized sludge can be used for agricultural application or as a day cover for the landfill.

Examples of known locations utilizing the N-Viro process include:

- Halifax, Nova Scotia
- Region of Niagara, Ontario
- Leamington, Ontario
- Sarnia, Ontario
- Summerside, PEI
- The City of Greater Sudbury is currently constructing a facility using the N-Viro process.

Examples of known locations of the in-vessel lime pasteurization process includes:

- Saanich Peninsula, Victoria, BC (RDP Technologies)
- Stellarton, Nova Scotia (RDP Technologies)

Guelph, Ontario uses the Lystek process as one of the biosolids management processes. A temporary Bioset process was installed in London, Ontario which was shut down in 2008.

Advantages of Alkaline Stabilization:

- Well established process. Demonstrated technology that has been used in Canada and the U.S. predominantly at smaller facilities.
- Stabilized sludge is stable for several months and will produce minimum odour during landfilling or land application.
- The stabilized sludge could be used for day cover in the landfill.
- Stabilized sludge could be stored on-site for a minimum cost during winter.
- Low to medium capital cost.
- Relatively simple process to construct and operate.
- Existing dewatering system could be integrated with process.
- It could provide a valuable alkaline source for acidic soil treatment. The fertilizer value of this product is good as most of the phosphorus removed during sewage treatment would be captured in the stabilized sludge. There could be some ammonia loss and the stabilized product may have to be fortified with a nitrogen source.
- The process will have minimum impact on existing sewage treatment process as very little if any by-products are returned to the treatment process.
- Higher solids content than that achievable with dewatering only. As a result of high temperature during stabilization, a significant portion of the remaining water is evaporated.

Disadvantages of Alkaline Stabilization:

- Potential source of odour during stabilization that needs to be mitigated using appropriate design approaches. The process and storage areas have to be enclosed and exhaust air scrubbed before emitting it into the environment.
- Medium operating cost. Major operating cost item is the lime or alternative alkaline reagent. The operating cost may be reduced by using alternative alkaline chemicals that are waste products of an industrial production.
- The mass of waste sludge is increased, as lime has to be added to the sludge.
- Material handling of dehydrated lime. The daily demand is approximately 13 tonnes.
  Large quantity of material will increase truck traffic to and from the processing facility.
- Potential for dust generation at storage facilities.
- Loss of nitrogen reduces the recycling potential of nutrients.

3.1.4 Geotube Freeze-Thaw

This process has been used for sludge management in Europe and the USA. There area few installations where the process has been applied in Ontario or in Canada. The Geotube process provides a simple solution to sludge management.

The Geotube freeze-thaw process is a simple sludge dewatering process specially geared for small sewage treatment plants. It only provides sludge dewatering, no additional sludge conditioning such as stabilization would take place during the process. Geotube is manufactured from water permeable and strong textile resembling geotextile. The tubes come in different sizes. The tubes are located over an area, such as a paved surface or a sludge drying bed, where any runoff and filtrate from the tube could be captured. The tube is filled up with waste sludge. The waste sludge is conditioned with a polymer before feeding it into the tube. This will enhance solids separation and dewatering of sludge. Once the tube is full it is closed, water is squeezed out of the tube by forces of gravity. Dewatered sludge is left behind with 20 to 40% solids content. If the sludge is left over a winter season on site, the solids content could be further increased, up to 50%, as a result of freeze and thaw process.

The Geotube process provides dewatering; however, it will not produce a stabilized sludge or reduce the solids mass of sludge. The dewatered sludge may not be used for agricultural or other land application unless it is stabilized. Because of the potential re-growth of microorganisms and resulting odour formation, dewatered sludge from this process is not suitable as a day cover for landfill operation.

Typically, the Geotube is cut open and the dewatered sludge is hauled away. The Geotube could be reused as a geotextile. Different sized tubes are available, from 1 m to 3 m in diameter with a total liquid sludge volume from a few cubic meters up to 20 m^3. Approximately 3 to 5 bags with a 20 m^3 volume would have to be used daily and the sludge left on site for a minimum of 1 to 3 months for efficient dewatering.

In 2012, Geotubes were installed at the Greenway PCP in London, Ontario after successful piloting of the Geotubes for dewatering. Before the installation of Geotubes, ash from the fluid bed incinerator was stored in ash basins. When one of the basins was full, ash was dewatered and removed by draglines and trucks.

At the plant, the Geotube treatment process consists of filling the Geotube container with slurry of ash. Polymer is introduced into the media to promote flocculation which allows the solids to bind and separate water more efficiently. Once the bag is filled to its recommended storage capacity the dewatered contents are left to dry further and then the ash can be removed. St. Mary's Cement is currently recycling the dewatered ash.

<u>Advantages of Geotube process:</u>

- Low upfront capital cost for waste sludge dewatering.
- Low-tech process with minimum maintenance.

<u>Disadvantages of Geotube process:</u>

- The process is more applicable for smaller treatment plants with sludge management and dewatering problems or as a temporary measure for medium sized plants while existing sludge dewatering system is being maintained.
- Requires large surface area for storing the Geotubes while the process goes through the required dewatering steps.
- Filtrate from process may contain soluble phosphorus and ammonia as a result of anaerobic conditions of sludge in the tube.
- The process does not produce a stabilized sludge that could be land applied. If landfilled and proper cover is not provided, it may generate odour.

3.1.5 Chemical and Heat Treatment

Waste sludge may be exposed to a low pH (pH of 3 to 4) environment and high temperatures (50 to 60°C) in the presence of intensive mixing. Following treatment, the pH is adjusted to neutral. As a result of this treatment the viable microorganism content and viscosity of sludge are reduced. The sludge in this form could be stored for several months without affecting its quality. Because of the low viscosity, it is easier to store, pump and dewater the treated sludge. The low microorganism content of sludge allows for land application and landfilling. The treated sludge would have approximately 3 to 5 % solids content, consequently there would be no significant change in the volume of sludge. The sludge following treatment and storage could be land applied in a liquid form. For landfill application, the sludge would have to be dewatered following treatment.

Advantages of chemical and heat treatment:

- Low to medium capital cost.
- Low active microbial count and low sludge viscosity.
- Sludge could be stored for an extended period of time without affecting its quality.
- Reduced cost for sludge dewatering and mixing in a holding tank.
- Reduced volume of dewatered sludge as a result of improved sludge quality and destruction/lyses of microbial cells.

Disadvantages of chemical and heat treatment:

- High operating cost for sludge heating and chemicals.
- The process does not provide sludge with reduced volatile solids; consequently microorganisms may re-grow on it and cause odour if not properly handled or disposed of.
- Processed sludge is not suitable for use as a day cover.
- There is no net reduction in solids content of sludge.
- Significant amounts of phosphorus and some ammonia are released into the liquid phase as a result of microbial cell lyses. Pre-treatment of centrate and filtrate, generated during dewatering, is required to minimize the impact of this return stream on plant operation.

3.1.6 Enhanced Sludge Dewatering

The existing sludge dewatering system cannot produce a dewatered sludge with greater than 20 to 25% of solids content. Using heat conditioning before or during dewatering together with an advanced filter press technology, the solids content of dewatered sludge could be increased to 40 to 50%. As an additional benefit, the microbial activity of dewatered sludge is greatly reduced as a result of heat treatment and the high final solids content. The volume of sludge produced could be reduced by approximately 50%. The volume of dewatered sludge would be approximately 5,000 m^3/year, or less than half of the sludge produced presently.

The sludge could be efficiently disposed of at landfill. However, this process will not provide any reduction in volatile solids content; consequently the same amount of volatile organic load would be added to the landfill. The organic load will enhance landfill gas generation.

The dewatered material will not likely be suitable for use as a daily cover, because it is not stabilized, and it may produce some odour when exposed to moisture. Consequently, there may be a risk for odour formation if used as a landfill day cover. However, because of the simplicity of the process, it may be beneficial to set up a pilot project to assess the impact of using this material on landfill operation, specifically odour formation when used as a daily cover.

This process may be combined with a low dose of alkaline treatment that inhibits microbiological activity for a short time, say until the daily cover is exposed to the elements. However, the appropriate level of lime treatment would have to be assessed using a bench scale or pilot scale trials.

Advantages of enhanced sludge dewatering:

- High solids content with little odour formation potential during processing and initial placing of material into landfill. Short-term odour formation may be controlled by small dose of lime addition as described above.
- Simple plant modifications and small land requirement.
- Low to medium capital cost.
- Small quantities of contaminants returned to sewage treatment from this process. The prerequisite of reduced return of contaminants is that the waste sludge has to be kept sweet, i.e., well aerated before dewatering.
- This process could supplement other sludge management options such as anaerobic/aerobic sludge digestion.

Disadvantages of enhanced sludge dewatering

- The process does not reduce the organic solids content of sludge. This may have an impact on landfill operation in the form of landfill gas generation.
- Operating cost may be greater than that for existing dewatering system.
- Potential for odour generation.
- Not likely suitable for use as landfill cover.

3.1.7 Composting

Composting is a biological, self-heating stabilization process that results in a low odour, well-stabilized biosolids that can be stored indefinitely. Composting not only diverts organic materials from disposal in landfills, it also provides a valuable material for agriculture, horticulture and landscaping by returning nutrients and organic matter to the soil. Five key variables govern the decomposition process:

- Oxygen content;
- Moisture content;
- Temperature;
- The carbon-nitrogen ratio; and
- Particle size.

Composting of organic wastes is becoming a more popular option for waste diversion in Canadian municipalities. Although there are many examples of operating composting facilities in Ontario and throughout Canada the number of facilities accepting municipal biosolids is generally restricted to other provinces. This was largely due to the more onerous Compost Quality Standards in Ontario relative to other provinces such as Quebec and British Columbia. However, the recent revision of the Ontario Compost Quality Standards by the MOECC (July 2012) may provide enhanced flexibility in composting biosolids in Ontario. In general, the revised Standards apply only to aerobic composting of non-hazardous organic materials for the purpose of producing a humous like compost material intended for use as a soil conditioner.

There are several different approaches to composting organic waste which can range from low level technology in the form of open windrows to more sophisticated proprietary containerized/in-vessel/tunnel approaches or indoor channelized methods. Many of the proprietary technologies claim to be uniquely different or superior. The different methodologies are briefly described below.

Turned Windrow Composting

The most common composting system utilized in Ontario is open windrow. It is mainly utilized for leaf and yard waste composting and to a smaller extent source separated organics due to potential odour problems. Turned windrow composting involves placing material in standing piles of some shape and regularly turning them to aerate the material. Windrows are typically two to four metres in height and will vary in length depending on the available space. Most windrow facilities are located outdoors.

Aerated Static Pile

Aerated static pile is similar to turned windrow composting except that air is forced in (or out) of the pile and there is no need for turning the windrows. The air is circulated through perforated pipes running the length of the pile. The fans can be controlled by a timer or a temperature feedback system. The circulating air provides oxygen for the composting process and assists in preventing excessive heat build-up in the pile. This technology is successfully being used in Kelowna and Penticton to compost biosolids.

Channel Composting

A channel composting system is typically constructed inside a building with defined channels constructed to contain the feedstock. The channel walls are typically 2 metres high and the width varies. The feedstock is placed between the two walls. The material is mechanically turned and typically, aeration is enhanced with a forced air system in the floor of the channel. Outdoor turned windrow or aerated static pile technologies are used to complete the composting process.

Tunnel (In-Vessel) Composting Systems

A tunnel composting process is conducted in some sort of sealed container or chamber where the environment is highly controlled and where access is restricted. Some of the tunnel technologies are designed to have a continual flow of waste through the system. Others place a complete batch of compost in the tunnel and then fully empty the tunnel when it is done. These systems typically include an aeration system with air circulated through perforated pipes within the tunnel. Once the compost is removed from the tunnel, either turned windrow or aerated static pile systems are used to complete the composting process.

A typical biosolids composting configuration may comprise of the following:

- Indoor facility for the receipt and pre-processing of the biosolids;
- Pre-processing (e.g. grinding) supplementary waste (e.g. wood chips, leaf and yard waste, etc.);
- Mixing of the biosolids with other supplementary organic wastes/carbon sources to reduce the moisture content, enhance the aerobic activity and increase the C:N ratio of the biosolids;

- Indoor or containerized facility to facilitate the composting process in a controlled environment;
- Perforated pipes and blowers to supply air to the compost;
- Exhaust air and odour control facilities; and
- Outdoor compost curing and storage.

According to the new Composting Standards (July 2012), compost shall be tested for the parameters listed in the Table 3.1(a) below and shall be categorized according to the concentrations listed for each metal, as calculated on a dry weight basis:

- Category AA compost must not contain regulated metals in concentration that exceeds any of the limits set out in Column 2 of Table 3.1(a)
- Category A compost must not contain regulated metals in concentration that exceeds any of the limits set out in Column 3 of Table 3.1(a)
- Category B compost must not contain regulated metals in concentration that exceeds any of the limits set out in Column 4 of Table 3.1(a)

Table 3.1(a)

MAXIMUM CONCENTRATION FOR METALS IN COMPOST

Column 1	Column 2	Column 3	Column 4
Metal	**Category AA Compost**	**Category A Compost**	**Category Compost B**
	mg/kg dry weight		
Arsenic	13	13	75
Cadmium	3	3	20
Chromium	210	210	1060
Cobalt	34	34	150
Copper	100	100	760
Lead	34	34	500
Mercury	0.8	0.8	5
Molybdenum	5	5	20
Nickel	62	62	180
Selenium	2	2	14
Zinc	500	700	1850

Source: Ontario Compost Quality Standards, Ontario Ministry of the Environment, July 2012

Advantages of composting:

- Returns nutrients to the soil.
- Improves soil structure.
- Helps soil retain moisture.
- Contributes to healthy soil ecosystem.
- Can reduce the need for fertilizers and pesticides.
- Helps to conserve water.
- Category AA and A compost are exempt from transport and use approvals, however requires a Nutrient Management Plant (NMP) and/or NASM Plan and must be applied in accordance with the NMP or NASM Plan and O.Reg.267/03.
- Category B compost may be used as a daily, intermediate cover at a landfill that has an ECA (waste disposal site) that permits the use of Category B compost as cover.

- Facility could be sized to include leaf and yard waste and possibly source separated organics to allow for co-composting of feedstock.
- Potential to add industry feedstock and share costs.

Disadvantages of composting:

- Category B compost is not an exempt waste and is therefore subject to Part V of the EPA and Reg. 347, including approvals for transportation and management. Category B compost is exempt from the above approvals when it is applied to agricultural land as a nutrient and satisfies the requirements of O.Reg 267/03 under the NMA (still requires approval for transportation).
- Category B compost is typically not permitted for areas with regular human contact such as parks and residential areas.
- Requires significant quantities of supplementary organic wastes/carbon sources to reduce moisture content and improve aerobic conditions.
- Relatively high life cycle costs.
- Process is sensitive to feedstock quality.

3.1.8 Thermal Processes

Thermal processing involves high temperature treatment of biosolids and results in a large reduction in the volume of end product which requires disposal and, in some cases allows for energy recovery.

3.1.8.1 Thermal Oxidation (Incineration)

Incineration is the combustion of the organic solids to form carbon dioxide and water. The temperature in the combustion zone of furnaces is typically 760 to 870^{o}C. The solids that remain at the end of the process are in an inert form commonly known as ash.

Raw dewatered sludge, dewatered biosolids cake (including Class A) and thermally dried pellets are all suitable for incineration. Incineration takes advantage of the fuel value of these materials, and the energy recovered can be used in heat exchangers and waste heat boilers to save on energy use at the processing plant. The efficiency of the process is increased by the dryness (% solids) of the incinerator feed material, as well as the organics content.

Incineration results in a large reduction in volume and mass in comparison to other management options. The mass of solids in the ash is approximately 10% of that in the incinerator feed sludge, thus reducing the mass that must be further managed offsite.

Incineration also achieves complete destruction of pathogens (disease-causing organisms), as well as organics. The remaining ash is inert and not susceptible to further biological activity or decomposition. It may be disposed as a conventional waste (i.e., non-hazardous), provided that a sewer use control program is enforced to prevent excess amounts of industrial wastes such as heavy metals from entering the wastewater treatment plant that practices incineration.

Two types of incinerator units are generally used for thermal oxidation; multiple hearth and fluidized bed. Fluidized Bed Incinerators (FBI) are considered to be superior and are usually utilized in new systems.

Multiple Hearth Incineration

As the name implies, multiple hearth incinerators consist of a series of refractory brick hearths, stacked vertically. A rotating shaft through the centre of the hearths supports rake arms for each hearth, thereby facilitating drying and incineration. Solids are usually fed through at the top hearth and are directed to successive inner or outer dropholes as they move down through the hearths. Most of the ash is discharged from the bottom hearth. The incinerator is divided into three zones:

- Top or drying zone, where solids are initially fed;
- Middle, or combustion zone; and,
- Bottom, or cooling zone, where the combustion air enters.

A multiple hearth incinerator typically requires 50 to 150% excess air (over that required for complete combustion), and may still have problems related to incomplete combustion. Over the years, multiple hearth incinerators have required modifications to meet more stringent emission limits. Many units have experienced incomplete combustion, including “yellow plume” from the stack. Modifications to rectify these deficiencies have included afterburner chambers, exhaust gas recirculation, add-on thermal oxidizers and improved scrubbers. Most operating multiple hearth incinerators have added afterburners (and/or other retrofits) to improve emissions control.

Examples of facilities using multiple hearth incinerators, the vast majority of which have added afterburners (and/or other retrofits) to provide emissions control to meet the regulatory requirements, include:

- Highland Creek Treatment Plant in Toronto; and,
- Montreal Urban Community.

Examples of multiple hearth incineration facilities that have been shut-down rather than making the investment to address age and condition upgrades, as well as emissions control retrofits, include:

- Woodward Avenue WPCP (Hamilton);
- Ashbridges Bay Treatment Plant (Toronto); and,
- Greenway WPCP (London, Ontario; replaced by fluidized bed incinerator in 1988).

Figure 3.1(a) presents the multiple hearth incineration process.

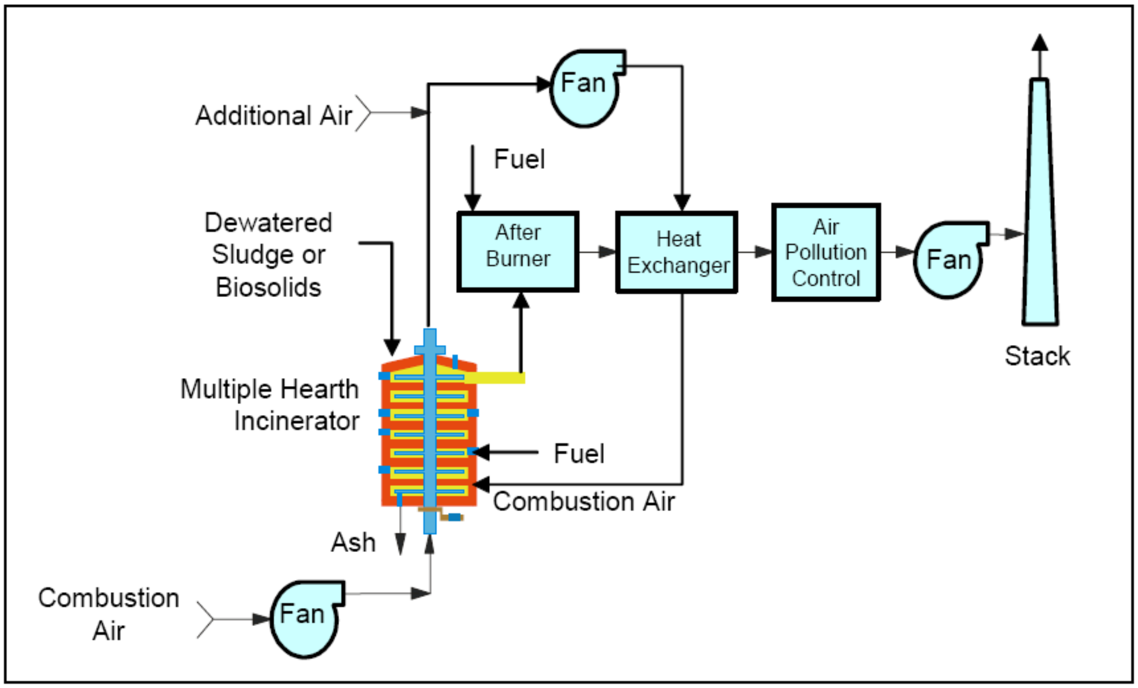


Figure 3.1(a) Schematic of Multiple Hearth Incineration

Fluidized Bed Incineration

Fluidized bed incinerators are steel cylinders lined with refractory bricks to withstand the high operating temperatures of the unit. As long as feed solids are sufficiently dry (25 to 35% total solids), the need for auxiliary fuel can be minimized. Modern dewatering equipment is capable of achieving this level of dryness, including the centrifuges and presses used in the City.

In the fluidized bed design, good fuel-air mixing is achieved and typically only 30 to 50% excess air (over that required for complete combustion) is required. The design also allows for good control of combustion air. These features result in more complete combustion and comparatively lower levels of regulated exhaust emissions such as carbon monoxide (CO), total hydrocarbons (THCs) and oxides of nitrogen (NOx)

Exhaust gas, carrying all ash, passes through energy recovery facilities and air pollution control equipment prior to being released into the atmosphere. Ash is usually recovered as a wet slurry from the exhaust gas scrubbing equipment. Examples of facilities using fluidized bed incineration in Ontario include:

- Lakeview Wastewater Treatment Plant (Region of Peel - Mississauga);
- Duffin Creek WPCP (Region of Durham);
- Greenway WPCP (City of London, Ontario);

Figure 3.1(b) presents a schematic of the fluidized bed incineration process.

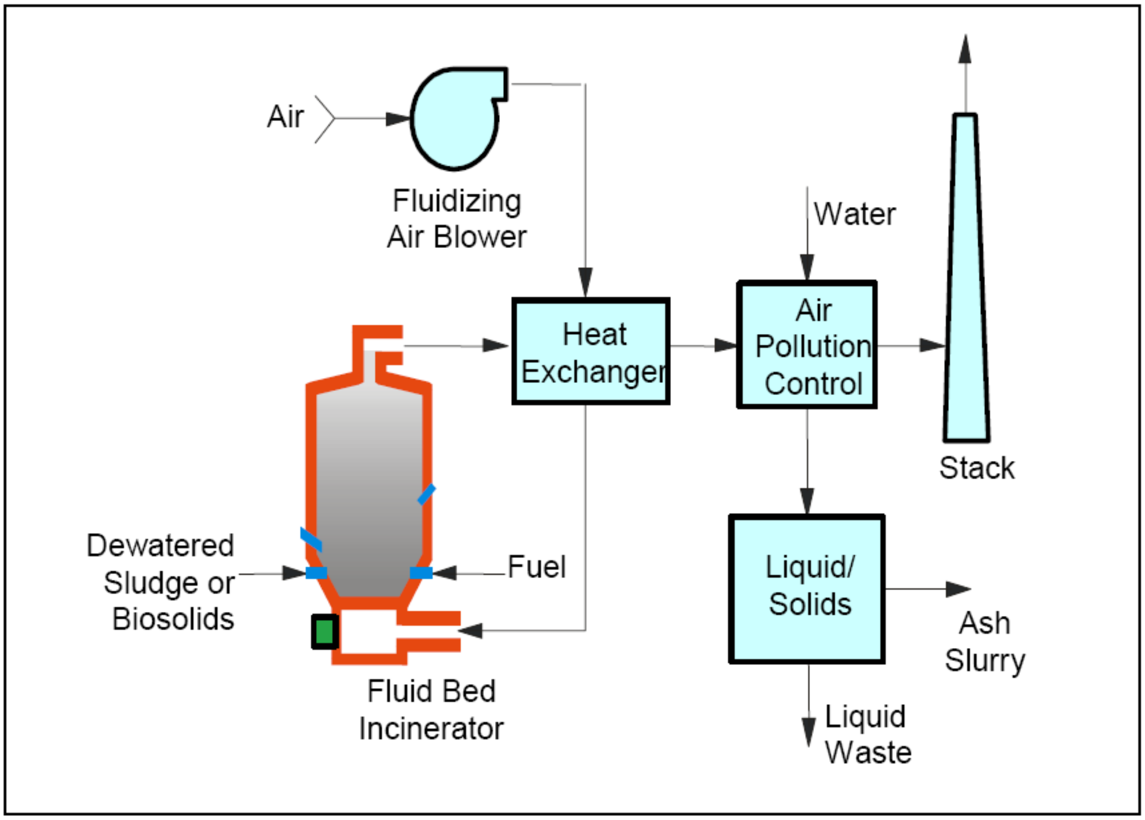


Figure 3.1(b) Schematic of Fluidized Bed Incineration

The fluidized bed incinerator is more efficient than multiple hearth incinerators because solids are fed directly into the high temperature combustion zone in a concurrent configuration where the turbulence allows for good fuel-air mixing. Moreover, fluidized bed typically requires only 30 to 50% excess air, in comparison to 50 to 150% required by multiple hearths. Nearly all new incinerators installed in the last 20 years utilize the fluidized bed technology.

<u>Experience</u>

Incineration of biosolids has been widely practiced in North America and Europe for many decades. In Toronto, there is multiple hearth incineration experience at both the Ashbridges Bay TP and Highland Creek TP. The Ashbridges Bay TP experienced yellow plume emission problems, which led to the shut-down of the incineration process. Three of the original six incinerators were demolished when the new pelletization facility was constructed in 2003, and the remaining three are not operating. At the Highland Creek TP, two multiple hearth incinerators remain in operation, and afterburners have been added for emission control. The largest Canadian multiple hearth incinerators operate at the Montreal wastewater treatment plant, where the facility is used for management of raw sludge (from this enhanced primary treatment plant). At that facility, afterburners have been added for emission control.

Ontario has three fluidized bed facilities among the largest in the North American wastewater industry, including facilities in Mississauga (Peel), Durham and London. Typically, ash is stored on-site for extended periods or indefinitely, with ultimate disposal in a municipal landfill. Ash from the Duffin Creek treatment plant in York- Durham service area is used in the St. Mary's cement manufacturing process.

Ash from the London, Ontario incinerator located at the Greenway PCP was collected and temporarily stored in ash basins. In late 2012, Geotubes installed to dewater the ash and the ash basins were taken out of service. St Mary's Cement is currently recycling the dewatered ash from the Greenway PCP.

Advantages of thermal incineration of biosolids:

- Stabilization (digestion) of biosolids is not required - raw dewatered sludge has higher thermal content than digested biosolids.
- Complete destruction of pathogens and organic portion of the feed.
- Significant reduction in material (ash) to be managed off-site relative to any other management options.
- Heat recovery can be used in other areas of the plant.
- Low potential for onsite and offsite odours.
- Small land area required and operation is not dependent on weather conditions.
- Resultant inert ash can be disposed of as a conventional non-hazardous waste, can be recycled in cement manufacturing, or can be stored for extended periods in ash lagoons.

Disadvantages of biosolids incineration:

- There is negative public perception in some areas of Ontario and elsewhere regarding the potential health effects of incineration.
- Complex air pollution control equipment upgrades may be required to ensure emissions standards can be consistently achieved.
- Ash reuse programs have not been well established.
- High capital cost.
- No recycling of nutrients.
- High lifecycle costs.

3.1.8.2 Pelletization

Following sludge dewatering to approximately 25% minimum solids content, the sludge is mixed with dust particles captured during the drying-pelletization process. The dust particles coat the outside face of the sludge granules and produces sludge pellets. The sludge pellets are introduced into a dryer where in the presence of hot air flow the material is dried to approximately 80% solids content. Following the drying step, the dried material is classified based on size. Acceptable pellets are stored in a silo with a nitrogen gas atmosphere. Solids with a larger than accepted size are crushed to smaller sized particles and then blended with the captured small particulate matter fraction and added to the raw sludge feed. It is simple to transport and land apply or landfill dried pellets. The pellets could be fortified with additional fertilizers to increase its value as an organic fertilizer.

Advantages of pelletization

- Small quantity of stable product is produced.

- No odour formation from product.
- Nutrient value of product is not reduced; it may be used as a fertilizer for gardens and nurseries, i.e. as a higher value product and not as a waste.

Disadvantages of pelletization

- The existing dewatering system may need to be upgraded to produce the right solids content for feed to the process.
- Complex system.
- Expensive process.
- High operating cost for heating and enhanced dewatering.
- Process is more applicable for larger plants.

One of the biosolids management methods at the Ashbridges Bay WWTP, Toronto includes pelletization of the biosolids. In 2012, approximately 40% wet tonnes of the total biosolids generated were managed by pelletization. Pellet quality met the standards set out by the Canadian Fertilizer Act.

3.1.8.3 Gasification

The gasification process converts sludge or biosolids into a combustible gas, referred to as synthesis gas, or "syngas", which can be recovered. Syngas is a combination of carbon monoxide and hydrogen gas. While incineration fully converts the input waste into energy and ash, gasification heats the material under controlled conditions, deliberately limiting the conversion so that combustion does not take place directly.

Gasification is a technology that has been widely used in the production of fuels and chemicals for over 50 years. Syngas can be used as a fuel to generate electricity and heat, or as a basic chemical raw material for a large number of applications in the petrochemical and refining industries.

The gasification process takes place in two reaction steps. The first reaction in the gasification process, referred to as pyrolysis, is the degradation of the sludge or biosolids in the absence of air, into a black, carbon-rich "char". In the second reaction, the char is gasified by partial combustion in the presence of oxygen or air to produce syngas, as noted earlier.

The efficiency of a gasification process in recovering energy depends on the moisture content of the feed. The maximum moisture should not exceed 40% (i.e., 60% solids) for performance viability. Further drying of dewatered biosolids, beyond that generally achievable by mechanical means, would be required ahead of the gasification process.

Syngas from the process requires cleaning before it can be used as a fuel source. Proven wet and dry emission scrubbing technologies such as cyclones, tray towers, and bag houses have been used in gasification product gas cleaning trains.

Figure 3.1(c) presents a schematic of the gasification process.

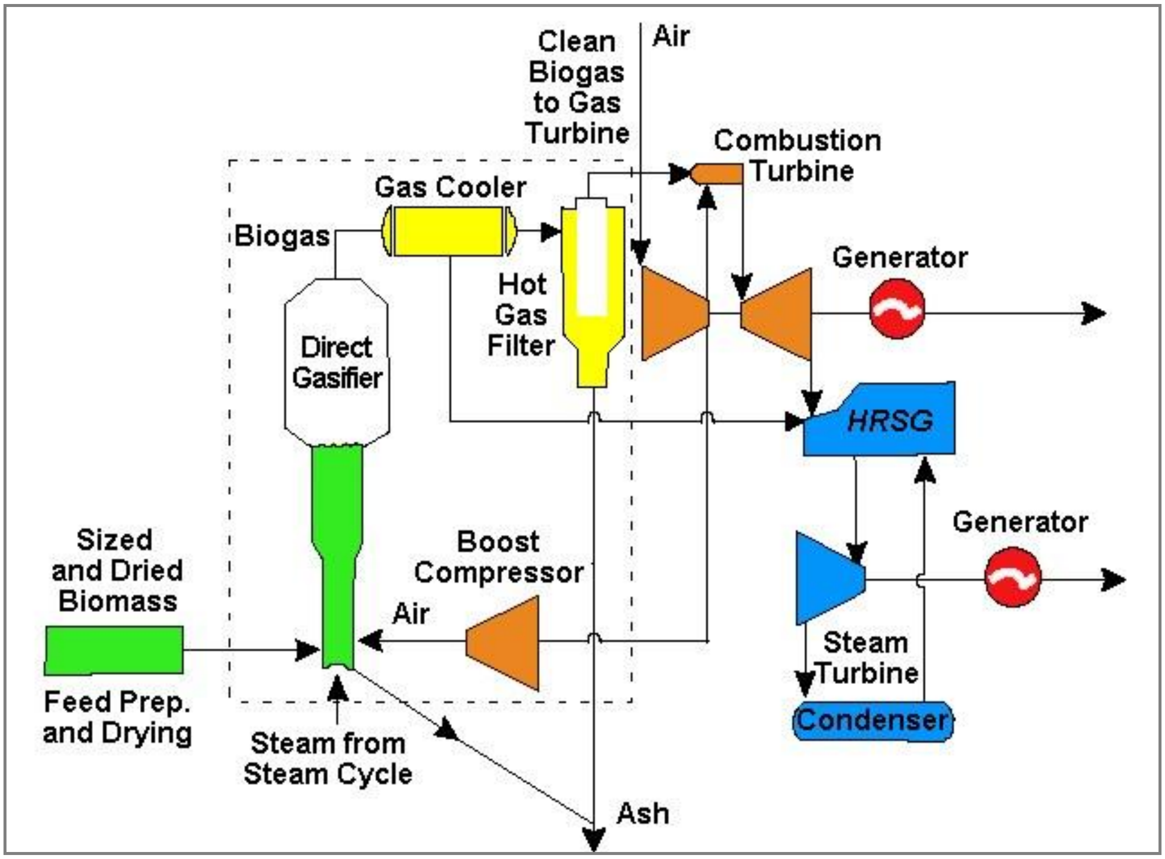


Figure 3.1(c) Schematic of Gasification

__Experience__

Gasification has been in commercial use for more than fifty years as a process technology for the refining, chemical, and power industries. Coal and petroleum based materials provide the vast majority of feedstocks for world gasification capacity. Historically syngas from gasification has been used primarily as a raw material for the production of chemicals. In 1989, chemical production accounted for almost one-half of syngas use worldwide. This is changing as more power generation projects are being constructed and planned.

Gasification of wastes, including wastewater treatment sludges, paper sludges and organic solid wastes has been studied in recent years. Despite success in some systems, most of the proprietary systems being promoted have only been operated using wastewater treatment plant sludge at small pilot-scales. There have also been some significant problems at particular projects that raise concerns about operational reliability.

Many studies have shown that gasification can be commercially feasible, but project costs are typically higher than conventional alternatives. In addition, hard data on true capital cost and operating costs for 'real-world' applications are unavailable.

Advantages of biosolids gasification:

- Stabilization (digestion) of biosolids is not required - raw dewatered sludge has higher thermal content than digested biosolids.
- Complete destruction of pathogens and organic portion of the feed.
- Production of valuable fuel syngas which can be used for power generation, or as chemical feedstock.
- Produce lower volume of flue gas and less emissions of nitrous oxides (NOx) and carbon dioxide, compared to incineration.
- Production of elemental sulphur or sulphur dioxide with market value.
- Significant reduction in material (char) to be managed off-site (similar to incineration). Resultant inert char can be disposed of as a conventional non-hazardous waste or recycled.
- Low potential for onsite and offsite odours.
- Small land area required and operation is not dependent on weather conditions.

Disadvantages of biosolids gasification:

- Sludge requires pre-treatment to reduce moisture content (solids drying).
- Relatively complex process.
- Potential to generate toxic compounds that can be present in the liquid, solids or gas streams
- Safety issues related to the generation of explosive gases
- Limited full-scale experience and cost data.
- Noteworthy problems in some systems raising concerns of operational reliability.
- Economically unattractive compared to other conventional technologies, such as incineration although potential future option.

3.2 Current Municipal Biosolids Management Practices in Ontario and other Jurisdictions

Canadian wastewater treatment facilities produce more than 660,000 dry tonnes of biosolids and sludge per year. In most provinces, more than 80% of biosolids are land applied. In Ontario about 40% of the biosolids are land-applied, about 40% are landfilled and about 20% are incinerated. In Quebec, about 27% of biosolids are land applied, 31% are landfilled, and the remainder, about 42% are incinerated. In Nova Scotia and Prince Edward Island, land application is the only option.

In Alberta, most WWTPs anaerobically digest their biosolids, including Edmonton and Calgary WWTPs. There are two WWTPs in Edmonton and three in Calgary. In Calgary the biosolids are land applied. In Edmonton the biosolids generated are land applied or co- composted with (MSW). The City of Edmonton is currently looking for utilization outlets for the composted material. Liquid biosolids are stored in a Regional Lagoon.

Current residual management practices in some of the Ontario jurisdictions are summarized Table 3.2(a).

Table 3.2(a) CURRENT MUNICIPAL BIOSOLIDS MANAGEMENT PRACTICES IN ONTARIO							
Municipality	**Biosolids Treatment**	**Biosolids Disposal/Use**					
		Land Application	**Landfill**	**Incineration**	**Thermal Drying (Pelletizing)**	**Alkaline Stabilization**	**Composting**
Halton	Anaerobic digestion and dewatering		Secondary*				
Niagara	Anaerobic digestion					N-Viro	
Hamilton	Anaerobic digestion		Secondary				
Brant	Dewatering						
Brantford	Anaerobic digestion		Secondary				
London	Dewatering w/o digestion	Secondary	Secondary				
Windsor	Heat drying						
Sarnia	Dewatering					N-Viro	
Region of Waterloo	Anaerobic+ Aerobic digestion		Secondary				
Guelph	Anaerobic digestion		Secondary			Lystek	
Peel	Dewatering						
Haldimand	Aerobic digestion						
Toronto	Anaerobic digestion and dewatering + dewatering w/o digestion	Secondary					
Barrie	Anaerobic digestion						
Norfolk	Anaerobic+ Aerobic digestion						
Oxford	Anaerobic+ Aerobic digestion						
Durham	Anaerobic digestion						
Peterborough	Anaerobic digestion					Lystek	
Kingston	Anaerobic digestion		Secondary				
Leamington	Dewatering					N-Viro	
Ottawa	Anaerobic digestion						Out of Province

* Indicates secondary or contingency disposal process

3.3 Management Alternatives

In this section, the management or end-use of sewage biosolids is discussed. An on-going challenge to managing biosolids is that there are benefits, risks and specific considerations for every management option. In general, municipal biosolids management options depend on the characteristics and quality of the biosolids, the treatment process used to produce the biosolids and the legislative framework of the province.

Municipal biosolids management options can be classified into two broad categories - beneficial use options and disposal options. Beneficial use options capitalize on the nutrient and organic matter value and energy content of the biosolids for use in:

- Energy production (e.g. combustion)
- Compost and soil products
- Agricultural land application as a fertilizer or soil conditioner
- Forestry application as a fertilizer or soil conditioner
- Land reclamation.

When combustion is used for municipal sludge or municipal biosolids management, it may be considered a disposal option or a beneficial use option. To qualify as a beneficial use option, combustion must meet the following three criteria:

- Result in a positive energy balance
- Emit low levels of nitrous oxides
- Recover a significant portion of ash or phosphorus

Generally the end-use of sewage biosolids comprises of some form of land application. The Ministry of Environment and Climate Change has identified biosolids produced from sources other than agricultural sources, as Non Agricultural Source Materials (NASM). The NASM term is used in this section. The use of NASM in Ontario is regulated by the Ministry of Environment and Climate Change and the Ministry of Agriculture and Rural Affairs. All the involved personnel – generator, hauler and the user need to have licenses, approvals or certificates for handling the NASM from these ministries.A general process configuration for Land Application is typically as follows:

- Sludge, partially stabilized or stabilized, (i.e. it must meet the guidelines) by biological and/or chemical processes.
- Thickening/Dewatering.
- Transportation.
- Land application – Injecting or spreading operation.

3.3.1 Agricultural Land Application

Use of NASM in agricultural applications has been practiced for a long time. Under this category, the use is not limited to farmers, but also extends to Horticulturists, Landscapers and the general public.

In this use, the NASM (both partially or completely stabilized) can be applied in both liquid and wet solids form. The NASM is handled by a licensed contractor (hauler or broker), who will haul the NASM for immediate disposal on the land or for winter storage in a licensed facility.

The implementation of this alternative includes many constraints (refer to Sections 3.3.1) and requires a significant inventory of agricultural lands. The availability of agricultural lands that may be suitable for land application of processed biosolids in Sault Ste. Marie and Algoma District was identified to gain an appreciation for this potential market. Table 5 entitled “Land use, by province, Census Agricultural Region (CAR), Census Division (CD) and Census Consolidated Subdivision (CCS), 2001” was sourced from the Statistic Canada website. Relevant data from the table is summarized in the Table 3.3(a).

Table 3.3(a)

INVENTORY OF AGRICULTURAL LANDS

Area	Total Number of Farms	Total Area of Farms (ha)
Sault Ste. Marie	36	1,000
Algoma District	317	40,000

The relatively small number of farms and their geographic distribution within Algoma District will present some challenges in applying stabilized biosolids to agricultural lands. For comparison purposes, in Lambton County in southwestern Ontario where the application of biosolids on agricultural lands is prominent, there are 2,427 farms totaling 244,655 ha. The density of farms in Lambton County is 0.81 farms per square kilometer relative to less than 0.01 farms per square kilometer in Algoma District.

Maximum application rates for biosolids to agricultural lands are a function of the metals concentrations in the biosolids and the allowable metals concentrations in the soil. The regulated metals concentrations in the Nutrient Management Act for materials applied to land are summarized in Table 3.3(b). Also included in the table are the dewatered biosolids quality data from the two plants. The values presented for each plant reflect the average and highest recorded value for the specific parameter from six samples from each plant over the period from 2009 to 2013. A more comprehensive summary is also included in Appendix A.

Table 3.3(b)

REGULATED METALS CONCENTRATIONS AND DEWATERED BIOSOLIDS QUALITY

Criterion	Nutrient Management Act (max. metals concentration in processed sewage sludge applied to land up to 8 tonnes/ha/5 yrs)	Nutrient Management Act (max. metals concentration in processed sewage sludge applied to land up to 22 tonnes/ha/5 yrs)	East Plant Avg. Concentration (Max. Concentration)	West Plant Avg. Concentration (Max. Concentration)
Arsenic	170	75	2.47 (4.1)	2.72 (4.8)
Cadmium	34	20	0.92 (1.41)	0.74 (1.28)
Chromium	2800	1060	21.0 (35.0)	19.2 (23.7)
Cobalt	340	150	2.52 (3.61)	2.78 (4.25)
Copper	1700	760	305 (372)	236 (434)
Lead	1100	500	76 (191)	20 (60)
Mercury	11	5	0.37 (0.77)	0.09 (0.15)
Molybdenum	94	20	5.63 (8.89)	5.10 (6.36)
Nickel	420	180	12.4 (18.6)	9.8 (13.2)
Selenium	34	14	2.1 (3.2)	1.7 (4.8)
Zinc	4200	1850	390 (528)	255 (432)

A summary of **maximum** application rates and the land area required to consume processed biosolids generated at the two water pollution control plants is included in Table 3.3(c). The calculations are included in Appendix B.

Table 3.3(c) AGRICULTURAL LAND AREA REQUIRED FOR PROCESSED BIOSOLIDS			
Stabilization Method	**Estimated Annual Quantity of Stabilized Biosolids**	**MAXIMUM[3] Application Rate (tonne/ha/5 years)**	**Minimum Total Land Area Required (ha)**
Aerobic Digestion	6,200	8 [1]	1085
Alkaline Stabilization	9,400	25 [2]	1175

Notes:
1. Guidelines for the Utilization of Biosolids and Other Wastes on Agricultural Lands.
2. Maximum application rate for product produced using the N-Viro process in Sarnia.
3. These application rates may have to be reduced due to other factors.

Land application of NASM offers several advantages and some disadvantages.

Advantages of land application:

- Serves as a nutrient source – major and micro nutrients, for the plants and crops.
- Aids in the improvement of soil properties such as texture, tilth, friability and water retaining capacity.
- Indirect benefit to the City by reduced fertilizer costs for farmers.
- Biosolids dewatering is not required.
- Relatively inexpensive operation to apply the processed biosolids.
- A good method for the disposal of biosolids and thus a good environmental solution.

Disadvantages of land application:

- Transportation costs.
- Labor intensiveness.
- Large area of land required.
- Limitations/restrictions in the use of biosolids due to its constituents.
- Time sensitivity (winter weather, crop harvesting/storage requirements).
- Seasonal application.
- Weather dependant.
- Dependant on willingness of farmers to accept biosolids and farming practices
- Restriction to public accessibility of land due to the likely presence of certain chemical constituents and pathogenic organisms.
- Potential for public opposition which may stem from the stigma or odours generated by the biosolids degradation.
- Potential for generation of greenhouse gases from degradation of biosolids in the land.
- Potential for future municipal liability.

3.3.2 Forest and Non Agricultural Land Application

The rationale for use of NASM in forestry and land reclamation projects is similar to application on agricultural lands. One of the purposes of NASM application is to increase the forest productivity, especially on marginally productive soils. Other reasons include excessive harvesting of trees, or disturbances due to natural disasters such as fires, land sliding and flooding.

Other land uses include re-vegetation and re-stabilization of contaminated industrial sites, construction sites, sites lost due to natural disasters and mine rehabilitation and dedicated land disposal sites (landfills).

Advantages of the Forest and Non Agricultural Land Application:

- Serves as a nutrient source – major and micro nutrients, for the plants and trees in forest.
- Improved natural habitat.
- Biosolids dewatering is not required.
- Aids in reclaiming valuable pieces of land.
- Serves as a filler material (upon addition of materials such as lime kiln dust, cement dust and fly ash) in the reclamation of contaminated land sites, rehabilitation of mineral mines.
- Serves as an erosion control material at construction sites and for road work.

Disadvantages of Land Application:

- Consistent application rate is difficult due to rough terrain, limited trails for application vehicles.
- Transportation costs.
- Labor intensiveness.
- Large area of land required.
- Time sensitivity (winter weather/storage requirements).
- Restriction to public accessibility of land due to the likely presence of certain chemical constituents and pathogenic organisms.
- Potential for generation of greenhouse gases from degradation of biosolids in the land.
- Limitations or restrictions in the use of biosolids due to its constituents.
- Potential for future municipal liability.

In Ontario, the preferred method of NASM disposal is agricultural land use. About 80% of municipalities – large, medium and small either totally or partially use this mode of disposal. At some places in eastern Ontario, NASM is used in forestry applications-specifically for plantations of hybrid poplars. Use of NASM is also under nascent (research or pilot testing) conditions as a filler material or construction material in other applications such as a mine rehabilitation, land reclamation and at construction sites in Ontario.

3.3.3 Application as Landfill Cover

Landfill disposal has been, and continues to be, a popular biosolids disposal option, but there is ever increasing competition for available landfill space. The use of processed biosolids suitable for landfill cover is becoming more attractive to municipalities to avoid high cost of landfill tipping fees. Biosolids that have been highly stabilized are suitable for a landfill cover and this practice has been successfully implemented in other jurisdictions. The processed material is typically blended with native soils to improve workability and texture. This is a practical alternative in the case of Sault Ste. Marie given that there is a projected soil deficit (daily/interim and final cover requirements) over the remaining lifespan of the existing landfill.

The implementation of this alternative will require the disposal of a suitable volume of waste on an annual basis to consume the processed biosolids. Approximately 50,000 tonnes of waste is disposed of annually exclusive of biosolids. Presently cover materials are sourced from winter street sweepings, contaminated soils and native on-site soils. Calculations were completed to identify the quantity of processed biosolids that could potentially be consumed as landfill cover (refer to Appendix C). Based on the calculations, it is estimated that there is capacity to consume some 15,000 tonnes of processed biosolids to meet annual daily and interim cover requirements. In addition to daily and interim cover there is also a requirement for approximately 111,000 m^3 of native final cover material for the existing disposal footprint. The processed biosolids could also be blended with native soils to address the final cover requirements.

Although the current annual waste disposal quantity can support the application of the projected annual quantity of processed biosolids, the waste quantity may be reduced substantially in the future with other waste diversion initiatives (e.g. source separated organics) and/or other waste disposal practices (e.g. energy from waste or disposal in alternative facilities outside of the service area). Furthermore the projected remaining landfill site life is in the range of 7.5 years. The site life may however be increased through settlement of waste and/or a possible landfill expansion. An Environmental Assessment is currently being undertaken to address future waste disposal needs in the City of Sault Ste. Marie and an expansion of the existing landfill is currently being assessed in detail.

Advantages of Landfill Cover Application:

- Consumes a significant volume in a single location - low transportation costs/impacts.
- In the case of the City of Sault Ste. Marie landfill, there is a shortage of native earthen materials on site – processed biosolids may eliminate or reduce the need to import other materials.
- Year around application (not weather dependant)
- Reliable disposal method.
- Relatively inexpensive.
- Not labour intensive.
- Reduced exposure to potential future liability.

Disadvantages of Landfill Cover Application:

- Limited use of the nutrient value of the material.
- Potential for some residual odour after processing.
- The landfill must have adequate leachate collection and control systems to prevent groundwater contamination since use of biosolids as a cover can generate a significant amount of leachate.
- Potential for generation of greenhouse gases from degradation of biosolids – many larger landfill sites, including the City of Sault Ste. Marie landfill are now mandated to have active gas collection systems.

3.3.4 Industrial Re-use

A number of industrial use alternatives exist, such as use of biosolids or ash as an ingredient in brick-making, aggregate, and cement. Fuel can also be derived from biosolids.

Industrial use of biosolids is generally specific to local market opportunities and may require the use of proprietary and/or innovative treatment technologies. There is not a known local market for industrial use of biosolids or ash in the City at present. Developing a market in other municipalities involves considerable costs and effort, as well as time. Therefore, this option is not considered further in the discussion.

3.4 Regulatory Framework – Existing Guidelines / Standards / Regulations

In this section, the existing legislation and policies currently in place to regulate biosolids in Ontario is summarized. In Ontario, there are no bans or restrictions on the use or disposal of sewage biosolids, provided an appropriate Environmental Compliance Approval (ECA), issued by the MOECC is available for the use or disposal practice. In addition the future of land application is also considered.

3.4.1 Guidelines for the Utilization of Biosolids and Other Wastes on Agricultural Land

On June 27, 2002 (O.Reg 267/03), the Ontario government passed The Nutrient Management Act (NMA) to address land-applied materials containing nutrients. This Act includes provisions for the development of strong new standards for all land-applied materials containing nutrients, a proposal to ban the land application of untreated septage over a five-year period, and proposed new requirements such as: the review and approval of nutrient management plans, certification of land applicators and a new registry system for all land applications.

If the sewage biosolids are processed and utilized for agricultural land application, it then falls under the NMA. Analytical results for testing of the biosolids must consistently meet Provincial Guidelines (*Guidelines for the Utilization of Biosolids and Other Wastes on Agricultural Land, March 1996; Revised January 1998; MOE and OMAFRA*). Before waste is applied to agricultural land it must be treated in such a manner to minimize odour potential and reduce the number of pathogenic organisms and other potentially harmful constituents to an acceptable level as defined in the Guidelines. (i.e. sewage biosolids must be stabilized).

The MOECC is responsible for issuing Environmental Compliance Approvals for organic soil conditioning sites and as such, reviews detailed proposals for new sites with respect to parameters such as application rates, spreading procedures and soil characteristics. The applicant must establish the potential benefit of waste spreading to agriculture. Also considered in the approval process are factors including site location, land and soils characteristics, and proposed site management methods to minimize risk of contamination to surface watercourses, groundwater, wells and residences.

The land application contractor (spreader) keeps records of all fields receiving biosolids and the quantity applied to each field, as well as nutrient content per cubic metre. The farmer is provided with information on annual average quantities of metals per cubic metre of biosolids, if requested.

The biosolids hauler must receive an "Organic Waste Management System Certificate" for the biosolids materials before they can be moved from the water pollution control plants to the land application site. The farmer should be advised of nutrient concentration, i.e. available nitrogen, so that biosolids material and fertilizer application rates may be adjusted. Nutrient application rates should be based on fertilizer recommendation for the specific crop.

The Guidelines dictate that sewage biosolids should not be spread on frozen or ice covered soil. Therefore, storage of the biosolids is required for times when land application is not possible, including inclement weather, unsuitable soil conditions and during required waiting periods between land applications. The draft NMA requires that licensed storage facilities have 240 days of storage available. The private contractor (may be a hauler only, or hauler/applicator) who is responsible for disposal of biosolids from the two Wastewater Treatment Plant Facilities will have to store the material for the winter months and during inclement weather.

Future of Land Application

A study prepared for the Water Environment Association of Ontario reviewed the safety of the application of sewage biosolids to agricultural land (*Fate and Significance of Selected Contaminants in Sewage Biosolids Applied to Agricultural Land through Literature Review and Consultation with Stakeholder Groups, April 2001*). The authors concluded that, based on scientific research into human health, there are no significant health risks to people and animals when biosolids are applied at rates that fall within Ontario guideline limits and that sewage biosolids can be safely utilized on agricultural land. However, public perception is that biosolids application may cause surface water and private well contamination and aerial disease transmission. The concerns arise from several issues including the contamination of the Walkerton water supply and perceived inadequate monitoring and control of sewage biosolids application. Therefore, public acceptance will be a critical component of the future success of the land application of sewage biosolids programs. The study recommends formation of a task force with representatives from wastewater treatment generators/regulators, the medical communities and the public to explore pathogen issues and build consensus to resolve issues such as evaluation of health impacts, definition of risks and acceptable risks, development and monitoring studies to improve the current application program, and disseminating information to stakeholders including the media and the general public.

The NMA provides a comprehensive nutrient management framework for Ontario's agricultural industry, municipalities and other generators of materials containing nutrients, including clear environmental protection guidelines. It builds on the existing system by giving current best management practices the force of law, and creating comprehensive, enforceable, province-wide standards to regulate the management of all land-applied materials containing nutrients. The Act contains amendments to the *Environmental Protection Act*, the *Highway Traffic Act*, the *Ontario Water Resources Act* and the *Pesticides Act*, and consequential amendments to the *Farming and Food Production Protection Act*, 1998 to ensure consistency and give higher recognition to the standards.

It is of note that the Act itself provides the regulatory authority to develop and enforce regulations for nutrient management practices.

The Regulations were first issued in draft form in late 2002 for public comment. The 'Public', consisting of numerous groups directly or indirectly affected by the Regulation, has been voluble in its comments and the two ministries (Ministry of Environment and Ministry of Agriculture and Food) involved are reviewing these. A revised version of the Regulations is anticipated some time in the future. It has been understood that certain changes, generally relaxing timetables for enforcement of rules as they apply to farmers, will be made. Comments from the municipal biosolids 'community' (generators, and applicators, etc.) have noted that the Regulations seem to unduly penalize "non-agricultural source materials", including municipal biosolids, in that the provisions of the former Guidelines are perpetuated in terms of seasonal limits, but even longer winter prohibitions with longer storage requirements (eight months), as well as pre-harvest waiting periods, depths to bedrock, land slopes, and setbacks, etc. are stipulated. In addition, municipal biosolids, called "non-agricultural source material", must have fewer than 2 million colony forming units per dry gram (US EPA Class B), whereas no such pathogen criterion exists for agricultural source material (manure).

A key component of this act is that any non- agricultural operation (e.g. municipal, institutional, commercial and industrial operations) which generate or manage NASM shall have an approved Nutrient Management Strategy (NMS). As well the receiver of nutrients from any source including biosolids must have an acceptable Nutrient Management Plan (NMP) which manages rates of nitrogen and phosphorus and thus minimize adverse environmental impact.

The Nutrient Management Act appears not to give more favorable treatment to non-agriculture source materials of low pathogen content, such as equivalent to US EPA Class A, e.g. thermophilically digested biosolids, or to pulp and paper sludge which is essentially free of pathogens, and continues to identify these materials as 'prescribed'. The Nutrient Management Act regulations state that materials that are produced in accordance with the Federal Fertilizers Act are not 'prescribed' and therefore not governed by the Act, except as to nutrient levels. This would include thermally dried pellets or granules, and alkaline-stabilized biosolids.

The net effect of the NMA on the City of Sault Ste. Marie is that the land application of biosolids is likely to be more restrictive and regulated in the future. It is worthy to note that the NMA doesn't govern the landfill and composting operations of NASM.

3.4.2 Compost Standards

In 2004 the City of Sault Ste. Marie completed a Co-composting Pilot Study which included consideration of municipal biosolids and residential organics as feedstocks in varying proportions. The conclusions reached in that study in relation to biosolids composting are summarized below.

Biosolids are not being actively composted in the Province of Ontario. Biosolids are effectively being composted in British Columbia, Quebec and New Brunswick. The single largest restriction to composting *biosolids in the Province of Ontario is the Interim Guidelines. Based on the current standards, biosolids do not meet the feedstock restrictions and cannot meet the unrestricted use guidelines.*

Based on the above, it is recommended that the City not compost biosolids at this time. Factors that may influence this recommendation in the future include:

- *Changes in the compost standards in the Province of Ontario; and*
- *Province imposed ban on landfilling biosolids.*

Since the completion of the 2004 study, the MOECC developed and released, in July 2012, new compost quality standards and guidelines for producing compost in Ontario. The revised Ontario Compost Quality Standards address both the quality of the finished compost and feedstock. The standards set out three qualities of finished compost (AA, A and B) in comparison to the single quality standard that existed with previous standards. The new Compost Guidelines are intended to provide enhanced flexibility in managing biosolids through composting. Under these Guidelines composting of biosolids would become a viable alternative management strategy in Ontario. There are however a number of restrictions that impact the use of sewage biosolids as a feedstock in the composting process.

There are three proposed categories of compost: Category AA, Category A and Category B. Category AA does not contain septage, sewage biosolids, or pulp and paper biosolids, so is not considered further in this discussion. For categories A and B, the quality of both the feedstock material and final compost is regulated. Compost produced using sewage biosolids can only produce a category “A” or “B” compost quality. Furthermore, to achieve category “A” compost, sewage biosolids must be restricted to 25% or less of the feedstock blend on a dry weight basis. Appropriately labelled category “A” compost produced with biosolids can then be used and transported without further approvals. Conversely however, category “B” compost requires Ministry approval for use.

In Table 3.4(a) we have compared the new feedstock restrictions and finished compost quality standards to the dewatered biosolids quality data from the two plants. The values presented for each plant reflect the average and highest recorded value for the specific parameter for six samples from each plant over the period from 2009 to 2013. A more comprehensive summary is also included in Appendix A.

Table 3.4(a) ONTARIO COMPOST QUALITY STANDARDS (2012) AND DEWATERED BIOSOLIDS QUALITY					
Criterion	Raw Feedstock (Categories A and B Compost)	Finished Compost (Category A)	Finished Compost (Category B)	East Plant Avg. Concentration (Max. Concentration)	West Plant Avg. Concentration (Max. Concentration)
		mg/kg dry weight			
Arsenic	170	13	75	2.47 (4.1)	2.72 (4.8)
Cadmium	34	3	20	0.92 (1.41)	0.74 (1.28)
Chromium	2800	210	1060	21.0 (35.0)	19.2 (23.7)
Cobalt	340	34	150	2.52 (3.61)	2.78 (4.25)
Copper	1700	400	760	305 (372)	236 (434)
Lead	1100	150	500	76 (191)	20 (60)
Mercury	11	0.8	5	0.37 (0.77)	0.09 (0.15)
Molybdenum	94	5	20	5.63 (8.89)	5.10 (6.36)
Nickel	420	62	180	12.4 (18.6)	9.8 (13.2)
Selenium	34	2	14	2.1 (3.2)	1.7 (4.8)
Zinc	4200	700	1850	390 (528)	255 (432)

Based on the representative data presented in the table, the biosolids from both plants meet the feedstock quality requirements and hence are suitable for use in producing compost. Furthermore it appears the quality of the biosolids is suitable to produce at least a “B” category compost and is likely suitable for producing and “A” category compost considering that the sewage biosolids must be restricted to 25% or less of the feedstock blend on a dry weight basis for category “A” compost. The production of category “A” compost will however require additional compostable feedstock.

The Federal Fertilizers Act and its regulations also identify labelling and application rate requirements for any compost that is sold.

3.4.3 Fertilizer Regulations

The Fertilizer Act and Regulations are administered by Agriculture and Agri-Food Canada (AAFC). It is the aim of these standards to help ensure that fertilizers and supplements, including processed sewage, compost and other by-products, are safe and pose a minimum potential for detrimental effects from metal contamination. The heavy metal standards provide maximum cumulative additions to soils (as well as maximum acceptable metal concentrations in products). Standards for heavy metals are adopted as a result of long-term effects of heavy metals in soils. Some metals are relatively toxic to plants and others are toxic to animals or humans while some of the non-essential metals have long-term cumulative effects which are not fully understood.

The standards are conservative because significant metal concentrations are already present in the soils of some areas. In addition, uncontrolled factors such as soil acidity, soil cation exchange capacity and plant species all affect the degree of uptake of some of the metals.

All fertilizers and supplements, including sewage biosolids, composts and other by-products must also meet the maximum cumulative metal additions to soil as provided in these Regulations.

The Regulations under the National Fertilizers Act also provides standards and requirements for registration, labelling, and analysis.

If the sewage biosolids is processed and offered for sale either as a fertilizer or as a component of fertilizer, it then falls under the Federal Fertilizers Act and Regulations governing fertilizers containing organic materials. Although not specifically addressed in the regulations, under these conditions the biosolids is usually dried and considered to be essentially pathogen free. The regulations state that minimum levels of nutrients in the material must be identified and all products are subject to heavy metal concentration standards.

3.4.4 Incineration and Gasification

Incineration or gasification of sludge and biosolids materials generated in Ontario is governed under the Ontario *Environmental Protection Act* (EPA), Regulation 347.

When the sludge and or biosolids incinerator is located on an existing wastewater treatment plant site, it can be approved within the ECA for the wastewater treatment facility, issued under the Ontario Water Resources Act.

Ash is typically a non-hazardous waste and can be disposed of in a municipal landfill. A site specific ECA may be required for any recycling options. An incineration facility outside the approved wastewater treatment facility boundaries would be considered a waste disposal facility under O.Reg. 347 of the Environmental Protection Act. An environmental assessment (screening or full) may also be required depending on the proposed capacity and plant configuration and an ECA would be required.

Whether on the wastewater treatment plant (generation) site or off-site, all incineration facilities are governed by the terms and conditions of site-specific ECA for air emissions. This ECA documents the emissions control equipment, monitoring, emissions limits and recordkeeping requirements for each facility.

Fluidized bed incineration facilities perform well within the current and anticipated future air emission requirements. For the older multiple hearth technologies, air pollution control equipment will become more complex to meet more stringent regulatory standards.

3.4.5 USEPA Class A, B and EQ Classifications

The US EPA Standards for the Use or Disposal of Sludge (40 CFR 503) include two approaches for controlling pathogens that may be present in raw sludge: Class A in which disinfection processes reduce pathogen levels in biosolids to “below detectable levels” and Class B in which disinfection processes “significantly reduce” pathogen levels in biosolids. Risks relating to land applying Class B biosolids are further controlled by access and crop harvesting restrictions. The purpose of these restrictions is to ensure that the pathogen levels in biosolids are reduced to levels considered safe for the biosolids to be land applied or surface disposed. In addition to those two, another classification “EQ” exist, which is defined as those sewage biosolids that meet metal standards, Class A and vector reduction standards defined in Part 40CFR 503.

In Ontario, the existing quality requirement for NASM closely follows, although not identically, that of the Class B requirements. One of the significant differences between NMA and USEPA in this aspect is the indicator organism, with the former using Escherichia Coli, whereas the latter using Fecal Coliforms.

3.5 Evaluation Methodology and Criteria

The development and evaluation of alternative solutions and designs is completed in two phases. The first phase examines each alternative solution in relation to the problem/opportunity while considering all environmental impacts. In the second phase various design options are considered for the preferred alternative selected in phase 1.

Evaluation matrices were developed by the project team to rank the alternative management and processing options in relation to doing nothing. A total of six (6) and sixteen (16) evaluation criteria were established to rank the management and processing alternatives respectively. Each evaluation criterion is described in Tables 3.5(a) and 3.5(b).

Table 3.5(a)

EVALUATION CRITERIA – MANAGEMENT ALTERNATIVES

Criterion	Description
Land Area Requirements	Estimated land area required for disposal of processed biosolids.
Net Costs	A qualitative comparison of the estimated net costs for each alternative.
Timing Restrictions / Storage Requirements	A comparison of the timing restrictions that are expected to apply in disposing of the processed biosolids and the requisite storage requirements.
Potential Future Liability	Consideration of the future liability that could be traced back to the City.
Administrative Requirements	Consideration of the complexity and time commitment required to administer the alternative.
Environmental Benefits	Consideration of the environmental benefits that are anticipated.

Table 3.5(b)

EVALUATION CRITERIA – PROCESSING ALTERNATIVES

Criterion	Description
Technical	
Flexibility – Biosolids Quality	Sensitivity of the Alternative to the biosolids quality – ability to meet performance objectives for a range of feedstock compositions
Flexibility – Biosolids Quantity	Sensitivity of the Alternative to the quantity of biosolids – ability to accommodate variations in quantity
Flexibility – Regulatory Changes	Anticipated ability to meet future changes in regulations.
Approvals Requirements	Anticipated degree of difficulty in gaining system approval including EA requirements.
Proven and Reliable Technology	Proven track record operating in North America for similarly sized installations.

Table 3.5(b) EVALUATION CRITERIA – PROCESSING ALTERNATIVES	
Criterion	**Description**
Compatibility with Current WPCP Processes	Changes required to existing wastewater infrastructure to accommodate the Alternative.
O&M Requirements	Complexity of the Alternative and level of operator skill and attention required.
Potential for Use as Landfill Cover	Potential to use the processed material or by-products of the process for landfill cover.
Odour Mitigation	Potential to mitigate odour impacts at the facilities and along transportation routes.
Natural Environment	
Air	Potential for impacts to the air in the form of emissions (odour excluded evaluated separately).
Water	Potential for impacts to surface and ground water quality.
Land	Potential for impacts to land.
Social Environment	
Public Health	Potential for impacts to public health.
Land Use – Processing	Site size requirements and the availability of suitable lands.
Land Use – Disposal	Availability of sites for the use/disposal of the processed material.
Financial	
Lifecycle Costs	A qualitative comparison of the lifecycle cost expectations for each alternative.

A comparative qualitative approach was developed to evaluate each of the management and processing alternatives relative to the "Do Nothing" Alternative. Ratings ranging from -2 to +2 were assigned to each alternative under each criterion as follows:

Rating	Criteria
-2	Much worse relative to Do Nothing
-1	Worse relative to Do Nothing
0	Status quo
+1	Better relative to Do Nothing
+2	Much better relative to Do Nothing

All criteria considered in the evaluation of management alternatives were assigned the same weighting. However, in the case of the processing alternatives evaluation, criteria weightings ranging from 1 to 3 were assigned to each criterion. Weightings greater than one were assigned to those criteria that reflect the key objectives of the undertaking. Criteria that were assigned higher weightings are identified below:

- Potential for use as landfill cover – assigned weighting = 3
- Odour mitigation – assigned weighting = 3
- Lifecycle costs – assigned weighting = 3

These weightings are aligned with the key objectives identified in Sections 1.2 and 2.0.

This evaluation methodology was selected in lieu of a more complex quantitative approach to provide the general public with a better understanding of the evaluation process. A summary of the evaluations is included in Tables 3.5(c) and 3.5(d) and the detailed evaluation matrices are included in Appendix D.

Table 3.5(c) – SUMMARY OF EVALUATION RESULTS – MANAGEMENT ALTERNATIVE SOLUTIONS

Alternative Solution	Land Area Requirements	Net Costs	Timing Restrictions / Storage Requirements	Potential Future Liability	Administrative Requirements	Environmental Benefits	Total
Criteria Weighting	x1	x1	x1	x1	x1	x1	
Agricultural Land Application	-2	-2	-2	-2	-2	+2	-8
Forest and Non-Agricultural Land Application	-2	-2	-1	-2	-2	+2	-7
Landfill Cover	0	-1	+1	0	0	+1	+1

Table 3.5(d) – SUMMARY OF EVALUATION RESULTS – PROCESSING ALTERNATIVE SOLUTIONS

Alternative Solution	Technical									Natural Environment			Social Environment			Financial	Total
	Flexibility – Biosolids Quality	Flexibility – Biosolids Quantity	Flexibility – Regulatory Changes	Approvals	Proven & Reliable Technology	Compatibility With Current WPCP Processes	O&M Requirements	Potential for Use as Landfill Cover	Odour Mitigation	Air	Water	Land	Public Health	Land Use – Processing	Land Use – Disposal	Lifecycle Costs	
Criteria Weighting	x 1	x 1	x 1	x 1	x 1	x 1	x 1	x 3	x 3	x 1	x 1	x 1	x 1	x 1	x 1	x 3	
Anaerobic Digestion	-2	-2	2	2	0	-1	-1	0	3	0	0	0	2	-1	2	-5	-1
Aerobic Digestion	0	-1	2	2	0	0	-1	0	3	0	0	0	2	-1	2	-4	4
Alkaline Stabilization	0	0	2	2	0	0	-1	6	5	-1	0	0	2	-1	1	-3	12
Geotube Freeze and Thaw	0	0	0	0	-1	0	0	0	0	0	-1	0	0	-2	0	0	-4
Chemical and Heat Treatment	0	0	2	-1	-1	0	-1	0	3	0	0	0	2	-1	1	-3	1
Enhanced Dewatering	-1	0	0	0	0	0	-1	0	3	0	0	0	1	0	1	-2	1
Thermal Processes	0	0	1	0	-1	0	-2	3	6	-1	0	0	1	-2	1	-6	0
Composting	0	0	2	1	0	0	-1	6	5	0	0	0	2	-1	1	-5	10

The results of the evaluation included in Table 3.5 (c) indicate that application of the final processed material as landfill cover clearly received the most favourable scoring. This alternative was carried forward into the next phase of the study process.

The summary of results included in Table 3.5(d) for the processing alternatives indicate that two alternatives received more favourable scoring relative to the other alternatives. The following alternatives were carried forward for further consideration in the next phase of the study process:

- Alkaline Stabilization; and
- Composting.

4. Identification and Evaluation of Alternative Design Concepts

Following the evaluation of Alternative Solutions, the following alternatives were short-listed for a more rigorous evaluation based on conceptual design development and lifecycle costing:

1. Alkaline Stabilization; and
2. Composting.

The conceptual design development and assumptions made for each of these alternatives are described in subsections 4.2 and 4.3 respectively.

Prior to initiating the conceptual design development for the short-listed alternatives, consideration was given to alternative site locations for a processing facility. The alternative locations considered and the criteria considered in selecting a preliminary preferred location are summarized in Section 4.1.

4.1 Facility Location

Three alternative locations were considered for the short-listed processing facilities:

1. East End Water Pollution Control Plant;
2. West End Water Pollution Control Plant; and
3. The Municipal Landfill Site.

These sites were identified as suitable candidates given that these sites are owned by the City, the biosolids are generated at the WPCP's, the anticipated beneficial use of the processed biosolids, in whole or in part, is daily, interim or final cover at the Municipal landfill site and vacant lands are available at or adjacent to each of these sites.

An evaluation matrix was developed by the project team to rank the alternative locations relative to each other. A total of five (5) evaluation criteria were established to rank the alternative locations. Each of the evaluation criteria is described in Table 4.1(a). The lifecycle costs are not expected to vary significantly for the alternative locations being considered.

Table 4.1(a) EVALUATION CRITERIA FACILITY LOCATION OPTIONS	
Criterion	**Description**
Transportation	Potential impacts associated with the transportation of biosolids and the processed material (noise, vibrations, emissions).
Adjacent Land Use	Potential nuisance impacts to adjacent land uses (odour, dust, noise, vibrations).
Future Land Use	Potential impact of the proposed facilities on the future anticipated land uses at the site.
Operations	Potential impact of the proposed processing operations on the existing site operations and the ability to integrate the new operations.
Processing Plant Upset	Potential impact of a processing plant upset.

A comparative qualitative approach was developed to evaluate each of the alternatives relative to each other. Ratings ranging from +1 to +3 were assigned to each alternative under each criterion to rank alternatives relative to each other with higher values assigned to alternatives that were clearly superior under a given criterion.

The detailed evaluation matrix is included in Appendix D and a summary of the scoring assigned to each alternative under each criterion is provided in Table 4.1(b).

Table 4.1(b) SUMMARY OF EVALUATION RESULTS FACILITY LOCATION OPTIONS			
Criterion	**EEWPCP**	**WEWPCP**	**Landfill**
Transportation	+2	+1	+3
Adjacent Land Use	+1	+2	+3
Future Land Use	+1	+1	+2
Current Operations	+1	+1	+2
Processing Plant Upset	+1	+2	+3
TOTALS	**+6**	**+7**	**+13**

The landfill site received the highest overall scoring and is the preliminary preferred location for the short listed alternatives.

4.2 Alkaline Stabilization

In this section, alkaline stabilization is discussed in more detail and a conceptual design and lifecycle costs are presented. For the purposes of comparison to other technologies, the NViro process is referenced to provide estimated area requirements and costing.

Alkaline stabilization involves the mixture of biosolids with an alkaline material, such as lime, cement kiln dust and fly ash. When the pH value of the mixture is maintained at or about 12 for at least 72 hours, and a temperature of 52^{o}C is maintained for at least 12 hours of this period, the resulting material will meet relevant regulatory requirements in Ontario for agricultural and non-agricultural land applications or Class A US EPA quality criteria.

Figure 4.2(a) presents a general schematic of an alkaline stabilization process. In Sault Ste. Marie mechanical dewatering is completed at each of the waste water treatment plants and would not be required in the Biosolids processing facility. In addition, the proposed principle end use (landfill cover) will not require off-site hauling for land application.

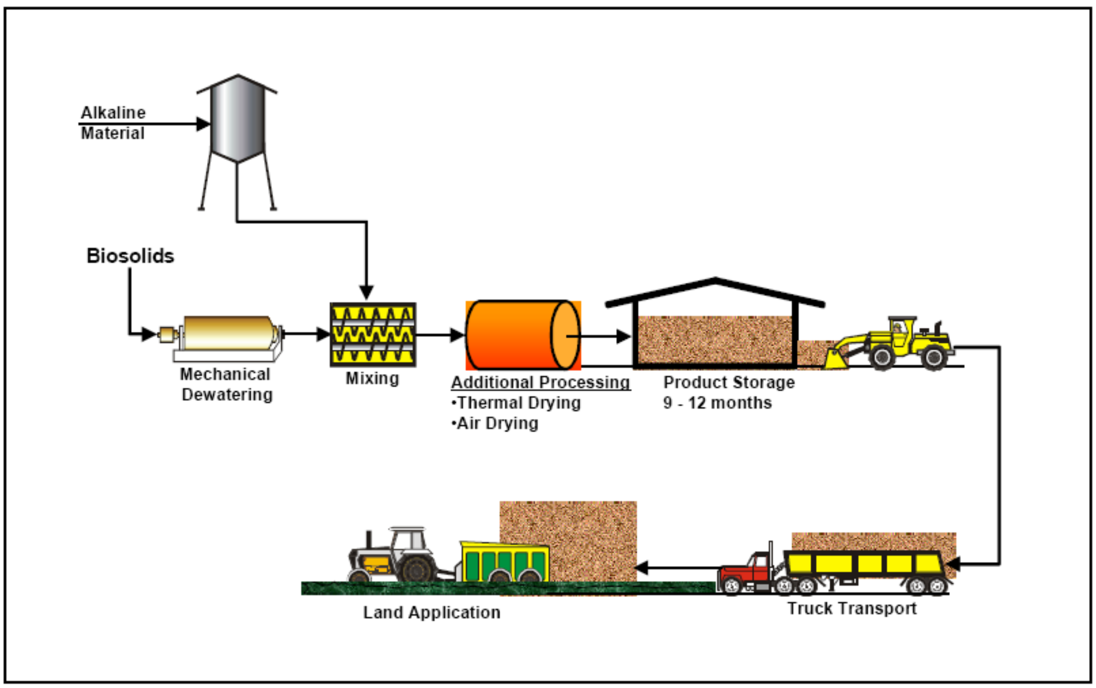


Figure 4.2(a) Schematic of Alkaline Stabilization and Distribution of Biosolids

The equipment necessary for alkaline stabilization is relatively simple, and includes feed conveyance equipment, an alkaline material storage and conveyance system and mixer. Some proprietary technologies include drying to obtain a drier finished material. Air emission and odour control equipment is required to minimize dust and odours.

The alkaline stabilized material can be stored in covered facilities for extended periods; however, extended storage can result in odour generation. Extensive storage requirements can be costly and may require significant odour control equipment. For end-use as a landfill cover, the storage requirements can be reduced relative to the requirements for agricultural land application.

The alkaline stabilized material is suitable for landfill cover, agricultural and non-agricultural land application, a lime substitute, source of organic matter or specialty fertilizer. The material offers the benefits of improving soil properties such as pH, texture and water holding capacity.

4.2.1 Experience Elsewhere

In Ontario, alkaline stabilization using the N-Viro™ process has been practised for several years at smaller facilities in Leamington and Sarnia. The resulting material is used primarily for agricultural land application in south western Ontario, an area with acidic sandy soils suited to an alkaline product. Both of these facilities process less than 20 dry tonnes per day. A new facility has recently been approved in the Region of Niagara, Ontario, to process a portion of biosolids generated in the Region and construction of a new facility has also been initiated in Sudbury, Ontario.

The process has also been widely used in North America for more than 20 years. These facilities tend to be smaller in size (i.e., <20 dry tonnes per day), but several large facilities are in operation. Two of the larger plants include Middlesex County, New Jersey at 130 dry tonnes per day, and Toledo, Ohio, at 30 dry tonnes per day. Middlesex County has experienced problems with agricultural outlets for the product as a result of odours and other operational problems that caused negative public perception.

The mixing paddles first used at Middlesex to blend the alkaline dust with the sludge were found to be inadequate, resulting in some odours. Blending units were modified, curing areas were enclosed, and an odour control system was added, effectively ending odour problems at the facility.

The alkaline stabilized material typically has the ability to buffer acidic soils, and therefore, the market demand is generally in geographic areas with acidic soils, or in areas where the material can be applied without adversely affecting the soil's properties.

4.2.2 The Process

The dewatered cake from the east and west plants will be trucked to the alkaline stabilization facility at the landfill. The dewatered cake will be received in the underground bin.

Once the sludge is received in the hopper of the mixing system, the alkaline admixture is mixed with the dewatered sludge cake. The amount of alkaline admixture varies according to the amount of heat required in the process, the type of sludge, the characteristics of the alkaline admixture, and the intended beneficial reuse market. Blending takes place in the mixer.

The product is then dried to the desirable 60-65% solids content utilizing a single-pass, rotary-drum dryer. The dryer discharges to a "heat-pulse" cell. A combination of heat from the dryer and a chemical reaction between the alkaline materials and the moisture in the sludge cake raises the temperature to a controlled range of between 52° C and 62° C and the pH to slightly above 12. The material is held in the heat-pulse cell(s) in the controlled temperature range for a period of 12 hours.

The soil product is ready for distribution as soon as the heat pulse phase is complete or it can be stored right on-site. The soil amendment product meets the requirements of applicable Agriculture and Agri-Food Canada (Ag Canada), Fertilizers Act and Regulations, and Provincial guidelines for its use in the agricultural sector. It will also be suitable for use as daily or interim cover when mixed with native sands at the landfill site.

4.2.3 Odour Control

A venturi scrubber is used for particulate removal, and is followed by a biofilter for odour control. Air from the mixer area, the heat-pulse, product storage area and the exhaust from the dryer, are all treated. There is no need for an acid scrubber system since sludge is not digested, however, if in the future sludge digestion is expected then an additional acid scrubber may be added to remove ammonia.

4.2.4 Building Layout

A conceptual layout of the Alkaline Stabilization Building is illustrated in Figure 4.2(b).

Figure 4.2(b) Conceptual Layout of Alkaline Stabilization Facility

4.2.5 Conceptual Site Plan

A conceptual site plan for the new Alkaline Stabilization facility is illustrated in Figure 4.2(c). In total, an area of approximately 130m x 87m will be required, assuming that a buffer area of 30m is provided around the perimeter of the site.

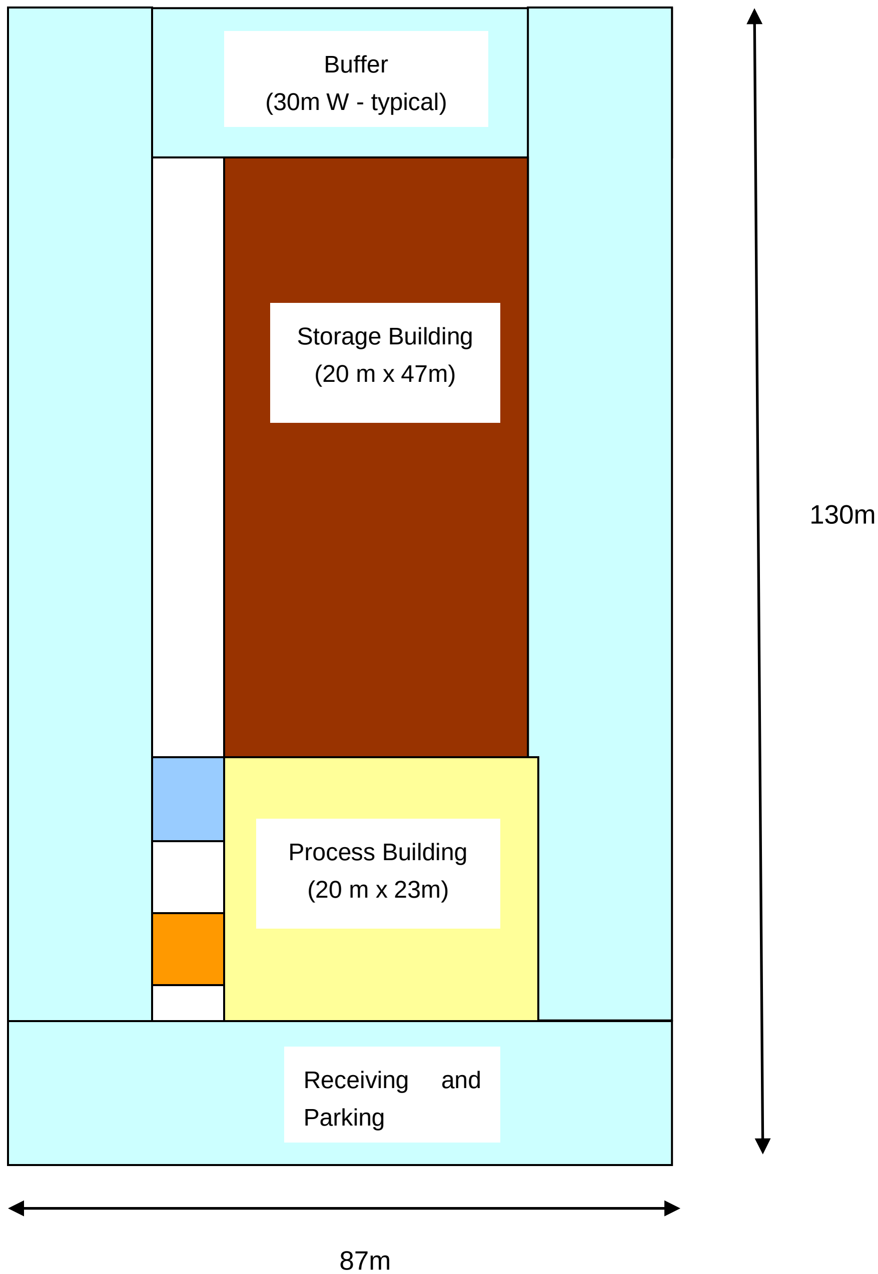


Figure 4.2(c) Conceptual Site Plan of Alkaline Stabilization Facility

4.2.6 Preliminary Lifecycle Costs

Capital and operating cost estimates were prepared based on information obtained from vendors and other operating examples. The capital and operating cost estimates were then used to develop a lifecycle cost estimate. The parameters used in developing the lifecycle costs are summarized below:

Analysis Period = 20 years
Interest rate = 4%
Rate of Return = 2%
General Inflation Rate = 2.7% (average of 1, 3 and 5years – source Bank of Canada)
Energy Inflation = 7.5%
Commodity Inflation = 5%

The latter two figures were developed based on consideration of the recent and longer term historical inflation rates for industrial commodities and energy available through the Bank of Canada and Statistics Canada. A sensitivity analysis was also completed for the "Energy Inflation" rate. Analyses were completed with an Energy Inflation Rate of 5%, 7.5% and 12.5%.

The capital, operating and lifecycle cost estimates are included in Appendix E and the lifecycle costs are summarized in the table below.

Table 4.2(a)
ESTIMATED LIFECYCLE COST PER WET TONNE
ALKALINE STABILIZATION

Energy Inflation Rate	Cost per Wet Tonne in Year 1
5%	$166
7.5%	$174
12.5%	$201

4.3 Conventional Tunnel Composting

The regulatory requirements for compost stabilization in Ontario are set out in revised Ontario Compost Quality Standards (July 2012). For the purposes of the conceptual design it is assumed that a conventional tunnel composting process would be used in Sault Ste. Marie, which requires minimum 3 day retention at a minimum temperature of 55^{o}C to meet pathogen destruction requirements. The composting facility would be designed to meet the temperature and oxygen monitoring requirements set out in the standards.

Based on a review of select available dewatered sewage sludge data it appears the quality of the biosolids generated at both plants are suitable to produce at least category "B" compost and potentially category "A" compost. Therefore, the compost produced is suitable for landfill cover and likely suitable for agricultural and non-agricultural land applications (ie. compost and alkaline stabilized material can likely be used in similar capacities).

4.3.1 Overview of Composting Facility

The conceptual design of the composting facility has been developed for Sault Ste, Marie based on a conventional tunnel composting technology, which is essentially aerated (forced air) static pile performed inside an enclosed vessel (tunnel). Similar sludge composting facilities have been constructed and are in operation in Western Canada in Prince Albert SK, Banff AB and Fort McMurray AB. All three facilities have been designed to meet CCME requirements for pathogen destruction.

The following paragraphs provide the conceptual design of an indoor sludge composting facility for Sault Ste. Marie which is intended to process 10,000 wet tonnes per year of dewatered sludge cake at 25% dry solids by weight. The following discussion on the conceptual design of the composting system is organized in accordance with the seven-step composting model recommended by the Composting Council of Canada:

1. Sludge delivery, receiving, unloading and quality control (Feedstock Recovery);
2. Mixing and blending of dewatered sludge with woodchips (Feedstock Preparation);
3. Compost stabilization (Composting);
4. Odour and Leachate Treatment;
5. Compost Screening;
6. Compost Curing; and
7. Compost Storing, Marketing and Distribution.

The discussion on the seven-step model is followed by a discussion on the building and site development concepts and estimated lifecycle costs.

4.3.2 Feedstock Recovery

The purpose of the Feedstock Recovery step is to ensure that the feedstock (dewatered sludge) entering the composting process is properly handled and controlled to ensure compliance with the finished product standards. The only organic feedstock that will be composted at this facility is wastewater sludge generated by the two WPCPs.

Sludges generated from the East End and West End WPCPs will be dewatered at their respective sites and transported to a centralized composting facility located at the municipal landfill.

The primary sludge/WAS blended feedstock from the East End WPCP will be generated by a BNR process and as such will have a high phosphorus concentration, which is typically in the range of 4 to 6% by weight. With an elevated concentration of phosphorus the feedstock is particularly well-suited for composting and beneficial re-use, because of its high nutrient value. The feedstock from the West End WPCP will be blended primary sludge and WAS but alum is used for chemical P removal.

Both feedstocks, either by themselves, or in combination are amenable to stabilization by composting and beneficial re-use. In practice, it would be desirable to mix the sludges from each WPCP to ensure that a consistent feedstock is provided in each tunnel.

The dewatered cake from the wastewater treatment facilities will be transported to the composting facility and discharged to a live bottom hopper in the mixing room. For the purposes of the conceptual design, it is assumed that the dry solids concentration of the dewatered cake will be reduced to 20% (from current content of approximately 25%) thereby increasing the annual wet weight tonnage to 12,500 (from current tonnage of 10,000), as experience has shown that a slightly wetter cake is more suitable for composting.

The mixing room will be completely enclosed with concrete floor and walls, and a steel roofing system. The room will be equipped with a ventilation system to provide six air changes/hour and the exhaust air from the room will be used as supply air for the compost process air blowers. The building will also be insulated to minimize the potential for condensation and "fogging" to occur inside the building during the winter months and to minimize energy losses.

Wood amendment will be obtained from local and area sources and delivered to site and stored outside the compost building. Batches of amendment will be moved inside the building and stored in the mixing area, as required.

Segregated clean wood waste is accepted at the municipal landfill. The average annual quantity of wood chips produced is typically in the range of 1000 to 2500 tonnes. A significant quantity of wood amendment would have to be sourced externally to meet the annual tonnage required (ie. approximately 25,000t – this quantity may be reduced moderately with some re-use of the amendment – refer to Section 4.3.6).

4.3.3 Feedstock Preparation

The purpose of the Feedstock Preparation step is to ensure that the characteristics of the feedstock are suitable for the composting process and subsequent steps. The parameters of particular interest include porosity, microbial diversity, nutrient balance, pH, and moisture content. Of these, moisture content and porosity will be the most critical for wastewater sludge composting.

Moisture Content and Porosity

Experience has shown that an initial raw compost solids content of 40% (or 60% moisture content) is optimum as this provides a balance between the need to ensure that there is sufficient free air space in the pile for air to pass through the pile with minimal restriction, sufficient moisture for the biological stabilization process, and sufficient moisture for evaporative cooling to control the temperature in the pile during the composting process.

If the moisture content of either the sludge or amendment changes, it will be necessary to adjust the ratio in order to get the proper mix. For example, a reduction in the solids concentration will require additional amendment and/or final product to attain a final moisture content of 60% prior to composting.

Microbial Diversity

Recycling about 10% to 20% of the finished compost product will improve microbial diversity, because the finished compost already has the microbial flora necessary to seed the composting process.

Nutrient Balance

Nutrient balance, as expressed by the ratio of carbon to nitrogen (C/N), is achieved by mixing the nitrogen rich sludge with the carbon rich wood chips. Table 4.3.3(a) illustrates the C/N ratio for a typical municipal sludge/wood chip blend, based on the characteristics of the blended sludge feedstock that is expected to be generated in Sault Ste. Marie.

Table 4.3(a)
NUTRIENT BALANCE FOR COMPOST MIX

Parameter	Raw Dewatered Sludge Cake	Amendment	Recycle	Raw Compost Mix	Finished Compost
Dry Solids, kg/d	6,840	25,029	3,360	35,229	21,200
VSS/TSS, %	85	85	85	85	
Solids Content, %	20	54	60	40	60
Moisture Content, %	80	46	40	60	40
Wet Weight, kg/d	34,200	46,350	5,600	86,150	35,300
Moisture, kg/d	27,360	27,820	2,240	57,420	14,100
Nitrogen Weight, kg/d	581	43	34	658	592
Carbon Weight, kg/d	5,810	10,879	510	17,199	10,300
C/N Ratio	10	253	15	26.1	17
TKN, %	10	.2	1	0.8	2.8
Bulk Weight, kg/m^3	1,000	450	800	600	500
Volume, m^3/d	34.2	103.0	7.0	144	71

The acceptable range of C:N ratios is from 25:1 to 40:1, and the proposed conceptual mix design for Sault Ste. Marie will provide a C:N ratio of 26:1 at the start of the composting process.

The dewatered cake in the live bottom hopper will be transferred to a mixer, and combined with amendment and compost recycle. As part of a typical mix cycle, amendment and recycle will be added to the mixer in proportions prescribed by the compost mix. The mass of products in the mixer will be recorded using load cells on the base of the mixer, then dewatered cake will be added automatically to the mixer using a conveyor to transport cake from the live bottom hopper. When an appropriate mass of dewatered cake has been added to the mixer, the transfer conveyor will stop, and a mix sequence will be initiated.

The mix sequence will take approximately five to six minutes, and when complete, the raw compost product will be discharged to the floor of the Compost Building. The product will then be loaded into the compost tunnels using a front-end loader, and once the tunnel is full, the compost process will be initiated by Operations Staff.

4.3.4 Compost Stabilization

The purpose of the composting step is to stabilize the wastewater sludge through aerobic biological degradation and pathogen destruction. During the process, a diverse population of microbes consumes simple sugars, starches, fats and proteins to produce heat. The elevated temperature of compost stabilization destroys pathogens and stabilizes the organic material.

The process is designed to provide a total of 21 days within the composting process. Of the 21 days, 2 days are allowed for an initial temperature rise, a minimum of 3 days above a temperature of 55°C, and 16 days above a temperature of 45°C. The compost pile will be allowed to cool before it is removed from a tunnel.

The basis of sizing the tunnels is summarized in Table 4.3(b).

Table 4.3(b)
COMPOST TUNNEL SIZING

Parameter	
Annual Feedstock Wet Weight, t/y	12,500
Daily Feedstock Wet Weight, t/d	34.2
Dewatered Cake Solids, %	20
Density, kg/m^3 (dewatered cake)	1,000
Raw Sludge Dry Solids, kg/d	6,840
Raw Sludge Volume, m^3/d	34.2
Amendment and Recycle Ratio	3.2
Volume Reduction Factor, %	0
Total Volume/day, m^3/d	144
Batch Cycle Time, d	21
Total Number of Tunnels	7
Total Number of Active Tunnels	5
Number of Days to Fill Tunnel,	4.2
Total Required Volume/Batch, m^3	605
Width of each Tunnel, m	6.0
Length of Each Tunnel, m	27.0
Fill Height of Raw Compost in Tunnel, m	3.8
Height of Tunnel, m	5.0
Working Volume of each Tunnel, m^3	616

Oxygen and Temperature Control

The oxygen supply system consists of seven process air blowers (one dedicated to each tunnel), which will be centrifugal design and constructed of 316 SS. The blowers will provide air to the composting process under positive pressure. Air is distributed under the compost piles using a series of perforated pipes in the floor slab. Prior to building a compost pile, a layer of coarse wood chips is placed over the floor to ensure uniform distribution of air throughout the pile and prevent the ‘spigots’ in the floor slab from plugging. The wood chip layer will be approximately 300 mm thick at the center of the tunnel, and taper near the walls to prevent air from short-circuiting up the walls.

Air will be withdrawn from the headspace between the compost pile and the roof and will be either recycled and mixed with fresh air and returned to the compost pile, or allowed to exhaust from the building. Each tunnel will be operated independently under positive pressure at varying airflow rates. A minimum of four temperature probes will be inserted into each pile and will be used to monitor the temperature of the piles. The computer control system will use the temperature as a parameter to automatically adjust the volume of fresh and recycled air to be delivered to each pile.

The basis of sizing the blowers is summarized in Table 4.3(c).

Table 4.3(c) BLOWER SIZING	
Number	7
Flow, m^3/min	322
Pressure, kPa	5
Power, kW	40

4.3.5 Odour Control and Leachate Treatment

The primary source of odour from the compost facility will be exhaust air from the compost tunnels. The exhaust air will have high concentrations of ammonia ranging from 200 ppm to 800 ppm. Based on operating experience in Prince Albert and Banff, the average ammonia concentration is expected to be approximately 200 ppm. In addition to ammonia, the exhaust air will contain low concentrations of H_2S, amines, volatile organic compounds, and other reduced sulphur compounds.

The exhaust air from the composting system will be treated in a two-stage treatment process. In the first stage, a wet scrubber will be used to reduce the ammonia concentration to below 50ppm. After scrubbing, the exhaust gas will be treated using synthetic media biofiltration.

The composting process will generate leachate that will need to be treated at the wastewater treatment facilities. The leachate will be directed to the existing pump station at the landfill. The leachate will have elevated levels of ammonia and a high pH, therefore corrosion protection will need to be considered in the design of the conveyance system.

4.3.6 Compost Screening

The compost product may be screened before or after curing. The advantage of screening before curing is that it reduces the amount of material that needs to be handled during the curing process, which is a consideration if an aerated floor is to be used for curing. Furthermore, screening allows some portion of the amendment to be re-used, but 60 to 80% of the biodegradable matter from the wood is lost in each compost cycle, therefore new amendment is required for its heating value during the composting process.

4.3.7 Compost Curing

The purpose of the compost-curing step is to complete the decomposition of the more chemically complex substances such as cellulose lignins. These substances decompose very slowly, primarily by actinomycetes and fungi. If compost is not cured, this continuing biological activity can cause odours and/or plant growth problems, such as toxicity and nitrogen deficiency caused by the nitrogen used in the continuing decomposition process.

Curing is not necessary for all compost applications, such as agricultural applications, where the compost will be spread immediately and no crops will be grown for some time. However, for many beneficial re-use applications a minimum curing time of 30 days should be provided and at least six months is recommended.

For the purposes of the conceptual design, it is assumed that the compost product will be cured by windrowing on the pad immediately adjacent to the Compost Building.

4.3.8 Compost Storage and Distribution

It is assumed that the final product will be used for landfill cover. In the future, the City could choose to develop other value-add markets for the finished compost product provided the relevant regulatory requirements can be met. As these new markets are developed, the compost storage and distribution operating procedures will need to be revised to suit the requirements of the end-market.

4.3.9 Building Layout

A conceptual layout of the Compost Building is illustrated in Figure 4.3(a).

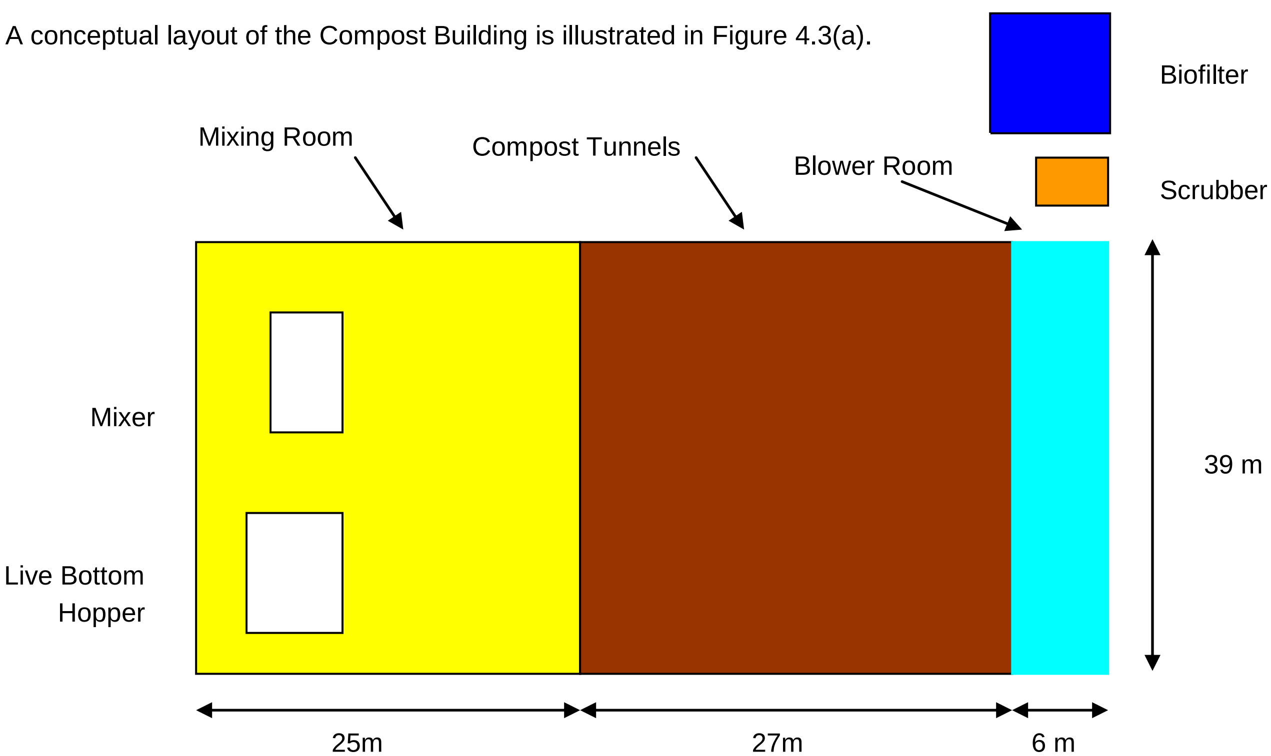


Figure 4.3(a) Conceptual Layout of Composting Facility

4.3.10 Conceptual Site Plan

A conceptual site plan for the new composting facility is illustrated in Figure 4.3(b). In total, an area of approximately 200m x 160m will be required, assuming that a buffer area of 30m is provided around the perimeter of the site.

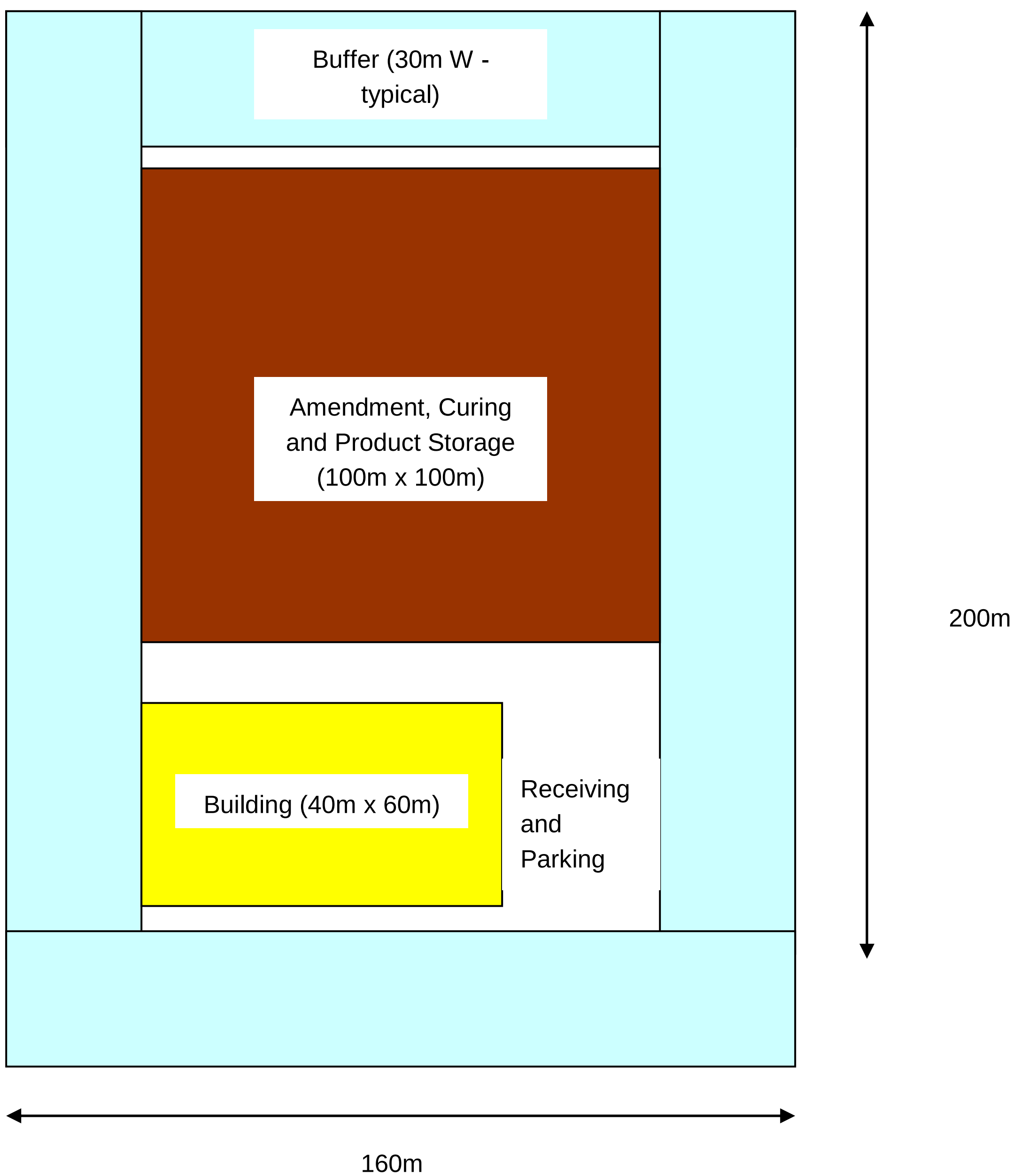


Figure 4.3(b) Conceptual Site Plan of Composting Facility

4.3.11 Preliminary Lifecycle Costs

Capital and operating cost estimates were developed based on information obtained from other operating examples. The capital and operating cost estimates were then used to develop a lifecycle cost estimate. The parameters used in developing the lifecycle costs are summarized below:

Analysis Period = 20 years
Interest rate = 4%
Rate of Return = 2%
General Inflation Rate = 2.7% (average of 1, 3 and 5years – source Bank of Canada)
Energy Inflation = 7.5%
Commodity Inflation = 5%

The latter two figures were developed based on consideration of the recent and longer term historical inflation rates for industrial commodities and energy available through the Bank of Canada and Statistics Canada. A sensitivity analysis was also completed for the "Energy Inflation" rate. Analyses were completed with an Energy Inflation Rate of 5%, 7.5% and 12.5%.

The capital, operating and lifecycle cost estimates are included in Appendix F and the lifecycle costs are summarized in the table below.

Table 4.3(d)
ESTIMATED LIFECYCLE COST PER WET TONNE
TUNNEL COMPOSTING

Energy Inflation Rate	Cost per Wet Tonne in Year 1
5%	$168
7.5%	$173
12.5%	$188

4.4 Transportation of Dewatered Sludge

An integral consideration in the overall preferred design concept is the transportation of the dewatered biosolids to the proposed processing plant site (ie. the City Landfill on Fifth Line). Biosolids are currently transported using City-owned and City-leased trailers that are covered with impermeable tarps. There are a total of two trailers in use at the WEWPCP and two trailers at the EEWPCP. The transportation services are contracted to a private hauling company.

The reduction of odours in transit was identified as a key objective of the study. The existing trailer units are covered by tarps and are not sealed to contain odours. Odour mitigation can be achieved through the implementation of better containment of foul air during transportation.

Alternatives to mitigate current odour problems during transit comprise of custom built dump trailers or roll-off bins with openings specially designed to reduce the emission of foul air during transit. Custom built units could be incorporated into a tender or request for proposals for the biosolids hauling (i.e. supplied by the hauler) in which case the hauler would be responsible for care and maintenance of the units. Alternatively the City could purchase the necessary transportation units (trailers or roll-off bins) and commission the services of a hauler only.

The hauling contract should also incorporate the services required to jockey the roll-off bins or dump trailers at each facility to make more efficient use of dewatering equipment when individual transportation units are enroute to the landfill. This would require the provision of three units at the EEWPCP and three units at the WEWPCP. The additional units would improve the efficiency of the dewatering operations (i.e. make better use of dewatering equipment during normal shift times) and allow individual units to be removed from service for short periods of time for maintenance and repair. The contract specifications or RFP document would also require very strict hauler response times to maintain efficiency with the dewatering operations.

Hauling of biosolids is currently procured through an annual purchase order (i.e. January to December) issued by the plant operators (i.e. PUC). It is recommended that the City/PUC consider a Request for Proposal (RFP) process to secure future hauling services using sealed containers (roll-off bins or dump trailers). An RFP process will allow the City to evaluate various elements of the proposed service in addition to cost.

4.5 Selection of Preliminary Preferred Design Option

A preferred preliminary design option was selected by the project team for presentation to the public. The preferred design concept was developed based on the results of the evaluations completed. The preliminary preferred design concept proposed was as follows:

- Construct an alkaline stabilization facility at the City landfill site on Fifth Line;
- Use the processed material for daily, interim and final cover at the City landfill;
- Consider other beneficial options for the processed material in the future including agricultural land application, forestry applications, land reclamation, cover at other landfills and blending with SSO or compost – these other options will be a function of the capacity to utilize all of the processed material at the landfill, market demand, financial viability, regulatory requirements, and potential liability; and
- Commission the use of custom made transportation units (dump trailers or roll-off bins) to mitigate nuisance odours during transit.

The rationale for the selection of this design concept is summarized below:

- Alkaline stabilization scored the highest in the evaluation process and is a proven and reliable process;
- The estimated life cycle costs for alkaline stabilization are lower in comparison to tunnel composting;
- There will be no changes required in transporting the dewatered biosolids (continue to use the same routes) – no additional impacts;
- There is a deficit of cover material at the landfill site;

- The processed material is used on-site at the landfill resulting in significantly reduced transportation costs and associated impacts;
- Potential future liability is reduced with use as landfill cover (City owned property with leachate controls and ground water monitoring);
- There are several other possible end use options for the processed material if it can not be fully consumed as landfill cover; and
- Custom-made transportation units will mitigate nuisance odours during transit.

5. PUBLIC CONSULTATION – December 2008

A public input session was conducted on Thursday December 11, 2008 in the Biggings Room of the Sault Ste. Marie Civic Centre. The session provided a forum for interested individuals, agency representatives, and property owners, to review and discuss the alternatives, the evaluation criteria and preliminary preferred alternative.

Representatives of AECOM and the City of Sault Ste. Marie were in attendance throughout the session to provide information, address questions, and facilitate discussions. The information session was open from 3:30 p.m. to 7:30 p.m. with a total of ten individuals recording their names on the sign-in sheet (Appendix G).

5.1 Notification of the Open House

Notification of the Open House was advertised as follows:

- Sault Star on November 22, 2008 and December 6, 2008;
- Sault This Week on December 3, 2008;
- Individual notices were mailed to property owners situated within 500 m of the landfill site;
- Digital copies were emailed to all members of Council and to individuals that expressed an interest in serving on the Environmental Monitoring Committee.

5.2 Information Available to Participants

Comment sheets and an Information Bulletin, summarizing the completed tasks and activities were available at the Open House. Displays were also posted on the walls to disseminate information to any individuals that attended. The following displays were posted on the walls are included in Appendix G and summarized below:

- A display welcoming residents;
- A display instructing residents what they should do;
- A schematic outlining the steps involved in the Class EA Process;
- Introductory slide reflecting the City's commitment to diverting waste;
- Biosolids definition;

- Problems/opportunities being addressed;
- Alternative management strategies considered;
- Criteria used to evaluate the management alternatives (2 slides);
- Scoring approach used in the evaluation;
- Summary of the results of the management alternatives evaluation(2 slides);
- Process schematic for the Alkaline Stabilization alternative;
- Process schematic for the Composting alternative;
- Lifecycle costs for Alkaline Stabilization and Composting alternatives;
- Aerial photos of the three alternative sites considered to host the proposed facility (3 slides);
- Criteria used to evaluate the alternative sites;
- Summary of the results of the alternative sites evaluation;
- Description of preliminary preferred solution;
- Next steps in the process.

5.3 Comments and Questions

Comments and questions were received before, during and following the open house. The questions/comments together with the responses are summarized in Table 5.3(a).

Table 5.3(a)
Questions/Comments and Responses

Person/Agency	Question/Comment	Response
Ministry of Municipal Affairs and Housing	Requested to be included on the contact list to facilitate additional comments.	Included on contact list.
	Identified that the project should be consistent with Provincial Policy Statement 2005; specifically Section 1.6.8	The preferred option is consistent with Provincial Policy Statement 2005 as the facility will be sized to accommodate present and future requirements. Furthermore the preferred option results in a beneficial use of the biosolids. The project will be designed in accordance with Provincial legislation and standards.
	Consider Official Plan policies in Section 2.5 (S.1, S.2 and S.3)	In relation to Section 2.5 of the Official Plan the City is presently undertaking an Environmental Assessment to address future long term waste disposal needs and this project is consistent with the Municipal objective of diverting solid waste from disposal.
Rosina MacDonald	What are the options being considered?	There were a total of 11 alternatives considered The alternatives were evaluated based on technical criteria, possible natural and social environmental impacts and costs. Details of the alternatives and the evaluation were also forwarded to Mrs. MacDonald.
	Will these options create any more odour than we already	One of the key considerations in the study process is the mitigation of odours in the vicinity of the landfill. Presently the biosoilds are transported to

Table 5.3(a) Questions/Comments and Responses		
Person/Agency	**Question/Comment**	**Response**
	experience?	the landfill and disposed of in the active disposal area. Under the preliminary preferred alternative the biosolids would be transported into an enclosed building on the landfill site. Once in the building the biosolids will be dumped, mixed with lime and heated/dried. An odour control system will also be incorporated as part of the project to treat the air from the facility prior to its release to the atmosphere. The processed material will be stored inside the building for a period of time to facilitate curing. Ultimately the material will be blended with native soils and used as landfill cover. At the site itself, the proposed processing will result in a significant reduction in odours from the biosolids. The biosolids will continue to be transported from the two wastewater treatment plants to the landfill site as they are now. The City is however investigating the possibility of upgrading the trailers that are used to transport the biosolids with the intent of mitigating odours during transport as well.
	Will these options create less negative impact on the environment? (or more?)	This process will mitigate odours associated with the current disposal of the biosolids in the active disposal area and will also result in the beneficial use for this resource (ie. landfill cover). This process is being used extensively elsewhere. Sarnia is a good example…..it has been visited by City staff and ourselves. The process currently used in Sarnia is being proposed here. In Sarnia, the processed material is in high demand and is being land applied to farmer's fields.
	Will there be any other activities that neighbours in the surrounding area should be concerned about?	One of the principle reasons the City is proposing to undertake this project is to reduce odours associated with the landfill. The project will include the construction of a facility on the landfill site to accommodate the proposed process. There will be no change in the transportation of biosolids to the site other than the possible upgrading of the trailers. The biosolids will now be dumped indoors and processed to reduce odours prior to being incorporated into the landfill as cover material. Air from the facility will be treated prior to release to the atmosphere. In addition to the proposed biosolids treatment facility, other ongoing additional mitigating measures include a planned extension of the purge well system, and the installation of an <u>active</u> landfill gas collection system which will replace the <u>passive</u> flares and reduce methane gas release and odours.

Table 5.3(a) Questions/Comments and Responses		
Person/Agency	**Question/Comment**	**Response**
Source Water Protection Committee	Requested to be included on the distribution list for any projects/work related to the landfill.	Included on contact list.
Fred Haavisto	The projected 10,000 tonnes per year of sewage sludge, amounts to an average 27.4 tonnes per day. Is this tonnage based on the wet weight of 75% moisture content?	Yes it is the wet tonnage at approximately 75% moisture.
	Is the sewage sludge taken out on a regular daily basis or periodically?	The sludge is trucked to the landfill 5 days per week (i.e. Monday to Friday).
	Is this material conventionally trucked to the landfill using some kind of tanker?	The material is trucked in covered water tight trailers.
	Has a chemical analysis of the sewage sludge been completed? If so, I would appreciate receiving same.	Data was provided for influent, effluent and sludge from both wastewater treatment plants.
Sault Ste. Marie District MOECC Office	What impact will the lime have on the leachate generated at the landfill?	Although no meaningful data could be sourced to identify direct impacts to leachate, lime stabilized biosolids are being utilized extensively in agricultural applications and other landfill sites. Input received based on the Sarnia experience is that the lime stabilized material will not release significant alkalinity. In addition the landfill site has a fairly rigorous leachate collection and management system. There is an extensive groundwater monitoring program in place at the landfill to facilitate timely response to leachate impacts.

In addition to the questions raised at and following the open house, several individuals requested information via email. Information disseminated via email included the Information Bulletin, the slides that were posted at the open house and biosolids quality data.

6. Class EA Deferral

Following the December 2008 open house, and over a period of several years, several technology vendors approached the City with presentations and demonstrations to showcase capabilities in processing municipal biosolids. In some cases the vendors requested significant time periods to pilot test the biosolids and/or to develop cost proposals. In order to ensure the Class EA process was considering all relevant processing alternatives the City delayed the completion of this Class EA pending receipt of relevant proposals and information from various vendors.

The information obtained through the various demonstrations and presentations was subsequently considered relative to the various alternatives presented in Section 3 of this report. Through that process it became apparent that the proprietary technologies that were showcased by various vendors were ultimately represented by the alternatives documented in Section 3. It was concluded that no specific additions were required to the processing alternatives identified and considered in Section 3 of this report.

Although changes to the alternatives included in Section 3 were not warranted, the introduction of the revised Ontario Compost Quality Standards in 2012 impacted the evaluation of the composting alternative. The standards were modified, in part, to provide enhanced flexibility in composting sewage biosolids. Relevant sections of this report have been updated to reflect the regulatory changes that occurred in 2012. In addition to that, the evaluation of the alternative solutions and design concepts has also been modified to reflect those regulatory changes. The primary impact of those changes was a moderate improvement in the ratings assigned to the composting alternative under several criteria. The ranking of the alternatives did not change but the overall conclusions have been modified accordingly.

With the passage of time, it was also necessary to revisit the estimated costs for the various alternatives. Throughout the report the costs have been updated to reflect the current cost environment.

As a result of the study changes described in the preceding paragraphs, the preferred preliminary design option has been modified relative to what is presented in Section 4.5. Both composting and alkaline stabilization rated similarly in the alternative solutions evaluation and the design concepts evaluation. Both alternatives are capable of addressing the principle study objectives included in Section 1.2 of this report. Both alternatives also require similar mitigation strategies and provide flexibility in the potential end use of the processed product. Based on the results of the revised evaluations completed, the preliminary preferred design concept consists of the following:

- Construct an alkaline stabilization or composting facility at the City landfill site on Fifth Line;
- Use the processed material for daily, interim and final cover at the City landfill;
- Consider other beneficial options for the processed material in the future including agricultural land application, forestry applications, land reclamation, cover at other landfills and blending with SSO or compost – these other options will be a function of the capacity to utilize all of the processed material at the landfill, market demand, financial viability, regulatory requirements, and potential liability; and
- Use of custom made transportation units (dump trailers or roll-off bins) to mitigate nuisance odours during transit.

The rationale for the selection of this design concept is summarized below:

- Alkaline stabilization and composting scored the highest and equal in the evaluation process and are both proven and reliable processes;
- The true life cycle costs for alkaline stabilization versus composting are best established through a request for proposal process;

- There will be no changes required in transporting the dewatered biosolids (continue to use the same routes) – no additional impacts;
- There is a deficit of cover material at the landfill site;
- The processed material is used on-site at the landfill resulting in significantly reduced transportation costs and related impacts;
- Potential future liability is reduced with use as landfill cover (City owned property with leachate controls and ground water monitoring);
- There are several other possible end use options for the processed material if it can not be consumed as landfill cover;
- Custom-made transportation units will mitigate nuisance odours during transit; and
- Public acceptance/support.

7. Public Consultation – December 2014

A public input session was conducted on Tuesday, December 2, 2014 in the Russ Ramsay Room of the Sault Ste. Marie Civic Centre. The session provided a forum for interested individuals, agency representatives, and property owners, to review and discuss the alternatives, the evaluation criteria and preliminary preferred alternatives and design concepts.

Representatives of AECOM and the City of Sault Ste. Marie were in attendance throughout the session to provide information, address questions, and facilitate discussions. The information session was open from 3:30 p.m. to 7:30 p.m. with a total of 16 individuals recording their names on the sign-in sheet (Appendix H).

7.1 Notification of the Open House

Notification of the Open House was advertised as follows:

- Sault Star on November 22, 2014;
- Sault This Week on November 20, 2014 and November 27, 2014;
- Individual notices were mailed to relevant agencies, First nations, property owners situated within 500 m of the landfill site and all individuals that had previously expressed an interest in the study; and
- Digital copies were emailed to all members of Council and to Environmental Monitoring Committee members.

7.2 Information Available to Participants

Comment sheets and an Information Bulletin, summarizing the completed tasks and activities and highlighting the recent study progress, were available at the Open House. The following displays were also posted on the walls to disseminate information to any individuals that attended (copies included in Appendix H):

- A display welcoming residents;

- A display instructing residents what they should do;
- A schematic outlining the steps involved in the Class EA Process;
- Biosolids definition;
- Problems/opportunities being addressed;
- Project history;
- Alternative management strategies considered;
- Criteria used to evaluate the management alternatives (2 slides);
- Scoring approach used in the evaluation;
- Summary of the results of the management alternatives evaluation(2 slides);
- Alternative management strategies evaluation conclusions;
- Criteria used to evaluate the alternative sites;
- Aerial photos of the three alternative sites considered to host the proposed facility (3 slides);
- Summary of the results of the alternative sites evaluation;
- Alternative facility locations evaluation conclusions;
- Process schematic for the Alkaline Stabilization alternative;
- Process schematic for the Composting alternative;
- Lifecycle costs for alkaline Stabilization and Composting alternatives;
- Description of preliminary preferred design concept;
- Rationale for selection of preliminary preferred;
- Next steps in the process.

7.3 Comments and Questions

A limited number of written comments and questions were received during and following the open house. The questions together with the responses are summarized in Table 7.3(a). In addition to the written comments received, we have also included in the Table, the principle comments received verbally from the open house participants if they were not otherwise included in the written comments from others.

Table 7.3(a) Questions/Comments and Responses	
Question/Comment	**Response**
The odours have been getting worse in recent years and are evident when the biosolids pass our house in transit to the site and also from the landfill site itself.	One of the key reasons for initiating the biosolids management project was to mitigate odours in transit to the site and also at the site itself. The City has been working to reduce odours associated with the landfill site activities over time and various steps have been taken as outlined below. In October 2003, the City initiated an odour study in response to an increased number of complaints concerning odour from the landfill. At the time, there were several suspected sources, including receipt of sewage sludge, receipt of other wastes, wastes exposed by bears, surface emissions from the landfill (ie. landfill gas), and leachate seeps. While the study was underway, the City initiated several activities to reduce odour from suspected sources. These initiatives included: • Changes to sludge handling; • Purchase and deployment of odour control granules to neutralize surface emissions; • Application of clay cover to an inactive but uncompleted area (due to settlement) of the landfill in the northeast corner.

Table 7.3(a) Questions/Comments and Responses	
Question/Comment	**Response**
	Complaints continued through the winter of 2003/2004 in spite of these efforts, but the number of complaints declined into the spring of 2004. A formalized complaint recording procedure was adopted and complaints were analysed to assist in the determination of the source of the odour and factors contributing to odour complaint incidents (eg. weather conditions). An odour study was completed in July 2004 (Dillon, 2004). It concluded that landfill gas emissions were the likely source of odours. Based on observation of odour and measurements of surface emissions of methane gas, the northeast corner of the landfill was identified as the primary location of odorous emissions. The study evaluated control alternatives and recommended installation of passive gas wells equipped with individual gas flares as the preferred method of control. Twenty-four vent flares were installed on gas wells in the northeast portion of the landfill. All flares were operational in late December, 2004. The flares were inspected on a regular basis and necessary maintenance was undertaken to ensure continuous combustion. Regular maintenance and upgrades included moving the igniters to a lower position on the flare head, installing shrouds to shield the flare heads from wind, and thawing blockages of frozen condensate in the flame arrestors. Six additional vent flares were installed in the summer of 2007 bringing the total number of vent flares to 30. The vent flares were effective in mitigating off-site odour impacts from landfill gas emissions. The vent flares were decommissioned in the fall of 2010 in conjunction with the construction of an active landfill gas collection system as described later in this section. In December 2006 an odour control spray system was also installed along a portion of the south fence line. The system included four spray nozzles mounted directly on the fence. The system ran 24/7 approximately nine months of the year (ie. April to November). This system was decommissioned in the summer of 2010 when excavation activities related to the active landfill gas collection system required the removal of the fence. Throughout the construction period a portable deodorizing system was employed to mitigate off-site odours. In the summer of 2008 the Provincial government introduced new regulations mandating the installation of landfill gas collection systems for sites larger than 1.5 million cubic metres which included the City of Sault Ste. Marie landfill. In 2010 the City completed an upgrade from a "passive" system to an "active" landfill gas collection system over a portion of the site. The "active" system includes many of the existing gas wells in combination with a series of new gas wells. Each of the wells is connected to an underground pipe network and a blower station. The blowers generate a vacuum within the well/pipe network and draw gas from the landfill mass and burn it at a central enclosed flare. The system reduces the quantity of methane released to the atmosphere (ie: reduces the carbon footprint of the site) and also reduces odours generated at the site. The active landfill gas collection system was commissioned in December 2010 and has been continuously active with the exception of occasional shutdowns required for system maintenance and repairs. In addition to landfill gas, biosolids (ie: sewage sludge) delivered to the site for disposal may also contribute to off-site odours. The City continues to be proactive in its efforts to manage and mitigate odours associated with the transport, management and disposal of biosolids. An odour neutralizing agent (ie. Benzaco Odour Armour) is applied to the biosolids at the water pollution control plants prior to delivery to the landfill site. Once the biosolids are tipped at the working face they are mixed with other wastes and cover is applied promptly. A hand held sprayer is used by the vehicle operators to apply a Benzaco supplied odour neutralizing agent to the empty trailers before they leave the site.

Table 7.3(a) Questions/Comments and Responses	
Question/Comment	**Response**
	Early in 2013, mesh tarps were replaced with impermeable, waterproof tarps on one biosolids trailer at the west plant and two biosolids trailers at the east plant to mitigate odour release in transit to the landfill. Regular trailer washing was also initiated in 2013 to remove residual biosolids from the outside faces and wheels of the trailers. The operation of a portable fogging machine was initiated in September 2013. The machine effectively distributes an odour neutralizing agent (ie. "Odour Armour") in the form of a light mist. The fogging machine typically runs from the time the first load of biosolids arrives until after the last load has been received, tipped and covered. The spraying of empty trailers with odour neutralizer is completed year round and trailer washing and use of the odour fogger is completed throughout the spring, summer and fall. The intent of this Biosolids Management study was in large part initiated to look for further opportunities to mitigate odour concerns. The processing of the biosolids, either through composting or alkaline stabilization will significantly reduce pathogens and odour generation from the biosolids. These processes have both been successfully implemented elsewhere in Canada. The processing will be completed entirely within an indoor facility in a controlled environment and will include a biofilter to treat odourous air from the facility. The final product that is produced elsewhere through these processes is being sold and used as a nutrient rich product for use in agricultural and horticultural applications. In addition the study includes a recommendation to implement improved, air tight trailer units for transport of the biosolids from the two plants to the landfill to further mitigate odours in transit to the site.
Concerned with heavy metal content if the final product is to be used for agriculture.	The intent is to primarily use the processed product to cover waste in the landfill (ie. landfill cover). However the City may allow perspective operators to market/sell the processed product for other beneficial uses including agricultural applications. There are strict policies in place for maximum metals content and allowable application rates that operators must comply with.
Concern was expressed with well water quality. Some residents suggested the City should be testing their well supplies to confirm potability while others felt the municipal water distribution system should be extended to their house to ensure long term safety.	There are approximately 97 active groundwater monitors on and adjacent to the city landfill and the City undertakes an extensive groundwater quality monitoring program annually that typically includes the sampling of 30 to 40 wells three times each year in accordance with the site certificate of approval issued by the MOE. The program is designed to assess compliance with MOE's reasonable use policy which dictates that the discharge of groundwater to a neighbouring property must have no more than a negligible or trivial effect on the existing or potential reasonable use of a property. More specifically the reasonable use criteria are in place to ensure groundwater on adjacent properties can be used for drinking water. The results of the monitoring program are included in a comprehensive annual monitoring report that is submitted to the MOE. The City is also undertaking a separate individual environmental assessment to address a possible expansion of the disposal footprint to the west and north. The City will also consider the property owner requests in conjunction with the site expansion environmental assessment.

8. Final Conceptual Design

Following the evaluation of alternative solutions and design concepts, including careful consideration of the input received through the public consultation process, the preferred design concept consists of the following:

- Construct an alkaline stabilization or composting facility at the City landfill site on Fifth Line;
- Use the processed material for daily, interim and final cover at the City landfill;
- Consider other beneficial use options for the processed material including agricultural land application, forestry applications, land reclamation, and blending with SSO or compost – these other options will be a function of the capacity to utilize all of the processed material at the landfill, market demand, financial viability, regulatory requirements, and potential liability; and
- Use of custom made transportation units (dump trailers or roll-off bins) to mitigate nuisance odours during transit.

The rationale for the selection of this design concept is summarized below:

- Alkaline stabilization and composting scored the highest and were generally equivalent in the evaluation process and both are proven and reliable processes;
- The true life cycle costs for alkaline stabilization versus composting are best established through a request for proposal process;
- There will be no changes required in transporting the dewatered biosolids (continue to use the same routes) – no additional impacts;
- There is a deficit of cover material at the landfill site;
- The processed material is used on-site at the landfill resulting in significantly reduced transportation costs and related impacts;
- Potential future liability is reduced with use as landfill cover (City owned property with leachate controls and ground water monitoring);
- There are several other possible end use options for the processed material if it cannot be consumed as landfill cover;
- Custom-made transportation units will further mitigate nuisance odours during transit; and
- Public acceptance/support.

An active landfill gas collection system was constructed in 2010. The collected gas is currently being flared. There may be an opportunity to utilize waste heat generated through the landfill gas project in the drying/heating of the biosolids. This should be considered in the design phase.

9. Conclusions and Recommendations

This project has been planned as a Schedule B undertaking under the Municipal Class EA process. A number of processing alternatives and facility locations were considered and evaluated. Two processing technologies – alkaline stabilization and composting received similar scoring and are capable of addressing the objectives that were established at the onset of the study. The City is encouraged to consider the following conclusions and recommendations:

- Construct a biosolids processing/management facility at the landfill site using a request for proposal process (RFP);
- The RFP should allow vendors that are capable of processing dewatered biosolids using composting or alkaline stabilization technologies;
- The Terms of Reference (TOR) for the RFP should be developed to allow consideration of key performance criteria with particular emphasis on managing odours at the site and long term costs;
- The City should consider including, in the TOR, the service of transporting the biosolids to the landfill site from the two WPCPs with significant emphasis on managing odours enroute;
- Although the preferred end use of the processed biosolids is landfill cover, the TOR should provide adequate opportunity for qualified vendors to provide other end use management options;
- The on-site processed material storage facilities should consider a range of possible end use alternatives;
- The City should consider financing options for project implementation including potential funding from higher levels of government; and
- The City should consider various alternatives for implementation including conventional design and tender, design/build, design/build/operate and design/build/operate/finance.

It is recognized that implementation of the preferred design option may take some time due to budgetary challenges and other factors. The conclusions and recommendation presented above should be revisited in the event of any material changes to the assumptions made or if there are any significant technological advances in biosolids management.

Appendix A

Historical Biosolids Quality Data

City of Sault Ste. Marie
East End and West End Water Treatment Control Plant
Dewatered Sludge Quality Data (updated Aug. 2014)

Parameter (Heavy Metals in Final Product)	MOE Prior to 2012 (for finished compost and feedstock)	MOE 2012 Standards				East End Plant								West End Plant							
		AA	A	B (and feed for Category AA compost)	Feed for Categories A and B Compost	Jan 29 2009	Feb 23 2010	Mar 29 2011	Feb 16 2012	Oct 25 2012	Oct 22 2013	Average	Maximum	Jan 29 2009	Feb 24 2010	Mar 29 2011	Feb 16 2012	Oct 25 2012	Oct 22 2013	Average	Maximum
Arsenic (As)	13	13	13	75	170	<0.48	2.3	2.5	2.2	3.25	4.1	2.47	4.1	<0.5	2.9	2.5	2.8	2.83	4.8	2.72	4.8
Cadmium (Cd)	3	3	3	20	34	0.566	0.927	1.41	1.14	0.760	0.73	0.92	1.41	1.28	0.683	0.43	0.685	0.483	0.852	0.74	1.28
Cobalt (Co)	34	34	34	150	340	2.52	2.2	2.2	2.53	2.08	3.61	2.52	3.61	1.41	1.98	1.93	3.49	3.64	4.25	2.78	4.25
Chromium (Cr)	210	210	210	1060	2800	10.3	35	18.9	21.2	16.3	24	20.95	35	19.4	21	14.9	17.7	18.7	23.7	19.23	23.7
Copper (Cu)	100	100	400	760	1700	167	356	349	372	279	307	305	372	434	224	179	174	160	242	236	434
Mercury (Hg)	0.8	0.8	0.8	5	11	<0.048	0.664	0.29	0.39	0.770	<0.05	0.37	0.77	<0.05	<0.05	0.15	0.095	0.140	<0.05	0.09	0.15
Molybdenum (Mo)	5	5	5	20	94	8.89	4.8	4.5	4.5	6.00	5.11	5.63	8.89	5.28	4.3	2.7	5.96	6.36	5.99	5.10	6.36
Nickel (Ni)	62	62	62	180	420	5.85	12.5	14.3	13.3	9.96	18.6	12.42	18.6	13.2	9.41	8.63	10.3	6.28	10.8	9.77	13.2
Lead (Pb)	150	150	150	500	1100	28.6	76.5	191	61.9	33.5	62.8	75.72	191	60.3	12.4	13.5	10.3	13.2	7.35	19.51	60.3
Selenium (Se)	2	2	2	14	34	<0.48	3.1	3.2	1.9	2.40	1.5	2.10	3.2	<0.5	<0.5	1.3	0.84	2.02	4.8	1.66	4.8
Zinc (Zn)	500	500	700	1850	4200	199	480	528	399	355	381	390	528	432	232	183	155	243	282	255	432

Note: the most onerous exceedance has been highlighted for each parameter.

Appendix B

Land Area Requirements Calculations

AECOM

City of SSM - Dewatered and Processed Solids Calculation for Land Application
(Maximum Application rates)

Client:	**City of Sault Ste.Marie**			Prepared:	**JAA**
Project:	**Biosolids Master Plan**			Checked:	**RET**
TSH Project No:	**38-60455**			Date:	**29-Aug-14**

Aerobic Digestion

Use the dewatered suspended solids concentration	280000	mg/L	From histrocial record
or	280	g/L	
or	28	%	
or*	280	kg/m^3	

Lime Stabilization

Use the dewatered and stabilized Suspended solids Concentration**	625000	mg/L	from N-Viro Process
or	625	g/L	
or	62.5	%	
or	625	kg/m^3	

Stabilization Method	Estimated Annual Quantity of Stabilized Biosolids (in m^3)	Estimated Annual Quantity of Stabilized Biosolids (in dry tonnes)	Application Rate (DryTonnes /ha/ 5 years)	Land Area Required Annually (ha)	Total Land Area Required (ha)
Aerobic Digestion	6,200	1736	8	217.0	1085
Lime Stabilization***	9,400	5875	25	235.0	1175

Note:*In dry tonnes
**Typically dried product will have 60 - 65 percent solid concentration
***Recommended application rate for Sarnia Soil Amendment. The same application rate is used here.

Appendix C

Landfill Cover Calculations

City of SSM - Dewatered and Processed Solids Calculation for Landfill Cover

Client:	**City of Sault Ste.Marie**			Prepared:	**RET**
Project:	**Biosolids Master Plan**			Checked:	**JAA**
TSH Project No:	**38-60455**			Date:	**29-Aug-14**

a.Appproximate annual waste disposal quantity (tonnes)	50,000	(excludes landfilled biosolids)
b.In-place waste density (tonnes/cu.m)	0.70	from annual report
c.Annual watse disposal quantity (cu.m)	71,429	(a/b)
d.Annual volume of daily/interim cover (cu.m)	17,857	(4 parts waste:1 part cover)
e.Total cover requirements (cu.m)	261,092	from annual report
f.Available native soil	0.00	from annual report (excludes borrow pit)
g.Cover deficit	261,092	(e-f)
h.Contaminated soil/sweeepings available for cover	11,416	tonnes (estimated from 2009-2013 historical records)
i.Estimated density of soil/sweepings in landfill	1.70	tonnes/cu.m
j.Contaminated soil/sweeepings available for cover	6,716	cu.m (h/i)
k.Proportion of native availble for cover	0.00	cu.m native/cu.m (f/e)
l.Annual biosloids required to meet cover needs	11,142	cu.m (d-j)*(1-k)
m.Loose density of final processed biosolids	0.93	tonnes/cu.m (from N-Viro)
n.Assumed density of processed biosolids in landfill	1.20	tonnes/cu.m
o.Estimated annual tonnage of biosolids required for cover	13,370	tonnes (l*n)

Note: there will also be a large quantity of processed biosolids required to address the final cover requirements.

Appendix D

Evaluation Matrices

Alternative Solutions	Technical								
	Flexibility - Biosolids Quality	Flexibility - Biosolids Quantities	Flexibility - Regulatory Changes	Approvals	Proven & Reliable Technology	Compatibility with Current WPCP Processes	O&M Requirements	Potential for Use as Landfill Cover	Odour Mitigation
Criteria Weighting	**X 1**	**X 1**	**X 1**	**X 1**	**X 1**	**X 1**	**X 1**	**X 3**	**X 3**
Anaerobic Digestion	It can handle a relatively narrow range of sludge quality	It may take several days until the digester can be acclimated to increased loads	Will meet present and will likely meet anticipated regulations	Standard, well proven process and allows for potential beneficial uses of processed material.	Well proven, decades of experience. Reliable for municipal applications	Requires pretreatment of decant and centrate before rework in treatment plant.	More complex system to operate relative to existing system	Digested sludge could be used for land application as a fertilizer. Not likely suitable for landfill cover due to residual odour.	Potential odour during sludge digestion and transfer of digested sludge. Odour mitigation can be engineered. Reduced odour for digested and dewatered sludge during shipping and landfillling/land application but potential exists for odour reformation.
	-2	**-2**	**+2**	**+2**	**0**	**-1**	**-1**	**0**	**+3**
Aerobic Digestion	It can handle a wide range of sludge quality	The process can handle variable loads as long the system design considers these variations	Will meet present and will likely meet anticipated regulations	Standard, well proven process and allows for potential beneficial uses of processed material.	Well proven, decades of experience. Reliable for municipal applications	Existing plant processes could accommodate this process without any modifications	More complex system to operate relative to existing system	Digested sludge could be used for land application as a fertilizer. Not likely suitable for landfill cover due to reformation of odour over a short time.	Potential odour during sludge digestion and transfer of digested sludge. Odour mitigation can be engineered. Reduced odour for digested and dewatered sludge during shipping and landfillling/land application but potential exists for odour reformation.
	0	**-1**	**+2**	**+2**	**0**	**0**	**-1**	**0**	**+3**
Alkaline Stabilization	It can handle a wide range of sludge quality. Quality does not significantly affect process, only final use of end product	The process can handle variable loads as long the system design considers these variations	Will meet present and will likely meet anticipated regulations	Standard, well proven process and allows for potential beneficial uses of processed material.	Well proven, decades of experience. Reliable for municipal applications	Existing plant processes could accommodate this process without any modifications	More complex system to operate relative to existing system	Processed sludge could be used for land application as a fertilizer. Sludge could be used as a day cover in landfill	Potential odour during sludge processing and transferring. Odour mitigation can be engineered. Reduced odour formation for processed and dewatered sludge during shipping and landfillling/land application. No odour reformation for significant time periods.
	0	**0**	**+2**	**+2**	**0**	**0**	**-1**	**+6**	**+5**

Alternative Solutions	Technical								
	Flexibility - Biosolids Quality	**Flexibility - Biosolids Quantities**	**Flexibility - Regulatory Changes**	**Approvals**	**Proven & Reliable Technology**	**Compatibility with Current WPCP Processes**	**O&M Requirements**	**Potential for Use as Landfill Cover**	**Odour Mitigation**
Criteria Weighting	**X 1**	**X 1**	**X 1**	**X 1**	**X 1**	**X 1**	**X 1**	**X 3**	**X 3**
Geotube freeze and thaw	It can handle a wide range of sludge quality. Quality does not affect process.	The process can handle variable loads as long the system design considers these variations.	Will meet present but may not meet future regulations (eg. Landfill ban on biosolids).	Simple process but limited MOE experience and limited potential for beneficial use of processed material.	Limited experience with this system	Geotubes to replace existing dewatering system	Similar operational requirements relative to existing system	No change relative to existing biosolids.	No change – odours will continue to be generated from the processed biosolids.
	0	**0**	**0**	**0**	**-1**	**0**	**0**	**0**	**0**
Chemical and heat treatment	It can handle a wide range of sludge quality. Quality does not significantly affect process, only final use of end product	The process can handle variable loads as long the system design considers these variations	Will meet present and will likely meet anticipated regulations	Limited MOE experience, but processed material has potential for beneficial use.	Only pilot operation exists	Existing plant processes could accommodate this process without any modifications	More complex system to operate relative to existing system	Processed sludge could be used for land application as a fertilizer. Sludge not likely suitable as a day cover in landfill	Potential odour during process. Odour mitigation can be engineered. Chemically treated and dewatered sludge will provide minimum odour during transportation and disposal. Odour formation potential if sludge exposed to moisture without proper cover.
	0	**0**	**+2**	**-1**	**-1**	**0**	**-1**	**0**	**+3**
Enhanced Dewatering	It can handle a relatively narrow range of sludge quality without system adjustment	The process can handle variable loads as long the system design considers these variations	Will meet present but may not meet future regulations (eg. Landfill ban on biosolids).	Standard, well proven process but limited potential for beneficial use of processed material.	As a dewatering device it is a proven technology but cannot be used as treatment for land application	Existing plant processes could accommodate this process without any modifications	More complex system to operate relative to existing system	Processed sludge not suitable for land application and not likely suitable for use as a day cover due to the potential for odour reformation with moisture.	Potential odour during process. Odour mitigation can be engineered. Reduced odour during transportation and disposal. Odour formation potential if sludge exposed to moisture without proper cover.
	-1	**0**	**0**	**0**	**0**	**0**	**-1**	**0**	**_3**
Thermal Process (Incineration) Gasification and pyrolysis	It can handle a wide range of sludge quantity. Quality does not significantly affect process, only final use of end product. Water content on feed has a major impact on process.	The process can handle a variable loads as long as the system design considers this variations.	Will meet present but future regulations may be more onerous (e.g. Multiple hearth incinerators)	Proven process but limited MOE experience.	Incineration is well proven but others are in the pilot and demonstration phases.	Existing plant processes could accommodate this process without any modifications	More complex system to operate relative to existing system - most complex system	Some residual may be suitable for landfill cover. Significant reduction in solids volume.	Potential odour during process and transfer of sludge. Odour mitigation can be engineered. Limited odour in residual ash during shipping and landfilling.

Alternative Solutions	Technical								
	Flexibility - Biosolids Quality	**Flexibility - Biosolids Quantities**	**Flexibility - Regulatory Changes**	**Approvals**	**Proven & Reliable Technology**	**Compatibility with Current WPCP Processes**	**O&M Requirements**	**Potential for Use as Landfill Cover**	**Odour Mitigation**
Criteria Weighting	**X 1**	**X 1**	**X 1**	**X 1**	**X 1**	**X 1**	**X 1**	**X 3**	**X 3**
	0	**0**	**+1**	**0**	**-1**	**0**	**-2**	**+3**	**+6**
Composting (assumed to be in vessel or indoor)	Sludge quality may impact the process. The revised Ontario Compost Quality Standards introduced in 2012 are more flexible. The sludge is suitable as a feedstock and is suitable to produce a category B and likely a category A compost.	The process can handle a variable loads as long as the system design considers variations. The production of category "A" compost can only incorporate a maximum of 25% biosolids on a dry weight basis.	The new 2012 regulations are less stringent and the biosolids can be used to produce a category "B" and likely a category "A" compost.	Approvals agencies are familiar with composting however ,biosolids composting is generally new in Ontario. Need to demonstrate appropriate controls for environmental impacts.	Biosolids composting is well proven with a significant operating history in other parts of Canada.	Existing plant processes could accommodate this process without any modifications.	There are some complexities associated with composting due to sensitivities to C:N ratios, moisture content, etc. City has experience with leaf and yard waste composting and can adapt to biosolids.	Can produce a category "B" and likely a category "A" compost that can likely be land applied. Otherwise suitable for daily and final cover at landfill.	Potential odour during composting and transfer of sludge. Odour mitigation can be engineered. Reduced odour formation for composted sludge during shipping and landfilling/land application.
	0	**0**	**+2**	**+1**	**0**	**0**	**-1**	**+6**	**+5**

Alternative Solutions	Natural Environment			Social Environment			Financial
	Air	Water	Land	Public Health	Land Use - Processing	Land Use - Disposal	Lifecycle Costs
Criteria Weighting	**X 1**	**X 1**	**X 1**	**X 1**	**X 1**	**X 1**	**X 3**
Anaerobic Digestion	No significant difference	No significant difference	No significant difference – additional facilities likely to be installed in already developed areas	Stabilized sludge would reduce the potential for exposure to pathogenic microorganisms	Moderate site size and suitable municipal sites likely available.	Reduced volume to dispose of and some flexibility for disposal/use of stabilized product.	High as a result of high capital cost. Some potential to generate electricity and heat from biogas which could provide some revenue to offset high costs.
	0	**0**	**0**	**+2**	**-1**	**+2**	**-5**
Aerobic Digestion	No significant difference	No significant difference	No significant difference – additional facilities likely to be installed in already developed areas	Stabilized sludge would reduce the potential for exposure to pathogenic microorganisms	Moderate site size and suitable municipal sites likely available.	Reduced volume to dispose of and greater flexibility for disposal/use of stabilized product.	As a result of high operating cost, the lifecycle cost of this option is very high despite the relatively low capital cost when compared to anaerobic digestion
	0	**0**	**0**	**+2**	**-1**	**+2**	**-4**
Alkaline Stabilization	Some potential for dust nuisance from alkaline admixture.	No significant difference	No significant difference – additional facilities likely to be installed in already developed areas	Stabilized sludge would reduce the potential for exposure to pathogenic microorganisms	Moderate site size and suitable municipal sites likely available.	Greater flexibility for disposal/use of stabilized product including use as landfill cover.	Medium capital and operating costs.
	-1	**0**	**0**	**+2**	**-1**	**+1**	**-3**
Geotube freeze and thaw	No significant difference	Some increased potential for release of leachate to the ground/surface water system	No significant difference – additional facilities likely to be installed in already developed areas	Somewhat reduced pathogenic count if sludge went through freeze/thaw process but similar to existing.	More significant land area requirements – site availability would have to be confirmed.	No significant difference	Lifecycle costs are expected to be similar to existing.
	0	**-1**	**0**	**0**	**-2**	**0**	**0**
Chemical and heat treatment	No significant difference	No significant difference	No significant difference – additional facilities likely to be installed in already developed areas	Stabilized sludge would reduce the potential for exposure to pathogenic microorganisms +2	Moderate site size and suitable municipal sites likely available. -1	Greater flexibility for disposal/use of stabilized product. +1	Medium capital and operating costs. -3
	0	**0**	**0**	**+2**	**-1**	**+1**	**-3**
Enhanced Dewatering	No significant difference	No significant difference	No significant difference – additional facilities likely to be installed in already developed areas	Heat conditioning reduces pathogen content somewhat.	Can likely be accommodated within the existing plant footprints	Some reduction in the quantity to disposed of and limited flexibility for disposal/use of final product.	Medium/low capital and operating costs.

Alternative Solutions	Natural Environment			Social Environment			Financial
	Air	Water	Land	Public Health	Land Use - Processing	Land Use - Disposal	Lifecycle Costs
Criteria Weighting	**X 1**	**X 1**	**X 1**	**X 1**	**X 1**	**X 1**	**X 3**
	0	**0**	**0**	**+1**	**0**	**+1**	**-2**
Incineration High Temperature Fluidized Bed Incineration	Some potential for increased air emissions.	No significant difference	No significant difference – additional facilities likely to be installed in already developed areas	Complete destruction of pathogens and organic portion of the feed Some increased exposure to reduced air quality.	Moderate site size and suitable municipal sites may be available. Typically this process is more difficult to site.	Significant volume reduction but limited flexibility with the disposal/use of the residual ash.	High as a result of high capital and operating costs. At the same time heat recovery could be used in other areas of the plant. BTU value of biosolids is of a concern. Auxiliary fuel might be needed for optimal operating conditions.
	-1	**0**	**0**	**+1**	**-2**	**+1**	**-6**
Composting (assumed to be in vessel or indoor)	No significant difference	No significant difference	No significant difference – additional facilities likely to be installed in already developed areas	Final product would be stabilized with reduced exposure for pathogenic microorganisms.	Fairly significant land area requirements for processing and suitable municipal sites likely available.	Some volume reduction and greater flexibility with the disposal/use of processed material.	Medium to high capital cost with reasonable operating costs.
	0	**0**	**0**	**+2**	**-1**	**+1**	**-5**

Alternative Solution	Land Area Requirements	Net Costs	Timing Restrictions / Storage Requirements	Potential Future Liability	Administrative Requirements	Environmental Benefits
Agricultural Land Application	• Significant land area required based on allowable application rates.	• Revenue potential from sale of product. • High transportation costs to gain access to disposal lands. • Costs for spreading.	• Significant storage requirements may be regulated (i.e.: 240 days). • Must be applied to suit crop harvesting. • Cannot be applied on frozen ground.	• Disposal occurring on privately owned lands – liability could be traced back to the City. • No controls or monitoring at sites.	• Requires a Nutrient Management strategy. • Each receiver of processed biosolids requires an acceptable Nutrient Management Plan. • Ongoing sampling and analysis required to confirm compliance with standards.	• Additional transportation impacts. • Serves as a nutrient source. • May improve soil properties.
	-2	**-2**	**-2**	**-2**	**-2**	**+2**
Forest and Non-Agricultural Land Application	• Significant land area required based on allowable application rates.	• Revenue potential from sale of product. • High transportation costs to gain access to disposal lands. • Costs for spreading.	• Similar restrictions are expected to apply as noted for agricultural land application but are expected to be less onerous.	• Disposal occurring on non-City owned lands – liability could be traced back to the City. • No controls or monitoring at sites.	• Requires a Nutrient Management strategy. • Each receiver of processed biosolids requires an acceptable Nutrient Management Plan. • Ongoing sampling and analysis required to confirm compliance with standards.	• Additional transportation impacts. • Serves as a nutrient source. • May improve soil properties.
	-2	**-2**	**-1**	**-2**	**-2**	**+2**
Landfill Cover	• Managed within the landfill footprint – small area of land required. • No restrictions on application rates anticipated.	• Limited cost for blending with native soil. • Low transportation costs.	• Timing restrictions limited only by the volume of waste disposed of – this could become a factor in the future with the planned implementation of a demonstration EFW facility and possible enhancement in diversion programs.	• Disposal occurring within a City owned landfill site with leachate management and monitoring infrastructure.	• No significant administrative requirements.	• Limited use of nutrient value. • No additional transportation impacts.
	0	**-1**	**+1**	**0**	**0**	+1

Appendix E

Lime Stabilization – Cost Estimates

Alkaline Stabilization System
City of Sault Ste. Marie

LIFE CYCLE COST ESTIMATE

Project Life --> **20** yrs

Capital Costs:	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Capital Construction Costs	$14,475,625																				
Operating Costs:																					
Labour																					
1 full time equivalent employee		$80,000	$82,160	$84,378	$86,657	$88,996	$91,399	$93,867	$96,401	$99,004	$101,677	$104,423	$107,242	$110,138	$113,111	$116,165	$119,302	$122,523	$125,831	$129,228	$132,718
Supplies																					
Alkaline Admixture		$170,000	$178,500	$187,425	$196,796	$206,636	$216,968	$227,816	$239,207	$251,167	$263,726	$276,912	$290,758	$305,296	$320,560	$336,588	$353,418	$371,089	$389,643	$409,125	$429,582
Energy																					
Electricity		$59,889	$64,381	$69,209	$74,400	$79,980	$85,978	$92,427	$99,359	$106,810	$114,821	$123,433	$132,690	$142,642	$153,340	$164,841	$177,204	$190,494	$204,781	$220,140	$236,650
Natural Gas		$154,867	$166,482	$178,968	$192,391	$206,820	$222,331	$239,006	$256,932	$276,202	$296,917	$319,185	$343,124	$368,859	$396,523	$426,262	$458,232	$492,599	$529,544	$569,260	$611,955
Rolling Stock Fuel		$15,000	$16,125	$17,334	$18,634	$20,032	$21,534	$23,150	$24,886	$26,752	$28,759	$30,915	$33,234	$35,727	$38,406	$41,287	$44,383	$47,712	$51,290	$55,137	$59,272
QA/QC		$23,000	$23,621	$24,259	$24,914	$25,586	$26,277	$26,987	$27,715	$28,464	$29,232	$30,021	$30,832	$31,665	$32,519	$33,398	$34,299	$35,225	$36,176	$37,153	$38,156
Maintenance Allowance		$23,000	$23,621	$24,259	$24,914	$25,586	$26,277	$26,987	$27,715	$28,464	$29,232	$30,021	$30,832	$31,665	$32,519	$33,398	$34,299	$35,225	$36,176	$37,153	$38,156
Vendor Services		$85,000	$87,295	$89,652	$92,073	$94,559	$97,112	$99,734	$102,426	$105,192	$108,032	$110,949	$113,945	$117,021	$120,181	$123,426	$126,758	$130,181	$133,695	$137,305	$141,012
Administration and Contingency		$115,000	$118,105	$121,294	$124,569	$127,932	$131,386	$134,934	$138,577	$142,319	$146,161	$150,107	$154,160	$158,323	$162,597	$166,988	$171,496	$176,127	$180,882	$185,766	$190,782

Totals Year -->	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Capital Construction Amortized over 20 yrs at Interest Rate		$1,065,142	$1,065,142	$1,065,142	$1,065,142	$1,065,142	$1,065,142	$1,065,142	$1,065,142	$1,065,142	$1,065,142	$1,065,142	$1,065,142	$1,065,142	$1,065,142	$1,065,142	$1,065,142	$1,065,142	$1,065,142	$1,065,142	$1,065,142
Operating Costs		$725,756	$760,289	$796,778	$835,346	$876,127	$919,263	$964,906	$1,013,218	$1,064,374	$1,118,557	$1,175,968	$1,236,817	$1,301,333	$1,369,758	$1,442,351	$1,519,391	$1,601,175	$1,688,020	$1,780,268	$1,878,283
Total capital amortized + operating(with inflation)		**$1,790,897**	**$1,825,431**	**$1,861,920**	**$1,900,488**	**$1,941,269**	**$1,984,405**	**$2,030,048**	**$2,078,360**	**$2,129,515**	**$2,183,699**	**$2,241,110**	**$2,301,959**	**$2,366,475**	**$2,434,900**	**$2,507,493**	**$2,584,533**	**$2,666,316**	**$2,753,162**	**$2,845,410**	**$2,943,425**
PV Total capital amortized + operating	**$36,459,276**	**$1,755,782**	**$1,754,547**	**$1,754,529**	**$1,755,757**	**$1,758,267**	**$1,762,095**	**$1,767,279**	**$1,773,861**	**$1,781,883**	**$1,791,394**	**$1,802,442**	**$1,815,079**	**$1,829,362**	**$1,845,350**	**$1,863,104**	**$1,882,692**	**$1,904,183**	**$1,927,652**	**$1,953,177**	**$1,980,840**
Total capital + operating cost over 20 years	**$45,370,816**																				
Average cost per wet tonne (with inflation)		**$174**	**$179**	**$184**	**$189**	**$194**	**$199**	**$204**	**$210**	**$215**	**$221**	**$227**	**$233**	**$240**	**$246**	**$253**	**$260**	**$267**	**$274**	**$281**	**$289**
Total average cost (with inflation)		**$1,741,100**	**$1,788,110**	**$1,836,389**	**$1,885,971**	**$1,936,892**	**$1,989,188**	**$2,042,897**	**$2,098,055**	**$2,154,702**	**$2,212,879**	**$2,272,627**	**$2,333,988**	**$2,397,006**	**$2,461,725**	**$2,528,191**	**$2,596,452**	**$2,666,557**	**$2,738,554**	**$2,812,495**	**$2,888,432**
PV Total average cost	**$36,459,340**	**$1,706,961**	**$1,718,675**	**$1,730,470**	**$1,742,346**	**$1,754,303**	**$1,766,342**	**$1,778,464**	**$1,790,670**	**$1,802,958**	**$1,815,332**	**$1,827,790**	**$1,840,334**	**$1,852,963**	**$1,865,680**	**$1,878,483**	**$1,891,375**	**$1,904,355**	**$1,917,424**	**$1,930,583**	**$1,943,832**

Notes

Interest Rate	4 %	
Rate of Return	2 %	
General Inflation	2.7 %	average for one three and five years, source Bank of Canada
Energy Inflation	7.5 %	
Commodity Inflation	5 %	

10 000 tonnes/yr at 25% solids concentration

Prepared By: Hector Sanchez, Dillon
Checked By: Rick Talvitie, AECOM

* Note This opinion on probable cost is based on an assumed scope of work only. Actual costs can only be established following further investigation, detailed design, and tendering. Costs exclude taxes.

Alkaline Stabilization System
City of Sault Ste. Marie

LIFE CYCLE COST

Project Life --> **20** yrs

Capital Costs:	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Capital Construction Costs	$14,475,625																				
Operating Costs:																					
Labour																					
1 full time equivalent employee		$80,000	$82,160	$84,378	$86,657	$88,996	$91,399	$93,867	$96,401	$99,004	$101,677	$104,423	$107,242	$110,138	$113,111	$116,165	$119,302	$122,523	$125,831	$129,228	$132,718
Supplies																					
Alkaline Admixture		$170,000	$178,500	$187,425	$196,796	$206,636	$216,968	$227,816	$239,207	$251,167	$263,726	$276,912	$290,758	$305,296	$320,560	$336,588	$353,418	$371,089	$389,643	$409,125	$429,582
Energy																					
Electricity		$59,889	$62,883	$66,027	$69,329	$72,795	$76,435	$80,257	$84,270	$88,483	$92,907	$97,553	$102,430	$107,552	$112,929	$118,576	$124,505	$130,730	$137,266	$144,130	$151,336
Natural Gas		$154,867	$162,610	$170,741	$179,278	$188,242	$197,654	$207,536	$217,913	$228,809	$240,249	$252,262	$264,875	$278,119	$292,024	$306,626	$321,957	$338,055	$354,958	$372,705	$391,341
Rolling Stock Fuel		$15,000	$15,750	$16,538	$17,364	$18,233	$19,144	$20,101	$21,107	$22,162	$23,270	$24,433	$25,655	$26,938	$28,285	$29,699	$31,184	$32,743	$34,380	$36,099	$37,904
QA/QC		$23,000	$23,621	$24,259	$24,914	$25,586	$26,277	$26,987	$27,715	$28,464	$29,232	$30,021	$30,832	$31,665	$32,519	$33,398	$34,299	$35,225	$36,176	$37,153	$38,156
Maintenance Allowance		$23,000	$23,621	$24,259	$24,914	$25,586	$26,277	$26,987	$27,715	$28,464	$29,232	$30,021	$30,832	$31,665	$32,519	$33,398	$34,299	$35,225	$36,176	$37,153	$38,156
Vendor Services		$85,000	$87,295	$89,652	$92,073	$94,559	$97,112	$99,734	$102,426	$105,192	$108,032	$110,949	$113,945	$117,021	$120,181	$123,426	$126,758	$130,181	$133,695	$137,305	$141,012
Administration and Contingency		$115,000	$118,105	$121,294	$124,569	$127,932	$131,386	$134,934	$138,577	$142,319	$146,161	$150,107	$154,160	$158,323	$162,597	$166,988	$171,496	$176,127	$180,882	$185,766	$190,782
Totals Year -->	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Capital Construction Amortized over 20 yrs at Interest Rate		$1,065,142	$1,065,142	$1,065,142	$1,065,142	$1,065,142	$1,065,142	$1,065,142	$1,065,142	$1,065,142	$1,065,142	$1,065,142	$1,065,142	$1,065,142	$1,065,142	$1,065,142	$1,065,142	$1,065,142	$1,065,142	$1,065,142	$1,065,142
Operating Costs		$725,756	$754,545	$784,572	$815,893	$848,565	$882,652	$918,219	$955,332	$994,063	$1,034,487	$1,076,682	$1,120,729	$1,166,714	$1,214,727	$1,264,862	$1,317,218	$1,371,897	$1,429,008	$1,488,665	$1,550,987
Total capital amortized + operating(with inflation)		**$1,790,897**	**$1,819,687**	**$1,849,714**	**$1,881,034**	**$1,913,707**	**$1,947,794**	**$1,983,360**	**$2,020,474**	**$2,059,205**	**$2,099,629**	**$2,141,824**	**$2,185,871**	**$2,231,856**	**$2,279,869**	**$2,330,004**	**$2,382,360**	**$2,437,039**	**$2,494,150**	**$2,553,807**	**$2,616,129**
PV Total capital amortized + operating	**$34,711,347**	**$1,755,782**	**$1,749,027**	**$1,743,027**	**$1,737,785**	**$1,733,303**	**$1,729,585**	**$1,726,635**	**$1,724,455**	**$1,723,051**	**$1,722,427**	**$1,722,590**	**$1,723,544**	**$1,725,297**	**$1,727,856**	**$1,731,227**	**$1,735,420**	**$1,740,442**	**$1,746,303**	**$1,753,012**	**$1,760,580**
Total capital + operating cost over 20 years	**$43,018,411**																				
Average cost per wet tonne (with inflation)		**$166**	**$170**	**$175**	**$180**	**$184**	**$189**	**$194**	**$200**	**$205**	**$211**	**$216**	**$222**	**$228**	**$234**	**$241**	**$247**	**$254**	**$261**	**$268**	**$275**
Total average cost (with inflation)		**$1,657,600**	**$1,702,355**	**$1,748,319**	**$1,795,523**	**$1,844,003**	**$1,893,791**	**$1,944,923**	**$1,997,436**	**$2,051,367**	**$2,106,754**	**$2,163,636**	**$2,222,054**	**$2,282,050**	**$2,343,665**	**$2,406,944**	**$2,471,931**	**$2,538,673**	**$2,607,218**	**$2,677,612**	**$2,749,908**
PV Total average cost	**$34,710,816**	**$1,625,098**	**$1,636,251**	**$1,647,480**	**$1,658,786**	**$1,670,170**	**$1,681,632**	**$1,693,172**	**$1,704,792**	**$1,716,492**	**$1,728,272**	**$1,740,132**	**$1,752,074**	**$1,764,098**	**$1,776,205**	**$1,788,395**	**$1,800,668**	**$1,813,026**	**$1,825,468**	**$1,837,996**	**$1,850,609**

Notes

Interest Rate	4 %	
Rate of Return	2 %	
General Inflation	2.7 %	average for one three and five years, source Bank of Canada
Energy Inflation	5 %	
Commodity Inflation	5 %	

10 000 tonnes/yr at 25% solids concentration

* Note — This opinion on probable cost is based on an assumed scope of work only. Actual costs can only be established following further investigation, detailed design, and tendering. Costs exclude taxes.

Alkaline Stabilization System
City of Sault Ste. Marie

LIFE CYCLE COST

Project Life --> **20** yrs

Capital Costs:	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Capital Construction Costs	$14,475,625																				
Operating Costs:																					
Labour																					
1 full time equivalent employee		$80,000	$82,160	$84,378	$86,657	$88,996	$91,399	$93,867	$96,401	$99,004	$101,677	$104,423	$107,242	$110,138	$113,111	$116,165	$119,302	$122,523	$125,831	$129,228	$132,718
Supplies																					
Alkaline Admixture		$170,000	$178,500	$187,425	$196,796	$206,636	$216,968	$227,816	$239,207	$251,167	$263,726	$276,912	$290,758	$305,296	$320,560	$336,588	$353,418	$371,089	$389,643	$409,125	$429,582
Energy																					
Electricity		$59,889	$67,375	$75,797	$85,271	$95,930	$107,922	$121,412	$136,588	$153,662	$172,870	$194,478	$218,788	$246,137	$276,904	$311,517	$350,456	$394,263	$443,546	$498,989	$561,363
Natural Gas		$154,867	$174,225	$196,003	$220,504	$248,067	$279,075	$313,959	$353,204	$397,355	$447,024	$502,902	$565,765	$636,486	$716,046	$805,552	$906,246	$1,019,527	$1,146,968	$1,290,339	$1,451,631
Rolling Stock Fuel		$15,000	$16,875	$18,984	$21,357	$24,027	$27,030	$30,409	$34,210	$38,487	$43,298	$48,710	$54,799	$61,648	$69,354	$78,024	$87,777	$98,749	$111,092	$124,979	$140,601
QA/QC		$23,000	$23,621	$24,259	$24,914	$25,586	$26,277	$26,987	$27,715	$28,464	$29,232	$30,021	$30,832	$31,665	$32,519	$33,398	$34,299	$35,225	$36,176	$37,153	$38,156
Maintenance Allowance		$23,000	$23,621	$24,259	$24,914	$25,586	$26,277	$26,987	$27,715	$28,464	$29,232	$30,021	$30,832	$31,665	$32,519	$33,398	$34,299	$35,225	$36,176	$37,153	$38,156
Vendor Services		$85,000	$87,295	$89,652	$92,073	$94,559	$97,112	$99,734	$102,426	$105,192	$108,032	$110,949	$113,945	$117,021	$120,181	$123,426	$126,758	$130,181	$133,695	$137,305	$141,012
Administration and Contingency		$115,000	$118,105	$121,294	$124,569	$127,932	$131,386	$134,934	$138,577	$142,319	$146,161	$150,107	$154,160	$158,323	$162,597	$166,988	$171,496	$176,127	$180,882	$185,766	$190,782

Totals Year -->	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Capital Construction Amortized over 20 yrs at Interest Rate		$1,065,142	$1,065,142	$1,065,142	$1,065,142	$1,065,142	$1,065,142	$1,065,142	$1,065,142	$1,065,142	$1,065,142	$1,065,142	$1,065,142	$1,065,142	$1,065,142	$1,065,142	$1,065,142	$1,065,142	$1,065,142	$1,065,142	$1,065,142
Operating Costs		$725,756	$771,777	$822,051	$877,054	$937,320	$1,003,447	$1,076,105	$1,156,046	$1,244,113	$1,341,252	$1,448,524	$1,567,120	$1,698,377	$1,843,793	$2,005,054	$2,184,051	$2,382,908	$2,604,011	$2,850,038	$3,124,001
Total capital amortized + operating(with inflation)		**$1,790,897**	**$1,836,919**	**$1,887,193**	**$1,942,196**	**$2,002,462**	**$2,068,588**	**$2,141,246**	**$2,221,188**	**$2,309,255**	**$2,406,394**	**$2,513,666**	**$2,632,262**	**$2,763,518**	**$2,908,935**	**$3,070,196**	**$3,249,193**	**$3,448,050**	**$3,669,152**	**$3,915,180**	**$4,189,143**
PV Total capital amortized + operating	**$42,035,015**	**$1,755,782**	**$1,765,589**	**$1,778,344**	**$1,794,289**	**$1,813,691**	**$1,836,847**	**$1,864,084**	**$1,895,762**	**$1,932,281**	**$1,974,081**	**$2,021,649**	**$2,075,521**	**$2,136,290**	**$2,204,609**	**$2,281,201**	**$2,366,861**	**$2,462,468**	**$2,568,992**	**$2,687,500**	**$2,819,173**
Total capital + operating cost over 20 years	**$52,965,635**																				
Average cost per wet tonne (with inflation)		**$201**	**$206**	**$212**	**$217**	**$223**	**$229**	**$236**	**$242**	**$248**	**$255**	**$262**	**$269**	**$276**	**$284**	**$291**	**$299**	**$307**	**$316**	**$324**	**$333**
Total average cost (with inflation)		**$2,007,400**	**$2,061,600**	**$2,117,263**	**$2,174,429**	**$2,233,139**	**$2,293,433**	**$2,355,356**	**$2,418,951**	**$2,484,262**	**$2,551,337**	**$2,620,224**	**$2,690,970**	**$2,763,626**	**$2,838,244**	**$2,914,876**	**$2,993,578**	**$3,074,405**	**$3,157,413**	**$3,242,664**	**$3,330,216**
PV Total average cost	**$42,035,770**	**$1,968,039**	**$1,981,545**	**$1,995,144**	**$2,008,836**	**$2,022,623**	**$2,036,503**	**$2,050,479**	**$2,064,551**	**$2,078,720**	**$2,092,985**	**$2,107,349**	**$2,121,811**	**$2,136,373**	**$2,151,034**	**$2,165,796**	**$2,180,659**	**$2,195,625**	**$2,210,693**	**$2,225,864**	**$2,241,140**

Notes

Interest Rate 4 %
Rate of Return 2 %
General Inflation 2.7 % average for one three and five years, source Bank of Canada
Energy Inflation 12.5 %
Commodity Inflation 5 %
10 000 tonnes/yr at 25% solids concentration

* Note — This opinion on probable cost is based on an assumed scope of work only. Actual costs can only be established following further investigation, detailed design, and tendering. Costs exclude taxes.

AECOM DILLON CONSULTING

Alkaline Stabilization
Construction Cost Estimate

Client:	**City of Sault Ste.Marie**	Prepared:	**HS**
Project:	**Biosolids Master Plan**	Checked:	**RET**
Project No:	**38-60455**	Date:	**30-Oct-14**

Description	Unit	Unit Cost	Quantity	Amount
General Items and Site Development	LS	$1,000,000	1	$1,000,000
Process Building	sq.m.	$2,500	420	$1,050,000
Product Storage Building	sq.m.	$2,000	860	$1,720,000
Equipment	LS	$3,950,000	1	$3,950,000
HVAC and Plumbing	LS	$600,000	1	$600,000
Electrical	LS	$600,000	1	$600,000
Instrumentation	LS	$250,000	1	$250,000
Miscellaneous	LS	$900,000	1	$900,000
Subtotal				**$10,070,000**
Estimating Allowance (25%)				$2,517,500
Subtotal Construction				**$12,587,500**
Engineering and Approvals (15%)				$1,888,125
Total				**$14,475,625**

AECOM DILLON CONSULTING

Alkaline Stabilization
Operating Cost Estimate

Client:	**City of Sault Ste.Marie**	Prepared:	**HS**
Project:	**Biosolids Master Plan**	Checked:	**RET**
Project No:	**38-60455**	Date:	**30-Oct-14**

Description	**Unit**	**Unit Cost**	**Quantity**	**Amount**
Labour				
1 full time equivalent employee	fte	$80,000.00	1	$80,000
Supplies				
Alkaline admixture	tonne	$50.00	3400	$170,000
Energy				
Electricity	kWh	$0.11	544444	$59,889
Natural Gas	cu.m.	$0.46	336667	$154,867
Rolling Stock Fuel	litres	$1.50	10000	$15,000
QA/QC	LS	$23,000.00	1	$23,000
Maintenance Allowance	LS	$23,000.00	1	$23,000
Vendor Services	LS	$85,000.00	1	$85,000
Administration and Contingency	LS	$115,000.00	1	$115,000
Total				**$725,800**

Appendix F

Tunnel Composting – Cost Estimates

Tunnel Composting System
City of Sault Ste. Marie

LIFE CYCLE COST ESTIMATE

AECOM

DILLON CONSULTING

Project Life --> 20 yrs

Capital Costs:	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Capital Construction Costs	$19,665,719																				
Operating Costs:																					
Labour																					
1 full time equivalent employee		$80,000	$82,160	$84,378	$86,657	$88,996	$91,399	$93,867	$96,401	$99,004	$101,677	$104,423	$107,242	$110,138	$113,111	$116,165	$119,302	$122,523	$125,831	$129,228	$132,718
Supplies																					
Wood		$86,250	$90,563	$95,091	$99,845	$104,837	$110,079	$115,583	$121,362	$127,431	$133,802	$140,492	$147,517	$154,893	$162,637	$170,769	$179,308	$188,273	$197,687	$207,571	$217,949
Sulphuric Acid		$14,000	$14,700	$15,435	$16,207	$17,017	$17,868	$18,761	$19,699	$20,684	$21,719	$22,805	$23,945	$25,142	$26,399	$27,719	$29,105	$30,560	$32,088	$33,693	$35,377
Energy																					
Electricity		$96,360	$103,587	$111,356	$119,708	$128,686	$138,337	$148,713	$159,866	$171,856	$184,745	$198,601	$213,496	$229,508	$246,721	$265,226	$285,117	$306,501	$329,489	$354,200	$380,766
Natural Gas		$17,250	$18,544	$19,935	$21,430	$23,037	$24,765	$26,622	$28,619	$30,765	$33,072	$35,553	$38,219	$41,086	$44,167	$47,480	$51,041	$54,869	$58,984	$63,408	$68,163
Rolling Stock Fuel		$15,000	$16,125	$17,334	$18,634	$20,032	$21,534	$23,150	$24,886	$26,752	$28,759	$30,915	$33,234	$35,727	$38,406	$41,287	$44,383	$47,712	$51,290	$55,137	$59,272
QA/QC		$23,000	$23,621	$24,259	$24,914	$25,586	$26,277	$26,987	$27,715	$28,464	$29,232	$30,021	$30,832	$31,665	$32,519	$33,398	$34,299	$35,225	$36,176	$37,153	$38,156
Maintenance Allowance		$46,000	$47,242	$48,518	$49,828	$51,173	$52,555	$53,973	$55,431	$56,927	$58,464	$60,043	$61,664	$63,329	$65,039	$66,795	$68,598	$70,451	$72,353	$74,306	$76,313
Administration and Contingency		$115,000	$118,105	$121,294	$124,569	$127,932	$131,386	$134,934	$138,577	$142,319	$146,161	$150,107	$154,160	$158,323	$162,597	$166,988	$171,496	$176,127	$180,882	$185,766	$190,782

Totals Year -->	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Capital Construction Amortized over 20 yrs at Interest Rate		$1,447,038	$1,447,038	$1,447,038	$1,447,038	$1,447,038	$1,447,038	$1,447,038	$1,447,038	$1,447,038	$1,447,038	$1,447,038	$1,447,038	$1,447,038	$1,447,038	$1,447,038	$1,447,038	$1,447,038	$1,447,038	$1,447,038	$1,447,038
Operating Costs		$492,860	$514,646	$537,599	$561,790	$587,297	$614,201	$642,589	$672,557	$704,202	$737,632	$772,960	$810,310	$849,809	$891,598	$935,825	$982,649	$1,032,240	$1,084,780	$1,140,462	$1,199,496
Total capital amortized + operating(with inflation)		**$1,939,898**	**$1,961,684**	**$1,984,637**	**$2,008,828**	**$2,034,335**	**$2,061,239**	**$2,089,627**	**$2,119,595**	**$2,151,240**	**$2,184,670**	**$2,219,998**	**$2,257,348**	**$2,296,847**	**$2,338,636**	**$2,382,863**	**$2,429,687**	**$2,479,278**	**$2,531,818**	**$2,587,500**	**$2,646,534**
PV Total capital amortized + operating	**$36,160,878**	**$1,901,861**	**$1,885,510**	**$1,870,168**	**$1,855,847**	**$1,842,560**	**$1,830,321**	**$1,819,146**	**$1,809,054**	**$1,800,061**	**$1,792,190**	**$1,785,463**	**$1,779,903**	**$1,775,538**	**$1,772,394**	**$1,770,503**	**$1,769,896**	**$1,770,608**	**$1,772,676**	**$1,776,140**	**$1,781,041**
Total capital + operating cost over 20 years	**$44,706,263**																				
Average cost per wet tonne (with inflation)		**$173**	**$177**	**$182**	**$187**	**$192**	**$197**	**$203**	**$208**	**$214**	**$219**	**$225**	**$231**	**$238**	**$244**	**$251**	**$258**	**$264**	**$272**	**$279**	**$286**
Total average cost (with inflation)		**$1,726,850**	**$1,773,475**	**$1,821,359**	**$1,870,535**	**$1,921,040**	**$1,972,908**	**$2,026,177**	**$2,080,883**	**$2,137,067**	**$2,194,768**	**$2,254,027**	**$2,314,885**	**$2,377,387**	**$2,441,577**	**$2,507,499**	**$2,575,202**	**$2,644,732**	**$2,716,140**	**$2,789,476**	**$2,864,792**
PV Total average cost	**$36,160,939**	**$1,692,990**	**$1,704,609**	**$1,716,307**	**$1,728,086**	**$1,739,945**	**$1,751,886**	**$1,763,909**	**$1,776,014**	**$1,788,202**	**$1,800,474**	**$1,812,830**	**$1,825,271**	**$1,837,798**	**$1,850,410**	**$1,863,109**	**$1,875,895**	**$1,888,769**	**$1,901,731**	**$1,914,782**	**$1,927,923**

Notes

Interest Rate 4 %
Rate of Return 2 %
General Inflation 2.7 % average for one three and five years, source Bank of Canada
Energy Inflation 7.5 %
Commodity Inflation 5 %
10 000 tonnes/yr at 25% solids concentration

Prepared By: Hector Sanchez, Dillon
Checked By: Rick Talvitie, AECOM

* Note This opinion on probable cost is based on an assumed scope of work only. Actual costs can only be established following further investigation, detailed design, and tendering. Costs excludes taxes.

Tunnel Composting System
City of Sault Ste. Marie

LIFE CYCLE COST

Project Life --> **20** yrs

Capital Costs:	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Capital Construction Costs	$19,665,719																				
Operating Costs:																					
Labour																					
1 full time equivalent employee		$80,000	$82,160	$84,378	$86,657	$88,996	$91,399	$93,867	$96,401	$99,004	$101,677	$104,423	$107,242	$110,138	$113,111	$116,165	$119,302	$122,523	$125,831	$129,228	$132,718
Supplies																					
Wood		$86,250	$90,563	$95,091	$99,845	$104,837	$110,079	$115,583	$121,362	$127,431	$133,802	$140,492	$147,517	$154,893	$162,637	$170,769	$179,308	$188,273	$197,687	$207,571	$217,949
Sulphuric Acid		$14,000	$14,700	$15,435	$16,207	$17,017	$17,868	$18,761	$19,699	$20,684	$21,719	$22,805	$23,945	$25,142	$26,399	$27,719	$29,105	$30,560	$32,088	$33,693	$35,377
Energy																					
Electricity		$96,360	$101,178	$106,237	$111,549	$117,126	$122,982	$129,132	$135,588	$142,368	$149,486	$156,960	$164,808	$173,049	$181,701	$190,786	$200,326	$210,342	$220,859	$231,902	$243,497
Natural Gas		$17,250	$18,113	$19,018	$19,969	$20,967	$22,016	$23,117	$24,272	$25,486	$26,760	$28,098	$29,503	$30,979	$32,527	$34,154	$35,862	$37,655	$39,537	$41,514	$43,590
Rolling Stock Fuel		$15,000	$15,750	$16,538	$17,364	$18,233	$19,144	$20,101	$21,107	$22,162	$23,270	$24,433	$25,655	$26,938	$28,285	$29,699	$31,184	$32,743	$34,380	$36,099	$37,904
QA/QC		$23,000	$23,621	$24,259	$24,914	$25,586	$26,277	$26,987	$27,715	$28,464	$29,232	$30,021	$30,832	$31,665	$32,519	$33,398	$34,299	$35,225	$36,176	$37,153	$38,156
Maintenance Allowance		$46,000	$47,242	$48,518	$49,828	$51,173	$52,555	$53,973	$55,431	$56,927	$58,464	$60,043	$61,664	$63,329	$65,039	$66,795	$68,598	$70,451	$72,353	$74,306	$76,313
Administration and Contingency		$115,000	$118,105	$121,294	$124,569	$127,932	$131,386	$134,934	$138,577	$142,319	$146,161	$150,107	$154,160	$158,323	$162,597	$166,988	$171,496	$176,127	$180,882	$185,766	$190,782

Totals Year -->	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Capital Construction Amortized over 20 yrs at Interest Rate		$1,447,038	$1,447,038	$1,447,038	$1,447,038	$1,447,038	$1,447,038	$1,447,038	$1,447,038	$1,447,038	$1,447,038	$1,447,038	$1,447,038	$1,447,038	$1,447,038	$1,447,038	$1,447,038	$1,447,038	$1,447,038	$1,447,038	$1,447,038
Operating Costs		$492,860	$511,431	$530,767	$550,901	$571,868	$593,707	$616,455	$640,153	$664,844	$690,572	$717,383	$745,327	$774,454	$804,817	$836,472	$869,479	$903,898	$939,793	$977,233	$1,016,286
Total capital amortized + operating(with inflation)		**$1,939,898**	**$1,958,469**	**$1,977,805**	**$1,997,939**	**$2,018,906**	**$2,040,745**	**$2,063,493**	**$2,087,191**	**$2,111,882**	**$2,137,610**	**$2,164,421**	**$2,192,365**	**$2,221,492**	**$2,251,855**	**$2,283,510**	**$2,316,517**	**$2,350,936**	**$2,386,832**	**$2,424,271**	**$2,463,324**
PV Total capital amortized + operating	**$35,182,442**	**$1,901,861**	**$1,882,419**	**$1,863,729**	**$1,845,786**	**$1,828,586**	**$1,812,123**	**$1,796,395**	**$1,781,398**	**$1,767,129**	**$1,753,585**	**$1,740,764**	**$1,728,665**	**$1,717,285**	**$1,706,624**	**$1,696,682**	**$1,687,457**	**$1,678,951**	**$1,671,162**	**$1,664,094**	**$1,657,746**
Total capital + operating cost over 20 years	**$43,389,461**																				
Average cost per wet tonne (with inflation)		**$168**	**$173**	**$177**	**$182**	**$187**	**$192**	**$197**	**$202**	**$208**	**$214**	**$219**	**$225**	**$231**	**$238**	**$244**	**$251**	**$257**	**$264**	**$271**	**$279**
Total average cost (with inflation)		**$1,680,100**	**$1,725,463**	**$1,772,050**	**$1,819,896**	**$1,869,033**	**$1,919,497**	**$1,971,323**	**$2,024,549**	**$2,079,212**	**$2,135,350**	**$2,193,005**	**$2,252,216**	**$2,313,026**	**$2,375,477**	**$2,439,615**	**$2,505,485**	**$2,573,133**	**$2,642,608**	**$2,713,958**	**$2,787,235**
PV Total average cost	**$35,181,975**	**$1,647,157**	**$1,658,461**	**$1,669,842**	**$1,681,302**	**$1,692,841**	**$1,704,458**	**$1,716,155**	**$1,727,933**	**$1,739,791**	**$1,751,731**	**$1,763,753**	**$1,775,857**	**$1,788,044**	**$1,800,315**	**$1,812,670**	**$1,825,110**	**$1,837,635**	**$1,850,246**	**$1,862,944**	**$1,875,729**

Notes

Interest Rate 4 %
Rate of Return 2 %
General Inflation 2.7 % average for one three and five years, source Bank of Canada
Energy Inflation 5 %
Commodity Inflation 5 %
10 000 tonnes/yr at 25% solids concentration

* Note This opinion on probable cost is based on an assumed scope of work only. Actual costs can only be established following further investigation, detailed design, and tendering. Costs excludes taxes.

Tunnel Composting System
City of Sault Ste. Marie

LIFE CYCLE COST

Project Life --> **20** yrs

Capital Costs:	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Capital Construction Costs	$19,665,719																				
Operating Costs:																					
Labour																					
1 full time equivalent employee		$80,000	$82,160	$84,378	$86,657	$88,996	$91,399	$93,867	$96,401	$99,004	$101,677	$104,423	$107,242	$110,138	$113,111	$116,165	$119,302	$122,523	$125,831	$129,228	$132,718
Supplies																					
Wood		$86,250	$90,563	$95,091	$99,845	$104,837	$110,079	$115,583	$121,362	$127,431	$133,802	$140,492	$147,517	$154,893	$162,637	$170,769	$179,308	$188,273	$197,687	$207,571	$217,949
Sulphuric Acid		$14,000	$14,700	$15,435	$16,207	$17,017	$17,868	$18,761	$19,699	$20,684	$21,719	$22,805	$23,945	$25,142	$26,399	$27,719	$29,105	$30,560	$32,088	$33,693	$35,377
Energy																					
Electricity		$96,360	$108,405	$121,956	$137,200	$154,350	$173,644	$195,349	$219,768	$247,239	$278,144	$312,912	$352,026	$396,029	$445,533	$501,224	$563,877	$634,362	$713,657	$802,864	$903,222
Natural Gas		$17,250	$19,406	$21,832	$24,561	$27,631	$31,085	$34,971	$39,342	$44,260	$49,792	$56,016	$63,018	$70,896	$79,758	$89,727	$100,943	$113,561	$127,756	$143,726	$161,691
Rolling Stock Fuel		$15,000	$16,875	$18,984	$21,357	$24,027	$27,030	$30,409	$34,210	$38,487	$43,298	$48,710	$54,799	$61,648	$69,354	$78,024	$87,777	$98,749	$111,092	$124,979	$140,601
QA/QC		$23,000	$23,621	$24,259	$24,914	$25,586	$26,277	$26,987	$27,715	$28,464	$29,232	$30,021	$30,832	$31,665	$32,519	$33,398	$34,299	$35,225	$36,176	$37,153	$38,156
Maintenance Allowance		$46,000	$47,242	$48,518	$49,828	$51,173	$52,555	$53,973	$55,431	$56,927	$58,464	$60,043	$61,664	$63,329	$65,039	$66,795	$68,598	$70,451	$72,353	$74,306	$76,313
Administration and Contingency		$115,000	$118,105	$121,294	$124,569	$127,932	$131,386	$134,934	$138,577	$142,319	$146,161	$150,107	$154,160	$158,323	$162,597	$166,988	$171,496	$176,127	$180,882	$185,766	$190,782

Totals Year -->	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Capital Construction Amortized over 20 yrs at Interest Rate		$1,447,038	$1,447,038	$1,447,038	$1,447,038	$1,447,038	$1,447,038	$1,447,038	$1,447,038	$1,447,038	$1,447,038	$1,447,038	$1,447,038	$1,447,038	$1,447,038	$1,447,038	$1,447,038	$1,447,038	$1,447,038	$1,447,038	$1,447,038
Operating Costs		$492,860	$521,077	$551,746	$585,137	$621,551	$661,324	$704,835	$752,507	$804,814	$862,289	$925,529	$995,203	$1,072,061	$1,156,948	$1,250,809	$1,354,705	$1,469,830	$1,597,523	$1,739,286	$1,896,810
Total capital amortized + operating(with inflation)		**$1,939,898**	**$1,968,115**	**$1,998,784**	**$2,032,175**	**$2,068,589**	**$2,108,362**	**$2,151,873**	**$2,199,545**	**$2,251,852**	**$2,309,327**	**$2,372,567**	**$2,442,241**	**$2,519,099**	**$2,603,986**	**$2,697,847**	**$2,801,743**	**$2,916,868**	**$3,044,561**	**$3,186,324**	**$3,343,848**
PV Total capital amortized + operating	**$39,282,001**	**$1,901,861**	**$1,891,690**	**$1,883,499**	**$1,877,416**	**$1,873,584**	**$1,872,165**	**$1,873,335**	**$1,877,290**	**$1,884,249**	**$1,894,453**	**$1,908,168**	**$1,925,690**	**$1,947,346**	**$1,973,496**	**$2,004,540**	**$2,040,918**	**$2,083,118**	**$2,131,678**	**$2,187,191**	**$2,250,314**
Total capital + operating cost over 20 years	**$48,957,604**																				
Average cost per wet tonne (with inflation)		**$188**	**$193**	**$198**	**$203**	**$209**	**$214**	**$220**	**$226**	**$232**	**$238**	**$245**	**$251**	**$258**	**$265**	**$272**	**$280**	**$287**	**$295**	**$303**	**$311**
Total average cost (with inflation)		**$1,875,900**	**$1,926,549**	**$1,978,566**	**$2,031,987**	**$2,086,851**	**$2,143,196**	**$2,201,062**	**$2,260,491**	**$2,321,524**	**$2,384,205**	**$2,448,579**	**$2,514,691**	**$2,582,587**	**$2,652,317**	**$2,723,930**	**$2,797,476**	**$2,873,008**	**$2,950,579**	**$3,030,244**	**$3,112,061**
PV Total average cost	**$39,282,106**	**$1,839,118**	**$1,851,739**	**$1,864,447**	**$1,877,242**	**$1,890,125**	**$1,903,097**	**$1,916,157**	**$1,929,307**	**$1,942,548**	**$1,955,879**	**$1,969,302**	**$1,982,816**	**$1,996,424**	**$2,010,125**	**$2,023,920**	**$2,037,810**	**$2,051,794**	**$2,065,875**	**$2,080,053**	**$2,094,328**

Notes

Interest Rate	4 %	
Rate of Return	2 %	
General Inflation	2.7 %	average for one three and five years, source Bank of Canada
Energy Inflation	12.5 %	
Commodity Inflation	5 %	

10 000 tonnes/yr at 25% solids concentration

* Note This opinion on probable cost is based on an assumed scope of work only. Actual costs can only be established following further investigation, detailed design, and tendering. Costs excludes taxes.

Tunnel Composting

Construction Cost Estimate

Client:	**City of Sault Ste.Marie**	Prepared:	**HS**
Project:	**Biosolids Master Plan**	Checked:	**RET**
Project No:	**38-60455**	Date:	**30-Oct-14**

Description	Unit	Unit Cost	Quantity	Amount
General Items and Site Development	LS	$1,000,000	1	$1,000,000
Mixing and Blower Rooms	sq.m.	$2,500	1209	$3,022,500
Tunnels	LS	$3,858,000	1	$3,858,000
Equipment	LS	$4,900,000	1	$4,900,000
Miscellaneous	LS	$900,000	1	$900,000
Subtotal				**$13,680,500**
Estimating Allowance (25%)				$3,420,125
Subtotal Construction				**$17,100,625**
Engineering and Approvals (15%)				$2,565,094
Total				**$19,665,719**

AECOM DILLON CONSULTING

Tunnel Composting
Operating Cost Estimate

Client:	**City of Sault Ste.Marie**	Prepared:	**HS**
Project:	**Biosolids Master Plan**	Checked:	**RET**
Project No:	**38-60455**	Date:	**30-Oct-14**

Description	**Unit**	**Unit Cost**	**Quantity**	**Amount**
Labour				
1 full time equivalent employee	fte	$80,000.00	1	$80,000
Supplies				
Wood	cu.m.	$2.30	37500	$86,250
Sulphuric Acid	Allowance	$14,000.00	1	$14,000
Energy				
Electricity	kWh	$0.11	876000	$96,360
Natural Gas	cu.m.	$0.46	37500	$17,250
Rolling Stock Fuel	litres	$1.50	10000	$15,000
QA/QC	LS	$23,000.00	1	$23,000
Maintenance Allowance	LS	$46,000.00	1	$46,000
Administration and Contingency	LS	$115,000.00	1	$115,000
Total				**$492,860**

Appendix G

December 2008 Public Open House

Ministry of Municipal Affairs and Housing

Ministère des Affaires municipales et du Logement

Municipal Services Office
Northeastern
159 Cedar Street, Suite 401
Sudbury ON P3E 6A5
Telephone: 705-564-0120
Toll Free: 1-800-461-1193
Fax: 705-564-6863
Web : www.mah.gov.on.ca/onramp-ne

Bureau des services aux municipalités
Région du Nord-est
159 rue Cedar, Local 401
Sudbury ON P3E 6A5
Téléphone: 705-564-0120
Sans frais: 1-800-461-1193
Télécopieur: 705-564-6863
Site Web: www.mah.gov.on.ca/onramp-ne

Ontario

December 16, 2008

BY MAIL and E-MAIL

60455
Public Input

R. Talvitie, P.Eng
Project Manager
AECOM.
523 Wellington Street East
Sault Ste. Marie, Ontario P6A 2M4

RE: CITY OF SAULT STE. MARIE BIOSOLIDS MANAGEMENT PLAN

The Ministry of Municipal Affairs and Housing has been circulated as a member of your Government Review Team, this letter outlines our preliminary comments. We request to be circulated throughout this process; providing our Ministry with the opportunity to comment and review future documentation. Further, we wish to request a copy of the Class Environmental Assessment Terms of Reference when this document is available.

Provincial Policy Statement 2005

Any development proposal for a Waste Management Facility must be consistent with the Provincial Policy Statement 2005; specifically Section 1.6.8 Waste Management.

Sault Ste. Marie Official Plan (1996)

The City of Sault Ste. Marie Official Plan contains policies within Section 2.5 (S.1, S.2 and S.3) which must be considered in the creation of a new Biosolids Management Plan. Please note that the City Planning Department is currently working to update the existing Official Plan; it may be useful to have discussions with their staff regarding your proposal. Communication with their staff will ensure future land use planning takes into consideration land use compatibility surrounding the proposed Biosolids Management Area at the landfill, transportation routes and any proposed expansion(s) or alteration(s).

Thank you for providing our office with the opportunity to participate in your Biosolids Management Plan Class Environmental Assessment. If you have any questions regarding the above comments please contact Charlsey White, Planner Algoma District, at (705) 564-6855.

Sincerely;

H M Robertson

Heather Robertson, M.C.I.P., R.P.P
Manager, Community Planning and Development
Northeastern Municipal Services Office

Talvitie, Rick

From: Talvitie, Rick
Sent: December 9, 2008 11:01 AM
To: 'Fred Haavisto'
Cc: 'Susan Hamilton Beach'
Subject: RE: Biosolids Mgmt Plan
Attachments: Revised - West NPRI Analytical Results 2006.pdf; c_L369333 West Plant Report.pdf; c_L369653 East Plant Report.pdf; Revised - East Plant Sludge cake NPRI Analytical Results 2006.pdf; Information Bulletin.pdf

60455
Public Input.

Hi Fred,

Thank you for the interest in this project. I have attached an Information Bulletin which provides some additional information.

I have embedded below, my responses to your questions.

Let me know if you have any other questions or comments.

We hope to see you at the open house.

Regards,

Rick Talvitie, P. Eng.
Branch Manager
rick.talvitie@aecom.com

AECOM
523 Wellington Street East,
Sault Ste. Marie, Ontario Canada P6A 2M4
T 705.942.2612 F 705.942.3642
www.aecom.com

My email has changed to rick.talvitie@aecom.com. Please update your address books accordingly.

Effective October 2008, Earth Tech, Gartner Lee, TSH and UMA are known collectively as AECOM. AECOM provides a blend of global reach, local knowledge, innovation and technical excellence in delivering solutions that enhance and sustain the world's built, natural, and social environments.

From: Fred Haavisto [mailto:haavisto@soonet.ca]
Sent: December 9, 2008 12:22 AM
To: Talvitie, Rick
Cc: Fred Haavisto

Subject: Biosolids Mgmt Plan

Rick Talvitie:

I saw the notice in the Sault Star and thought I would like to attend, but would like a few details.

1) The projected 10,000 tonnes per year of sewage sludge, amounts to an average 27.4 tonnes per day. Is this tonnage based on the wet weight of 75% moisture content? Yes it is the wet tonnage at approximately 75% moisture.

2) Is the sewage sludge taken out on a regular daily basis or periodically? The sludge is trucked to the landfill 5 days per week (ie. Monday to Friday).

3) Is this material conventionally trucked to the landfill using some kind of tanker? The material is trucked in covered water tight trailers.

4) Has a chemical analysis of the sewage sludge been completed. If so, I would appreciate receiving same. I have attached some analytical results. The data provided includes influent, effluent and sludge from both waste water treatment plants.

Possibly these queries would be answered during the Open House on Thursday, but in case I don't have the opportunity to come down, I thought I would ask.

Thanks for now

Fred Haavisto
V.F. Haavisto "*Community Forester*"
15 Grace Street
Sault Ste. Marie, Ontario P6A 2S7
Tel./Fax 705-946-6328
E-mail: haavisto@soonet.ca

60455 Public Input

Talvitie, Rick

From: Talvitie, Rick
Sent: December 9, 2008 10:30 AM
To: 'Rosina MacDonald'
Cc: 'Susan Hamilton Beach'
Subject: RE: letter Dated Nov. 17, 2008
Attachments: evaluation matrix.pdf; Information Bulletin.pdf

Hi Rosina,

Attached are some additional details for your consideration. Later this week I will also forward a copy of the display panels that will be posted at the open house. I have embedded my responses to your questions below. I hope these responses are helpful.

In addition, I would be happy to review the project with you in our office at a time that is more convenient for you.

Let me know if I can be of any further assistance.

Regards,

Rick Talvitie, P. Eng.
Branch Manager
rick.talvitie@aecom.com

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My email has changed to rick.talvitie@aecom.com. Please update your address books accordingly.

From: Rosina MacDonald [mailto:macrosina@shaw.ca]
Sent: December 8, 2008 4:42 PM
To: Talvitie, Rick
Subject: letter Dated Nov. 17, 2008

Dear Rick,

Project Number: 60455

I will be unable to attend the open house about the Class Enviromental Assessment-Biosolids (Sewage Sludge) Management Plan, but if circumstances change I would like to attend.
I have read your letter and can't find any information in it to inquire about.
What are the options being considered? There were a total of 11 alternatives considered (refer to the attached Information Bulletin). The alternatives were evaluated based on technical issues, possible natural and social environmental impacts and costs. A summary of the evaluations is attached for your information and reference.

My questions would be:
Will these options create any more odour than we already experience? One of the key considerations in the study process is the mitigation of odours in the vicinity of the landfill. Presently the biosoilds are transported to the landfill and disposed of in the active disposal area. Under the preliminary preferred alternative the biosolids would be transported into an enclosed building on the landfill site. Once in the building the biosolids will be dumped, mixed with lime and heated/dried. An odour control system will also be incorporated as part of the project to treat the air from the facility prior to its release to the atmosphere. The processed material will be stored inside the building for a period of time to facilitate curing. Ultimately the material will be blended with native soils and used as landfill cover.
Will these options create less negative impact on the enviroment? (or more?) This process will mitigate odours associated with the current disposal of the biosolids in the active disposal area and will also result in the beneficial use for this resource (ie. landfill cover). This process is being used extensively elsewhere. Sarnia is a good example.....it has been visited by City staff and ourselves. The process currently used in Sarnia is being proposed here. In Sarnia, the processed material is in high demand and is being land applied to farmer's fields.
Will there be any other activities that neighbours in the surrounding are should be concerned about? One of the principle reasons the City is proposing to undertake this project is to reduce odours associated with the landfill. The project will include the construction of a facility on the landfill site to accommodate the proposed process. There will be no change in the transportation of biosolids to the site other than the possible upgrading of the trailers. The biosolids will now be dumped indoors and processed to reduce odours prior to being incorporated into the landfill as cover material. Air from the facility will be treated prior to release to the atmosphere. In addition to the proposed biosolids treatment facility, other ongoing additional mitigating measures include a planned extension of the purge well system, and the installation of an active landfill gas collection system which will replace the passive flares and reduce methane gas release and odours.

I can only hope that this is not just a case of moving the noxious odour from one area of the city (i.e. the vicinity of the waste water treatment plant and along the transportation routes) to another. At the site itself, the proposed processing will result in a significant reduction in odours from the biosolids. The biosolids will continue to be transported from the two waste water treatment plants to the landfill site as they are now. The City is however investigating the possibility of upgrading the trailers that are used to transport the biosolids with the intent of mitigating odours during transport as well.

I hope this helps!......Let me know if you would like to discuss further....thx

Rosina MacDonald
165 Old Hwy. 17 North,
Sault Ste. Marie,
Ontario, P6A5K7
(705)-759-8640

AECOM

AECOM
523 Wellington Street East, Sault Ste. Marie, ON, Canada P6A 2M4
T 705.942.2612 F 705.942.3642 www.aecom.com

Communication Record

Date: December 5, 2008 Project Number: 60455

Time:

Between: Frank Manzo and Rick Talvitie

Re: **Biosolids Management Plan Class EA**

PLEASE NOTE: If this communication record does not agree with your records of the meeting, or if there are any omissions, please advise. Otherwise it will assumed that the contents of this record are correct.

Comments:

FM suggested that the preferred management strategy is incineration or cremation.

RT explained that incineration was an option considered in the process but has not been identified as the preliminary preferred due primarily to its high cost.

RT cited the Liberty Energy example in Hamilton which will process 600 t/day. In Sault Ste. Marie we generate 25 to 30 t/day.

Appendix H

December 2014 Public Open House

ATTENDANCE RECORD
PUBLIC INPUT SESSION

Project Name: **Biosolids Management Class EA** **Date: December 2, 2014**
Meeting Description: **Public Open House No. 2** **Location: Civic Centre** **Time: 3:30 p.m. to 7:30 pm**

NAME (please print)	ADDRESS	TELEPHONE

City of Sault Ste. Marie

Biosolids Management
CLASS ENVIRONMENTAL ASSESSMENT

Issue No. 2 **INFORMATION BULLETIN** November, 2014

Introduction

Waste water in the City of Sault Ste. Marie is treated at two separate sewage treatment plants; the East End and West End plants. The biosolids or sludge that is generated at these plants is dewatered and transported to the City of Sault Ste. Marie landfill for disposal. Historically approximately 10,000 tonnes of biosolids have been disposed of each year. The biosolids accounted for approximately 17% of the overall waste disposed of in 2013. The existing landfill is projected to have approximately 7.5 years of remaining disposal capacity (at the end of 2013).

Background

This Study was initiated in 2008, a public open house was conducted in December 2008 and a final Draft report was prepared in September 2009. The study completion was subsequently deferred at the request of technology vendors to allow them to make presentations and submissions to the City regarding the capabilities of their respective technologies. In addition the province of Ontario introduced new compost standards in July 2012 which impacted the evaluation of one of the alternatives. The evaluations and report have been updated to reflect the passage of time.

Problem/Opportunity

The City initiated this project to address the following problems/opportunities:

- The diversion of biosolids from disposal would enhance the projected longevity of the existing landfill.
- There may be an opportunity to further mitigate odours in transporting and managing the biosolids.
- There are challenges in managing the biosolids at the landfill due to its poor workability and high liquid content. This problem has been exacerbated with the significant reduction in fibrous materials landfilled (ie: increased diversion of paper type products) and the disposal of commercial waste in other sites.
- There is a shortage of earthen cover materials available at the landfill to meet future operational needs.

What is a Class Environmental Assessment?

Municipal infrastructure projects must be undertaken in accordance with the Environmental Assessment ("EA") Act. Municipal infrastructure projects of this type are not subject to a complete environmental assessment but are subject to a "Class" Environmental Assessment (“Class EA”). The Class EA process was developed to ensure that environmental concerns and public input are considered in the implementation of municipal infrastructure projects.

Under this process it is mandatory to consult with the public and relevant review agencies. A pubic open house is being conducted to provide an opportunity for agencies, area residents and the general public to review and comment on the alternative solutions and design concepts being considered.

Any input or comments received through the public consultation process will be considered in the planning and design of this project. Individuals are encouraged to submit comments, in writing, to the project team.

Biosolids Processing Alternatives

Alternative processing solutions were identified and assessed to address the identified problems/ opportunities. The biosolids processing alternatives consist of:

1. Do nothing – provides a basis for comparing the other alternatives.
2. Anaerobic Digestion – bacteria convert solids to a biogas (methane, carbon dioxide, hydrogen sulfide) in the absence of air.
3. Aerobic Digestion – air is introduced and dissolved oxygen and bacteria breakdown the solids and produce carbon dioxide and water.
4. Lime Stabilization – introduce an alkaline material and in some cases heat to raise the pH and reduce the microbiological population.
5. Geotube Freeze-Thaw – place biosolids in a geosynthetic “sock” and add polymers to allow water to drain by gravity over time.
6. Chemical and Heat Treatment – add chemicals and heat to lower the pH and reduce the microbiological population.
7. Enhanced Sludge Dewatering – reduced the liquid content through enhanced filtration and the introduction of heat.
8. Composting – an aerobic, self heating stabilization process requiring the introduction of an amendment to produce a suitable C:N ratio and improve porosity.
9. Pelletization – mixed with dust which coats the sludge granules and air dried to 80% solids content.
10. Incineration – combustion at temperatures in the range of 760°C to 870°C producing carbon dioxide and water.
11. Gasification – a high heat process (>700°C) in the absence of air to create a syngas.

A detailed evaluation of the alternatives was completed with due consideration of technical issues, natural and social environmental impacts and costs.

Preliminary Preferred Processing Alternative

There was a clear preference for **composting and alkaline stabilization**. Design concepts were subsequently developed for both of these alternatives.

The principle reasons for selecting both processing alternatives are as follows:

- Both processes scored similarly in the evaluation and both eliminate the need for disposal of biosolids in the landfill.
- The processed material properties are similar to soil and are suitable for use as landfill cover or for other land application (eg. agriculture or forestry).

- The processed material is less odorous and safer to handle.
- No time of use restrictions as landfill cover resulting in reduced storage requirements.
- No impacts to existing waste water treatment processes.
- Both are well established and reliable processes.

In addition to these processing alternatives, consideration was also given to the end use of the processed product and the location of a processing facility.

End Use Alternatives
Following the selection of a preferred processing strategy, three alternative end use applications were considered for the processing material:

1. Disposal in landfill.
2. Land application (agriculture or forestry).
3. Landfill cover.

An evaluation of these end uses was completed with due consideration of technical criteria, environmental benefits and costs.

Preliminary Preferred End Use Alternative
Based on the results of the evaluation, the preliminary preferred end use for the processed material is landfill cover. The principle reasons for the selection of this alternative are as follows:

- Reduced land area requirements for application.
- No timing restrictions for application resulting in reduced storage area requirements.
- Less onerous administrative requirements.
- Lower costs and less potential for future liability.

The City also recognizes that Vendors may have an interest in marketing and distributing the processed material. Consideration of other end use alternatives will be permitted during the implementation phase.

Alternative Sites
Following the selection of preliminary preferred processing and end use alternatives, three alternative locations were considered for the proposed processing facility:

1. East End Sewage Treatment Plant;
2. West End Sewage Treatment Plant; and
3. The Municipal Landfill Site.

An evaluation of these sites was completed with due consideration of potential land use, transportation and nuisance impacts.

Preliminary Preferred Site
Based on the results of the evaluation the preliminary preferred site selected to host the facility is the landfill.

The principle reasons for the selection of this site are as follows:

- Minimizes the total travel distance/time and related impacts.
- Will provide a means of mitigating biosolids odour issues at the landfill.
- Can be integrated with current operations.
- Vacant land is available on site.
- Lower density of sensitive uses in proximity to the site.

The City is also investigating upgrades to the trailers that are used to transport biosolids to the landfill site with the intent of mitigating odours during transport.

Your Involvement
You are encouraged to review the project plans and documentation and to ask any questions of the Engineering Consultant or City Officials. Comment sheets have been provided for you to record your opinions, comments and concerns. The Engineering Consultant will accept comments relating to the planning and design of this project until January 9, 2015. Comments can be left with the Consultant at the Public Information Centre or mailed, emailed or delivered to:

AECOM Canada Ltd.
523 Wellington Street East,
Sault Ste. Marie ON P6A 2M4

Attention: Rick Talvitie, P.Eng.
Project Manager
rick.talvitie@aecom.com

Next Steps in the Class EA Process
Once the comments have been received (ie: after January 9, 2015), the Engineering Consultant will compile the information and finalize the preferred solution/design concept. All of the comments received will be considered and incorporated into the planning for this project.

Once the preferred solution/design concept is finalized the project documentation will be finalized and a Notice of Completion will be advertised and issued to all individuals that expressed an interest in the project. The public will be given an opportunity to review the final project documentation over a period of 30 calendar days.

Provided no significant concerns or objections to the proposed undertaking are received during the 30 day review period the City may proceed with the project design and construction subject to the receipt of all necessary technical approvals.

In some cases concerns regarding a project cannot be resolved through discussions with the project Consulting Engineer and/or City Officials. In this unlikely event a person / agency may request that the Minister of Environment make an order for the project to comply with Part II of the Environmental Assessment Act (referred to as a Part II Order). A Part II Order addresses individual Environmental Assessments. Requests for a Part II Order must clearly identify the rationale for the objection and ultimately the Minister will decide based on the process followed and the rationale for the decisions reached.

Thank-you….we appreciate the time you have taken to review the preliminary project documentation!

City of Sault Ste. Marie

Biosolids Management Class EA
Public Open House (December 2, 2014)

COMMENT SHEET

Name (print)	Address	Phone No.

I/We have the following comments:

Thank you for your comment(s). Please indicate whether you would like to be notified to provide comments on the Final Report.

☐ Yes I would like to be notified to allow comment on the Final Report.

☐ NO I would not like to be notified regarding the Final Report.

Please leave the completed form in the drop box or mail or deliver it to:

AECOM
523 Wellington Street East
Sault Ste. Marie, Ontario P6A 2M4
FAX: 705-942-3642
Email: rick.talvitie@aecom.com

Attention: Mr. Rick Talvitie, P.Eng.

AECOM

Welcome

City of Sault Ste. Marie Biosolids Management Class Environmental Assessment

Public Information Session

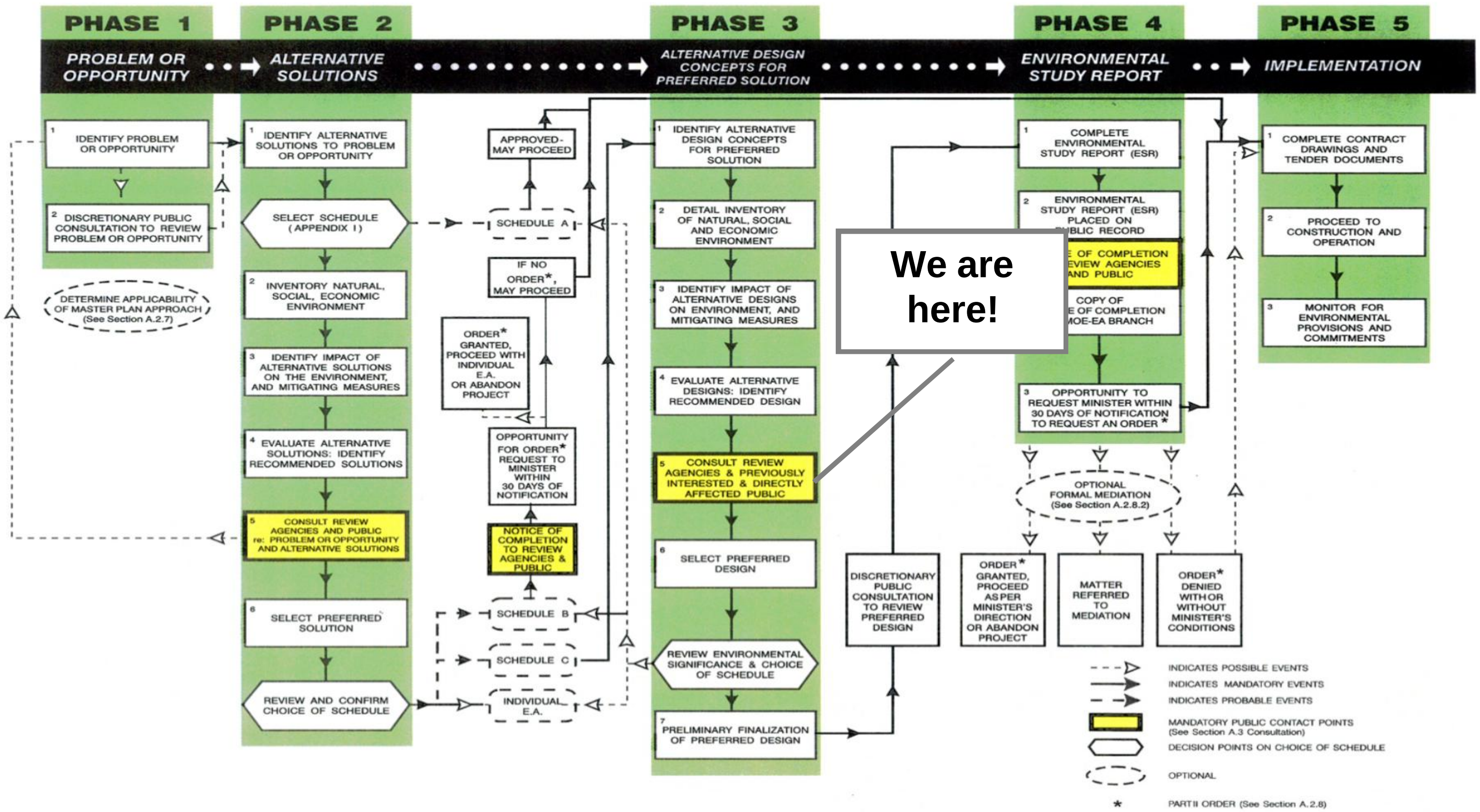
December 2, 2014 – 3:30 pm to 7:30 pm

What am I supposed to do?

1. Sign the attendance register.
2. Pick up an information package.
3. View the displays.
4. Ask questions.
5. Complete a comment sheet.

Representatives from the City of Sault Ste. Marie and the Engineering Consultant (AECOM) are present to answer your questions.

Class Environmental Assessment Process



Biosolids Management Plan – Class EA

What are Biosolids?

Biosolids are a nutrient-rich organic materials resulting from the treatment of domestic sewage at a waste water treatment facility.

Problem/Opportunities Being Addressed

- Approximately 10,000 tonnes of biosolids are landfilled annually….this represents approximately 17% of the total waste landfilled.
- There may be an opportunity to further mitigate odour generated in transporting and managing the biosolids.
- Biosolids are difficult to work with within the landfill due to their high liquid content (75% moisture).
- There is a shortage of earthen cover material available for future operations at the landfill site.

Project History

- Study initiated in 2008 and a Final Draft report was issued in September 2009.
- Final completion delayed to allow consideration of unsolicited proposals from technology vendors.
- Vendor submissions received and assessed.
- Concluded various vendors appropriately considered within the processing alternatives evaluation.
- New provincial composting regulations released July/12.
- Reporting updated to reflect new composting regulations and various other changes over time.
- Modest changes to recommendations.

Alternative Management Strategies

1. Do Nothing
2. Digestion (Anaerobic and Aerobic)
3. Alkaline Stabilization
4. Geotube Freeze-Thaw
5. Chemical and Heat Treatment
6. Enhanced Dewatering
7. Composting
8. Thermal Processing (incineration, pelletization, gasification)

Evaluation of Alternative Management Strategies

EVALUATION CRITERIA	
Criterion	**Description**
Technical	
Flexibility – Biosolids Quality	Sensitivity of the Alternative to the biosolids quality – ability to meet performance objectives for a range of feedstock compositions
Flexibility – Biosolids Quantities	Sensitivity of the Alternative to the quantity of biosolids – ability to accommodate variations in quantity
Flexibility – Regulatory Changes	Anticipated ability to meet future changes in regulations.
Approvals Requirements	Anticipated degree of difficulty in gaining system approval including EA requirements.
Proven and Reliable Technology	Proven track record operating in North America for similarly sized installations.
Compatibility with Current WPCP Processes	Changes required to existing waste water infrastructure to accommodate the Alternative.
O&M Requirements	Complexity of the Alternative and level of operator skill and attention required.
Potential for Use as Landfill Cover	Potential to use the processed material or by-products of the process for landfill cover.
Odour Mitigation	Potential to mitigate odour impacts at the facilities and along transportation routes.

Evaluation of Alternative Management Strategies

EVALUATION CRITERIA	
Criterion	**Description**
Natural Environment	
Air	Potential for impacts to the air in the form of emissions (odour excluded evaluated separately).
Water	Potential for impacts to surface and ground water quality.
Land	Potential for impacts to land.
Social Environment	
Public Health	Potential for impacts to public health.
Land Use-Processing	Site size requirements and the availability of suitable lands.
Land Use-Disposal	Availability of sites for the use/disposal of the processed material.
Financial	
Lifecycle Costs	A qualitative comparison of the lifecycle cost expectations for each alternative.

Evaluation of Alternative Management Strategies

- Scoring ranges from -2 to +2.
- Zero is equivalent to Do Nothing.
- A score above zero indicates the alternative is preferable to Doing Nothing under a given criterion.
- A score below zero indicates Doing Nothing is preferable to the Alternative under a given criterion.
- Weightings range from 1 to 3.
- Higher weightings assigned to criteria that reflect the principle objectives of the study.

Evaluation of Alternative Management Strategies

Alternative Solution	Technical								
	Flexibility – Biosolids Quality	Flexibility – Biosolids Quantities	Flexibility – Regulatory Changes	Approvals	Proven & Reliable Technology	Compatibility With Current WPCP Processes	O&M Require ments	Potential for Use as Landfill Cover	Odour Mitigation
Criteria Weighting	**x 1**	**x 1**	**x 1**	**x 1**	**x 1**	**x 1**	**x 1**	**x 3**	**x 3**
Anaerobic Disgestion	-2	-2	2	2	0	-1	-1	0	3
Aerobic Digestion	0	-1	2	2	0	0	-1	0	3
Alkaline Stabilization	0	0	2	2	0	0	-1	6	5
Geotube Freeze and Thaw	0	0	0	0	-1	0	0	0	0
Chemical and Heat Treatment	0	0	2	-1	-1	0	-1	0	3
Enhanced Dewatering	-1	0	0	0	0	0	-1	0	3
Thermal	0	0	1	0	-1	0	-2	3	6
Composting	0	0	2	1	0	0	-1	6	5

Evaluation of Alternative Management Strategies

Alternative Solution	Natural Environment			Social Environment			Financial	Total
	Air	Water	Land	Public Health	Land Use – Processing	Land Use – Disposal	Lifecycle Costs	
Criteria Weighting	x 1	x 1	x 1	x 1	x 1	x 1	x 3	
Anaerobic Disgestion	0	0	0	2	-1	2	-5	-1
Aerobic Digestion	0	0	0	2	-1	2	-4	4
Alkaline Stabilization	-1	0	0	2	-1	1	-3	12
Geotube Freeze and Thaw	0	-1	0	0	-2	0	0	-4
Chemical and Heat Treatment	0	0	0	2	-1	1	-3	1
Enhanced Dewatering	0	0	0	1	0	1	-2	1
Thermal	-1	0	0	1	-2	1	-6	0
Composting	0	0	0	2	-1	1	-5	10

Evaluation of Alternative Management Strategies Conclusions Reached

Two alternatives received more favourable scoring relative to the other alternatives. The following alternatives were carried forward for further consideration in the next phase of the study process:

- Alkaline Stabilization; and
- Composting.

Alternative Sites Evaluation

EVALUATION CRITERIA	
Criterion	**Description**
Transportation	Potential impacts associated with the transportation of biosolids and the processed material (noise, vibrations, emissions).
Adjacent Land Use	Potential nuisance impacts to adjacent land uses (odour, dust, noise, vibrations).
Future Land Use	Potential impact of the proposed facilities on the future anticipated land uses on the site.
Operations	Potential impact of the proposed processing operations on the existing site operations and the ability to integrate the new operations.
Processing Plant Upset	Potential impact of a processing plant upset.

East End Waste Water Treatment Plant

Biosolids Management Plan – Class EA

West End Waste Water Treatment Plant

Biosolids Management Plan – Class EA

Landfill Site

Biosolids Management Plan – Class EA

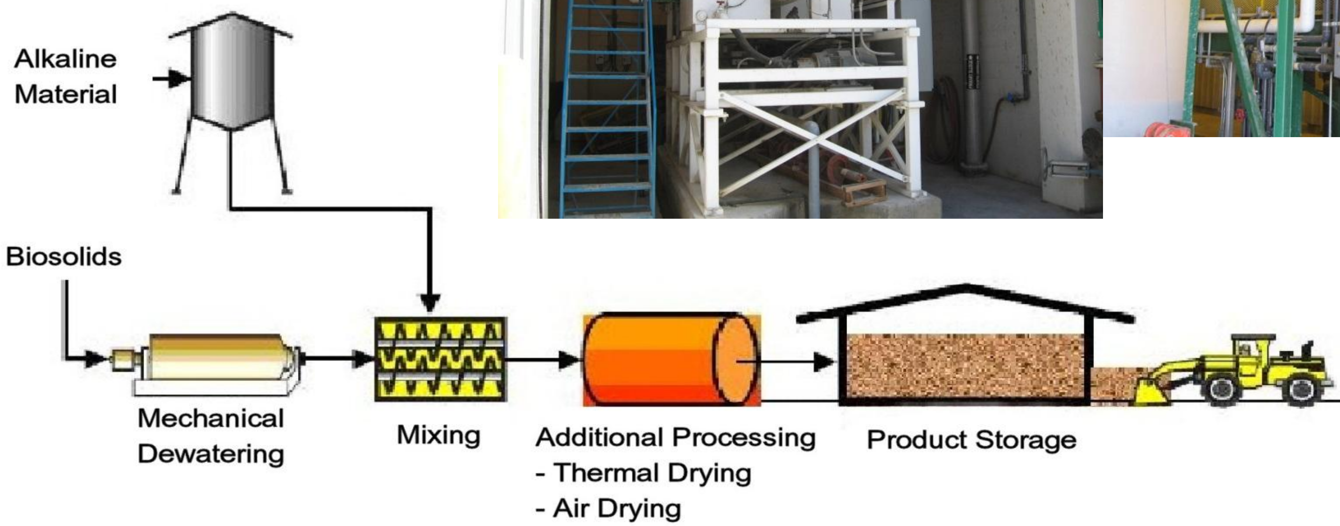
Alternative Sites Evaluation

SUMMARY OF EVALUATION RESULTS			
Criterion	**EEWPCP**	**WEWPCP**	**Landfill**
Transportation	+2	+1	+3
Adjacent Land Use	+1	+2	+2
Future Land Use	+1	+1	+1
Current Operations	+1	+1	+2
Processing Plant Upset	+1	+2	+2
TOTALS	**+6**	**+7**	**+10**

Evaluation of Alternative Facility Locations Conclusions Reached

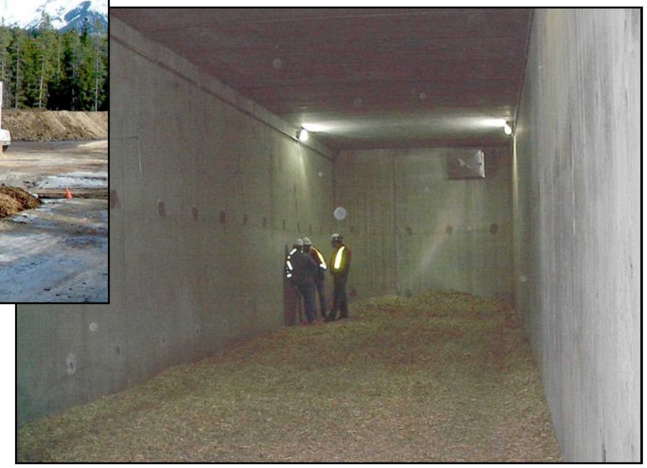
The landfill site received the highest overall scoring and is the preliminary preferred location to host a processing facility.

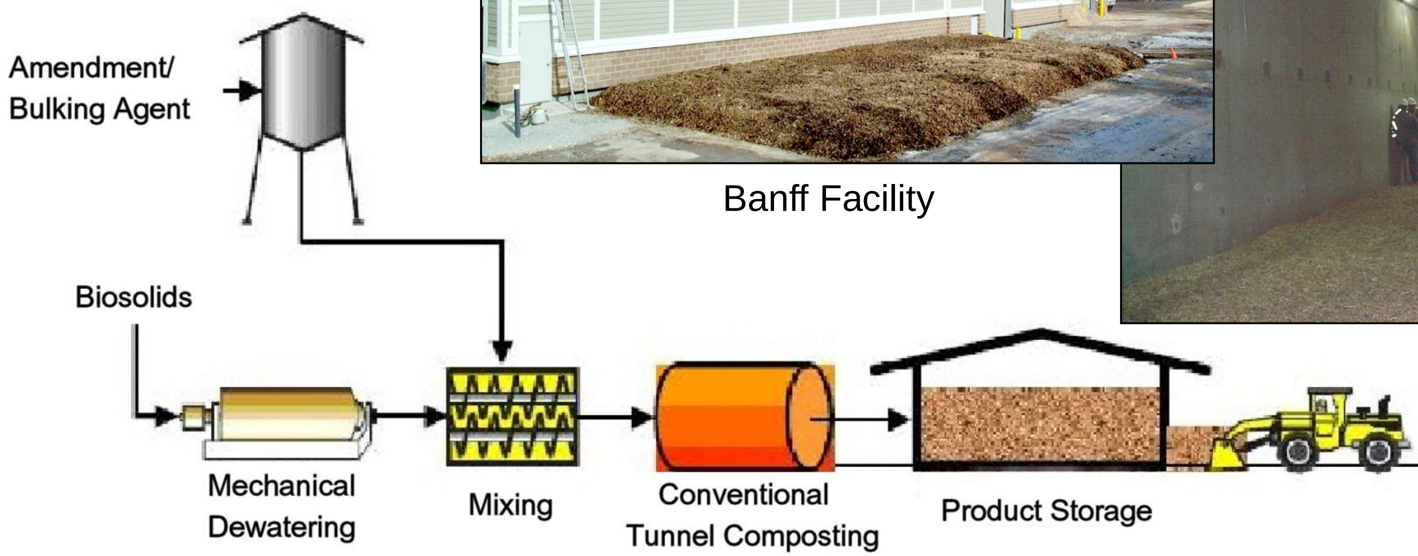
Alkaline Stabilization



Composting

Banff Facility





Lifecycle Cost Comparison: Lime Stabilization vs. Composting

- Lime Stabilization estimated cost = $166 to $201 per wet tonne
- Composting estimated cost = $168 to $188 per wet tonne

Preliminary Preferred Solution

- Process the dewatered biosolids from both waste water treatment plants in an alkaline stabilization or composting facility to be constructed at the landfill site. The facility will include odour control and the processed material will be combined with native fill and used as landfill cover.
- Consider other beneficial uses (eg. land application – agriculture, forest, etc.) for the processed material.
- Consider upgrading the trailers used to transport biosolids to the landfill site with the intent of enhancing existing odour mitigation.

Rationale for Selection of the Preliminary Preferred

- Alternatives scored similarly;
- Mitigates odours at the landfill and in transit;
- Removes biosolids from the waste stream (beneficial use);
- Addresses the shortage of cover material at the landfill;
- Limited storage requirements;
- No impacts to existing waste water treatment process;
- Both are well established and simple processes.

Next Steps

- Summarize the public and agency input received;
- Identify any changes required to the preliminary preferred design concept based on input received;
- Issue a Notice of Completion and allow for further input over a 30 day period; and
- Proceed with a Request for Proposal provided there are no requests for a Part II Order (subject to Council approval) - true capital costs are best established through a request for proposal process.