

## APPENDIX A6: TM 6 – Evaluation Methodology

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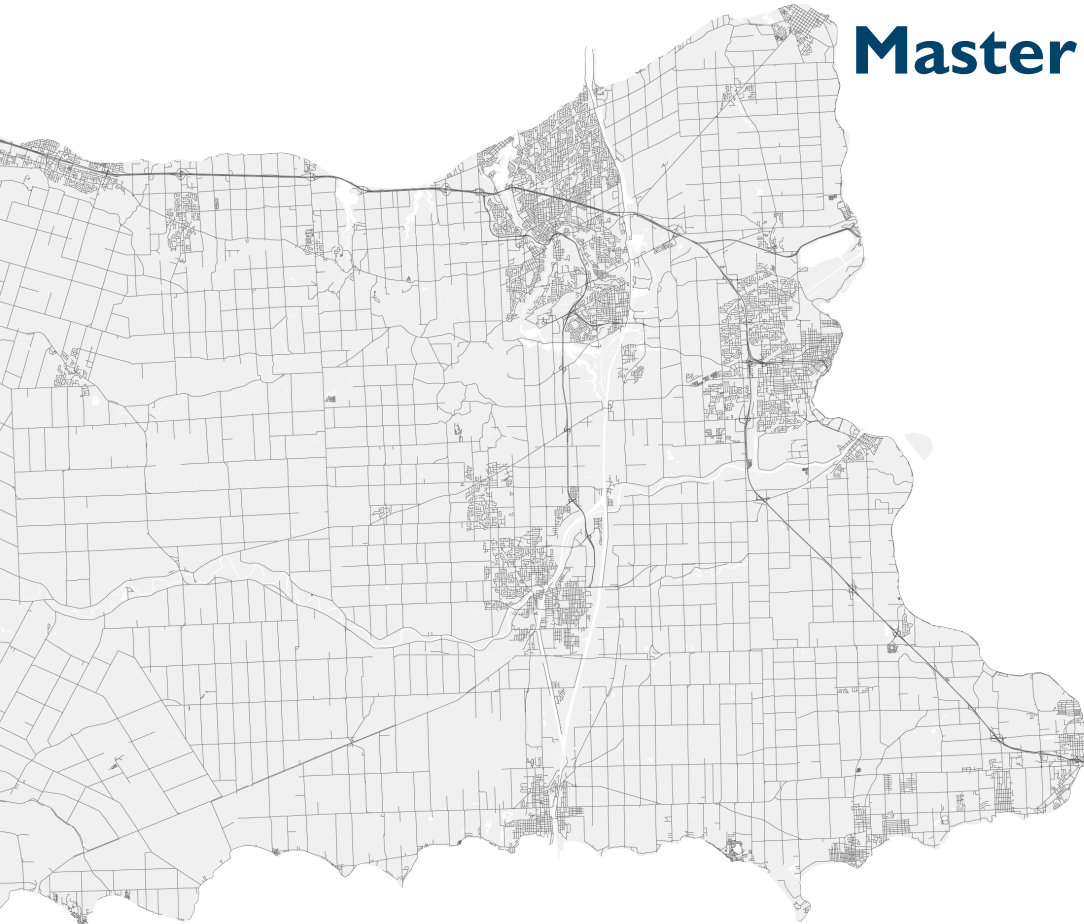
# Niagara Region

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Technical Memorandum 6  
Evaluation Methodology and Criteria for Assessing Alternatives

# 2021 Biosolids Management Master Plan Update

November 2023



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**621143 – Niagara Biosolids Management Master Plan Update  
Technical Memorandum 6 – Evaluation Methodology and Criteria**

**QA/QC - SIGN OFF SHEET**

This report has been reviewed and approved by the undersigned.



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## **I.0 Introduction**

### **I.1 Background and Purpose**

Niagara Region has an extensive water and wastewater treatment serving system, with ten (10) wastewater treatment plants (WWTP) and six (6) water treatment plants. The majority of liquid biosolids from the WWTPs are trucked to the centralized Garner Road Biosolids and Dewatering Facility. The residuals from the water treatment processes at the DeCew, Grimsby and Niagara Falls WTPs are also transported to the Garner Road Facility to be mixed with Regional biosolids. The residuals from the remaining WTPs are conveyed to the WWTPs through the wastewater collection system.

The biosolids and residuals received at the Garner Road Facility are either stored and trucked to be utilized directly on agricultural lands or dewatered and transported to the N-Viro facility (an owned subsidiary of Walker Environmental), a biosolids processing facility located in Thorold.

The Region has two third-party service providers to help manage their biosolids. Each provider manages approximately 50% of the Region's biosolids:

- **Thomas Nutrient Solutions:** responsible for managing Niagara's land application program. They are responsible for identifying and partnering with farmers on biosolids application to their agricultural land. They are also responsible for haulage, and lagoon operation and maintenance at the Garner Road Facility.
- **Walker Environmental:** responsible for further treatment of biosolids through their alkaline stabilization N-Viro process and marketing and selling the end product through licensed distributors who sell the material as fertilizer and provide direct application service to farmers in Ontario.

In 2011, the Region of Niagara completed a Biosolids Management Master Plan (BMMP) to review the Region's management practices and assess alternative management strategies and to develop a strategy for managing their biosolids (including residuals) to 2031 in a sustainable and diverse manner. Since completion of the 2011 BMMP, there have been regulatory and environmental changes, as well as updated population growth projections that will have implications for biosolids management in Niagara.

The purpose of this study is to complete a BMMP Update to develop a strategy for continuing to manage biosolids from the wastewater treatment plants (WWTPs) and residuals from the water treatment plant (WTPs) in a transparent, sustainable, reliable, environmentally friendly, cost-efficient, and flexible manner. The BMMP will build upon the 2011 BMMP, while also considering regulatory and environmental changes and infrastructure works implemented since its completion.

## 1.2 Technical Memorandum Outline

This Technical Memorandum (TM) is organized in the following sections:

1. **Introduction:** This section describes the BMMP purpose and TM outline.
2. **Class Environmental Assessment (EA) Process:** Section 2 provides a description of Ontario's EA Act with specific emphasis on the Municipal Class EA process for completing Master Plans.
3. **2021 Biosolids Management Master Plan Approach:** Details on the approach for completing this 2021 BMMP are presented, including the approach to screening alternatives, developing biosolids management strategies, assessing the strategies and establishing the preferred overall implementation details. Screening ("must have") and detailed evaluation criteria are also provided.
4. **Summary and Next Steps:** This section summarizes the evaluation process and the next steps to applying the process.

## 2.0 Class Environmental Assessment Process

### 2.1 Ontario's Environmental Assessment Act

Ontario's Environmental Assessment Act (EAA) was passed in 1975 and was proclaimed in 1976. The EAA requires proponents to examine and document the environmental effects that could result from major projects or activities and their alternatives. Municipal undertakings became subject to the EAA in 1981.

The EAA's comprehensive definition of the environment is:

- Air, land or water,
- Plant and animal life, including human life,
- The social, economic, and cultural conditions that influence the life of humans or a community,
- Any building, structure, machine or other device or thing made by humans,
- Any solid, liquid, gas, odour, heat, sound, vibration, or radiation resulting directly or indirectly from human activities; and,

- Any part or combination of the foregoing and the interrelationships between any two or more of them, in or of Ontario.

The purpose of the EAA is the betterment of the people on the whole or any part of Ontario by providing for the protection, conservation, and wise management of the environment in Ontario (RSO1990, c.18, s.2).

## 2.2 Principles of Environmental Planning

The EAA sets a framework for a rational, objective, transparent, replicable, and impartial planning process based on the following five key principles:

1. **Consultation with affected parties.** Consultation with the public and government review agencies is an integral part of the planning process. Consultation allows the proponent to identify and address any concerns cooperatively before final decisions are made. Consultation should begin as early as possible in the planning process.
2. **Consideration of a reasonable range of alternatives.** Alternatives include alternative treatment technologies, alternative end uses for the biosolids products, and alternative overall management strategies (i.e., combinations of technologies and end uses).
3. **Identification and consideration of the effects of each alternative on all aspects of the environment.** These aspects include the natural, social, cultural, technical, and economic environments.
4. **Systematic evaluation of alternatives in terms of their advantages and disadvantages to determine their net environmental effects.** The evaluation shall increase in the level of detail as the study moves from the evaluation of treatment technologies and end uses to the biosolids management strategies. Net effects refer to the potential impacts after mitigation techniques are considered.
5. **Provision of clean and complete documentation of the planning process followed to allow “traceability” of decision-making with respect to the project.** The planning process must be documented in such a way that it may be repeated with similar results.

## 2.3 Class Environmental Assessments

“Class” Environmental Assessments (Class EAs) were approved by the Minister of the Environment in 1987 for municipal projects having predictable and mitigable impacts to meet Ontario’s EAA requirements in a streamlined manner.

The Municipal Class EA, prepared by the Municipal Engineers Association (MEA) (October 2000, as amended in 2007, 2011, 2015, and 2023) outlines the procedures to be followed to satisfy Class EA requirements for water, wastewater, stormwater management and road projects.

The process includes up to five phases:

- **Phase 1:** Problem or Opportunity Definition,
- **Phase 2:** Identification and Evaluation of Alternative Solutions to determine a preferred solution while taking input from the public and other stakeholders into consideration,
- **Phase 3:** Examination of Alternative Methods of implementation of the preferred solution while taking input from the public and other stakeholders into consideration,
- **Phase 4:** Documentation of the Class EA process in the form of an Environmental Study Report (ESR) for public review; and
- **Phase 5:** Implementation and Monitoring.

Public and agency consultation are integral to the Class EA planning process. Projects subject to the Class EA process are classified into following “schedules” depending on the degree of expected impacts. It is noted that the March 2023 amendments to the MEA Class EA came into effect March 2023 during this Master Plan process. Although the process for completing the Master Plan presented herein did not change, the schedule classification was revised as follows:

- **Exempt Projects (Formerly known as Schedule A and A+ Projects)** These projects are minor or emergency operational and maintenance activities. These projects are typically smaller in scale and do not have a significant environmental effect. These projects are exempt from Ontario’s EA Act and are pre-approved; however, the public is to be advised prior to the project implementation for those projects formerly categorized as Schedule A+.
- **Projects Eligible to be Screened to Exemption:** These projects are eligible for exemption based on the results of a screening process. There are two (2) screening processes identified in the Municipal Class EA process:
  - Collector Road Screening Process (CR)
  - Archaeological Screening Process (ASP)

If the screening process determines that the project is not exempt, the applicable Schedule B or C assessment process must be completed. Proponents can also choose at the outset of the project to not follow a screening process and just complete the applicable Schedule B or C process.

- **Schedule ‘B’** projects require completion of Phases 1 and 2 of the Class EA process including defining the problem, developing and evaluating alternative solutions, selecting and developing a preferred solution and documentation in a Project File Report. The proponent is also required to consult with the affected public and relevant review agencies throughout the Class EA and provide at least 30-days for the public to review the Project File Report. If there are still outstanding issues after the public review period, requests may be made to the Minister of the Environment for a Part II Order. A Part II



Order is also known as bumping-up the project to a Schedule 'C' Class EA or an Individual EA. Provided that no significant impacts are identified and no requests for a Part II Order are received, Schedule 'B' projects are approved, and work may proceed directly to implementation.

- Schedule 'C'** projects must satisfy all five phases of the Class EA process. These projects have the potential for greater environmental impacts. Phase 3 involves the assessment of alternative methods of carrying out the project, as well as public consultation on the preferred conceptual design. Phase 4 normally includes the preparation of an Environmental Study Report (ESR) that is filed for public review. Provided no significant impacts are identified, and no requests for Part II Order are received, Schedule 'C' projects are approved, and work can proceed to implementation.

The Municipal Class EA Planning and Design process is illustrated in Figure 2-1.

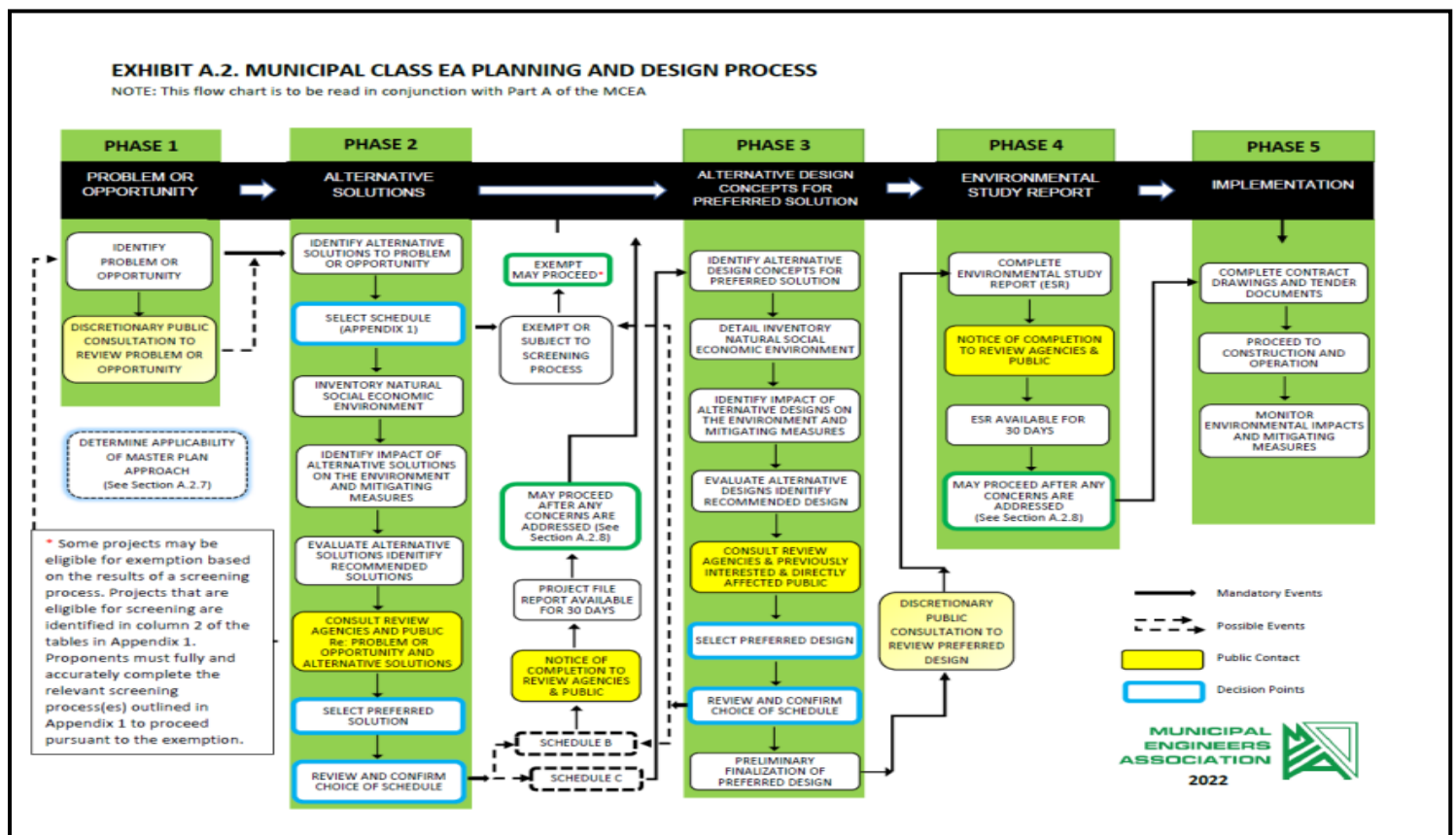


Figure 2-1 Municipal Class EA Process Schematic, as amended March 1, 2023

## 2.4 Master Plan Process

The Municipal Class EA for water and wastewater projects recognizes the importance of Master Plans as the basis for sound environmental planning. In accordance with the Municipal Class EA, Master Plans are:

“Long range plans which integrate infrastructure requirements for existing and future land use with environmental assessment planning principles. These plans examine an infrastructure system(s) or group of related projects in order to outline a framework for planning for subsequent projects and/or developments.”

Master plans have distinguishing features that set them apart from project specific studies. These features include the following:

- Master plans are broad in scope and focus on the analysis of a system for the purpose of outlining a framework for the provision of future works and developments.
- Specific projects recommended in a master plan are part of a larger management system and are distributed geographically throughout the study area.

The implementation of specific projects may occur over an extended time frame. According to the Class EA document, a master plan must at least satisfy the requirements of Phases 1 and 2 of the Class EA process and incorporate the five key principles of environmental planning, as identified in Section 2.2. The master plan must also document public and agency consultation at each phase of the process and a reasonable range of alternative solutions must be identified and systematically evaluated.

The 2021 Biosolids Management Master Plan is designed to build on decision-making completed in the previous 2011 Biosolids Management Master Plan. It also considers changes to population forecasts, regulations, and policies, as well as infrastructure works completed since filing of the 2011 BMMP. The objective is to refine the overall biosolids strategy for all communities within Niagara Region.

This study follows Approach 1 of the approved master planning Class EA process. This approach involves preparing a Master Plan at the conclusion of Phase 2 of the Class EA process, which is made available for a minimum 30-day public review period. This approach allows for Schedule A and A+ projects identified in the Master Plan to move forward to implementation and become the basis for future investigations for specific Schedule B and C projects.

## 3.0 2021 Biosolids Management Master Plan Approach

### 3.1 General Approach

Key components of the decision-making process at each Phase of the Class EA are:

**Phase 1 - Background and Problem Definition/Opportunity Statement:** This Phase of the Class EA process involves review of background information, including the current processes and operations at the WWTPs and WTPs and at Garner Road. The existing performance of the facilities is also evaluated, and their ability to meet future treatment needs to the year 2051 based on population growth projections is assessed. The information will be used to help define the BMMP goals and objectives, and ultimately the Phase 1 problem definition/opportunity statement.

**Phase 2 – Assessment of Alternative Solutions:** Given the complexity of the Niagara water and wastewater system, developing a preferred strategy for the long-term management of biosolids requires a detailed evaluation of various alternatives, including end-use options, technology options, management strategies and service delivery options.

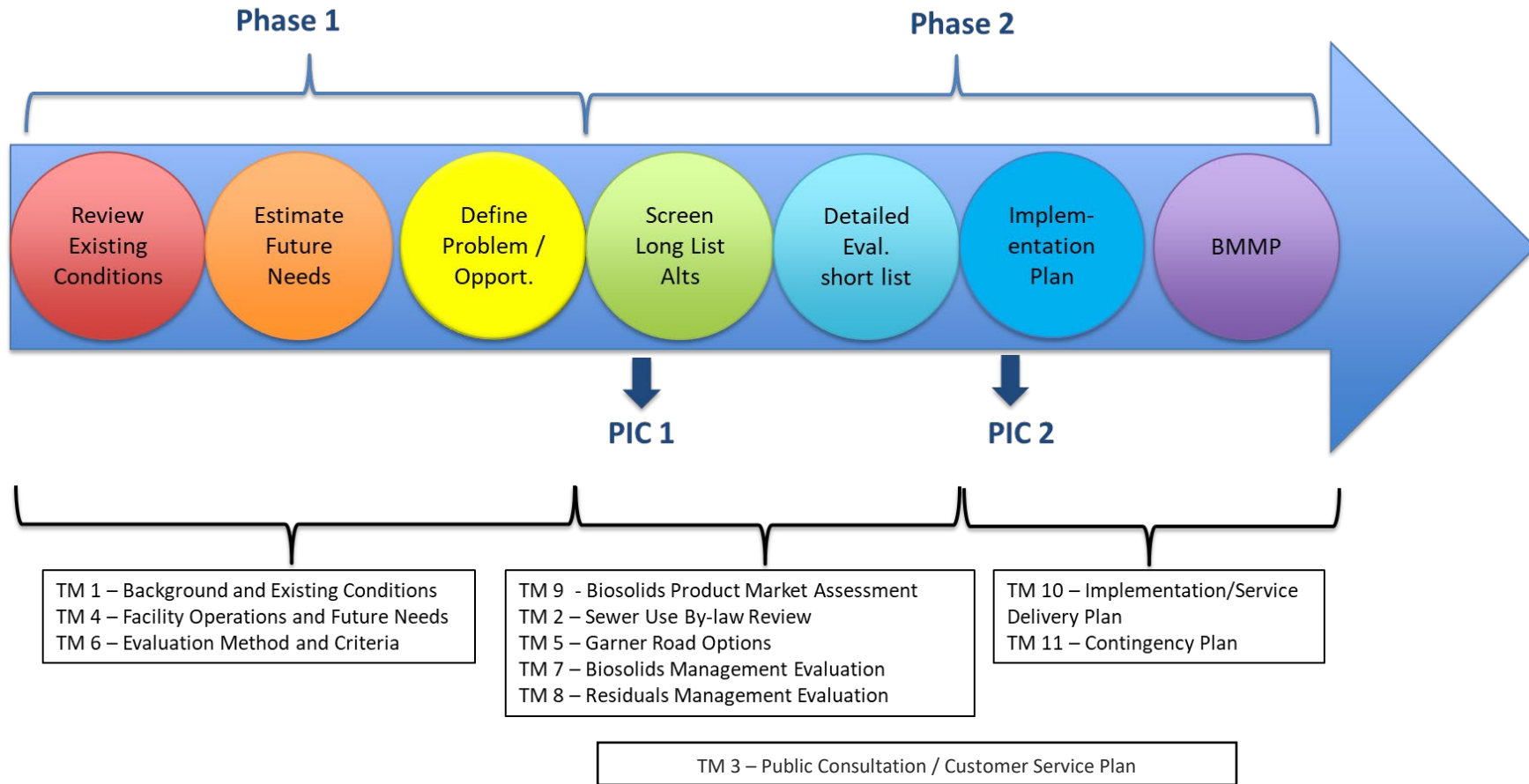
Phase 2 takes the following systematic approach to developing and assessing alternatives, to establish the preferred overall strategy:

1. A long-list of end-use market options and a long-list of treatment technologies and their related end use products are identified and screened based on “must have criteria”. The end use options and technologies/products that “pass” the screening process are carried forward. Compatible end use options are combined with technologies/products to establish a short list of overall biosolids management strategies.
2. The biosolids management strategies are assessed in detail using evaluation criteria that consider all components of the environment – natural, social, cultural, technical, and economic. Preferred strategies are selected based on this detailed evaluation. The preferred strategies are then developed in detail by assessing specific upgrade scenarios at the WWTPs, WTPs and Garner Road and biosolids transportation considerations to meet the objectives of the chosen strategies.
3. An implementation plan for the preferred strategy is developed, including consideration of 3<sup>rd</sup> party management of biosolids vs. in-house management by the Region, as well as contingency planning for various failure scenarios. The implementation plan sets out the infrastructure works, contractual considerations and schedule for the Region to continue to efficiently manage their biosolids to the year 2051.

**Documentation:** The assessment process is documented in a series of Technical Memoranda, which will form the basis of the Biosolids Management Master Plan Update Report, which will be filed for a minimum 30-day public review period, following Council approval.

**Public and Stakeholder Consultation:** Public and stakeholder consultation is an important and necessary component of any successful Master Plan process. An extensive public and stakeholder consultation program is undertaken as part of this 2021 BMMP Update to allow input and comments throughout the process. All comments received are addressed and considered through the Master Plan process.

**Figure 3-1** provides an overview of the planning process for the 2021 BMMP Update, while further details on the process are provided in the following sections.



**Figure 3-1: Planning Process for the 2021 Niagara Biosolids Management Master Plan Update**

### 3.2 Phase I: Problem/Opportunity Statement

The purpose of this project is to develop a BMMP Update to provide direction for biosolids management activities in the Niagara Region to the year 2051. This BMMP will consider the decisions made during the 2011 BMMP and any changes in Niagara’s treatment system and biosolids management approach since its completion. It will also consider regulatory, population growth and environmental changes since completion of the 2011 BMMP.

The problem/opportunity statement for this BMMP Update is to:

**Identify and develop a strategy for meeting Niagara’s biosolids treatment needs to the year 2051, in a manner that is transparent, sustainable, reliable, environmentally friendly, cost effective and flexible.**

The BMMP will be developed to:

- Meet the unique needs of Niagara Region and its customers, including treatment requirements, land uses and users, and environmental features.
- Meet future needs associated with population growth, new regulations, climate resiliency, and energy efficiency.
- Provide greater flexibility and reliability for biosolids management, both in the short term (i.e., 5 years) and long term (to the year 2051).
- Improve biosolids marketability.
- Address community expectations regarding level of service, odour, air/noise, water quality, protection of the environment and aesthetics.

The problem/opportunity statement has been developed through preliminary background review and discussions with the Region.

### 3.3 Phase 2: Alternative Solutions

Figure 3-2 illustrates the Phase 2 evaluation process, followed by details of each step in the process.

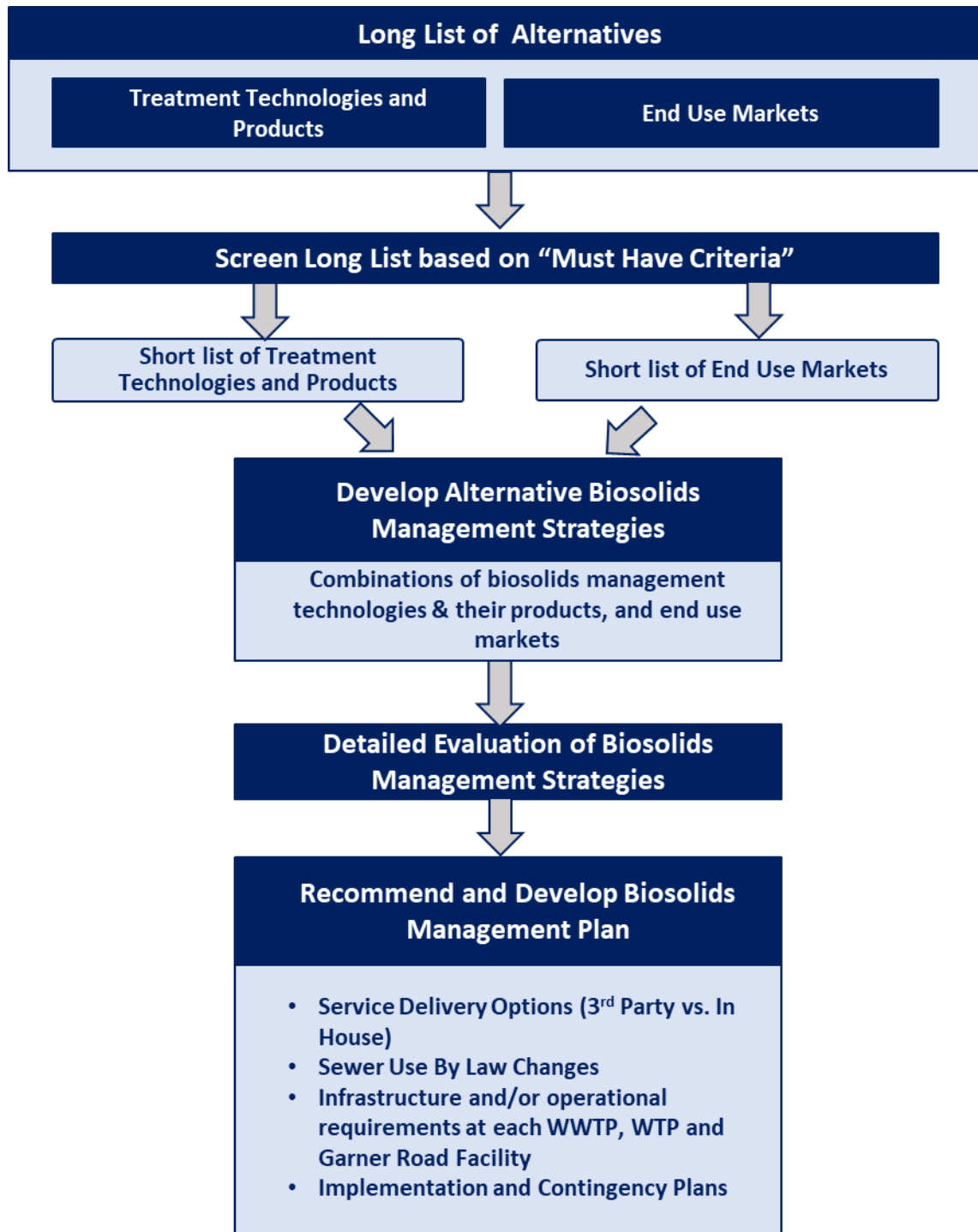


Figure 3-2: Phase 2 Evaluation Process

### 3.3.1 Step I: Screening of Long List of Technologies and End Use Options

Biosolids are an end-product of the wastewater treatment process. In the case of Niagara, residuals, a by-product of the water treatment process, are mixed with the biosolids.

As illustrated in Table 3-1, biosolids management strategies can be categorized as beneficial land use, thermal conversion, landfilling, co-management with source separated organics (SSO) and energy recovery. The selection of management option depends on:

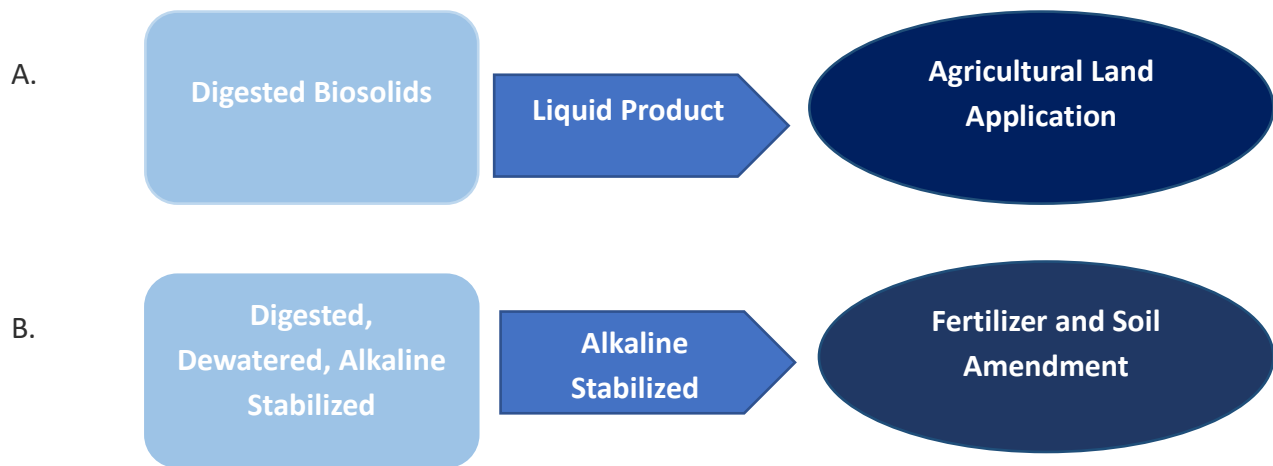
- the type of treatment process applied and the products that result from the treatment process, and
- the different markets where a product can be used.

**Table 3-1. Example Biosolids Technologies, Products and Market End Uses**

Management Strategy	Biosolid Process and Products	Market End Uses
Beneficial Use on Land	<ul style="list-style-type: none"> <li>▪ Digested biosolids (liquid)</li> <li>▪ Digested biosolids (dewatered cake)</li> <li>▪ Manufactured soil material</li> <li>▪ Advanced digested biosolids; liquid or cake</li> <li>▪ Thermal-dried biosolids</li> <li>▪ Alkaline stabilized biosolids</li> <li>▪ Thermal-alkaline hydrolysis biosolids</li> <li>▪ Composted biosolids products</li> </ul>	<ul style="list-style-type: none"> <li>▪ Agricultural land application</li> <li>▪ Silviculture (tree farming)</li> <li>▪ Horticultural market</li> <li>▪ Golf courses, parks and recreation</li> <li>▪ Landscaping</li> <li>▪ Land rehabilitation</li> </ul>
Thermal Conversion	<ul style="list-style-type: none"> <li>▪ Incinerator residual ash disposal</li> <li>▪ Incinerator residual ash use</li> <li>▪ Gasification</li> <li>▪ Pyrolysis</li> <li>▪ Wet Oxidation</li> <li>▪ Hydrothermal Liquification</li> </ul>	<ul style="list-style-type: none"> <li>▪ Municipal waste landfill</li> <li>▪ Incorporation into cement</li> <li>▪ Other ash reuse options</li> <li>▪ Heat and synthetic natural gas (syngas)</li> <li>▪ Bio-oil, biochar</li> </ul>
Landfilling	<ul style="list-style-type: none"> <li>▪ Unstabilized dewatered cake</li> <li>▪ Stabilized dewatered cake</li> <li>▪ Compost products</li> <li>▪ Thermally dried product</li> </ul>	<ul style="list-style-type: none"> <li>▪ Municipal landfill and landfill cover</li> <li>▪ Monofill (dedicated landfill)</li> </ul>
Co-management with Source Separated Organics (SSO)	<ul style="list-style-type: none"> <li>▪ Co-digestion</li> <li>▪ Compost products</li> </ul>	<ul style="list-style-type: none"> <li>▪ Management with source separated organics</li> </ul>

Niagara’s current management strategy is beneficial land use (primarily on agricultural lands within the Region), utilizing two technologies and related products:





As discussed above, the Region has two third-party service providers to help manage their biosolids:

- Thomas Nutrient Solutions: responsible for managing Niagara’s land application program of digested liquid biosolids.
- Walker Environmental: responsible for further treatment of biosolids through their alkaline stabilization process, and marketing and selling the end product through licensed distributors who sell the material as fertilizer.

Other management strategies may be applicable to Niagara. To develop these alternative strategies the potential markets for biosolids and the technologies /products that are applicable in Niagara must be first identified.

**Market Assessment:** End-use markets for biosolids products produced in Niagara Region are identified through a market assessment. The market assessment considers the different biosolids products and their characteristics, identifies target markets/outlets available and provides an overview of estimated demand and market potential. The results of the end use market assessment are detailed in TM 9.

**Technologies and Products:** In consideration of the market end-use assessment, screening of applicable biosolids treatment technologies (and their associated products) is being undertaken. The screening criteria are illustrated in Table 3-2: Screening Criteria for Treatment Technologies and their Associated Products.

**Table 3-2: Screening Criteria for Treatment Technologies and their Associated Products**

SCREENING CRITERIA	DESCRIPTION
Maturity of Technology	The technology must have been in use for long enough that most of its initial operational issues and inherent problems have been removed or reduced by further development. It must be robust, reliable and have a successful track record.
Compatibility with existing and future site development and biosolids end use markets.	The technology must be compatible with existing infrastructure investments and be constructible given existing site conditions at the Garner Road Facility. It must also compliment the end use alternatives and markets that have been identified for the Region of Niagara.
Proven application at similar scale facilities	The technology must be able to manage biosolids at the quantities that are and will be trucked to the Garner Road Facility; furthermore, the technology must have a successful operating history at facilities of similar capacity.
Implementable	The technology must be able to address implementation challenges at the Garner Road Facility or other centralized facilities. The challenges include space constraints, impacts of side stream waste generated, regulatory changes, public concerns including traffic, air quality and odour impacts.

Based on the results of the screening exercise, alternative biosolids management strategies are developed by combining treatment, products, and end-uses.



### 3.3.2 Step 2: Assessment of Biosolids Management Strategies

The biosolids management strategies are evaluated against four key factors: natural environment impacts, socio/cultural impacts, technical feasibility, and financial viability (costs) associated with each alternative. The criteria were developed to reflect the goals and objectives of Niagara. Each factor is comprised of specific criteria, and a rating system will be used to evaluate each strategy based on those criteria.

To clearly differentiate the potential positive and negative impacts or outcomes of each alternative solution on the identified criteria, a rating scale of 1 to 10 was developed. The rating scale is defined as follows:

**Table 3-3– Evaluation Rating Scale**

Impact Description	Impact Rating
Positive or no impact	9-10
Minor impact	7-8
Moderate impact	5-6
High impact	3-4
Severe impact	1-2

The following table, Table 3-4, identifies the criteria and associated rating scale identified to measure the potential impact of each biosolids management strategy on the four focus areas. Each criterion shows the associated impacts or outcomes using the 1-10 rating scale identified in Table 3-3.

**Table 3-4 – Evaluation Criteria**

Comparative Criteria	Criteria Description	Measures for Evaluation
<b>Natural Environment</b>		
Terrestrial System	Potential for biosolids management alternative to impact terrestrial habitats or systems, including terrestrial features/ functions (ANSIs, ESAs), unique vegetation species, mature trees, existing park/ open spaces linkages or wildlife.	<ul style="list-style-type: none"> <li>• <b>Impact Rating 9-10:</b> Alternative has positive or no effect on terrestrial systems.</li> <li>• <b>Impact Rating 7-8:</b> Alternative has low impact on terrestrial systems.</li> <li>• <b>Impact Rating 5-6:</b> Alternative has moderate impact on terrestrial systems.</li> <li>• <b>Impact Rating 3-4:</b> Alternative has high impact on terrestrial systems.</li> <li>• <b>Impact Rating 1-2:</b> Alternative has severe impact on terrestrial systems.</li> </ul>
Aquatic System	Potential of the alternative to impact aquatic habitats or systems, including possible impacts on aquatic life and species at risk features/ functions.	<ul style="list-style-type: none"> <li>• <b>Impact Rating 9-10:</b> Alternative has positive or no effect on aquatic systems.</li> <li>• <b>Impact Rating 7-8:</b> Alternative has low impact on aquatic systems.</li> <li>• <b>Impact Rating 5-6:</b> Alternative has moderate impact on aquatic systems.</li> <li>• <b>Impact Rating 3-4:</b> Alternative has high impact on aquatic systems.</li> <li>• <b>Impact Rating 1-2:</b> Alternative has severe impact on aquatic systems.</li> </ul>
Surface Water Quality	Potential of the alternative to impact surface water quality and support the Region’s Source Protection Program.	<ul style="list-style-type: none"> <li>• <b>Impact Rating 9-10:</b> Alternative has positive or no effect on surface water quality</li> <li>• <b>Impact Rating 7-8:</b> Alternative has low impact on surface water quality</li> <li>• <b>Impact Rating 5-6:</b> Alternative has moderate impact on surface water quality</li> <li>• <b>Impact Rating 3-4:</b> Alternative has high impact on surface water</li> <li>• <b>Impact Rating 1-2:</b> Alternative has severe impact on surface water quality</li> </ul>
Groundwater Water Quality and Quantity, and Source Water Protection	Potential of the alternative to impact the quality and quantity of groundwater.	<ul style="list-style-type: none"> <li>• <b>Impact Rating 9-10:</b> Alternative has positive or no effect on groundwater quality and quantity, and supports the Region’s Source Protection Program..</li> <li>• <b>Impact Rating 7-8:</b> Alternative has low impact on groundwater quality and quantity, and the Region’s Source Protection Program..</li> <li>• <b>Impact Rating 5-6:</b> Alternative has moderate impact on groundwater quality and quantity, and the Region’s Source Protection Program.</li> <li>• <b>Impact Rating 3-4:</b> Alternative has high impact on groundwater quality and quantity, quality and the Region’s Source Protection Program.</li> <li>• <b>Impact Rating 1-2:</b> Alternative has severe impact on groundwater quality and quantity, and the Region’s Source Protection Program..</li> </ul>

Comparative Criteria	Criteria Description	Measures for Evaluation
Soil Quality	Potential of the alternative to impact the quality and productivity of the soil.	<ul style="list-style-type: none"> <li>• <b>Impact Rating 9-10:</b> Alternative has positive or no effect on soil quality.</li> <li>• <b>Impact Rating 7-8:</b> Alternative has low impact on soil quality; .</li> <li>• <b>Impact Rating 5-6:</b> Alternative has moderate impact on soil quality.</li> <li>• <b>Impact Rating 3-4:</b> Alternative has high impact on soil quality.</li> <li>• <b>Impact Rating 1-2:</b> Alternative has severe impact on soil quality.</li> </ul>
Air Quality (Air Emissions)	The potential of the alternative to minimize air emissions and protect air quality.	<ul style="list-style-type: none"> <li>• <b>Impact Rating 9-10:</b> Alternative has positive or no effect on air quality.</li> <li>• <b>Impact Rating 7-8:</b> Alternative has low impact on air quality; .</li> <li>• <b>Impact Rating 5-6:</b> Alternative has moderate impact on air quality.</li> <li>• <b>Impact Rating 3-4:</b> Alternative has high impact on air quality.</li> <li>• <b>Impact Rating 1-2:</b> Alternative has severe impact on air quality.</li> </ul>
Greenhouse Gas (GHG) Emissions (Climate Change)	The potential of the alternative to minimize GHG emissions and support Niagara's Corporate Climate Change Initiatives.	<ul style="list-style-type: none"> <li>• <b>Impact Rating 9-10:</b> Alternative reduces or controls GHG emissions.</li> <li>• <b>Impact Rating 7-8:</b> Alternative results in low increases in GHG emissions.</li> <li>• <b>Impact Rating 5-6:</b> Alternative results in moderate increases in GHG emissions.</li> <li>• <b>Impact Rating 3-4:</b> Alternative results in high increases in GHG emissions.</li> <li>• <b>Impact Rating 1-2:</b> Alternative results in very high (severe) increases in GHG emissions.</li> </ul>
<b>Social-Cultural Environment</b>		
Odour at Garner Road	The potential of the alternative to produce odour detectable at the nearest sensitive receptor (post-construction).	<ul style="list-style-type: none"> <li>• <b>Impact Rating 9-10:</b> Alternative reduces or controls odours.</li> <li>• <b>Impact Rating 7-8:</b> Alternative produces minimal odours.</li> <li>• <b>Impact Rating 5-6:</b> Alternative produces moderate levels of odour.</li> <li>• <b>Impact Rating 3-4:</b> Alternative produces high levels of odour.</li> <li>• <b>Impact Rating 1-2:</b> Alternative produces very high levels of odour.</li> </ul>
Noise/Vibrations during Operations	The potential of the alternative to produce noise/vibrations detectable at the nearest sensitive receptor (post-construction).	<ul style="list-style-type: none"> <li>• <b>Impact Rating 9-10:</b> Alternative reduces or controls noise/vibrations.</li> <li>• <b>Impact Rating 7-8:</b> Alternative produces minimal noise/vibrations.</li> <li>• <b>Impact Rating 5-6:</b> Alternative produces moderate noise/vibrations.</li> <li>• <b>Impact Rating 3-4:</b> Alternative produces high noise/vibrations.</li> <li>• <b>Impact Rating 1-2:</b> Alternative produces very high noise/vibrations.</li> </ul>

Comparative Criteria	Criteria Description	Measures for Evaluation
Visual/Aesthetics	The potential of the alternative to impact the scenic attributes of the community and surrounding areas.	<ul style="list-style-type: none"> <li>• <b>Impact Rating 9-10:</b> Alternative improves or compliments the scenic attributes of the community and surrounding land area.</li> <li>• <b>Impact Rating 7-8:</b> Alternative has low impact on the scenic attributes of the community and surrounding land area.</li> <li>• <b>Impact Rating 5-6:</b> Alternative has moderate impact on the scenic attributes of the community and surrounding land area.</li> <li>• <b>Impact Rating 3-4:</b> Alternative has high impact on the scenic attributes of the community and surrounding land area.</li> <li>• <b>Impact Rating 1-2:</b> Alternative has severe impact on the scenic attributes of the community and surrounding land area.</li> </ul>
Truck Traffic/ Transportation System	The potential of the alternative to increase truck traffic and demands on the transportation system.	<ul style="list-style-type: none"> <li>• <b>Impact Rating 9-10:</b> Alternative will reduce or control truck traffic and demands on the existing transportation system.</li> <li>• <b>Impact Rating 7-8:</b> Alternative will have low impact on truck traffic and demands on the existing transportation system.</li> <li>• <b>Impact Rating 5-6:</b> Alternative will have moderate impact on truck traffic and demands on the existing transportation system.</li> <li>• <b>Impact Rating 3-4:</b> Alternative will high impact on truck traffic and demands on the existing transportation system.</li> <li>• <b>Impact Rating 1-2:</b> Alternative will have severe impact on truck traffic and demands on the existing transportation system.</li> </ul>
Disruption During Construction	The potential of the alternative to impact surrounding landowners and users, including disruption to traffic and parking, noise and odour generation, parks, and greenspace impacts.	<ul style="list-style-type: none"> <li>• <b>Impact Rating 9-10:</b> Construction of the alternative does not impact communities and surrounding landowners and users.</li> <li>• <b>Impact Rating 7-8:</b> Construction of the alternative will result in minimal disruptions to communities and surrounding landowners and users.</li> <li>• <b>Impact Rating 5-6:</b> Construction of the alternative will result in moderate disruptions to communities and surrounding landowners and users.</li> <li>• <b>Impact Rating 3-4:</b> Construction of the alternative will result in high disruptions to communities and surrounding landowners and users.</li> <li>• <b>Impact Rating 1-2:</b> Construction of the alternative will result in severe disruptions to communities and surrounding landowners and users.</li> </ul>

Comparative Criteria	Criteria Description	Measures for Evaluation
Property Acquisition and Easements	The potential for the alternative to require property acquisition or easements.	<ul style="list-style-type: none"> <li>• <b>Impact Rating 9-10:</b> Alternative does not require property acquisition or easements.</li> <li>• <b>Impact Rating 7-8:</b> Alternative requires minimal property acquisition or easements.</li> <li>• <b>Impact Rating 5-6:</b> Alternative requires property acquisition or easement up to \$1Mil.</li> <li>• <b>Impact Rating 3-4:</b> Alternative requires property acquisition or easement between \$1 and \$5Mil.</li> <li>• <b>Impact Rating 1-2:</b> Alternative requires property acquisition or easement &gt;\$5Mil.</li> </ul>
Recreational Use and Users	The potential for the alternative to impact recreational uses and users	<ul style="list-style-type: none"> <li>• <b>Impact Rating 9-10:</b> Alternative does not impact recreational land and water uses.</li> <li>• <b>Impact Rating 7-8:</b> Alternative has low impact on recreational land and water uses.</li> <li>• <b>Impact Rating 5-6:</b> Alternative has moderate impact on recreational land and water uses.</li> <li>• <b>Impact Rating 3-4:</b> Alternative has high impact on recreational land and water uses.</li> <li>• <b>Impact Rating 1-2:</b> Alternative severe impact on recreational land and water uses.</li> </ul>
Nutrient Recovery / Beneficial Reuse for Agricultural Land Users	The potential for the alternative to impact agricultural uses and users	<ul style="list-style-type: none"> <li>• <b>Impact Rating 9-10:</b> Alternative improves agricultural productivity.</li> <li>• <b>Impact Rating 7-8:</b> Alternative has low negative impact on agricultural productivity.</li> <li>• <b>Impact Rating 5-6:</b> Alternative has moderate negative impact on agricultural productivity.</li> <li>• <b>Impact Rating 3-4:</b> Alternative has high negative impact on agricultural productivity.</li> <li>• <b>Impact Rating 1-2:</b> Alternative has severe negative impact on agricultural productivity.</li> </ul>

Comparative Criteria	Criteria Description	Measures for Evaluation
Human Health and Well Being	The potential for the alternative to impact occupational and community health and safety.	<ul style="list-style-type: none"> <li>• <b>Impact Rating 9-10:</b> Alternative increases occupational and community health and safety.</li> <li>• <b>Impact Rating 7-8:</b> Alternative has low negative impact on occupational and community health and safety.</li> <li>• <b>Impact Rating 5-6:</b> Alternative has moderate negative impact on occupational and community health and safety; some mitigation required.</li> <li>• <b>Impact Rating 3-4:</b> Alternative has high negative impact on occupational and community health and safety.</li> <li>• <b>Impact Rating 1-2:</b> Alternative has severe negative impact on occupational and community health and safety.</li> </ul>
Existing and Future Adjacent Land Use Compatibility	The extent to which the alternative fits in with the existing land and future planned land uses in the area.	<ul style="list-style-type: none"> <li>• <b>Impact Rating 9-10:</b> Alternative is compatible with existing and future planned land use.</li> <li>• <b>Impact Rating 7-8:</b> Alternative is somewhat compatible with existing and future planned land use; few conflicts exist.</li> <li>• <b>Impact Rating 5-6:</b> Alternative is moderately compatible with existing and future planned land use; moderate conflicts exist.</li> <li>• <b>Impact Rating 3-4:</b> Alternative is not very compatible with existing and future planned land use; several conflicts exist.</li> <li>• <b>Impact Rating 1-2:</b> Alternative is incompatible with existing and future planned land use.</li> </ul>
Archaeology/ Cultural Heritage	The potential of alternative to impact any archaeological sites and/ cultural heritage areas	<ul style="list-style-type: none"> <li>• <b>Impact Rating 9-10:</b> Alternative does not impact archaeology and/or cultural heritage sites.</li> <li>• <b>Impact Rating 7-8:</b> Alternative has low impact on archaeology and/or cultural heritage sites.</li> <li>• <b>Impact Rating 5-6:</b> Alternative has moderate potential to impact archaeology and/or cultural heritage sites.</li> <li>• <b>Impact Rating 3-4:</b> Alternative has high impact on archaeology and/or cultural heritage sites.</li> <li>• <b>Impact Rating 1-2:</b> Alternative has very severe impact on archaeological and/or cultural heritage sites.</li> </ul>



Comparative Criteria	Criteria Description	Measures for Evaluation
<b>Technical Considerations</b>		
Proven Performance	The ability of the alternative to meet performance and product quality criteria.	<ul style="list-style-type: none"> <li>• <b>Impact Rating 9-10:</b> Alternative is very effective in meeting performance and product quality criteria.</li> <li>• <b>Impact Rating 7-8:</b> Alternative is somewhat effective in meeting performance and product quality criteria.</li> <li>• <b>Impact Rating 5-6:</b> Alternative is moderately effective in meeting performance and product quality criteria.</li> <li>• <b>Impact Rating 3-4:</b> Alternative has minimal ability to meet performance and product quality criteria.</li> <li>• <b>Impact Rating 1-2:</b> Alternative is unable to meet performance and product quality criteria.</li> </ul>
Long Term Sustainability	The ability of the alternative to meet current needs, while not compromising the ability to meet future needs and market demands. [i.e., The ability of the alternative to provide sustainable treatment and end-use markets through the planning period (to year 2051) and reduce risks to the Region.]	<ul style="list-style-type: none"> <li>• <b>Impact Rating 9-10:</b> Alternative can easily adapt to meet future needs and market demands with very little risk to the Region.</li> <li>• <b>Impact Rating 7-8:</b> Alternative has some ability to adapt to meet future needs and market demands with a low risk to the Region.</li> <li>• <b>Impact Rating 5-6:</b> Alternative has moderate ability to adapt to meet future needs and market demands with moderate risk to the Region.</li> <li>• <b>Impact Rating 3-4:</b> Alternative has minimal ability to adapt to meet future needs and market demands with a high level of risk to the Region.</li> <li>• <b>Impact Rating 1-2:</b> Alternative has no ability to adapt to meet future needs and market demands with a severe level of risk to the Region.</li> </ul>

Comparative Criteria	Criteria Description	Measures for Evaluation
Ease of Operation	The alternative’s relative complexity as it relates to operation and maintenance of the Region’s wastewater & water treatment systems.	<ul style="list-style-type: none"> <li>• <b>Impact Rating 9-10:</b> Alternative is easy to operate and maintain with current staff levels and training.</li> <li>• <b>Impact Rating 7-8:</b> Alternative is somewhat easy to operate and maintain; some minor staff training will be required.</li> <li>• <b>Impact Rating 5-6:</b> Alternative is moderately complex to operate and maintain; additional staff training required.</li> <li>• <b>Impact Rating 3-4:</b> Alternative is highly complex to operate and maintain; additional staff and staff training required.</li> <li>• <b>Impact Rating 1- 2:</b> Alternative is significantly more complex to operate and maintain; significant additional staff and staff training required.</li> </ul>
Resiliency	The ability to adapt to abrupt changes in the environment (ie. seasonal changes) and emergency situations. (i.e., Treatment processes have system redundancy and end-use markets are diverse.)	<ul style="list-style-type: none"> <li>• <b>Impact Rating 9-10:</b> Alternative is very resilient and provides significant redundancy during regular and emergency situations.</li> <li>• <b>Impact Rating 7-8:</b> Alternative is resilient and provides redundancy during regular and emergency situations.</li> <li>• <b>Impact Rating 5-6:</b> Alternative is moderately resilient and provides some redundancy during regular and emergency situations.</li> <li>• <b>Impact Rating 3-4:</b> Alternative has low resilience and offers little redundancy during regular and emergency situations.</li> <li>• <b>Impact Rating 1-2:</b> Alternative is not resilient to abrupt changes in the environment and emergency situations.</li> </ul>
Ease of Implementation (including marketability)	The ability to implement the strategy and associated impacts to the Region’s existing biosolids program, including ability to market the product	<ul style="list-style-type: none"> <li>• <b>Impact Rating 9-10:</b> Alternative is very easy to implement without disturbing the Region’s current biosolids management program, and produces a product that is highly marketable within the Region.</li> <li>• <b>Impact Rating 7-8:</b> Alternative is easy to implement without disturbing the Region’s current biosolids management program, and produces a product that has good marketability within the Region.</li> <li>• <b>Impact Rating 5-6:</b> Alternative is somewhat involved to implement and may slightly disturb the Region’s current biosolids management program, and produces a product that has some marketability within the Region.</li> </ul>

Comparative Criteria	Criteria Description	Measures for Evaluation
		<ul style="list-style-type: none"> <li>• <b>Impact Rating 3-4:</b> Alternative is challenging to implement, will disturb the Region’s current biosolids management program, and produces a product with poor marketability.</li> <li>• <b>Impact Rating 1-2:</b> Alternative is very challenging to implement, will disturb the Region’s current biosolids management program, and produces a product with little to no marketability</li> </ul>
Compatibility with existing infrastructure	The ability for the alternative to be compatible within the existing wastewater and water treatment systems.	<ul style="list-style-type: none"> <li>• <b>Impact Rating 9-10:</b> Alternative is very compatible with existing infrastructure and can be easily implemented.</li> <li>• <b>Impact Rating 7-8:</b> Alternative is somewhat compatible with existing infrastructure but may have some minor challenges in implementing.</li> <li>• <b>Impact Rating 5-6:</b> Alternative is moderately compatible with existing infrastructure and has moderate challenges in implementing.</li> <li>• <b>Impact Rating 3-4:</b> Alternative is highly incompatible with existing infrastructure and has many challenges in implementing.</li> <li>• <b>Impact Rating 1-2:</b> Alternative is not compatible with existing infrastructure and will have significant challenges in implementing.</li> </ul>
Energy use and recovery	The ability of the alternative to include energy efficient technologies, reduce overall energy requirements, and potentially result in energy recovery.	<ul style="list-style-type: none"> <li>• <b>Impact Rating 9-10:</b> Alternative is energy efficient and has high potential for energy recovery.</li> <li>• <b>Impact Rating 7-8:</b> Alternative is somewhat energy efficient and has some potential for energy recovery.</li> <li>• <b>Impact Rating 5-6:</b> Alternative is moderately energy efficient and has moderate potential for energy recovery.</li> <li>• <b>Impact Rating 3-4:</b> Alternative is not very energy efficient and has little potential for energy recovery.</li> <li>• <b>Impact Rating 1-2:</b> Alternative is not energy efficient and uses significant amounts of energy with little to no opportunity for recovery.</li> </ul>
Climate Change Adaptability	The ability of the alternative to adapt to climate change impacts (i.e., wet weather flow, severe events, higher Lake levels).	<ul style="list-style-type: none"> <li>• <b>Impact Rating 9-10:</b> Alternative can easily adapt to climate change.</li> <li>• <b>Impact Rating 7-8:</b> Alternative has some ability to adapt to climate change.</li> <li>• <b>Impact Rating 5-6:</b> Alternative has moderate ability to adapt to climate change.</li> <li>• <b>Impact Rating 3-4:</b> Alternative has very minimal ability to adapt to climate change.</li> <li>• <b>Impact Rating 1-2:</b> Alternative has no ability to adapt to climate change.</li> </ul>

Comparative Criteria	Criteria Description	Measures for Evaluation
Permits and Approvals	Ease of receiving permits and approvals, including permits and approvals to implement treatment technologies and end-use options.	<ul style="list-style-type: none"> <li>• <b>Impact Rating 9-10:</b> Alternative requires few permits/approvals without long lead times; does not impact project timelines and/or complexity.</li> <li>• <b>Impact Rating 7-8:</b> Alternative requires some permits/approvals but does not impact project timelines and/or complexity.</li> <li>• <b>Impact Rating 5-6:</b> Alternative requires a moderate number of approvals/permits and may impact on project timelines and/or complexity.</li> <li>• <b>Impact Rating 3-4:</b> Alternative has many complicated approvals/permits and adds time to the project schedule and/or project complexity.</li> <li>• <b>Impact Rating 1-2:</b> Alternative requires significant complicated approvals/permits that add significant time to project schedule and/or project complexity.</li> </ul>
<b>Economic Considerations</b>		
Capital Cost	Capital costs estimates to provide a relative comparison of alternatives	<ul style="list-style-type: none"> <li>• <b>Scale of 1 to 10</b> developed based on relative difference in capital costs of alternatives, with 10 having the lowest relative costs and 1 having the highest costs.</li> </ul>
Operating and Maintenance (O&M) Costs	Operating costs compared to other alternatives will be provided.	<ul style="list-style-type: none"> <li>• <b>Scale of 1 to 10</b> developed based on relative difference in O&amp;M costs of alternatives, with 10 having the lowest relative costs and 1 having the highest costs.</li> </ul>
Life-Cycle Costs	Life-cycle costs (30-year) compared to other alternatives.	<ul style="list-style-type: none"> <li>• <b>Scale of 1 to 10</b> developed based on relative difference in life-cycle costs of alternatives, with 10 having the lowest relative costs and 1 having the highest costs.</li> </ul>

Alternative impacts for each criterion are scored by a team of engineers, scientists, and planners based on the conceptual design assumptions, technical evaluations, cost estimates, and environmental inventories completed as part of the Phase 2 evaluation. Impacts are qualified where possible.

Impact ratings are summed for each criteria category and normalized, such that each category (i.e., natural, social/cultural, technical, and economic) is weighted equally at 25% each. The alternative with the highest summed score out of 100% has the least net effects. To identify the sensitivity of recommended solution to different Regional priorities and goals, a sensitivity analysis will also be undertaken by applying different importance weighting to criteria categories. A recommended design concept will be selected with the Region based on the evaluation and sensitivity analysis. The preferred alternative will be confirmed based on comments and feedback received from project stakeholders including the public and review agencies.

### **3.3.3 Step 3: Development of Niagara's Biosolids Management Plan**

Based on the evaluation of alternative biosolids management strategies, the strategy that best meets the goals and objectives of the Region of Niagara is recommended as part of Niagara's Biosolids Management Plan. The preferred strategy is selected to meet the Region's goals of improving biosolids marketability and maintaining a sustainable and reliable program for the long term.

To develop the Biosolids Management Program the following further evaluations is completed to identify:

1. In-house vs 3<sup>rd</sup> Party Service Delivery: Scenarios for managing biosolids including in-house, 3<sup>rd</sup> Party, or a combination of both, will be established and reviewed, and a preferred approach developed.
2. Sewer Use By-Law Changes: Determine if changes to the existing sewer use by-law will be required to meet biosolids quality requirements now and in the future.
3. Treatment and Infrastructure works and/or operational changes at the WWTPs, WTP and Garner Road.

## 4.0 Summary and Next Steps

This TM presents the overall approach for assessing alternatives and establishing the overall BMMP, including screening and evaluation criteria. It is also noted that the evaluation of alternatives is often an iterative process and final evaluation process is documented in TM7.

The existing conditions and future treatment requirements are documented, in TM 1 and TM 4, respectively. These are the basis for defining the problem (see Section 3.2) and establishing the long list of alternative technologies/products and end uses (see Section 3.3.1).