November 2013

REGION OF WATERLOO
WASTE MANAGEMENT MASTER PLAN

Final Master Plan Report

Submitted to:
Region of Waterloo
Transportation and Environmental Services Waste Management Division
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REPORT

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Executive Summary

Waterloo Region is a community consisting of seven local area municipalities including the Cities of Cambridge, Kitchener and Waterloo, and the Townships of North Dumfries, Wellesley, Wilmot and Woolwich. The Region of Waterloo (Region) and the local area municipalities are responsible for providing a variety of municipal services to its residents. In general, the Waste Management Division of the Region's Transportation & Environmental Services Department is responsible for providing residential waste collection, diversion and disposal services for Waterloo Region. Industrial, commercial and institutional waste diversion and disposal is governed by the Province of Ontario. The Waste Management Division is also responsible for operating the Region's one active landfill, five closed landfills, one bulk waste transfer facility, six small vehicle transfer stations, and a Material Recovery Centre.

Long term strategic planning has laid the foundation for municipal waste management in Waterloo Region since the 1980's. Since the completion of the "*1986 Region Waste Management Master Plan"* (WMMP), the Region has adopted an integrated approach to waste management that balances the need for waste reduction and diversion services, as well as waste disposal. In 1998, the Region's Waterloo Waste Management Centre registered to the ISO 14001 standard. The Waterloo Waste Management Centre, which includes the Region's active landfill site, was the first municipal waste management facility in North America to do so. Continuous improvement to the Environmental Management System has resulted in successful re-registration to the standard ever since. Other recent key initiatives, which have resulted from the Region's approach to balanced waste management services, include a three-year (2005 – 2007) waste reduction sequencing plan, a focus on implementing Blue Box Best Practices, and the introduction of the green bin organics program to all single family households in Waterloo Region by 2010. Based on the guidance provided by the original 1986 WMMP, infrastructure modernization, service integration, and program initiatives have resulted in a threefold increase in the amount of material diverted from landfill disposal between 1995 and 2011 amidst a population increase of nearly 35% over the same period.

Building upon the successes and experience gained over the last 25 years, the Region began the development of a renewed strategy to guide waste management services over the next 20+ years. The Region of Waterloo is one of only a few municipalities in Ontario with significant remaining local landfill capacity. As such, the new WMMP includes careful consideration of post-diversion residual waste management options that are consistent with the Region's corporate and strategic vision. In addition, the new WMMP addresses key challenges being faced by Waterloo Region, including:

- Regional growth;
- Regulatory demands and changing legislation;
- Increasing environmental protection measures;
- Evolving provincial waste management directives;
- Increasing demand for innovative and sustainable solutions;
- Public perception of emerging and evolving waste management opportunities; and
- The potential financial implications of long term management options.

The WMMP study was initiated in April 2012. The WMMP study involved collaboration with a Steering Committee comprised of Region councillors and staff, and a Stakeholder's Group comprised of Waterloo Region residents and representatives of community and environmental organizations, business and industry organizations, area municipalities and universities, and technical consultants.

Over the study period, the Region reviewed current waste management programs and performance, identified opportunities to divert even more waste from landfill, identified options for future residual waste management and evaluated their sustainability, and recommended options for the long term management of Waterloo Region's residual waste. The tasks comprising the WMMP study were documented in a series of reports, all of which are summarized in this Final Waste Management Master Plan Report. Individual reports include: *Mission Statement and Guiding Principles Report*, *Communication and Consultation Plan*, series of nine *Interim Reports*, *Full-Cost Accounting Analysis for Waste Disposal at the Waterloo Landfill, Sustainable Approaches to Soil, Sediment and Materials Management Feasibility Study,* and two *Consultation Summary Reports*. All reports, including the Final Report are available on the Region's Waste Management web page (http://www.regionofwaterloo.ca/waste).

The WMMP documents the current status of the Region's waste management practices, programs, operations and facilities, provides projections of future diversion rates and residual waste generation volumes, and establishes a strategy to guide waste management services over the next 20 years that is aligned with the planning, regulatory and technical context. The preferred strategy targets three primary and complementary areas of focus, and includes the following recommended actions:

Diversion

- Implement curbside collection policy changes to increase diversion (e.g. bag limits, bi-weekly garbage collection, standardized Regional residential waste collection), and consider "user pay" options (e.g. bag tags).

Residual Waste Management

- Further investigate thermal technology options (e.g. Feasibility Study, Business Case, Life Cycle Analysis).
- Continue pursuit of opportunities with the Water Services Division to maximize inherent synergies for processing and disposal of residual waste and biosolids.

Planning

- Adopt a waste hierarchy that includes "Recovery" as the 4th R and consider recovery of energy and resources above waste disposal.
- Establish an inter-municipal working group to explore potential partnership opportunities.

Glossary of Terms

Biosolids: Primarily organic solid product produced by wastewater treatment processes.

Diversion: The segregation of waste from final disposal for a more beneficial, secondary use, including reuse, recycling and composting.

Diversion Rate: The total quantity of waste that is diverted for reuse or recycling as a function of the total quantity of all wastes generated. A diversion rate can be expressed as a percentage or on a per capita basis.

Full Cost Accounting: Systematic approach for identifying, summing, and reporting the actual upfront, operating and post-closure costs of solid waste management

Industrial, Commercial and Institutional (IC&I): Includes manufacturing establishments, goods and/or services retailers, and for-profit and not-for-profit institutions (e.g. schools, hospitals, places of worship, etc.). Waste management services for Waterloo Region's Industrial, Commercial and Institutional establishments are subject to eligibility and can be confirmed by contacting the Region's Waste Management Division.

Landfill Capacity: The total volume of waste, expressed in cubic metres, that a landfill site is designed and approved to hold.

Life Cycle Analysis: used to model the environmental footprint by estimating the benefits and impacts as part of a complete waste management system from collection to final disposal.

Mechanical Biological Treatment: Uses a combination of mechanical separation and digestion to process waste. Recyclables and large items are first removed. Following separation, the remaining organic waste is treated biologically to produce compost, fertilizer and biogas. MBT can generate a moderate to significant amount of energy. After processing, the residual waste is sent to landfill.

Person Equivalents: The person equivalent is a quantification of the environmental impact caused annually by the activities of an average European person. It comprises contributions to all the major environmental impacts from global to local as well as consumption of resources.

Region of Waterloo: The regional level municipal government in Waterloo Region, established on January 1, 1973, and responsible for providing approximately 60 percent of municipal government services in the community, including public health, social services, planning, housing and community services, human resources and transportation and environmental services.

Residual Waste: Overall term for the waste remaining after waste has been diverted that requires final disposal at a landfill site or other type of waste disposal facility where the material is destroyed; also commonly referred to by the term "garbage."

Thermal Treatment: Uses heat to convert waste to produce carbon dioxide, water and heat. Before treatment, recyclables and large items are removed. While thermal treatment significantly reduces the volume of waste, the ash that is left over must be disposed or used in another process.

Waste: A material that is discarded as no longer useful or required by an individual, a household, or a commercial / industrial operation, whether or not it may be disposed or diverted.

Waste Management Master Plan (WMMP): A comprehensive long-term strategy that identifies present and future waste management needs for Waterloo Region and establishes a direction for on-going development of the Region's integrated waste management system.

Waste Transfer Station: A type of waste management facility where waste for diversion and waste for disposal may be dropped off and consolidated into large loads for eventual transfer to a facility for reuse or recycling, or to a waste disposal site for final disposal.

Waterloo Region: The geographic area comprised of the cities of Cambridge, Kitchener and Waterloo and the townships of North Dumfries, Wellesley, Wilmot and Woolwich.

WMMP Study: The process currently being undertaken by the Waste Management Division of the Region of Waterloo to build upon the success of the *1986 Region Waste Management Master Plan* and establish an updated WMMP that will guide waste management services over the next 20+ years.

Glossary of Abbreviations

BFIP	Brownfield Financial Incentives Program
C&D	Construction and Demolition
CO_2	Carbon Dioxide
GHG	Greenhouse Gas
GoldSET	Golder Sustainability Evaluation Tool
IC&I	Industrial, Commercial and Institutional
Kg	Kilogram
LCA	Life Cycle Analysis
LRT	Light Rapid Transit
MBT	Mechanical Biological Treatment
MCDA	Multi-Criteria Decision Analysis
MHSW	Municipal Hazardous or Special Waste
MRC	Material Recovery Centre
MSAR	Mechanical Separation for Additional Recovery
P3	Public-Private Partnerships
Region	Region of Waterloo
SSO	Source Separated Organics
SWM	Stormwater Management
TT	Thermal Treatment (combustion, pyrolysis, gasification)
WMC	Waste Management Centre
WMMP	Waste Management Master Plan
WTS	Waste Transfer Station

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1.0 INTRODUCTION & BACKGROUND

Waterloo Region is a community consisting of seven local area municipalities including the Cities of Cambridge, Kitchener and Waterloo, and the Townships of North Dumfries, Wellesley, Wilmot and Woolwich. The Region of Waterloo (Region) and the local area municipalities are responsible for providing a variety of municipal services to its residents. In general, the Waste Management Division of the Region's Transportation & Environmental Services Department is responsible for providing residential waste collection, diversion and disposal services for Waterloo Region. Industrial, commercial and institutional waste diversion and disposal is governed by the Province of Ontario. The Waste Management Division is also responsible for operating the Region's one active landfill, five closed landfills, one bulk waste transfer facility, six small vehicle transfer stations, and a Material Recovery Centre.

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Building upon the successes and experience gained over the last 25 years, the Region began the development of a renewed strategy to guide waste management services over the next 20+ years. The Region of Waterloo is one of only a few municipalities in Ontario with significant remaining local landfill capacity. As such, the new WMMP includes careful consideration of post-diversion residual waste management options that are consistent with the Region's corporate and strategic vision. In addition, the new WMMP addresses key challenges being faced by Waterloo Region, including:

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The WMMP study was initiated in April 2012. The WMMP study involved collaboration with a Steering Committee comprised of Region councillors and staff, and a Stakeholder's Group comprised of Waterloo Region residents and representatives of community and environmental organizations, business and industry organizations, area municipalities and universities, and technical consultants.

The WMMP study process (Figure 1) included a comprehensive review of current waste management programs and performance, identification of opportunities to divert even more waste from landfill, identification of options for future residual waste management and evaluation of their sustainability, and recommendations of options for the long term management of Waterloo Region's waste. The tasks comprising the WMMP study were documented in a series of reports, all of which are summarized in this Final Waste Management Master Plan Report. Individual reports include: *Mission Statement and Guiding Principles Report*, *Communication and Consultation Plan*, series of nine *Interim Reports*, *Full-Cost Accounting Analysis for Waste Disposal at the Waterloo Landfill, Sustainable Approaches to Soil, Sediment and Materials Management Feasibility Study,* and two *Consultation Summary Reports*. All reports, including the Final Report are available on the Region's Waste Management web page (http://www.regionofwaterloo.ca/waste).

The intent of this document is to provide a succinct summary of the tasks completed and clearly identify recommendations in three primary and complementary areas of focus: Diversion, Residual Waste Management and Planning that have culminated from the process. Detailed information about the study tasks is provided within the Interim Reports which are appended to this document.

The establishment of a shared vision within the community was an integral first step towards developing a sustainable WMMP that can be endorsed by the community and Regional Council. The *Mission Statement and Guiding Principles* report presents the mission statement for the WMMP study and establishes the framework for meaningful public involvement and guided the decision making and planning process.

Mission Statement

To develop a sustainable waste management master plan, in consultation with the community, that is environmentally, socially and fiscally responsible while meeting the current and future needs of Waterloo Region.

Guiding Principles

In the development of the WMMP, the Region will:

1) Consider options which support waste reduction, reuse, recycling, and recovery ahead of disposal.

2) Use an open and transparent decision making process to explore, evaluate and recommend responsible waste management services.

3) Foster innovation and incorporate flexibility to adapt to emerging technologies, policies, growth and opportunities for collaboration.

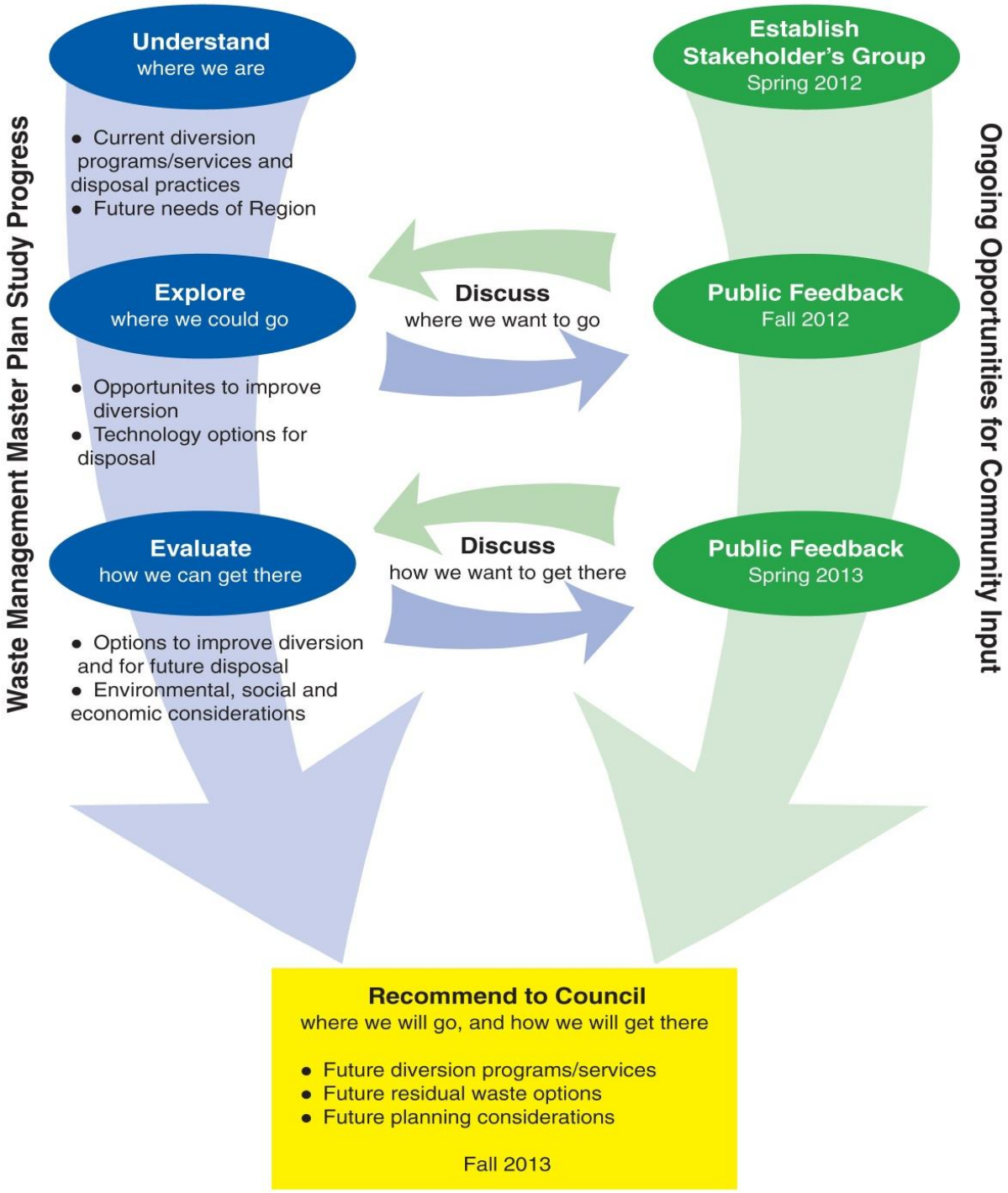


Figure 1: Waste Management Master Plan Study Process

2.0 PUBLIC CONSULTATION

At the outset of the WMMP study process, a Communication and Consultation Plan was developed. The overarching goal of the consultation framework was to support the WMMP study by informing, engaging and obtaining feedback from a diverse range of stakeholders. The intent of involving stakeholders at the planning stage is to develop a waste management strategy with a high degree of community support. Specifically, the objectives of the consultation program were to:

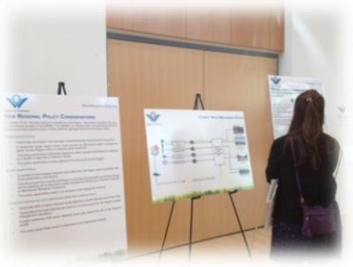
- Provide information about the Project to all stakeholders, including residents;
- Deliver information in a form that is clear and easy to understand;
- Engage the community throughout the planning process to obtain meaningful feedback;
- Improve the consultation process and the WMMP by incorporating stakeholder feedback and input, as well as public ideas and opinions; and
- Demonstrate how issues and concerns raised during the consultation process were taken into consideration and influenced decision making.



Stakeholders were engaged throughout the WMMP planning process using a variety of methods, including:

- Stakeholder's Group;
- Steering Committee;
- Interim reports to Planning and Works Committee;
- An Inter-Municipal Workshop;
- Public Information Centres;
- Online surveys;
- Radio, TV, newspapers, social media; and
- Outreach at community events.





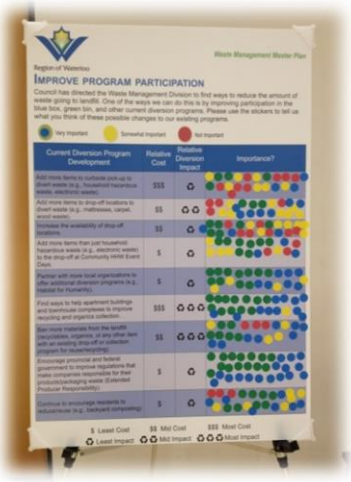
The Region carried out two rounds of focused consultation on the WMMP (Figure 1). The purpose of Consultation Series No. 1 (Fall 2012) was to:

- provide information about the WMMP study,
- obtain feedback on current waste management services, and
- Obtain feedback on ways to improve diversion.

Activities included Public Information Centres in the Cities of Cambridge, Kitchener and Waterloo and Woolwich Township, outreach at community events, as well as the implementation of a digital engagement program including an online survey. Feedback was collected from a total of 616 individuals, and is documented in the *Consultation Series No. 1: Summary Report,* and discussed in Section 6.0 of this report.

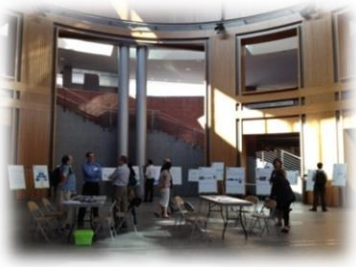
The purpose of Consultation Series No. 2 (Spring 2013) was to:

- obtain feedback on the evaluation process for residual waste disposal options,
- obtain feedback on the preferred waste disposal technology, and
- obtain feedback on policies that could be considered to complement the implementation of the preferred disposal technology.



Activities included Public Information Centres in the Cities of Cambridge, Kitchener and Waterloo and Wilmot Township, as well as the implementation of a digital engagement program including an online survey. Feedback was collected from a total of 211 individuals and is documented in the *Consultation Series No. 2: Summary Report,* and discussed in Section 9.0 of this report.

An Inter-Municipal Workshop was held in June 2012 to identify potential areas for partnership with neighbouring municipalities. In attendance at this meeting were representatives from nine neighbouring municipalities.



In addition to engaging the community as a whole, an integral part of the WMMP study was collaboration with a Steering Committee comprised of Region councillors and staff, and a Stakeholder's Group comprised of Waterloo Region residents and representatives from local municipalities, non-government organizations, universities, businesses, and special interest groups. These groups were engaged throughout the study process and provided feedback on the Mission Statement and Guiding Principles for the WMMP Study, the evaluations documented within the Interim Reports, materials for the Public Information Centres and the recommendations documented in this report.

Key Findings

Consultation Series No. 1: Participants indicated support for biweekly garbage collection, reduced bag limits and Extended Producer Responsibility as possible new diversion initiatives. Participants also identified the need for improved diversion programs or service in apartment buildings including green cart program, designated sorting areas for recycling, and adequately sized bins. The Region could subsidize the cost of paper green bin liners or allow certified compostable liners to improve program participation.

Inter-municipal Workshop: Neighbouring municipalities share common challenges including limited remaining landfill capacity, adapting to changing policy, measuring diversion, funding/financing programs, encouraging program engagement, and managing program expectations. All municipalities expressed an interest in collaborative partnerships that are sensible, financially beneficial and politically feasible.

Consultation Series No. 2: Participants expressed support for waste treatment options other than landfilling. Thermal Treatment was identified as the preferred option. Feedback indicated a strong preference against exporting waste outside of Waterloo Region and for a local sustainable option. If a Thermal Treatment option was selected respondents indicated that waste import would be acceptable as a means to improve financial feasibility.

3.0 FUTURE WASTE GENERATION AND LANDFILL CAPACITY

Forecasting waste quantities is a critical component of waste management planning. Future projections, including population growth, waste composition data and landfill capacity, provide a tool to inform strategic direction and compare options for policy decisions, and to develop or improve existing waste diversion programs, treatment and disposal. *Interim Report 1: Waste Generation Projections & Landfill Capacity Assessment* provides a projection of future diversion and disposal quantities received by the Region and assesses remaining disposal capacity at the Waterloo Landfill Site.

Key Findings:

- Assuming steady growth, the annualized average growth rate for Waterloo Region from 2011 to 2031 is 1.79%. The population is projected to increase from 553,000 in 2011 to 763,400 in 2031.
- Assuming residential diversion rates remain constant at 52%, residential waste requiring disposal is projected to increase from about 93,000 tonnes in 2011 to 130,000 tonnes in 2031.
- Should a higher diversion rate (e.g., 60%) be achieved, residential waste requiring disposal in 2031 is estimated at 108,500 tonnes.
- Regional Industrial, Commercial and Institutional (IC&I) waste diversion and generation quantities are not well defined, therefore it is difficult for the Region to predict how much IC&I waste will be disposed of at the Waterloo Landfill in the future.
- The quantity of IC&I waste requiring disposal in 2031 may range from approximately 79,000 to 156,000 tonnes compared to 119,000 tonnes in 2011.
- As of December 2011 the total volume remaining at the Waterloo Landfill Site was 7,380,405 m^3. This is equivalent to 4,428,243 tonnes at an actual average gross waste density of 600 kg/m^3.
- Based on these assumptions the Waterloo Landfill Site is projected to reach capacity between 2028 and 2031.

Conclusions

Waterloo Region is one of only a few municipalities in Ontario with significant remaining landfill capacity. However, the results of the *Waste Generation Projections & Landfill Capacity Assessment* indicate that the Waterloo Landfill Site may reach capacity before the end of the WMMP planning period (between 2028 and 2031). Continued planning for residual waste management options to support future growth is a key recommendation of this WMMP.

4.0 CURRENT WASTE MANAGEMENT PROFILE

Interim Report No. 2: Current Waste Management Profile provides an understanding of the Region of Waterloo's current waste management services and establishes a baseline for the development of the WMMP. The report compares current operations and performance with other similar municipalities in Ontario and identifies potential variables and external factors affecting the future development of the Region's waste management services.

The Region's waste management services include the following:

- **Facilities:** the Region owns and is responsible for the operation of a network of waste management facilities to support waste disposal and waste diversion programs in Waterloo Region (Table 1).
- **Programs:** residential waste is collected by the Region's contracted waste collection service providers, delivered by residents to one of the Region's drop-off depots, or managed directly by residents through other alternative programs (e.g., backyard composting, provincial bottle deposit-return system, return-to-retailer programs, donation to charitable organizations). Programs are summarized in Table 2.
- **Policies**: the Region has prohibited the disposal of numerous materials through policy measures to encourage waste diversion (Table 3). Alternately each of these materials can be dropped off for recycling or composting at one of the Region's waste management centres (WMCs) or waste transfer stations (WTSs).

Table 1: Region of Waterloo Waste Management Facilities

Facility	Status	Current Facility Components
Waterloo Waste Management Centre (WMC)	ISO 14001 certified Operating under MOE Environmental Compliance Approval No. A140301	Landfill
		Material Recovery Centre (MRC)
		Compost transfer/stockpile area, including organic waste transfer bunkers
		Small vehicle transfer station
		Waste diversion transfer area, including a Municipal Hazardous and Special Waste (MHSW) depot
Cambridge WMC	Operating under MOE Environmental Compliance Approval No. A140104 and A140110	Small vehicle transfer station
		Bulk waste transfer station (WTS)
		Compost facility
		Inert disposal area
		MHSW depot
Rural Waste Transfer Stations (WTS)	Accepting residential loads less than 200 kilograms (kg)	North Dumfries (Ayr) WTS
		Wellesley (Crosshill) WTS
		Woolwich (Elmira) WTS
		Wilmot (Huron Road) WTS
Regional Closed Landfill Sites	Closed in 2003	Cambridge Landfill
	Closed in 1987	Ayr Landfill
	Closed in 1987	Cheese Factory Road Landfill
	Closed in 1978	Kitchener Landfill
	Closed in 1986	Woolwich Landfill

Table 2: Region of Waterloo Waste Management Programs

Program	Current Program Components
Waste Diversion	Blue box/cart recycling
	Organics (i.e., leaf and yard waste, source separated organics (SSO)) composting
	Construction and demolition waste recycling (drywall, wood pallets, scrap metal, ceramic, concrete, brick and glass)
	Reuse diversion programs (textiles, housewares, building materials, bicycle reuse, reusable paint)
	Provincial extended producer responsibility programs (electronic waste, scrap tires, MHSW)
	Industrial Commercial and Institutional (IC&I) waste diversion support programs
	Curbside collection for large metal goods and appliances
Waste Disposal	Curbside collection – single/semi-detached households
	Curbside collection – multi-residential households (with limitations)
	Garbage drop-off at Cambridge and Waterloo WMC

Table 3: Regional Waste By-Laws

By-Law / Ban	Date	Description
By-Law 98-87	December 17, 1987	By-Law to regulate the receiving, dumping & disposing of waste. Includes provisions relating to illegal dumping, waste drop off at Regional waste management facilities, scavenging, and tipping fees.
ER-88-110.1	September 1, 1988	Disposal of Waste Tire Ban
ER-90-125	April 1, 1991	Old Corrugated Cardboard Landfill Ban
By-Law 02-011	January 30, 2002	By-Law to Prohibit & Regulate the Collection of Waste Includes provisions relating to waste collection (e.g. set out times and limits), waste preparation for curbside collection, and collection container/receptacle specifications.
E-02-072	January 1, 2003	Wooden Pallet Landfill Ban
E-02-070	March 31, 2003	Curbside Garbage Collection of Grass Ban
E-04-092	June 6, 2005	Landfill and Curbside Waste Collection of Electronic Waste Ban

Waste generated in Waterloo Region is broadly divided into two sectors – residential and IC&I. The Waste Management Division is responsible for providing waste collection, diversion and disposal services for Waterloo Region's residential sector, including:

- Collection and the proper disposal of waste generated;
- Collection, processing and marketing of recyclables and other diverted materials;
- Receipt and proper disposal of Municipal Hazardous or Special Waste (MHSW);
- Development of promotional and educational programs for waste reduction, diversion and collection;
- Maintenance and operation of the Region's waste management facilities; and
- Planning for the on-going provision of sustainable waste reduction, diversion and disposal services.

A schematic of the Region's residential waste management system is shown in Figure 2.

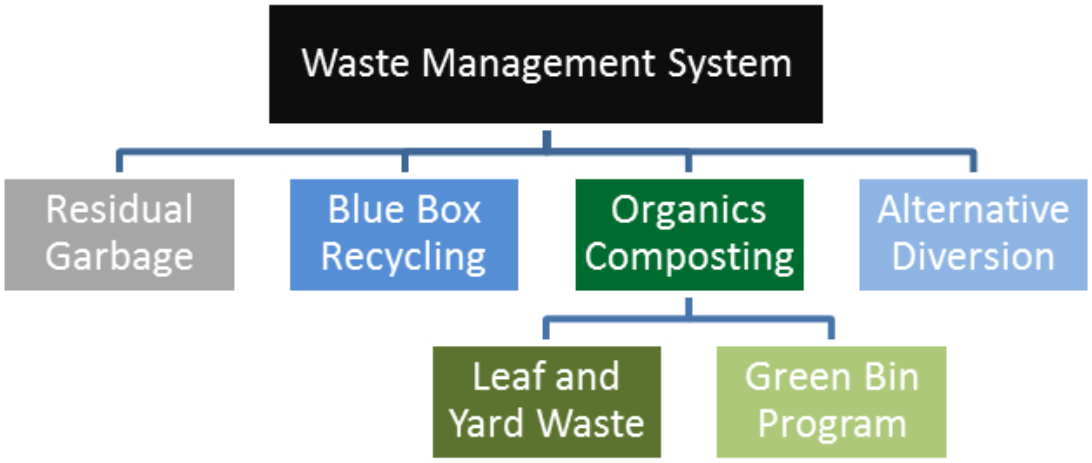


Figure 2: Schematic of Residential Waste System for the Region of Waterloo

Waste collection services offered by the Region to multi-residential households, including townhouses and apartments, are subject to limitations, details of which are described in *Interim Report No. 2.* Most multi-residential sites are required to contract private waste collection services.

The Region does not have direct control over the management of wastes generated by local IC&I establishments. IC&I waste diversion and disposal is governed through provincial regulations. However, the Region's Waste Management Division offers the following services to Waterloo Region's IC&I sector:

- Receipt and proper disposal of waste at select Region waste management facilities;
- Receipt, processing and marketing of recyclables and other recoverable materials (subject to eligibility); and
- The provision of information and guidance on waste reduction and diversion opportunities.

Key Findings

- A comparison of residential and IC&I waste disposal quantities between 2006 and 2011 indicates that 60% of the waste disposed of at the Waterloo WMC has historically come from Waterloo Region's IC&I sector.
- Figure 3 and 4 describe the quantity and composition of residential waste currently managed by the Region.

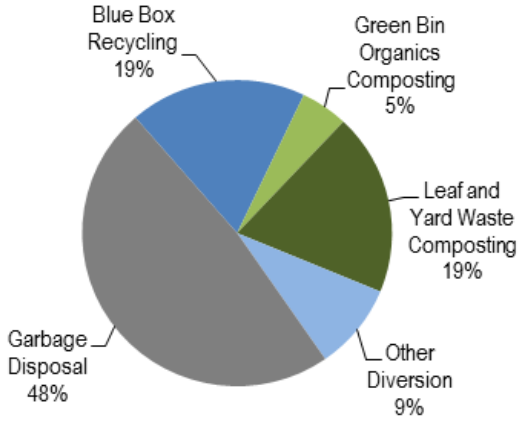


Figure 3: Residential Waste Managed by the Region of Waterloo (2011)

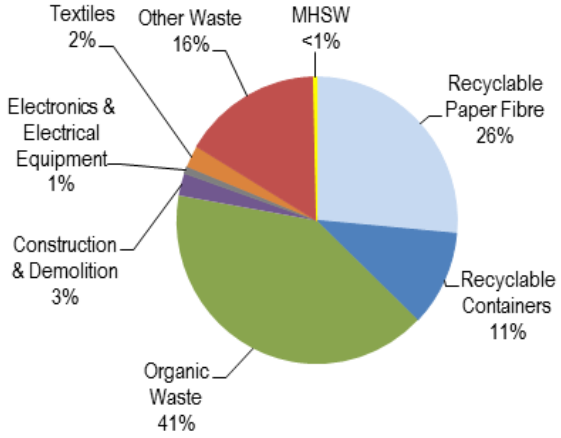


Figure 4: Overall Composition of Waste Generated by Single/Semi Detached Households (2011)

- Figure 5 presents per capita waste diversion and disposal statistics for the Region. There has been a plateau in the residential diversion rate since 2009. This likely reflects high voluntary participation in the blue box program where approximately 77% of material that is eligible for diversion through the blue box program is captured. This capture rate of 77% is reflective of a mature program. Green bin capture rate is low at 19%

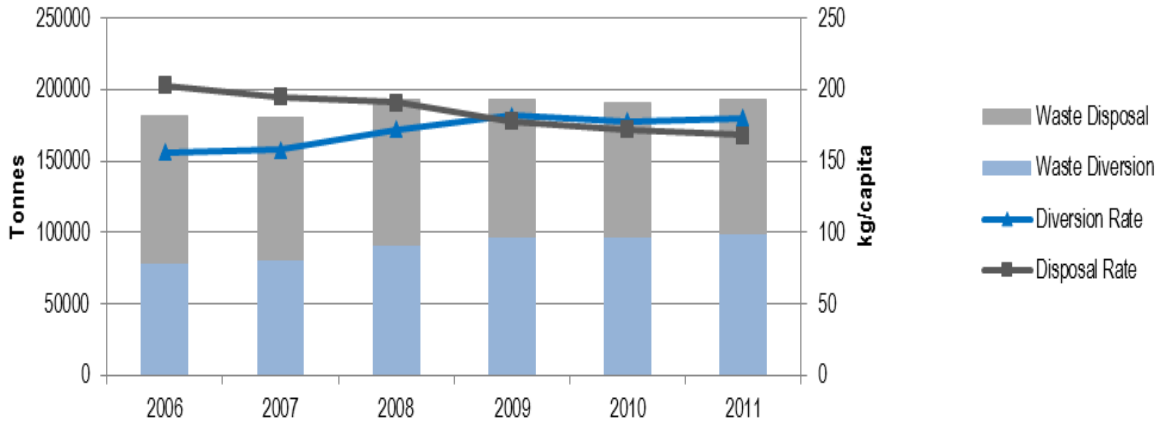


Figure 5: Per Capita Residential Waste Diversion and Disposal (2006 - 2011)

- Data on total IC&I waste generation and diversion in Waterloo Region is not available as it resides largely with the private sector. Data presented here provide an overview of the quantity of IC&I waste received for disposal at the Region's waste management facilities for management (Figure 6). Approximately 38% of the waste sampled consisted of material types permitted for diversion through the Region's IC&I drop-off diversion programs.

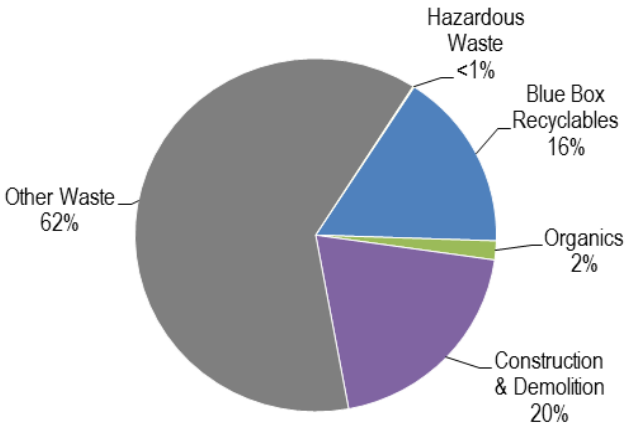


Figure 6: Estimated Composition of IC&I Garbage Stream 2011 (Waterloo Region, by volume)

- Data indicate a declining trend in IC&I waste disposal since 2006 (Figure 7). This has been driven by a decrease in IC&I waste generation, improved waste diversion practices, disposal of waste at other privately operated waste management facilities located in Waterloo Region, and export of waste out of Waterloo Region. It is important to note that 2009 to 2011 data coincides with recession and economic slowdown, and therefore may impact the overall trend that is observed.

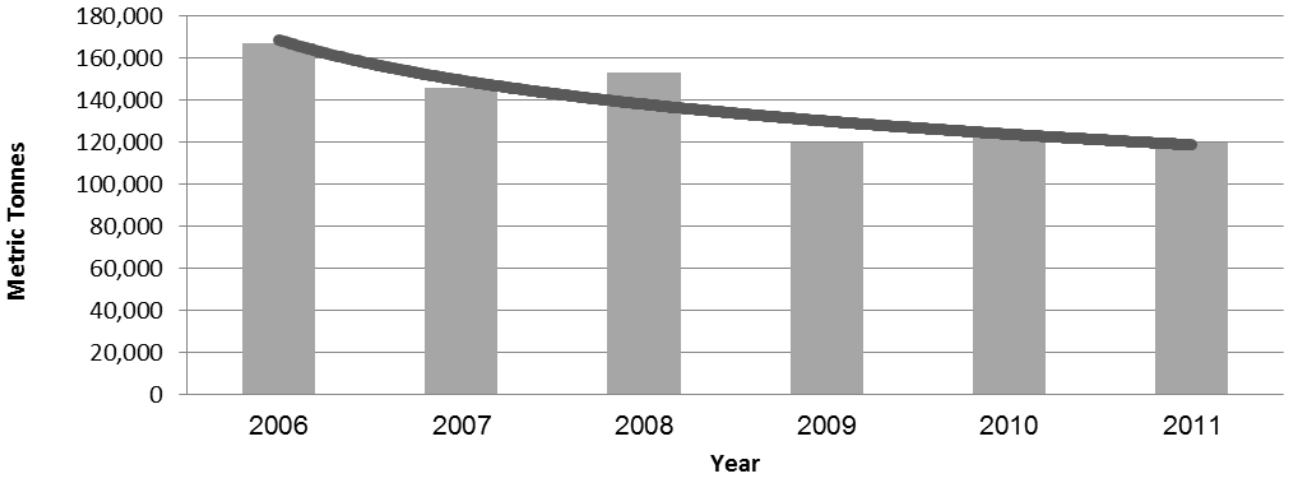


Figure 7: IC&I Waste Disposal Quantities at the Waterloo Landfill Site (2006-2011)

- In 2011, revenue was generated from various sources (e.g. sale of recyclables, tipping fees charged at the WMCs and WTSs), off-setting a portion of the annual funding required by the Waste Management Division (Figure 8). Details on the revenues from the sale of blue box recyclables, as well as user fees at Cambridge and Waterloo WMCs and at each of the WTS is presented in the report.

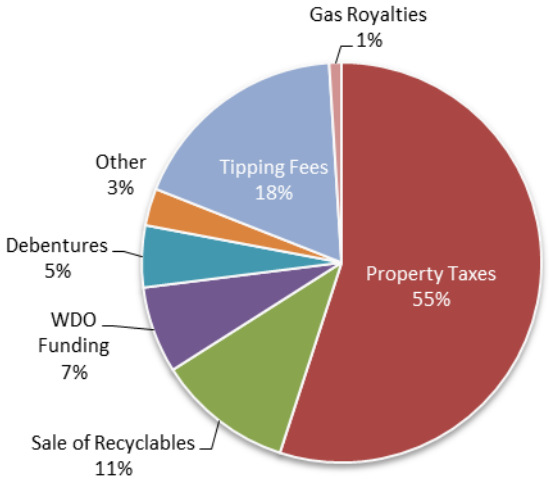


Figure 8: Revenue Sources for Waste System (2011)

- In 2011 the operating budget for the Waste Management Division totalled $44 millon and was allocated to various programs and services as shown in Figure 9.
- In 2011, costs included the delivery and promotion of diversion and disposal programs, the operation and maintenance of waste management facilities (open and closed), equipment, program contracts, administration, and capital financing (Figure 9).

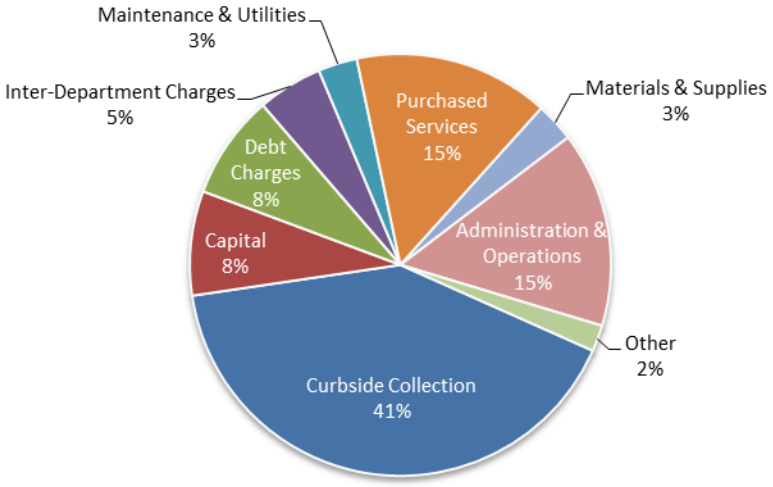


Figure 9: Operating and Capital Expenditure Summary (2011)

Conclusions

The *Current Waste Management Profile* provides an understanding of the Region's current waste management services and establishes a baseline for the development of the WMMP. The report indicates that while IC&I waste has historically made up 60% of waste disposed of at the Waterloo Landfill, there has been a declining trend and accordingly decreased revenue from tipping fees since 2006. The residential diversion rate has plateaued since 2009. This likely reflects high voluntary participation in the blue box program where approximately 77% of material that is eligible for diversion through the blue box program is captured. This capture rate is reflective of a mature program. The capture rate of the green bin capture rate is low at 19%, indicating room for increased participation.

5.0 FULL-COST ACCOUNTING ANALYSIS FOR WASTE DISPOSAL

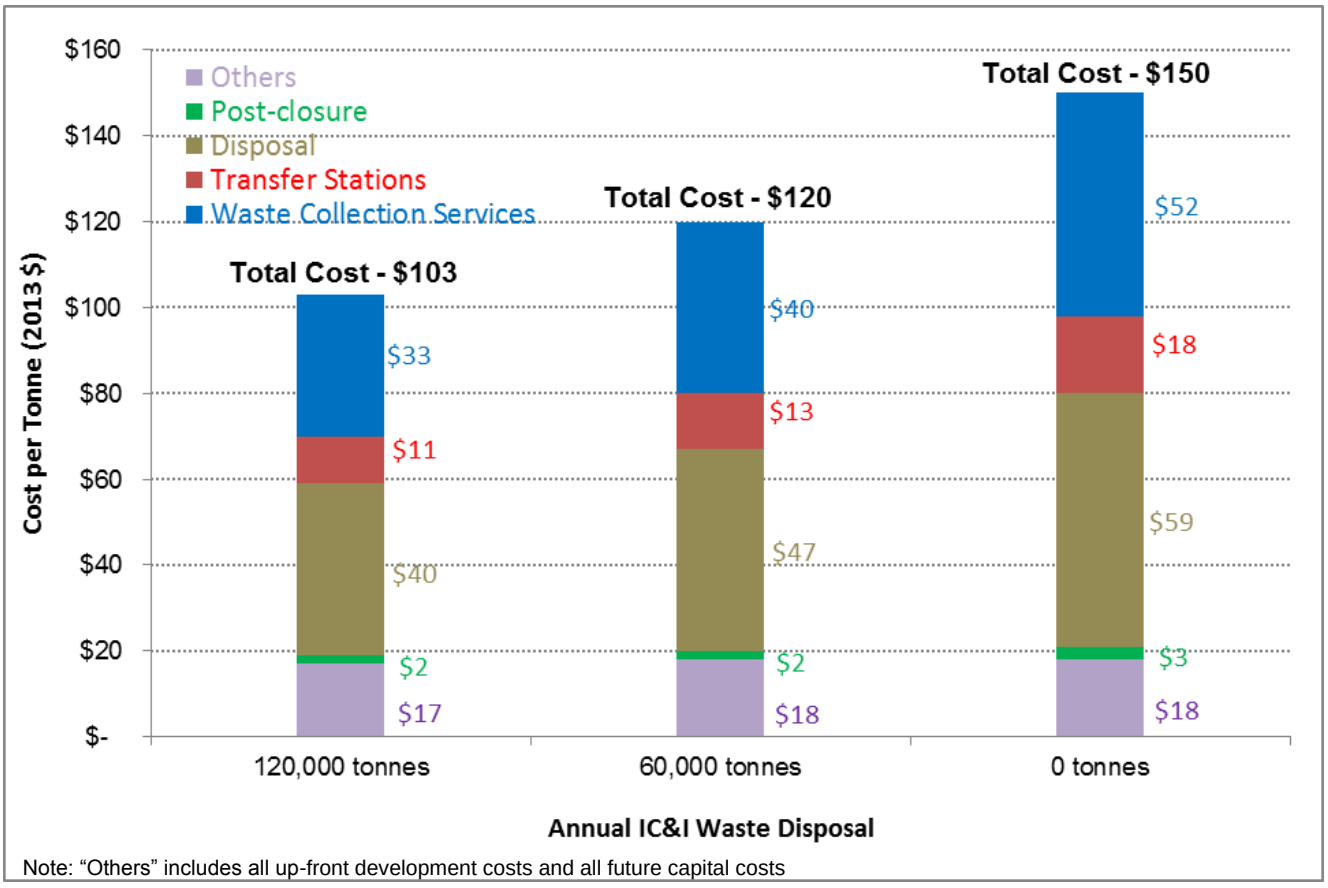
As part of the WMMP study, the Region completed a Full-Cost Accounting Analysis of waste disposal costs to determine the true cost per tonne for collection, transfer, transport and landfill disposal of residential and IC&I waste at the Waterloo Landfill Site. A Full-Cost Accounting Analysis is a systematic approach for identifying, summing, and reporting the actual upfront, operating and post-closure costs of solid waste management. A cost-based approach characterized as a break-even analysis was the financial model for the analysis. The analysis included direct costs associated with disposal, past and future expenditures, potential externalities (e.g., environmental impacts), historical and current financial information (actual expenditures), current operational costs, and landfill closure and post closure costs. The financial impact of the Region's waste collection services, transfer stations and future post-closure costs was also assessed. The analysis was based on the current residential waste tonnage of 93,000 tonnes. A sensitivity analysis was carried out to assess the impacts on the break even cost of various IC&I waste disposal tonnages (120,000, 60,000, and 0 tonnes of IC&I waste disposal per year). For reference, current tipping fees at the Waterloo Landfill Site are $74 per tonne.

Key Findings

The results of the analysis, including the true unit costs of waste collection, transfer, transport and disposal at the Waterloo Landfill Site for the various scenarios are presented in Table 4 and Figure 10.

Table 4: Results of Full-Cost Accounting Analysis for Waste Disposal at the Waterloo Landfill (2013)

	Scenarios (Annual IC&I Waste Disposal)		
	120,000 tonnes	60,000 tonnes	0 tonnes
Estimated Site Closure	2029	2034	2043
Estimated Break Even Cost (2013 $)	$103 per tonne	$120 per tonne	$150 per tonne
Cost of Each Contributing Item			
Waste Collection Services	$33 per tonne	$40 per tonne	$52 per tonne
Transfer Stations	$11 per tonne	$13 per tonne	$18 per tonne
Disposal	$40 per tonne	$47 per tonne	$59 per tonne
Post-Closure	$2 per tonne	$2 per tonne	$3 per tonne
Other	$17 per tonne	$18 per tonne	$18 per tonne



Note: "Others" includes all up-front development costs and all future capital costs

Figure 10: Cost per Tonne Composition

Conclusions

The results of the *Full Cost Accounting Analysis* indicate that the break even cost of waste disposal (per tonne) increases as the amount of IC&I waste disposed of at the landfill decreases; however the lifespan of the landfill increases. Full cost accounting principles should be utilized by the Region for ongoing planning.

6.0 WASTE REDUCTION AND DIVERSION OPPORTUNITIES

Reducing the amount of waste requiring landfill is a core strategic focus area for the Region, and as such, the Region will continue to make waste diversion a priority even after a new residual waste solution has been identified and implemented. In addition to identifying options for future residual waste management, the WMMP evaluated options to increase the amount of waste that is being diverted from disposal, and therefore extend the lifespan of the Region's landfill. *Interim Report 7: Waste Reduction and Diversion Opportunities* provides a further assessment of the Region's current waste management system and performance, and identifies a list of potential waste reduction and diversion opportunities.

6.1 Current Waste Management System Performance and Analysis

Key Findings

- The Region has the lowest per capita waste generation and waste disposal rate based on a comparison amongst similarly sized Urban Regional Municipalities;
- Residential waste diversion in the Region demonstrated an increasing trend from 43% in 2006 to 52% in 2011;
- An estimated 55% of garbage from residential collection consisted of organic waste (SSO and leaf and yard waste) which could have been diverted into the Region's organics/composting stream;
- Approximately 11% of the waste entering the landfill consisted of recyclable paper fibre and containers which are accepted by the Region's blue box recycling program;
- It is estimated that the Region is capturing 77% of the available blue box recyclables; and
- It is estimated that the Region is capturing 19% of the available green bin organics, which is relatively low compared to other municipalities. Possible reasons for the low green bin capture rate are discussed in *Interim Report 7: Waste Reduction and Diversion Opportunities*:

Conclusions

The *Current Waste Management System Performance and Analysis* found that while Waterloo Region has demonstrated a high level of participation in blue box diversion programs there is room for more materials to be diverted from landfill by increasing participation in the green bin organics program. There also still remains potential for increased participation in other recycling programs (e.g., blue bin program).

6.2 Public Feedback on Diversion Opportunities

During Consultation Series No. 1 (Fall 2012), participants were asked about current and future waste services. Specifically, feedback was requested on opportunities to improve participation in existing diversion services (responses are summarized in Figure 11), as well as possible new diversion initiatives (responses are summarized in Figure 12).

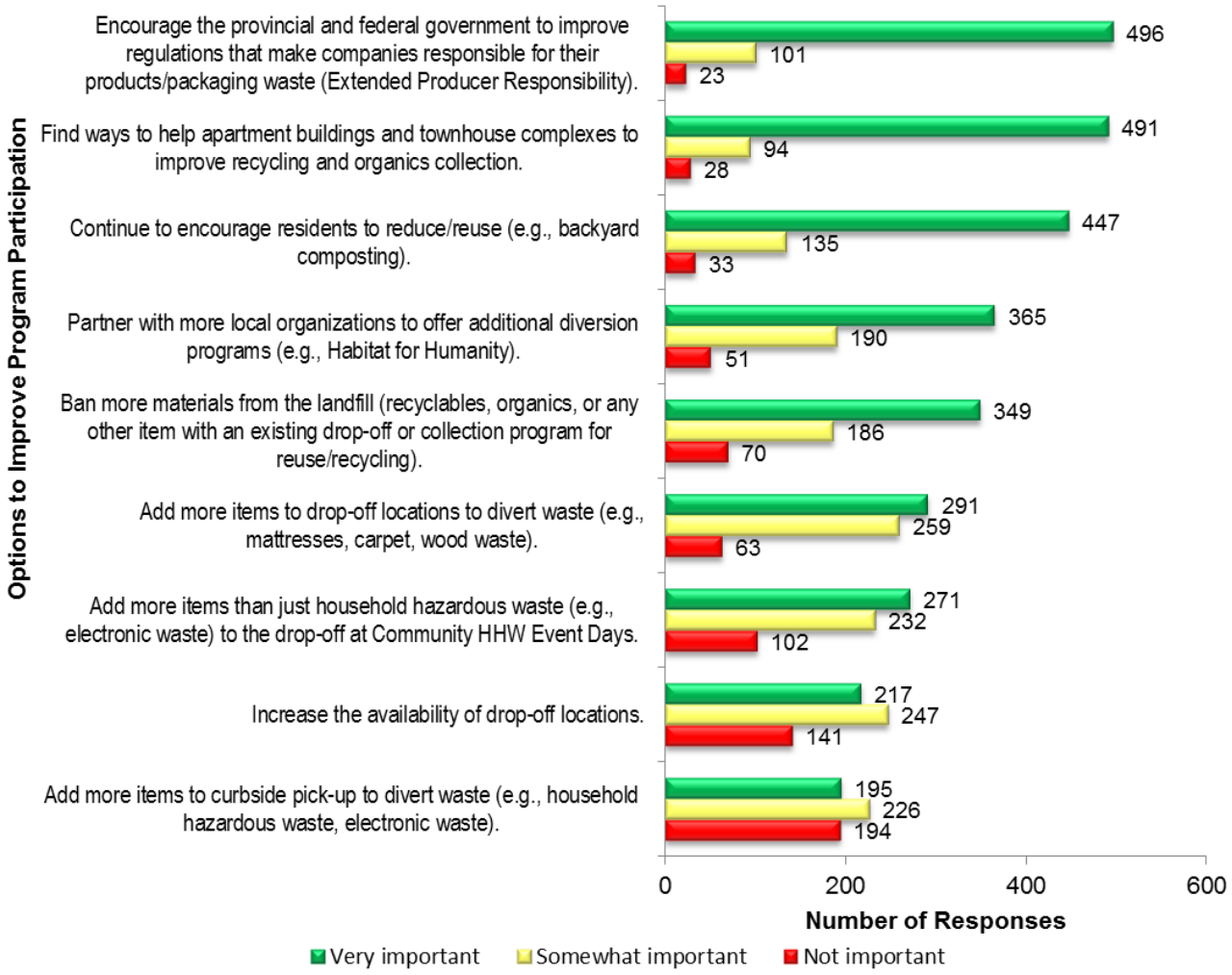


Figure 11: Feedback on Options to Improve Program Participation and Increase Diversion

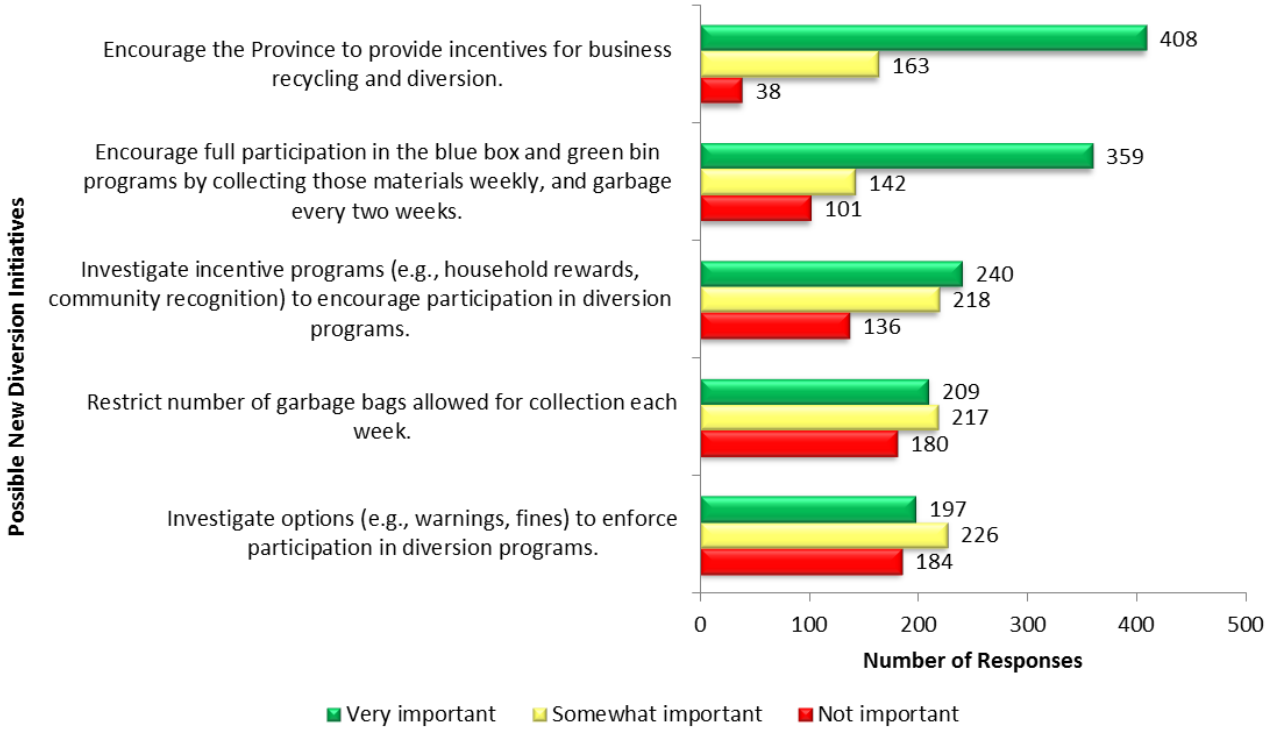


Figure 12: Feedback on Possible New Diversion Initiatives to Increase Diversion

6.3 Identification and Evaluation of Diversion Opportunities

The following sources were used to identify a list of waste reduction and diversion options for evaluation:

- Feedback received by the public at the Public Information Centres held by the Region for the WMMP;
- Blue Box Program Enhancement and Best Practices Assessment Project (KPMG and R.W. Beck, 2007. Final Report on Blue Box Program Enhancement and Best Practices Assessment Project, Volume 1 and Volume 2.); and
- Other opportunities (as identified by Regional staff and other sources).

Interim Report No.8: Evaluation of Waste Reduction and Diversion Opportunities documents the development of evaluation criteria and a comparison of the relative advantages and disadvantages of various reduction and diversion opportunities against these criteria. Comprehensive evaluation criteria were developed to take into account all aspects of sustainability: financial, social and environmental considerations as described in Figure 13.

Criteria	*Description and Ranking*
Financial Cost effectiveness (e.g. capital costs, operating and maintenance costs)	1. <$50,000 capital cost or <$50,000 annually 2. $50,000 to <$250,000 capital cost or $50,000 to <$250,000 annually. 3. $250,000 to <$500,000 capital cost or $250,000 to <$500,000 annually. 4. $500,000 or greater capital cost or $500,000 or greater annually
Environmental Impact on GAP waste diversion rate or the quantity of waste going to the Waterloo Landfill	1. Anticipated waste reduction/diversion 3 per cent or greater. 2. Anticipated waste reduction/diversion from 1 per cent to <3 per cent. 3. Anticipated waste reduction/diversion <1per cent. 4. Likely to increase waste going to Waterloo Landfill.
Technical Proven results in other areas (including the opportunities and challenges associated with implementation)	1. Proven success in other areas / Best Practice. 2. Some success (e.g. pilot) in some areas of North America. 3. Unproven or untried or lower success rate.
Social Community acceptability (including accessibility and convenience)	1. Identified as preferred by the public at PIC #1, or through other direct communication channel from public (e.g. social media). 2. Generally accepted option. May encounter some public opposition. 3. Difficult to implement due to potential widespread opposition.
Risks and Implications Liability, public health concerns, environmental risks, nuisances, market stability, etc.	1. High probability of expected results. Little risk of liability or environmental issues. 2. Results may vary. May have potential for liability or environmental risk. 3. Region has little control – relies on other jurisdictions. Potential for market instability and environmental risks.

Figure 13: Diversion Option Evaluation Criteria

Key Findings

A summary of the evaluation of the potential waste reduction and diversion options is shown Table 5 and incorporates prioritized final ranking scores from the evaluation (i.e. the lower the total score, the higher the priority).

FIRST PRIORITY SECOND PRIORITY THIRD PRIORITY

Table 5: Diversion Evaluation Summary

Waste Reduction and Diversion Initiatives		Evaluation Criteria					
		Cost	Environmental	Technical	Social	Risks and Implications	Total
Planning	Multi-Municipal Planning Approach	1	3	1	2	1	8
	Establish Defined Performance Measures	1	3	1	2	1	8
Policy	Standardize Existing Regional Waste Bylaws	1	3	1	2	1	8
	Standardization of Waste Programs	**3**	**1**	**1**	**1**	**1**	**7**
	Extended Producer Responsibility	1	3	1	1	3	9
	Disposal Bans	2	3	2	2	2	11
	Encourage Provincial Government to Standardize Waste Programs in Ontario	1	3	3	2	3	12
	Improve Accessibility to Existing Diversion Programs	2	3	2	2	2	11
Enforcement	Enforce Participation in Waste Diversion Programs	2	1	2	1	2	8
Facilities	Partner with Local Organizations	1	3	2	1	1	8
	Modified Tipping Fees	1	3	2	2	2	10
	Modification of Depot Drop-Offs	**1**	**2**	**1**	**1**	**1**	**6**
	Advocate for Increased Availability of Community Drop-Off Bins	1	3	2	1	1	8
	Standardize Items at Drop-Off Locations	4	2	1	1	1	9
	Increase Number of Items Accepted in Drop-Off Diversion Programs	2	3	1	1	3	10
IC&I Sector	Advocate for Improved Enforcement of Ontario Regulation 103/94	1	3	3	2	3	12
	Encourage the Province to Provide Increase Incentives for IC&I Diversion	1	3	3	1	2	10
Garbage Collection and Diversion Programs	**Bi-Weekly Garbage Collection**	**2**	**1**	**1**	**1**	**1**	**6**
	Reduce and Standardize Garbage Bag Limits	**2**	**1**	**1**	**1**	**1**	**6**
	User Pay System	**2**	**1**	**1**	**1**	**1**	**6**
	Improve Convenience of Diversion Programs	2	3	2	1	1	9
Blue Box Specific	Single Stream Recycling	3	4	3	2	2	14
	Additional Recycling Capacity	4	3	2	2	2	13

Table 5: Diversion Evaluation Summary (continued)

	Waste Reduction and Diversion Initiatives	Evaluation Criteria					
		Cost	Environmental	Technical	Social	Risks and Implications	Total
	Expand Materials Accepted in the blue box	2	3	2	2	3	12
Green Bin Specific	**Enhance Program to Maximize Diversion**	**1**	**2**	**1**	**1**	**1**	**5**
	Expand SSO Program	2	3	1	2	1	9
	Permit SSO Drop-Off at WTSs and WMCs	1	3	3	2	2	11
Multi-Residential	Continue to Help Multi-Residential Improve Waste Diversion Programs	2	2	1	1	2	8
	Multi-Residential Rebates as a Tool to Encourage Diversion	2	4	2	1	2	11
	Provide Multi-Residential Garbage Collection	3	4	2	1	3	13
	Partner with Local Area Municipalities to Establish Building Specifications that Support Waste Diversion	2	2	2	1	2	9
Promotion and Education	**Continue to Encourage Residents to Reduce Waste**	**2**	**2**	**1**	**1**	**1**	**7**
	Increase the Number of Waste Facility Tours	1	3	1	2	1	8
	Improve Promotion of Diversion Programs	2	2	2	2	1	9
	Continue to Develop Partnerships to Promote Waste Diversion	1	3	2	1	1	8
	Promote Waste Exchange Programs	2	3	2	2	1	10
	Encourage Return to Retailer Programs	1	3	2	2	1	9
	Digital Engagement Tools	2	3	2	2	1	10
	Expand Target Groups for Communications Programs	2	3	1	1	1	9
Public Use and Special Events	Enhance Diversion Programs for Special Events	1	3	2	2	2	10
	Partner with Area Municipalities for Public Space Diversion	2	3	2	2	3	12

Conclusions

The *Evaluation of Waste Reduction and Diversion Opportunities* report identifies first priority initiatives for consideration to increase waste diversion and reduction. These initiatives include implementation of bi-weekly garbage collection, reduction and standardization of garbage bag limits, implementation of a user pay system, standardization of waste programs, modification of depot drop-offs, enhancing programs to maximize diversion, and continuing to encourage residents to reduce waste.

7.0 SUSTAINABLE APPROACHES TO SOIL, SEDIMENT AND MATERIALS MANAGEMENT FEASIBILITY STUDY

The *Sustainable Approaches to Soil, Sediment and Materials Management Study* was completed to evaluate the feasibility of program(s) and/or facilities for the sustainable management of excess soils and like materials (e.g., concrete, brick, etc.) generated during construction activities, as well as the management of sediments resulting from the clean out of stormwater management (SWM) facilities. Increasing volumes of these materials are anticipated to be generated within the Region over the next ten years and beyond, being driven by increasing population growth and intensification, expansion of the Region's transportation infrastructure including construction of the Light Rapid Transit (LRT) system, and construction of new cells in the Region's Waterloo landfill. In addition, increasing volumes of excess SWM facility-derived sediments are expected to be generated as area municipalities undertake maintenance to return these facilities to their design capacities. For example, between the three area municipalities (Cities of Kitchener, Waterloo, and Cambridge), over 300,000 tonnes of sediment is estimated to be excavated and require management over the next ten to twenty years.

Excess materials from these sources may constitute an increasingly significant quantity of materials that may be directed to the Region's only operating landfill (the Waterloo Landfill. In 2012, the Waterloo landfill received 4,062 tonnes of inert material, 2.2% of the total waste stream. In consideration of increasing pressures on its landfill capacity and a desire to identify more sustainable alternatives to the disposal of these materials has prompted the current study.

The key objectives for undertaking this feasibility study were to evaluate on a preliminary basis whether:

- The establishment of such a facility or program would be warranted based on the anticipated quantities of excess soils or similar materials that would be generated within the Region over the next decade; and
- Facilities or programs to promote the reuse or recycling of soils and like materials would be feasible within the Region from a regulatory standpoint.

This study was undertaken in part to address issues or gaps identified by other programs or studies at the Region. In particular, the Region's Brownfield Financial Incentives Program (BFIP) has directed a significant portion of incentive funding to the landfill disposal of contaminated soils, suggesting that there would be benefit to the sustainable reuse of these materials. In addition, excess soils or similar materials represent another stream that could be reused or recycled in accordance with the objectives and strategies of the Region's newly updated Waste Management Master Plan.

A number of benefits have been identified for such recycling programs (as identified by the Residential and Civil Construction Alliance of Ontario), including:

- Preservation of landfill capacity for materials that cannot be recovered (such as municipal solid waste);
- Recycling of these materials reduces pressure on primary aggregates;
- Reuse of materials at sites near their sites of origin reduces transportation requirements, with corresponding reductions in transportation-related greenhouse gas emissions, wear-and-tear on transportation routes, and traffic congestion associated with the movement of materials between sites; and

- Depending on treatment requirements, recycling of these materials may present lower overall project costs as compared with landfill disposal and replacement of these materials. For example, a program of interim soil storage and a reuse strategy developed by the City of Guelph in coordination with the Ministry of Transportation in constructing the Hanlon Expressway and Laird Road interchange was estimated to have saved $900,000 in project construction costs.

These benefits have prompted adoption in other jurisdictions and elsewhere in Ontario, with increasing regulatory support from the Ontario Ministry of the Environment to promote the reuse of materials. The most advanced program of soil recycling exists in the Netherlands, where there exists regulation prohibiting the landfill disposal of materials that could be treated or reused and a network of soil storage and treatment facilities. In the Netherlands, regulatory requirements prohibiting landfill disposal of most contaminated soils exist in conjunction with landfill taxation policies that are intended to discourage the landfill disposal of excess soils where treatment or recycling is possible. In other jurisdictions, including Ontario, excess soils are currently regarded and regulated as wastes. Despite this designation, other such jurisdictions have adopted recycling initiatives, with the most advanced program having been developed by CL:AIRE, a non-governmental organization in the United Kingdom. Less comprehensive programs have also been developed in Scotland and Northern Ireland. These programs have gained regulatory acceptance and have contributed to significant diversions of excess soils from landfill. Similar regulatory initiatives are underway in Ontario and suggest that the establishment of recycling or reuse programs for these materials is feasible from a regulatory standpoint.

Within the Region, volumetrically significant sources of excess soils and like materials are:

- Residential and commercial land development;
- LRT construction;
- Highway and road network expansion;
- Right-of-way maintenance activities;
- Landfill expansion; and
- Stormwater management facility cleanout programs undertaken by area municipalities.

As is the case with other areas of Ontario where commercial soil recycling facilities have been established, the most significant sink for excess materials within the Region is expected to be the use of these materials for the purposes of rehabilitating aggregate pits and quarries which are under private ownership. Other potential sinks include:

- LRT construction;
- Construction of other transportation infrastructure; and
- Municipal right-of-way maintenance projects.

The above potential sinks fall under the jurisdiction of the Region, area municipalities or the Ministry of Transportation. Considered in total, the available sinks for excess soils would only exceed the anticipated supply of excess soils if the rehabilitation of aggregate pits and quarries is included in the total. As indicated above, this is typical of other areas of Ontario as well.

Quantities of excess materials that may be generated within the Region are consistent with the volumes of material on which facilities in other areas of Ontario and in other jurisdictions have been developed. However, the locations, timing and environmental and geotechnical characteristics of these excess materials cannot be confirmed based on currently available information. In light of this uncertainty, the premature establishment of fixed facilities or sites for the interim storage or treatment of excess materials may pose operational and financial risk at this time. This study therefore recommends a targeted program of information collection regarding potential projects with soil excesses or soil deficits. In order to promote the uniformity of data collection and centralization of this information, it is recommended that an electronic database or similar collection system be established and operated. This information collection could include an amendment to the Region's special waste approvals program to collect information that would support the linkage of soil excesses to potential projects where these materials could be reused.

This program of information collection could subsequently be expanded through inclusion of Geographic Information System-based mapping and online data collection that could yield a "virtual" soil banking system similar to the systems operated by a number of municipal authorities in the Netherlands. These systems aim to link areas of soil excess to suitable areas and projects with a soil deficit without the requirement for the municipality or operator to take physical ownership or custody of the excess materials. If the functionality of such a system could be demonstrated by application to projects managed by the Region, its area municipalities and townships, and potentially other public agencies, such a system could be expanded to allow private-sector entities to contribute information to such a system. Such an expanded system would function in a similar fashion to the municipally operated systems in other jurisdictions, and could include the levying of brokerage fees by the Region for facilitating transfers of materials between sites.

Based on the operation of such a system of data collection and brokering of transfers of materials between sites, information could be obtained to further evaluate the feasibility of more capital-intensive programs or facilities to promote soil recycling, including the establishment of interim storage sites or fixed treatment or management centres as a future initiative.

Conclusions

The *Sustainable Approaches to Soil, Sediment and Materials Management Feasibility Study* identifies that while the diversion of soils from landfilling will extend its capacity additional information is needed prior to implementing a storage or treatment process or facility. The Region should consider developing a tracking system to collect information about the geographic location, environmental and geotechnical characteristics of excess soil materials. This information can be used to identify sources of excess material and aid in siting receiving sites, including future fixed collection or treatment facilities.

8.0 OPPORTUNITIES AND CONSTRAINTS

Interim Report 4: Opportunities & Constraints identifies current and forecasted opportunities that may support or enhance the recommendations of the WMMP, and potential constraints that may challenge future waste management services in Waterloo Region.

Key Findings

Figure 14 provides a summary of the opportunities and constraints identified. Key opportunities include:

- **Synergies with the Biosolids Master Plan**: consider inherent synergies that may exist between the processing and disposal of residual waste and biosolids that could maximize resources and potential energy recovery. Considering solutions for the management of biosolids and the residual waste may provide some economics of scale in the development of future infrastructure.
- **Inter-municipal partnerships**: neighbouring municipalities have expressed an interest in collaborative partnerships that are sensible, financially beneficial and politically feasible. Some neighbouring municipalities have capacity to process recyclables in existing facilities. A number of municipalities indicated that they are currently or will soon be considering residual waste management options.
- **Resource recovery and energy generation**: the opportunity to establish a clear strategic direction by adopting a waste hierarchy which includes consideration for resource recovery and energy generation above disposal of waste. Both the U.S. Environmental Protection Agency and the European Union formally recognize energy recovery as an important component of the waste management hierarchy. The recent Rethink Waste (March 2013) report from the Ontario Waste Management Association also advocates for a redefinition of Ontario's waste hierarchy to recognize material and energy recovery. Formal adoption of a waste hierarchy for the Region that includes "Recovery" as the 4th R, and considers recovery of energy and resources above waste disposal aligns the philosophy embodied in the Environmental Sustainability Strategy with high level strategic direction for waste management in the Region. Setting a future direction for waste management that includes resource recovery is key from both an environmental and economic perspective.

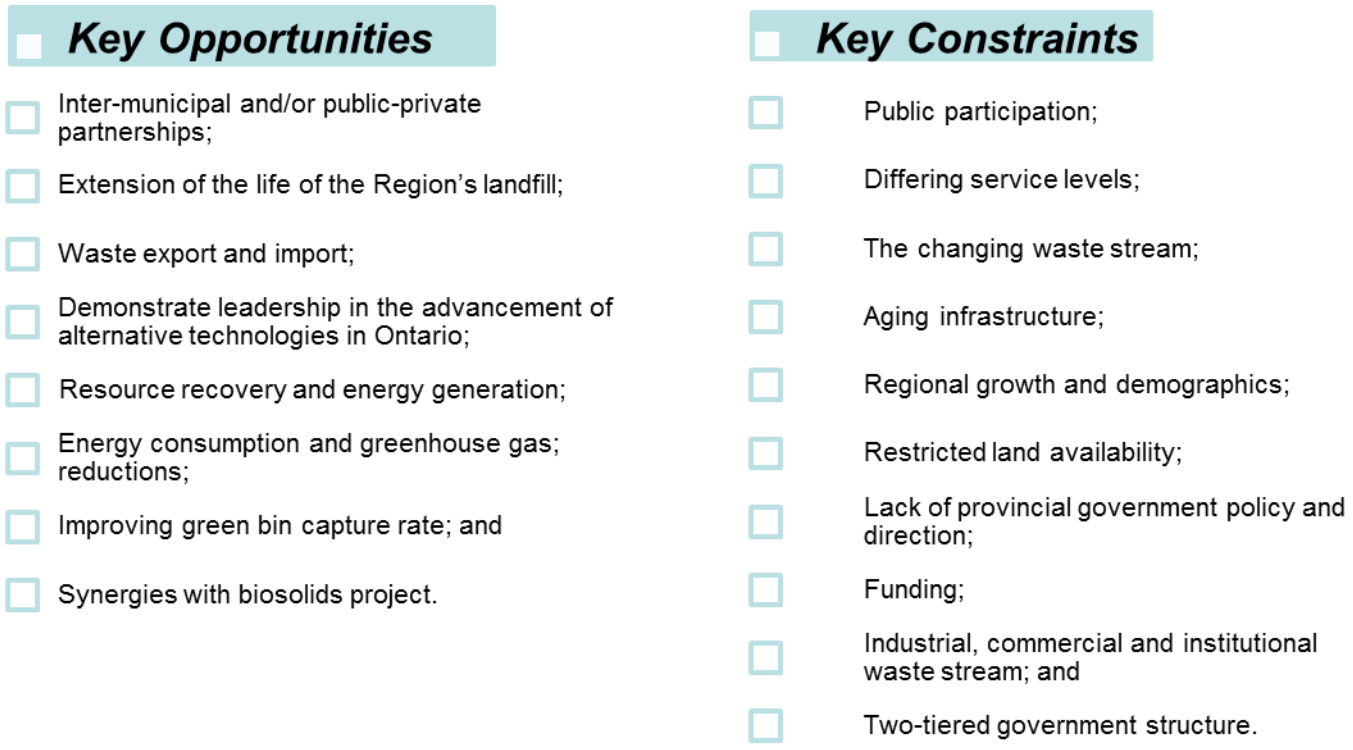


Figure 14: Opportunities and Constraints for Future Waste Management Planning.

Conclusions

The Opportunities & Constraints report findings will assist with on-going assessment and implementation of waste management programs, services and infrastructure that are sustainable and adaptable to change over the long-term planning period. Key opportunities for future planning include synergies with the Biosolids Master Plan, inter-municipal partnerships, and adoption of a waste hierarchy that includes "Recovery" as the 4th R and considers recovery of energy and resources above waste disposal.

9.0 RESIDUAL WASTE MANAGEMENT TECHNOLOGIES EVALUATION

Recognizing the finite life of the Region's Waterloo Landfill Site, the study identified and evaluated alternative options for the management of the Region's residual waste (i.e. garbage). The methodology was premised on the concepts of local and global sustainability, designed to generate a list of options and to then evaluate fatal flaws, sustainability and environmental footprint of each option to provide a comprehensive picture of the relative strengths and weaknesses of each option. These four steps are depicted in Figure 15.

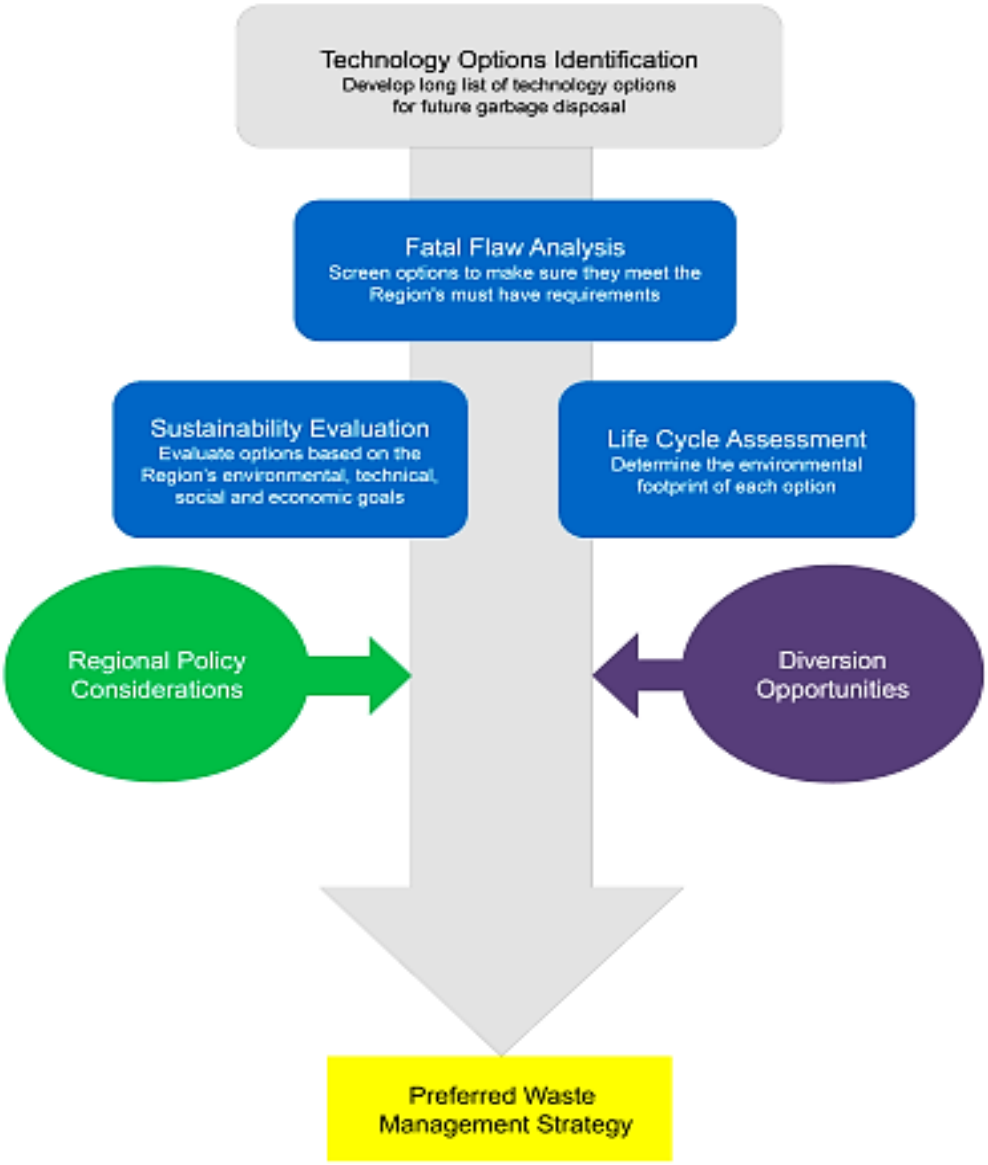


Figure 15: Steps in the Evaluation of Residual Waste Management Options

9.1 Technology Options Identification

Six groupings of technology options were identified as potential residual waste management options for the Region, including:

- Landfill;
- Landfill mining;
- Mechanical Separation for Additional Material Recovery;
- Thermal Treatment;
- Mechanical Biological Treatment; and
- Steam Classification.

Detailed descriptions of these options can be found in *Interim Report No. 3 – Review and Preliminary Evaluation of Residual Waste Management Options*.

9.2 Fatal Flaw Analysis

The fatal flaw analysis was designed to eliminate residual waste management options that did not satisfy the Region's minimum requirements. In collaboration with the WMMP Project Team and Steering Committee, fatal flaw criteria were identified as outlined in Figure 16. Detailed descriptions of the analysis can be found in *Interim Report No. 3 – Review and Preliminary Evaluation of Residual Waste Management Options*.



Figure 16: Fatal Flaw Criteria

Key findings

- Landfill mining, although a viable proven option, would not provide for 20 years of waste disposal capacity.
- Mechanical separation, although a viable proven option, would not provide an additional 20 years of waste disposal capacity.

- Steam classification has the potential to integrate with the Region's existing policies and infrastructure, to meet regulatory requirements in the province, and to support additional recovery, however this option is not considered to be well established worldwide.

Conclusion

The *Fatal Flaw Analysis* determined that Landfill Mining, Mechanical Separation and Steam Classification do not to meet the Region's requirements for integration, recovery and reliability. Thermal Treatment, Landfill, and Mechanical Biological Treatment form the short-list of residual waste disposal options and were carried through to the next step of the evaluation.

9.3 Sustainability Evaluation (GoldSET©)

Interim Report No. 5 – Sustainability Evaluation of Residual Waste Management Options provides an overview of the relative strengths and weaknesses of each option based on considerations from the environmental, social, economic and technical dimensions. As a first step, evaluation criteria were selected to align with the Region-specific goals identified in each of the four dimensions (Figure 17).

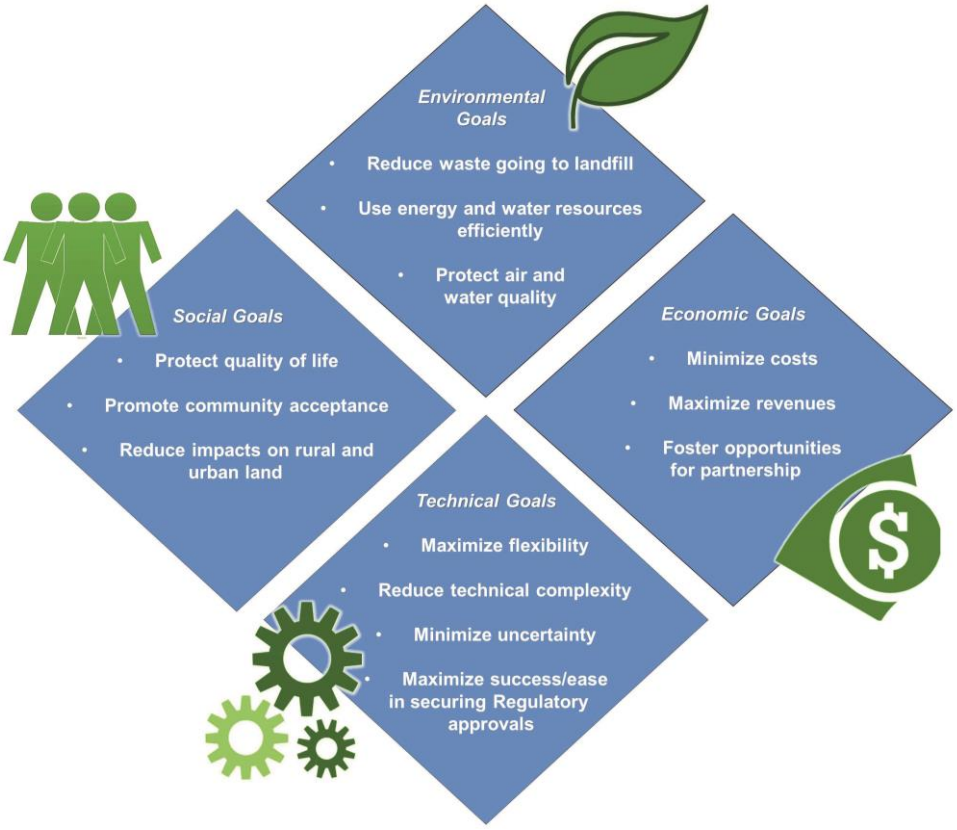


Figure 17: Sustainability Evaluation Goals

The options were then scored on the basis of the criteria. The qualitative and quantitative criteria were assigned and scored for each option through an in-depth literature review, input of industry experts and through various workshops with the Region. Each dimension was evaluated to provide a score out of 100 for each option.

Key Findings:

Residual waste management alternatives evaluated during the study included consideration of all available technologies such as landfilling, mechanical, biological and thermal processes, and energy and resource recovery. Alternatives were evaluated according to a customized methodology that incorporated the principles of the Region's Environmental Sustainability Strategy, and considered technical, social, environmental and economic dimensions. The results of the sustainability evaluation are shown on Figure 18.

Overall, Thermal Treatment was the best performing option when all dimensions where considered together. Thermal technologies can minimize local environmental and social impacts due to:

- the advent of high performing emissions control equipment,
- small footprint requirement,
- opportunities for conversion of residual waste to energy, and
- significant volume of waste reduction and corresponding low residual requiring disposal.

The percentage of residual remaining as ash or slag after thermal treatment can vary between 10 – 30% depending on the specific technology. The ash or slag can be post-processed to recover both ferrous and non-ferrous metals, and some ashes can be beneficially re-used in the production of concrete.

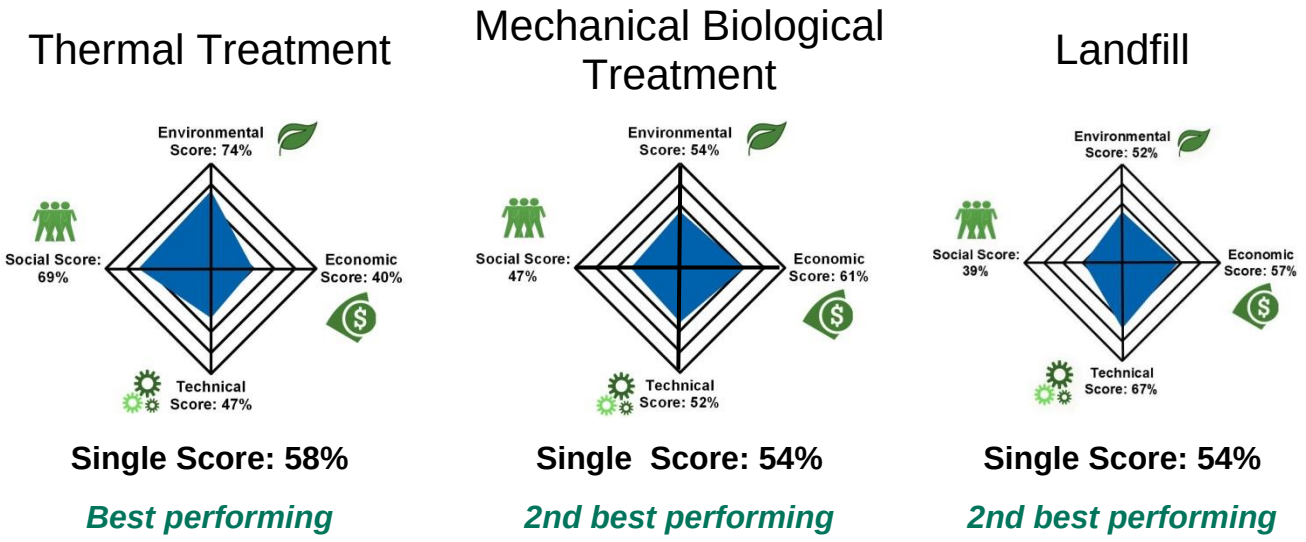


Figure 18: Sustainability Evaluation Results

Conclusion

The *Sustainability Evaluation of Residual Waste Management Options* found that Thermal Treatment was the best performing option with the highest single score. Mechanical Biological Treatment was the most balanced option, however scored lower overall than Thermal Treatment.

9.4 Environmental Footprint Evaluation (Life Cycle Analysis)

The next step in the study evaluation process was to complete a life cycle analysis (LCA) to determine the environmental footprint, or global impact of each option. The results of this evaluation are presented in *Interim Report No. 6: Life Cycle Assessment.* Six impact categories were evaluated as part of the LCA:

- Resource depletion: amount of non-renewable resources consumed (e.g. metals and fossil fuels);
- Greenhouse gas emissions: amount of greenhouse gas emissions;
- Human health effects: emission of compounds that can cause negative health effects;
- Aquatic health effects: emissions to freshwater that may cause harm to fish, plants and insects;
- Acid rain: emissions that could contribute to acid rain (e.g. sulphur dioxide and nitrogen oxides); and
- Eutrophication: emission of nutrients to water bodies (e.g. phosphorous and nitrogen). Nutrients can stimulate plant grown (e.g. algal blooms) resulting in low oxygen levels in the water.

For each option, the LCA modelled impacts to each of the categories for the Region's current residential waste management system and waste composition. The evaluation assumed the current residential waste diversion rate of 52% would be maintained.

Key Findings

The environmental footprint of each garbage disposal technology was evaluated based on the six environmental impact categories. The results of this analysis are summarized in Figures 19, 20 and 21. Reduced emissions or offsets are represented by the green bars, while increased emissions are represented by the red bars.

- **Landfill:** Landfills have the largest environmental footprint. Currently, 93,000 tonnes of residential waste is landfilled in the Region each year. The greenhouse gas emissions of the current waste management system are estimated to be over 7.8 million kilograms (kg) of carbon dioxide (CO_2) equivalents per year, equal to the annual greenhouse gas emissions from approximately 1,650 passenger vehicles.
- **Mechanical Biological Treatment:** Mechanical Biological Treatment has a smaller environmental footprint than landfill. Generating energy from biogas reduces energy generation from fossil fuels. Resource consumption is reduced by recovering metals, plastics, and wood. Compared to the current waste system, over 37 million kg CO_2 equivalents are avoided. That's equal to avoiding the greenhouse gas emissions from 7,660 passenger vehicles for one year. If the end product of the Mechanical Biological Treatment process is used as compost, approximately 37,000 tonnes of residual waste would be disposed of by landfilling each year.
- **Thermal Treatment:** Thermal Treatment has a smaller environmental footprint than landfilling. Generating energy from waste offsets impacts from fossil fuelled power generation stations. Recycling metals also avoids the use of fossil fuels for the extraction and processing of ore to produce new metal. Resource consumption is further reduced by recovering metals from the ash that remains following thermal treatment. Resource depletion offsets resulting from thermal treatment are greater than those associated with mechanical biological treatment. Compared to the current system, over 27 million kg CO_2 equivalents are avoided. That's equal to avoiding the annual greenhouse gas emissions from approximately 5,600

passenger vehicles. If ash is used as an aggregate (e.g. in concrete production), approximately 6,600 tonnes of residual waste would be disposed of by landfilling each year; a significantly smaller amount than that associated with mechanical biological treatment.

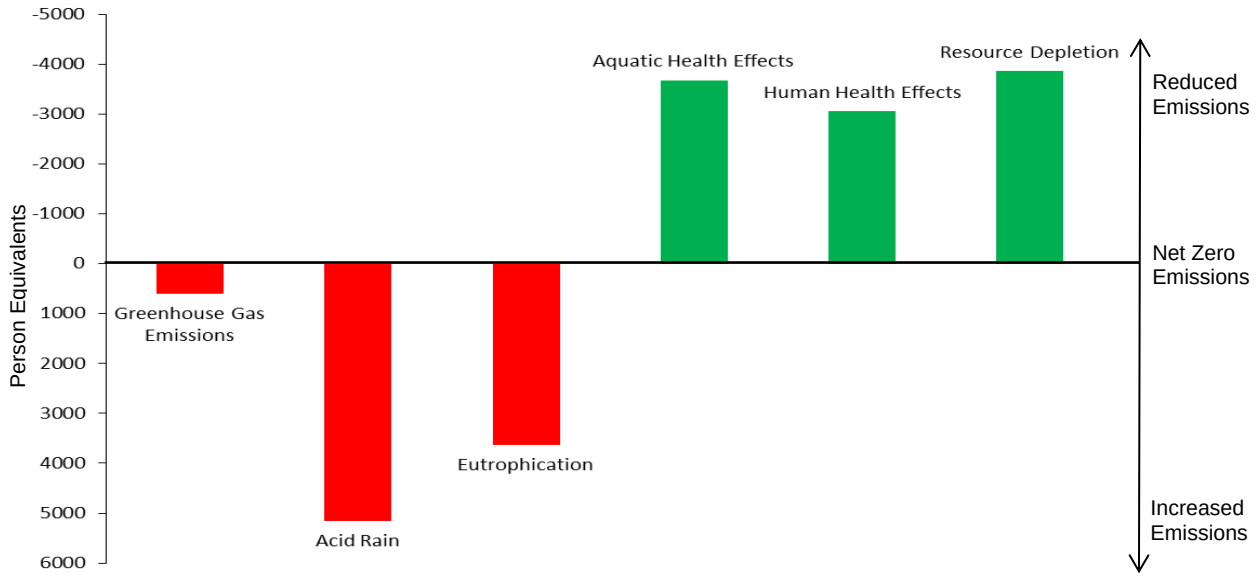


Figure 19: Life Cycle Analysis Results for Landfill (52% Residential Diversion)

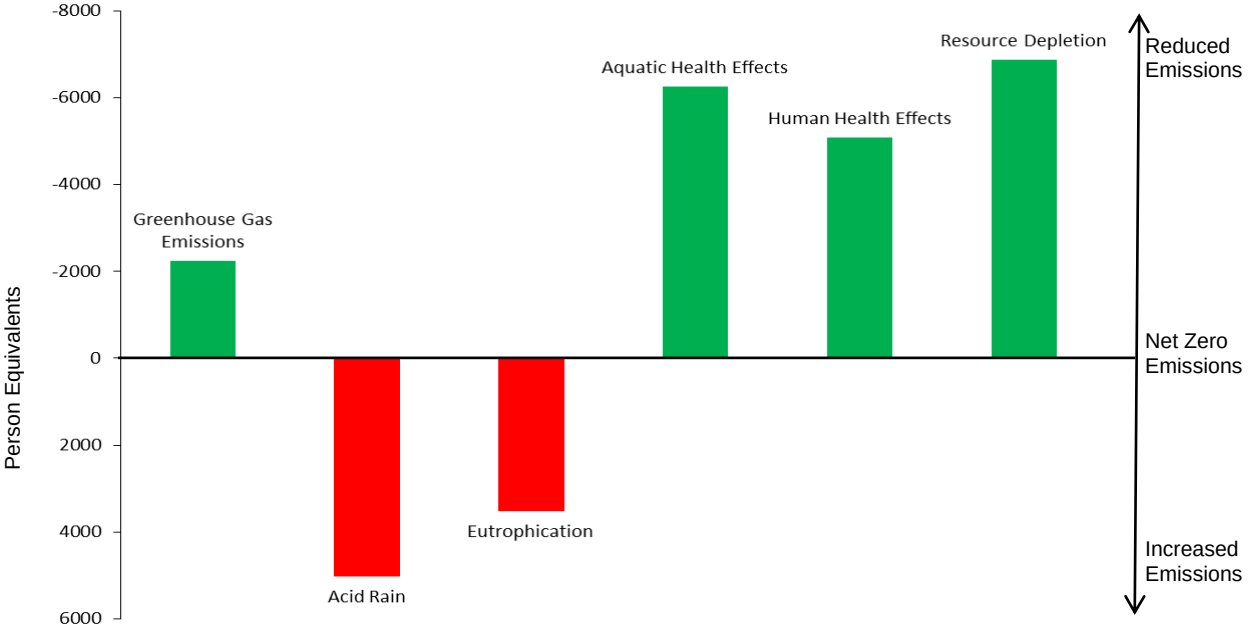


Figure 20: Life Cycle Analysis Results for Mechanical Biological Treatment (52% Residential Diversion)

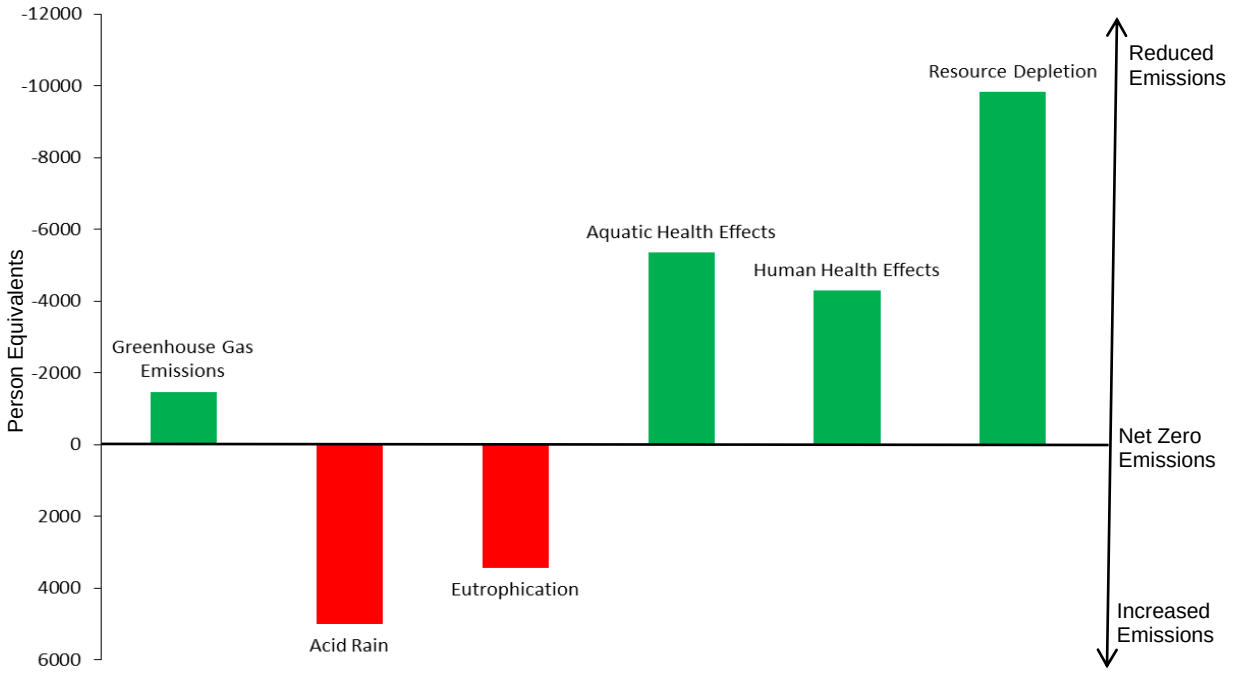


Figure 21: Life Cycle Analysis Results for Thermal Treatment (52% Residential Diversion)

Conclusion

The *Life Cycle Assessment* determined that Thermal Treatment and Mechanical Biological Treatment were the best performing options. All options result in some residual garbage requiring landfill disposal. While Mechanical Biological Treatment may outperform Thermal Treatment in greenhouse gas emission offsets, Thermal Treatment has the greatest resource depletion offset and a lower final residual requiring disposal. Landfill was the worst performing option, ranking lowest in five of the impact categories.

9.5 Public Feedback on Disposal Technology Options

During Consultation Series No. 2 (Summer 2013), participants were asked to provide feedback on the evaluation process for future garbage disposal options. Sixty-nine percent of respondents were either “Satisfied” or “Very Satisfied” with the process. Participants were also presented with the evaluation results and asked to rank the three preferred garbage disposal technologies. The results are shown in Figure 22. Thermal Treatment was selected as the most preferred option, followed by Mechanical Biological Treatment, and Landfill. Common themes among the public’s comments included:

- Thermal treatment has proven to be successful in other countries making it a good choice.

- Environmental and social considerations should be more important than economic considerations when evaluating disposal options.
- Thermal treatment presents an opportunity to recover energy.
- Landfill is an outdated and unsustainable option that requires too much land.
- A Thermal Treatment facility would require less land than a Landfill, and also produces energy.
- Some commented that Thermal Treatment and Mechanical Biological Treatment were almost equal as the top choice. Others identified that maybe the two technologies should be combined.

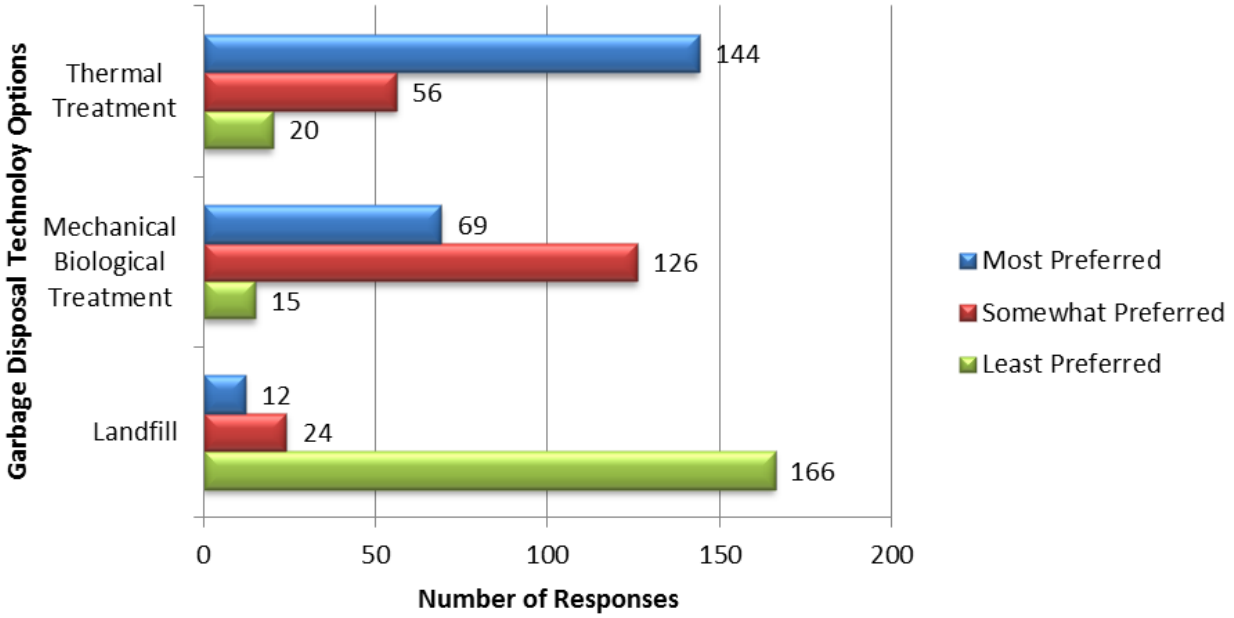


Figure 22: Participant Ranking Of Technology Options for Future Residual Waste Disposal

9.6 Residual Waste Treatment Policy Considerations

Policy measures were considered to complement the implementation of the WMMP recommendations. A description of potential policy options was compiled as part of *Interim Report No. 3 – Review and Preliminary Evaluation of Residual Waste Management Options*. The following provides a review of options that may be considered for the management of the Region's residual waste.

Key Findings

- **Waste Export:** A waste export policy would allow the transfer and disposal of residual waste managed by the Region to a waste management site located outside of Waterloo Region. The Region would negotiate a fee (i.e., cost per tonne) that would be paid to the waste disposal site in exchange for the disposal service. The waste management site may be located within another jurisdiction in Ontario, another Canadian province, or the United States (e.g., New York State, Pennsylvania, etc.), and may be either publicly or privately owned. Options within Ontario include three privately owned sites in Greater

Toronto/Southwestern Ontario (i.e., Waste Management of Canada Corporation's Petrolia and Twin Creeks landfill sites, and Niagara Waste Systems Limited's Walker South landfill site), and Algonquin Power & Utilities Corporation's thermal treatment facility in Brampton, Ontario.

- Consultation Series No. 2 - Public Feedback:
  - 73% of respondents thought the Region should not consider adopting a residual waste (garbage) export policy.
  - It is important that the Region continue to manage waste within its borders. Local waste management is seen as the sustainable option, and allows the Region to have control of the environmental and safety standards for how waste is disposed.
  - Waste export could be considered in association with a treatment (or energy from waste) facility not a landfill. Waste export can be regarded as a cost savings measure.

- **Waste Import:** The Region would maintain or establish a new waste management facility within Waterloo Region's municipal boundaries and accept residential and/or IC&I waste from a service area extending beyond Waterloo Region. The Region would charge a fee (i.e., cost per tonne) in exchange for the waste management service. This option would allow the Region to finance or obtain the quantity of waste needed to achieve economies of scale and ensure the financial viability of the new residual waste management facility. Contracts could be established between the Region and interested parties to reduce financial risk. Tipping fees would be required to be maintained at a competitive rate. Design, operations, management and eventual closure of the waste management site would be the responsibility of the Region.
  - Consultation Series No. 2 - Public Feedback:
    - 66% of respondents thought that the Region should consider an import policy.
    - Waste import should be considered if needed to achieve capacity or economies of scale for a waste treatment facility (not a landfill), and could also potentially provide a funding source.

- **Industrial, Commercial & Institutional Restriction:** Restricting the disposal of IC&I waste at the Region's landfill site is a policy option that, if adopted by the Region, would extend the life of the landfill. However, restricting IC&I waste from disposal at the Waterloo Landfill Site would significantly decrease the tipping fee revenues that the Region receives.
  - Consultation Series No. 2 - Public Feedback:
    - 54% of respondents thought that the Region should consider an IC&I restriction policy
    - Many identified that it is important that restrictions should be aimed at encouraging IC&I to reduce the amount of waste produced. It was suggested that restrictions be placed on the types of materials, rather than the amount of materials, and that diversion programs, including education, be expanded to include IC&I.
    - Respondents also identified the risk of illegal, unsafe and environmentally damaging dumping if restrictions were implemented.

9.7 Residual Waste Technology Evaluation Conclusions

Based on the results from the *Sustainability Evaluation* and the *Life Cycle Assessment*, and on the feedback collected from the public during *Consultation Series No. 2*, Thermal Treatment was identified as the preferred option for future residual waste management.

The Sustainability Evaluation determined that Thermal Treatment is the best performing option when all dimensions (social, environmental, technical and economic) are considered together. Thermal technologies can minimize local environmental and social impacts due to:

- the advent of high performing emissions control equipment,
- small footprint requirement,
- opportunities for significant conversion of residual waste to energy, and
- significant volume of waste reduction and corresponding low residual requiring disposal.

The Life Cycle Analysis evaluated the impact of Thermal Treatment at a global scale by comparing a variety of residual waste management scenarios. The analysis provides an assessment of the environmental footprint from all stages of a waste management system. Notable results include:

- Thermal Treatment could result in an avoidance of greenhouse gas (GHG) emissions equivalent to keeping almost 4000 cars off the road or burning over 44,000 barrels of oil. This is primarily as a result of avoided emissions by off-setting the need to generate electricity from fossil fuels.
- Thermal Treatment has a significant impact on avoided resource depletion, equivalent to the resource consumption impact of almost 10,000 individuals. This is due to material recovery, and more significantly, energy generation. Virgin resources used to manufacture materials and fossil fuel used for energy production is displaced by renewable energy from thermal treatment.

During Consultation Series No. 2, participants were asked to provide feedback on the technology evaluation process and preferred future garbage disposal technologies. 69% of respondents (165 of 241 total) were either Satisfied or Very Satisfied with the evaluation process. Respondents were asked to rank the three short-listed garbage disposal technologies (Thermal Treatment, Mechanical Biological Treatment and Landfill) in order of preference. The most preferred technology was Thermal Treatment at 66% (144 individuals). Mechanical Biological Treatment was most preferred by 33% (69 individuals) of respondents and 6% (12 individuals) felt that Landfill was the most preferred option. Overwhelmingly, the least preferred option for 82% (166 individuals) of survey respondents was Landfill. Thermal Treatment and Mechanical Biological Treatment were least preferred by 9% (20 individuals) and 7% (15 individuals) of respondents, respectively.

Overall, Thermal Treatment technology presents a sustainable option for future waste management in Waterloo Region that can be combined with policies, programs and initiatives to increase diversion. It enables the Region to foster innovation and pursue opportunities for collaboration with neighbouring municipalities or private entities. Further, Thermal Treatment is a flexible technology that can be used to accommodate future projected growth and changing waste streams.

Conclusions

Based on the feedback collected from the public during *Consultation Series No. 2*, the results from the *Sustainability Evaluation* and the *Life Cycle Assessment*, Thermal Treatment was identified as the preferred option for future residual waste management. Furthermore, the Region should continue to consider policy options for residual waste management that could extend the life of the landfill and/or support the treatment of residual waste at a Thermal Treatment facility within or outside Waterloo Region's borders.

10.0 FINAL WMMP RECOMMENDATIONS

The new WMMP is founded upon the principles described in the Region's Environmental Sustainability Strategy and builds upon the successes and experience gained over the last 25 years. The WMMP documents the current status of the Region's waste management practices, programs, operations and facilities, provides projections of future diversion rates and residual waste generation volumes, and establishes a strategy to guide waste management services over the next 20 years that is aligned with the planning, regulatory and technical context.

The preferred strategy targets three primary and complementary areas of focus, and includes the following recommended actions:

Diversion

- Implement curbside collection policy changes to increase diversion (e.g. bag limits, bi-weekly garbage collection, standardized Regional residential waste collection), and consider "user pay" options (e.g. bag tags).

Residual Waste Management

- Further investigate Thermal Technology options (e.g. Feasibility Study, Business Case, Life Cycle Analysis).
- Continue pursuit of opportunities with the Water Services Division to maximize inherent synergies for processing and disposal of residual waste and biosolids.

Planning

- Adopt a waste hierarchy that includes "Recovery" as the 4th R and consider recovery of energy and resources above waste disposal.
- Establish an inter-municipal working group to explore potential partnership opportunities.

Report Signature Page

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