Durham/York
Residual Waste Study

Evaluation of "Alternatives to" and Identification of the Preferred Residuals Processing System

DRAFT EXECUTIVE SUMMARY

April 18, 2006

MacViro

Jacques Whitford

Executive Summary

The Minister of the Environment approved the Terms of Reference for the Durham/York Residual Waste Environmental Assessment Planning Study (the Study) on March 31, 2006. In Accordance with these Terms of Reference a number of alternatives were formulated and evaluated. Based on the evaluation of these "Alternatives To" it is concluded that the preferred system for managing the residual waste remaining after achieving 60% to 75% diversion is the thermal treatment of the residual waste with the recovery of materials from the ash or char (e.g., a mass burn incinerator). It is recognized that new material processing and thermal technologies (e.g., gasification of solid removed fuels) may offer benefits in the terms of improved air emissions, energy conversion efficiency and costs. Unfortunately these technologies are not well proven as yet. Given this situation it is proposed that these new thermal technologies, along with proven thermal treatment technologies, be considered at the vendor selection step, after the facility-siting step, in the Environmental Assessment process.

ES-1 Introduction and Background to the Report

The *Draft Report on the Evaluation of "Alternatives to" and Identification of the Preferred Residuals Processing System* has been prepared to present the results of the first major step in the Study for public and agency review and comment. This is a draft report intended solely for the purpose of public and agency consultation.

The evaluation of "Alternatives To" the undertaking serves as the initial step in the Durham/York Residual Waste EA. "Alternatives to" are defined as fundamentally different ways of managing waste and achieving the purpose of the undertaking. The purpose of the undertaking as described in the Approved EA Terms of Reference is:

> ***"To process - physically, biologically and/or thermally - the waste that remains after the application of both Regions' at-source waste diversion programs in order to recover resources - both material and energy - and to minimize the amount of material requiring landfill disposal.***
>
> ***In proceeding with this undertaking only those approaches that will meet or exceed all regulator requirements will be considered."***

The results of the initial EA step – identification of a preferred long-term residuals processing system for Durham and York - are presented as a conclusion from the consultant team's consideration of alternative system advantages and disadvantages and environmental priorities. The environmental priorities represent the results of consultation with the public and review agencies.

A final version of this report and the consultant team conclusion, incorporating input from the public and agencies, is scheduled to be prepared and presented to the Joint Waste Management Group on May 30, 2006, after a 30-day consultation period which will begin on April 19, 2006 and end on May 19, 2006. The Joint Waste Management Group will not make a decision on its recommendation until after the consultation period ends and comments received have been

considered. The recommendation from the Joint Waste Management Group may be forwarded for consideration to the respective committees and Councils of both Regions during June 2006.

All parties reviewing this draft report are encouraged to submit their comments including those that are supportive or opposing and those that pose questions or make suggestions for modification to the results. Where a strong rationale in support of any suggested modification related to the systems evaluation is present, the comments will be considered and reasonably incorporated into the final report and recommendations to the Joint Waste Management Group.

ES-2 Methodology for Evaluation of Alternative Systems

To fully address the purpose of the undertaking, different waste management approaches capable of processing and recovering resources from post-diversion waste were combined into alternative residuals processing systems. The Study EA Terms of Reference established that alternative systems comprised of the following approaches and technologies would be formulated and evaluated:

- ✓ Mechanical Treatment;
- ✓ Biological Treatment; and
- ✓ Thermal Treatment.

Note: Thermal Treatment includes combustion, gasification and pyrolysis.

The following summarizes the seven (7) step methodology outlined in the Approved EA Terms of Reference to be applied to formulate and then comparatively evaluate alternative residuals processing systems.

Step 1 - Prior to initiation of the evaluation of "Alternatives To", the proposed evaluation methodology and criteria were reviewed in consultation with the public and agencies. This review sought additional input on the proposed evaluation steps and evaluation criteria presented in the EA Terms of Reference to establish and confirm the relative priorities to be considered during the evaluation.

Step 2 - The component alternatives were assembled into a range of alternative residuals processing systems with each system being capable of managing the entire projected residual waste stream.

Step 3 - Data collection was undertaken for the purpose of applying each of the comparative evaluation criteria to each of the alternative residuals processing systems. The proposed disposal system comparative evaluation criteria were included in Appendix "E" – Table E-1 of the approved EA Terms of Reference. There was provision for adjustment for suggested indicators and data sources at the initiation of the EA evaluation based on input received from agencies and the public at Step 1.

Step 4 - The comparative evaluation criteria were applied to each of the alternative residual processing systems and potential effects identified.

Step 5 - Each of the potential effects identified at Step 4 were considered with respect to the availability of measures to mitigate (i.e., measures that may be applied to

reduce or eliminate a negative potential effect) or enhance (measures that may be applied to improve or increase the magnitude of a benefit or positive effect) the effects, and identify the remaining or 'net effects'.

Step 6 - The net effects associated with each disposal system under each comparative criterion were compared and a list of relative advantages and disadvantages associated with each alternative processing system developed.

Step 7 - The relative advantages and disadvantages of each alternative residuals processing system were considered in the context of priorities established in consultation with the public and agencies and the preferred system selected. The preferred system is the one exhibiting the preferred balance of advantages and disadvantages considering the priority of environmental categories and criteria established by the public and agencies.

As an initial task in the system development step, each municipality's at-source waste diversion program was reviewed to assess the suitability of the established sixty (60) percent at-source diversion targets. This review concluded that waste reduction and 'at-source' diversion approaches will continue to be preferred over disposal but that, given the current and projected diversion opportunities available to Durham and York, the set targets of 60% diversion by 2011 and 75% diversion in future years are reasonable for use in the formulation and evaluation of alternative systems.

In determining the scope of alternative systems to be evaluated, the focus was on covering the range of options to recover resources, both materials and energy, from the residual waste stream rather than all possible combinations of the alternative approaches available for consideration. Resource recovery options included recovery of recyclable materials for sale to market, energy from biogas and energy from the thermal treatment of wastes or solid recovered fuel. The intent of the Study is to identify a preferred long-term alternative that maximizes the recovery of resources and minimizes the reliance on landfill as a primary method of disposal.

Landfill facilities will be assumed to continue to play a role for the disposal of certain materials that cannot be otherwise processed or diverted. A landfill only system, whereby a new landfill site capable of managing all waste that remains after at-source diversion would not meet the purpose of the undertaking, and thus was not considered in this study. Rationale for the exclusion of this option is provided in the approved EA Terms of Reference and detailed documentation supporting the identification of the preferred "Alternative to".

Once developed, the alternative residuals processing systems were evaluated by application of the established evaluation criteria and environmental priorities and using the net effects analysis outlined in Steps three (3) to seven (7) in the "Alternatives to" evaluation methodology. The preferred residuals processing system is that which offers the preferred balance of advantages and disadvantages given the environmental priorities established by the communities of Durham and York through the public consultation process.

ES-3 Consultation with the Public and Agencies

On March 7th, 8th and 9th, the Regions of Durham and York held Public Information Sessions to discuss the "Alternatives to" and the proposed evaluation process. The four (4) alternative systems to be evaluated were presented, as well as at-source diversion measures and the potential for resource recovery that was considered with each system alternative. In addition, the evaluation methodology and evaluation priorities that were developed during the preparation of the EA Terms of Reference were presented for public review. To verify public agreement with the range of alternative systems to be evaluated and the evaluation priorities, attendees were asked to complete a questionnaire. In the questionnaire, respondents were asked for input on the range of alternatives to be evaluated to rank the five (5) categories of the environment as "Extremely Important", "Very Important", "Somewhat Important", "Not Very Important", or "Not at all Important". The environmental categories considered in the evaluation process included the Natural, Social/Cultural, Economic, Technical and Legal/Jurisdictional Environments. A total of 83 open house attendants completed the questionnaire.

In addition, the Joint Waste Management Group retained the services of the public polling firm Ipsos Reid. The firm conducted an online self-complete Internet survey, and received responses from a total of 449 Durham residents and 423 York residents. The sample was chosen to be representative of the population demographics of the two Regions. The format was similar to the open house questionnaire, and respondents were asked to assign priority levels to the same five (5) environmental categories listed above.

The results of the Public Information Sessions questionnaire and online public survey were combined to determine the priorities, pending approval by the Joint Waste Management Group, to be assigned to each of the environmental categories. The final ranking of the priorities is shown in Table ES-1 below.

The Regions of Durham and York also distributed the proposed evaluation criteria and copies of the open house display panels to the stakeholders and agencies that have been identified to date for review and comment. This list of stakeholders and agencies includes approximately 400 groups consisting of government agencies (Federal, Provincial, and Municipal), educational institutions, First Nations organizations, and environmental groups.

ES-4 Establishment of Priorities and Application in the Evaluation

An influential aspect of the evaluation process was the identification and application of priorities assigned to the various components of the environment by the public. A key characteristic of the Environmental Assessment Act, and most planning processes with a focus on sustainability, is the requirement to consider a broadly defined environment (i.e., more than just the natural environment). Accordingly, the different categories of the environment considered in this study and the relative priorities assigned by the communities of Durham and York were as follows:

Table ES-1 Environmental Considerations by Assigned Priorities

Environmental Category	Relative Priority
Natural Environmental Considerations	Most Important
Social / Cultural Considerations	Important
Economic / Financial Considerations	Important
Technical Considerations	Important
Legal Considerations	Least Important

ES-5 Formulation and Evaluation of Alternative System

The evaluation of "Alternatives to", as a first finding, concluded that the reduction and "at-source" diversion of municipal solid waste are and will remain the most preferred components of an integrated waste management system. With this in mind and given the current and projected diversion opportunities available to Durham and York, it was determined that the established percent at-source waste diversion targets are reasonably aggressive targets on which to base the planning of long-term residuals processing capacity.

The following four alternative systems were then formulated using the alternative processing approaches from the approved EA Terms of Reference:

System 1 - Mechanical and Biological Treatment with Biogas Recovery

System 2(a) - Thermal Treatment of Mixed Waste with Recovery of Materials from the Ash / Char

System 2(b) - Thermal Treatment of Solid Recovered Fuel

System 2(c) - Thermal Treatment of Solid Recovered Fuel with Biogas Recovery

Utilizing the seven (7) step alternative system evaluation methodology described above the relative advantages and disadvantages of the alternative residuals processing systems were identified and summarized below.

System 1 – Mechanical Biological Treatment with Biogas Recovery

System 1 involves mechanical processing to recover recyclable material from the waste, anaerobic digestion of the food waste to recover a relatively small amount of renewable energy, and the landfilling of the resulting residues. It is essentially a stabilized landfill alternative with 77% of the residual waste stream ultimately going to export landfill.

Advantages of this system include:

- Lowest potential impacts on the air environment;
- More flexible to changes in waste quantities and composition;
- Potentially lower overall system costs provided low cost landfill capacity can be obtained from a third party;
- Potential to increase diversion through the recovery of additional recyclables – an advantage shared with Systems 2b and 2c.

Because this system is primarily a landfill alternative, it has a number of disadvantages including:

- Greatest potential impacts to water and land;
- Greatest potential to disrupt sensitive habitat;
- Lowest energy generation – both renewable and total;
- Greatest potential social impact on the landfill host community; and
- Least reliable due to dependence on export landfill contracts.

Systems 2a and 2b – Thermal Treatment of Municipal Solid Waste of Solid Recovered Fuel

Systems 2a and 2b are both based on thermal treatment. In 2a, recyclable metals are recovered following thermal treatment from the ash or char. In 2b, recyclable materials, including metals and some plastics, are recovered prior to thermal treatment. In both cases, only the small proportion of the residual waste stream – typically 10-15% by volume – goes to landfill. If the bottom ash could be used as construction material as it is in Europe and is being studied in the United States, this number could be reduced to less than 5%.

In summary, the advantages associated with Systems 2a and 2b include:

- Lowest potential impacts to water and land;
- Least potential to disrupt sensitive habitats;
- Greatest energy generation – both renewable and total;
- Lowest potential social impact on landfill host community due to a minimizing of the quantities requiring landfill;
- Higher reliability due to minimum dependence on export landfill; and
- Costs, although high, are comparable in the case of System 2a, with System 1.

The disadvantages of the thermal treatment systems include:

- Highest potential impacts on the air environment, although current technology has the proven ability to exceed all applicable air emissions standards;
- Less flexibility to changes in waste quantities and composition;
- Need to manage hazardous residues from the pollution control system. *(It can be argued that this is not really a disadvantage as the hazardous compounds – primarily heavy metals – are in the waste stream to begin with and simply landfilled in System 1. With the thermal systems, these contaminants are concentrated and removed for stabilization and/or management in a secure landfill.)*

When comparing Systems 2a and 2b, alternative 2a has the advantages of:

- More proven and reliable technology; and
- Lower costs – based on experience to-date.

Alternative 2b has the advantages of:

- The potential to recover more recyclables – some plastics as well as metals; and
- Potential improvements in air emissions, energy conversion efficiency and costs that may be provided by new technologies presently under development.

System 2c – Thermal Treatment of Solid Recovered Fuel With Biogas Recovery

System 2c includes the mechanical and biological treatment component of System 1 followed by the thermal treatment, rather than the straight landfilling of the residue. Ultimately the inert non-recyclable materials, AD digestate and ash/char all require landfill disposal. Approximately 45% of the residual stream will require export landfill under this alternative versus the 77% for System 1.

The major advantage of the system includes:

- The ability to recover additional recyclable materials and also to make beneficial use of the post diversion waste stream.

It has the disadvantage of:

- Highest cost and lowest technical reliability due to the amount and complexity of the required processing equipment.

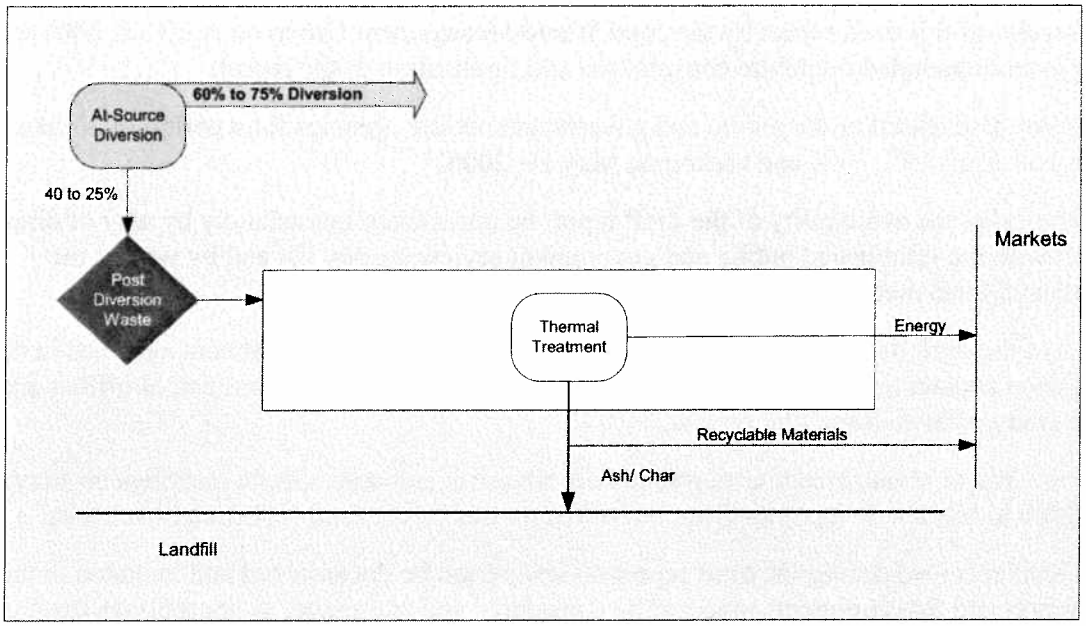
The attached Table ES-2 provides a more comprehensive overview of how each of the systems compares to one another in terms of their relative advantages and disadvantages when considering each of the evaluation criterion.

ES-6 Conclusion on Preferred System

Based on the consideration of relative advantages and disadvantages and environmental priorities identified above, the preferred long-term residuals processing system identified to manage the post-diversion or residual wastes is *System 2(a) – Thermal Treatment of MSW and Recovery of Energy followed by Recovery of Materials from the Ash/Char*. More specifically, System 2(a) entails the establishment of thermal treatment capacity to process the residual waste stream and recover energy, followed by the removal of materials that may be sold to market from the ash/char residue, and finally the landfilling of all process residues (non-combustible materials removed prior to treatment and the ash/char).

A more detailed description of the system, its individual components, and the need for a waste management hierarchy to support the continued improvement of waste reduction and at-source diversion performance prior to processing is provided in the main report. The flow of materials through System 2(a) is represented in Figure ES-1 below.

Figure ES-1 System 2(a) – Thermal Treatment of Mixed Waste with Recovery of Materials from the Ash / Char



Although System 2(a) has been identified as the Preferred Long Term Residual Processing System, it is important to note that System 2(b) also exhibits an acceptable range of advantages and disadvantages.

For some of the criteria where System 2(b) did not rank equivalent to 2(a), (technical risks, costs and legal/contractual risks for example), the determination of the relative advantages and disadvantages was based upon the information that was readily available on both the mechanical and biological processes that are being used to recover solid fuel in other jurisdictions and on the thermal technologies that can process this fuel. Many of the technologies that could be used to thermally treat the solid recovered fuel (e.g., gasification) in System 2(b) are regarded as 'new technologies', with active research and development, but are less proven than the technologies that are currently available to combust residual waste in System 2(a).

Should Durham and York Regions not meet their projected waste diversion targets within the currently planned timeframe, System 2(b) could be utilized to capture additional recyclables and compostables in the waste stream that have not been source separated by residents. This will contribute to the Regions' overall respective waste diversion rates.

It is therefore recommended that, pending the approval of System 2(a) as the preferred residuals processing system, the competitive process used during the evaluation of "Alternative Methods" (Sites) allow for the submission of proposals to implement both System 2(a) and System 2(b), and that the final decision on the technologies used to implement the preferred residuals processing system be based on the results of this competitive process.

It is important to note that, at this time, the identification of System 2(a) as the preferred "Alternative to" represents a conclusion of the consultant team and not a decision on the part of the two municipalities. This decision will not be made until the public and agencies have been consulted on the conclusion and its supporting rationale presented in this draft report.

ES-7 Next Steps

With the receipt of this draft report by the Joint Waste Management Group on April 18, 2006 the following is recommended on public consultation and finalization of the report:

- The report be released to the public and government review agencies for a period of 30 days starting on April 19th, 2006 and ending on May 19, 2006.
- Notification of the availability of the draft report be undertaken immediately by way of direct contact with the established public and government review agency list and by way of the website and local media for the general public.
- Copies of the draft documentation be forwarded to the public and government agencies in the established contact lists and that copies be placed in the local libraries, municipal offices and on the study website for public review.
- The Joint Waste Management Group schedule, advertise and hold special meetings on May 17th, 2006 to receive delegations from interested parties on the draft report and its results.
- Comments received during the draft report review period be documented and included in the final report and that comments received be considered and addressed, as appropriate, during finalization of the report.

TABLE ES-2
ALTERNATIVE DISPOSAL SYSTEM
MAJOR ADVANTAGES AND DISADVANTAGES

NATURAL ENVIRONMENTAL CONSIDERATIONS (MOST IMPORTANT PRIORITY)

Criterion	Indicator	System 1 *Mechanical, Biological Treatment with Biogas Recovery*	System 2 (a) *Thermal Treatment of MSW & Recovery of Materials from Ash/Char*	System 2 (b) *Thermal Treatment of Solid Recovered Fuel*	System 2 (c) *Thermal Treatment of Solid Recovered Fuel with Biogas Recovery*
Criterion 1: **Environmental burden at a global or macro-environmental scale, including impacts to air, land and water.**	**Predicted Emissions released to atmosphere by system**	***MAJOR ADVANTAGE*** • Lowest net emissions of Greenhouse Gases (tonnes) • Lower net emissions of Acid Gases (tonnes) • Highest net emissions of Smog Precursors (tonnes) • Lowest net emissions of Heavy Metals & Organics to Air	**MAJOR DISADVANTAGE** • Highest Net emissions of Greenhouse Gases (tonnes) • Highest net emissions of Acid Gases (tonnes) • Higher net emissions of Smog Precursors (tonnes) • Highest net emissions of Heavy Metals & Organics to Air	**DISADVANTAGE** • Higher net emissions of Greenhouse Gases (tonnes) • Lower net emissions of Acid Gases (tonnes) • Lower net emissions of Smog Precursors (tonnes) • Higher net emissions of Heavy Metals & Organics to Air	**DISADVANTAGE** • Higher net emissions of Greenhouse Gases (tonnes) • Lowest net emissions of Acid Gases (tonnes) • Lowest net emissions of Smog Precursors (tonnes) • Lower net emissions of Heavy Metals & Organics to Air
	Predicted pollutants released to water resources by system	**MAJOR DISADVANTAGE** • Highest net emissions of Heavy Metals & Organics to Water.	***MAJOR ADVANTAGE*** • Lowest net emissions of Heavy Metals & Organics to Water.	**ADVANTAGE** • Lower net emissions of Heavy Metals & Organics to Water	**NEUTRAL** • Higher emissions of Heavy Metals & Organics to Water
	Need to manage residues classified as hazardous waste associated with system.	• Hazardous elements remain in materials processed and/or landfilled and may be emitted by way of landfill emissions / collected by landfill pollution control systems. • No hazardous waste stream associated with residue from Facility Air Pollution Control Equipment associated with system.	• Approximately 15,500 tonnes per year of hazardous residue from pollution control equipment requires management at a licensed facility if the quantity of residual material managed by the facility is 400,000 TPY. • Costs to manage hazardous wastes at an approved facility have been included in estimated system costs.	• Approximately 8,500 tonnes per year of hazardous residue from pollution control equipment requires management at a licensed facility if the quantity of residual material managed by the facility is 400,000 TPY. • Costs to manage hazardous wastes at an approved facility have been included in estimated system costs.	• Approximately 5,500 tonnes per year of hazardous residue from pollution control equipment requires management at a licensed facility if the quantity of residual material managed by the facility is 400,000 TPY. • Costs to manage hazardous wastes at an approved facility have been included in estimated system costs.
		NEUTRAL • Opposing views of this consideration weigh segregation of hazardous materials and proper management versus discharging via mixed waste to landfill where they may or may not leach out of the disposed wastes.			

Criterion	Indicator	System 1 *Mechanical, Biological Treatment with Biogas Recovery*	System 2 (a) *Thermal Treatment of MSW & Recovery of Materials from Ash/Char*	System 2 (b) *Thermal Treatment of Solid Recovered Fuel*	System 2 (c) *Thermal Treatment of Solid Recovered Fuel with Biogas Recovery*
Criterion 1: **Environmental burden at a global or macro-environmental scale, including impacts to air, land and water.** ***(cont'd)***	**Impacts to land by system.**	**MAJOR DISADVANTAGE** • Siting process for a 11.4 ha Mechanical/Biological treatment facility in an urban/industrial setting will provide a high likelihood that facility location makes an appropriate use of land resources. • Primary facility site would likely be located within a designated urban boundary and/or on lands appropriately designated for the use. • Due to lack of approved landfill capacity within Durham and York, assumed that landfill capacity for residues would exist at a licensed municipal or private landfill. • A minimum of 287,000 cubic metres of landfill space will be required annually to dispose of system residues.	***MAJOR ADVANTAGE*** • Siting process for a 9.6 ha thermal facility in an urban/industrial setting will provide a high likelihood that facility location makes an appropriate use of land resources. • Primary facility site would likely be located within a designated urban boundary and/or on lands appropriately designated for the use. • Due to lack of approved landfill capacity within Durham and York, assumed that landfill capacity for residues would exist at a licensed municipal or private landfill. • A minimum of 50,000 cubic metres of landfill space will be required annually to dispose of system residues.	**ADVANTAGE** • Siting process for a 14.6 ha thermal facility in an urban/industrial setting will provide a high likelihood that facility location makes an appropriate use of land resources. • Primary facility site would likely be located within a designated urban boundary and/or on lands appropriately designated for the use. • Due to lack of approved landfill capacity within Durham and York, assumed that landfill capacity for residues would exist at a licensed municipal or private landfill. • A minimum of 81,000 cubic metres of landfill space will be required annually to dispose of system residues.	**NEUTRAL** • Siting process for a 13.5 ha thermal facility in an urban/industrial setting will provide a high likelihood that facility location makes an appropriate use of land resources. • Primary facility site would likely be located within a designated urban boundary and/or on lands appropriately designated for the use. • Due to lack of approved landfill capacity within Durham and York, assumed that landfill capacity for residues would exist at a licensed municipal or private landfill. • A minimum of 114,000 cubic metres of landfill space will be required annually to dispose of system residues.
Criterion 1:	**OVERALL**	**DISADVANTAGE**	**MAJOR ADVANTAGE**	**ADVANTAGE**	**NEUTRAL**
Criterion 2: **Consumption/preservation of non-renewable environmental resources.**	**Potential of system to consume non-renewable fossil fuel or displace non-renewable fossil fuel consumption for energy generation.**	**MAJOR DISADVANTAGE** • Net lifecycle energy (i.e. electricity, heat, virgin material displacement credit, etc.) impact of 606,357 GJ conserved annually. • Net Electrical Energy Generation from renewable sources of 10,313 MWh	***MAJOR ADVANTAGE*** • Net lifecycle energy (i.e. electricity, heat, virgin material displacement credit, etc.) impact of 1,348,786 GJ conserved annually. • Net Electrical Energy Generation from renewable sources of 86,180 MWh	***MAJOR ADVANTAGE*** • Net lifecycle energy (i.e. electricity, heat, virgin material displacement credit, etc.) impact of 1,428,480 GJ conserved annually. • Net Electrical Energy Generation from renewable sources of 85,673 MWh	**ADVANTAGE** • Net lifecycle energy (i.e. electricity, heat, virgin material displacement credit, etc.) impact of 1,230,067GJ conserved annually. • Net Electrical Energy Generation from renewable sources of 56,822 MWh
Criterion 3: **Potential for destruction or disruption of sensitive terrestrial and/or aquatic habitats at an eventual site.**	**Total Volume of Landfill Capacity Required to manage Post-Processing Residual Waste**	**MAJOR DISADVANTAGE** • **Significant** requirement for landfill disposal of system residues increases potential for removal or disruption of sensitive natural habitats due to typically rural setting of landfill facilities.	***MAJOR ADVANTAGE*** • **Low** requirement for landfill disposal of system residues reduces potential for removal or disruption of sensitive natural habitats due to typically rural setting of landfill facilities.	**ADVANTAGE** • **Low/Moderate** requirement for landfill disposal of system residues reduces potential for removal or disruption of sensitive natural habitats due to typically rural setting of landfill facilities.	**NEUTRAL** • **Moderate** requirement for landfill disposal of system residues reduces potential for removal or disruption of sensitive natural habitats due to typically rural setting of landfill facilities.
		• Estimated 11.4 ha. Site Requirement	• Estimated 9.6 ha. Site Requirement	• Estimated 14.6 ha. Site Requirement	• Estimated 13.5 ha. Site Requirement

Criterion	Indicator	System 1 Mechanical, Biological Treatment with Biogas Recovery	System 2 (a) Thermal Treatment of MSW & Recovery of Materials from Ash/Char	System 2 (b) Thermal Treatment of Solid Recovered Fuel	System 2 (c) Thermal Treatment of Solid Recovered Fuel with Biogas Recovery
	Land use setting typically associated with establishment of facilities comprising system.	**NEUTRAL** • All facility(ies) site(s) can be located in designated urban area and on industrially designated lands with potential for impacts on sensitive habitats unlikely.			
Criterion 3:	**OVERALL**	**MAJOR DISADVANTAGE**	**MAJOR ADVANTAGE**	**ADVANTAGE**	**NEUTRAL**
Criterion 4: **Potential to increase diversion rate and/or make best use of residual (post-diversion) waste materials.**	**Potential of system facilities to remove any remaining materials in the post-diversion waste stream for use in a non-disposal manner.**	***MAJOR ADVANTAGE*** • System ensures achievement of 60% diversion target and offers potential 10% increase in rate of diversion from disposal to 70%.	**ADVANTAGE** • System ensures achievement of 60% diversion target and in existing regulatory environment offers potential 2% increase in rate of diversion from disposal to 62%.	***MAJOR ADVANTAGE*** • System ensures achievement of 60% diversion target and in existing regulatory environment offers potential 8% increase in rate of diversion from disposal to 68%.	***MAJOR ADVANTAGE*** • System ensures achievement of 60% diversion target and in existing regulatory environment offers potential 10% increase in rate of diversion from disposal to 70%.
	Potential of system facilities to manage and make beneficial use of materials in the post-diversion waste stream including those materials for which diversion may decline or disappear in the future.	**ADVANTAGE** • **Moderate** - If markets for compost and recycled paper fibres were to decline, this system could anaerobically digest these materials to recover energy. • If there were approved markets for Class B compost and use of some recovered materials as aggregate, diversion from landfill disposal could increase to 84%.	***MAJOR ADVANTAGE*** • **High** - If markets for recycled plastics, low-value paper etc. were to decline or disappear, this system could recover significant quantities of energy from these materials. • In addition, if European practice of curing and recycling bottom ash into aggregate materials was approved in Ontario, diversion from landfill disposal could increase to 95%.	***MAJOR ADVANTAGE*** • **High** - If markets for recycled plastics, low-value paper etc. were to decline or disappear, this system could recover significant quantities of energy from these materials. • In addition, if European practice of curing and recycling bottom ash into aggregate materials was approved in Ontario, diversion from landfill disposal could increase to 89%.	***MAJOR ADVANTAGE*** • **High** - If markets for recycled plastics, low-value paper etc. were to decline or disappear, this system could recover significant quantities of energy from these materials. • In addition, if European practice of curing and recycling bottom ash into aggregate materials was approved in Ontario, diversion from landfill disposal could increase to 87%.
Criterion 4:	**OVERALL**	**ADVANTAGE**	**ADVANTAGE**	**MAJOR ADVANTAGE**	**MAJOR ADVANTAGE**
NATURAL ENVIRONMENTAL CONSIDERATIONS	**OVERALL**	**DISADVANTAGE**	**MAJOR ADVANTAGE**	**MAJOR ADVANTAGE**	**ADVANTAGE**

SOCIAL / CULTURAL CONSIDERATIONS (IMPORTANT PRIORITY)

Criterion	Indicator	System 1 *Mechanical, Biological Treatment with Biogas Recovery*	System 2 (a) *Thermal Treatment of MSW & Recovery of Materials from Ash/Char*	System 2 (b) *Thermal Treatment of Solid recovered fuel*	System 2 (c) *Thermal Treatment of Solid recovered fuel with Biogas Recovery*
Criterion 5: **Potential for land use conflicts from siting of facilities required for alternative.**	**Number of waste management facilities associated with alternative system.**	**NEUTRAL** • For comparative purposes it is assumed that all components of all of the alternative residuals processing systems would be located at a single location within Durham/York. As a result, all systems would have the same relative impact regarding the number of waste management facilities. The 'single facility, single site' system configuration represents the most efficient system configuration and would provide the economies of scale that are being sought in the Durham/York study. In general, a 'single facility, single site' configuration also represents the configuration which would be expected to have a lower potential for environmental and social impacts, as the total land area required and number of potential receptors that could be impacted by the systems, increases as the number of sites required for each system increases.			
	Potential for land use conflicts considering location requirements of waste management facilities.	**MAJOR DISADVANTAGE** • For comparative purposes it is assumed that all components of the MBT System would be located at a single location within Durham/York. • MBT facility would likely be located within a designated urban boundary and/or on lands appropriately designated for the use. • Significant quantity of residual materials (30% of total waste stream) will require landfill disposal at a facility located outside of the study area, resulting in a higher potential for land use conflicts associated with export to waste in other communities. • Highest potential traffic related impacts, related to the haul of materials from the thermal facility to landfill.	***MAJOR ADVANTAGE*** • For comparative purposes it is assumed that all components of the Thermal System would be located at a single location within Durham/York. • Thermal facility would likely be located within a designated urban boundary and/or on lands appropriately designated for the use. • Small quantity of residual materials (9% of total waste stream) will require landfill disposal at a facility located outside of the study area, resulting in a low potential for land use conflicts associated with export to waste in other communities. • Lowest potential traffic related impacts, related to the haul of materials from the MBT/thermal facility to landfill.	***MAJOR ADVANTAGE*** • For comparative purposes it is assumed that all components of the MBT/Thermal System would be located at a single location within Durham/York. • MBT/Thermal facility would likely be located within a designated urban boundary and/or on lands appropriately designated for the use. • Small quantity of residual materials (13% of total waste stream) will require landfill disposal at a facility located outside of the study area, resulting in a low potential for land use conflicts associated with export to waste in other communities. • Low potential traffic related impacts, related to the haul of materials from the MBT/thermal facility to landfill.	**NEUTRAL** • For comparative purposes it is assumed that all components of the MBT/Thermal System would be located at a single location within Durham/York. • MBT/Thermal facility would likely be located within a designated urban boundary and/or on lands appropriately designated for the use. • Moderate quantity of residual materials (18% of total waste stream) will require landfill disposal at a facility located outside of the study area, resulting in some potential for land use conflicts associated with export to waste in other communities. • Low potential traffic related impacts, related to the haul of materials from the MBT facility to landfill.
Criterion 5: **Potential for land use conflicts from siting of facilities required for alternative.** ***(cont'd)***	**Types and degree of Nuisance Impacts associated with waste management facilities based on Operational experience**	**MAJOR DISADVANTAGE** • Relatively equivalent potential impacts for most nuisance related parameters (dust, noise, litter) • Higher potential for odour related impacts, due to biological component of the MBT system and as potential odorous materials will be hauled from the MBT facility to landfill for disposal.	***MAJOR ADVANTAGE*** • Relatively equivalent potential impacts for most nuisance related parameters (dust, noise, litter) • Lower potential for odour related impacts as there is no biological component of the Thermal system, and as the residue hauled to landfill is inert.	**ADVANTAGE** • Relatively equivalent potential impacts for most nuisance related parameters (dust, noise, litter) • Higher potential for odour related impacts, due to biological component of the system, however, the residue hauled to landfill is inert as all biological residues are combusted.	**DISADVANTAGE** • Relatively equivalent potential impacts for most nuisance related parameters (dust, noise, litter) • Higher potential for odour related impacts, due to biological component of the system and as potential odorous materials will be hauled from the MBT facility to landfill for disposal.
SOCIAL / CULTURAL CONSIDERATIONS	**OVERALL**	**MAJOR DISADVANTAGE**	**MAJOR ADVANTAGE**	**ADVANTAGE**	**DISADVANTAGE**

ECONOMIC / FINANCIAL CONSIDERATIONS (IMPORTANT PRIORITY)

Criterion	Indicator	System 1 *Mechanical, Biological Treatment with Biogas Recovery*	System 2 (a) *Thermal Treatment of MSW & Recovery of Materials from Ash/Char*	System 2 (b) *Thermal Treatment of Solid recovered fuel*	System 2 (c) *Thermal Treatment of Solid recovered fuel with Biogas Recovery*
Criterion 6: **Net system costs per tonne of waste managed** – in a systems context. Includes: • Capital and operating costs over operational period of system (2011 to 2045). • Estimated costs associated with perpetual care of component facilities in accordance with current environmental and municipal accounting requirements. • Estimated revenues associated with system once fully implemented and operational. • Potential subsidies and revenues that may be realized during establishment and future operation of system.		**ADVANTAGE** • Net System Cost per tonne ranges from $114 to $155, including capital, operating, financing, perpetual care, revenues and subsidies.	**ADVANTAGE** • Net System Cost per tonne ranges from $97 to $160, including capital, operating, financing, perpetual care, revenues and subsidies.	**DISADVANTAGE** • Net System Cost per tonne ranges from $116 to $188, including capital, operating, financing, perpetual care, revenues and subsidies.	**MAJOR DISADVANTAGE** • Net System Cost per tonne ranges from $140 to $213, including capital, operating, financing, perpetual care, revenues and subsidies.
Criterion 7: **Sensitivity of system costs and affordability to external financial influences.** Includes: • Types of revenues and subsidies currently available to off-set system costs and predicted sustainability of these sources into the future. • Degree to which system affordability relies on revenues and subsidies during long-term operation of the system.		**MAJOR DISADVANTAGE** • Net system cost assumes markets for recyclable materials recovered from mechanical component of MBT facility and biogas from anaerobic digester. Revenues offset in the range of 13 to 16% of average annual costs. • Revenue from sale of recyclables is likely least secure of all revenue streams. • System generates considerably more post-process residue that would require landfill disposal and therefore will be more susceptible to rising landfill disposal costs.	**NEUTRAL** • Net system cost assumes markets for energy generated from thermal treatment of waste and for materials recovered from ash/char. Revenues off-set approximately 50 to 73% of average annual costs of facility. • Revenue from sale of electricity is likely most secure of all revenue streams. • System would have a minor influence related to the marketplace for disposal of APC residues / ashes / chars.	**NEUTRAL** • Net system cost assumes markets for energy generated from thermal treatment of a solid recovered fuel and for materials recovered from the SRF facility. Revenues off-set approximately 43 to 63% of average annual costs. • Revenue from sale of electricity is likely most secure of all revenue streams. • System would have a minor influence related to the marketplace for disposal of APC residues / ashes / chars.	**DISADVANTAGE** • Net system cost assumes markets for energy generated from thermal treatment of an solid recovered fuel and for materials and biogases recovered from facility that processes MSW into SRF. Revenues off-set approximately 32 to 47% of average annual costs. • Revenue from sale of electricity is likely most secure of all revenue streams. • System would be influenced by marketplace for disposal of APC residues / ashes / chars.
ECONOMIC / FINANCIAL CONSIDERATIONS	**OVERALL**	**DISADVANTAGE**	**ADVANTAGE**	**DISADVANTAGE**	**MAJOR DISADVANTAGE**

TECHNICAL (IMPORTANT PRIORITY)

Criterion	Indicator	System 1 *Mechanical, Biological Treatment with Biogas Recovery*	System 2 (a) *Thermal Treatment of MSW & Recovery of Materials from Ash/Char*	System 2 (b) *Thermal Treatment of Solid recovered fuel*	System 2 (c) *Thermal Treatment of Solid recovered fuel with Biogas Recovery*
Criterion 8: **Technical risks associated with waste management alternative.**	**Flexibility of alternative system to changes in waste quantities, composition and availability of system diversion and disposal components.**	**ADVANTAGE** • MBT component would be designed for a specified throughput and any quantities over that design capacity would have to be managed by way of extended operating hours or by-pass to a landfill.	**MAJOR DISADVANTAGE** • Although changes to waste characteristics are not a significant issue, significant changes in quantity can be problematic. A reduction in quantity affects the assumed economics of the facility and may be corrected by way of alternate sourcing of feedstock. An increase may require MSW to bypass the facility.	**DISADVANTAGE** • Incorporation of mechanical, biological and thermal components allows for adjustments in process line to accommodate some changes in waste types and quantities.	**DISADVANTAGE** • Incorporation of mechanical, biological and thermal components allows for adjustments in process line to accommodate some changes in waste types and quantities.
Criterion 8: **Technical risks associated with waste management alternative.**	**Reliability of alternative system and component technologies and need for contingency landfill capacity.**	**MAJOR DISADVANTAGE** • MBT component is considered reasonably reliable given past experience with mechanical component although experience with anaerobic digestion of mixed wastes is less common. • High Dependence on landfill capacity elsewhere in the Province results in lowest reliability.	***MAJOR ADVANTAGE*** • Operating experience with this technology has established a reasonable operating track record and a much-improved track record with regards to environmental protection. • Lowest dependence on landfill capacity elsewhere in Province.	DISADVANTAGE • System is dependent on several different types of technologies and mechanical equipment that lends itself to the highest potential for breakdown or failure. • Moderate dependence on landfill capacity elsewhere in Province.	DISADVANTAGE • System is highly dependent on several different types of technologies and mechanical equipment that lends itself to the highest potential for breakdown or failure. • Moderate dependence on landfill capacity elsewhere in Province.
TECHNICAL	**OVERALL**	**MAJOR DISADVANTAGE**	**NEUTRAL**	**DISADVANTAGE**	**DISADVANTAGE**

LEGAL CONSIDERATIONS (LESS IMPORTANT PRIORITY)

Criterion	Indicator	System 1 *Mechanical, Biological Treatment with Biogas Recovery*	System 2 (a) *Thermal Treatment of MSW & Recovery of Materials from Ash/Char*	System 2 (b) *Thermal Treatment of Solid recovered fuel*	System 2 (c) *Thermal Treatment of Solid recovered fuel with Biogas Recovery*
Criterion 9: **Legal / contractual risks associated with waste management alternative.**	**Types and complexity of approvals required implementing components of system.**	**DISADVANTAGE** • System will require at a minimum, approval under the Ontario Environmental Assessment Act and Ontario Environmental Protection Act. • MBT facility would likely be located within a designated urban boundary and/or on lands appropriately designated for the use. Accordingly, potential for land use conflicts would be minimal and may facilitate obtaining the necessary approvals to implement and operate the facility. • System has higher landfill requirements, so that while MBT component may be more acceptable for approval within Durham and York, the use of a significant quantity of landfill space outside of the study area is likely to be less acceptable (particularly for the host community).	**NEUTRAL** • System will require at a minimum, approval under the Ontario Environmental Assessment Act and Ontario Environmental Protection Act. • Thermal facility would likely be located within a designated urban boundary and/or on lands appropriately designated for the use. Accordingly, potential for land use conflicts would be minimal and may facilitate obtaining the necessary approvals to implement and operate the facility.	**NEUTRAL** • System will require at a minimum, approval under the Ontario Environmental Assessment Act and Ontario Environmental Protection Act. • Thermal facility would likely be located within a designated urban boundary and/or on lands appropriately designated for the use. Accordingly, potential for land use conflicts would be minimal and may facilitate obtaining the necessary approvals to implement and operate the facility.	**NEUTRAL** • System will require at a minimum, approval under the Ontario Environmental Assessment Act and Ontario Environmental Protection Act. • Thermal facility would likely be located within a designated urban boundary and/or on lands appropriately designated for the use. Accordingly, potential for land use conflicts would be minimal and may facilitate obtaining the necessary approvals to implement and operate the facility.
Criterion 9: **Legal / contractual risks associated with waste management alternative.** ***(cont'd)***	**Degree to which system implementation and operation relies on private or public sector partnerships.**	**<u>MAJOR DISADVANTAGE</u>** **Implementation:** • MBT technologies are largely propriety and will likely require some form of contractual arrangement with the private sector vendor(s) for implementation. • System requires considerable landfill disposal capacity that must be obtained through contract with a third party. **Operation:** • Assumed in evaluation operation of MBT facilities is contracted out to the private sector. However, the respective municipalities could operate publicly if the necessary staff were retained and trained on facility operations.	**DISADVANTAGE** **Implementation:** • Thermal technologies are largely propriety and will likely require some form of contractual arrangement with the private sector vendor(s) for implementation. **Operation:** • Assumed in evaluation operation of thermal facilities is contracted out to the private sector. However, the respective municipalities could operate publicly if the necessary staff were retained and trained on facility operations.	**DISADVANTAGE** **Implementation:** • Thermal and MBT technologies are largely propriety and will likely require some form of contractual arrangement with the private sector vendor(s) for implementation. **Operation:** • Assumed in evaluation operation of thermal facilities is contracted out to the private sector. However, the respective municipalities could operate publicly if the necessary staff were retained and trained on facility operations.	**DISADVANTAGE** **Implementation:** • Thermal and MBT technologies are largely propriety and will likely require some form of contractual arrangement with the private sector vendor(s) for implementation. **Operation:** • Assumed in evaluation operation of thermal facilities is contracted out to the private sector. However, the respective municipalities could operate publicly if the necessary staff were retained and trained on facility operations.
LEGAL CONSIDERATIONS	**OVERALL**	**MAJOR DISADVANTAGE**	**DISADVANTAGE**	**DISADVANTAGE**	**DISADVANTAGE**