TECHNICAL MEMORANDUM

MORRISON HERSHFIELD

DATE: April 19, 2013
PROJECT No.: 5130323 00
TO: Russ Smith, Anke Bergner,
Capital Regional District.

CC:

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RE: **The 4th R: RESOURCE RECOVERY OPTIONS MEMO**

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1. Introduction

The Public and Technical Advisory Committee (PTAC) has discussed the first three Rs of the waste management hierarchy (reduce, reuse and recycle/composting) as they apply to municipal solid waste and construction and demolition materials. This memo deals with the next step of the waste management hierarchy; recovery. Generally, recovery refers to the capture of the energy embodied in the waste that remains after recycling, and is followed by the disposal of any residual products. Recovery may also include the beneficial use of other resources within the waste system.

The purpose of this memo, in conjunction with previous memos, is to develop strategies for the new Integrated Solid Waste and Resource Management Plan (ISWRMP) up to 2020. The CRD has established practices for the first 3 R's which are expected to lead to 70% diversion by 2015. The ISWRMP is now focusing its attention on the last 2 R's as they have the potential to increase diversion beyond 70% and ensure that the Hartland Landfill remains a long term sustainable residual management option.

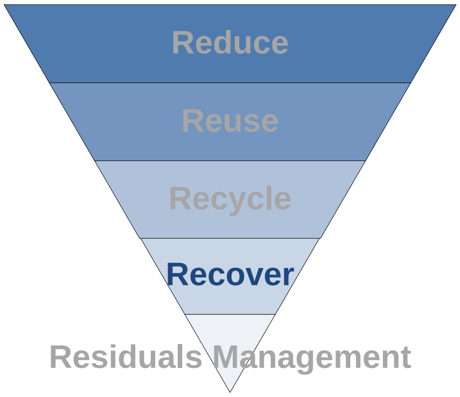

Figure 1 Waste Management Hierarchy

Many technologies can be employed for resource recovery. Maximal resource recovery can be achieved by combining individual technologies. In this memo, we have developed scenarios that combine technologies to achieve varying degrees of resource recovery.

The information in this memo is for consideration by PTAC. It is intended to stimulate discussion both at the meeting and online (before and after the meeting). At the meeting, we will have a presentation of the memo content, followed by small group sessions that focus on each of the scenarios. At the meeting, PTAC will be asked to review the information presented in this memo, and to provide input on the general direction and options.

2. RESOURCE RECOVERY OVERVIEW

1.1 Definition

Resource Recovery is often applied to energy recovery only (the 4th R). Resource Recovery actually means: extraction and utilization of materials and energy from the waste stream. This can include reuse of materials. For the purpose of this memo, reuse and recycling (including composting) are recognized as part of the larger resource recovery picture. However, the focus of this memo and subsequent discussion is on the recovery of energy and non-energy resources at the Hartland Landfill.

1.2 Resource Recovery Technologies and Approaches

The following is a comprehensive listing and brief description of resource recovery technologies that are available to take the CRD beyond the first three R's. At later stages in this memo, these technologies will be referred to as technical options and combined into resource recovery scenarios. Composting is considered a form of recycling organics and is has therefore been dealt with in previous memos.

Mechanical separation of residual waste for additional recycling

This process is often also referred to as a “dirty materials recovery facility” or “dirty MRF”. The process takes the residual waste stream (after removal of recyclables and organics at source) and mechanically processes it to remove additional recyclables. Since the at-source recycling programs are highly effective, few additional materials of value can be recovered at this point. Experience in the UK and Europe indicates that the materials that can be extracted consist of mostly metals and glass; only metals have a market value in BC at this time. Removing additional plastics and fibres is possible, but in general the costs are high, quality is low, and the amounts removed are low. Overall, mechanical separation in addition to source separation removes only small amounts of additional material while adding substantially to the costs for complex equipment and its operation.

Anaerobic digestion

Separated wet or semi-wet organic materials can be anaerobically digested (AD) to create a biogas, which in turn can be combusted to make electricity and heat or used as an alternate fuel. This technology is common for agricultural manures and is being increasingly used to recover energy from food waste. Kitchen scraps will be banned from disposal at Hartland Landfill in 2015 and it is expected that the private sector will manage this material. The CRD may have to get involved in composting/AD if the private sector is not responsive in developing infrastructure to facilitate the kitchen scraps ban.

Mechanical separation and biological treatment of residual waste for additional recycling and production of refuse derived fuel

This process is also referred to as MBT (mechanical biological treatment). The primary purpose is to make a refuse derived fuel (RDF) that can be used on-site , or exported to other users (such as cement kilns) to displace fossil fuels. Metals are removed and recycled as part of the mechanical preparation process. The result is a dried waste that can be shredded and formed into pellets that resemble wood chips and can be sent to cement kilns or other industries for use as fuel to replace coal or natural gas. The use of RDF has the same advantages as other forms of thermal resource recovery. The heat content in the residual waste is recovered, metals are extracted and recycled, and landfill life is substantially extended (especially if the ash is not returned to the landfill, for example if the RDF is burned in cement kilns). This is a proven technology and can be implemented in the short term.

Conventional combustion

The most common technologies for waste to energy (WTE) in use today are mass burn, or for smaller systems, controlled air combustion technology. The quantity of residual waste in the CRD means that mass burn is the most appropriate conventional combustion technology. This is proven technology that could be employed without technical or financial risk. The heat content of the waste is utilized, either for the production of electricity and/or as a large scale heat source. If the plant is located near an energy user such as an industrial facility or high density residential area, then heat can be sold as well as electricity, increasing the thermal recovery efficiency of the plant to well over 60% (versus under 30% for electricity only). This is a proven technology and can be implemented in the short term.

Advanced thermal recovery technologies

Several newer technologies are being developed for the recovery of thermal energy from residual waste, usually based on some form of gasification or pyrolysis. In some cases plasma systems are used to create a glass-like vitrified ash that can be used as aggregate, thus reducing landfillable residue to a small fraction of the input. Some gasification systems are capable of converting the synthetic gas into methanol or ethanol (i.e. a liquid fuel) which can offset conventional hydrocarbons and be burned by vehicles elsewhere. These technologies are currently being tested, and may be proven in the next several years. They are therefore more suitable for long term planning.

Landfill gas capture

A landfill is essentially an uncontrolled anaerobic digester. Landfill gas consists primarily of methane and CO_2, and is generated when organic materials decompose anaerobically. Landfill gas is both burnable (it has a heating value) and contains greenhouse gases (GHGs). The CRD has a landfill gas capture and utilization system in place. Currently, landfill gas is captured and converted to electricity, which is sold to BC Hydro. The BC Ministry of Environment would like to see 75% of the landfill gas that is generated in a landfill captured and preferably utilized. The CRD plans to improve landfill gas recovery in the short term to meet that goal.

Non-energy recovery of resources from Hartland

Recovery may include the beneficial reuse of other resources within the waste system. There are two possibilities for non-energy recovery of resources at Hartland landfill: aggregate recovery and landfill mining.

- Aggregate recovery:

Normal landfill operation requires a balance of cut and fill. In Hartland's case this means that rock excavations are taken to the depth necessary to effectively implement the landfill's engineered fill plan. When the landfill reaches its design capacity, the standard practice is to expand the landfill or to site a new landfill. As a potential long term, sustainable resource, Hartland site must be used to hold as much waste as possible. This can be achieved by excavating as much rock as possible to create more space for the disposal of residual waste materials. Hartland disposal capacity is a resource that must be preserved for generations. The material that is excavated, in this case rock, will greatly exceed what is needed as cover material at the landfill. However, crushed rock is a commodity with a value on the aggregate market. Selling this material, which is a necessary by-product of landfill optimization and operations, can help to offset ever-rising operation costs of waste management.

- Landfill mining:

Landfill mining involves digging up waste that has been buried for some time, recovering or re using materials that can be recycled, sorting out the cover material, and re-burying the remaining material, typically with greater compaction and less cover than was initially used. The process results in the creation of additional landfill airspace, typically as much as 25% or more, however this is highly dependent on the waste material type and past cover application. Recovery of recyclable material from municipal solid waste is typically limited to metals which have value, and concrete/wood which can be reduced in size and reused in the landfill operations. Landfill mining is typically only applied at sites where remedial measures are required or where landfill airspace is at a premium, as it is more expensive than developing or expanding a new site. Landfill mining will be discussed in a future memo.

1.3 Current Applications of Resource Recovery

Resource recovery in North America and in Europe generally follows the waste hierarchy shown at the beginning of this memo. Recycling, including the recovery and composting/AD of organics take priority over energy recovery, which takes priority over land disposal. In Europe, there are general guidelines that require a target recycling/diversion rate of 60% (without energy recovery). There is also a European directive that progressively prohibits the disposal of unprocessed organic waste at landfills. This has facilitated WTE as an appropriate means of treating the waste before disposal (while recovering energy) and has also led to additional organics management technologies such as MBT, usually with the resultant product being made into refuse derived fuel. Overall, the more economically and environmentally advanced countries in the EU have embraced the concept of zero waste to landfill, but this generally includes an energy recovery component, usually in the form of WTE or RDF. Figure 2 shows the proportion of waste that is recycled, combusted and landfilled by country in the EU.

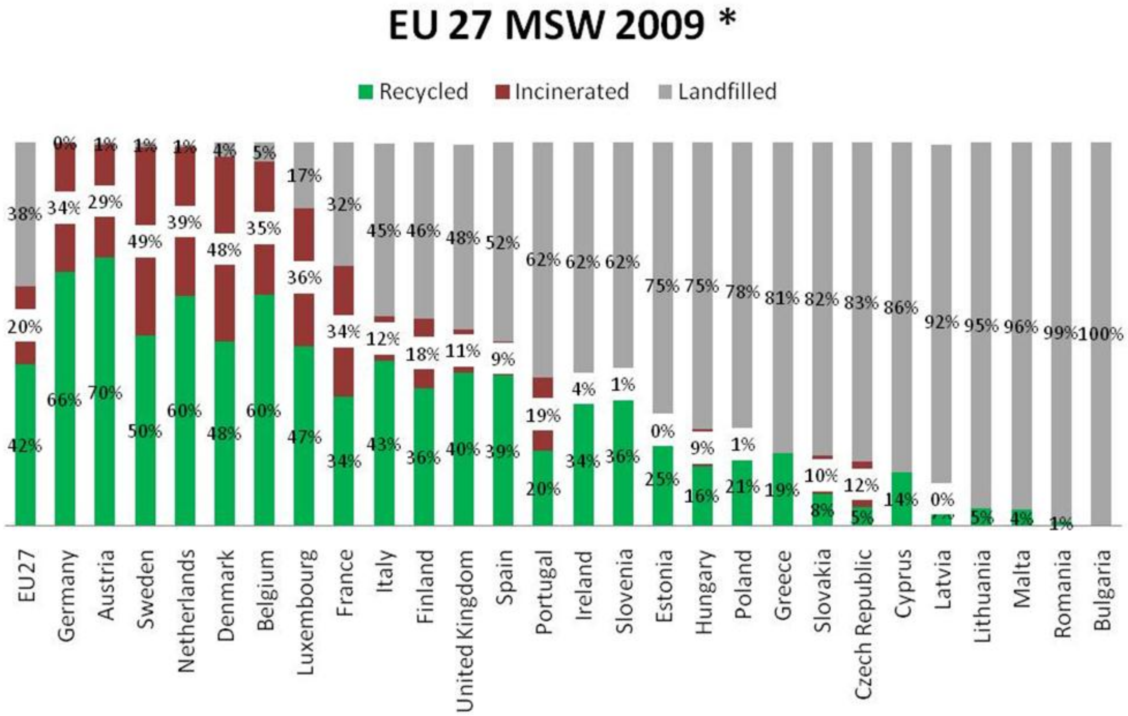

Figure 2 Proportion of waste that is recycled, combusted and landfilled by country in the European Union (Source: Eurostat).

As can be seen in this figure, Germany, Austria, Sweden, Netherlands, Denmark and Belgium all dispose of 5% or less to landfill, while they recycle between 47% and 70% and use WTE for energy recovery for 29% to 49% of the waste.

In Canada, waste disposal and diversion targets are set at the provincial level and municipalities and Regional Districts are responsible for developing and implementing plans for diversion. The first three R’s are widely accepted and are being practiced country wide. Results vary, and diversion rates based on the first 3 R’s (including organics) vary widely. The City of Edmonton, which has one of the largest indoor compost plants in Canada is diverting over 60% of its residential waste, and will boost its overall diversion of residential waste to 90% with the use of an energy recovery plant (waste to biofuel).

Metro Vancouver currently reports a 55% diversion rate and with the implementation of region wide organics collection is targeting 70% by 2015. The ultimate goal is diverting 80% by 2020. For the balance of waste after this diversion, (almost a million tonnes of waste per year remain), the Region is proposing a second WTE facility with a capacity of 370,000 tonnes per year.

There are few energy recovery facilities in Canada. There are only two commercially operating AD systems for kitchen scraps, both in the City of Toronto. Most landfills recover energy in the form of landfill gas, primarily because it contains potent GHGs, and most larger landfills utilize that gas for the production of electricity or heat. Local examples include the Hartland Landfill, Nanaimo Landfill and the Burns Bog Landfill in Delta.

The main WTE facilities recovering energy thermally in Canada are:

- Burnaby, BC, 280,000 TPY (tonnes per year), mass burn
- Quebec City, QC, 280,000 TPY, mass burn
- Algonquin Peel, ON, 150,000 TPY, multiple unit modular
- Durham/York, ON, 140,000 TPY, mass burn (under construction)
- Metro Vancouver, BC, 370,000 TPY, (planned for 2018)

The BC Ministry of Environment has a policy since March of 2010 that defines the status of resource recovery utilizing WTE technologies:

"The Ministry of Environment expects local governments to have a minimum target of 70% reduction of waste, before utilizing a WTE facility as a waste management option. The 70% target is calculated only from Reduce, Reuse and Recycle initiatives."

"The Ministry expects that the resource recovery (energy recovery) facilities (4th R) meet at least 60% of the energy potential of the MSW used as fuel."

3. CURRENT SITUATION

The Stage 1 Report for the Integrated Solid Waste and Resource Management Plan (ISWRMP) described the current system to manage solid waste in the Region. Figure 3 illustrates the current resource recovery system, with which CRD achieved a diversion rate of 46% in 2011 (and was estimated to achieve 50% in 2012). In 2011, a total of 136,414 tonnes of solid waste were disposed of at Hartland Landfill and an estimated 116,031 tonnes of waste were recovered through various programs (source separation of recyclables, yard and garden waste and kitchen organics).

For comparison with resource recovery options presented later in this memo, the current cost to landfill residual waste at the Hartland Landfill is $49 per tonne.

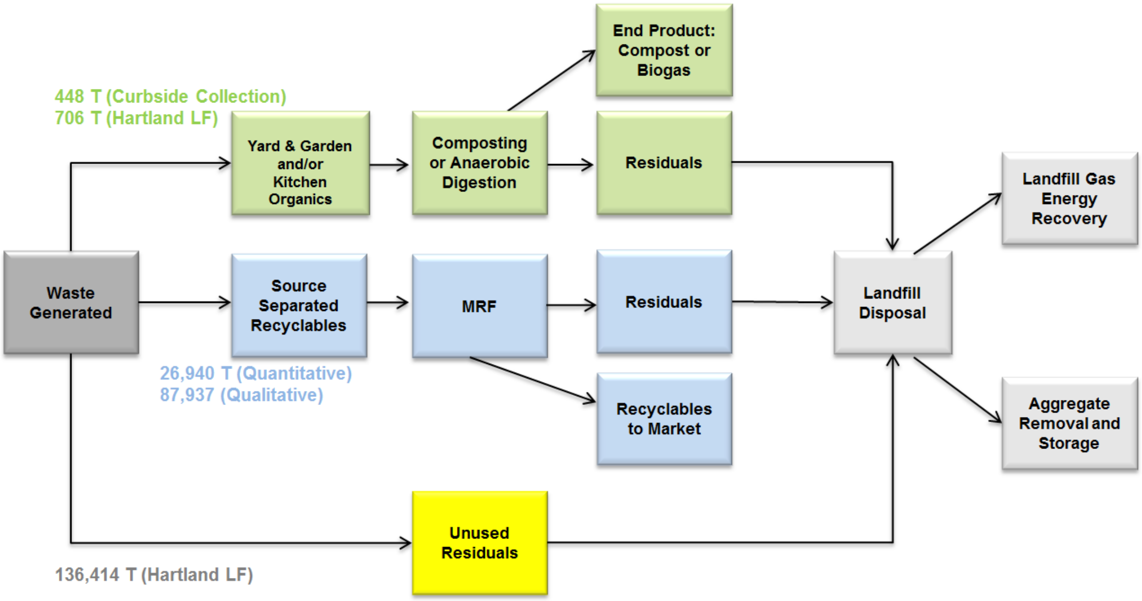

Figure 3 Flow Diagram Illustrating the Current Resource Recovery Methods Used by CRD with Material Flows Shown in Tonnes (T) and Key Opportunity for Further Resource Recovery Highlighted.

CRD’s waste composition studies indicate that the largest components of waste in the landfill (by weight) are organics, paper, plastic and wood, and that an estimated 75% of the material landfilled is potentially recyclable or compostable. This indicates that further resource recovery is potentially viable and would have the effect of substantially increasing the landfill lifespan.

Issues

The following issues have been identified in previous work by Maura Walker and Associates:

- Challenge 24:
    - When and how to implement resource recovery
    - Which technology is best suited for the CRD’s waste stream and size?
    - How much will it cost and is it financially sustainable?
    - Where should a resource recovery facility be located?
    - Should the facility serve other jurisdictions?
- Challenge 25: Integration with Liquid Waste (note: this is beyond the scope of this memo)

Landfill gas recovery

A Landfill Gas (LFG) Management Plan for the Hartland landfill was developed in 2011 by Conestoga-Rovers Associates to develop an enhanced LFG management plan with the overall goal of increasing LFG collection. The following key information comes from the LFG Management Plan, which is available to PTAC members who wish to access more technical information:

- Approximately 2,664 tonnes of methane was collected during 2010 and the 2010 LFG collection efficiency at the Hartland landfill was approximately 32 percent. Today the LFG collection efficiency is 50 percent.
- In order to meet the requirements of the LFG Management Regulation by 1 January 2016, the LFG Management Plan recommends a number of upgrades to the cell infrastructure to be completed between 2011 and 2036. The average LFG collection system capital cost per cubic metre of airspace is estimated at approximately two dollars ($2.00/m^3) in 2011, which equates to a cost of about $300,000 per year.
- The target collection efficiency of 75 percent can be achieved by 2016 if the LFG infrastructure is installed and operated as per the LFG Management Plan.

Non-energy resource recovery from Hartland landfill

The concept of a rock quarry that would maximize the air space available at Hartland landfill and at the same time generate large volumes of surplus aggregate was first proposed in 1993. This issue has been examined in detail by CRD staff. In 2012 about 150,000 m3 aggregate was stock piled at Hartland North with a net revenue potential of $1.5 to $2.75 million. At the same time, the regional supply of aggregate is decreasing, while demand is increasing. Research showed that Hartland can augment the supply of aggregate to select infrastructure projects without long-term impact to private suppliers. Aggregate recovery can benefit a range of different projects such as parks, trails, community associations, municipal or government projects. The CRD could partner with local suppliers (wholesale or retail) to market the aggregate.

Landfill lifespan

Based on current estimates and assuming the diversion of kitchen scraps, the Hartland Landfill is expected to be full around 2040-2045.

The technical options/scenarios discussed in this memo offer opportunities to substantially increase the life of the Hartland Landfill, potentially fulfilling its mandate as a long term, sustainable waste management asset.

Liquid waste management

The CRD is currently implementing the Core Area Wastewater Treatment Program. The approved Liquid Waste Management Plan Amendment No. 8 specified Hartland landfill as a location for the biosolids energy centre for the program. A public consultation process for the siting of the biosolids facility will take place in late spring of 2013 and will help identify which location is preferred by the broader community.

Potential for resource recovery - Work done to date

The CRD has already undertaken a substantial amount of work to investigate how resource recovery could be increased. A number of studies and staff reports provided much of the technical detail for the scenarios presented in Section 4. These resources include the following, and are available to PTAC members who wish to access more technical information:

- Tri-regional WTE study (2010, AECOM)
  The Tri-regional WTE study looked at options for consolidating waste from the CRD, CVRD and RDN to improve economies of scale for energy recovery. Scenarios were compared with sites located in RDN, in CRD and in CVRD; as well as one off-site scenario with waste transported to a third party site at Gold River. It was determined that:
  - WTE, regardless of location would cost in the order of $100 to $110 per tonne once transportation is factored in.
  - Employing advanced technologies to make fuel from waste at this time carries a cost premium and would be over $130 per tonne.
  - If the transportation component is removed for the CRD and only CRD waste is combusted in a WTE plant with district energy, the cost drops to about $90 per tonne.

- Household Organics Management – Phase 1 (2010, AECOM, HB Lanarc)
  The purpose of this study was to review short and long term options for kitchen scraps in the CRD. The Liquid Waste Management Plan was proposing to co-digest kitchen scraps with biosolids to increase the energy recovery, but this option would not be available in the short term (until 2017 at the earliest). The Study investigated various technical options and scenarios and came to the following conclusions:
  - The most economical long term solution is to co-digest kitchen scraps with biosolids.
  - The final deposition of biosolids residuals to the land is not desired in the CRD, therefore co-digestion would also preclude the use of kitchen scraps for use as soil amendment (after the AD process), since they would be mixed with biosolids. The biosolids solution is to dry them and use them as fuel for cement kilns.
  - Since biosolids will not be available in the short term, it was recommended to proceed with interim composting or AD for a minimum of 8 years and consider co-digestion at that time.

4. Resource Recovery Technologies and Options

The following table summarizes the technical options described in Section 1.2. Technologies are shown as options in a matrix that identifies potential benefits and costs.

In subsequent sections, these technical options are combined to create three possible resource recovery scenarios, which are then evaluated in greater depth.

Table 1 Summary of the benefits and costs of various recovery options.

Tech. No.	Recovery Option	Materials Recovery Potential	Energy Recovery Potential	Landfill Life Expansion Potential	GHG Reduction (global view)	Affordability of Capital Investment*	Affordability of Operating Costs (net of revenues)*	Comments
	Recovery Options for Mixed Unused Waste Before Disposal							
1	Mechanical separation of unused residuals to recover additional recycling (e.g. metals, and glass)	Low (5% assumed for metals and glass)	None	Low	Medium	Moderate Estimated to be about $12 million initially, with refurbishment every 10 years	Moderate Typically about $40 per tonne	Relatively high capital investment for the recovery of small volumes of metals and some glass and potentially some plastics (glass has minimal market value).
	Technology Options for Thermal Energy Recovery from Unused Waste Before Disposal							
2	Mechanical separation and biological treatment of residual waste for additional recycling and production of refuse derived fuel (RDF)	Low (5% assumed for metals and glass)	High (over 60% efficiency if used to replace natural gas or coal)	High/Very High	Medium	Moderate About $60 million to build	Moderate $40 per tonne to operate, but no net revenue from sale of RDF expected	Contingent on markets being found for RDF that will pay for the fuel. If transportation costs outweigh fuel value, economics of this option are weakened.
3	Conventional combustion (mass burn/controlled air systems)	Low (3% typical for metals recovery)	High (27% efficiency for electricity only; over 60% with district energy)	High	Medium	Low About $160 million to build	High About $10 per tonne. Electricity sales cover most O&M costs	This is the only thermal energy recovery technology proven for short term implementation.
4	Advanced technologies (pyrolysis, gasification, plasma)	Low (3% typical for metals recovery)	High (27% efficiency for electricity only; over 60% with district energy)	High/Very High	Medium/High	Low About $180 million to build	Moderate About $20 per tonne. Energy sales help offset O&M costs	Potential for future, beyond 2020, once technologies are proven

Tech. No.	Recovery Option	Materials Recovery Potential	Energy Recovery Potential	Landfill Life Expansion Potential	GHG Reduction (global view)	Affordability of Capital Investment*	Affordability of Operating Costs (net of revenues)*	Comments
	Biological Options for Energy Recovery from Residual Waste Before and after Disposal							
5	Anaerobic digestion	Moderate Kitchen scraps over 20% of waste are recovered	Moderate (energy recovered only from kitchen scrap portion of waste)	Moderate	High	Moderate About $10 million for kitchen scraps only	Moderate About $40 per tonne, after energy sales	Could be implemented by private sector in response to Regional Kitchen Scraps Strategy.
6	Landfill gas capture	Low	Moderate (only organics create gas, other energy is lost)	Low	High	High Part of landfill gas management strategy	High Part of landfill gas management strategy	Already in place and being expanded in short term to meet Ministry of Environment targets of 75% gas capture.
	Non-Energy Resource Recovery							
7	Aggregate recovery	High	None	Medium	Low	High Part of normal landfill operations	High Assuming aggregate can be sold	Rock removal necessary part of landfill optimization. Aggregate sales have revenue potential to offset future operating costs
8	Landfill mining	Low	None	Medium Discussed in separate memo	Low	Moderate Discussed in separate memo	Moderate Discussed in separate memo	Future option for creating landfill space

* Cost estimates are order of magnitude based on previous studies and publicly available information.

5. Resource Recovery Scenarios

Individual resource recovery technologies can be combined to increase the overall recovery rate and to increase efficiency. These combinations of technologies are referred to in this memo as scenarios, which reflect what can be achieved in the very short term with moderate effort, what can be implemented in the midterm, and what has better potential for the future after 2020. The analysis of the potential of resource recovery has been structured around the following three scenarios:

1. Enhancement of Existing System
2. Short Term Options up to 2020
3. Long Term Options past 2020

In the Table 2 below, the applicability of the scenarios in the short and long term is shown, as well as which technologies would be used in each scenario.

Table 2 Technical options for resource recovery scenarios

SCENARIO NUMBER	**1**	**2**	**3**
Short Term	Yes	Yes	No
Long Term	Yes	Yes	Yes
Mechanical separation of residual waste to recover additional recycling (e.g. metals, and glass)	✓		
Anaerobic Digestion		✓	
MBT with RDF production		✓	
Conventional combustion		✓	
Advanced thermal technologies			✓
Landfill gas capture	✓	✓	✓
Non-energy resource recovery	✓	✓	✓
Landfill mining	✓		

Common to all scenarios will be continuation or expansion of the existing programs to achieve waste reduction, reuse and recycling, including composting and existing and future product stewardship

programs. Also common to all scenarios will be maximizing the life of the landfill by making best use of the existing space through excavation of rock for future airspace.
Landfill gas capture and utilization will be enhanced in all scenarios to help meet the BC MOE guideline of 75% gas capture.

The advanced WTE technology is only considered in scenario three, since it is not commercially proven at this time and there would be short term financial and technical risks. Some of the new technologies under development hold the promise of converting waste to liquid fuels and/or vitrifying the residue so that there is almost nothing left to dispose of at the landfill. Since some plants for these advanced technologies are already in planning or under construction, it is expected that the technologies may have operating and cost data available within 5 to 10 years and might then be considered mature or proven technologies for consideration.

Scenario 1: Enhancement of existing system

Brief Description:
In Scenario 1 the emphasis remains on waste diversion before the residuals are brought to the landfill. Maximum diversion is achieved through the source separation (recycling and composting) and product stewardship programs that target materials generated by the residential, ICI and C&D sectors. At the landfill, resource recovery can be enhanced through additional mechanical separation primarily for the removal of metals and through additional landfill gas extraction. Thermal recovery options (WTE) are not considered in this scenario. While the recovery of rock/aggregate is part of normal operations to create cells for waste placement, this scenario includes realizing opportunities to make the cells deeper to allow the placement of more waste and to generate more aggregate, if there are markets for this material. The optimization of cell construction and aggregate generation requires additional detailed analysis.

The additional mechanical recovery of materials could increase landfill life by about 2 years. By optimizing the rock excavations, landfill life can be extended by an additional 3 years, for a total of 5 additional years of landfill life being available under this scenario. The Hartland landfill would be available until about 2045.

A flow diagram of Scenario 1 is shown Figure 4 with areas for potential activity highlighted.

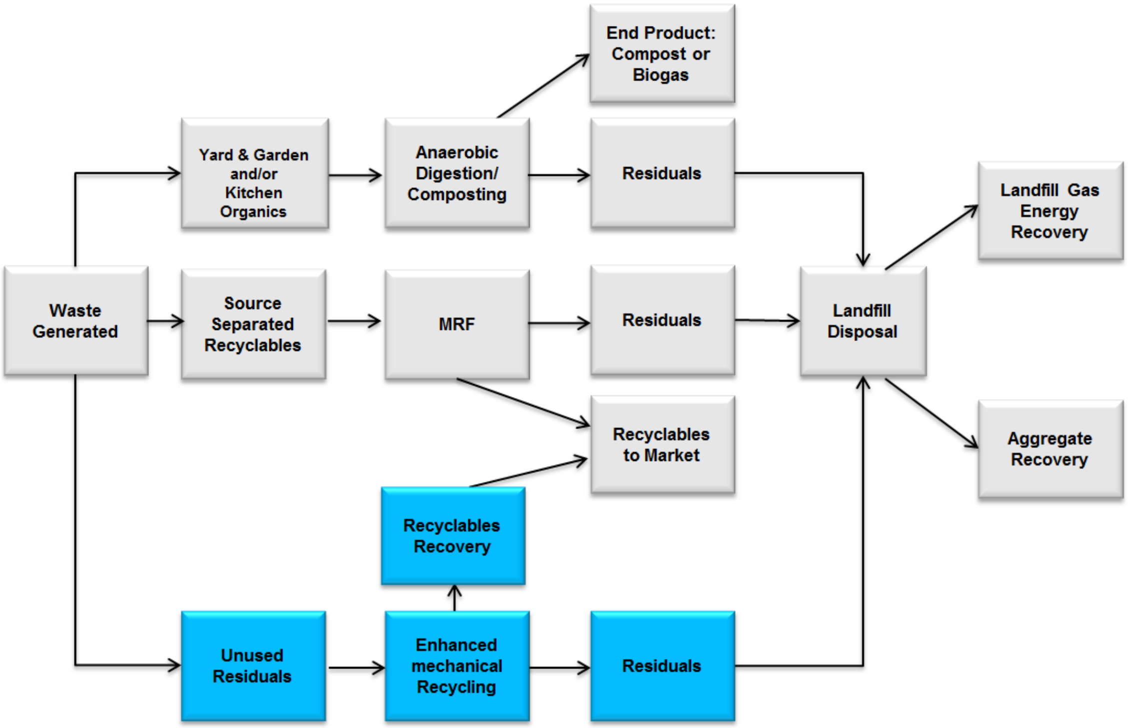

Figure 4 Flow Diagram Illustrating the Enhancement of Existing System

Advantages of Scenario 1:

- Emphasis of resource recovery remains the traditional recycling and composting of materials (higher level of waste hierarchy)
- Lowest initial capital costs
- Lower initial operating costs
- Can be combined with other resource recovery options at any time in the future (flexibility)

Disadvantages of Scenario 1:

- Energy resources are not captured
- Landfill life is only extended by about 5 years
- The practical diversion limit utilizing recycling and organics programs is in the order of 70-80%, leaving the balance (or non-recyclable waste) still going to landfill
- Landfilling of residual waste is a cost, whereas other options may generate revenue from the energy still in the residual waste

Scenario 2: Short term options up to 2020

Description:

This scenario includes all source separated resource recovery activities and adds the recovery of energy from the residual waste using conventional WTE technology or RDF. This will reduce the amount of residual waste going to landfill (up to 90% by volume) and substantially extend landfill life. Additional mechanical separation at the landfill would not be used since most WTE plants extract metals for recycling after combustion.

Using AD technology may be an option for this scenario if the private sector does not adequately respond to the Regional Kitchen Scraps Strategy. Landfill gas extraction would continue to be optimized to meet regulatory targets.

Assuming thermal recovery is employed, the waste going to landfill is reduced 90% by volume. Further assuming that WTE would be implemented in 2020, the landfill life could therefore be extended to 2127, or by an additional 87 years.

A flow diagram of Scenario 2 is shown in Figure 5 with areas for potential activity highlighted.

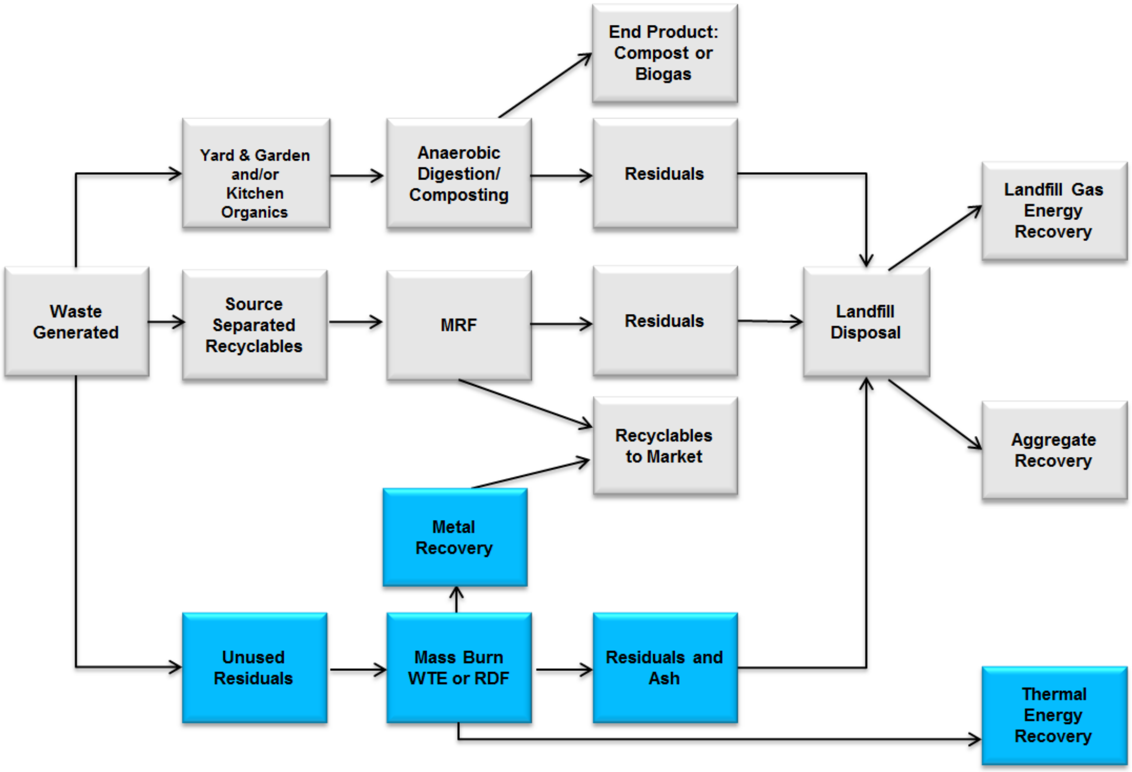

Figure 5 Flow Diagram Illustrating the Short Term Options up to 2020

Advantages of Scenario 2:

- Immediate recovery of the energy remaining in the residual waste after recycling
- Maximizes landfill life if implemented in the short term

- Revenues from the sale of energy
- Could utilize separately collected kitchen scraps if private sector does not adequately provide capacity for this material

Disadvantages of Scenario 2:

- Short term financing and permitting requirements of a WTE or RDF plant
- Limited to traditional combustion systems and RDF production in the short term
- Technology, once chosen, is “locked-in” for at least 25 years with limited upgrade possibilities
- Potential to miss opportunities to find common solution to biosolids management requirement coming from liquid waste management operations if WTE or AD is implemented too soon

Scenario 3: Long term options past 2020

Description:

This scenario defers the selection and installation of WTE systems until after 2020, when emerging technologies may be commercially proven. It still results in a substantial savings in landfill space, although less than Scenario 2, since radical diversion is delayed by 5 or more years. However, this scenario provides time for the CRD to observe the impact of the Regional Kitchen Scraps Strategy and other source separation programs, and to explore possible synergies with biosolids management from the liquid waste program.

Depending on the technology employed, landfill life will be the same as for scenario 2 (until 2127), or if a plasma system is chosen with minimal residual going to landfill, then the landfill could be used for disposal until 2205 (an extension of 165 years).

A flow diagram of Scenario 3 is shown in Figure 6 with areas for potential activity highlighted.

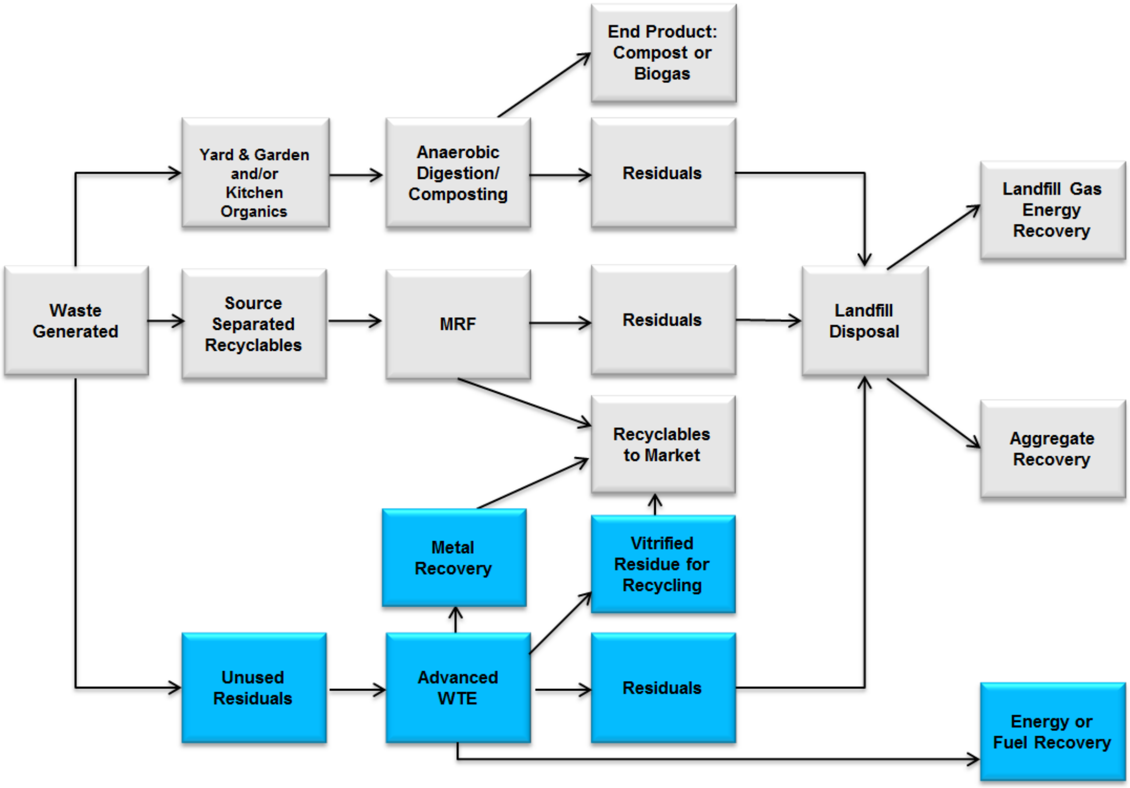

Figure 6 Flow Diagram Illustrating the Long Term Options past 2020

Advantages of Scenario 3:

- Much improved recovery of the energy remaining in the residual waste after recycling
- Landfill life is extended well into the future
- Revenues will be available from the sale of energy
- Newer technologies may be able to convert energy into other fuels
- Waiting with implementation until after 2020 offers more flexibility of technology selection and sizing
- Potential to coordinate activities with liquid waste management of residuals (biosolids)

Disadvantages of Scenario 3:

- Landfill remains major disposal solution until newer technology is implemented
- Newer technologies may not develop as quickly as expected, or be as efficient or cost effective as projected
- Long term commitment to complex technology is required

6. DISCUSSION OF SCENARIOS

The following table summarizes the potential benefits and costs of the resource recovery scenarios described in the previous section.

Table 3 Summary of the benefits and costs of various recovery options.

Scenario No.	Recovery Options Included	Materials Recovery Potential	Energy Recovery Potential	Landfill Life Expansion Potential	GHG Reduction (global view)	Affordability of Capital Investment	Affordability of Operating Costs (net of revenues)	Comments
1 Enhanced of existing system	• Recycling, composting/AD Mechanical separation of metals and glass • LFG recovery • Aggregate • Landfill mining (potential)	Moderate	None	Moderate About 5 years from mechanical separation and aggregate	Medium Substantial contribution from recycling	Moderate	Moderate	Relatively small volumes of additional recyclables expected from complex mechanical process. Landfill mining expected to be costly if required in the future.
2 Short term options	• Recycling, composting • Potentially AD • MBT with RDF or WTE • Metal recovery • LFG recovery • Aggregate	Moderate	High	High More than 80 additional years of landfill life	Medium/ High Substantial contribution from recycling. RDF can replace fossil fuels	Low Substantial investment needed in WTE or RDF infrastructure	High Sale of energy can offset majority of operating costs	High initial capital costs, but long term life cycle costs may be lowest due to revenues from energy sales. Requires facility replacement every 25 to 50 years
3 Long term options	• Recycling, composting • Potentially AD • Advanced WTE with ash recycling • Metal recovery • LFG recovery • Aggregate	High Assumes ash will be recycled fully	High	Very High More than 150 additional years of landfill life	High Substantial contribution from recycling. Advanced WTE can replace fossil fuel	Low Highest cost for advanced technologies expected	Moderate Sale of energy can offset some operating costs	Advanced technologies hold promise of highest resource recovery and landfill life. At least 10 years needed for these technologies to develop to commercial scale and be proven.

When comparing scenarios, the following should be considered:

- Enhancement of the existing system (Scenario 1) will have the lowest initial capital cost, but operating costs may be higher in the long term, since there would be no substantial recovery of energy and its associated revenues. Studies in other jurisdictions have shown that life-cycle costs over the long term may be lower for scenarios that include WTE than for landfill only. Under this scenario, the landfill will have to be replaced or expanded sooner than with more aggressive resource recovery and landfill mining may have to be implemented in the future to extend landfill capacity.
- WTE in the short term (Scenario 2) offers a substantial increase in resource recovery, landfill diversion and consequently landfill life. However, if major investments are made in WTE technologies (thermal or biological), this basically locks-in the technology for many years, since WTE, RDF and AD equipment is generally built and used for at least 20 to 25 years. The production of RDF has the advantage over mass burn that the fuel can be burned at a different location where combustion facilities are already in place and initial capital costs are lower than for mass burn. AD takes only a small portion of the waste stream and thus by itself, contributes the smallest amount to resource recovery and landfill life extension. AD and mass burn have the advantage that markets for electricity are stable in the longer term.
- Continuation of current (or enhanced) resource recovery efforts in the short term and implementing high resource recovery in the long term (Scenario 3) offers a high degree of flexibility. This scenario buys time to observe the development of technology for additional energy resource extraction and also to gauge the efficiency of waste diversion and product stewardship programs, which are being implemented in the next five years. It still offers ample time to invest in advanced technologies that will reduce waste to a minimum and extend the life of the Hartland landfill well into the future. The deferral of thermal recovery may offer possibilities to employ technologies that are more efficient than current ones at energy capture and residue reduction.

A thorough discussion around financial implication of various ISWRMP scenarios will further inform future conclusions and recommendations.