Comox Valley REGIONAL DISTRICT

Staff report

DATE: November 24, 2017

FILE: 5360-30/SWMP

TO: Chair and Directors
Comox Valley Regional District
(Comox Strathcona Waste Management) Board

FROM: Russell Dyson
Chief Administrative Officer

Supported by Russell Dyson
Chief Administrative Officer

R. Dyson

RE: Waste to Energy Business Case Assessment – Final Results

Purpose
The purpose of this report is to present final results and recommendations regarding the Comox Strathcona Waste Management (CSWM) Waste to Energy (WTE) business case assessment.

Recommendations from the Chief Administrative Officer:
THAT the Comox Valley Regional District (Comox Strathcona Waste Management) Board receive the final report from Morrison Hershfield titled 'Comox Strathcona Waste Management Waste to Energy Assessment, dated November 22, 2017.

AND FURTHER THAT the Comox Valley Regional District (Comox Strathcona Waste Management) Board reassess the viability of Waste to Energy and alternate disposal technologies in 2022 as part of the major ten year update of the Solid Waste Management Plan.

AND FINALLY THAT the Comox Valley Regional District (Comox Strathcona Waste Management) Board refer the final Waste to Energy Assessment report to the Association of Vancouver Island and Coastal Communities for further referral to member governments.

Executive Summary
In the summer of 2017 CSWM posted a Request for Information for WTE technologies. Six submissions were received and evaluated based on evaluation criteria with Waste Treatment Technologies (WTT) Netherlands B.V., Eco Waste Solutions and Sustane Technologies Inc. (Sustane) ranked as the top technologies/vendors. These vendors were then carried forward through a more detailed assessment including cost and greenhouse gas modelling. This final assessment is provided by Morrison Hershfield in their report titled "Comox Strathcona Waste Management Waste to Energy Assessment" dated November 22, 2017 and attached as Appendix A. The following points summarize the key findings:

- WTE technologies evaluated include a range from conventional combustion to anaerobic digestion to converting waste into fuel for burning by a third party. Some vendors provided a combination of technologies in their final solution.
- Four potential sites were considered and evaluated for siting a WTE facility. It was concluded that all sites could be used and that future transportation and site servicing costs will be important factors in any final siting.
- Regulatory requirements to proceed with WTE include an update of the Solid Waste Management Plan (SWMP) along with extensive public engagement and education. An

environmental assessment, although not necessarily required by regulation, may be requested by the BC Ministry of Environment due to public concern.

- The assessment compares the cost of conventional landfilling (status quo) to modeled scenarios for three WTE technologies over 25, 40 and 50 year time periods to determine the most cost effective solution.
- Conventional landfilling as per the 2012 Comox Strathcona SWMP continues to be the most cost effective final disposal solution by approximately $30 to $110 per tonne less than WTE.
- Of the WTE technologies evaluated, Sustane offers lower costs than the other two vendors, however they attract greater risk for the Comox Valley Regional District due to lack of installed infrastructure and untested technology.
- Initial capital construction costs for the three WTE technologies are as follows:
    - WTT Netherlands BV - $26.0M
    - Eco Waste Solutions - $52.7M
    - Sustane Technologies Inc. - $25.0M
- Creating a solid fuel (RDF or bio-pellets) is substantially less expensive that traditional WTE, however the risk with RDF or bio-pellets is finding long tem markets for the product.
- WTE can provide an approximate five per cent reduction in Green House Gas (GHG) emissions over landfilling.

Although WTE can provide benefits in terms of reduced GHG emissions and the further reuse and recycling of materials the results of the long term cost modeling show that landfilling remains the most cost effective waste disposal option for the region.

As technologies continue to advance and improve over time it is suggested that CSWM revisit an assessment of alternative waste disposal technologies in 2022 in conjunction with a full update to the SWMP and prior to expansion of the Comox Valley Waste Management Centre landfill. It is also suggested that the report be referred to the Association of Vancouver Island and Coastal Communities so that it can be further disseminated to other local governments for their information and consideration.

Prepared by:

M. Rutten

Marc Rutten, P.Eng.
General Manager of
Engineering Services

Attachments: Appendix A – "Comox Strathcona Waste Management Waste to Energy Assessment, November 22, 2017"

Appendix A

MORRISON HERSHFIELD

REPORT

COMOX STRATHCONA WASTE MANAGEMENT

Waste to Energy Assessment

Prepared for: **Comox Valley Regional District**

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Project No. 5170574.00 November 22, 2017

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EXECUTIVE SUMMARY

Comox Strathcona Waste Management (CSWM) provides solid waste management services to the Comox Valley Regional District (CVRD) and the Strathcona Regional District (SRD). The Solid Waste Management Plan (SWMP) adopted in 2013 identifies the long-range preference to explore and pursue energy recovery from residual waste through Waste to Energy (WTE) technologies. The purpose of this WTE assessment is to compare the cost of conventional landfilling to modeled scenarios which include a new WTE facility as part of the CSWM system.

There is a need to ensure long-term waste management solutions are the best value for the tax payer and meet environmental and social standards and expectations. This study has been commissioned to re-evaluate WTE as a means to reduce waste management costs in the long term, while providing the region with secure long term processing and disposal capacity for solid waste.

For the purpose of this study, the definition of WTE has been expanded to include energy from organics through anaerobic digestion (AD) and converting waste into fuel for burning by a third party (refuse-derived fuel [RDF] and bio-pellets). Within this report, references to WTE technologies or facilities encompasses this definition of WTE.

To gather essential information for this assessment, a public request for information (RFI) was posted on BC Bid and resulted in the submission of six responses from vendors offering energy recovery technologies:

- Eco Waste Solutions (EWS)
- REDWAVE, a Division of BT-Wolfgang Binder GmbH
- SALT Canada Inc.
- Sustane Technologies Inc. (Sustane)
- WastAway
- WTT Netherlands BV (WTT)

EWS was the only vendor offering conventional combustion with energy recovery in the form of electricity and heat. Redwave, Sustane, WastAway and WTT all offered some form of recyclables recovery plus the preparation of waste derived solid fuel for sale to third parties. SALT offered a form of aerobic landfill stabilization with subsequent mining of the landfill for recyclables and organics. Vendors were made aware of the additional diversion up to 70% required prior to the consideration of WTE under BC MOE policy, and waste quantities provided to the vendors reflected this additional diversion.

All submissions were subjected to an evaluation to determine a ranking of suitability for the region. The evaluation was based on criteria developed with the CVRD and endorsed by the Select Committee and Board. The evaluation resulted in the following technologies being chosen (jointly with the CVRD and Select Committee) for further assessment and comparison:

- WTT because it offers a combination of proven technologies to recover energy biologically (AD), recover additional recyclables, and create RDF for sale to third parties;
- EWS because it offers a conventional and proven combustion technology which will produce energy in the form of electricity and for which markets generally are available; and

- Sustane because it offers innovative technology to convert plastics to a synthetic diesel, recycle metals and convert organics into bio-pellets for sale to third parties.

This was not a selection process. The selection of a vendor would occur at a later date through a competitive and public procurement process, should the decision be made to proceed with the implementation of a WTE facility after this study.

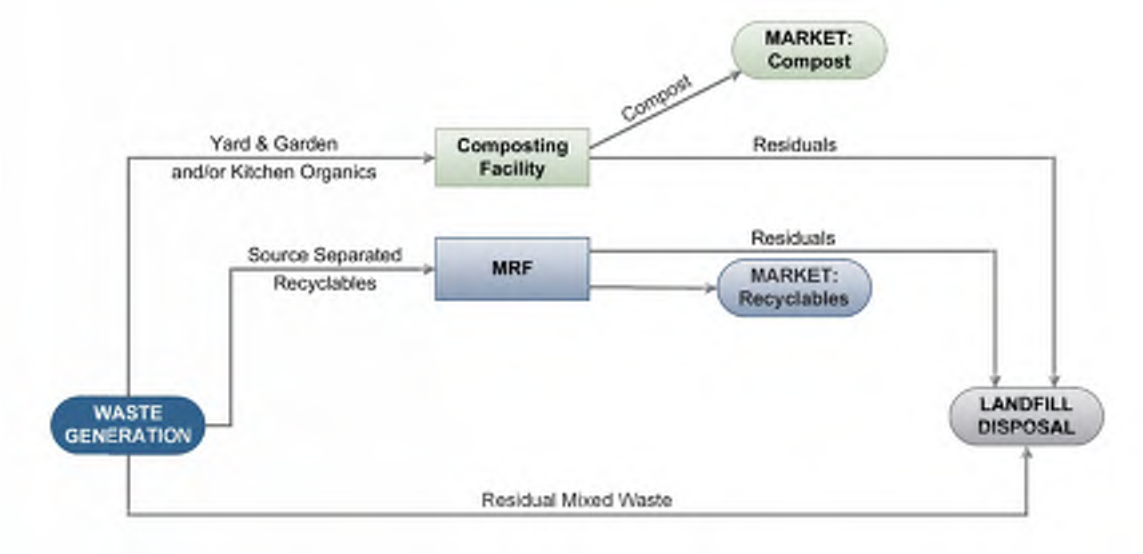
Three locations were considered for the potential facility; Comox Valley, Campbell River and Gold River. Four potential sites in these areas were reviewed in detail looking at zoning, transportation, proximity to waste sources, access to utilities, buffers, air-shed, and site suitability. Essentially, all sites could be used and each has some advantages and disadvantages. Being close to where most of the waste is generated reduces hauling costs and makes the CVWMC attractive, as it also has existing waste management infrastructure that could serve dual purposes. However, lack of adequate process water and sanitary sewer is a drawback. Gold River would be attractive from infrastructure and permitting perspectives, but transportation costs make this site considerably more expensive. Ultimate selection of a site will depend on the technology and could be finalized once a decision has been made to proceed with a procurement process for the implementation of a WTE facility. All three areas are considered during the analysis of options.

Regulatory requirements are limited to an amendment of the solid waste management plan (SWMP), along with public engagement and education. As part of the SWMP amendment, the Ministry of Environment (MOE) will direct necessary actions for obtaining an operating certificate (OC). An environmental assessment is likely not required due to the small scale of the proposed facility, however, at the request of special interest groups, the general public, or other interested parties, the MOE may mandate an environmental assessment.

Applying the three preferred technologies to the study region resulted in the following options:

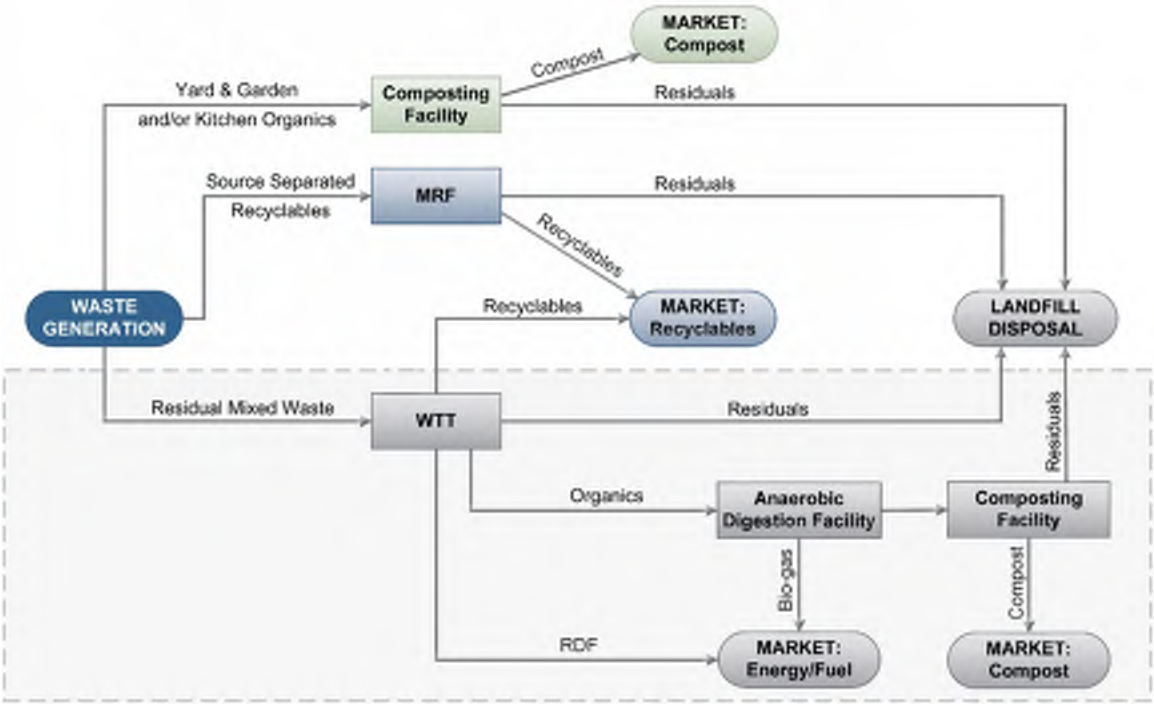
Option 0 – Status Quo

In order to determine whether to proceed further with evaluating WTE options and confirm potential costs or savings, the status quo is reviewed and compared to the WTE options. Under this status quo option, waste generated in the SRD is landfilled at the CRWMC Landfill until closure, after which time the existing transfer station is utilized to transfer waste to the CVWMC Landfill for disposal. The CRWMC Landfill is expected to reach capacity in 2023 and final closure would occur after that. Flow of the various waste streams under Option 0 is shown in the figure below. The grey-shaded area in the figure below and in subsequent figures shows the portion of the current CSWM system and, where applicable, the WTE technology processes that are included in the model options.



Option 1 – WTT (Mixed waste processing with anaerobic digestions and production of RDF)

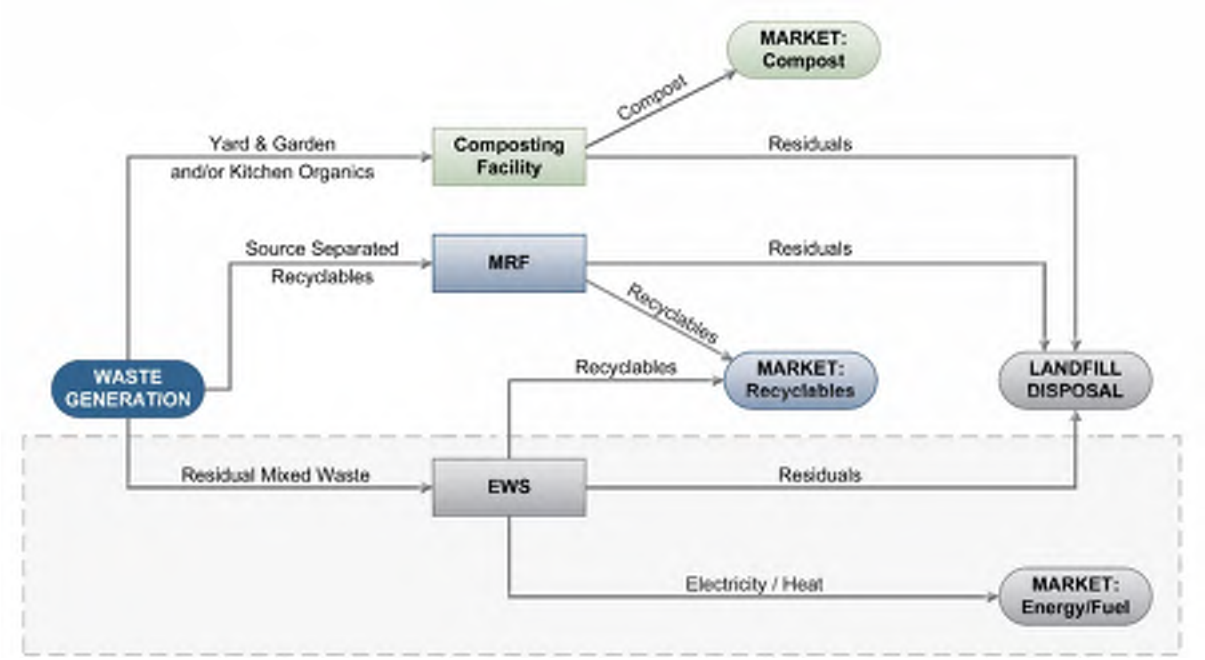
Under this option a WTT facility would be added into the system and constructed in either of the three locations under consideration. The facility would divert organics, metal and cardboard and generate biogas and RDF. The residual stream is estimated to 33.5% of the input waste tonnages. A flow diagram showing the various components of the WTT system is shown below.



Option 2 – EWS (Conventional combustion WTE technology)

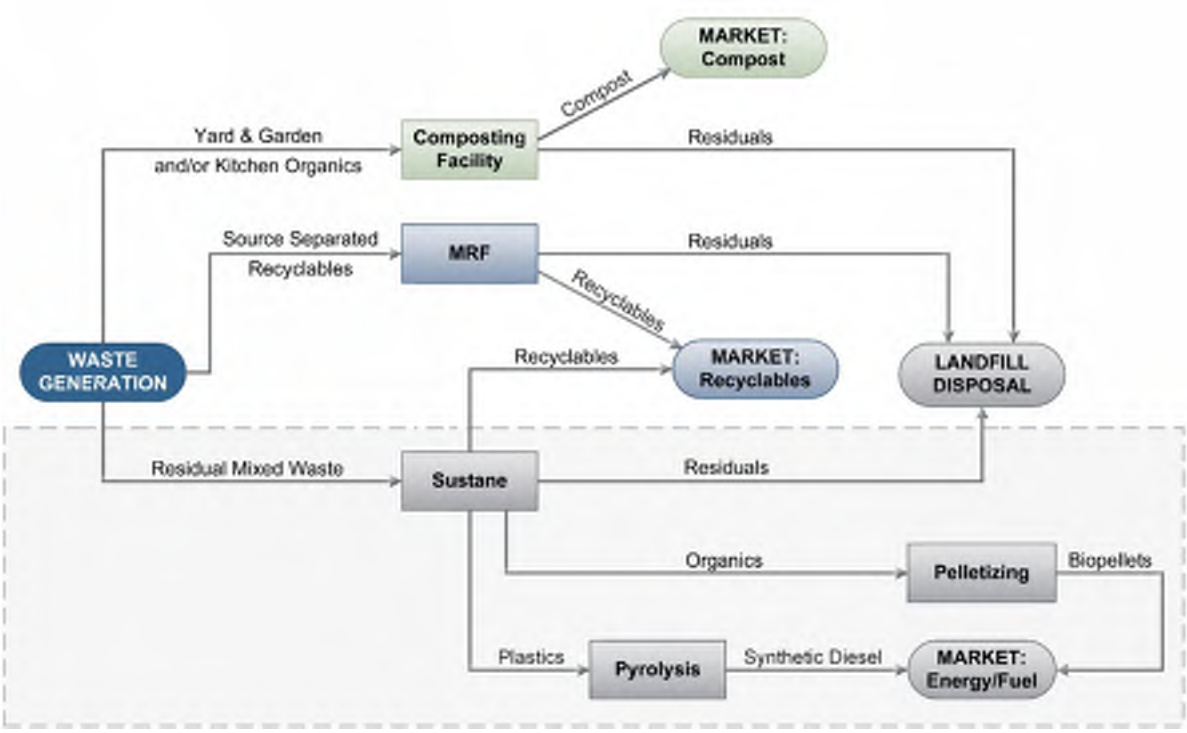
Under this option an EWS facility would be added into the system and constructed in either of the three locations under consideration. The received waste would be incinerated without prior sorting or diversion, however metals could be recycled from the bottom ash. The residual ash is estimated to be

17% of the input waste based on the vendor submission. A flow diagram showing the EWS system is shown below.



Option 3 – Sustane (Mixed waste processing with production of bio-pellets and synthetic diesel through pyrolysis)

Under this option a Sustane facility would be added into the system and constructed in either of the three locations presented above. The received waste would be processed, metals and plastics would be diverted, and bio-pellets and synthetic diesel would be produced. The residual waste for landfilling is considered inert and is estimated at 11% of the input waste. A flow chart of the Sustane system is shown in the figure below.



Cost Model

In order to evaluate the long-term system costs of each option, coupled with the different potential locations, the long-term cost models developed by AECOM in 2011 were updated. For the technology options, specific aspects of the model were updated along with capital and operational costs. All costs were projected over 50 years. The following 4 options plus sub-options (for a total of 10) were compared:

- Option 0 - Status Quo
- Option 1 – WTT
  - 1(a) - WTT located in Comox Valley
  - 1(b) - WTT located in Campbell River
  - 1(c) - WTT located in Gold River
- Option 2 – EWS
  - 2(a) - EWS located in Comox Valley
  - 2(b) - EWS located in Campbell River
  - 2(c) - EWS located in Gold River
- Option 3 – Sustane
  - 3(a) - Sustane located in Comox Valley
  - 3(b) - Sustane located in Campbell River
  - 3(c) - Sustane located in Gold River

A comparison of the three technology costs and revenues is shown in the table below. Note that costs shown only include capital and operating costs specific to the WTE facilities, and do not include the entire system. Nor is potential capital upgrades included. It has been assumed that the technologies can function for 50 years, and capital costs will be paid off after 25 years.

The capital costs were provided by the vendors in response to the RFI. The costs were reviewed and modified if the number provided didn't include requested costs such as a building for waste receiving and processing. The capital costs were also compared to other similar facilities to determine whether they were reasonable.

		Capital Cost WTE Facility *(one time lump sum $)*	**Capital Cost** *($/tonne)*	**Operating Cost** *($/tonne)*	**Revenue** *($/tonne)*	**Total Break-Even Tipping Fee** *($/tonne)*
Year 1-25	**WTT**	$26.00M	$38.21	$120.00	-$7.20	$151.01
	EWS	$52.68M	$77.41	$116.00	-$31.90	$161.52
	Sustane	$25.00M	$36.74	$82.07	-$29.33	$89.48
Years 26-50	**WTT**	N/A	N/A	$120.00	-$7.20	$112.80
	EWS	N/A	N/A	$116.00	-$31.90	$84.10
	Sustane	N/A	N/A	$82.07	-$29.33	$52.74

The need for landfilling would be reduced to different levels depending on the technology option. The increased diversion from applying one of the WTE technologies would affect the life of the landfill and subsequently the timing of capital projects (cell construction and closure). Landfill savings at the CVWMC are included in the long-term cost model.

A transfer station would be required in Campbell River should the new WTE facility be located in Comox Valley or Gold River. It has been assumed that the current transfer station would be utilized to its expected end of life (2051) with some capital upgrades and repaving in 2032. The transfer station would then be replaced in 2052.

A transfer station would be required in Comox Valley should the new WTE facility be located in Campbell River or Gold River. It has been assumed a new transfer station would be built at the CVWMC. The transfer station would require capital upgrades every 20 years.

The capital and operational costs of the transfer stations are included in the cost model calculations.

The total system cost over 30, 40 and 50 years associated with each technology option and sub-option is presented below. The total cost for the technology options, transfer stations and landfill within each option were also determined for the stated periods. Cost projections include capital costs (new facilities, landfill expansion and closure as well as equipment), operating costs, and revenues from the sale of energy and products/recyclables. The results from the previous assessment developed in 2011 have been included in the table as well for comparison purposes.

Option		30 years	40 years	50 years
2017 Long-Term Cost Model		*($/tonne)*	*($/tonne)*	*($/tonne)*
0	Status Quo	$82	$79	$76
1(a)	WTT in Comox Valley	$164	$159	$151
1(b)	WTT in Campbell River	$174	$167	$159
1(c)	WTT in Gold River	$199	$193	$185
2(a)	EWS in Comox Valley	$168	$153	$140
2(b)	EWS in Campbell River	$177	$159	$146
2(c)	EWS in Gold River	$196	$181	$168
3(a)	Sustane in Comox Valley	$120	$111	$103
3(b)	Sustane in Campbell River	$126	$115	$107
3(c)	Sustane in Gold River	$150	$140	$132
2011 Long-Term Cost Model (AECOM, 2011)				
1	Small-scale conventional combustion WTE facility in Comox/Courtney	$164	$143	$130
2	Large-scale conventional combustion WTE facility in Campbell River	$89	$88	$88
3	Large-scale conventional combustion WTE facility in Gold River	$114	$113	$113
A	CVWMC Landfill – one regional landfill	$69	$62	$74
B	Campbell River – one regional landfill	$74	$71	$83
C	CVWMC and CRWMC Landfills – two reginal landfills	$73	$68	$65

As can be seen from the table above, the lowest cost WTE option is a Sustane facility in Comox Valley. However, this does not compare favourably with the Status Quo option. Landfilling remains about 30% less costly than the lowest cost WTE option. However, any of the WTE options offer an extended landfill lifespan well beyond the modelling period and lower GHG impacts.

The most proven WTE technology (EWS) is about twice the cost of landfilling, but offers the most secure method of waste destruction and energy recovery.

It is important to note that the per-tonne costs outlined above do not include the entire CSWM system costs. Services outside of the residuals management such as the future composting facility and recycling services are not included within this cost analysis as these services would continue with or without the implementation of a WTE facility. However, the costs include transfer of the disposed waste, as well as capital and operating costs of transfer stations and landfills.

Greenhouse Gas Emissions (GHG)

The GHG emissions for each of the options, including status quo, was assessed for a period of 40 years. The assessment included the GHG emissions for the technology options, landfilling and transfer station operations (including waste hauling). The location of a WTE facility has a relatively small impact on the overall GHG emissions. However, the recycling of metals, cardboard and plastics contribute to large GHG offsets. The net GHG emissions range from -777 tonnes CO_2e (Option 1(a)) to 821 tonnes CO_2e (Option 0) over the assessed 40 year period.

In terms of GHG emissions, each WTE technology is favourable when compared to the status quo landfilling option. In particular, the WTT technology offers a net negative GHG emissions which is mainly attributed to the recycling of non-ferrous metals and cardboard.

Conclusion

The results from long-term cost modeling presented in this report indicates that the estimated cost to continue landfilling at the CRWMC Landfill until closure and to continue landfilling and expanding the CVWMC Landfill is approximately $80/tonne. Waste processing through one of the assessed WTE technology options would increase this cost by $31 to $110 per tonne, or $78M-$316M over a 50 year period. This cost per tonne represents the total system cost and include capital and operational costs related waste disposal (WTE and/or landfilling), waste transfer (transfer station and waste hauling) as well as any revenue from diverted materials or generated product or energy.

The lowest cost option is a WTE facility utilizing the technology provided by Sustane located at the CVWMC with system costs of $120 per tonne for the first 30 years, which drops to $103 per tonne at 50 years in operation. This cost per tonne remains higher than the status quo landfill operations. Sustane technology is an advanced combination of processes and individual technologies with only one identified reference facility in Europe. Very little is known about this plant and the effectiveness of the individual components. Anecdotally, it is known that some of the key technologies offered have had issues when applied on a commercial scale and there are no known operating examples in North America at this time. There is therefore a technical and commercial risk associated with this technology which may impact its feasibility and cost.

The two main factors affecting the overall system cost for the options is the facility break-even tipping fee, along with transportation cost of waste, ash and residuals. Once new facilities are in operation, landfill operational costs are reduced by up to 56% and the landfill capital cost by up to 33% over the 50 year projection period. The capital and operational costs for a WTE facility are then added to that reduced landfilling cost.

The siting and regulatory review indicate no significant barriers to implementing a WTE facility within the CSWM system. A consultation plan should be developed once a site and technology is selected. A SWMP amendment would also be required should WTE be implemented. It is recommended that consultation for WTE and a SWMP amendment occur at the same time.

Traditional WTE is a proven technology with generally available markets for the energy and a high degree of landfill space savings, however, it is expensive compared to most other technologies. Creating a solid fuel (RDF or bio-pellets) is substantially less expensive than WTE, mostly because capital and operational costs of the actual combustion component is borne by a third party. The main risk with RDF and bio-pellets is finding long term markets for the product. Without a market, both

WTT and Sustane would not meet their goal of being net energy producers nor would diversion of a large amount of waste from landfilling be possible. In other words, without secure long term markets for waste derived fuel, the processed material would have to be landfilled after being processed at a high cost. Though, WTE offers many benefits, the results from the long-term cost model show that landfilling remains the most cost effective waste disposal option for the region.

1. INTRODUCTION

1.1 Background

Comox Strathcona Waste Management (CSWM) provides solid waste management services to the Comox Valley Regional District (CVRD) and the Strathcona Regional District (SRD). The Solid Waste Management Plan (SWMP) adopted in 2013 identifies the long range preference to explore and pursue energy recovery from residual waste through Waste to Energy (WTE) technologies. WTE, also defined as thermal processing or thermal treatment, involves the conversion of municipal solid waste into gaseous, liquid and solid products and a concurrent or subsequent release of heat energy. The heat energy is then used in many cases to generate electricity.

Two main landfills are used for disposal of the majority of the region's waste. The Campbell River Waste Management Centre (CRWMC), located near Campbell River, handles waste from the SRD while the Comox Valley Waste Management Centre (CVWMC), located in Cumberland, handles waste from the CVRD. The Landfill at CVWMC is currently being expanded with a new engineered landfill and the Landfill at CRWMC is expected to close in the next 5-6 years. The total amount of landfill disposal for 2016 was 63,390 tonnes[1].

There are extensive recycling programs throughout the region and centralized composting is also being implemented to remove organics from the disposed waste stream.

There is continued interest in WTE technologies for managing of the residual waste component of the municipal solid waste (MSW) due to the current high cost of landfilling and the anticipated need for ongoing investments for landfill expansion.

WTE was studied in detail in 2011 by the CSWM. The most recent work involved expanding on and updating the previous study. There have been new developments in the WTE industry which involve integrating systems for the combined processing of waste to recover energy biologically and thermally, while making best use of residuals coming off the processes, e.g. compost and ash.

1.2 Scope and Timeline

Morrison Hershfield was engaged by the CSWM to assess WTE technologies. The project commenced in May 2017 with the preparation of a Request for Information (RFI). It was issued to suppliers of WTE and refuse derived fuel (RDF) production systems.

All information received in the response to the RFI was evaluated. Three technologies were selected for further research and assessment. The potential costs of the options were assessed against projected landfill costs. Other considerations such as siting, regulatory requirements, and environmental impacts (such as waste diversion potential and greenhouse gas (GHG) emissions) were compared to the current status quo systems.

[1] CSWM 2016 Disposal Tonnages

1.3 Objectives

Tipping fees in the region are currently $130 per tonne and the overall solid waste system is also supported by taxation. The CSWM is concerned about continued increases in solid waste management costs and about placing an even heavier financial burden on its taxpayers. This study identifies WTE technologies that are able to recover energy while substantially reducing the volume of waste/residuals going to landfill. This study also identifies the potential for cost savings from reduced landfill costs and compares them to the costs of WTE. This information should enable the CSWM to make an informed decision on whether or not to include WTE in its integrated system.

For the purpose of this study, the definition of WTE has been expanded to include energy from organics (anaerobic digestion or AD) and converting waste into fuel for burning by a third party (refuse derived fuel (RDF) and bio-pellets). Within this report, references to WTE technologies or facilities encompasses this definition of WTE.

2. REQUEST FOR INFORMATION PROCESS

Vendors of the various WTE technologies were invited to submit responses to a Request for Information (RFI) posted on BC Bid on June 13, 2017. Appendix A includes a memo outlining the detailed evaluation of the RFI submissions. In addition, specific vendors, primarily based in Europe, were approached and referred to the BC Bid website for access to the RFI. The European vendors were selected on the basis of the Consultant team's knowledge of firms who provide the selected technologies. The vendors were given until July 14, 2017, to submit responses to the RFI.

The purpose of the RFI was to obtain vendor specific information so that technologies could be ranked for suitability to CSWM. The RFI provided background information and clarified that technologies must be capable of processing quantities equivalent to approximately 125 tonnes MSW per day from the CSWM area. The vendors were requested to assume that waste reduction initiatives are being implemented to achieve a 70% diversion rate, which results in an estimated heating value of the residual waste that could range from 11 to 13 GJ/tonne. BC MOE developed a policy in 2010, requiring regional districts to plan to reach 70% diversion prior to considering WTE (BC MOE, 2010). This policy was considered during the development of the CSWM SWMP.

This section provides a summary of the RFI responses and evaluation.

2.1 Overview of RFI Responses

A total of six different vendors of mixed municipal solid waste (MSW) processing and energy recovery technologies responded. A brief summary of vendor claims, with additional comments by MH, follows:

- Eco Waste Solutions (EWS)
- REDWAVE, a Division of BT-Wolfgang Binder GmbH
- SALT Canada Inc.
- Sustane Technologies Inc. (Sustane)
- WastAway
- WTT Netherlands BV (WTT)

2.1.1 Eco Waste Solutions (EWS)

EWS is a well-known Canadian supplier of smaller conventional incineration systems. EWS is proposing that the WTE facility will comprise two EWS Enercon Thermal Conversion Modules. Each module will have a capacity of 100 tonnes per day. The system operates under excess air conditions with precisely controlled combustion through temperature and oxygen level controls and flue gas recirculation.

Air pollution control systems are included and are generally provided by companies specialized in supplying this equipment. Air pollution control equipment can be specified to meet current emission limits, or even stay well below them if desired.

The system is designed to produce electricity or steam, or both. The bottom ash by-product has been tested according to U.S. EPA Toxicity Characteristic Leachate Procedure (TCLP) for incinerator ash. The vendor has stated that all test results have been well below any standards set by the U.S. EPA

and have proven the ash to be non-hazardous, non-leaching and essentially inert. The vendor claims that beneficial use can include road construction backfill, road re-surfacing material, aggregate replacement in cement, landfill cover or a beneficial additive to some soils to improve drainage or correct pH.

There are numerous facilities currently using this technology and it is well proven.

2.1.2 REDWAVE, a Division of BT-Wolfgang Binder GmbH

REDWAVE offers a mechanical-biological waste treatment technology for the mixed residual MSW. Mixed waste is mechanically separated into wet (organics) and dry components and sensor-based sorting recovers recyclables from the dry component. The wet organics are biologically dried and stabilized, and together with the residue from dry sorting are converted into a refuse derived fuel (RDF). RDF can be utilized in cement kilns, pulp mills and or other industry with high energy demand to offset fossil fuels. The vendor mentions two pulp mills located on the Island, in Port Alberni and Crofton, as potential markets, however no market for the RDF has been established.

This is a proven technology in Europe. It is generally not used in Canada due to its cost and difficulties in establishing long term markets for the RDF.

2.1.3 SALT Canada Inc.

SALT Canada Inc. offers a technology that consists of two distinct steps. In the first step, conventional landfill cells are made aerobic (similar to composting) by injecting large amounts of air. The waste is stabilized and the cell can be opened and mined within four years. In a second step, valuable materials (recyclables) are then mechanically extracted and the remaining waste is processed into fuel or RDF while the landfill cell can be used for repeat filling. This requires an overall time frame of six years between final cell filling and preparation for the cell for further waste acceptance.

This is a somewhat unusual approach and to the best of our knowledge has not yet been successfully applied in its entirety. Anecdotally, landfills are rarely mined due to cost, and when they are mined it is generally to create new space for disposal. There is a substantial risk that the recovered materials will be contaminated and have a low value. As with any RDF, the challenge is finding long term markets for the fuel.

2.1.4 Sustane Technologies Inc.

The technology offered by Sustane uses proprietary de-bonding, separation and cleaning processes, to obtain end products including clean biomass pellets, synthetic diesel, and metals. The biomass pellets are not considered RDF as they contain virtually no plastics. The vendor claims that this has been done in Nova Scotia where the fuel has been certified by the Department of Environment, Nova Scotia, as recovered biomass, with all the attributes of forest based biomass.

Plastics are separated and the low-density plastics fraction is processed into a synthetic diesel product for internal use (25%) and also for sale (75%).The remaining part of the MSW is bio dried and pelletized to create a fuel for local markets, which the vendor claims will be biomass. The synthetic diesel product will achieve ASTM specifications, typically at a 50% blend and will be sold as a marine diesel or industrial/commercial fuel oil (No. 2) replacement.

Based on the vendor's experience in Nova Scotia, the proposed facility will generate recovered materials that can stimulate additional "green" businesses. The vendor suggests that CSWM may wish to consider an "Eco-Park" concept to reap the benefit of this enabling technology.

The vendor stated that they can offer the biomass pellets at a price discount to forestry-based biomass to facilitate the sale process for use in pulp and paper boiler applications.

This technology has been proven in Europe and the first Canadian plant is currently under construction in Chester, Nova Scotia. This operation will process 200 tonnes per day of MSW. A facility in Madrid, Spain, has a relatively similar throughput to the one requested processing 100 tonnes per day (built in 2010).

2.1.5 WastAway

WastAway proposes a technology which processes MSW into RDF. A multi-stage process includes pre-shredding of MSW, metals removal, inerts screening, a Hydrolyzer (a form of continuous-flow autoclave), dryer and pelletizer to form RDF. Only one operational plant exists in the U.S., and this facility is mainly a demonstration facility. The preparation of fuel is relatively recent for this reference plant.

WastAway identified Nanaimo Forest Products – Harmac Pacific Pulp as a potential buyer of the RDF for use in their boilers. The submission names David Bramley, Environmental Superintendent, to be available to confirm interest if required. The interest has not been confirmed at this stage.

2.1.6 WTT Netherlands BV

Waste Treatment Technologies (WTT) has numerous reference facilities across Europe and proposed two combinations of technologies feasible for CSWM:

- RDF production and biodrying, or
- RDF production, AD and biodrying.

Both of the aforementioned options offer production of RDF. As stated previously for other vendors, RDF can replace fossil fuels at cement manufacturers in BC. The option with AD also produces biogas, which can be converted into electricity/heat. The bio-dried product can be upgraded/refined to make RDF. Alternatively, the AD residue can be composted. The quality of the compost that comes from the processing of mixed MSW can have numerous contaminants, which may limit end markets for land application.

If a facility is selected to generate AD, the bio drying and AD tunnels can be built as hybrid or dual purpose tunnels. These hybrid tunnels can operate under both anaerobic and aerobic conditions. By operating an AD tunnel as composting tunnel the capacity of the tunnel will be tripled. This technology is therefore very flexible to handle smaller or larger volumes.

This is a proven technology in Europe. No facility using WTT technology to produce RDF is in operation in Canada, however WTT technology is being used in the Surrey Biofuel Facility to produce compost and biogas.

2.2 Evaluation of RFI Submissions

2.2.1 Evaluation Criteria

Each vendor submission was evaluated by two members of the Consultant's project team through a two-tier process. Each submission was evaluated against Essential evaluation criteria and Desirable evaluation criteria. All submissions met the Essential Criteria, and were assessed further against Desirable Criteria.

The major categories of Desirable Criteria are:

- Innovation and Risk.
- Technology.
- Environmental and Social.
- Economics and Affordability.
- Submission Completeness.

Weighting was allocated to the key categories based on knowledge of local conditions and client priorities. A sensitivity analysis of these weightings was also completed.

Where information gaps were identified, the vendors were approached for further information. If data gaps remained after follow up, the evaluator used their best judgement based on professional experience to evaluate the vendor's submission. Where no information was available from the vendor and it was not possible to fill remaining data gaps with any confidence, a score of 1 (out of 3, 3 being the best score) was given against the relevant criteria.

2.2.2 Rankings of Submissions

The RFI received a total of six submissions, of which five were directly related to the production of conventional RDF from MSW. Only one submission was for conventional (thermal) WTE.

All six vendors provided sufficient details to carry out the evaluation process effectively and all (with limited reference facility information from SALT) had a number of reference facilities operating at or above the potential feedstock generation rates anticipated for the CSWM service area.

On completion of the evaluation process for technology providers in accordance with the evaluation criteria and weighting shown above, the submissions were ranked as shown in Table 1.

Table 1: Ranking of submissions.

VENDOR	TECHNOLOGY	SCORE
WTT	AD and RDF	83%
EWS	Thermal WTE	81%
REDWAVE	RDF	79%
Sustane	RDF and pyrolysis	77%
WastAway	RDF	75%
SALT	Aerobic Landfill, RDF	54%

A summary of the scoring justification for each vendor is presented below:

- WTT has the highest score because the technology produce both energy and fuel. Markets for the energy (electricity or bio-gas) are proven and available; while the markets for the RDF are uncertain at this time. The technology is proven and less costly than thermal WTE. Emissions are minimal at the location of the facility, but there will be emissions where the RDF is burned and these cannot be determined until the user of the RDF is known.
- The conventional WTE offered by EWS is proven, reliable, and the markets for the main energy recovered (electricity) are generally available. Additional waste heat will be available which could lead to the development of facilities that require heat, such as greenhouses. The major downside to traditional WTE is the cost, which is substantially higher than for the offered RDF technologies.
- REDWAVE is an advanced mechanical recycling and RDF production technology. They have good reference facilities and the system is expected to be reliable. A major unanswered question, as with the other RDF technologies is finding markets for the product, and determining the actual emissions when (and where) the product is burned as fuel.
- Sustane offers a separation of plastics from organic materials and the creation of biomass pellets. The separated plastics are subjected to pyrolysis to create a diesel equivalent fuel. While highly desirable, there have been very limited commercially successful applications of pyrolysis for waste products.
- WastAway offers an RDF process with a special process step that breaks down the microbial structure of the organic materials in the waste. WastAway claims it makes a better fuel, however, the process seems much more complex than other RDF technologies. The firm only has one full scale demonstration facility operating at this time. However, WastAway has gone farther than other firms in establishing potential markets for RDF.
- The SALT technology, while in the end making an RDF, is highly unconventional, and there are many unanswered questions and lacking reference facilities, which resulted in lower scoring.

Vecoplan LLC, which is a well-known and reputable German company, also provides a technology for the production of RDF. Vecoplan did not submit a response to the RFI, but provided to Morrison Hershfield a web link to a video showing both actual video and concept animations of its energy recovery facility installation with the City of Edmonton. Vecoplan could not be evaluated without a formal submission to the RFI, however, their information supports the feasibility of recovering recyclables and making of RDF through modern mechanical systems, as offered by other vendors.

2.3 Conclusions from RFI Evaluation

Of the six submissions, only one offered a conventional WTE technology. All others provided some form of conversion to RDF or other fuel.

Conventional WTE ranked near the top primarily because the technology is well proven and markets for energy (electricity and heat) and recovered metals are generally available. In addition, the bottom ash could be recycled or used for various purposes, resulting in very little residue going to landfill.

RDF processing offered by the various vendors is also proven, although the degree varies with the technology. The greatest challenge with RDF or biomass is finding long term markets for the fuel, and

without the markets, the technologies are – simply put – very expensive ways of extracting recyclables and stabilizing the balance of residual waste.

Currently in Canada conversion of waste into fuels is appealing as a solution to reduce landfill disposal needs and to extract the most value from the waste stream. However, some of the technologies that are proposed by the vendors are still not proven in Canada. For example it must be seen how the facility using Sustane technology in Halifax, Nova Scotia, which is currently under construction, will deliver and prove the viability of the biomass market. The Halifax facility also plans to convert the plastics fraction of the MSW into a liquid fuel, similar to diesel fuel, while the organics will be converted into burnable pellets. While basically attractive from a technical perspective, it must be recognized that there is a technical, and subsequently commercial risk with this technology, since newer, unproven technologies often experience longer start-up times and higher costs than anticipated.

Morrison Hershfield presented the evaluation process and rankings to the CSWM Board and Select Committee subsequently identified three preferred WTE technologies:

- EWS
- WTT
- Sustane

EWS provides a conventional WTE technology which involves immediate generation of electricity and heat on the site. The other two vendors (WTT and Sustane) provide technologies that involve preparing the waste into a fuel on the site, and then shipping the waste derived fuel to a third party for combustion. These three technologies were considered in the options and cost assessments as outlined in this report.

3. ASSESSMENT OF SITING AND REGULATORY REQUIREMENTS

3.1 Overview of Potential Sites

Three locations were considered for the potential WTE facility; Comox Valley, Campbell River and Gold River. A total of four sites were considered – two sites within the Campbell River area were reviewed in the siting assessment.

3.1.1 Comox Valley Area

In the Comox Valley area, the Comox Valley Waste Management Centre (CVWMC) has been identified as a potential site for a WTE facility. The Comox Valley Waste Management Centre (CVWMC) covers an area of approximately 90 hectares and is located approximately 1 km northwest of the Village of Cumberland, BC, at 3699 Bevan Road.

The CVWMC is owned and operated by the CSWM service. The CVWMC is operated under a host community agreement entered with the Village of Cumberland in July 2013. The agreement expires at the end of 2032 (AECOM, 2017). The Landfill currently operates under Amended OC MR-5050, issued on September 20, 2016 by the BC MOE.

The CVWMC is transitioning from an unlined landfill with limited environmental controls to an engineered site with a double-lined cell and landfill gas and leachate management systems. The landfill expansion of Cell 1 was completed in 2017 and the leachate management system was completed in October 2017. The site has a landfill gas collection and flaring system, recycling and waste drop-off/storage areas, a biosolids compositing facility at the north end of the CVWMC, an organics composting pilot project facility at the south end of the CVWMC and a closed asbestos disposal area which lies immediately to the northeast of the landfilled area.

3.1.2 Campbell River Area

In the Campbell River area, two potential sites have been identified: the Campbell River Waste Management Centre (CRWMC) and the former Elk Falls mill site.

The CRWMC is located approximately 6.5 km east of the City of Campbell River, on Argonaut Road. The site is composed of two land parcels, Blocks C and J within District Lot 85 of the Sayward Land District. The site covers 29.7 hectares. It is owned by the CVRD and operated by Berry and Vale under contract with the CVRD.

The CRWMC site is authorized for the purpose of landfilling under the Operational Certificate defined as Block C of District Lot 85, Sayward Land District. The property to the north that may be used in the future for landfill purposes is defined as Block J of District Lot 85, Sayward Land District. Both properties are under Crown Land Leases, with titles being transferred from the District of Campbell River to the CVRD. The landfill is currently operated under OC MR-02401. The landfill is expected to close in 2024, pending Ministry of Environment approval. There is currently a transfer station at this site and it is assumed that the long term plan for the remainder of the site is to remain a closed landfill.

The Elk Falls mill site is located approximately 5.5 km north of Campbell River on 4405 Island Highway. The land parcel covers 174 ha. The Elk Falls mill was in operation between 1952 and 2009, and the portion of the property where the mill was located is currently not used.

3.1.3 Gold River Area

In Gold River, the former pulp mill site has been identified by the CSWM as a potential site for a WTE facility. This site has been discussed as an option for WTE for over ten years. In 2003 Muchalaht Industries Inc. was formed and bought the site and formed Green Island Energy (GIE). Since 2003 Covanta, who operates numerous WTE facilities in North America, and GIE have sought environmental permits to operate a WTE facility at this site and have held local public meetings The development was endorsed by the Village of Gold River and the neighbouring Mowachaht Muchalaht First Nations Band Council (Letter from Village of Gold River Mayor to the Fraser Valley Regional District. July 9, 2012).

As of 2012 the proposed project was fully permitted and had achieved all operation approvals through the Ministry of Environment. The project was put on hold due to delay in commitment from various regional districts on Vancouver Island and Metro Vancouver (CVRD 2012).

3.2 Siting Criteria

Each of the four potential sites were assessed against the following siting criteria:

- Zoning
- Transportation
- Proximity to feedstock sources
- Access to utilities
- Buffers to neighbours
- Air-shed and prevailing winds
- Siting suitability

A summary of the evaluation is provided in the tables Table 2-Table 5 below.

Table 2: Siting assessment of the Comox Valley area - CVWMC site.

Location	Comox Valley - CVWMC
Zoning	The site is zoned as I-3 under the Village of Cumberland Bylaw No. 1027 for use of compost, recycling, and refuse disposal.
Transportation access	The CVWMC has one public entrance that serves both residential and commercial customers. The scalehouse is located at the site entrance and close to the public recyclable drop-off area. The CVWMC also has a site operations entrance located approximately 500 m northwest of the main site access road along Bevan Road that is used for access to the biosolids mulching facility, and is currently being used by contractors during construction of Cell 1 (GHD, 2016a).
Proximity to feedstock sources	Close to generators in Comox Valley. Feedstock from Campbell River needs to be hauled 60 km. Since this site is closest to the largest concentration of generated waste, it will, on a regional basis, incur the lowest hauling costs.
Access to utilities	The site has access to gas and power, but water and sanitary sewer are not available at this time.

Location	Comox Valley - CVWMC
Buffers to neighbours	Already sited as landfill with adequate buffer zone requirements as per the Landfill Criteria. The landfill footprint is required to maintain a 50 m buffer from the property boundary. The closest residential dwellings are located approximately 1.5 km south east of the site.
Air-shed and prevailing winds	The predominant wind direction in the neighbouring town of Courtenay varies throughout the year. The wind is most often from the south (February to May, and October to November) and from the west from (May to October), and from the east (November to February) (Weather Spark, 2017a).
Air emissions	Due to the existing proximity to neighbours, an air dispersion model may be appropriate to determine how air emissions, especially odorous emissions, might affect surrounding receptor areas. The well-known process utilizes meteorological information from local data sources such as those measured by Environment Canada at nearby stations (if available) or obtained from the Ministry of Environment. Emissions from combustion facilities are generally managed with assistance from a dispersion analysis. A stack size can then be determined so that any potential emissions are dispersed in a manner that does not impact human receptors. This is also possible for odours provided they are captured. The Surrey biofuel plant uses a stack for dispersing odours.
Siting suitability	The following factors should be considered when assessing this as a potential site for a WTE facility: ▪ The site use is compatible with other waste management uses ▪ It is located near the largest concentration of solid waste generated in the region, thus direct-haul (without a transfer station) is possible for the majority of waste ▪ Infrastructure needed for waste acceptance is already in place, such as scales, access roads, fencing, and buffers. ▪ Utilities are available on-site except water and sanitary sewer. There is a leachate treatment system onsite may have the potential for use to treat other wastewater from the site.

Table 3: Siting assessment of the Campbell River area – CRWMC site.

Location	Campbell River - CRWMC
Zoning	The site is currently zoned as Industrial Four (I-4) under the City of Campbell River Bylaw No. 3250, 2006.
Transportation access	The site has one entrance, a weigh scale and scalehouse with a full-time attendant. The site is located on Argonaut Road, off Highway 28, just east of Campbell River.
Proximity to feedstock sources	Close to generators in Campbell River. Feedstock from Comox Valley needs to be hauled 60 km.
Access to utilities	There is access to power and water but there is no leachate collection system at the site.
Buffers to neighbours	The property directly west of Block C is owned by Island Ready Mix and houses operations and equipment for concrete manufacturing and a gravel pit. Directly south of the Site is a gravel pit. Mature forests situated on Crown Land are located to the north and east of the Site. There are three residential dwellings located approximately 500 meters to the northeast of the landfill footprint. The property immediately to the east of Block J is occupied by a single dwelling residential lot (GHD, 2016b)

Location	Campbell River - CRWMC
Air-shed and prevailing winds	In Campbell River, the wind is most often from the west from April to October and most often from the east for the rest of the year (Weather Spark, 2017b).
Air emissions	Due to the existing proximity to neighbours, an air dispersion model may be appropriate to determine how air emissions, especially odorous emissions, might affect surrounding receptor areas.
Siting suitability	The following factors should be considered when assessing this as a potential site for a WTE facility: ▪ The site use is compatible with other waste management uses ▪ It is located near the second largest concentration of waste in the region. However, the largest amount of waste would have to be transferred to this site. ▪ Infrastructure needed for waste acceptance is already in place, such as scales, access roads, fencing, and buffers. ▪ Some, but not all utilities are available on-site.

Table 4: Siting assessment of the Campbell River area – Elk Falls Mill site.

Location	Campbell River – Elk Falls Mill
Zoning	The site is currently zoned as Industrial Two (I-2) under the City of Campbell River Bylaw No. 3250, 2006. This zoning covers areas for manufacturing, processing, fabricating assembling, packaging, and transport or shipping of goods and services, including marine transport and water based industrial activities. Permitted uses includes recycle centre and/or scrap metal yard. Re-zoning is required before the site can be used for waste management purposes.
Transportation access	The site can be accessed from the North Island Highway via Top Road or Duncan Bay road.
Proximity to feedstock sources	Close to generators in Campbell River. Feedstock from Comox Valley needs to be hauled 60 km.
Access to utilities	Unclear regarding status of utilities on-site, however the site is assumed to have gas, power, water and sewer within close proximity thanks to neighbouring land use.
Buffers to neighbours	Proximity to residential properties on the east side of the land parcel. Residential land uses within 100 from property boundary.
Air-shed and prevailing winds	In Campbell River, the wind is most often from the west from April to October and most often from the east for the rest of the year (Weather Spark, 2017b).
Air emissions	Due to the existing proximity to neighbours, an air dispersion model may be appropriate to determine how air emissions, especially odorous emissions, might affect surrounding receptor areas.
Siting suitability	The following factors should be considered when assessing this as a potential site for a WTE facility: ▪ The site is not currently used for waste management and would require rezoning ▪ It is located near the second largest concentration of waste in the region. However, the largest amount of waste would have to be transferred to this site. ▪ The site has road access, but it is not known how increased traffic will impact residents. ▪ Some utilities are near the site from previous industrial activity ▪ The development of a WTE facility at this location is constrained by proximity to residences.

Table 5: Siting assessment of the Gold River area – former pulp mill site.

Location	Gold River – Former Pulp Mill Site
Zoning	The area of the site is zoned as heavy industrial (M-1), service industrial (M-2), waterfront industrial (M-3), aquaculture industrial (M-4) as per Bylaw No. 635, "Village of Gold River Zoning Bylaw, 2003.
Transportation access	The site is accessed from the Gold River Highway (Number 28). The status of the access road within the site is unconfirmed since the site is not currently in use.
Proximity to feedstock sources	Located 160 km and 100km from the two major feedstock sources, Comox Valley and Campbell River. This will require two transfer stations and substantial transportation costs.
Access to utilities	Unconfirmed since the site is not currently in use, but because of its previous industrial use, it is assumed that access to utilities is possible.
Buffers to neighbours	Large buffer with over 10 km to the closest residential dwellings.
Air-shed and prevailing winds	Not confirmed
Air emissions	Although large buffer distances to neighbours, an air dispersion model may be appropriate to determine how air emissions, especially odorous emissions, might affect surrounding receptor areas.
Siting suitability	The following factors should be considered when assessing this as a potential site for a WTE facility: ▪ The site is not currently used for waste management, but was supported by the Village of Gold River for WTE in the past (CVRD 2012). ▪ It is located far from the two largest waste sources and will require two transfer stations. Operations will incur high transportation costs ▪ The site has road access, but its suitability is unknown ▪ Some utilities are near the site from previous industrial activity ▪ The site has local support in the community for WTE

In summary, all sites described above could be used for a WTE facility and each have advantages and disadvantages. Proximity to the largest amount of waste generated reduces hauling costs and makes the CVWMC attractive, as it also has existing waste management infrastructure that could serve dual purposes. However, lack of adequate process water and sanitary sewer is a drawback. Gold River is suitable from infrastructure and permitting perspectives, but it is likely that the distance to haul make transportation costs for this site considerably more expensive. The Elk Falls Mill is an unused former industrial site with utilities and therefore may not require significant utility upgrades. However it is sited within 100 m of a residential development, which may present public consultation challenges. Ultimate selection of a site will depend on the technology and could be finalized once a decision has been made to proceed with WTE and begin a procurement process. The three general areas, Comox Valley, Campbell River and Gold Rivers are considered in the long-term cost model and analysis in Section 4.

3.3 Overview of Regulatory Requirements

WTE is an allowable activity under the *Environmental Management Act*. All local governments that plan to direct a portion of their municipal solid waste (MSW) to a WTE facility must seek an amendment to their SWMP to reflect this intention. The CSWM has already signalled the intention to consider WTE as a part of the solid waste management system.

The SWMP highlighted opportunities for integrated resource recovery, which the CSWM will be pursuing during implementation of the plan. In particular, integrated resource recovery will be considered when assessing organics processing and WTE options.

In the SWMP 2013 it is stated that "...it is anticipated that WTE may become part of the solid waste management system for CSWM in the future and that solid waste planning must consider WTE technologies and include such consideration in reporting to the Board for all related authorizations."

If the CSWM deems WTE feasible to implement, this must also be reflected in the SWMP.

A WTE facility would require public consultation as part of the following requirements:

- **Solid Waste Management Plan** (SWMP) - as noted above, previous consultation between 2010 and 2012 included the consideration of a WTE facility. If CSWM intended to proceed with a WTE facility, the SWMP would require amendment and there would be consultation requirements, with the minimum requirements determined by BC Ministry of Environment (MOE).

  Guidelines released by the MOE in 2010 and 2011 indicate that a Region must have plans for 70% diversion before WTE should be considered for the remaining residuals. There have been no updates to these guidelines, which have been requested. However, for this project, residuals under consideration for the technical options are all based on 70% diversion.

- **Environmental Assessment** - A new WTE facility must comply with the *Environmental Assessment Act* if it meets the thresholds specified in the Reviewable Projects Regulation. There are two potential environmental assessment triggers that could apply to this project:

  1. If it has a rated nameplate capacity > 50MW of electricity, or
  2. If it has a design capacity of processing > 225 tonnes of MSW/day.

  Neither of these apply to a potential WTE facility in the CSWM service area. The capacity will be closer to 5MW and the daily throughput is likely to be approximately 130 tonnes per day. An Environmental Assessment (EA) may be required if one is requested by the public, and the decision is made by the minister, or their delegate.

- **Operational Certificate** (OC)[2] - In the letter approving the SWMP, the Ministry of Environment (MOE) will direct the regional district to consult with the regional operations branch of the MOE in the finalization of the necessary operational certificates (OCs), which give authorization to a WTE facility.

  The approval of OCs will be based on the detailed operating and environmental protections measures for the solid waste management facility specified in the SWMP. Amendments to an OC may require an amendment to the SWMP requiring minster approval. It is thus important to achieve the right balance between ensuring the site will be operated in accordance with standards agreed to in the approval process and providing sufficient flexibility to make minor changes easily. The SWMP, together with the required OCs, will form the basis of the authority to operate these facilities.

[2] A certificate issued under section 28 of the *Environment Act* for the design, operation, maintenance, performance and closure of sites or facilities used for the storage, treatment or disposal of waste or recyclable material.

- **Other permit requirements** - Municipal approvals may be required including zoning and development permits.

A facility must be designed and operated in a manner that protects the receiving environment. Additional regulatory requirements include:

- **BC Approved and Working Water Quality Guidelines** (WQGs) – All surface water monitoring results collected at a WTE facility site must be compared to the applicable WQGs.
- **Contaminated Sites Regulation** (CSR) - All environmental monitoring results collected at a WTE facility site must be compared to the applicable CSR standards. Groundwater monitoring results fall under CSR standards.
- **Regional Solid Waste Plan Local Service Area Establishment Bylaw No. 1822, 1996** - The establishment of a WTE facility must be aligned with the Regional Solid Waste Plan Local Service Area Establishment Bylaw No. 1822, 1996. The purpose of the bylaw to "establish the local service of collection, removal and disposal of waste, noxious, offensive or unwholesome substances and provide for the regulation, storage and management of municipal solid waste and recyclable material including the regulation of facilities and commercial vehicles." The bylaw may need to be updated to allow the processing of waste.

4. SYSTEM OPTIONS AND COST ANALYSIS

4.1 Introduction

Based on the vendor submissions received as part of the RFI process, it was determined that three potential technologies would be evaluated further. The three selected technologies are:

1. Waste Treatment Technologies Netherlands BV (WTT)
2. Eco Waste Solutions (EWS)
3. Sustane Technologies Inc. (Sustane)

For each technology option a potential tipping fee was determined based on the vendor's submissions supplemented with additional information and calculations. This information was applied to waste projections developed for the CVRD and SRD waste catchments to determine long-term costs. Capital and operating costs were estimated and included in the model. Costs were adjusted as needed to account for reduced waste management as a result of the different WTE technology options. The options were evaluated over a 50-year time horizon, based on the assumption a new facility would be operational in five years and start receiving waste in 2021.

Three potential general areas were assessed in the long-term model and considerations around these are presented in Section 4.2. The three technology options and associated assumptions are presented in Sections 4.3 - 4.4.3 below. The modelling and resulting estimated costs are presented in Sections 4.5 - 4.6.

4.2 Facility Location

For the purpose of the log-term cost model, three general areas for facility siting were considered; Comox Valley area, Campbell River area and Gold River. The capital and operating costs of the different technology options was assumed to be independent of the chosen location. Considering the CRWMC Landfill is expected to reach capacity in 2024, there will only be one landfill option in the region after that date, the Landfill at the CVWMC.

Depending on the location of the new facility, one or two transfer stations will be required to transport the waste from Campbell River, Comox Valley or both. For the purpose of this assessment and the long term modelling it was assumed that such a facility will be located at the existing waste management centers in Campbell River and Comox Valley.

Ash, residuals and excess waste would be landfilled at the CVWMC Landfill. Excess waste includes waste that is generated during facility shut-downs longer than 3 days (the transfer station and facility receiving building design capacity) as well as that in excess of the facility design capacity. No waste would be sent to the new facility from the SRD until the CRWMC Landfill has reached capacity.

Ash and residuals from a facility located in Campbell River would not be sent to the CRWMC Landfill for three reasons:

- The CRWMC Landfill is unlined and is unlikely to be approved for disposal of WTE ash.
- It would be more practical to landfill all ash at one location.

- Though residuals (excluding ash) could be landfilled at the CRWMC Landfill it has been assumed they are landfilled at the CVWMC Landfill to provide an apples to apples comparison between the technology options.

Waste would be hauled to the WTE facility location and ash/residuals hauled from the WTE facility to the CVWM Landfill. For the long-term cost model, it was assumed that ash and residuals would not be back-hauled. Though this would provide cost savings, it may not be possible due to the nature of the ash and residuals. The hauling cost associated with waste transferred from Gold River and other remote communities was not included in the assessment. These tonnages are small (<5%) of CSWM's total residual waste.

Table 6 below summarizes the hauling routes and siting options for the potential WTE facility.

Table 6: Hauling and siting options for the potential WTE facility

Facility identifier	Facility location	Hauling of Waste	Hauling of Residuals/Ash	Transfer station required	Ash, residual and excess waste disposal location
a	Comox Valley area	SRD waste to Comox Valley	N/A	Campbell River	CVWMC Landfill
b	Campbell River area	CVRD waste Campbell River	Campbell River to Comox Valley	Comox Valley	CVWMC Landfill
c	Gold River	SRD and CVRD waste to Gold River	Gold River to Comox Valley	Campbell River and Comox Valley	CVWMC Landfill

4.3 Option 0 – Status Quo

In order to determine whether to proceed further with evaluating WTE options and confirm potential costs or savings, the status quo is reviewed and compared to the WTE options. The inclusion of status quo also facilitates evaluation of the effect a new WTE facility would have on landfill capacity and operations. Under this option waste generated in the SRD is landfilled at the CRWMC Landfill until closure, after which time the existing transfer station is utilized to transfer waste to the CVWMC Landfill for disposal. The CRWMC Landfill is expected to reach capacity in 2023 and closure would occur a year later.

Waste generated in Comox Valley is landfilled at the CVWMC Landfill. The Landfill is currently being expanded with a projected capacity of 5,200,000 m^3 to 5,700,000 m^3 depending on the approach chosen, as presented in the Comox Valley Waste Management Centre Master Plan (AECOM, 2017). For the purpose of this assessment it has been assumed the CVWMC Landfill will be developed according to the masterplan including Cell 1-4, 5a and 6, which offers 5,200,000 m^3 of airspace. Filling of Cell 1 begins in 2017.

Capital costs associated with closure and landfill expansion are presented in Appendix B.

4.4 Waste-to-Energy Options

Some of the assumptions for modeling the WTE technologies are relevant for each technology. These assumptions include:

- A new WTE facility would be constructed in any of the three locations presented in Section 4.2 above.
- The annual throughput at the facility would be approximately 46,000 tonnes with the exception of the first 3 years when waste generated in SRD would be landfilled at the CRWMC Landfill until capacity is reached.
- The facility is assumed to be in operation 2021, as suggested in the RFI. This allows for permitting, finding an established market for the potential RDF or other end product as well as emission testing and permitting of the use of the end product as fuel at the receiving market.
- The facilities have a reported availability of 90% (330 days per year) or better.
- The residual waste (including ash) would be transported to, and landfilled at CVWMC Landfill. Cell development, closure, life of operating equipment and operating costs are adjusted to account for the reduced waste placement compared to status quo.

4.4.1 Option 1 – WTT

In option 1, the WTE facility would divert organics, metal and cardboard and generate biogas and RDF. Though the WTT technology has the ability to separate plastics it was assumed that this fraction is landfilled based on the following:

- The value of the material is currently uncertain due to market and China's operation green fence.
- The vendor did not include the cost of equipment used to separate PET and HDPE in the submitted capital cost.

The residual stream is estimated to 33.5% of the input waste tonnages.

The WTE facility would be operated 6 days a week allowing for regular maintenance during which time waste can be stockpiled and processed. It was assumed the WTE facility is unavailable for 14 days per year, in periods longer than 3 days, during which time waste would be sent to the CVWMC Landfill for disposal.

Capital and operating costs provided by the vendor were examined for inclusion in the long-term cost model. The value of the generated product, bio gas and metals, was estimated as well. Diverted cardboard, RDF and compost/biodried product were assumed to have no net value, due to market conditions and geographic location. This is discussed further in Section 4.5.3.

A regional compost facility is being planned and developed for operation in Campbell River. Some of the organics that could be used for AD will therefore be diverted directly to composting. The waste volumes used as a basis for WTT's concept take this into account, meaning the WTT concept is based on a reduced volume of organics being available. Without a regional compost facility, WTT's AD capacity would be greater, which would increase economies of scale and could slightly reduce total costs per tonne. If, on the other hand, composting capacity in Campbell River is increased substantially, it would make the AD and composting component of the WTT process superfluous, and the WTT technology would be limited to extracting recyclables and producing RDF from the residual waste stream.

4.4.2 Option 2 – EWS

In option 2, the received waste is incinerated at the WTE facility without prior sorting or diversion, however metals could be recycled from the bottom ash. The residual ash is estimated to be 17% of the input waste, this based on the vendor submission.

The vendor reports that the 2 modular system would allow for continuous operations, where one module would be run at increased capacity while the other is serviced. Though, for the purpose of this assessment, it was assumed the entire facility will need to be shut down for an extended period for maintenance of the generator and emission control units. It was assumed the facility is unavailable for 28 days per year, in periods longer than 3 days, during which time waste is sent to the CVWMC Landfill. The facility is assumed to be unavailable an additional non-continuous 7 days, during which time waste temporarily would be stock-piled.

The permitting process may be longer than that for the other two WTE options assessed due the nature of the technology. However, this could be balanced by the additional time required to establish a market for the waste derived fuel along with emission testing and permitting by the third party proposing to use the fuel.

Capital and operating costs provided be the vendor were examined for inclusion in the long-term cost model. The value of the generated electricity and diverted metals, was estimated as well. This is discussed further in Section 4.5.3.

The proposed regional compost facility at Campbell River would have a positive effect on the EWS technology. Removal of wet organics from the waste stream could result in a net increase in waste heating value, thus enabling more power output coming from a smaller amount of waste being burned. In addition, a smaller facility would be required for the remaining waste after organics for composting have been removed, resulting in beneficial impact on the overall facility costs.

4.4.3 Option 3 – Sustane

In option 3, the received waste would be processed, metals and plastics would be diverted, and bio-pellets and synthetic diesel produced. The residual waste for landfilling is considered inert and is estimated at 11% of the input waste, this based on the vendor submission.

According to the vendor, the facility would operate 350 planned days per year and 6.5 days per week allowing time for regular maintenance during which time waste is temporarily stockpiled. It was assumed the facility is unavailable for 15 days per year, in periods longer than 3 days, during which time waste is sent to the CVWMC Landfill for disposal.

Capital and operating costs provided by the vendor were examined for inclusion in the long-term cost model. The value of the generated synthetic diesel and diverted metals, was estimated as well. Bio-pellets were assumed to having no market value at this time, due to market conditions and geographic location. This is discussed further in Section 4.5.3.

The development of the regional composting facility at Campbell River will have no impact on the Sustane technology as presented, since the proponent already took into account the reduced organics when developing the concept. Any further reduction in organics through increased organics capture and composting (beyond what is currently planned for the Campbell River facility) would reduce the amount of bio-pellets being produced, thus reducing the economies of scale. The result

would be that the pelletizing facility would be idle and not producing product for part of the time. If the operator's finances depend on the sale of pellets, then this could have a financial impact on operations. Conversely, if more organics are available, the Sustane technology could produce more bio-pellets, thus achieving better economies of scale and the sale of more fuel pellets.

4.5 Long-term Cost Models

In order to evaluate the long-term costs of each option, coupled with the different potential locations, the long-term cost models developed by AECOM in 2011 were updated. Population and waste generation projections were performed and coupled with available airspace and updated landfill construction schedule and associated costs. For the WTE technology options, specific aspects of the model were updated along with capital and operational costs.

All costs were projected over 50 years. Appendix B includes the detailed projections of 10 different options:

- Option 0 - Status Quo
- Option 1 – WTT
  - 1(a) - WTT located in Comox Valley
  - 1(b) - WTT located in Campbell River
  - 1(c) - WTT located in Gold River
- Option 2 – EWS
  - 2(a) - EWS located in Comox Valley
  - 2(b) - EWS located in Campbell River
  - 2(c) - EWS located in Gold River
- Option 3 – Sustane
  - 3(a) - Sustane located in Comox Valley
  - 3(b) - Sustane located in Campbell River
  - 3(c) - Sustane located in Gold River

For comparison between the options and against the results from the previous assessment, results were obtained for the total cost and per-tonne cost for each option over 30, 40 and 50 years. The total cost for the WTE technology options, transfer stations and landfill within each option were also determined for the stated periods.

All cost estimates were evaluated and summarised in "today's dollars". The net present value calculation was not used to compare the results. Determining the net present value of each option may provide better indication of the true cost of each option but it is not deemed necessary for comparing the options over the long term. Net present value calculations would add a level of complexity to the analysis that is unnecessary for the comparison of options.

4.5.1 Populations and Waste Projections

The population was projected over the evaluation period to determine annual waste generation. Population projections for the period 2009-2041 are based on BC STATS, BC Ministry of Citizens' Services PEOPLE projections (August 2017) (BC STATS, 2017). An annual population growth rate of 1% was applied to the CVRD and 0.5% to the SRD thereafter, this based on the average growth of the projection period 2009-2041. The average annual waste generation rate was assumed to be 0.6 tonnes/capita for the 2009-2015 time period based on the 2011 model (AECOM, 2011), 0.57 tonnes/capita for the 2016-2020 time period (based on scale records) and reduced to 0.40 tonnes/capita for the 2021-2067 time period. Implementation of organics and additional recycling is assumed to result in a 30% decrease in the disposal rate starting 2021.

4.5.2 WTE Facility Capacity

The capacity of the new WTE facility was determined based on the combined projected waste generation in the SRD and CVRD in 2024 (the year after expected closure of the CRWMC Landfill) and the facility availability. As the different technologies are expected to have varying availability, the capacity in 2024 varies between technologies. For comparison purposes, the highest capacity offered in 2024 (WTT) was applied to all three WTE technology options. The annual capacity was estimated to approximately 46,000 tonnes. Over the 50 year projection period the estimated waste generation in the SRD and CVRD does not warrant for the facility to be expanded and annual throughput has therefore been projected constant over the period. All technology options were expected to operate at reduced capacity the first 3 years until the CRWMC Landfill is closed and waste transferred to the new facility. In addition, due to availability and waste generation, an EWS facility would operate on a slightly reduced schedule for the first few years.

4.5.3 WTE Facility Cost and Revenue

A per tonne breakeven tipping fee for the different technologies was determined based on capital and operating costs provided by the vendors, which were assessed and compared to similar facilities and adjusted as required. The capital cost was amortized over 25 years at an assumed interest rate of 4.75%. The tipping fee over the first 25 years is comprised of an amortized capital cost and annual operating cost. The tipping fee thereafter is assumed to be comprised of operational costs only.

The capital costs include design, fabrication, shipping allowance to Vancouver Island, construction and supervision, commissioning and start-up, trial operation, manuals and training of operators, initial emissions testing, one year of spare parts and 50% performance bond for 5 years, as requested in the RFI. The capital cost provided by WTT does not include the cost for HDPE and PET separation nor a drum dryer. It was therefore assumed that plastics are not separated through the WTT process. The WTT response to the RFI does not identify what is included in the capital cost provided. However, comparison to other similar facilities shows that the cost is reasonable and is assumed to include all of the requested items. The capital cost provided by EWS does not include the cost of a building for waste receiving, storing and processing. It is assumed that a fairly basic building would be required for receiving, storing and processing, similar to the current transfer station located at the CRWMC. The capital cost for EWS was therefore adjusted and increased by $680,000 (capital cost of the Campbell River transfer station inflated to 2017 dollars). Sustane identifies that buildings and offices are included in the submitted cost, as well as 20% contingency. No adjustment to the Sustane capital cost was deemed necessary.

The operating costs include labour, fixed operating expenses, variable operating costs, spare parts and other (specified by vendor) as requested in the RFI. The operating cost per tonne processed at the WTT facility is reported to range between $80 and $120 per tonne input. No further detail was provided; therefore, the operating cost was conservatively assumed to be $120 per tonne. No adjustment was needed for the operating cost presented by EWS. Sustane reported a comparably low operating cost, relative to the other two WTE technology options. The different fixed and variable cost components were reviewed. The cost of electricity was compared to market value and the cost of water to local water use rates, which both aligned. The hourly labour was adjusted to $20/hr plus benefits and salaries increased by 20% which was applied to the overall operating cost per tonne for Sustane.

The value and potential revenue associated with recyclables extracted, and product derived from the different WTE technology options was assessed. The operating cost of the different technology options could fully or partially be offset by the revenue associated with the sale of metals, synthetic diesel, bio gas and electricity. Due to uncertainties in the current recycling market along with distance to market it was assumed that no net commercial value was associated with the following:

- plastics
- cardboard
- bio-pellets
- RDF
- Compost/biodried product

The following rates were assumed when estimating revenue streams:

- Metals: $100/ tonne (from waste stream), $80/tonne (from bottom ash)
- Synthetic diesel: $0.61/L
- Bio gas: $0.06/kWh (when converted to electricity)
- Electricity: $0.06/kWh

Table 7 below summarizes the capital and operating costs as well as estimated revenues per tonne of waste processed. The total estimated break even tipping fees for the three WTE technology options are also presented.

Table 7: Technology option tipping fee including capital and operating cost as well as estimated associated revenue.

		Capital Cost WTE Facility *(one time lump sum $)*	**Capital Cost** *($/tonne)*	**Operating Cost** *($/tonne)*	**Revenue** *($/tonne)*	**Total Break-Even Tipping Fee** *($/tonne)*
Year 1-25	WTT	$26.00M	$38.21	$120.00	-$7.20	$151.01
	EWS	$52.68M	$77.41	$116.00	-$31.90	$161.52
	Sustane	$25.00M	$36.74	$82.07	-$29.33	$89.48
Years 26-50	WTT	N/A	N/A	$120.00	-$7.20	$112.80
	EWS	N/A	N/A	$116.00	-$31.90	$84.10
	Sustane	N/A	N/A	$82.07	-$29.33	$52.74

It was assumed permits and approvals represent 1% of the capital cost.

The required lot size reported by the three technology vendors varied between 2 and 5 ha. The cost of industrial land in the three examined locations was estimated based on the costs used in the 2011 model and increased values of real estate in the region. Conservatively it was assumed that for any location the property would need to be purchased for the WTE facility. It is understood that the CVRD currently owns potentially suitable property for locating the WTE facility – such as the CVWMC. Elimination or reduction of the cost to purchase property will reduce the capital costs overall; however, this capital cost remains a small portion (<1%) of the overall system costs for each option.

4.5.4 Landfill, Transfer Station and Hauling Costs

The need for landfilling would be reduced to different levels depending on the WTE technology option selected. The increased diversion from applying one of the WTE technologies would affect the life of the landfill and subsequently the timing of capital projects (cell construction and closure). The capital projects for the landfills are directly tied to available airspace and filling rate. The annual operating cost would also be affected along with the life of the operating equipment. Landfill specific costs were therefore identified, adjusted were applicable and included in the long-term cost model.

It was assumed that the CRWMC Landfill will continue current operations until landfill closure. The available airspace at the CRWMC Landfill as of the end of 2016 was assumed to be 288,500 m^3 based on estimates provided in 2016 Closure and Post-Closure Fund Estimates (GHD, 2017). Capital costs associated with phasing and closure as well as post-closure costs applied to the long-term cost model are based on those presented in the same document. Operating costs were estimated based on CVRD operating budget for CRWMC as well as the 2018-2022 budget for the same facility. The CRWMC is operated under contract which includes operation of the entire facility including the landfill. In developing the annual operating cost for the CRWMC Landfill the following was assumed:

- 100% of the budgeted cost of bird control is associated with landfilling.
- 50% of the operating contract is used for landfill operation.
- 2% of the operating budget covers utilities, office supplies etc. directly related to landfilling.

All ash, residuals and excess waste was assumed to be landfilled at the CVWMC Landfill. Available airspace, cell development and closure including associated capital costs of the CVWMC Landfill expansion are based on 2016 Closure and Post-Closure Fund Estimates (GHD, 2017) and the CVWMC Masterplan (AECOM, 2017). Post-closure cost is based on the GHD estimate. The operating cost was developed though detailed review of the CVRD 2016 budget, where line item costs associated with the CVWMC were identified and a percentage thereof allocated to landfill operations. The staffing requirement was assumed to include 1 FTE landfill manager, 2 FTE operators and 0.5 FTE engineering analyst, which is based on input from CVRD staff. Operating costs for leachate treatment were also added to estimated total annual operating cost. It was assumed that leachate treatment associated cost would increase from $250,000 per year to $500,000, based on input from CVRD staff. The staggering of leachate treatment costs was linked to landfill cell development as follows: $250,000 per year during filling of Cell 1, $375,000 per year during filling of Cell 2, and $500,000 per year during filling of all subsequent cells.

A transfer station would be required in Campbell River should the new facility be located in Comox Valley or Gold River. It was assumed that the current transfer station, constructed in 2012, would be utilized to its expected end of life (2051) with some capital upgrades and repaving in 2032. The

transfer station would then be replaced in 2052. Waste transportation trailers would require replacement every 8 years.

A transfer station would be required in Comox Valley should the new facility be located in Campbell River or Gold River. It was assumed a new transfer station would be built at the CVWMC. The transfer station would require capital upgrades every 20 years and waste transportation trailers would require replacement every 8 years.

The transfer stations were assumed to be staffed 10 hours per day, 7 days a week. Operating costs associated with the two potential transfer stations were developed assuming the following staffing requirements:

- 1 Superintendent
- 2 Scale house operators (0.75FTE)
- 2 Spotters/Labourers (0.75FTE) Campbell River / 3 Spotters/Labourers (0.75FTE) Comox Valley
- 2 Loader operators (0.75FTE)
- 1 Administration staff (0.2FTE)

The transportation cost between Campbell River and Comox Valley was estimated to be $370 per load, assuming an average load of 25 tonnes. This cost is estimated based on hauling contracts in place in 2014 and information provided by the hauling contractor. The per load transportation cost between Gold River and Campbell River and Comox Valley is based on current hauling contact and was estimated to $500 and $700 per load respectively, assuming an average load of 25 tonnes. The hauling cost does not include trailers. The number of trailers required specific to the amount of waste requiring hauling was estimated. The cost was estimated to $100,000 per trailer with an assumed life of 8 years. This cost was included in the transfer station capital costs.

4.6 Summary of Results

Detailed long-term cost model tables are presented in Appendix B. The costs represented the entire system and include the costs of construction, operating and maintaining transfer station(s) and landfills, transportation of waste, residuals and ash and the calculated tipping fee associated with the different WTE technology options. All costs are presented in 2017 dollars. The capital costs for the WTE technology options were amortized to calculate a tipping fee, however amortization of other capital costs and inflation were not included in the cost models. Each table shows the transfer station and landfill capital and operating costs over the analysed 50 years. Short notes are included to identify capital projects and upgrades. Totals for capital, operating and WTE options costs are included as well as the calculated cost per tonne for the next 30, 40 and 50 years. Waste projections and the WTE technology options' effect on landfill phasing is also presented in the tables.

The total system cost over 30, 40 and 50 years associated with each WTE technology option and sub-option is presented Table 8 below. Option 3(a) – Sustane located in Comox Valley offers the lowest overall system cost.

Table 8: Summary of total system cost over 30, 40, and 50 years.

Option		30 years	40 years	50 years
1(a)	WTT in Comox Valley	$270,597,000	$356,459,000	$436,131,000
1(b)	WTT in Campbell River	$287,472,000	$373,848,000	$457,913,000
1(c)	WTT in Gold River	$328,192,000	$433,529,000	$533,976,000
2(a)	EWS in Comox Valley	$277,559,000	$342,426,000	$404,803,000
2(b)	EWS in Campbell River	$291,591,000	$355,843,000	$421,484,000
2(c)	EWS in Gold River	$323,597,000	$405,603,000	$484,864,000
3(a)	Sustane in Comox Valley	$197,673,000	$248,122,000	$296,081,000
3(b)	Sustane in Campbell River	$207,994,000	$257,418,000	$308,230,000
3(c)	Sustane in Gold River	$247,184,000	$314,200,000	$380,027,000

The cost per tonne waste for each option (including Option 0) over 30, 40 and 50 years is presented in Table 9. The results from the previous assessment developed in 2011 have been included as well for comparison purposes.

The cost per tonne found for the different options in the assessment are comparable to that found for a small scale conventional combustion WTE facility in 2011. The difference between status quo and the least expensive technology option is $36 per tonne if calculated over 30 years. The difference decreases to $26 per tonne when calculated over 50 years. The cost per tonne is calculated by dividing the total system cost by the total tonnes requiring disposal during the same time period, i.e. not the tonnes of waste processed though one of the technology options.

Table 9: Summary of cost per tonne waste for each technology options and status quo, calculated over 30, 40 and 50 years, including results from the 2011 long-term cost model.

Option		30 years	40 years	50 years
2017 Long-Term Cost Model				
0	Status Quo	$82	$79	$76
1(a)	WTT in Comox Valley	$164	$159	$151
1(b)	WTT in Campbell River	$174	$167	$159
1(c)	WTT in Gold River	$199	$193	$185
2(a)	EWS in Comox Valley	$168	$153	$140
2(b)	EWS in Campbell River	$177	$159	$146
2(c)	EWS in Gold River	$196	$181	$168
3(a)	Sustane in Comox Valley	$120	$111	$103
3(b)	Sustane in Campbell River	$126	$115	$107
3(c)	Sustane in Gold River	$150	$140	$132

Option		30 years	40 years	50 years
2011 Long-Term Cost Model (AECOM, 2011)				
1	Small-scale conventional combustion WTE facility in Comox/Courtney	$164	$143	$130
2	Large-scale conventional combustion WTE facility in Campbell River	$89	$88	$88
3	Large-scale conventional combustion WTE facility in Gold River	$114	$113	$113
A	CVWMC Landfill – one regional landfill	$69	$62	$74
B	Campbell River – one regional landfill	$74	$71	$83
C	CVWMC and CRWMC Landfills – two reginal landfills	$73	$68	$65

4.7 Discussion

4.7.1 Long-Term Cost and Landfill Lifespan

The estimated cost to continue landfilling at the CRWMC Landfill until closure and to continue landfilling and expanding CVWMC Landfill is approximately $80/tonne. Waste processing through one of the assessed WTE technology options would increase this cost by $31 to $110 per tonne, or $78M-$316 over a 50 year period. This cost per tonne represents the total system cost and include capital and operational costs related waste disposal (WTE and/or landfilling), waste transfer (transfer station and waste hauling) as well as any revenue from diverted materials or generated product or energy.

It is important to note that the per-tonne costs outlined above do not include the entire CSWM system costs. Services outside of the residuals management such as the future composting facility and recycling services are not included within this cost analysis as these services would continue with or without the implementation of a WTE facility.

The two main factors affecting the overall system cost for the options is the facility break-even tipping fee, along with transportation cost of waste, ash and residuals. Once new WTE facilities are in operation, landfill operational costs are reduced by up to 56% and the landfill capital cost by up to 33% over the 50 year projection period.

Revenue from sale of RDF (options 1(a)-(c)), should a market be established, would have little effect on the overall results. Each $10/tonne increment of RDF revenue (assuming 12% of input as per vendor submission) would reduce the system cost per tonne by one dollar

The most cost effective location for a new facility is in Comox Valley. This location offers the lowest hauling cost as less waste is generated in the SRD than the CVRD and no haul of ash/residual is required. Locating the facility in Comox Valley would also allow for use of the current transfer station in Campbell River which has an estimated remaining life of 35 years. Other factors affect the suitably of the locations which include access to processing water and potential cost savings associated with integration of organics transfer and processing.

Though a WTE facility will reduce the amount of waste that is landfilled and lower the landfill costs, it will not eliminate the need for a landfill. Costs related to construction and operation of a WTE facility would be added to the reduced costs of landfilling.

Processing of waste through one of the three WTE technology options would extend the life of the CVWMC Landfill. The estimated available airspace as of the end of 2016 was 5,220,000 m^3. This capacity of planned Cell 1-6 at The CVWMC Landfill would almost be reached at the end of 2067 should landfilling remain the only waste disposal option. The approximate available airspace at the CVWMC Landfill at the end of 2067 for the WTE technology options are as follow:

- WTT - 3,040,000 m^3
- EWS - 3,757,000 m^3
- Sustane - 3,816,000 m^3

This would increase the life of the CVWMC Landfill by 37 years (WTT), 50 years (EWS) and 51 years (Sustane), assuming the capacity of the WTE facilities remain unchanged over time. There are some technical risks associated with the Sustane technology which are not factored into these figures.

4.7.2 Integrated Resource Recovery

Integrated resource recovery addresses the issue of maximizing the use of technology or process outputs under consideration of local conditions and opportunities. RFI proponents were asked to comment on opportunities to enhance local businesses and identify additional opportunities. Based on the submissions and the MH knowledge of the technologies and the local conditions, the following opportunities have been identified:

- WTT – The technology offered by WTT is already fairly comprehensive in removing materials for recycling and making best use of the remaining resources in the waste stream. It has been noted that sorting of PET and HDPE is not included, although these materials generally have some value. There may be an opportunity for a local recycler to work with WTT to recover these materials and convert them locally into recycled products.
- In addition, WTT technology is fairly complex, and training would be provided to local operators and firms for maintenance and repair. These skills would then rest in the community and could spawn business that service other communities that are not yet as advanced and just beginning to look at such technologies.
- EWS – Conventional combustion does not leave much room for making additional use of individual materials, but does offer two possibilities for local initiatives:
    - Waste heat – This is generally a fairly low grade heat that needs to be dissipated by cooling towers when electricity is made with a steam turbine generator. Instead of losing this heat, it could be made available to local entrepreneurs at a low cost who wish to use it for commercial purposes, such as heating greenhouses. The cost of heat transfer and transport would need to be considered by the local entrepreneur and if this is low enough through close proximity to the facility, then this could be an interesting opportunity.
    - Bottom ash – Bottom ash is generally non-toxic and can be landfilled. It represents about 20% of the incoming waste by weight and less than 10% by volume. Nevertheless, there are still costs associated with landfilling the ash. In Europe, ash is often processed and upgraded so that it can be used as a building or road construction material. There could be an opportunity for a local construction company to develop the expertise to treat and

condition the ash for other uses, thus establishing themselves as an expert in this field, while making a profit from the re-use of the ash itself.

- Sustane – Sustane is proposing several new technologies and as with WTT, training would be provided to local operators and firms for maintenance and repair. These skills would then rest in the community and could spawn business that service other communities that are not yet as advanced and just beginning to look at such technologies. Sustane is also offering a unique and rarely used technology, namely the pyrolysis of plastics, which could spawn a whole new industry of bringing in plastics from other regions to enhance the production of synthetic diesel fuel.

5. GREENHOUSE GAS EMISSIONS ASSESSMENT

5.1 Greenhouse Gases Overview

In 2014, the contribution of waste to BC's GHG emissions was 9% as presented in the 2016 Climate Leadership Plan (see Figure 1 below). The main source of GHG emissions within the waste sector is municipal solid waste landfills which contribute to approximately 95% of BC's waste sourced GHG emissions.

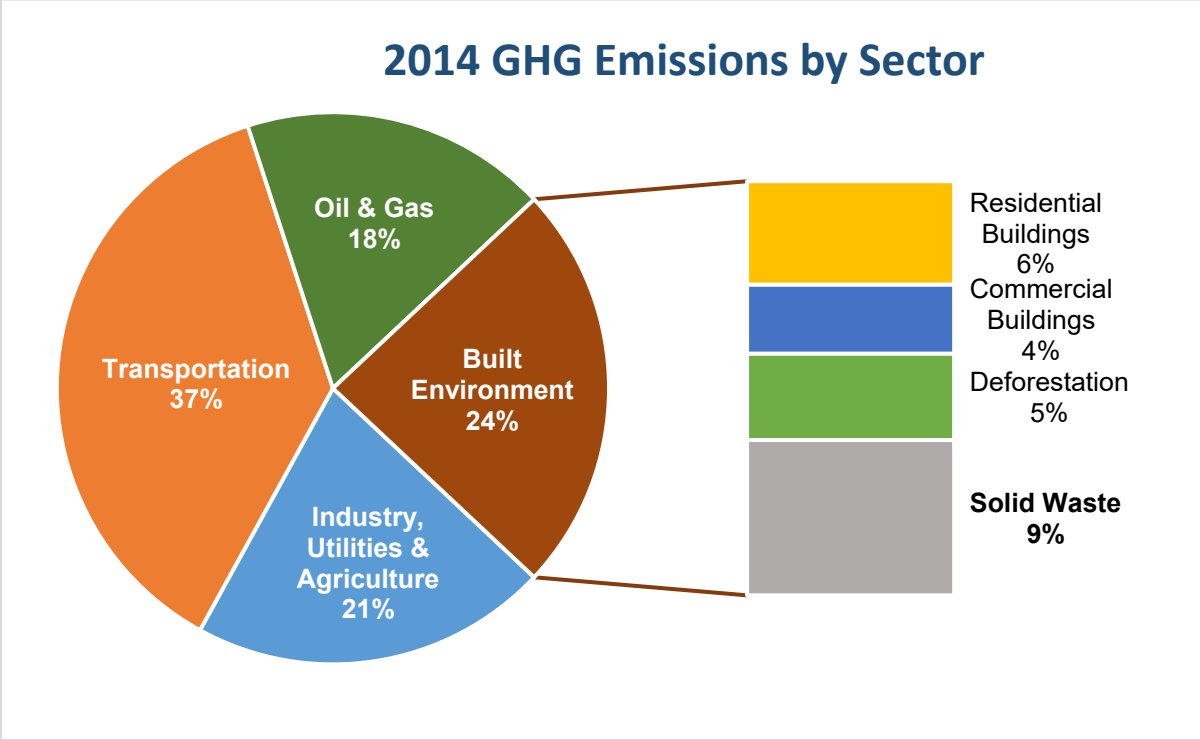


Figure 1: 2014 GHG Emissions by Sector (Adapted from: BC Government, 2016).

The BC government outlined actions to create a waste-to-resource strategy to reduce GHG emissions from organic waste, in the Climate Leadership Plan. These actions are:

- Supporting materials exchange pilot projects that create innovative uses for waste products.
- Creating a waste-to-resource strategy to reduce waste to landfill.
- Establishing a food waste prevention target of 30% and increasing the organics diverted from landfills to 90%.

Conventional WTE facilities produce GHGs through combustion which consist mostly of mostly carbon dioxide, some nitrous oxide and other trace substances. Since methane is 21 times more potent as a greenhouse gas than carbon dioxide, combusting waste rather than landfilling it reduces some of the GHG impact from waste management (a landfill that collects and flares methane operates on the same principle, except that the energy value is lost).

A part of the residual waste combusted is biogenic, meaning it is organic in nature. Combustion of biogenic waste does not contribute to increased GHG emissions, the process is considered carbon

neutral. The biogenic portion of the waste stream is generally 50% to 60% and this depends highly on local conditions and programs that are in place. Energy recovered from the biogenic portion of the waste is not considered a GHG contributor and can be used to offset energy generated using fossil fuels. Since BC generated electricity is mostly from hydro sources, there are no substantial offsets available from selling green electricity in the province.

5.2 Methodology and Assumptions

A detailed Greenhouse Gas Emissions Assessment was completed by AECOM as part of the 2011 WTE assessment. The scope of this GHG assessment is to update the analysis that was completed by AECOM in 2011. Therefore, the methodology and assumptions largely remain the same as those presented in the 2011 report.

For each option as presented in Section 4, estimates were made of the net GHG emissions from the WTE facility, the landfill and transfer stations, which includes transportation of waste to the facility, and residual waste and ash therefrom. GHG emissions were projected over a 40 year period. The analysis and results are summarized in Table 11; the detailed analysis is presented in Appendix C.

Technology Options

The GHG assessment was performed for all WTE technology options, including Option 0 - Status Quo, assuming the same waste generation, diversion and disposal as that used for the long-term cost model (refer to Section 4.5.2). For the purpose of this analysis and comparison between the different options, it was also assumed that the waste composition remains unchanged over the projection period. Though the waste composition will change as diversion increases it would not change the comparison between the options as all would be affected by the change. (Note that increased diversion was not applied to the GHG assessment performed in 2011, this to provide an “apples to apples” comparison of the WTE options and the previously landfill options assessment.)

For emissions from the EWS WTE facility, calculations for CO_2, N_2O and CH_4 emissions are based on the methodology presented in IPCC (2006) and U.S. EPA (2016a). Consistent with IPCC (2006) guidelines, only the combustion of carbon of fossil origin (plastics, certain textiles, rubber, liquid solvents, and waste oil) is considered to contribute to net increase in CO_2 emissions. The combustion of biogenic portion of the waste stream is considered to be CO_2 neutral since it is part of the natural carbon cycle so long as it does not cause a long term decline in the total carbon embodied in living biomass (e.g. forests) (IPCC, 2006).

Nitrous oxide (N_2O) emissions from waste combustion originate from components of the waste stream that contain nitrogen. In addition to waste composition, N_2O emissions can also differ depending on the waste combustion technology, combustion conditions and the technology applied for NOx reduction (IPCC, 2006).

Methane emissions are typically a very minor source of emissions from waste incineration. Methane emissions are dependent on the continuity of the incineration process, the incineration technology and management practices. Methane emissions are the result of incomplete combustion which is influenced by the combustion conditions in the combustor’s (temperature, residence time, and air ratio) (IPCC, 2006). In large well-functioning facilities CH_4 emissions should be very small (IPCC, 2006).

As for the 2011 AECOM GHG emission assessment, the WTE emission factors found in the 2009 Metro Vancouver study (CH2M Hill, 2009) were assumed appropriate and applied to this assessment. The greenhouse gas emissions analysis was conducted for Metro Vancouver and calculations were based on Metro Vancouver 2008 waste composition and 52% effective diversion until 2015 after which an estimated composition was applied based of 70% diversion.

The emissions factors found the in the Metro Vancouver study (CH2M Hill, 2009) and applied to this greenhouse gas assessment are listed below.

- CO_2 – 0.320 tonnes CO_2e / tonne MSW;
- CH_4 – 0.0000031 tonnes CO_2e / tonne MSW; and
- N_2O – 0.016 tonnes CO_2e / tonne MSW.

For the purpose of this assessment it was assumed that the same emission factors apply to incineration of RDF produced at the WTT facility. However, if the RDF is used to offset the use of natural gas in industrial boilers, or coal in cement plants, then additional GHG credits should be available for the biogenic portion of the fuel.

Synthetic diesel generated through the Sustane process is produced through pyrolysis of plastics. Combustion of the synthetic diesel does, therefore, contribute to GHG emissions. The vendor estimates that approximately 2,000 m^3 synthetic diesel will be produced per year, which equals 43.45 L/tonne waste processed. The emission factor for the synthetic diesel is estimated to 0.0027 CO_2e/L and was calculated based on the average of light fuel oil, diesel fuel and marine diesel (BC MOE, 2014).

All technology options offer recycling opportunities. The EWS technology provides the opportunity for ferrous metal recovery from the bottom ash, metals that would otherwise be disposed in a landfill. WTE plants with a ferrous metal recovery system can recover 90% of steel in MSW (U.S. EPA, 2010). WTT offer separation and diversion of ferrous and non-ferrous metals as well as cardboard. Though WTT offer the technology to divert plastics, diversion of plastic have not been included in this assessment as it was not included in the vendor RFI submission. The Sustane technology would also separate and divert ferrous and non-ferrous metals as well as plastics. The avoided GHG emissions per tonne material are listed below (U.S. EPA, 2016b and U.S. EPA, 2016c):

- Ferrous metal (steel) – incineration: 1.78 tonnes CO_2e per tonne metal
  Ferrous metal (steel) – recycling: 1.99 tonnes CO_2e per tonne metal
- Non-ferrous metal (assumed aluminium): 10.01 CO_2e per tonne metal
- PET plastics: 1.23 CO_2e per tonne plastics
- HDPE plastics: 0.96 CO_2e per tonne plastics
- Low density plastics: 0
- Cardboard: 6.15 CO_2e per tonne cardboard

Experience at the Burnaby WTE facility is that metal recovery from bottom ash is approximately 3% by weight of the incoming MSW. This recovery rate was applied to the EWS option. It was also assumed that the diversion rate of ferrous metal through the WTT and Sustane processes is 3% of the waste throughput. The diversion of non-ferrous metal was assumed 1.8% of throughput based on the Sustane vendor submission. The diversion of cardboard and plastics was estimated to 7% of

throughout which is approximately half of the available materials based on the waste composition presented the CSWM SWMP (AECOM, 2012).

Generation of electricity also contributes to GHG offsets. However, the offsets are small in BC as the power to a large extent is generated from hydro. Power generation from the EWS facility was estimated assuming the lower heating value (LHV) of the waste is 10.5 GJ/tonne and the net electricity conversion efficiency is 16%. Biogas, generated through the WTT anaerobic digestion, was assumed to generate 200kWh per tonne organics processed.

The operation of either of the assessed WTE facilities will contribute to GHG emissions as all of the options will require some electricity as well as fuel (natural gas, propane etc.). However, operational GHG contributions cannot be measured until the processes are at a much more advanced state of development and design. Operational GHG emissions are not included in this assessment and it was assumed the emissions are relatively comparable between the WTE technology options.

The total emissions from the WTE technology options were determined by subtracting offsets created by recycling and power generation from the emissions created by combustion. Activities that either contribute to or offset GHG emissions for the different WTE technology options are summarized in Table 10 below.

Table 10 Summary of GHG contributions and offsets associated with the three technology options.

Technology Option	GHG Contribution	GHG Offsets
WTT	Landfilling of residual waste Combustion of RDF	Recycling of ferrous and non-ferrous metals and cardboard. Generation of electricity from biogas
EWS	Landfilling of residual waste Combustion of MSW	Recycling of ferrous metals Generation of electricity
Sustane	Landfilling of residual waste Combustion of synthetic diesel	Recycling of ferrous and non-ferrous metals and plastics

Landfilling

For the purpose of this assessment and comparison of the different options, landfill gas generation and associated GHG emissions were only estimated for the CVWMC Landfill. All analyzed options include unchanged landfilling at the CRWMC Landfill until closure. Inclusion of GHG emissions from the CRWMC Landfill would not change the comparative results of the options assessed. The landfill gas generation was assumed the same for all technology options since all are assumed to have the same capacity which results in the same amount of excess waste being sent to landfill. Ash and processing residuals are considered inert and do not contribute to landfill gas generation.

The U.S. Environmental Protection Agency's Landfill Gas Emissions Model (LandGEM) was used to estimate the quantity of landfill gas generated on an annual basis at the CVWMC Landfill. LandGEM provides results for total landfill gas, methane, carbon dioxide and non-methane organic compounds (NMOCs).

Based on the results from LandGEM, two similar methodologies (California Air Resources Board, et. al., 2010 and U.S. EPA, 2004) were used to determine the net emissions of GHGs. The methodology consists of the following steps:

1. Determine the amount of methane generated (from LandGEM);
2. Determine the amount of methane collected using an assumed collection efficiency;
3. Determine the amount of methane destroyed (typically 99% of that collected);
4. Determine the amount of methane oxidized by soil cover (10%); and
5. Determine the amount of methane emitted, which is equal to the amount generated minus the amounts destroyed and oxidized.

Landfill gas was assumed collected with an efficiency of 75%, which is the required minimum under BC's Landfill Gas Regulation and related guidelines. Carbon dioxide emissions from destruction of methane as well as decomposition of organics in the landfill are considered biogenic and part of the natural carbon cycle and are therefore not considered contributing to greenhouse gas emissions.

The amount of methane emitted was multiplied by 21 times to provide a total landfill GHG emissions equivalent in tonnes of CO_2e. It was assumed LFG is flared and no LFG to energy offsets applied.

Emissions are also generated through electricity and fuel consumption by on-site facilities and by landfill operations equipment. While relatively minor, these emissions were included in the total GHG emissions from landfills. Emissions factors for CO_2e per tonne of waste for these emissions were obtained from Determination of the Impact of Waste Management Activities on Greenhouse Gas Emissions (Government of Canada, 2005). The total emissions from the landfill were determined by summing the emissions from landfill gas, on-site facilities and operations equipment.

While carbon from waste will be stored in the landfills, this was not included in the accounting of net GHGs. The IPCC provides guidance on determining the carbon storage for landfills, but this is only estimated for inclusion as an information item and it is not included in inventory estimates of GHG emissions.

Transfer Station Operation and Waste Hauling

For the transfer stations emissions were estimated for transfer station operations and for waste hauling.

Transfer station operations activities that contribute to GHG emissions include natural gas use (e.g. for forklifts), diesel fuel use (e.g., heavy equipment) and various use of electricity. Emissions from these sources can vary greatly depending on the design of the transfer station and its operations. To be conservative, a factor of 0.0044 tonnes of CO_2e / tonne of waste (Eisted et. al., 2009) was selected for the analysis. The emissions for hauling of waste, residuals and ash were determined by estimating fuel consumption per tonne waste hauled, which was multiplied with the emission factor for diesel fuel of 0.00269 tonnes of CO_2e/L (Canadian diesel fuel factor, California Air Resources Board et. al., 2010).

The total emissions from transfer stations were determined by summing the emissions from transfer station operations and hauling of waste, ash and residuals.

5.3 Summary of Results

The net GHG emissions estimated for the 10 assessed options are presented in Table 11. A period of 40 years was used to assess the GHG emissions, and the totals for the WTE technology options, landfilling and transfer station operations (including waste hauling) are detailed in Table 11. The location of a facility has relatively small impact on the overall GHG emissions. However, the recycling of metals, cardboard and plastics contribute to large GHG offsets. The net GHG emissions range from -777 tonnes CO_2e (option 1(a)) to 821 tonnes CO_2e (option 0) over the assessed 40 year period.

Table 11: GHG emission summary over 40 years.

Options		Technology	Landfill	Transfer Station(s)	Total
		tonnes CO_2e	*tonnes CO_2e*	*tonnes CO_2e*	*tonnes CO_2e*
0	Status Quo	0	813,000	8,000	821,000
1(a)	WTT in Comox Valley	-956,000	171,000	8,000	-777,000
1(b)	WTT in Campbell River	-956,000	171,000	14,000	-771,000
1(c)	WTT in Gold River	-956,000	171,000	40,000	-745,000
2(a)	EWS in Comox Valley	443,000	171,000	8,000	179,000
2(b)	EWS in Campbell River	443,000	171,000	12,000	183,000
2(c)	EWS in Gold River	443,000	171,000	36,000	207,000
3(a)	Sustane in Comox Valley	-306,000	171,000	8,000	179,000
3(b)	Sustane in Campbell River	-306,000	171,000	11,000	182,000
3(c)	Sustane in Gold River	-306,000	171,000	34,000	205,000

5.4 Discussion

Removal of organics by 2021 will reduce the GHG emissions from the landfill, however the GHG generation estimates for the WTE technologies are significantly less than from the landfill. In particular WTT offers significant GHG reduction which is mainly attributed to the recycling of non-ferrous metals and cardboard.

The GHG generated from transfer station(s) and waste transfer is a small portion of the overall generation, therefore the location of the WTE facility does not have a significant impact on GHG emissions. The landfill gas generated is the same for all WTE options, this is because the facilities are assumed to have the same capacity resulting in equal amounts of waste in excess of the capacity being landfilled. This generation of GHG would be reduced if the WTE facilities had sufficient capacity to process all of the waste generated in the next 50 years.

The landfill gas collection efficiency for the landfill is assumed at 75% for the model, however the actual efficiency of collection would impact the GHG generation for the landfill in all scenarios. In addition, in the WTE options, the proportion of organics to landfill is significantly reduced when compared to status quo.

6. CONSTRAINTS, RISKS AND TIMELINES

This section summarizes a qualitative assessment of the constraints, risk and timelines for the selected options. WTE has a reputation of carrying a variety of risks which may be technical, financial and social. The overview of risks and constraints as presented in the 2011 WTE Assessment (AECOM, 2011) are based on experience of professionals who have worked in the WTE field. A more detailed and quantitative assessment of risks and constraints will be necessary, should the project proceed.

As part of this WTE assessment a high level overview of a Consultation Strategy was provided as a separate report. A summary of the key elements of the Consultation Strategy are provided below. A specific Consultation Plan will need to be developed should the CVRD proceed with WTE.

Furthermore an assessment of the siting and regulatory review was provided in Section 3. A summary of the siting constraints and risks is provided below.

6.1 Technical Risks and Constraints

Sustane, located in Comox Valley, is the lowest-cost WTE option. However, the Sustane technology requires about 20,000 litres of water per day. It is not known at this time what the cost would be to supply that amount of water to a facility located at the CVWMC, however it must be anticipated that this will increase capital costs for this site.

Water supply could also be an issue for EWS and to a lesser degree for WTT if they are located at the CVWMC site.

Sustane is also introducing pyrolysis of plastics. While this is an ideal way of converting plastics into a form of energy that can be readily sold and used, this type of technology, to the best of our knowledge, has found very little use on a commercial scale. There is a risk that the technology is still relatively new and may face technical problems during implementation.

A technical (and also commercial) risk with Sustane and WTT technologies is that the recovered recyclables may not be clean enough to sell to the recycling markets. This has been accounted for with some materials by giving them no commercial value in the financial assessment. It should be noted that no consideration has been given to the worst case scenario where no market is available for the materials and disposal is the only remaining option.

6.2 Environmental and Regulatory Risks and Constraints

Emissions from modern WTE facilities must meet high emissions standards. As discussed in the 2011 WTE Assessment (AECOM, 2011), management of emissions from WTE facilities is done by proven technologies and any risks to the environment or human health can be considered mitigated.

As presented in Section 5, a WTE facility is more favourable than landfilling with consideration given to GHG emissions.

There are no regulatory risks as discussed in Section 3. It is assumed given the small size of the WTE facilities presented in this report, there will be no trigger for an Environmental Assessment (EA). However, if there is significant public pressure, MOE may require and EA.

6.3 Financial Risks and Constraints

One of the greatest financial risks is not finding markets for the products recovered. In the case of WTT, this would be recyclables, compost and RDF (electricity can usually be sold to BC Hydro). Without markets, these products would have to be landfilled, following an expensive process to extract and process them. The financial risk for Sustane would be not finding markets that pay enough for their bio-pellets to offset their production cost as well as finding a market for the recovered recyclables.

Often funding for new and only marginally proven technologies can be difficult to obtain. If banks were called upon to finance a project with new technologies, they may be reluctant to proceed unless they can be convinced that the technologies are proven and are functioning full time on a commercial basis in other locations.

Similarly, it may be difficult to fund a project where there is a lot of public opposition. Conventional combustion based WTE has faced this in numerous locations in North America, and there has been only one commercial full scale WTE plant built in Canada in the past 20 years, which is located in Ontario.

6.4 Social Risks and Constraints

Public acceptance of any waste management system or technology is of greatest importance to the CSWM and Morrison Hershfield has proposed a Consultation Strategy that provides the overall direction for the consultation process. The consultation process and associated strategies will be refined when the CSWM selects the final preferred WTE technology and site. A summary of the consultation strategy is presented in Section 6.4.1 below.

6.4.1 Overview of consultation strategy

Regulatory requirements including consultation requirements are outlined in Section 3.3. The CSWM may want to adopt the following objectives for the consultation:

1. To *inform* the general public and potentially affected stakeholders about the potential need for a WTE facility, its potential locations and potential effects and benefits;
2. To *obtain input* from affected stakeholders (including general public) on the potential facility and locations components; and
3. To *collaborate* with member municipalities to undertake consultation events that broadly engage with the community on the topic.

The following communication strategies can be used by the CSWM and member municipalities to meet the objectives listed above:

- Organize Open Houses staffed with local experts at suitable locations.
- Hold targeted presentations to:
  - Councils of affected municipalities.
  - First Nation Councils.
  - Other stakeholder groups/organizations.
- Provide on-line information on website of the CVRD, SRD and member municipalities.

- Piggyback on municipal and CSWM communications (newsletters, mailers, utility bills, billboards, etc.).
- Use of social media (e.g. Facebook).
- Provide public information via TV/radio commercials/ radio advertisements.
- Opinion pieces published in local newspapers.
- Undertake feedback surveys (on-line, exit surveys at open houses, at other waste management facilities or via phone interviews).

Depending on MOE requirements, these strategies could be part of the SWMP revision process, the EA process (if an EA is required) or both.

Key stakeholder groups that will need to be consulted in regards to a potential WTE facility in the CSWM service area include First Nation communities, member municipality councils, neighbouring regional districts and municipalities as well as the public community.

The consultation methods should be selected to include three primary elements – process communications that clarify the planning process, targeted stakeholder engagement, and broad public consultation.

6.5 Siting Risks and Constraints

A siting review was undertaken and presented in Section 3. The major risk associated with siting is public opposition to the establishment of a WTE facility. This risk would need to be addressed through a Consultation Plan as discussed in the Consultation Strategy.

Technical constraints were identified in Section 3 with no significant constraints identified based on the preliminary siting review. Some locations do not have all utilities to site which have been considered in the capital costs associated with locating a WTE facility in that location.

6.6 Timelines

The proposed start date for a WTE facility as presented and modelled in this report is 2021. This is the earliest possible timeline which allows for permitting and the establish markets for any end-products. The consultation timeline remains a risk for delaying the start date of the facility. It is recommended that the CSWM integrate consultation on a SWMP amendment with consultation on a WTE facility. Firstly, consultation on a SWMP amendment can build support for a WTE facility in principle by clearly identifying the need, and the provision of information showing that WTE is a preferable option to meet that need. Once public support for WTE in principle is obtained, CWSM could begin the process of consultation on specific potential locations for a facility to obtain municipal and provincial approvals.

In addition, the proposed start date aligns with the diversion target of 70% with the removal of organics from the waste stream. The technology vendors have utilized the waste tonnage and composition assumed after organics diversion.

7. CONCLUSION

The results from the long-term cost modeling presented in this report indicate that the estimated cost to continue landfilling at the CRWMC Landfill until closure and to continue landfilling and expanding The CVWMC Landfill is approximately $80/tonne. Waste processing through one of the assessed WTE technology options would increase this cost by $31 to $110 per tonne, or $78M-$316M over a 50 year period. This cost per tonne represents the total system cost and include capital and operational costs related waste disposal (WTE and/or landfilling), waste transfer (transfer station and waste hauling) as well as any revenue from diverted materials or generated product or energy.

The lowest cost option would be a WTE facility utilizing the technology provided by Sustane located at in the Comox Valley area with system costs of $120 per tonne for the first 30 years, which drops to $103 per tonne at 50 years in operation. This cost per tonnes is still significantly higher than the status quo landfill operations. Sustane technology is an advanced combination of processes and individual technologies with only one identified reference facility in Europe. Very little is known about this plant and the effectiveness of the individual components. Anecdotally, it is known that some of the key technologies offered have had issues when applied on a commercial scale and there are no known operating examples in North America at this time. There is therefore a technical and commercial risk associated with this technology which may impact its feasibility and cost.

The cost per tonne outlined above do not include the entire CSWM system costs. Services outside of the residuals management such as the future composting facility and recycling services are not included within this cost analysis as these services would continue with or without the implementation of a WTE facility.

The two main factors affecting the overall system cost for the options is the facility break-even tipping fee, along with transportation cost of waste, ash and residuals. Once new facilities are in operation, landfill operational costs are reduced by up to 56% and the landfill capital cost by up to 33% over the 50 year projection period. The capital and operational costs for a WTE facility are then added to that reduced landfilling cost.

The primary unknowns at this time are the market for and value of the RDF, bio-pellets or biodried product/compost as well as extracted recyclables. Consideration has been given to the revenues from some recyclables, however, without a confirmed market, it is assumed there would be no revenue from the sale of RDF, bio-pellets or biodried product/compost.

A high level review of the potential technical, social and financial risks was provided. Viability of the WTE facility with respect to social risks is dependent on the success of the Consultation Plan which should be developed once a site and technology are selected. The siting review indicated that the four investigated sites all have potential for development of a WTE facility with some potentially requiring service upgrades like water and sanitary sewer.

In conclusion, traditional WTE is a proven technology with generally available markets for the energy and a high degree of landfill space savings, however, it is expensive compared to most other technologies. Creating a solid fuel (RDF or bio-pellets) is substantially less expensive than conventional WTE, mostly because capital and operational cost associated with the actual combustion component is borne by a third party. The main risk with RDF and bio-pellets is finding long term markets for the product. Without a market, both WTT and Sustane would not meet their goal of being net energy producers nor would diversion of a large amount of waste from landfilling be possible. In other words, without secure long term markets for waste derived fuel, the processed

material would have to be landfilled after being processed at a high cost. Though, WTE offers many benefits, the results from the long-term cost model show that landfilling remains the most cost effective waste disposal option for the region.

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APPENDIX A: RFI Evaluation Memo

MEMORANDUM

TO:	Lisa Butler, P.Eng., Engineering Analyst, CVRD	ACTION BY:	NA
FROM:	Konrad Fichtner, P.Eng.	FOR INFO OF:	The CSWM Select Committee
PLEASE RESPOND BY:		PROJECT No.:	5170574
RE:	Technical Memo – Evaluation of RFI Submissions for Energy Recovery Technologies	DATE:	August 3, 2017

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1. EXECUTIVE SUMMARY

On behalf of Comox Strathcona Waste Management (CSWM), Morrison Hershfield is conducting research into the feasibility of applying waste to energy (WTE) technologies to the solid waste generated in the Comox Valley Regional District (CVRD) and the Strathcona Regional District (SRD). As part of the process, a request for information (RFI) was issued to suppliers of WTE systems and also refuse derived fuel (RDF) suppliers. This memo summarizes the evaluation of the submissions received.

The RFI received a total of six submissions, of which five were directly related to the production of conventional RDF from municipal solid waste (MSW). Only one submission was for traditional (thermal) WTE:

- Eco Waste Solutions ("EWS") – Traditional WTE through combustion
- REDWAVE, a Division of BT-Wolfgang Binder GmbH – RDF production
- SALT Canada Inc. – Aerobic landfill with subsequent mining and RDF production
- Sustane Technologies Inc. – Mechanical separation, pyrolysis of plastics and RDF from balance
- Wastaway – RDF production
- WTT Netherlands BV – Anaerobic Digestion (AD) of organics and RDF from balance

Each submission was evaluated through a two-tier process, first against Essential Criteria and then against Desirable Criteria. The Essential Criteria include suitability for volumes and types of materials expected, ability to produce surplus energy/fuel, and be mature enough for commercial implementation. All the submissions met the Essential Criteria, and were assessed further against Desirable Criteria.

The major categories of Desirable Criteria are:

- Innovation and Risk.
- Technology.
- Environmental and Social.
- Economics and Affordability.

All six vendors provided sufficient details to carry out the evaluation process effectively and all (with limited reference facility information from SALT) had a number of reference facilities operating at or above the potential feedstock generation rates anticipated for the CSWM service area.

On completion of the evaluation process the submissions were ranked as shown in Table ES1.

Table ES1: Ranking of Submissions

VENDOR	TECHNOLOGY	SCORE
WTT	AD and RDF	83%
EWS	Thermal WTE	81%
REDWAVE	RDF	79%
Sustane	RDF and pyrolysis	77%
WastAway	RDF	75%
SALT	Aerobic Landfill, RDF	54%

As can be seen in the above rating table, the top two technologies/vendors have very similar scoring. However, the scores are achieved for different reasons:

- WTT has the highest score because they produce both energy and fuel. Markets for the energy (electricity or bio-gas) are proven and available; while the markets for the RDF are somewhat speculative at this time. The technology is proven and less costly than thermal WTE. Emissions are minimal at the location of the facility, but there will be emissions where the RDF is burned and these cannot be determined until the user of the RDF is known.
- The traditional WTE offered by EWS is proven, reliable, and the markets for the main energy recovered (electricity) are always there. Additional waste heat will be available which could lead to the development of facilities that require heat, such as greenhouses. The major downside to traditional WTE is the cost, which is substantially higher than for the offered RDF technologies.

The other RDF technologies have slightly to substantially lower scoring, depending on the performance of the technology and the information provided.

In summary, traditional WTE is a proven technology with secure markets for the energy and a high degree of landfill space savings, but it is expensive compared to most other technologies. RDF is substantially less expensive than WTE, mostly because the actual combustion takes place at an existing facility somewhere else that will burn the fuel produced. The biggest risk with RDF is finding long term markets for the product, without which none of the proposed RDF technologies would meet their goal of being net energy producers and diverting a large amount of waste from landfilling.

It is proposed to continue work carrying forward the WTT technology combination of AD and RDF, and the EWS technology of conventional WTE. These will be researched in more detail so that cost information can be put into the existing model to determine ultimately how these technologies compare financially with landfill expansion. Other components of the study, such as siting issues, regulatory requirements and consultation plan development will take place in parallel. The final report will also include levels of residuals, integration options, timelines, and GHG emissions.

2. PURPOSE

Morrison Hershfield (MH) has been retained by Comox Strathcona Waste Management (CSWM) to seek information from qualified waste-to-energy (WTE) technology vendors through a request for information process. The purpose is to gather and compare technology information and costs from technology suppliers/vendors interested in participating in an assessment of WTE for managing municipal solid waste (MSW) in the Comox Valley Regional District (CVRD) and the Strathcona Regional District (SRD).

Morrison Hershfield was commissioned to evaluate the Vendor submissions and present results to the CSWM WTE Select Committee for discussion. This technical memorandum (Memo) describes the evaluation process for the vendors, summarizes the vendor technologies and identifies the top scoring submissions.

3. RFI PROCESS

Vendors of the various energy recovery technologies were invited to submit responses to a Request for Information (RFI) posted on BC Bid on June 13, 2017. Appendix A contains the RFI documents that were posted publically. In addition, specific vendors, primarily based in Europe, were approached and referred to the BC Bid website for access to the RFI. The European vendors were selected on the basis of the Consultant team's knowledge of firms who provide the selected technologies. The vendors were given until July 14 to submit responses to the RFI.

The purpose of the RFI was to obtain vendor specific information so that technologies could be ranked for suitability to CSWM. The RFI provided background information and clarified that technologies must be capable of processing quantities equivalent to approximately 125 tonnes MSW per day from the CSWM area.

A total of six different vendors of mixed municipal solid waste (MSW) processing and energy recovery technologies responded, as follows:

- Eco Waste Solutions ("EWS")
- REDWAVE, a Division of BT-Wolfgang Binder GmbH
- SALT Canada Inc.
- Sustane Technologies Inc.
- Wastaway
- WTT Netherlands BV

4. SUMMARY OF TECHNOLOGIES OFFERED BY VENDORS

4.1 Eco Waste Solutions ("EWS")

EWS is a well-known Canadian supplier of smaller conventional incineration systems. EWS is proposing that the WTE facility will comprise two EWS Enercon Thermal Conversion Modules. Each module will have a capacity of 100 tonnes per day. The system operates under excess air conditions with precisely controlled combustion through temperature and oxygen level controls and flue gas recirculation.

Air pollution systems are included and are generally provided by companies specialized in supplying this equipment. Air pollution equipment can be specified to meet emission limits, or even stay well below them if desired.

The system is designed to produce electricity or steam, or both. The bottom ash by-product has been tested according to U.S. EPA. All test results have been well below any standards set by these regulatory agencies and have proven the ash to be non-hazardous, non-leaching and essentially inert. The vendor claims that beneficial use can include road construction backfill, road re-surfacing material, aggregate replacement in cement, landfill cover or a beneficial additive to some soils to improve drainage or correct pH.

There are numerous facilities currently using this technology and it is well proven.

4.2 REDWAVE, a Division of BT-Wolfgang Binder GmbH

REDWAVE offers a mechanical-biological waste treatment technology for the mixed residual MSW. Mixed waste is mechanically separated into wet (organics) and dry components and sensor-based sorting recovers recyclables from the dry component. The wet organics are biologically dried and stabilized, and together with the residue from dry sorting are converted into a refuse derived fuel (RDF). RDF can be utilized in cement kilns, pulp mills and or other industry with high energy demand to offset fossil fuels. The vendor mentions two pulp mills located on the Island, in Port Alberni and Crofton, as potential markets, however no market for the RDF has been established.

This is a proven technology in Europe. It is generally not used in Canada due to its cost and difficulties in establishing long term markets for the RDF.

4.3 SALT Canada Inc.

SALT Canada Inc. offers a technology that consists of two distinct steps. In the first step, conventional landfill cells are made aerobic (similar to composting) by injecting large amounts of air. The waste is stabilized and the cell can be opened and mined within four years. In a second step, valuable materials (recyclables) are then mechanically extracted and the remaining waste is processed into fuel or RDF while the landfill cell can be used for repeat filling. This requires an overall time frame of six years between final cell filling and preparation for the cell for further waste acceptance.

This is a somewhat unusual approach and to the best of our knowledge has not yet been successfully applied in its entirety. Anecdotally, landfills are rarely mined due to high cost, and when they are mined it is generally to create new space for disposal. There is a substantial risk that the recovered materials will be contaminated and have a low value. As with any RDF, the challenge is finding long term markets for the fuel.

4.4 Sustane Technologies Inc.

The technology offered by Sustane is using a proprietary de-bonding, separation and cleaning processes, to obtain end products including clean biomass pellets, synthetic diesel, and metals. The biomass pellets are not considered a refuse derived fuel (RDF) as they contain virtually zero plastics. The vendor claims that this has been done in Nova Scotia where the fuel has been certified by the Department of Environment, Nova Scotia, as recovered biomass, with all the attributes of forest based biomass.

Plastics are separated and the low-density plastics fraction is processed into a synthetic diesel product for internal use (25%) and also for sale (75%).The remaining part of the MSW is bio dried and pelletized to create biomass and biodiesel for local markets. The synthetic diesel product will achieve ASTM specifications, typically at a 50% blend and will be sold as a marine diesel or industrial/commercial fuel oil (No. 2) replacement.

Based on the Vendor’s experience in Nova Scotia, the proposed facility will generate recovered materials that can stimulate additional “green” businesses at the location. The submission suggests that CSWM may wish to consider an “Eco-Park” concept to reap the benefit of this enabling technology.

The vendor stated that they can offer the biomass pellets at a price discount to forestry-based biomass to facilitate the sale process for use in pulp and paper boiler applications.

This technology has been proven in Europe and the first Canadian plant is currently under construction in Chester, Nova Scotia. This operation will process 200 tonnes per day of MSW. A facility in Madrid, Spain, has a relatively similar throughput to the one requested with a 100 tonne per day (built in 2010).

4.5 WastAway

WastAway proposes a technology which processes MSW to RDF. A multi-stage process includes pre-shredding of MSW, metals removal, inerts screening, a Hydrolyzer (a form of continuous-flow autoclave), dryer and pelletizer to form RDF. Only one operational plant exists in the U.S., and this facility is more of a demonstration facility than a commercial one. The preparation fuel is relatively recent for this reference plant.

WastAway identified Nanaimo Forest Products – Harmac Pacific Pulp as a potential buyer of the RDF for use in their boilers. The submission names David Bramley, Environmental Superintendent, to be available to confirm interest if required. The interest has not been confirmed at this stage.

4.6 WTT Netherlands BV

Waste Treatment Technologies (WTT) has numerous reference facilities across Europe and proposed two combinations of technologies feasible for CSWM:

- RDF production and biodrying, or
- RDF production, AD and biodrying.

Both these options produce RDF. RDF can replace fossil fuels at cement manufacturers in BC. The option with AD also produces biogas, which can be converted into electricity/heat. The biodried product can be upgraded/refined to compost for land application. The quality of the compost that comes from the processing of mixed MSW can have numerous contaminants, which may limit end markets for land application.

If a facility is selected to generate AD, the bio drying and AD tunnels can be built as hybrid or dual purpose tunnels. These hybrid tunnels can operate under both anaerobic and aerobic conditions. By operating an AD tunnel as composting tunnel the capacity of the tunnel will be tripled. This technology is therefore very flexible to handle smaller or larger volumes.

This is a proven technology in Europe. No facility using WTT technology to produce RDF is in operation in Canada, however WTT technology is used in the Surrey Biofuel Facility to produce compost and biogas.

5. EVALUATION CRITERIA FOR VENDORS

Each submission was evaluated by two team members through a two-tier process. Each submission was evaluated against Essential evaluation criteria (Table 1) and Desirable evaluation criteria (

Table 2). All the submissions met the Essential Criteria, and were assessed further against Desirable Criteria.

The major categories of Desirable Criteria are:

- Innovation and Risk.
- Technology.
- Environmental and Social.

- Economics and Affordability.
- Submission Completeness.

The team allocated weighting to the key categories based on knowledge of local conditions and client priorities. A sensitivity of these weightings is summarized later in this memo.

Table 1: Essential Criteria Used for Evaluating Technology Categories

ESSENTIAL CRITERIA	GUIDANCE ON EVALUATION	EVALUATION RATING
Suitable for volumes expected	Technologies must have practical applications between 20% and 100% of the expected materials to be processed	Yes/ No
Suitable for types of materials expected	Must be able to process/recover types of waste materials expected in the residual waste	Yes/No
Energy recovery	If technology recovery energy, there must be a new surplus of energy after satisfying plant internal requirements	Yes/ No
Maturity	Technology must be proven with at least one full scale facility that has been in successful continuous operation for a year or more	Yes/ No

Table 2: Desirable Criteria Used for Evaluating Technology Categories with Allocated Weighting

DESIRABLE CRITERIA (WEIGHTING)		GUIDANCE ON EVALUATION RATING
Innovation and Risk (25%)	Technology readiness	1. No commercially operating plant, only pilot scale or demonstration facilities. 2. At least one full scale demonstration facility operating successfully for a year or more. 3. One or more commercially operating facilities for one+ years.
	Energy recovery efficiency/ potential	1. Low energy production (up to 100kWh per tonne of feedstock) or unlikely to find markets as fuel. 2. Moderate energy recovery (100 to 250 kWh per tonne of feedstock) or questionable markets for fuel. 3. High energy recovery (over 250 kWh per tonne of feedstock) or firm markets for fuel.
	Technology risk	1. Emerging technology, can be commercialized but scale-up factor greater than 3 forms significant risk. 2. Emerging technology, full scale systems have been trialed but may be difficult to get bank funding. 3. Proven technology, easy to commercialize, commercial funding should be available with good business case.
Technology (25%)	Operational flexibility	1. Modules can accept only designed throughput, no flexibility for higher or lower volumes of feedstock. 2. Moderate flexibility, can operate efficiently with plus/minus 20% of design capacity. 3. Highly flexible, up to 50% more or less feedstock can be handled.
	Complexity	1. Complex technology with sophisticated control requirements, high maintenance needs, and requires highly skilled operators.

DESIRABLE CRITERIA (WEIGHTING)		GUIDANCE ON EVALUATION RATING
		2. Can be operated with common industrial technical skills; requires regular maintenance and replacement of worn parts. 3. Simple and robust process which can be operated with basic trainable skills.
	Feedstock quality requirements	1. Very strict quality requirements requiring extra processing. 2. Moderate processing required. 3. Can take waste with minimal processing.
	Utility requirements	1. Requires full access to utilities, gas, water, power, and sewer. 2. Requires access to power and water. 3. Power access is all that is required.
	Expected availability and reliability	1. Questionable reliance, unproven. 2. Moderate reliance, availability of 80% expected. 3. Proven High reliability and availability of 90% achievable.
	Suitability for CSWM waste volumes and types	1. Technology modules too large for waste volumes expected. 2. Modules too small and many smaller modules must be used. 3. Well suited for CSWM waste volumes and types.
Environmental and Social (25%)	Emission control	1. Questionable ability to treat all emissions to best achievable standard. 2. Emission control systems fully proven. 3. No stack emissions from this process.
	Greenhouse gas (GHG) emissions	1. Questionable ability to reduce emissions in the local context. 2. GHG reduction likely but depends on end product. 3. GHG reduction guaranteed.
	Social benefits	1. Marginal benefits to the local community (small employment opportunities or limited opportunities for local use of end products, etc.). 2. Some social benefits 3. High potential for social benefits (many employment opportunities or opportunities for local use of end products, etc.).
	Residue to landfill (per tonne input)	4. High (more than 20% by weight). 5. Medium (5% to 20% by weight). 6. Low (under 5% by weight).
Economics and Affordability (25%)	Capital costs ($/tonne of installed annual capacity)	1. High, more than $800 per tonne. 2. Medium, $400 - $799 per tonne. 3. Low, under $400 per tonne.
	Operating costs ($/tonne), excluding capital but including profits from product or energy sales	1. High, over $100 per tonne. 2. Medium, $50 - $99 per tonne. 3. Low, under $50 per tonne.
	Quality of end products	1. Quality product moderate with questionable markets. 2. Good market potential but not yet established. 3. Firm markets already exist.

Where information gaps were identified, the Vendors were approached for further information. If data gaps still existed, the evaluator used his/her best judgement based on professional experience to score the Vendor. All scoring was justified with comments to provide transparency and consistency. Where no information was available from the Vendor and it was not possible to fill remaining data gaps with any confidence, a score of 1 was given against the relevant criteria.

Appendix B provides a summary spreadsheet for evaluation of all vendors.

6. RATING OF SUBMISSIONS

The RFI received a total of six submissions, of which five were directly related to the production of conventional RDF from MSW. Only one submission was for traditional (thermal) WTE.

All six vendors provided sufficient details to carry out the evaluation process effectively and all (with limited reference facility information from SALT) had a number of reference facilities operating at or above the potential feedstock generation rates anticipated for the CSWM service area.

On completion of the evaluation process for technology providers in accordance with the evaluation criteria and weighting shown above, the submissions were ranked as shown in Table 3.

Table 3: Ranking of Submissions

VENDOR	TECHNOLOGY	SCORE
WTT	AD and RDF	83%
EWS	Thermal WTE	81%
REDWAVE	RDF	79%
Sustane	RDF and pyrolysis	77%
WastAway	RDF	75%
SALT	Aerobic Landfill, RDF	54%

A summary of the scoring justification for each vendor is presented below:

- WTT has the highest score because they produce both energy and fuel. Markets for the energy (electricity or bio-gas) are proven and available; while the markets for the RDF are somewhat speculative at this time. The technology is proven and less costly than thermal WTE. Emissions are minimal at the location of the facility, but there will be emissions where the RDF is burned and these cannot be determined until the user of the RDF is known.
- The traditional WTE offered by EWS is proven, reliable, and the markets for the main energy recovered (electricity) are always there. Additional waste heat will be available which could lead to the development of facilities that require heat, such as greenhouses. The major downside to traditional WTE is the cost, which is substantially higher than for the offered RDF technologies.
- REDWAVE is an advanced mechanical recycling and RDF production technology. They have good reference facilities and the system is expected to be reliable. A major unanswered question, as with the other RDF technologies is finding markets for the product, and determining the actual emissions when (and where) the product is burned as fuel.

- Sustane adds to its RDF technology the separation of plastics which are subjected to pyrolysis to create a diesel equivalent fuel. While highly desirable, there have been very limited commercially successful applications of pyrolysis for waste products.
- WastAway offers an RDF process with a special process step that breaks down the microbial structure of the organic materials in the waste. WastAway claims it makes a better fuel, however, the process seems much more complex than other RDF technologies. The firm only has one full scale demonstration facility operating at this time. However, WastAway has gone farther than other firms in establishing potential markets for RDF.
- The SALT technology, while in the end making an RDF, is highly untraditional, and there are many unanswered questions and lacking reference facilities, which resulted in lower scoring.

Vecoplan LLC, which is a well-known and reputable German company, also provides a technology for the production of RDF. Vecoplan did not submit a response to the RFI, but provided to Morrison Hershfield a web link to a video showing both actual video and concept animations of its energy recovery facility installation with the City of Edmonton. Vecoplan could therefore not be evaluated, however, their information supports the feasibility of recovering recyclables and making of RDF through modern mechanical systems, as offered by other Vendors.

7. SENSITIVITY ANALYSIS

A sensitivity analysis was conducted to see what would happen if weighting criteria were changed to focus on **economics/affordability**. With 50% of the weighting on economics/affordability, 20% on environmental and 15% each on technology and innovation, the rankings are modified as shown in Table 4.

Table 4: Submission Rankings with Emphasis on Economics/Affordability

VENDOR	TECHNOLOGY	SCORE
WTT	AD AND RDF	81%
WASTAWAY	RDF	76%
REDWAVE	RDF	75%
SUSTANE	RDF AND PYROLYSIS	74%
EWS	THERMAL WTE	72%
SALT	AEROBIC LANDFILL, RDF	48%

This change in ranking demonstrates the high cost of thermal WTE compared to RDF systems.

The next sensitivity analysis was conducted to see what would happen if weighting criteria were changed to focus on **social/environmental**. With 50% of the weighting on social/environmental, 20% on economics/affordability and 15% each on technology and innovation, the rankings are modified as shown in Table 5.

Table 5: Submission Ranking with Emphasis on Social/Environmental

VENDOR	TECHNOLOGY	SCORE
WTT	AD and RDF	83%
Sustane	RDF and pyrolysis	82%
EWS	Thermal WTE	80%
REDWAVE	RDF	80%
WastAway	RDF	78%
SALT	Aerobic Landfill, RDF	58%

The social/environmental bias results in WTT staying the preferred technology because they recover energy with secure markets through AD in addition to RDF. Sustane benefits from the pyrolysis of plastics to oil.

Overall, the combination of AD with RDF is the preferred technology in all situations. Conventional WTE will rank higher or lower, depending on the emphasis on costs.

8. CONCLUSIONS

Of the six submissions, only one offered conventional WTE technology. All others provided some form of conversion to RDF or other fuel.

Conventional WTE ranked near the top primarily because the technology is well proven and markets for energy (electricity and heat) and recovered metals are also proven. In addition, the bottom ash could be recycled or used for various purposes, resulting in very little residue going to landfill.

RDF processing offered by the various Vendors is also proven, although the degree varies with the technology. The greatest challenge with RDF is finding long term markets for the fuel, and without the markets, the technologies are – simply put – very expensive ways of extracting recyclables and stabilizing the balance of residual waste.

Currently in Canada conversion of waste into fuels is appealing as a solution to reduce landfill disposal needs and to extract the most value from the waste stream. However, some of the technologies that are proposed by the vendors are still not proven in Canada. For example it must be seen how the WTE facility in Halifax, Nova Scotia, which is currently under construction, will deliver and prove the viability for RDF markets. The Halifax facility, which will use the Sustane technology plans to convert the plastics fraction of the MSW into a liquid fuel, similar to diesel fuel, while the organics will be converted into burnable pellets. As a point of interest, a larger waste to liquid fuel plant in Edmonton, which is based on the Canadian Enerkem gasification technology, is considerably larger than what is required for CSWM. Enerkem is considering new facilities only where a minimum of 200,000 tonnes per year of waste are available, which is presumably why they did not respond to this RFI.

Conventional WTE costs can be expected to be over $50 million to build the plant and over $80 per tonne to operate it, after the sale of energy.

RDF plants of the conventional and proven variety will be about $20 million to $30 million to build and $50 to $80 per tonne to operate. The primary unknowns are the market for and value of the RDF. Without a confirmed market, the operating costs would be much higher, since there would be no revenue from the sale of RDF and an additional disposal fee for the stabilized RDF at a landfill.

In summary, traditional WTE is a proven technology with secure markets for the energy and a high degree of landfill space savings, but it is expensive compared to most other technologies. RDF is substantially less expensive than WTE, mostly because the actual combustion component is an existing facility somewhere else that will burn the fuel produced. The biggest risk with RDF is finding long term markets for the product, without which none of the proposed RDF technologies would meet their goal of being net energy producers and diverting a large amount of waste from landfilling.

9. Next Steps

The project will proceed in accordance with the established work plan, carrying forward the two preferred technologies: RDF combined with AD, and traditional WTE. The next tasks are the Assessment of Siting and Regulatory Requirements and Consultation Plan Development. While these are being conducted, outstanding information will be gathered for the two top ranked technologies to enable a more detailed financial evaluation and comparison with current landfill expansion plans.

The final project task is the preparation of a summary report, which will:

- Look at residual waste from the two technology options and potential reuse and disposal options;
- Review possibilities for integrating the technologies with existing infrastructure (Integrated Resource Recovery);
- Integrate the technical options into the existing cost model;
- Develop cost and benefit comparison of a viable WTE alternative vs. the proposed CVWMC Cell 2 and 3 engineered landfill;
- Assess constraints, risks and timelines for selected options;
- Develop key tasks and timelines to commission a viable WTE technology as per the RFP requirements; and
- Provide estimates for potential net GHG emissions of selected WTE options and landfill operations.

The result will be a draft assessment report, which after review will be finalized and presented to the CSWM Board.

APPENDIX 1:
REQUEST FOR INFORMATION

Comox Strathcona Waste Management

Request For Information

Waste-to-Energy Technologies

Closing Date and Time:

Friday July 14, 2017 at 4:00 PM PDT

Contact Person:

Nathalie Maurer, P. Eng.
Environmental Engineer
Morrison Hershfield
nmaurer@morrisonhershfield.com

1. INTRODUCTION

Comox Strathcona Waste Management (CSWM), a function of the Comox Valley Regional District (CVRD), is seeking information from qualified waste-to-energy (WTE) technology vendors interested in participating in a feasibility assessment of WTE for managing municipal solid waste (MSW) in the Comox Valley Regional District (CVRD) and the Strathcona Regional District (SRD).

There is interest in WTE technologies for managing the residual waste component of the MSW stream. This is due to the current high cost of landfilling and the anticipated need for substantial investments for landfill expansion. Information being requested from WTE technology vendors will be used to undertake an assessment of whether there are financial, social and environmental benefits of applying WTE instead of increasing landfill capacity.

Information from vendors will be used to undertake the WTE feasibility assessment and these vendors will be recognized in the final assessment report as contributors. The final report will become a public document.

2. ACKNOWLEDGMENT LETTER

Upon receipt of the Request for Information document the Proponent shall complete the Acknowledgement Letter at the back of this document and submit the letter to Nathalie Maurer at nmaurer@morrisonhershfield.com or via fax at 604-454-0403.

3. BACKGROUND

3.1 Physical Setting

The Comox Valley Regional District (CVRD) is located approximately 70 km North West of Nanaimo, BC on the east coast of Vancouver Island. The majority of the CVRD's residents reside in Comox, Courtenay and Cumberland. The Strathcona Regional District (SRD) is located immediately north of the CVRD. The majority of SRD's residents reside in Campbell River. The two regional district centres are located approximately 50 km apart. The CVRD covers 1,725 km^2 and the SRD covers approximately 20,000 km^2. The region's climate is one of the mildest in Canada due to moderation by the Pacific Ocean, which also contributes heavy precipitation to the western coast of Vancouver Island.

3.2 Population and Community Growth

Over the next 10 years the southern waste-shed population (CVRD) is expected to grow at an average rate of 1.1% per year and the northern waste-shed (SRD) population is expected to grow at an average rate of 0.6% per year. From 2027 onwards, the population growth is expected to grow at an average rate of 0.9% and 0.3% for the southern and northern waste-sheds respectively. Table 1 below shows the estimated combined population growth for the next 50 years.

Table 1 Projected Population for next 50 years[1]

Year	CVRD Population	SRD Population	Combined Population
2016	66,527	44,671	111,198
2021	69,280	47,390	116,670
2026	73,002	48,661	121,663
2036	79,411	50,269	129,680
2046	86,855	51,798	138,652
2056	94,996	53,373	148,368
2066	103,900	54,996	158,896

3.3 Solid Waste Management System and Waste Generation

The Comox Strathcona Waste Management (CSWM) service covers waste management for both regional districts (CVRD and SRD). For additional information on the CSWM system the 2012 CSWM Solid Waste Plan can be found at the following link: http://www.cswm.ca/files/CSWM_amended_solid_waste_plan_2013.pdf.

Two main landfills are used for disposal of the majority of the region's waste. The Campbell River Waste Management Centre (CRWMC), located near Campbell River, handles waste from the SRD while the Comox Valley Waste Management Centre (CVWMC), located in

[1] Sub-Provincial Population Projections - P.E.O.P.L.E. 2016 (Aug 2016)

Cumberland, handles waste from the CVRD. The CVWMC is currently being expanded with a new engineered landfill and the CRWMC is expected to close in the next 5-6 years.

There are extensive recycling programs throughout the regions and centralized composting is also being implemented to remove organics from the waste stream. The goal of both regions is to achieve 70% diversion through recycling and composting by 2022 according to the Comox Strathcona Solid Waste Management Plan.

The landfill disposal for 2016 was 63,390 tonnes[2]. Of the total, approximately 58% of the waste was landfilled at the CVWMC and 37% went to the CRWMC. The remainder of the waste was disposed at small, remote landfills in Tahsis, Zeballos and Gold River.

To estimate the projected waste disposal tonnages, it was assumed that with the implementation of composting and additional recycling will result in a 30% decrease in the disposal rate. The estimated disposal tonnages for the next 50 years are shown in Table 2 below. Respondents to this RFI should assume 2021 tonnages for implementation of a WTE facility (this is after implementation of a regional organics management program, and the earliest that a WTE facility could conceivably be built).

Table 2 Projected Disposal Tonnages for next 50 years (based on 2016 per capita disposal rate less 30%)

Year	CVRD Disposal (tonnes)	SRD Disposal (Tonnes)	Total Disposal
2016	37,925	25,465	63,390
2021	27,646	18,911	46,557
2026	29,131	19,418	48,549
2036	31,689	20,060	51,748
2046	34,659	20,670	55,328
2056	37,908	21,298	59,206
2066	41,461	21,946	63,407

There is no waste composition analysis currently available for the CSWM area. Typical waste composition for mid-sized communities in BC may be used if required. Waste composition studies conducted by Nanaimo, BC would have similar values to the study region and the 2012 CSWM Solid Waste Management Plan provides an estimated composition of waste disposed.

3.4 Heating Value of MSW

Waste reduction initiatives are being implemented to achieve a 70% diversion rate, which results in an estimated heating value that could range from 11 – 13 GJ/tonne. New waste diversion is being achieved through the Province of BC's Product Stewardship expansion, which targets primarily packaging, and waste diversion will also be substantially improved

[2] CSWM 2016 Disposal Tonnages

through the construction of a regional composting facility. The reduction of food waste will increase the heating value of the waste, although this will be partially offset by the removal of large amounts of plastic and paper/cardboard packaging. It has been conservatively estimated by Morrison Hershfield that the lower heating value of waste, as received, will be 11 FGJ/tonne in the future once 70% diversion has been achieved.

3.5 Provincial Regulations and Guidelines

The BC Ministry of Environment (MoE) has issued a guideline document for the inclusion of WTE in solid waste management plans. The document may be found at http://www.env.gov.bc.ca/epd/mun-waste/guidelines.htm. The primary elements of the document that apply to this information request are:

- The Ministry 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 Recycling initiatives.

- The Ministry expects that resource recovery facilities (4th R) will obtain at least 60% of the potential energy from the MSW used as a fuel.

- If a WTE facility does not achieve 60% energy efficiency, the Ministry will consider the WTE facility as a residual management facility (5th R).

The BC MoE has established air quality standards for MSW incinerators. The criteria may be found at http://www2.gov.bc.ca/gov/content/environment/air-land-water/air/air-quality-management/regulatory-framework/objectives-standards. All new facilities must meet the standards set out in the MOE document.

4. WTE ASSESSMENT

4.1 Purpose and Objectives

On behalf of the CSWM, Morrison Hershfield is conducting a detailed review of WTE as a means of substantially reducing reliance on landfilling. Tipping fees in the region are currently $130 per tonne and the overall solid waste system is also supported by taxation. The region is concerned about continued increases in solid waste management costs and about placing an even heavier burden on its taxpayers. This study will enable the CSWM to make an informed decision on whether or not to include WTE in its integrated system. It will identify the cost savings from reduced landfill costs and compare them to the increased costs of WTE. It is expected to result in an apples to apples comparison of an integrated system (which includes diversion, transfer, etc.) with an integrated system that continues to rely primarily on landfilling for disposal.

A previous assessment of WTE was conducted in 2011 and focused on conventional, well proven WTE technologies. The approach in 2017 is to continue to include traditional WTE technologies, but also to open the door to innovative systems that show reasonable promise of being commercially viable and reliable. While the generation of energy and its use is an important aspect of financial viability and GHG reduction (compared to landfilling), the main focus is on the removal of residual waste (after recycling and composting) from the need for landfill disposal.

This study is driven primarily by the high unit cost of landfilling and the high capital cost of landfill expansion. The intent is to identify those WTE technologies that are able to recover energy while substantially reducing the volume of waste/residuals going to landfill at a cost lower than current landfill practices.

The proposed technologies should focus on the waste volumes projected to come from the CSWM service area. A major import of waste from other jurisdictions is not envisioned, however a smaller amount from neighbouring regional districts may be considered in the future. Proposed units could be centrally located or smaller decentralized units could be suggested to reduce transportation requirements should it be economically viable. Creation of local employment and potential spinoff benefits will be considered by the CSWM.

Environmental protection is an important component. It is expected that any proposed technology will meet current emission guidelines in BC for WTE technologies. Vendors are also requested to demonstrate the ability of their proposed technology to remain substantially below current emission limits. The reduction of GHG and a technology's ability to demonstrate this is an essential consideration.

This RFI is intended to inform the CSWM of the possibilities available to them and to guide their future decision making and ultimately, their procurement process. Vendors supporting this process with information will be recognized in the summary report.

4.2 Confidentiality

Information provided as part of this RFI will be summarized for the final assessment report, which will become a public document. Only summary information will be used from the submissions and qualifications of the vendors. Detailed submissions will not be included in the final assessment report. If it is necessary for a vendor to withhold information, the vendor should indicate what information is being withheld and for what reason (e.g. proprietary information).

4.3 Intent

The information requested in this document is intended to be used as information only and the submission of information does not create a legal or contractual relationship between the vendor and the CVRD. This is not intended to be a request for qualifications leading to a request for detailed proposals, nor is it intended to be a request for proposals that would result in legal obligations by either party.

4.4 Vendor's Expense

Costs for preparing the submission shall be borne by the vendor.

4.5 Ownership of Submissions and Freedom of Information

All documents and information submitted to the CVRD become the property of the CVRD. Each respondent should clearly identify any information that is considered to be confidential or proprietary information.

The CVRD is subject to the provisions of the Freedom of Information and Protection of Privacy Act. As a result, while section 21 of the Freedom of Information and Protection of Privacy Act does offer some protection for confidential third party business, financial and proprietary information, the CVRD cannot guarantee that any such information provided to the CVRD will remain confidential if a request for access is made under the Freedom of Information and Protection of Privacy Act.

4.6 Submission Requirements

To be considered for the assessment of WTE, interested technology vendors must submit the requested information (as specified in section 5: Questionnaire) by 4:00PM PDT, Friday, July 14, 2017.

Submissions may be sent electronically to Nathalie Maurer at Morrison Hershfield, at nmaurer@morrisonhershfield.com.

Late submissions will not be considered.

The person(s) authorized to sign on behalf of the vendor and to bind the vendor to statements made in response to this request for information must sign the submission form. Unsigned submissions will not be accepted.

The vendor shall be solely responsible for the delivery of their submission in the manner and time prescribed.

4.6.1 Enquiries

All enquiries related to this request for information are to be directed by email, no later than 4:00PM PDT, Friday, July 7, 2017, to:

Nathalie Maurer
Email: nmaurer@morrisonhershfield.com
Ph: 604-454-0402
Fax: 604-454-0403

Information obtained from any other source is not official and should not be relied upon.

4.6.2 Addenda

Addenda may be issued during the submission period in response to queries received. Addenda will be in written form and sent to all vendors who have responded to the acknowledgement letter (section 6). All addenda must be considered when responding to this request for information.

Verbal answers are binding only when confirmed by written addenda.

4.7 Submission Evaluation

This is a request for information and not a competitive process. There will not be a formal evaluation of submissions. Submissions will be reviewed with considerations given to the following categories: Innovation, Technology, Environmental/Social and Economics. Therefore, there may be a ranking of submissions to identify technologies that best meet the CSWM's needs and requirements. Contributions made by vendors will be recognized in the final report, which will become a public document.

4.8 Project Description

The following information, assumptions and instructions will assist vendors with preparing the requested information. For additional details, please address them to Morrison Hershfield's contact person. Information must be provided in the form provided in section 5.

4.8.1 Feedstock

- All residual waste that currently goes to landfill (after diversion) generated in the CSWM service area will be made available as feedstock for the WTE facility.
- Waste will be delivered to the facility 5 days per week with only typical fluctuations due to seasons and climate expected.

- Waste will be delivered as-is and no further processing will be undertaken by CSWM.

- Heating value for the purpose of this study can be assumed to be 11 GJ per tonne (lower heating value, as received). Typical seasonal fluctuations must be expected.

4.8.2 Technology

- All technologies that process residual waste for the purpose of recovering energy and substantially reducing volumes going to landfill will be considered. These include but are not limited to:
    - Small scale mass burn technology
    - Controlled air combustion systems
    - Fluidized bed systems
    - Rotary kiln combustion processes
    - Close coupled two stage gasification
    - True gasification (with syngas cleaning before further processing or combustion)
    - Other gasification or pyrolysis systems
    - Newer technologies not identified above

- In addition to complete systems that process residual waste into energy, consideration will also be given to technologies that convert residual waste into fuel. The viability of markets for this fuel must be demonstrated. Typical technologies might include:
    - Dirty material recovery facility (MRF) for additional recovery of recyclables and conversion of remaining waste to refuse derived fuel (RDF) or solid recovered fuel (SRF), either in pellet form or as fluff
    - Other fuel conversion technology

4.8.3 Size

- The facility shall be sized for the full amount of feedstock available in 2021 identified in Section 3.3. The technology's ability to handle more or less feedstock than the rated capacity must be defined. Note: it is recognized that WTE facilities may take longer to implement (as much as 5 – 7 years), however, 2021 was chosen as a theoretical earliest possible date for the purpose of this RFI).

- Module sizes need to be identified should any increase in capacity be required in the future.

- Vendors of newer technologies that are not commercially operating in other jurisdictions should include the scenario of a pilot demonstration facility as a first step, clearly outlining costs and potential benefits of this newer technology.

4.8.4 Site Location

- A site location has not been determined at this time. It may be located at one of the existing landfills. There may be other potential locations available – vendors are encouraged to investigate options for privately owned sites.
- Assume that costs for land are not part of the Vendor's responsibility.
- Assume that major utilities (water, power, sewer and natural gas) are available.
- Identify any synergies that the proposed process could benefit from if located at landfills (e.g. landfill gas utilization) or close to other industries in the region.
- Identify whether a preferred site has already been identified and provide a description of the site.

4.8.5 Development and Operating Timelines

- No development timeline is available at this time. Vendors are requested to provide realistic time estimates for the design, construction and commissioning of their equipment.
- Assume that the facility will operate for 25 years and include cost provisions for appropriate maintenance and upgrades of major components, if required.

4.8.6 Emissions and Residuals

- Emissions shall meet the criteria identified in Section 3.5.
- Due to the sensitivity of the airshed of the CSWM service area, vendors shall provide an indication of expected actual emissions of an operating plant and show how much key emissions are below regulated values. Expected emissions must be based on experience with similar operating facilities.
- Effluent must meet applicable municipal and provincial regulatory standards.
- Residuals shall be quantified and compared to process input tonnage.
- Types of residuals must be identified (e.g. ash, sludge, char, baghouse fines, etc.).

4.8.7 Transport and Hauling

- Assume that no transportation or hauling is required and all waste will be delivered by others to the facility.
- Assume hauling of residuals to a landfill, as identified by the vendor, will be handled by others. Residuals must be treated at the facility so that they can be safely landfilled.

4.8.8 Energy Recovery

- Assume the current value of electricity sold to the grid is $65/MWh.
- Assume the current value of natural gas is $3/GJ.
- District energy: Assume that there is no infrastructure to absorb excess heat at this time. For the possibility of planning future infrastructure around the WTE facility, please indicate how much heat (GJ/hr) could be available for heating purposes (without sacrificing power production efficiency).
- Assume current market value for recovered metals and assume that metals will be marketed by the vendor.

4.8.9 Ownership

- In a base case, the facility would be privately owned and operated. The CSWM will provide land and a long term (up to 25 year) commitment to supply waste as feedstock for a tipping fee.
- Vendors are requested to comment on alternative procurement/ownership models and indicate and quantify any advantages that may be derived from alternate models.

5. QUESTIONNAIRE

Vendors are requested to provide the following information. Incomplete submissions may be excluded from the review and may not be used for the WTE assessment.

1. Technology

    a. Technology type (combustion, gasification, pyrolysis, RDF, other)

    b. Identify key components (pre-processing, combustion, energy recovery, air pollution control):
        i. Describe pre-processing, if required
        ii. Identify type of combustion or gasification technology and describe briefly
        iii. Indicate what energy is recovered and how (e.g. electricity through steam turbine generator, or methanol from syngas)
        iv. Identify utility requirements, such as natural gas, propane, electricity, water, sewer, etc.

    c. Identify proposed module size:
        i. Include rated capacity
        ii. Indicate flexibility to operate full time at above or below rated capacity (give %)
        iii. Provide approximate footprint and height

    d. Provide high-level mass balance, including:
        i. Tonnes of waste being fed (before any processing)
        ii. Additional inputs (e.g. chemicals, reagents, etc.)
        iii. Water consumption
        iv. Discharges solid (bottom ash, fly ash, metals recycled, etc.)
        v. Discharges liquid

    e. Provide high level energy balance, including:
        i. Waste energy input
        ii. Auxiliary energy input (e.g. natural gas, electricity)
        iii. Total energy generated
        iv. Internal energy consumption
        v. Net energy for sale

    f. Provide expected availability of the technology (e.g. number of hours the plant operates per year at capacity and how many hours is the plant down for scheduled maintenance, plus allowance for unscheduled maintenance).

2. Energy Recovery

    a. Indicate the type of energy recovered

    b. Provide the net energy for sale per tonne of waste received

    c. Provide the potential additional waste-heat energy available per tonne of waste received

d. In the case of RDF/fuel preparation, identify potential markets and the energy amount that would be sold as fuel

e. Identify any potential use or reuse opportunities for any residual generated

3. Environmental

    a. Greenhouse gas (GHG) emissions
        i. Provide the expected net GHG benefits of the process per tonne of waste processed. Also include any assumptions for deriving the benefits.

    b. Other emissions
        i. Confirm that regulatory emission levels can be consistently maintained
        ii. Provide estimate (and basis of that estimate) of what typical emissions will be of the following during normal operations in mg/Rm^3 (based on a temperature of 25°C and a pressure of 101.3 kilopascal, corrected to 11% oxygen and 0% moisture):
            1. Particulates (PM10 and PM2.5)
            2. Carbon monoxide
            3. NOx
            4. Sulfur dioxide
            5. Hydrogen chloride
            6. Lead
            7. Mercury
            8. Dioxins/Furans I-TEQ (International Toxic Equivalents)

    c. Residue
        i. Indicate the total residue to landfill from the process for each tonne of waste processed (in tonnes).
    d. Effluent
        i. Identify effluent (if any) with indication of volumes, characteristics, and hazard level.

4. Social

    a. Provide the size of facility approximately in m^2.

    b. Include the desired size of site in hectares.

    c. Provide the typical number of employees (full time equivalents), including:
        i. Management
        ii. Skilled trades
        iii. Unskilled
        iv. If possible, provide staffing plan from an existing, similar facility showing types of skills needed.

    d. Indicate any spinoff benefits from the facility. May include creation of local jobs (outside of the facility boundaries) or other spinoff businesses, activities, etc.

5. Capital costs

    a. Provide estimated capital costs for the size of facility proposed. Base costs on site specific estimates and/or cost experience from existing, similar facilities:
        i. Provide costs in CAD$, based on theoretical project construction in 2021 and an expected plant life of 25 years.
        ii. Include in costs: Design, fabrication, shipping allowance to Vancouver Island, construction and supervision, commissioning and start-up, trial operation, manuals and training of operators, initial emissions testing, one year of spare parts and 50% performance bond for 5 years.
        iii. Exclude: Taxes, site/land costs, grid tie-in, financing, legal, insurance, environmental and building permits.

6. Operating costs

    a. Provide an estimate of operating costs per tonne of waste processed. Please also provide an approximate breakdown of the operating cost into:
        i. Labour %
        ii. Fixed operating expenses %
        iii. Variable operating costs %
        iv. Spare parts %
        v. Other (define) %

7. Reference facilities

    a. Indicate maturity of technology by identifying how many plants there are world-wide and in North America using this technology.

    b. Provide information on three reference facilities utilizing the same or similar technology and as close to the proposed size as possible. Information should include:
        i. Name and location of the facility
        ii. Brief description of the facility
        iii. Capacity and type of feedstock
        iv. Years in continuous commercial operation
        v. Type of energy recovery
        vi. Manager and/or contact person with email and phone number

8. Additional Information

Please provide additional information to demonstrate the technology track record and/or performance, to supplement the estimated costs, to supplement the information requested above and/or to indicate interest in the potential project.

6. ACKNOWLEDGEMENT LETTER

The undersigned has received a CSWM Request for Information package regarding waste-to-energy technologies and has the intent to submit the requested information. Failure to return this form may result in no further communication regarding this Request for Information.

Company

Address

Contact name and title

Contact phone number

Contact email address

Fax number

Signature Date

The acknowledgement letter is to be signed and returned immediately to:

Nathalie Maurer, P.Eng.
Environmental Engineer
Morrison Hershfield
Email: nmaurer@morrisonhershfield.com
Ph: 604-454-0402
Fax: 604-454-0403

7. SUBMISSION FORM

Comox Strathcona Waste Management
Request-For-Information
Waste-to-Energy Technologies

Closing Date and Time: 4:00 p.m. PDT, Friday, July 14, 2017.

This form must be completed, signed and included with the submission.

The undersigned confirms that their submission is in response to the Request for information for Comox Strathcona Waste Management regarding Waste-to-Energy Technologies, and the Proponent acknowledges receipt of addenda # _____ through addenda #_____

Company

Address

Contact name and title

Contact phone number

Contact email address

Fax number

Signature Date

600 Comox Road, Courtenay, BC V9N 3P6
Tel: 250-334-6000 Fax: 250-334-4358
Toll free: 1-800-331-6007
www.comoxvalleyrd.ca

Comox Strathcona Waste Management

Addendum #1

RFI - Waste-to-Energy Technologies

Closing Date and Time: Friday July 14, 2017 at 4:00 PM PDT

This addendum is issued in response to questions received regarding the above request for information.

Q: Can you confirm, that process water such as condensate can be discharged to the available sewer system and no consideration must be given to an on-site treatment system?

A: Process water can be discharged into an existing sewer system if one exists in the area, or trucked to a WWTP (at the proponent's expense). However, any discharge to into a sewer system must meet local sewer discharge guidelines or standard, and treatment of process water (if required) would be the proponent's responsibility.

Q: The information provided with the RFI state that there is an existing centralized composting in the CVRD, but does not include handling of bio-solids.

Must biosolids and / or digestate be considered in this RFI or are other solutions in place?

A: Proponents should assume that biosolids and digestate are not included in the feedstock. However, we welcome proponents to include information on ability of a technology to deal with biosolids and/or digestate as part of Additional Information.

Please confirm receipt of this addendum by return email to Nathalie Maurer, via email: nmaurer@morrisonhershfield.com. The receipt of the addendum should also be acknowledged in the RFI Submission Form.

600 Comox Road, Courtenay, BC V9N 3P6
Tel: 250-334-6000 Fax: 250-334-4358
Toll free: 1-800-331-6007
www.comoxvalleyrd.ca

Comox Strathcona Waste Management

Addendum #2

RFI - Waste-to-Energy Technologies

Closing Date and Time: Friday July 14, 2017 at 4:00 PM PDT

This addendum is issued in order to clarify the confidentiality of vendors' submissions.

Vendors are encouraged to submit as much information as possible to enable the review of their technology and proposed solution. It is recognized that this may require the inclusion of confidential information about technology performance or price. The CVRD is prepared to honour and keep confidential any sensitive information submitted, provided it is clearly marked in the RFI which information is to be kept confidential, so that there is no confusion on the part of the CVRD or Morrison Hershfield as to what can be included in the summary report/made public, and what cannot be included. Morrison Hershfield and the CVRD reserve the right to use sensitive information for their review along with drawing general conclusions from it, which will later be part of the public report on the technologies.

Please confirm receipt of this addendum by return email to Nathalie Maurer, via email: nmaurer@morrisonhershfield.com. The receipt of the addendum should also be acknowledged in the RFI Submission Form.

APPENDIX 2:
SUMMARY SCORING

APPENDIX 2: Detailed Evaluation Spreadsheet for Evaluation of Vendors - Summary Scoring

WTE Technologies

Evaluation Area	Allocated Weighting (%)	EWS	REDWAVE	SALT	Sustane	Wasteaway	WTT
Innovation	**25**	3.00	2.67	1.33	2.67	2.00	2.67
Technology	**25**	2.50	2.33	2.17	1.83	2.17	2.50
Environmental	**25**	2.50	2.50	2.00	2.75	2.50	2.50
Economics/Affordability	**25**	1.67	2.00	1.00	2.00	2.33	2.33
Submission completeness	**0**	3.00	2.00	1.00	2.00	2.00	2.00
	100	**2.42**	**2.38**	**1.63**	**2.31**	**2.25**	**2.50**

Ranking		
WTT	2.5	83%
EWS	2.4	81%
REDWAVE	2.4	79%
Sustane	2.3	77%
Wasteaway	2.3	75%
SALT	1.6	54%

APPENDIX B: Long-Term Cost Model

Table B1: Long Term Cost Model for Option 0 - Status Quo

Population and Disposal Rates

	Year	Projected CVRD Population	CVRD Waste	Projected SRD Population	SRD Waste	Total Annual Tonnage	Daily Tonnage	Combined Population	Tonnes to Campbell River TS	Tonnes MSW to CRWMC LF	Tonnes to MSW CVWMC LF
			tonnes		tonnes	tonnes / yr	tonnes / day		tonnes		tonnes
	2015	64,294	38,576	45,871	27,523	66,099	181	91,817		27,523	38,576
	2016	64,847	36,963	46,187	26,327	63,289	173	91,174		26,327	36,963
0	2017	65,592	37,387	46,490	26,499	63,887	175	92,091		26,499	37,387
1	2018	66,372	37,832	46,809	26,681	64,513	177	93,053		26,681	37,832
2	2019	67,139	38,269	47,116	26,856	65,125	178	93,995		26,856	38,269
3	2020	67,905	38,706	47,419	27,029	65,735	180	94,934		27,029	38,706
4	2021	68,667	27,467	47,706	19,082	46,549	128	87,749		19,082	27,467
5	2022	69,436	27,774	47,986	19,194	46,969	129	88,630		19,194	27,774
6	2023	70,213	28,085	48,267	19,307	47,392	130	89,520	Landfill closure	19,307	28,085
7	2024	70,986	28,394	48,539	19,416	47,810	131	90,402	19,416		47,810
8	2025	71,758	28,703	48,806	19,522	48,226	132	91,280	19,522		48,226
9	2026	72,527	29,011	49,064	19,626	48,636	133	92,153	19,626		48,636
10	2027	73,290	29,316	49,307	19,723	49,039	134	93,013	19,723		49,039
11	2028	74,047	29,619	49,543	19,817	49,436	135	93,864	19,817		49,436
12	2029	74,795	29,918	49,773	19,909	49,827	137	94,704	19,909		49,827
13	2030	75,531	30,212	49,992	19,997	50,209	138	95,528	19,997		50,209
14	2031	76,255	30,502	50,203	20,081	50,583	139	96,336	20,081		50,583
15	2032	76,971	30,788	50,405	20,162	50,950	140	97,133	20,162		50,950
16	2033	77,681	31,072	50,600	20,240	51,312	141	97,921	20,240		51,312
17	2034	78,366	31,346	50,775	20,310	51,656	142	98,676	20,310		51,656
18	2035	79,039	31,616	50,944	20,378	51,993	142	99,417	20,378		51,993
19	2036	79,710	31,884	51,110	20,444	52,328	143	100,154	20,444		52,328
20	2037	80,366	32,146	51,265	20,506	52,652	144	100,872	20,506		52,652
21	2038	81,010	32,404	51,411	20,564	52,968	145	101,574	20,564		52,968
22	2039	81,643	32,657	51,551	20,620	53,278	146	102,263	20,620		53,278
23	2040	82,270	32,908	51,686	20,674	53,582	147	102,944	20,674		53,582
24	2041	82,888	33,155	51,821	20,728	53,884	148	103,616	20,728		53,884
25	2042	83,717	33,487	52,080	20,832	54,319	149	104,549	20,832		54,319
26	2043	84,554	33,822	52,341	20,936	54,758	150	105,490	20,936		54,758
27	2044	85,400	34,160	52,602	21,041	55,201	151	106,440	21,041		55,201
28	2045	86,254	34,501	52,865	21,146	55,648	152	107,400	21,146		55,648
29	2046	87,116	34,846	53,130	21,252	56,098	154	108,368	21,252		56,098
30	2047	87,987	35,195	53,395	21,358	56,553	155	109,345	21,358		56,553
31	2048	88,867	35,547	53,662	21,465	57,012	156	110,332	21,465		57,012
32	2049	89,756	35,902	53,930	21,572	57,475	157	111,328	21,572		57,475
33	2050	90,653	36,261	54,200	21,680	57,941	159	112,333	21,680		57,941
34	2051	91,560	36,624	54,471	21,788	58,412	160	113,348	21,788		58,412
35	2052	92,476	36,990	54,743	21,897	58,888	161	114,373	21,897		58,888
36	2053	93,400	37,360	55,017	22,007	59,367	163	115,407	22,007		59,367
37	2054	94,334	37,734	55,292	22,117	59,851	164	116,451	22,117		59,851
38	2055	95,278	38,111	55,569	22,228	60,339	165	117,505	22,228		60,339
39	2056	96,230	38,492	55,847	22,339	60,831	167	118,569	22,339		60,831
40	2057	97,193	38,877	56,126	22,450	61,327	168	119,643	22,450		61,327
41	2058	98,165	39,266	56,406	22,563	61,828	169	120,727	22,563		61,828
42	2059	99,146	39,659	56,688	22,675	62,334	171	121,822	22,675		62,334
43	2060	100,138	40,055	56,972	22,789	62,844	172	122,927	22,789		62,844
44	2061	101,139	40,456	57,257	22,903	63,358	174	124,042	22,903		63,358
45	2062	102,151	40,860	57,543	23,017	63,877	175	125,168	23,017		63,877
46	2063	103,172	41,269	57,831	23,132	64,401	176	126,304	23,132		64,401
47	2064	104,204	41,681	58,120	23,248	64,929	178	127,452	23,248		64,929
48	2065	105,246	42,098	58,411	23,364	65,463	179	128,610	23,364		65,463
49	2066	106,298	42,519	58,703	23,481	66,000	181	129,779	23,481		66,000
50	2067	107,361	42,944	58,996	23,598	66,543	182	130,960	23,598		66,543
Totals		4,336,251	1,779,892	2,680,786	1,104,246	2,884,138		5,440,497	939,597	164,649	2,719,489

CVRD growth rate beyond 2041 = 1%
CVRD disposal rate 2009-2015= 0.60 *tonnes per person per year*
CVRD disposal rate 2016-20120= 0.57 *tonnes per person per year*
CVRD disposal rate 2021-2067= 0.40 *tonnes per person per year*
SRD growth rate beyond 2041 = 0.50%
SRD disposal rate 2009-2015= 0.60 *tonnes per person per year*
SRD disposal rate 2016-20120= 0.57 *tonnes per person per year*
SRD disposal rate 2021-2067= 0.40 *tonnes per person per year*
Days of operation = 330 *days per year*
Bottom ash/residuals to landfill = 10% *% of input*

CRWMC LF Fill Rate and Capacity

	Year	Volumetric MSW Disposal Rate	Daily Cover Soil	Operational Soil	Settlement	Net Fill Volume	Cumulative Fill Volume	Phase	Volumetric Capacity (m³)
		m³	m³	m³	m³	m³	m³		
	2015	39,318	13,106	786	786	52,424			
	2016	37,609	12,536	752	752	50,146		Phase 3	
0	2017	37,856	12,619	757	757	50,475	50,475	Phase 3	
1	2018	38,116	12,705	762	762	50,821	101,296	Phase 3	
2	2019	38,366	12,789	767	767	51,155	152,451	Phase 3	
3	2020	38,613	12,871	772	772	51,483	203,934	Phase 3	
4	2021	27,261	9,087	545	545	36,347	240,281	Phase 3	
5	2022	27,421	9,140	548	548	36,561	276,842	Phase 3	
6	2023	27,581	9,194	552	552	36,775	313,617	Closed	**288,480**
7	2024	0	0	0	0	0	313,617	Closed	
8	2025	0	0	0	0	0	313,617	Closed	
9	2026	0	0	0	0	0	313,617	Closed	
10	2027	0	0	0	0	0	313,617	Closed	
11	2028	0	0	0	0	0	313,617	Closed	
12	2029	0	0	0	0	0	313,617	Closed	
13	2030	0	0	0	0	0	313,617	Closed	
14	2031	0	0	0	0	0	313,617	Closed	
15	2032	0	0	0	0	0	313,617	Closed	
16	2033	0	0	0	0	0	313,617	Closed	
17	2034	0	0	0	0	0	313,617	Closed	
18	2035	0	0	0	0	0	313,617	Closed	
19	2036	0	0	0	0	0	313,617	Closed	
20	2037	0	0	0	0	0	313,617	Closed	
21	2038	0	0	0	0	0	313,617	Closed	
22	2039	0	0	0	0	0	313,617	Closed	
23	2040	0	0	0	0	0	313,617	Closed	
24	2041	0	0	0	0	0	313,617	Closed	
25	2042	0	0	0	0	0	313,617	Closed	
26	2043	0	0	0	0	0	313,617	Closed	
27	2044	0	0	0	0	0	313,617	Closed	
28	2045	0	0	0	0	0	313,617	Closed	
29	2046	0	0	0	0	0	313,617	Closed	
30	2047	0	0	0	0	0	313,617	Closed	
31	2048	0	0	0	0	0	313,617	Closed	
32	2049	0	0	0	0	0	313,617	Closed	
33	2050	0	0	0	0	0	313,617	Closed	
34	2051	0	0	0	0	0	313,617	Closed	
35	2052	0	0	0	0	0	313,617	Closed	
36	2053	0	0	0	0	0	313,617	Closed	
37	2054	0	0	0	0	0	313,617	Closed	
38	2055	0	0	0	0	0	313,617	Closed	
39	2056	0	0	0	0	0	313,617	Closed	
40	2057	0	0	0	0	0	313,617	Closed	
41	2058	0	0	0	0	0	313,617	Closed	
42	2059	0	0	0	0	0	313,617	Closed	
43	2060	0	0	0	0	0	313,617	Closed	
44	2061	0	0	0	0	0	313,617	Closed	
45	2062	0	0	0	0	0	313,617	Closed	
46	2063	0	0	0	0	0	313,617	Closed	
47	2064	0	0	0	0	0	313,617	Closed	
48	2065	0	0	0	0	0	313,617	Closed	
49	2066	0	0	0	0	0	313,617	Closed	
50	2067	0	0	0	0	0	313,617	Closed	

In-situ MSW waste density = 0.7 *tonnes per m³*
Operational soil = 2% *of waste volume per year*
Waste to cover ratio = 3:1
Settlement = 2% *of waste volume per year*

CVWMC LF Fill Rate and Capacity

	Year	Volumetric MSW Disposal Rate	Daily Cover Soil	Operational Soil	Settlement	Net Fill Volume	Cumulative Fill Volume	Phase / Cell	Phase / Cell	Volumetric Capacity (m³)
		m³	m³	m³	m³	m³	m³			
	2015	55,109	18,370	1,102	1,102	73,479				
	2016	52,804	17,601	1,056	1,056	70,405		Phase 2	Phase 2	**46,525**
0	2017	53,411	17,804	1,068	1,068	71,214	71,214	Cell 1	Phase 2	
1	2018	54,046	18,015	1,081	1,081	72,061	143,275	Cell 1	Cell 1	
2	2019	54,670	18,223	1,093	1,093	72,894	216,169	Cell 1	Cell 1	
3	2020	55,294	18,431	1,106	1,106	73,725	289,894	Cell 1	Cell 1	
4	2021	39,238	13,079	785	785	52,318	342,212	Cell 1	Cell 1	
5	2022	39,678	13,226	794	794	52,904	395,116	Cell 1	Cell 1	
6	2023	40,122	13,374	802	802	53,496	448,611	Cell 1	Cell 1	
7	2024	68,300	22,767	1,366	1,366	91,067	539,678	Cell 2	Cell 1	**517,470**
8	2025	68,894	22,965	1,378	1,378	91,858	631,536	Cell 2	Cell 2	
9	2026	69,481	23,160	1,390	1,390	92,641	724,177	Cell 2	Cell 2	
10	2027	70,055	23,352	1,401	1,401	93,407	817,584	Cell 2	Cell 2	
11	2028	70,623	23,541	1,412	1,412	94,164	911,748	Cell 2	Cell 2	
12	2029	71,182	23,727	1,424	1,424	94,909	1,006,657	Cell 2	Cell 2	
13	2030	71,727	23,909	1,435	1,435	95,637	1,102,294	Cell 2	Cell 2	
14	2031	72,262	24,087	1,445	1,445	96,349	1,198,643	Cell 2	Cell 2	
15	2032	72,786	24,262	1,456	1,456	97,048	1,295,691	Cell 2	Cell 2	
16	2033	73,303	24,434	1,466	1,466	97,738	1,393,429	Cell 2	Cell 2	
17	2034	73,795	24,598	1,476	1,476	98,393	1,491,822	Cell 2	Cell 2	
18	2035	74,276	24,759	1,486	1,486	99,035	1,590,857	Cell 3	Cell 2	**1,563,942**
19	2036	74,754	24,918	1,495	1,495	99,672	1,690,529	Cell 3	Cell 3	
20	2037	75,218	25,073	1,504	1,504	100,290	1,790,819	Cell 3	Cell 3	
21	2038	75,669	25,223	1,513	1,513	100,892	1,891,712	Cell 3	Cell 3	
22	2039	76,111	25,370	1,522	1,522	101,481	1,993,193	Cell 3	Cell 3	
23	2040	76,546	25,515	1,531	1,531	102,062	2,095,254	Cell 3	Cell 3	
24	2041	76,977	25,659	1,540	1,540	102,635	2,197,890	Cell 3	Cell 3	
25	2042	77,598	25,866	1,552	1,552	103,464	2,301,354	Cell 3	Cell 3	
26	2043	78,225	26,075	1,565	1,565	104,301	2,405,655	Cell 3	Cell 3	
27	2044	78,858	26,286	1,577	1,577	105,144	2,510,799	Cell 3	Cell 3	
28	2045	79,496	26,499	1,590	1,590	105,995	2,616,794	Cell 4	Cell 3	**2,604,832**
29	2046	80,140	26,713	1,603	1,603	106,854	2,723,648	Cell 4	Cell 4	
30	2047	80,790	26,930	1,616	1,616	107,720	2,831,368	Cell 4	Cell 4	
31	2048	81,445	27,148	1,629	1,629	108,594	2,939,962	Cell 4	Cell 4	
32	2049	82,106	27,369	1,642	1,642	109,475	3,049,437	Cell 4	Cell 4	
33	2050	82,773	27,591	1,655	1,655	110,365	3,159,802	Cell 4	Cell 4	
34	2051	83,446	27,815	1,669	1,669	111,262	3,271,064	Cell 4	Cell 4	
35	2052	84,125	28,042	1,683	1,683	112,167	3,383,230	Cell 4	Cell 4	
36	2053	84,810	28,270	1,696	1,696	113,080	3,496,310	Cell 4	Cell 4	
37	2054	85,501	28,500	1,710	1,710	114,001	3,610,312	Cell 5a	Cell 4	**3,559,580**
38	2055	86,198	28,733	1,724	1,724	114,931	3,725,242	Cell 5a	Cell 5a	
39	2056	86,901	28,967	1,738	1,738	115,868	3,841,110	Cell 5a	Cell 5a	
40	2057	87,611	29,204	1,752	1,752	116,814	3,957,924	Cell 5a	Cell 5a	
41	2058	88,326	29,442	1,767	1,767	117,768	4,075,693	Cell 5a	Cell 5a	
42	2059	89,048	29,683	1,781	1,781	118,731	4,194,424	Cell 5a	Cell 5a	
43	2060	89,777	29,926	1,796	1,796	119,703	4,314,127	Cell 5a	Cell 5a	
44	2061	90,512	30,171	1,810	1,810	120,683	4,434,809	Cell 6	Cell 5a	**4,334,704**
45	2062	91,253	30,418	1,825	1,825	121,671	4,556,481	Cell 6	Cell 6	
46	2063	92,002	30,667	1,840	1,840	122,669	4,679,149	Cell 6	Cell 6	
47	2064	92,756	30,919	1,855	1,855	123,675	4,802,825	Cell 6	Cell 6	
48	2065	93,518	31,173	1,870	1,870	124,691	4,927,515	Cell 6	Cell 6	
49	2066	94,286	31,429	1,886	1,886	125,715	5,053,230	Cell 6	Cell 6	
50	2067	95,061	31,687	1,901	1,901	126,748	5,179,978	Cell 6	Cell 6	

In-situ MSW waste density = 0.7 *tonnes per m³*
Operational soil = 2% *of waste volume per year*
Waste to cover ratio = 3:1
Settlement = 2% *of waste volume per year*

Table B1: Long Term Cost Model for Option 0 - Status Quo

Capital and Operating Costs

Year		Campbell River TS Capital	Campbell River TS Operating	Campbell River TS Transport	CVWMC LF Capital - Expansion	CVWMC LF Capital - Minor Capital	CVWMC LF Capital - Closure	CVWMC LF Operating - Expansion	CVWMC LF Operating - Post-Closure	CRWMC LF Capital	CRWMC LF Operating & Post-Closure	Total System	Campbell River TS Notes	CVWMC LF Notes	CRWMC LF Notes
	2015											$0			
	2016				$16,000,000							$16,000,000	New Transfer station constructed 2012-2013	Construction of leachate management system and Cell 1	
0	2017					$ 860,000	$ 265,000	$1,108,145		$250,868	$1,002,753	$3,487,000		Closure Phase 2	Phase 2 SW mgmt design & partial construction
1	2018					$ 200,000	$ 2,500,000	$1,108,145		$490,358	$1,002,753	$5,301,000		Closure Phase 2	Phase 2 Surface water management construction
2	2019					$ -		$1,108,145	$390,000	$191,695	$1,002,753	$2,693,000			Phase 2 Design and construction
3	2020	$200,000				$ 1,075,000		$1,108,145	$190,000	$491,790	$1,002,753	$4,068,000	New trailers every 8 years		Phase 2 LFG and final cover design
4	2021					$ 35,000		$1,108,145	$190,000	$5,630,329	$1,002,753	$7,966,000			Phase 2 LFG and final cover construction
5	2022					$ 550,000		$1,108,145	$190,000	$218,613	$1,002,753	$3,070,000			Phase 3 LFG and final cover design
6	2023					$ 585,000		$1,108,145	$190,000	$3,108,685	$1,002,753	$5,995,000			Phase 3 LFG and final cover construction
7	2024		$651,040	$287,351	$8,850,000	$ -		$1,108,145	$390,000		$190,000	$11,477,000		Construction Cell 2	
8	2025		$651,040	$288,932		$ 175,000		$1,233,145	$190,000		$190,000	$2,728,000			
9	2026		$651,040	$290,459		$ -	$ 1,350,000	$1,233,145	$190,000		$190,000	$3,905,000		Closure Cell 1	
10	2027		$651,040	$291,897		$ 585,000		$1,233,145	$190,000		$190,000	$3,141,000			
11	2028	$200,000	$651,040	$293,295		$ 200,000		$1,233,145	$190,000		$190,000	$2,957,000	New trailers every 8 years		
12	2029		$651,040	$294,656		$ 385,000		$1,233,145	$390,000		$190,000	$3,144,000			
13	2030		$651,040	$295,953		$ 1,075,000		$1,233,145	$190,000		$190,000	$3,635,000			
14	2031		$651,040	$297,202		$ -		$1,233,145	$190,000		$190,000	$2,561,000			
15	2032	$346,000	$651,040	$298,398		$ 550,000		$1,233,145	$190,000		$190,000	$3,459,000	Transfer station - parking and roads (20 yr life) + capital upgrades		
16	2033		$651,040	$299,552		$ 235,000		$1,233,145	$190,000		$190,000	$2,799,000			
17	2034		$651,040	$300,588		$ -		$1,233,145	$390,000		$190,000	$2,765,000			
18	2035		$651,040	$301,588	$7,800,000	$ 560,000		$1,233,145	$190,000		$190,000	$10,926,000		Construction Cell 3	
19	2036	$200,000	$651,040	$302,571		$ -		$1,358,145	$190,000		$190,000	$2,892,000	New trailers every 8 years		
20	2037		$651,040	$303,489		$ 550,000	$ 2,850,000	$1,358,145	$190,000		$190,000	$6,093,000		Closure Cell 2	
21	2038		$651,040	$304,353		$ 200,000		$1,358,145	$190,000		$190,000	$2,894,000			
22	2039		$651,040	$305,182		$ 35,000		$1,358,145	$390,000		$190,000	$2,929,000			
23	2040		$651,040	$305,981		$ 1,075,000		$1,358,145	$190,000		$190,000	$3,770,000			
24	2041		$651,040	$306,780		$ 385,000		$1,358,145	$190,000		$190,000	$3,081,000			
25	2042		$651,040	$308,314		$ 560,000		$1,358,145	$190,000		$190,000	$3,247,000			
26	2043		$651,040	$309,856		$ 200,000		$1,358,145	$190,000		$190,000	$2,899,000			
27	2044	$200,000	$651,040	$311,405		$ -		$1,358,145	$390,000		$190,000	$3,101,000	New trailers every 8 years		
28	2045		$651,040	$312,962	$5,440,000	$ 210,000		$1,358,145	$190,000		$190,000	$8,352,000		Construction Cell 4	
29	2046		$651,040	$314,527		$ -		$1,358,145	$190,000		$190,000	$2,704,000			
30	2047		$651,040	$316,100		$ 935,000	$ 3,010,000	$1,358,145	$190,000		$190,000	$6,650,000		Closure Cell 3	
31	2048		$651,040	$317,680		$ 200,000		$1,358,145	$190,000		$190,000	$2,907,000			
32	2049		$651,040	$319,268		$ -		$1,358,145	$390,000		$190,000	$2,908,000			
33	2050		$651,040	$320,865		$ 1,075,000		$1,358,145	$190,000		$190,000	$3,785,000			
34	2051	$241,000	$651,040	$322,469		$ 35,000		$1,358,145	$190,000		$190,000	$2,988,000	Transfer station permits etc		
35	2052	$2,615,000	$651,040	$324,081		$ 550,000		$1,358,145	$190,000		$190,000	$5,878,000	Transfer station - new facility + new trailers		
36	2053		$651,040	$325,702		$ 585,000		$1,358,145	$190,000		$190,000	$3,300,000			
37	2054		$651,040	$327,330	$4,450,000	$ -		$1,358,145	$390,000		$190,000	$7,367,000		Construction Cell 5a	
38	2055		$651,040	$328,967		$ 175,000		$1,358,145	$190,000		$190,000	$2,893,000			
39	2056		$651,040	$330,612		$ -	$ 4,400,000	$1,358,145	$190,000		$190,000	$7,120,000		Closure Cell 4	
40	2057		$651,040	$332,265		$ 585,000		$1,358,145	$190,000		$190,000	$3,306,000			
41	2058		$651,040	$333,926		$ 200,000		$1,358,145	$190,000		$190,000	$2,923,000			
42	2059		$651,040	$335,596		$ 385,000		$1,358,145	$390,000		$190,000	$3,310,000			
43	2060	$200,000	$651,040	$337,274		$ 1,075,000		$1,358,145	$190,000		$190,000	$4,001,000	New trailers every 8 years		
44	2061		$651,040	$338,960	$5,330,000	$ -		$1,358,145	$190,000		$190,000	$8,058,000		Construction Cell 6	
45	2062		$651,040	$340,655		$ 550,000		$1,358,145	$190,000		$190,000	$3,280,000			
46	2063		$651,040	$342,358		$ 235,000	$ 4,020,000	$1,358,145	$190,000		$190,000	$6,987,000		Closure Cell 5a	
47	2064		$651,040	$344,070		$ -		$1,358,145	$390,000		$190,000	$2,933,000			
48	2065		$651,040	$345,790		$ 560,000		$1,358,145	$190,000		$190,000	$3,295,000			
49	2066		$651,040	$347,519		$ -		$1,358,145	$190,000		$190,000	$2,737,000			
50	2067		$651,040	$349,257		$ 550,000		$1,358,145	$190,000		$190,000	$3,288,000			
Totals		$4,202,000	$28,645,760	$13,906,036	$31,870,000	$17,970,000	$18,395,000	$65,890,408	$11,310,000	$10,382,338	$15,379,269	$217,953,000			

30 years
$134,689,000 1,651,117 tonnes
$82 per tonne over 30 years

40 years
$177,141,000 2,242,559 tonnes
$79 per tonne over 40 years

50 years
$217,953,000 2,884,138 tonnes
$76 per tonne over 50 years

Table B2: Long Term Cost Model for Option 1(a) - WTT facility located in Comox Valley

Population and Disposal Rates

Year		Projected CVRD Population	CVRD waste	Projected SRD Population	SRD Waste	Total Annual Tonnage	Daily Tonnage	Combined Population	Tonnes to Comox Valley TS	Tonnes to Campbell River TS	Tonnes to WTT Facility	Tonnes per day to WTT facility	Tonnes MSW to CRWMC LF	Tonnes to MSW CVWMC LF	Tonnes Ash/Residuals to CVWMC LF
			tonnes		tonnes	tonnes / yr	tonnes / day		tonnes	tonnes	tonnes	tonnes / day		tonnes	
	2015	64,294	38,576	45,871	27,523	66,099	181	91,817					27,523	38,576	
	2016	64,847	36,963	46,187	26,327	63,289	173	91,174					26,327	36,963	
0	2017	65,592	37,387	46,490	26,499	63,887	175	92,091					26,499	37,387	0
1	2018	66,372	37,832	46,809	26,681	64,513	177	93,053					26,681	37,832	0
2	2019	67,139	38,269	47,116	26,856	65,125	178	93,995					26,856	38,269	0
3	2020	67,905	38,706	47,419	27,029	65,735	180	94,934					27,029	38,706	0
4	2021	68,667	27,467	47,706	19,082	46,549	128	87,749			26,413	80	19,082	1,054	8,848
5	2022	69,436	27,774	47,986	19,194	46,969	129	88,630			26,709	81	19,194	1,065	8,948
6	2023	70,213	28,085	48,267	19,307	47,392	130	89,520		Landfill closur	27,008	82	19,307	1,077	9,048
7	2024	70,986	28,394	48,539	19,416	47,810	131	90,402		19,416	45,976	139		1,834	15,402
8	2025	71,758	28,703	48,806	19,522	48,226	132	91,280		19,522	45,976	139		2,250	15,402
9	2026	72,527	29,011	49,064	19,626	48,636	133	92,153		19,626	45,976	139		2,660	15,402
10	2027	73,290	29,316	49,307	19,723	49,039	134	93,013		19,723	45,976	139		3,063	15,402
11	2028	74,047	29,619	49,543	19,817	49,436	135	93,864		19,817	45,976	139		3,460	15,402
12	2029	74,795	29,918	49,773	19,909	49,827	137	94,704		19,909	45,976	139		3,851	15,402
13	2030	75,531	30,212	49,992	19,997	50,209	138	95,528		19,997	45,976	139		4,233	15,402
14	2031	76,255	30,502	50,203	20,081	50,583	139	96,336		20,081	45,976	139		4,607	15,402
15	2032	76,971	30,788	50,405	20,162	50,950	140	97,133		20,162	45,976	139		4,974	15,402
16	2033	77,681	31,072	50,600	20,240	51,312	141	97,921		20,240	45,976	139		5,336	15,402
17	2034	78,366	31,346	50,775	20,310	51,656	142	98,676		20,310	45,976	139		5,680	15,402
18	2035	79,039	31,616	50,944	20,378	51,993	142	99,417		20,378	45,976	139		6,017	15,402
19	2036	79,710	31,884	51,110	20,444	52,328	143	100,154		20,444	45,976	139		6,352	15,402
20	2037	80,366	32,146	51,265	20,506	52,652	144	100,872		20,506	45,976	139		6,676	15,402
21	2038	81,010	32,404	51,411	20,564	52,968	145	101,574		20,564	45,976	139		6,992	15,402
22	2039	81,643	32,657	51,551	20,620	53,278	146	102,263		20,620	45,976	139		7,302	15,402
23	2040	82,270	32,908	51,686	20,674	53,582	147	102,944		20,674	45,976	139		7,606	15,402
24	2041	82,888	33,155	51,821	20,728	53,884	148	103,616		20,728	45,976	139		7,908	15,402
25	2042	83,717	33,487	52,080	20,832	54,319	149	104,549		20,832	45,976	139		8,343	15,402
26	2043	84,554	33,822	52,341	20,936	54,758	150	105,490		20,936	45,976	139		8,782	15,402
27	2044	85,400	34,160	52,602	21,041	55,201	151	106,440		21,041	45,976	139		9,225	15,402
28	2045	86,254	34,501	52,865	21,146	55,648	152	107,400		21,146	45,976	139		9,672	15,402
29	2046	87,116	34,846	53,130	21,252	56,098	154	108,368		21,252	45,976	139		10,122	15,402
30	2047	87,987	35,195	53,395	21,358	56,553	155	109,345		21,358	45,976	139		10,577	15,402
31	2048	88,867	35,547	53,662	21,465	57,012	156	110,332		21,465	45,976	139		11,036	15,402
32	2049	89,756	35,902	53,930	21,572	57,475	157	111,328		21,572	45,976	139		11,499	15,402
33	2050	90,653	36,261	54,200	21,680	57,941	159	112,333		21,680	45,976	139		11,965	15,402
34	2051	91,560	36,624	54,471	21,788	58,412	160	113,348		21,788	45,976	139		12,436	15,402
35	2052	92,476	36,990	54,743	21,897	58,888	161	114,373		21,897	45,976	139		12,912	15,402
36	2053	93,400	37,360	55,017	22,007	59,367	163	115,407		22,007	45,976	139		13,391	15,402
37	2054	94,334	37,734	55,292	22,117	59,851	164	116,451		22,117	45,976	139		13,875	15,402
38	2055	95,278	38,111	55,569	22,228	60,339	165	117,505		22,228	45,976	139		14,363	15,402
39	2056	96,230	38,492	55,847	22,339	60,831	167	118,569		22,339	45,976	139		14,855	15,402
40	2057	97,193	38,877	56,126	22,450	61,327	168	119,643		22,450	45,976	139		15,351	15,402
41	2058	98,165	39,266	56,406	22,563	61,828	169	120,727		22,563	45,976	139		15,852	15,402
42	2059	99,146	39,659	56,688	22,675	62,334	171	121,822		22,675	45,976	139		16,358	15,402
43	2060	100,138	40,055	56,972	22,789	62,844	172	122,927		22,789	45,976	139		16,868	15,402
44	2061	101,139	40,456	57,257	22,903	63,358	174	124,042		22,903	45,976	139		17,382	15,402
45	2062	102,151	40,860	57,543	23,017	63,877	175	125,168		23,017	45,976	139		17,901	15,402
46	2063	103,172	41,269	57,831	23,132	64,401	176	126,304		23,132	45,976	139		18,425	15,402
47	2064	104,204	41,681	58,120	23,248	64,929	178	127,452		23,248	45,976	139		18,953	15,402
48	2065	105,246	42,098	58,411	23,364	65,463	179	128,610		23,364	45,976	139		19,487	15,402
49	2066	106,298	42,519	58,703	23,481	66,000	181	129,779		23,481	45,976	139		20,024	15,402
50	2067	107,361	42,944	58,996	23,598	66,543	182	130,960		23,598	45,976	139		20,567	15,402
Totals		4,465,392	1,855,431	2,772,844	1,158,095	3,013,526		5,623,487	0	939,597	2,103,074			691,954	704,530

CRWMC LF Fill Rate and Capacity

Year		Volumetric MSW Disposal Rate	Daily Cover Soil	Operational Soil	Settlement	Net Fill Volume	Cumulative Fill Volume	Phase	Volumetric Capacity (m^3)
		m^3	m^3	m^3	m^3	m^3	m^3		
	2015	39,318	13,106	786	786	52,424			
	2016	37,609	12,536	752	752	50,146		Phase 3	
0	2017	37,856	12,619	757	757	50,475	50,475	Phase 3	
1	2018	38,116	12,705	762	762	50,821	101,296	Phase 3	
2	2019	38,366	12,789	767	767	51,155	152,451	Phase 3	
3	2020	38,613	12,871	772	772	51,483	203,934	Phase 3	
4	2021	27,261	9,087	545	545	36,347	240,281	Phase 3	
5	2022	27,421	9,140	548	548	36,561	276,842	Phase 3	
6	2023	27,581	9,194	551	552	36,775	313,617	Closed	**288,480**
7	2024	0	0	0	0	0	313,617	Closed	
8	2025	0	0	0	0	0	313,617	Closed	
9	2026	0	0	0	0	0	313,617	Closed	
10	2027	0	0	0	0	0	313,617	Closed	
11	2028	0	0	0	0	0	313,617	Closed	
12	2029	0	0	0	0	0	313,617	Closed	
13	2030	0	0	0	0	0	313,617	Closed	
14	2031	0	0	0	0	0	313,617	Closed	
15	2032	0	0	0	0	0	313,617	Closed	
16	2033	0	0	0	0	0	313,617	Closed	
17	2034	0	0	0	0	0	313,617	Closed	
18	2035	0	0	0	0	0	313,617	Closed	
19	2036	0	0	0	0	0	313,617	Closed	
20	2037	0	0	0	0	0	313,617	Closed	
21	2038	0	0	0	0	0	313,617	Closed	
22	2039	0	0	0	0	0	313,617	Closed	
23	2040	0	0	0	0	0	313,617	Closed	
24	2041	0	0	0	0	0	313,617	Closed	
25	2042	0	0	0	0	0	313,617	Closed	
26	2043	0	0	0	0	0	313,617	Closed	
27	2044	0	0	0	0	0	313,617	Closed	
28	2045	0	0	0	0	0	313,617	Closed	
29	2046	0	0	0	0	0	313,617	Closed	
30	2047	0	0	0	0	0	313,617	Closed	
31	2048	0	0	0	0	0	313,617	Closed	
32	2049	0	0	0	0	0	313,617	Closed	
33	2050	0	0	0	0	0	313,617	Closed	
34	2051	0	0	0	0	0	313,617	Closed	
35	2052	0	0	0	0	0	313,617	Closed	
36	2053	0	0	0	0	0	313,617	Closed	
37	2054	0	0	0	0	0	313,617	Closed	
38	2055	0	0	0	0	0	313,617	Closed	
39	2056	0	0	0	0	0	313,617	Closed	
40	2057	0	0	0	0	0	313,617	Closed	
41	2058	0	0	0	0	0	313,617	Closed	
42	2059	0	0	0	0	0	313,617	Closed	
43	2060	0	0	0	0	0	313,617	Closed	
44	2061	0	0	0	0	0	313,617	Closed	
45	2062	0	0	0	0	0	313,617	Closed	
46	2063	0	0	0	0	0	313,617	Closed	
47	2064	0	0	0	0	0	313,617	Closed	
48	2065	0	0	0	0	0	313,617	Closed	
49	2066	0	0	0	0	0	313,617	Closed	
50	2067	0	0	0	0	0	313,617	Closed	

CVWMC LF Fill Rate and Capacity

Year		Volumetric MSW Disposal Rate	Volumetric Ash / Residuals Disposal Rate	Daily Cover Soil	Operational Soil	Settlement	Net Fill Volume	Cumulative Fill Volume	Phase / Cell	Phase / Cell	Volumetric Capacity (m^3)
		m^3	m^3	m^3	m^3	m^3	m^3	m^3			
	2015	55,109		18,370	1,102	1,102	73,479				
	2016	52,804		17,601	1,056	1,056	70,405		Phase 2	Phase 2	
0	2017	53,411	0	17,804	1,068	1,068	71,214	71,214	Cell 1	Phase 2	
1	2018	54,046	0	18,015	1,081	1,081	72,061	143,275	Cell 1	Cell 1	
2	2019	54,670	0	18,223	1,093	1,093	72,894	216,169	Cell 1	Cell 1	
3	2020	55,294	0	18,431	1,106	1,106	73,725	289,894	Cell 1	Cell 1	
4	2021	1,505	12,641	502	30	30	14,647	304,542	Cell 1	Cell 1	
5	2022	1,522	12,782	507	30	30	14,811	319,353	Cell 1	Cell 1	
6	2023	1,539	12,925	513	31	31	14,977	334,330	Cell 1	Cell 1	
7	2024	2,620	22,003	873	52	52	25,496	359,826	Cell 1	Cell 1	
8	2025	3,214	22,003	1,071	64	64	26,288	386,114	Cell 1	Cell 1	
9	2026	3,801	22,003	1,267	76	76	27,070	413,184	Cell 1	Cell 1	
10	2027	4,375	22,003	1,458	88	88	27,837	441,021	Cell 1	Cell 1	
11	2028	4,943	22,003	1,648	99	99	28,593	469,614	Cell 1	Cell 1	
12	2029	5,502	22,003	1,834	110	110	29,338	498,953	Cell 1	Cell 1	
13	2030	6,047	22,003	2,016	121	121	30,066	529,019	Cell 2	Cell 1	**517,470**
14	2031	6,582	22,003	2,194	132	132	30,778	559,797	Cell 2	Cell 2	
15	2032	7,106	22,003	2,369	142	142	31,478	591,275	Cell 2	Cell 2	
16	2033	7,623	22,003	2,541	152	152	32,167	623,442	Cell 2	Cell 2	
17	2034	8,115	22,003	2,705	162	162	32,823	656,265	Cell 2	Cell 2	
18	2035	8,596	22,003	2,865	172	172	33,464	689,729	Cell 2	Cell 2	
19	2036	9,074	22,003	3,025	181	181	34,102	723,831	Cell 2	Cell 2	
20	2037	9,538	22,003	3,179	191	191	34,720	758,551	Cell 2	Cell 2	
21	2038	9,989	22,003	3,330	200	200	35,322	793,872	Cell 2	Cell 2	
22	2039	10,431	22,003	3,477	209	209	35,911	829,783	Cell 2	Cell 2	
23	2040	10,866	22,003	3,622	217	217	36,491	866,274	Cell 2	Cell 2	
24	2041	11,297	22,003	3,766	226	226	37,065	903,339	Cell 2	Cell 2	
25	2042	11,918	22,003	3,973	238	238	37,894	941,233	Cell 2	Cell 2	
26	2043	12,545	22,003	4,182	251	251	38,730	979,963	Cell 2	Cell 2	
27	2044	13,178	22,003	4,393	264	264	39,574	1,019,537	Cell 2	Cell 2	
28	2045	13,816	22,003	4,605	276	276	40,425	1,059,961	Cell 2	Cell 2	
29	2046	14,460	22,003	4,820	289	289	41,283	1,101,245	Cell 2	Cell 2	
30	2047	15,110	22,003	5,037	302	302	42,149	1,143,394	Cell 2	Cell 2	
31	2048	15,765	22,003	5,255	315	315	43,023	1,186,417	Cell 2	Cell 2	
32	2049	16,426	22,003	5,475	329	329	43,905	1,230,322	Cell 2	Cell 2	
33	2050	17,093	22,003	5,698	342	342	44,794	1,275,116	Cell 2	Cell 2	
34	2051	17,766	22,003	5,922	355	355	45,691	1,320,807	Cell 2	Cell 2	
35	2052	18,445	22,003	6,148	369	369	46,596	1,367,404	Cell 2	Cell 2	
36	2053	19,130	22,003	6,377	383	383	47,509	1,414,913	Cell 2	Cell 2	
37	2054	19,821	22,003	6,607	396	396	48,431	1,463,344	Cell 2	Cell 2	
38	2055	20,518	22,003	6,839	410	410	49,360	1,512,704	Cell 2	Cell 2	
39	2056	21,221	22,003	7,074	424	424	50,298	1,563,002	Cell 2	Cell 2	
40	2057	21,931	22,003	7,310	439	439	51,244	1,614,245	Cell 3	Cell 2	**1,563,942**
41	2058	22,646	22,003	7,549	453	453	52,198	1,666,443	Cell 3	Cell 3	
42	2059	23,368	22,003	7,789	467	467	53,161	1,719,604	Cell 3	Cell 3	
43	2060	24,097	22,003	8,032	482	482	54,132	1,773,736	Cell 3	Cell 3	
44	2061	24,832	22,003	8,277	497	497	55,112	1,828,848	Cell 3	Cell 3	
45	2062	25,573	22,003	8,524	511	511	56,101	1,884,949	Cell 3	Cell 3	
46	2063	26,322	22,003	8,774	526	526	57,098	1,942,047	Cell 3	Cell 3	
47	2064	27,076	22,003	9,025	542	542	58,105	2,000,152	Cell 3	Cell 3	
48	2065	27,838	22,003	9,279	557	557	59,120	2,059,272	Cell 3	Cell 3	
49	2066	28,606	22,003	9,535	572	572	60,144	2,119,416	Cell 3	Cell 3	
50	2067	29,381	22,003	9,794	588	588	61,178	2,180,594	Cell 3	Cell 3	

CVRD growth rate beyond 2041 = 1%
CVRD disposal rate 2009-2015= 0.60 *tonnes per person per year*
CVRD disposal rate 2016-20120= 0.57 *tonnes per person per year*
CVRD disposal rate 2021-2067= 0.40 *tonnes per person per year* *Reduction by 30%*
SRD growth rate beyond 2041 = 0.50%
SRDdisposal rate 2009-2015= 0.60 *tonnes per person per year*
SRD disposal rate 2016-20120= 0.57 *tonnes per person per year*
SRD disposal rate 2021-2067= 0.40 *tonnes per person per year* *Reduction by 30%*
Days of operation = 351 *days per year*
Bottom ash/residuals to landfill = 34% *% of input*

In-situ MSW waste density = 0.7 *tonnes per m^3*
Operational soil = 2% *of waste volume per year*
Waste to cover ratio = 3:1
Settlement = 2% *of waste volume per year*

In-situ ash / residuals waste density = 0.7 *tonnes per m^3*
In-situ MSW waste density = 0.7 *tonnes per m^3*
Operational soil = 2% *of waste volume per year*
Waste to cover ratio = 3:1
Settlement = 2% *of waste volume per year*

Table B2: Long Term Cost Model for Option 1(a) - WTT facility located in Comox Valley

Capital and Operating Costs

Year		Campbell River TS Capital	Campbell River TS Operating	Campbell River TS Transport	WTT Facility Tipping Fees	CVWMC LF Capital - Expansion	CVWMC LF Capital - Minor Capital	CVWMC LF Capital - Closure	CVWMC LF Operating - Expansion	CVWMC LF Operating - Post-Closure	CRWMC LF Capital	CRWMC LF Operating	Total System	Campbell River TS Notes	WTT Facility Notes	CVWMC LF Notes	CRWMC LF Notes
	2015												$0				
	2016					$16,000,000							$16,000,000	New Transfer station constructed 2012-2013		Construction of leachate management system and Cell 1	
0	2017						$ 860,000	$ 265,000	$1,108,145		$250,868	$1,002,753	$3,487,000			Closure Phase 2	Phase 2 SW mgmt design & partial construction
1	2018						$ 200,000	$ 2,500,000	$1,108,145		$490,358	$1,002,753	$5,301,000			Closure Phase 2	Phase 2 Surface water management construction
2	2019						$ -		$1,108,145	$390,000	$191,695	$1,002,753	$2,693,000				Phase 2 Design and construction
3	2020	$200,000			$882,279		$ 1,075,000		$1,108,145	$190,000	$491,790	$1,002,753	$4,950,000	New trailers every 8 years	Permits and land		Phase 2 LFG and final cover design
4	2021				$3,988,612		$ 35,000		$585,536	$190,000	$5,630,329	$1,002,753	$11,432,000		WTT facility begins operating		Phase 2 LFG and final cover construction
5	2022				$4,033,281		$ -		$585,536	$190,000	$218,613	$1,002,753	$6,030,000		-		Phase 3 LFG and final cover design
6	2023				$4,078,414		$ 35,000		$585,536	$190,000	$3,108,685	$1,002,753	$9,000,000				Phase 3 LFG and final cover construction
7	2024		$651,040	$287,351	$6,942,737		$ -		$585,536	$390,000		$190,000	$9,047,000				
8	2025		$651,040	$288,932	$6,942,737		$ -		$585,536	$190,000		$190,000	$8,848,000				
9	2026		$651,040	$290,459	$6,942,737		$ -		$585,536	$190,000		$190,000	$8,850,000				
10	2027		$651,040	$291,897	$6,942,737		$ 585,000		$585,536	$190,000		$190,000	$9,436,000				
11	2028	$200,000	$651,040	$293,295	$6,942,737		$ -		$585,536	$190,000		$190,000	$9,053,000	New trailers every 8 years			
12	2029		$651,040	$294,656	$6,942,737		$ 385,000		$585,536	$390,000		$190,000	$9,439,000				
13	2030		$651,040	$295,953	$6,942,737	$8,850,000	$ 175,000		$585,536	$190,000		$190,000	$17,880,000			Construction Cell 2	
14	2031		$651,040	$297,202	$6,942,737		$ -		$710,536	$190,000		$190,000	$8,982,000				
15	2032	$346,000	$651,040	$298,398	$6,942,737		$ -	$ 1,350,000	$710,536	$190,000		$190,000	$10,679,000	Transfer station - parking and roads (20 yr life) + capital upgrades		Closure Cell 1	
16	2033		$651,040	$299,552	$6,942,737		$ 235,000		$710,536	$190,000		$190,000	$9,219,000				
17	2034		$651,040	$300,588	$6,942,737		$ -		$710,536	$390,000		$190,000	$9,185,000				
18	2035		$651,040	$301,588	$6,942,737		$ 935,000		$710,536	$190,000		$190,000	$9,921,000				
19	2036	$200,000	$651,040	$302,571	$6,942,737		$ -		$710,536	$190,000		$190,000	$9,187,000	New trailers every 8 years			
20	2037		$651,040	$303,489	$6,942,737		$ 550,000		$710,536	$190,000		$190,000	$9,538,000				
21	2038		$651,040	$304,353	$6,942,737		$ -		$710,536	$190,000		$190,000	$8,989,000				
22	2039		$651,040	$305,182	$6,942,737		$ 35,000		$710,536	$390,000		$190,000	$9,224,000				
23	2040		$651,040	$305,981	$6,942,737		$ 175,000		$710,536	$190,000		$190,000	$9,165,000				
24	2041		$651,040	$306,780	$6,942,737		$ 385,000		$710,536	$190,000		$190,000	$9,376,000				
25	2042		$651,040	$308,314	$6,942,737		$ -		$710,536	$190,000		$190,000	$8,993,000				
26	2043		$651,040	$309,856	$6,942,737		$ 200,000		$710,536	$190,000		$190,000	$9,194,000				
27	2044	$200,000	$651,040	$311,405	$6,942,737		$ -		$710,536	$390,000		$190,000	$9,396,000	New trailers every 8 years			
28	2045		$651,040	$312,962	$6,942,737		$ 35,000		$710,536	$190,000		$190,000	$9,032,000				
29	2046		$651,040	$314,527	$5,186,093		$ -		$710,536	$190,000		$190,000	$7,242,000		Amotization period over		
30	2047		$651,040	$316,100	$5,186,093		$ 585,000		$710,536	$190,000		$190,000	$7,829,000				
31	2048		$651,040	$317,680	$5,186,093		$ -		$710,536	$190,000		$190,000	$7,245,000				
32	2049		$651,040	$319,268	$5,186,093		$ -		$710,536	$390,000		$190,000	$7,447,000				
33	2050		$651,040	$320,865	$5,186,093		$ 1,075,000		$710,536	$190,000		$190,000	$8,324,000				
34	2051	$241,000	$651,040	$322,469	$5,186,093		$ 35,000		$710,536	$190,000		$190,000	$7,526,000	Transfer station permits etc			
35	2052	$2,615,000	$651,040	$324,081	$5,186,093		$ -		$710,536	$190,000		$190,000	$9,867,000	Transfer station - new facility + new trailers			
36	2053		$651,040	$325,702	$5,186,093		$ 585,000		$710,536	$190,000		$190,000	$7,838,000				
37	2054		$651,040	$327,330	$5,186,093		$ -		$710,536	$390,000		$190,000	$7,455,000				
38	2055		$651,040	$328,967	$5,186,093		$ -		$710,536	$190,000		$190,000	$7,257,000				
39	2056		$651,040	$330,612	$5,186,093		$ -		$710,536	$190,000		$190,000	$7,258,000				
40	2057		$651,040	$332,265	$5,186,093	$7,800,000	$ 585,000		$710,536	$190,000		$190,000	$15,645,000			Construction Cell 3	
41	2058		$651,040	$333,926	$5,186,093		$ -		$835,536	$190,000		$190,000	$7,387,000				
42	2059		$651,040	$335,596	$5,186,093		$ 35,000	$ 2,850,000	$835,536	$390,000		$190,000	$10,473,000			Closure Cell 2	
43	2060	$200,000	$651,040	$337,274	$5,186,093		$ 175,000		$835,536	$190,000		$190,000	$7,765,000	New trailers every 8 years			
44	2061		$651,040	$338,960	$5,186,093		$ -		$835,536	$190,000		$190,000	$7,392,000				
45	2062		$651,040	$340,655	$5,186,093		$ -		$835,536	$190,000		$190,000	$7,393,000				
46	2063		$651,040	$342,358	$5,186,093		$ 235,000		$835,536	$190,000		$190,000	$7,630,000				
47	2064		$651,040	$344,070	$5,186,093		$ -		$835,536	$390,000		$190,000	$7,597,000				
48	2065		$651,040	$345,790	$5,186,093		$ 1,285,000		$835,536	$190,000		$190,000	$8,683,000				
49	2066		$651,040	$347,519	$5,186,093		$ -		$835,536	$190,000		$190,000	$7,400,000				
50	2067		$651,040	$349,257	$5,186,093		$ 550,000		$835,536	$190,000		$190,000	$7,952,000				
Totals		$4,202,000	$28,645,760	$13,906,036	$279,816,833	$16,650,000	$11,045,000	$6,965,000	$37,827,788	$11,310,000	$10,382,338	$15,379,269	$436,131,000				

WTT Facility Tipping Fee (1st 25 years) = *$151* per tonne

WTT Facility Tipping Fee (2nd 25 years) = *$113* per tonne

30 years
$270,597,000 1,651,117 tonnes
$164 per tonne over 30 years

40 years
$356,459,000 2,242,559 tonnes
$159 per tonne over 40 years

50 years
$436,131,000 2,884,138 tonnes
$151 per tonne over 50 years

Table B3: Long Term Cost Model for Option 1(b) - WTT facility located in Campbell River

Population and Disposal Rates

	Year	Projected CVRD Population	CVRD Waste	Projected SRD Population	SRD Waste	Total Annual Tonnage	Daily Tonnage	Combined Population	Tonnes to Comox Valley TS	Tonnes to Campbell River TS	Tonnes to WTT Facility	Tonnes per day to WTT facility	Tonnes MSW to CRWMC LF	Tonnes to MSW CVWMC LF	Tonnes Ash/Residuals to CVWMC LF
			tonnes		tonnes	tonnes / yr	tonnes / day		tonnes	tonnes	tonnes	tonnes / day		tonnes	
	2015	64,294	38,576	45,871	27,523	66,099	181	91,817					27,523	38,576	
	2016	64,847	36,963	46,187	26,327	63,289	173	91,174					26,327	36,963	
0	2017	65,592	37,387	46,490	26,499	63,887	175	92,091					26,499	37,387	0
1	2018	66,372	37,832	46,809	26,681	64,513	177	93,053					26,681	37,832	0
2	2019	67,139	38,269	47,116	26,856	65,125	178	93,995					26,856	38,269	0
3	2020	67,905	38,706	47,419	27,029	65,735	180	94,934					27,029	38,706	0
4	2021	68,667	27,467	47,706	19,082	46,549	128	87,749	26,413		26,413	80	19,082	1,054	8,848
5	2022	69,436	27,774	47,986	19,194	46,969	129	88,630	26,709		26,709	81	19,194	1,065	8,948
6	2023	70,213	28,085	48,267	19,307	47,392	130	89,520	27,008	Landfill closure	27,008	82	19,307	1,077	9,048
7	2024	70,986	28,394	48,539	19,416	47,810	131	90,402	26,561		45,976	139		1,834	15,402
8	2025	71,758	28,703	48,806	19,522	48,226	132	91,280	26,454		45,976	139		2,249	15,402
9	2026	72,527	29,011	49,064	19,626	48,636	133	92,153	26,351		45,976	139		2,660	15,402
10	2027	73,290	29,316	49,307	19,723	49,039	134	93,013	26,253		45,976	139		3,063	15,402
11	2028	74,047	29,619	49,543	19,817	49,436	135	93,864	26,159		45,976	139		3,460	15,402
12	2029	74,795	29,918	49,773	19,909	49,827	137	94,704	26,067		45,976	139		3,851	15,402
13	2030	75,531	30,212	49,992	19,997	50,209	138	95,528	25,979		45,976	139		4,233	15,402
14	2031	76,255	30,502	50,203	20,081	50,583	139	96,336	25,895		45,976	139		4,607	15,402
15	2032	76,971	30,788	50,405	20,162	50,950	140	97,133	25,814		45,976	139		4,974	15,402
16	2033	77,681	31,072	50,600	20,240	51,312	141	97,921	25,736		45,976	139		5,336	15,402
17	2034	78,366	31,346	50,775	20,310	51,656	142	98,676	25,666		45,976	139		5,680	15,402
18	2035	79,039	31,616	50,944	20,378	51,993	142	99,417	25,599		45,976	139		6,017	15,402
19	2036	79,710	31,884	51,110	20,444	52,328	143	100,154	25,532		45,976	139		6,352	15,402
20	2037	80,366	32,146	51,265	20,506	52,652	144	100,872	25,470		45,976	139		6,676	15,402
21	2038	81,010	32,404	51,411	20,564	52,968	145	101,574	25,412		45,976	139		6,992	15,402
22	2039	81,643	32,657	51,551	20,620	53,278	146	102,263	25,356		45,976	139		7,301	15,402
23	2040	82,270	32,908	51,686	20,674	53,582	147	102,944	25,302		45,976	139		7,606	15,402
24	2041	82,888	33,155	51,821	20,728	53,884	148	103,616	25,248		45,976	139		7,907	15,402
25	2042	83,717	33,487	52,080	20,832	54,319	149	104,549	25,144		45,976	139		8,343	15,402
26	2043	84,554	33,822	52,341	20,936	54,758	150	105,490	25,040		45,976	139		8,782	15,402
27	2044	85,400	34,160	52,602	21,041	55,201	151	106,440	24,935		45,976	139		9,225	15,402
28	2045	86,254	34,501	52,865	21,146	55,648	152	107,400	24,830		45,976	139		9,671	15,402
29	2046	87,116	34,846	53,130	21,252	56,098	154	108,368	24,724		45,976	139		10,122	15,402
30	2047	87,987	35,195	53,395	21,358	56,553	155	109,345	24,618		45,976	139		10,577	15,402
31	2048	88,867	35,547	53,662	21,465	57,012	156	110,332	24,511		45,976	139		11,036	15,402
32	2049	89,756	35,902	53,930	21,572	57,475	157	111,328	24,404		45,976	139		11,498	15,402
33	2050	90,653	36,261	54,200	21,680	57,941	159	112,333	24,296		45,976	139		11,965	15,402
34	2051	91,560	36,624	54,471	21,788	58,412	160	113,348	24,188		45,976	139		12,436	15,402
35	2052	92,476	36,990	54,743	21,897	58,888	161	114,373	24,079		45,976	139		12,911	15,402
36	2053	93,400	37,360	55,017	22,007	59,367	163	115,407	23,969		45,976	139		13,391	15,402
37	2054	94,334	37,734	55,292	22,117	59,851	164	116,451	23,859		45,976	139		13,874	15,402
38	2055	95,278	38,111	55,569	22,228	60,339	165	117,505	23,749		45,976	139		14,362	15,402
39	2056	96,230	38,492	55,847	22,339	60,831	167	118,569	23,638		45,976	139		14,855	15,402
40	2057	97,193	38,877	56,126	22,450	61,327	168	119,643	23,526		45,976	139		15,351	15,402
41	2058	98,165	39,266	56,406	22,563	61,828	169	120,727	23,414		45,976	139		15,852	15,402
42	2059	99,146	39,659	56,688	22,675	62,334	171	121,822	23,301		45,976	139		16,358	15,402
43	2060	100,138	40,055	56,972	22,789	62,844	172	122,927	23,187		45,976	139		16,868	15,402
44	2061	101,139	40,456	57,257	22,903	63,358	174	124,042	23,073		45,976	139		17,382	15,402
45	2062	102,151	40,860	57,543	23,017	63,877	175	125,168	22,959		45,976	139		17,901	15,402
46	2063	103,172	41,269	57,831	23,132	64,401	176	126,304	22,844		45,976	139		18,425	15,402
47	2064	104,204	41,681	58,120	23,248	64,929	178	127,452	22,728		45,976	139		18,953	15,402
48	2065	105,246	42,098	58,411	23,364	65,463	179	128,610	22,612		45,976	139		19,486	15,402
49	2066	106,298	42,519	58,703	23,481	66,000	181	129,779	22,495		45,976	139		20,024	15,402
50	2067	107,361	42,944	58,996	23,598	66,543	182	130,960	22,378		45,976	139		20,567	15,402
	Totals	4,465,392	1,855,431	2,772,844	1,158,095	3,013,526		5,623,487	1,163,486	0	2,103,083		218,498	691,945	704,533

CRWMC LF Fill Rate and Capacity

	Year	Volumetric MSW Disposal Rate	Daily Cover Soil	Operational Soil	Settlement	Net Fill Volume	Cumulative Fill Volume	Phase	Volumetric Capacity (m^3)
		m^3	m^3	m^3	m^3	m^3	m^3		
	2015	39,318	13,106	786	786	52,424			
	2016	37,609	12,536	752	752	50,146		Phase 3	
0	2017	37,856	12,619	757	757	50,475	50,475	Phase 3	
1	2018	38,116	12,705	762	762	50,821	101,296	Phase 3	
2	2019	38,366	12,789	767	767	51,155	152,451	Phase 3	
3	2020	38,613	12,871	772	772	51,483	203,934	Phase 3	
4	2021	27,261	9,087	545	545	36,347	240,281	Phase 3	
5	2022	27,421	9,140	548	548	36,561	276,842	Phase 3	
6	2023	27,581	9,194	552	552	36,775	313,617	Closed	**288,480**
7	2024	0	0	0	0	0	313,617	Closed	
8	2025	0	0	0	0	0	313,617	Closed	
9	2026	0	0	0	0	0	313,617	Closed	
10	2027	0	0	0	0	0	313,617	Closed	
11	2028	0	0	0	0	0	313,617	Closed	
12	2029	0	0	0	0	0	313,617	Closed	
13	2030	0	0	0	0	0	313,617	Closed	
14	2031	0	0	0	0	0	313,617	Closed	
15	2032	0	0	0	0	0	313,617	Closed	
16	2033	0	0	0	0	0	313,617	Closed	
17	2034	0	0	0	0	0	313,617	Closed	
18	2035	0	0	0	0	0	313,617	Closed	
19	2036	0	0	0	0	0	313,617	Closed	
20	2037	0	0	0	0	0	313,617	Closed	
21	2038	0	0	0	0	0	313,617	Closed	
22	2039	0	0	0	0	0	313,617	Closed	
23	2040	0	0	0	0	0	313,617	Closed	
24	2041	0	0	0	0	0	313,617	Closed	
25	2042	0	0	0	0	0	313,617	Closed	
26	2043	0	0	0	0	0	313,617	Closed	
27	2044	0	0	0	0	0	313,617	Closed	
28	2045	0	0	0	0	0	313,617	Closed	
29	2046	0	0	0	0	0	313,617	Closed	
30	2047	0	0	0	0	0	313,617	Closed	
31	2048	0	0	0	0	0	313,617	Closed	
32	2049	0	0	0	0	0	313,617	Closed	
33	2050	0	0	0	0	0	313,617	Closed	
34	2051	0	0	0	0	0	313,617	Closed	
35	2052	0	0	0	0	0	313,617	Closed	
36	2053	0	0	0	0	0	313,617	Closed	
37	2054	0	0	0	0	0	313,617	Closed	
38	2055	0	0	0	0	0	313,617	Closed	
39	2056	0	0	0	0	0	313,617	Closed	
40	2057	0	0	0	0	0	313,617	Closed	
41	2058	0	0	0	0	0	313,617	Closed	
42	2059	0	0	0	0	0	313,617	Closed	
43	2060	0	0	0	0	0	313,617	Closed	
44	2061	0	0	0	0	0	313,617	Closed	
45	2062	0	0	0	0	0	313,617	Closed	
46	2063	0	0	0	0	0	313,617	Closed	
47	2064	0	0	0	0	0	313,617	Closed	
48	2065	0	0	0	0	0	313,617	Closed	
49	2066	0	0	0	0	0	313,617	Closed	
50	2067	0	0	0	0	0	313,617	Closed	

CVWMC LF Fill Rate and Capacity

	Year	Volumetric MSW Disposal Rate	Volumetric Ash / Residuals Disposal Rate	Daily Cover Soil	Operational Soil	Settlement	Net Fill Volume	Cumulative Fill Volume	Phase / Cell	Phase / Cell	Volumetric Capacity (m^3)
		m^3	m^3	m^3	m^3	m^3	m^3	m^3			
	2015	55,109		18,370	1,102	1,102	73,479				
	2016	52,804		17,601	1,056	1,056	70,405		Phase 2	Phase 2	
0	2017	53,411	0	17,804	1,068	1,068	71,214	71,214	Cell 1	Phase 2	
1	2018	54,046	0	18,015	1,081	1,081	72,061	143,275	Cell 1	Cell 1	
2	2019	54,670	0	18,223	1,093	1,093	72,894	216,169	Cell 1	Cell 1	
3	2020	55,294	0	18,431	1,106	1,106	73,725	289,894	Cell 1	Cell 1	
4	2021	1,505	12,641	502	30	30	14,647	304,542	Cell 1	Cell 1	
5	2022	1,522	12,782	507	30	30	14,811	319,353	Cell 1	Cell 1	
6	2023	1,539	12,925	513	31	31	14,977	334,330	Cell 1	Cell 1	
7	2024	2,620	22,003	873	52	52	25,496	359,826	Cell 1	Cell 1	
8	2025	3,213	22,003	1,071	64	64	26,287	386,114	Cell 1	Cell 1	
9	2026	3,800	22,003	1,267	76	76	27,070	413,184	Cell 1	Cell 1	
10	2027	4,375	22,003	1,458	88	88	27,836	441,020	Cell 1	Cell 1	
11	2028	4,943	22,003	1,648	99	99	28,593	469,613	Cell 1	Cell 1	
12	2029	5,501	22,003	1,834	110	110	29,338	498,951	Cell 1	Cell 1	
13	2030	6,047	22,003	2,016	121	121	30,066	529,017	Cell 2	Cell 1	**517,470**
14	2031	6,581	22,003	2,194	132	132	30,778	559,795	Cell 2	Cell 2	
15	2032	7,106	22,003	2,369	142	142	31,478	591,273	Cell 2	Cell 2	
16	2033	7,623	22,003	2,541	152	152	32,167	623,440	Cell 2	Cell 2	
17	2034	8,115	22,003	2,705	162	162	32,822	656,262	Cell 2	Cell 2	
18	2035	8,596	22,003	2,865	172	172	33,464	689,726	Cell 2	Cell 2	
19	2036	9,074	22,003	3,025	181	181	34,102	723,827	Cell 2	Cell 2	
20	2037	9,537	22,003	3,179	191	191	34,719	758,547	Cell 2	Cell 2	
21	2038	9,989	22,003	3,330	200	200	35,321	793,868	Cell 2	Cell 2	
22	2039	10,431	22,003	3,477	209	209	35,910	829,779	Cell 2	Cell 2	
23	2040	10,866	22,003	3,622	217	217	36,491	866,270	Cell 2	Cell 2	
24	2041	11,296	22,003	3,765	226	226	37,065	903,334	Cell 2	Cell 2	
25	2042	11,918	22,003	3,973	238	238	37,894	941,228	Cell 2	Cell 2	
26	2043	12,545	22,003	4,182	251	251	38,730	979,958	Cell 2	Cell 2	
27	2044	13,178	22,003	4,393	264	264	39,573	1,019,531	Cell 2	Cell 2	
28	2045	13,816	22,003	4,605	276	276	40,424	1,059,955	Cell 2	Cell 2	
29	2046	14,460	22,003	4,820	289	289	41,283	1,101,239	Cell 2	Cell 2	
30	2047	15,110	22,003	5,037	302	302	42,149	1,143,388	Cell 2	Cell 2	
31	2048	15,765	22,003	5,255	315	315	43,023	1,186,411	Cell 2	Cell 2	
32	2049	16,426	22,003	5,475	329	329	43,904	1,230,315	Cell 2	Cell 2	
33	2050	17,093	22,003	5,698	342	342	44,794	1,275,109	Cell 2	Cell 2	
34	2051	17,766	22,003	5,922	355	355	45,691	1,320,800	Cell 2	Cell 2	
35	2052	18,445	22,003	6,148	369	369	46,596	1,367,396	Cell 2	Cell 2	
36	2053	19,130	22,003	6,377	383	383	47,509	1,414,905	Cell 2	Cell 2	
37	2054	19,821	22,003	6,607	396	396	48,430	1,463,335	Cell 2	Cell 2	
38	2055	20,518	22,003	6,839	410	410	49,360	1,512,695	Cell 2	Cell 2	
39	2056	21,221	22,003	7,074	424	424	50,297	1,562,993	Cell 2	Cell 2	
40	2057	21,930	22,003	7,310	439	439	51,243	1,614,236	Cell 3	Cell 2	**1,563,942**
41	2058	22,646	22,003	7,549	453	453	52,198	1,666,434	Cell 3	Cell 3	
42	2059	23,368	22,003	7,789	467	467	53,160	1,719,594	Cell 3	Cell 3	
43	2060	24,097	22,003	8,032	482	482	54,132	1,773,726	Cell 3	Cell 3	
44	2061	24,832	22,003	8,277	497	497	55,112	1,828,838	Cell 3	Cell 3	
45	2062	25,573	22,003	8,524	511	511	56,100	1,884,938	Cell 3	Cell 3	
46	2063	26,321	22,003	8,774	526	526	57,098	1,942,036	Cell 3	Cell 3	
47	2064	27,076	22,003	9,025	542	542	58,104	2,000,140	Cell 3	Cell 3	
48	2065	27,838	22,003	9,279	557	557	59,120	2,059,260	Cell 3	Cell 3	
49	2066	28,606	22,003	9,535	572	572	60,144	2,119,404	Cell 3	Cell 3	
50	2067	29,381	22,003	9,794	588	588	61,178	2,180,582	Cell 3	Cell 3	

CVRD growth rate beyond 2041 = 1%
CVRD disposal rate 2009-2015= 0.60 *tonnes per person per year*
CVRD disposal rate 2016-20120= 0.57 *tonnes per person per year*
CVRD disposal rate 2021-2067= 0.40 *tonnes per person per year* *Reduction by 30%*
SRD growth rate beyond 2041 = 0.50%
SRDdisposal rate 2009-2015= 0.60 *tonnes per person per year*
SRD disposal rate 2016-20120= 0.57 *tonnes per person per year*
SRD disposal rate 2021-2067= 0.40 *tonnes per person per year* *Reduction by 30%*
Days of operation = 351 *days per year*
Bottom ash/residuals to landfill = 33.5% *% of input*

In-situ MSW waste density = 0.7 *tonnes per m^3*
Operational soil = 2% *of waste volume per year*
Waste to cover ratio = 3:1
Settlement = 2% *of waste volume per year*

In-situ ash / residuals waste density = 0.7 *tonnes per m^3*
In-situ MSW waste density = 0.7 *tonnes per m^3*
Operational soil = 2% *of waste volume per year*
Waste to cover ratio = 3:1
Settlement = 2% *of waste volume per year*

Table B3: Long Term Cost Model for Option 1(b) - WTT facility located in Campbell River

Capital and Operating Costs

Year		Comox Valley TS Capital	Comox Valley TS Operating	Comox Valley TS Transport	Campbell River TS Transport	WTT Facility Tipping Fees	CVWMC LF Capital - Expansion	CVWMC LF Capital - Minor Capital	CVWMC LF Capital - Closure	CVWMC LF Operating - Expansion	CVWMC LF Operating - Post-Closure	CRWMC LF Capital	CRWMC LF Operating	Total System	Comox Valley TS Notes	Campbell River TS Notes	WTT Facility Notes	CVWMC LF Notes	CRWMC LF Notes
	2015													$0		New Transfer station constructed 2012-2013			
	2016						$16,000,000							$16,000,000				Construction of leachate management system and Cell 1	
0	2017							$ 860,000	$ 265,000	$1,108,145		$250,868	$1,002,753	$3,487,000				Closure Phase 2	Phase 2 SW mgmt design & partial construction
1	2018							$ 200,000	$ 2,500,000	$1,108,145		$490,358	$1,002,753	$5,301,000				Closure Phase 2	Phase 2 Surface water management construction
2	2019							$ -		$1,108,145	$390,000	$191,695	$1,002,753	$2,693,000					Phase 2 Design and construction
3	2020	$311,025			Ash / residuals	$691,115		$ 1,075,000		$1,108,145	$190,000	$491,790	$1,002,753	$4,870,000	Permits		Permits and land		Phase 2 LFG and final cover design
4	2021	$3,310,000	$709,508	$390,917	$130,957	$3,988,612		$ 35,000		$585,536	$190,000	$5,630,329	$1,002,753	$15,974,000	New transfer station		WTT facility begins operating		Phase 2 LFG and final cover construction
5	2022		$709,508	$395,294	$132,424	$4,033,281		$ -		$585,536	$190,000	$218,613	$1,002,753	$7,267,000					Phase 3 LFG and final cover design
6	2023		$709,508	$399,718	$133,905	$4,078,414		$ 35,000		$585,536	$190,000	$3,108,685	$1,002,753	$10,244,000					Phase 3 LFG and final cover construction
7	2024		$709,508	$393,097	$227,950	$6,942,766		$ -		$585,536	$390,000		$190,000	$9,439,000					
8	2025		$709,508	$391,516	$227,950	$6,942,766		$ -		$585,536	$190,000		$190,000	$9,237,000					
9	2026		$709,508	$389,989	$227,950	$6,942,766		$ -		$585,536	$190,000		$190,000	$9,236,000					
10	2027		$709,508	$388,550	$227,950	$6,942,766		$ 585,000		$585,536	$190,000		$190,000	$9,819,000					
11	2028		$709,508	$387,153	$227,950	$6,942,766		$ -		$585,536	$190,000		$190,000	$9,233,000					
12	2029	$200,000	$709,508	$385,791	$227,950	$6,942,766		$ 385,000		$585,536	$390,000		$190,000	$10,017,000	New trailers every 8 years				
13	2030		$709,508	$384,495	$227,950	$6,942,766	$8,850,000	$ 175,000		$585,536	$190,000		$190,000	$18,255,000				Construction Cell 2	
14	2031		$709,508	$383,246	$227,950	$6,942,766		$ -		$710,536	$190,000		$190,000	$9,354,000					
15	2032		$709,508	$382,050	$227,950	$6,942,766		$ -	$ 1,350,000	$710,536	$190,000		$190,000	$10,703,000				Closure Cell 1	
16	2033		$709,508	$380,896	$227,950	$6,942,766		$ 235,000		$710,536	$190,000		$190,000	$9,587,000					
17	2034		$709,508	$379,860	$227,950	$6,942,766		$ -		$710,536	$390,000		$190,000	$9,551,000					
18	2035		$709,508	$378,859	$227,950	$6,942,766		$ 935,000		$710,536	$190,000		$190,000	$10,285,000					
19	2036		$709,508	$377,876	$227,950	$6,942,766		$ -		$710,536	$190,000		$190,000	$9,349,000					
20	2037	$200,000	$709,508	$376,959	$227,950	$6,942,766		$ 550,000		$710,536	$190,000		$190,000	$10,098,000	New trailers every 8 years				
21	2038		$709,508	$376,095	$227,950	$6,942,766		$ -		$710,536	$190,000		$190,000	$9,347,000					
22	2039		$709,508	$375,266	$227,950	$6,942,766		$ 35,000		$710,536	$390,000		$190,000	$9,581,000					
23	2040		$709,508	$374,467	$227,950	$6,942,766		$ 175,000		$710,536	$190,000		$190,000	$9,520,000					
24	2041	$1,555,125	$709,508	$373,667	$227,950	$6,942,766		$ 385,000		$710,536	$190,000		$190,000	$11,285,000	Major capital upgrade every 20 years				
25	2042		$709,508	$372,133	$227,950	$6,942,766		$ -		$710,536	$190,000		$190,000	$9,343,000					
26	2043		$709,508	$370,592	$227,950	$6,942,766		$ 200,000		$710,536	$190,000		$190,000	$9,541,000					
27	2044		$709,508	$369,043	$227,950	$6,942,766		$ -		$710,536	$390,000		$190,000	$9,540,000					
28	2045	$200,000	$709,508	$367,486	$227,950	$6,942,766		$ 35,000		$710,536	$190,000		$190,000	$9,573,000	New trailers every 8 years				
29	2046		$709,508	$365,921	$227,950	$5,186,114		$ -		$710,536	$190,000		$190,000	$7,580,000			Amotization period over		
30	2047		$709,508	$364,348	$227,950	$5,186,114		$ 585,000		$710,536	$190,000		$190,000	$8,163,000					
31	2048		$709,508	$362,768	$227,950	$5,186,114		$ -		$710,536	$190,000		$190,000	$7,577,000					
32	2049		$709,508	$361,179	$227,950	$5,186,114		$ -		$710,536	$390,000		$190,000	$7,775,000					
33	2050		$709,508	$359,583	$227,950	$5,186,114		$ 1,075,000		$710,536	$190,000		$190,000	$8,649,000					
34	2051		$709,508	$357,979	$227,950	$5,186,114		$ 35,000		$710,536	$190,000		$190,000	$7,607,000					
35	2052		$709,508	$356,366	$227,950	$5,186,114		$ -		$710,536	$190,000		$190,000	$7,570,000					
36	2053	$200,000	$709,508	$354,746	$227,950	$5,186,114		$ 585,000		$710,536	$190,000		$190,000	$8,354,000	New trailers every 8 years				
37	2054		$709,508	$353,117	$227,950	$5,186,114		$ -		$710,536	$390,000		$190,000	$7,767,000					
38	2055		$709,508	$351,481	$227,950	$5,186,114		$ -		$710,536	$190,000		$190,000	$7,566,000					
39	2056		$709,508	$349,836	$227,950	$5,186,114		$ -		$710,536	$190,000		$190,000	$7,564,000					
40	2057		$709,508	$348,183	$227,950	$5,186,114	$7,800,000	$ 585,000		$710,536	$190,000		$190,000	$15,947,000				Construction Cell 3	
41	2058		$709,508	$346,521	$227,950	$5,186,114		$ -		$835,536	$190,000		$190,000	$7,686,000					
42	2059		$709,508	$344,852	$227,950	$5,186,114		$ 35,000	$ 2,850,000	$835,536	$390,000		$190,000	$10,769,000				Closure Cell 2	
43	2060		$709,508	$343,174	$227,950	$5,186,114		$ 175,000		$835,536	$190,000		$190,000	$7,857,000					
44	2061	$1,755,125	$709,508	$341,487	$227,950	$5,186,114		$ -		$835,536	$190,000		$190,000	$9,436,000	Major capital upgrade every 20 years				
45	2062		$709,508	$339,793	$227,950	$5,186,114		$ -		$835,536	$190,000		$190,000	$7,679,000					
46	2063		$709,508	$338,089	$227,950	$5,186,114		$ 235,000		$835,536	$190,000		$190,000	$7,912,000					
47	2064		$709,508	$336,378	$227,950	$5,186,114		$ -		$835,536	$390,000		$190,000	$7,875,000					
48	2065		$709,508	$334,657	$227,950	$5,186,114		$ 1,285,000		$835,536	$190,000		$190,000	$8,959,000					
49	2066		$709,508	$332,928	$227,950	$5,186,114		$ -		$835,536	$190,000		$190,000	$7,672,000					
50	2067		$709,508	$331,191	$227,950	$5,186,114		$ 550,000		$835,536	$190,000		$190,000	$8,220,000					
Totals		$7,731,275	$33,346,853	$17,219,589	$10,427,084	$279,626,783	$16,650,000	$11,045,000	$6,965,000	$37,827,788	$11,310,000	$10,382,338	$15,379,269	$457,913,000					

WTT Facility Tipping Fee (1st 25 years) = *$151* per tonne

WTT Facility Tipping Fee (2nd 25 years) = *$113* per tonne

30 years
$287,472,000 1,651,117 tonnes
$174 per tonne over 30 years

40 years
$373,848,000 2,242,559 tonnes
$167 per tonne over 40 years

50 years
$457,913,000 2,884,138 tonnes
$159 per tonne over 50 years

Table B4: Long Term Cost Model for Option 1(c) - WTT facility located in Gold River

Population and Disposal Rates

	Year	Projected CVRD Population	CVRD Waste	Projected SRD Population	SRD Waste	Total Annual Tonnage	Daily Tonnage	Combined Population	Tonnes to Comox Valley TS	Tonnes to Campbell River TS	Tonnes to WTT Facility	Tonnes per day to WTT facility	Tonnes MSW to CRWMC LF	Tonnes to MSW CVWMC LF	Tonnes Ash/Residuals to CVWMC LF
			tonnes		tonnes	tonnes / yr	tonnes / day		tonnes	tonnes	tonnes	tonnes / day		tonnes	
	2015	64,294	38,576	45,871	27,523	66,099	181	91,817					27,523	38,576	
	2016	64,847	36,963	46,187	26,327	63,289	173	91,174					26,327	36,963	
0	2017	65,592	37,387	46,490	26,499	63,887	175	92,091					26,499	37,387	0
1	2018	66,372	37,832	46,809	26,681	64,513	177	93,053					26,681	37,832	0
2	2019	67,139	38,269	47,116	26,856	65,125	178	93,995					26,856	38,269	0
3	2020	67,905	38,706	47,419	27,029	65,735	180	94,934					27,029	38,706	0
4	2021	68,667	27,467	47,706	19,082	46,549	128	87,749	26,413		26,413	80	19,082	1,054	8,848
5	2022	69,436	27,774	47,986	19,194	46,969	129	88,630	26,709		26,709	81	19,194	1,065	8,948
6	2023	70,213	28,085	48,267	19,307	47,392	130	89,520	27,008	Landfill closure	27,008	82	19,307	1,077	9,048
7	2024	70,986	28,394	48,539	19,416	47,810	131	90,402	26,561	19,416	45,976	139		1,834	15,402
8	2025	71,758	28,703	48,806	19,522	48,226	132	91,280	26,454	19,522	45,976	139		2,249	15,402
9	2026	72,527	29,011	49,064	19,626	48,636	133	92,153	26,351	19,626	45,976	139		2,660	15,402
10	2027	73,290	29,316	49,307	19,723	49,039	134	93,013	26,253	19,723	45,976	139		3,063	15,402
11	2028	74,047	29,619	49,543	19,817	49,436	135	93,864	26,159	19,817	45,976	139		3,460	15,402
12	2029	74,795	29,918	49,773	19,909	49,827	137	94,704	26,067	19,909	45,976	139		3,851	15,402
13	2030	75,531	30,212	49,992	19,997	50,209	138	95,528	25,979	19,997	45,976	139		4,233	15,402
14	2031	76,255	30,502	50,203	20,081	50,583	139	96,336	25,895	20,081	45,976	139		4,607	15,402
15	2032	76,971	30,788	50,405	20,162	50,950	140	97,133	25,814	20,162	45,976	139		4,974	15,402
16	2033	77,681	31,072	50,600	20,240	51,312	141	97,921	25,736	20,240	45,976	139		5,336	15,402
17	2034	78,366	31,346	50,775	20,310	51,656	142	98,676	25,666	20,310	45,976	139		5,680	15,402
18	2035	79,039	31,616	50,944	20,378	51,993	142	99,417	25,599	20,378	45,976	139		6,017	15,402
19	2036	79,710	31,884	51,110	20,444	52,328	143	100,154	25,532	20,444	45,976	139		6,352	15,402
20	2037	80,366	32,146	51,265	20,506	52,652	144	100,872	25,470	20,506	45,976	139		6,676	15,402
21	2038	81,010	32,404	51,411	20,564	52,968	145	101,574	25,412	20,564	45,976	139		6,992	15,402
22	2039	81,643	32,657	51,551	20,620	53,278	146	102,263	25,356	20,620	45,976	139		7,301	15,402
23	2040	82,270	32,908	51,686	20,674	53,582	147	102,944	25,302	20,674	45,976	139		7,606	15,402
24	2041	82,888	33,155	51,821	20,728	53,884	148	103,616	25,248	20,728	45,976	139		7,907	15,402
25	2042	83,717	33,487	52,080	20,832	54,319	149	104,549	25,144	20,832	45,976	139		8,343	15,402
26	2043	84,554	33,822	52,341	20,936	54,758	150	105,490	25,040	20,936	45,976	139		8,782	15,402
27	2044	85,400	34,160	52,602	21,041	55,201	151	106,440	24,935	21,041	45,976	139		9,225	15,402
28	2045	86,254	34,501	52,865	21,146	55,648	152	107,400	24,830	21,146	45,976	139		9,671	15,402
29	2046	87,116	34,846	53,130	21,252	56,098	154	108,368	24,724	21,252	45,976	139		10,122	15,402
30	2047	87,987	35,195	53,395	21,358	56,553	155	109,345	24,618	21,358	45,976	139		10,577	15,402
31	2048	88,867	35,547	53,662	21,465	57,012	156	110,332	24,511	21,465	45,976	139		11,036	15,402
32	2049	89,756	35,902	53,930	21,572	57,475	157	111,328	24,404	21,572	45,976	139		11,498	15,402
33	2050	90,653	36,261	54,200	21,680	57,941	159	112,333	24,296	21,680	45,976	139		11,965	15,402
34	2051	91,560	36,624	54,471	21,788	58,412	160	113,348	24,188	21,788	45,976	139		12,436	15,402
35	2052	92,476	36,990	54,743	21,897	58,888	161	114,373	24,079	21,897	45,976	139		12,911	15,402
36	2053	93,400	37,360	55,017	22,007	59,367	163	115,407	23,969	22,007	45,976	139		13,391	15,402
37	2054	94,334	37,734	55,292	22,117	59,851	164	116,451	23,859	22,117	45,976	139		13,874	15,402
38	2055	95,278	38,111	55,569	22,228	60,339	165	117,505	23,749	22,228	45,976	139		14,362	15,402
39	2056	96,230	38,492	55,847	22,339	60,831	167	118,569	23,638	22,339	45,976	139		14,855	15,402
40	2057	97,193	38,877	56,126	22,450	61,327	168	119,643	23,526	22,450	45,976	139		15,351	15,402
41	2058	98,165	39,266	56,406	22,563	61,828	169	120,727	23,414	22,563	45,976	139		15,852	15,402
42	2059	99,146	39,659	56,688	22,675	62,334	171	121,822	23,301	22,675	45,976	139		16,358	15,402
43	2060	100,138	40,055	56,972	22,789	62,844	172	122,927	23,187	22,789	45,976	139		16,868	15,402
44	2061	101,139	40,456	57,257	22,903	63,358	174	124,042	23,073	22,903	45,976	139		17,382	15,402
45	2062	102,151	40,860	57,543	23,017	63,877	175	125,168	22,959	23,017	45,976	139		17,901	15,402
46	2063	103,172	41,269	57,831	23,132	64,401	176	126,304	22,844	23,132	45,976	139		18,425	15,402
47	2064	104,204	41,681	58,120	23,248	64,929	178	127,452	22,728	23,248	45,976	139		18,953	15,402
48	2065	105,246	42,098	58,411	23,364	65,463	179	128,610	22,612	23,364	45,976	139		19,486	15,402
49	2066	106,298	42,519	58,703	23,481	66,000	181	129,779	22,495	23,481	45,976	139		20,024	15,402
50	2067	107,361	42,944	58,996	23,598	66,543	182	130,960	22,378	23,598	45,976	139		20,567	15,402
	Totals	4,465,392	1,855,431	2,772,844	1,158,095	3,013,526		5,623,487	1,163,486	939,597	2,103,083		218,498	691,945	704,533

CRWMC LF Fill Rate and Capacity

	Year	Volumetric MSW Disposal Rate	Daily Cover Soil	Operational Soil	Settlement	Net Fill Volume	Cumulative Fill Volume	Phase	Volumetric Capacity (m³)
		m³	m³	m³	m³	m³	m³		
	2015	39,318	13,106	786	786	52,424			
	2016	37,609	12,536	752	752	50,146		Phase 3	
0	2017	37,856	12,619	757	757	50,475	50,475	Phase 3	
1	2018	38,116	12,705	762	762	50,821	101,296	Phase 3	
2	2019	38,366	12,789	767	767	51,155	152,451	Phase 3	
3	2020	38,613	12,871	772	772	51,483	203,934	Phase 3	
4	2021	27,261	9,087	545	545	36,347	240,281	Phase 3	
5	2022	27,421	9,140	548	548	36,561	276,842	Phase 3	
6	2023	27,581	9,194	552	552	36,775	313,617	Closed	**288,480**
7	2024	0	0	0	0	0	313,617	Closed	
8	2025	0	0	0	0	0	313,617	Closed	
9	2026	0	0	0	0	0	313,617	Closed	
10	2027	0	0	0	0	0	313,617	Closed	
11	2028	0	0	0	0	0	313,617	Closed	
12	2029	0	0	0	0	0	313,617	Closed	
13	2030	0	0	0	0	0	313,617	Closed	
14	2031	0	0	0	0	0	313,617	Closed	
15	2032	0	0	0	0	0	313,617	Closed	
16	2033	0	0	0	0	0	313,617	Closed	
17	2034	0	0	0	0	0	313,617	Closed	
18	2035	0	0	0	0	0	313,617	Closed	
19	2036	0	0	0	0	0	313,617	Closed	
20	2037	0	0	0	0	0	313,617	Closed	
21	2038	0	0	0	0	0	313,617	Closed	
22	2039	0	0	0	0	0	313,617	Closed	
23	2040	0	0	0	0	0	313,617	Closed	
24	2041	0	0	0	0	0	313,617	Closed	
25	2042	0	0	0	0	0	313,617	Closed	
26	2043	0	0	0	0	0	313,617	Closed	
27	2044	0	0	0	0	0	313,617	Closed	
28	2045	0	0	0	0	0	313,617	Closed	
29	2046	0	0	0	0	0	313,617	Closed	
30	2047	0	0	0	0	0	313,617	Closed	
31	2048	0	0	0	0	0	313,617	Closed	
32	2049	0	0	0	0	0	313,617	Closed	
33	2050	0	0	0	0	0	313,617	Closed	
34	2051	0	0	0	0	0	313,617	Closed	
35	2052	0	0	0	0	0	313,617	Closed	
36	2053	0	0	0	0	0	313,617	Closed	
37	2054	0	0	0	0	0	313,617	Closed	
38	2055	0	0	0	0	0	313,617	Closed	
39	2056	0	0	0	0	0	313,617	Closed	
40	2057	0	0	0	0	0	313,617	Closed	
41	2058	0	0	0	0	0	313,617	Closed	
42	2059	0	0	0	0	0	313,617	Closed	
43	2060	0	0	0	0	0	313,617	Closed	
44	2061	0	0	0	0	0	313,617	Closed	
45	2062	0	0	0	0	0	313,617	Closed	
46	2063	0	0	0	0	0	313,617	Closed	
47	2064	0	0	0	0	0	313,617	Closed	
48	2065	0	0	0	0	0	313,617	Closed	
49	2066	0	0	0	0	0	313,617	Closed	
50	2067	0	0	0	0	0	313,617	Closed	

CVWMC LF Fill Rate and Capacity

	Year	Volumetric MSW Disposal Rate	Volumetric Ash / Residuals Disposal Rate	Daily Cover Soil	Operational Soil	Settlement	Net Fill Volume	Cumulative Fill Volume	Phase / Cell	Phase / Cell	Volumetric Capacity (m³)
		m³	m³	m³	m³	m³	m³	m³			
	2015	55,109		18,370	1,102	1,102	73,479				
	2016	52,804		17,601	1,056	1,056	70,405		Phase 2	Phase 2	
0	2017	53,411	0	17,804	1,068	1,068	71,214	71,214	Cell 1	Phase 2	
1	2018	54,046	0	18,015	1,081	1,081	72,061	143,275	Cell 1	Cell 1	
2	2019	54,670	0	18,223	1,093	1,093	72,894	216,169	Cell 1	Cell 1	
3	2020	55,294	0	18,431	1,106	1,106	73,725	289,894	Cell 1	Cell 1	
4	2021	1,505	12,641	502	30	30	14,647	304,542	Cell 1	Cell 1	
5	2022	1,522	12,782	507	30	30	14,811	319,353	Cell 1	Cell 1	
6	2023	1,539	12,925	513	31	31	14,977	334,330	Cell 1	Cell 1	
7	2024	2,620	22,003	873	52	52	25,496	359,826	Cell 1	Cell 1	
8	2025	3,213	22,003	1,071	64	64	26,287	386,114	Cell 1	Cell 1	
9	2026	3,800	22,003	1,267	76	76	27,070	413,184	Cell 1	Cell 1	
10	2027	4,375	22,003	1,458	88	88	27,836	441,020	Cell 1	Cell 1	
11	2028	4,943	22,003	1,648	99	99	28,593	469,613	Cell 1	Cell 1	
12	2029	5,501	22,003	1,834	110	110	29,338	498,951	Cell 1	Cell 1	
13	2030	6,047	22,003	2,016	121	121	30,066	529,017	Cell 2	Cell 1	**517,470**
14	2031	6,581	22,003	2,194	132	132	30,778	559,795	Cell 2	Cell 2	
15	2032	7,106	22,003	2,369	142	142	31,478	591,273	Cell 2	Cell 2	
16	2033	7,623	22,003	2,541	152	152	32,167	623,440	Cell 2	Cell 2	
17	2034	8,115	22,003	2,705	162	162	32,822	656,262	Cell 2	Cell 2	
18	2035	8,596	22,003	2,865	172	172	33,464	689,726	Cell 2	Cell 2	
19	2036	9,074	22,003	3,025	181	181	34,102	723,827	Cell 2	Cell 2	
20	2037	9,537	22,003	3,179	191	191	34,719	758,547	Cell 2	Cell 2	
21	2038	9,989	22,003	3,330	200	200	35,321	793,868	Cell 2	Cell 2	
22	2039	10,431	22,003	3,477	209	209	35,910	829,779	Cell 2	Cell 2	
23	2040	10,866	22,003	3,622	217	217	36,491	866,270	Cell 2	Cell 2	
24	2041	11,296	22,003	3,765	226	226	37,065	903,334	Cell 2	Cell 2	
25	2042	11,918	22,003	3,973	238	238	37,894	941,228	Cell 2	Cell 2	
26	2043	12,545	22,003	4,182	251	251	38,730	979,958	Cell 2	Cell 2	
27	2044	13,178	22,003	4,393	264	264	39,573	1,019,531	Cell 2	Cell 2	
28	2045	13,816	22,003	4,605	276	276	40,424	1,059,955	Cell 2	Cell 2	
29	2046	14,460	22,003	4,820	289	289	41,283	1,101,239	Cell 2	Cell 2	
30	2047	15,110	22,003	5,037	302	302	42,149	1,143,388	Cell 2	Cell 2	
31	2048	15,765	22,003	5,255	315	315	43,023	1,186,411	Cell 2	Cell 2	
32	2049	16,426	22,003	5,475	329	329	43,904	1,230,315	Cell 2	Cell 2	
33	2050	17,093	22,003	5,698	342	342	44,794	1,275,109	Cell 2	Cell 2	
34	2051	17,766	22,003	5,922	355	355	45,691	1,320,800	Cell 2	Cell 2	
35	2052	18,445	22,003	6,148	369	369	46,596	1,367,396	Cell 2	Cell 2	
36	2053	19,130	22,003	6,377	383	383	47,509	1,414,905	Cell 2	Cell 2	
37	2054	19,821	22,003	6,607	396	396	48,430	1,463,335	Cell 2	Cell 2	
38	2055	20,518	22,003	6,839	410	410	49,360	1,512,695	Cell 2	Cell 2	
39	2056	21,221	22,003	7,074	424	424	50,297	1,562,993	Cell 2	Cell 2	
40	2057	21,930	22,003	7,310	439	439	51,243	1,614,236	Cell 3	Cell 2	**1,563,942**
41	2058	22,646	22,003	7,549	453	453	52,198	1,666,434	Cell 3	Cell 3	
42	2059	23,368	22,003	7,789	467	467	53,160	1,719,594	Cell 3	Cell 3	
43	2060	24,097	22,003	8,032	482	482	54,132	1,773,726	Cell 3	Cell 3	
44	2061	24,832	22,003	8,277	497	497	55,112	1,828,838	Cell 3	Cell 3	
45	2062	25,573	22,003	8,524	511	511	56,100	1,884,938	Cell 3	Cell 3	
46	2063	26,321	22,003	8,774	526	526	57,098	1,942,036	Cell 3	Cell 3	
47	2064	27,076	22,003	9,025	542	542	58,104	2,000,140	Cell 3	Cell 3	
48	2065	27,838	22,003	9,279	557	557	59,120	2,059,260	Cell 3	Cell 3	
49	2066	28,606	22,003	9,535	572	572	60,144	2,119,404	Cell 3	Cell 3	
50	2067	29,381	22,003	9,794	588	588	61,178	2,180,582	Cell 3	Cell 3	

CVRD growth rate beyond 2041 = 1%
CVRD disposal rate 2009-2015= 0.60 tonnes per person per year
CVRD disposal rate 2016-20120= 0.57 tonnes per person per year
CVRD disposal rate 2021-2067= 0.40 tonnes per person per year *Reduction by 30%*
SRD growth rate beyond 2041 = 0.50%
SRDdisposal rate 2009-2015= 0.60 tonnes per person per year
SRD disposal rate 2016-20120= 0.57 tonnes per person per year
SRD disposal rate 2021-2067= 0.40 tonnes per person per year *Reduction by 30%*
Days of operation = 351 days per year
Bottom ash/residuals to landfill = 34% % of input

In-situ MSW waste density = 0.7 tonnes per m^3
Operational soil = 2% of waste volume per year
Waste to cover ratio = 3:1
Settlement = 2% of waste volume per year

In-situ ash / residuals waste density = 0.7 tonnes per m^3
In-situ MSW waste density = 0.7 tonnes per m^3
Operational soil = 2% of waste volume per year
Waste to cover ratio = 3:1
Settlement = 2% of waste volume per year

Table B4: Long Term Cost Model for Option 1(c) - WTT facility located in Gold River

Capital and Operating Costs

	Year	Comox Valley TS Capital	Comox Valley TS Operating	Comox Valley TS Transport	Campbell River TS Capital	Campbell River TS Operating	Campbell River TS Transport	Ash/residuals Transport from Gold River	WTT Facility Tipping Fees	CVWMC LF Capital - Expansion	CVWMC LF Capital - Minor Capital	CVWMC LF Capital - Closure	CVWMC LF Operating - Expansion	CVWMC LF Operating - Post-Closure	CRWMC LF Capital	CRWMC LF Operating	Total System	Comox Valley TS Notes	Campbell River TS Notes	WTT Facility Notes	CVWMC LF Notes	CRWMC LF Notes
	2015																$0					
	2016									$16,000,000							$16,000,000		New Transfer station constructed 2012-2013		Construction of leachate management system and Cell 1	
0	2017										$ 860,000	$ 265,000	$1,108,145		$250,868	$1,002,753	$3,487,000				Closure Phase 2	Phase 2 SW mgmt design & partial construction
1	2018										$ 200,000	$ 2,500,000	$1,108,145		$490,358	$1,002,753	$5,301,000				Closure Phase 2	Phase 2 Surface water management construction
2	2019										$ -		$1,108,145	$390,000	$191,695	$1,002,753	$2,693,000					Phase 2 Design and construction
3	2020	$311,025			$200,000				$460,000		$ 1,075,000		$1,108,145	$190,000	$491,790	$1,002,753	$4,839,000	Permits	New trailers every 8 years	Permits and land		Phase 2 LFG and final cover design
4	2021	$3,310,000	$709,508	$739,572			$0	$247,757	$3,988,612		$ 35,000		$585,536	$190,000	$5,630,329	$1,002,753	$16,439,000	New transfer station		WTT facility begins operating		Phase 2 LFG and final cover construction
5	2022		$709,508	$747,854			$0	$250,531	$4,033,281		$ -		$585,536	$190,000	$218,613	$1,002,753	$7,738,000					Phase 3 LFG and final cover design
6	2023		$709,508	$756,223			$0	$253,335	$4,078,414		$ 35,000		$585,536	$190,000	$3,108,685	$1,002,753	$10,719,000					Phase 3 LFG and final cover construction
7	2024		$709,508	$743,697		$651,040	$388,312	$431,257	$6,942,766		$ -		$585,536	$390,000		$190,000	$11,032,000					
8	2025		$709,508	$740,706		$651,040	$390,448	$431,257	$6,942,766		$ -		$585,536	$190,000		$190,000	$10,831,000					
9	2026		$709,508	$737,817		$651,040	$392,512	$431,257	$6,942,766		$ -		$585,536	$190,000		$190,000	$10,830,000					
10	2027		$709,508	$735,095		$651,040	$394,456	$431,257	$6,942,766		$ 585,000		$585,536	$190,000		$190,000	$11,415,000					
11	2028		$709,508	$732,452	$200,000	$651,040	$396,344	$431,257	$6,942,766		$ -		$585,536	$190,000		$190,000	$11,029,000		New trailers every 8 years		Construction Cell 2	
12	2029	$200,000	$709,508	$729,876		$651,040	$398,184	$431,257	$6,942,766		$ 385,000		$585,536	$390,000		$190,000	$11,613,000	New trailers every 8 years				
13	2030		$709,508	$727,423		$651,040	$399,936	$431,257	$6,942,766	$8,850,000	$ 175,000		$585,536	$190,000		$190,000	$19,852,000				Closure Cell 1	
14	2031		$709,508	$725,060		$651,040	$401,624	$431,257	$6,942,766		$ -		$710,536	$190,000		$190,000	$10,952,000					
15	2032		$709,508	$722,797	$346,000	$651,040	$403,240	$431,257	$6,942,766		$ -	$ 1,350,000	$710,536	$190,000		$190,000	$12,647,000		Transfer station - parking and roads (20 yr life) + capital upgrades			
16	2033		$709,508	$720,613		$651,040	$404,800	$431,257	$6,942,766		$ 235,000		$710,536	$190,000		$190,000	$11,186,000					
17	2034		$709,508	$718,653		$651,040	$406,200	$431,257	$6,942,766		$ -		$710,536	$390,000		$190,000	$11,150,000					
18	2035		$709,508	$716,761		$651,040	$407,552	$431,257	$6,942,766		$ 935,000		$710,536	$190,000		$190,000	$11,884,000					
19	2036		$709,508	$714,901	$200,000	$651,040	$408,880	$431,257	$6,942,766		$ -		$710,536	$190,000		$190,000	$11,149,000		New trailers every 8 years			
20	2037	$200,000	$709,508	$713,165		$651,040	$410,120	$431,257	$6,942,766		$ 550,000		$710,536	$190,000		$190,000	$11,698,000	New trailers every 8 years				
21	2038		$709,508	$711,530		$651,040	$411,288	$431,257	$6,942,766		$ -		$710,536	$190,000		$190,000	$10,948,000					
22	2039		$709,508	$709,962		$651,040	$412,408	$431,257	$6,942,766		$ 35,000		$710,536	$390,000		$190,000	$11,182,000					
23	2040		$709,508	$708,450		$651,040	$413,488	$431,257	$6,942,766		$ 175,000		$710,536	$190,000		$190,000	$11,122,000					
24	2041	$1,555,125	$709,508	$706,938		$651,040	$414,568	$431,257	$6,942,766		$ 385,000		$710,536	$190,000		$190,000	$12,887,000	Major capital upgrade every 20 years				
25	2042		$709,508	$704,036		$651,040	$416,641	$431,257	$6,942,766		$ -		$710,536	$190,000		$190,000	$10,946,000					
26	2043		$709,508	$701,120		$651,040	$418,724	$431,257	$6,942,766		$ 200,000		$710,536	$190,000		$190,000	$11,145,000					
27	2044		$709,508	$698,189	$200,000	$651,040	$420,818	$431,257	$6,942,766		$ -		$710,536	$390,000		$190,000	$11,344,000		New trailers every 8 years			
28	2045	$200,000	$709,508	$695,243		$651,040	$422,922	$431,257	$6,942,766		$ 35,000		$710,536	$190,000		$190,000	$11,178,000	New trailers every 8 years				
29	2046		$709,508	$692,282		$651,040	$425,036	$431,257	$5,186,114		$ -		$710,536	$190,000		$190,000	$9,186,000			Amotization period over		
30	2047		$709,508	$689,307		$651,040	$427,162	$431,257	$5,186,114		$ 585,000		$710,536	$190,000		$190,000	$9,770,000					
31	2048		$709,508	$686,317		$651,040	$429,297	$431,257	$5,186,114		$ -		$710,536	$190,000		$190,000	$9,184,000					
32	2049		$709,508	$683,312		$651,040	$431,444	$431,257	$5,186,114		$ -		$710,536	$390,000		$190,000	$9,383,000					
33	2050		$709,508	$680,292		$651,040	$433,601	$431,257	$5,186,114		$ 1,075,000		$710,536	$190,000		$190,000	$10,257,000					
34	2051		$709,508	$677,257	$241,000	$651,040	$435,769	$431,257	$5,186,114		$ 35,000		$710,536	$190,000		$190,000	$9,457,000		Transfer station permits etc			
35	2052		$709,508	$674,206	$2,615,000	$651,040	$437,948	$431,257	$5,186,114		$ -		$710,536	$190,000		$190,000	$11,796,000		Transfer station - new facility + new trailers			
36	2053	$200,000	$709,508	$671,141		$651,040	$440,138	$431,257	$5,186,114		$ 585,000		$710,536	$190,000		$190,000	$9,965,000	New trailers every 8 years				
37	2054		$709,508	$668,060		$651,040	$442,338	$431,257	$5,186,114		$ -		$710,536	$390,000		$190,000	$9,379,000				Construction Cell 3	
38	2055		$709,508	$664,963		$651,040	$444,550	$431,257	$5,186,114		$ -		$710,536	$190,000		$190,000	$9,178,000					
39	2056		$709,508	$661,851		$651,040	$446,773	$431,257	$5,186,114		$ -		$710,536	$190,000		$190,000	$9,177,000				Closure Cell 2	
40	2057		$709,508	$658,724		$651,040	$449,007	$431,257	$5,186,114	$7,800,000	$ 585,000		$710,536	$190,000		$190,000	$17,561,000					
41	2058		$709,508	$655,581		$651,040	$451,252	$431,257	$5,186,114		$ -		$835,536	$190,000		$190,000	$9,300,000					
42	2059		$709,508	$652,422		$651,040	$453,508	$431,257	$5,186,114		$ 35,000	$ 2,850,000	$835,536	$390,000		$190,000	$12,384,000					
43	2060		$709,508	$649,248	$200,000	$651,040	$455,775	$431,257	$5,186,114		$ 175,000		$835,536	$190,000		$190,000	$9,673,000		New trailers every 8 years			
44	2061	$1,755,125	$709,508	$646,057		$651,040	$458,054	$431,257	$5,186,114		$ -		$835,536	$190,000		$190,000	$11,053,000	Major capital upgrade every 20 years				
45	2062		$709,508	$642,851		$651,040	$460,345	$431,257	$5,186,114		$ -		$835,536	$190,000		$190,000	$9,297,000					
46	2063		$709,508	$639,628		$651,040	$462,646	$431,257	$5,186,114		$ 235,000		$835,536	$190,000		$190,000	$9,531,000					
47	2064		$709,508	$636,390		$651,040	$464,960	$431,257	$5,186,114		$ -		$835,536	$390,000		$190,000	$9,495,000					
48	2065		$709,508	$633,135		$651,040	$467,284	$431,257	$5,186,114		$ 1,285,000		$835,536	$190,000		$190,000	$10,579,000					
49	2066		$709,508	$629,864		$651,040	$469,621	$431,257	$5,186,114		$ -		$835,536	$190,000		$190,000	$9,293,000					
50	2067		$709,508	$626,577		$651,040	$471,969	$431,257	$5,186,114		$ 550,000		$835,536	$190,000		$190,000	$9,842,000					
	Totals	$7,731,275	$33,346,853	$32,577,600	$4,202,000	$28,645,760	$18,791,941	$19,726,916	$279,395,667	$16,650,000	$11,045,000	$6,965,000	$37,827,788	$11,310,000	$10,382,338	$15,379,269	$533,976,000					

WTT Facility Tipping Fee (1st 25 years) = *$151* per tonne

WTT Facility Tipping Fee (2nd 25 years) = *$113* per tonne

30 years
$328,192,000 1,651,117 tonnes
$199 per tonne over 30 years

40 years
$433,529,000 2,242,559 tonnes
$193 per tonne over 40 years

50 years
$533,976,000 2,884,138 tonnes
$185 per tonne over 50 years

Table B5: Long Term Cost Model for Option 2(a) - EWS facility located in Comox Valley

Population and Disposal Rates

	Year	Projected CVRD Population	CVRD Waste	Projected SRD Population	SRD Waste	Total Annual Tonnage	Daily Tonnage	Combined Population	Tonnes to Comox Valley TS	Tonnes to Campbell River TS	Tonnes to EWS Facility	Tonnes per day to EWS facility	Tonnes MSW to CRWMC LF	Tonnes to MSW CVWMC LF	Tonnes Ash/Residuals to CVWMC LF
			tonnes		tonnes	tonnes / yr	tonnes / day		tonnes	tonnes	tonnes	tonnes / day		tonnes	
	2015	64,294	38,576	45,871	27,523	66,099	181	91,817					27,523	38,576	
	2016	64,847	36,963	46,187	26,327	63,289	173	91,174					26,327	36,963	
0	2017	65,592	37,387	46,490	26,499	63,887	175	92,091					26,499	37,387	0
1	2018	66,372	37,832	46,809	26,681	64,513	177	93,053					26,681	37,832	0
2	2019	67,139	38,269	47,116	26,856	65,125	178	93,995					26,856	38,269	0
3	2020	67,905	38,706	47,419	27,029	65,735	180	94,934					27,029	38,706	0
4	2021	68,667	27,467	47,706	19,082	46,549	128	87,749			25,360	77	19,082	2,107	4,287
5	2022	69,436	27,774	47,986	19,194	46,969	129	88,630			25,644	78	19,194	2,131	4,335
6	2023	70,213	28,085	48,267	19,307	47,392	130	89,520		Landfill closur	25,931	79	19,307	2,154	4,383
7	2024	70,986	28,394	48,539	19,416	47,810	131	90,402		19,416	44,142	134		3,668	7,462
8	2025	71,758	28,703	48,806	19,522	48,226	132	91,280		19,522	44,526	135		3,699	7,527
9	2026	72,527	29,011	49,064	19,626	48,636	133	92,153		19,626	44,905	136		3,731	7,591
10	2027	73,290	29,316	49,307	19,723	49,039	134	93,013		19,723	45,277	137		3,762	7,654
11	2028	74,047	29,619	49,543	19,817	49,436	135	93,864		19,817	45,644	138		3,792	7,716
12	2029	74,795	29,918	49,773	19,909	49,827	137	94,704		19,909	45,976	139		3,851	7,772
13	2030	75,531	30,212	49,992	19,997	50,209	138	95,528		19,997	45,976	139		4,233	7,772
14	2031	76,255	30,502	50,203	20,081	50,583	139	96,336		20,081	45,976	139		4,607	7,772
15	2032	76,971	30,788	50,405	20,162	50,950	140	97,133		20,162	45,976	139		4,974	7,772
16	2033	77,681	31,072	50,600	20,240	51,312	141	97,921		20,240	45,976	139		5,336	7,772
17	2034	78,366	31,346	50,775	20,310	51,656	142	98,676		20,310	45,976	139		5,680	7,772
18	2035	79,039	31,616	50,944	20,378	51,993	142	99,417		20,378	45,976	139		6,017	7,772
19	2036	79,710	31,884	51,110	20,444	52,328	143	100,154		20,444	45,976	139		6,352	7,772
20	2037	80,366	32,146	51,265	20,506	52,652	144	100,872		20,506	45,976	139		6,676	7,772
21	2038	81,010	32,404	51,411	20,564	52,968	145	101,574		20,564	45,976	139		6,992	7,772
22	2039	81,643	32,657	51,551	20,620	53,278	146	102,263		20,620	45,976	139		7,302	7,772
23	2040	82,270	32,908	51,686	20,674	53,582	147	102,944		20,674	45,976	139		7,606	7,772
24	2041	82,888	33,155	51,821	20,728	53,884	148	103,616		20,728	45,976	139		7,908	7,772
25	2042	83,717	33,487	52,080	20,832	54,319	149	104,549		20,832	45,976	139		8,343	7,772
26	2043	84,554	33,822	52,341	20,936	54,758	150	105,490		20,936	45,976	139		8,782	7,772
27	2044	85,400	34,160	52,602	21,041	55,201	151	106,440		21,041	45,976	139		9,225	7,772
28	2045	86,254	34,501	52,865	21,146	55,648	152	107,400		21,146	45,976	139		9,672	7,772
29	2046	87,116	34,846	53,130	21,252	56,098	154	108,368		21,252	45,976	139		10,122	7,772
30	2047	87,987	35,195	53,395	21,358	56,553	155	109,345		21,358	45,976	139		10,577	7,772
31	2048	88,867	35,547	53,662	21,465	57,012	156	110,332		21,465	45,976	139		11,036	7,772
32	2049	89,756	35,902	53,930	21,572	57,475	157	111,328		21,572	45,976	139		11,499	7,772
33	2050	90,653	36,261	54,200	21,680	57,941	159	112,333		21,680	45,976	139		11,965	7,772
34	2051	91,560	36,624	54,471	21,788	58,412	160	113,348		21,788	45,976	139		12,436	7,772
35	2052	92,476	36,990	54,743	21,897	58,888	161	114,373		21,897	45,976	139		12,912	7,772
36	2053	93,400	37,360	55,017	22,007	59,367	163	115,407		22,007	45,976	139		13,391	7,772
37	2054	94,334	37,734	55,292	22,117	59,851	164	116,451		22,117	45,976	139		13,875	7,772
38	2055	95,278	38,111	55,569	22,228	60,339	165	117,505		22,228	45,976	139		14,363	7,772
39	2056	96,230	38,492	55,847	22,339	60,831	167	118,569		22,339	45,976	139		14,855	7,772
40	2057	97,193	38,877	56,126	22,450	61,327	168	119,643		22,450	45,976	139		15,351	7,772
41	2058	98,165	39,266	56,406	22,563	61,828	169	120,727		22,563	45,976	139		15,852	7,772
42	2059	99,146	39,659	56,688	22,675	62,334	171	121,822		22,675	45,976	139		16,358	7,772
43	2060	100,138	40,055	56,972	22,789	62,844	172	122,927		22,789	45,976	139		16,868	7,772
44	2061	101,139	40,456	57,257	22,903	63,358	174	124,042		22,903	45,976	139		17,382	7,772
45	2062	102,151	40,860	57,543	23,017	63,877	175	125,168		23,017	45,976	139		17,901	7,772
46	2063	103,172	41,269	57,831	23,132	64,401	176	126,304		23,132	45,976	139		18,425	7,772
47	2064	104,204	41,681	58,120	23,248	64,929	178	127,452		23,248	45,976	139		18,953	7,772
48	2065	105,246	42,098	58,411	23,364	65,463	179	128,610		23,364	45,976	139		19,487	7,772
49	2066	106,298	42,519	58,703	23,481	66,000	181	129,779		23,481	45,976	139		20,024	7,772
50	2067	107,361	42,944	58,996	23,598	66,543	182	130,960		23,598	45,976	139		20,567	7,772
	Totals	4,465,392	1,855,431	2,772,844	1,158,095	3,013,526		5,623,487	0	939,597	2,094,493		218,498	700,535	354,049

CRWMC LF Fill Rate and Capacity

	Year	Volumetric MSW Disposal Rate	Daily Cover Soil	Operational Soil	Settlement	Net Fill Volume	Cumulative Fill Volume	Phase	Volumetric Capacity (m³)
		m³	m³	m³	m³	m³	m³		
	2015	39,318	13,106	786	786	52,424			
	2016	37,609	12,536	752	752	50,146		Phase 3	
0	2017	37,856	12,619	757	757	50,475	50,475	Phase 3	
1	2018	38,116	12,705	762	762	50,821	101,296	Phase 3	
2	2019	38,366	12,789	767	767	51,155	152,451	Phase 3	
3	2020	38,613	12,871	772	772	51,483	203,934	Phase 3	
4	2021	27,261	9,087	545	545	36,347	240,281	Phase 3	
5	2022	27,421	9,140	548	548	36,561	276,842	Phase 3	
6	2023	27,581	9,194	552	552	36,775	313,617	Closed	**288,480**
7	2024	0	0	0	0	0	313,617	Closed	
8	2025	0	0	0	0	0	313,617	Closed	
9	2026	0	0	0	0	0	313,617	Closed	
10	2027	0	0	0	0	0	313,617	Closed	
11	2028	0	0	0	0	0	313,617	Closed	
12	2029	0	0	0	0	0	313,617	Closed	
13	2030	0	0	0	0	0	313,617	Closed	
14	2031	0	0	0	0	0	313,617	Closed	
15	2032	0	0	0	0	0	313,617	Closed	
16	2033	0	0	0	0	0	313,617	Closed	
17	2034	0	0	0	0	0	313,617	Closed	
18	2035	0	0	0	0	0	313,617	Closed	
19	2036	0	0	0	0	0	313,617	Closed	
20	2037	0	0	0	0	0	313,617	Closed	
21	2038	0	0	0	0	0	313,617	Closed	
22	2039	0	0	0	0	0	313,617	Closed	
23	2040	0	0	0	0	0	313,617	Closed	
24	2041	0	0	0	0	0	313,617	Closed	
25	2042	0	0	0	0	0	313,617	Closed	
26	2043	0	0	0	0	0	313,617	Closed	
27	2044	0	0	0	0	0	313,617	Closed	
28	2045	0	0	0	0	0	313,617	Closed	
29	2046	0	0	0	0	0	313,617	Closed	
30	2047	0	0	0	0	0	313,617	Closed	
31	2048	0	0	0	0	0	313,617	Closed	
32	2049	0	0	0	0	0	313,617	Closed	
33	2050	0	0	0	0	0	313,617	Closed	
34	2051	0	0	0	0	0	313,617	Closed	
35	2052	0	0	0	0	0	313,617	Closed	
36	2053	0	0	0	0	0	313,617	Closed	
37	2054	0	0	0	0	0	313,617	Closed	
38	2055	0	0	0	0	0	313,617	Closed	
39	2056	0	0	0	0	0	313,617	Closed	
40	2057	0	0	0	0	0	313,617	Closed	
41	2058	0	0	0	0	0	313,617	Closed	
42	2059	0	0	0	0	0	313,617	Closed	
43	2060	0	0	0	0	0	313,617	Closed	
44	2061	0	0	0	0	0	313,617	Closed	
45	2062	0	0	0	0	0	313,617	Closed	
46	2063	0	0	0	0	0	313,617	Closed	
47	2064	0	0	0	0	0	313,617	Closed	
48	2065	0	0	0	0	0	313,617	Closed	
49	2066	0	0	0	0	0	313,617	Closed	
50	2067	0	0	0	0	0	313,617	Closed	

CVWMC LF Fill Rate and Capacity

	Year	Volumetric MSW Disposal Rate	Volumetric Ash / Residuals Disposal Rate	Daily Cover Soil	Operational Soil	Settlement	Net Fill Volume	Cumulative Fill Volume	Phase / Cell	Phase / Cell	Volumetric Capacity (m³)
		m³	m³	m³	m³	m³	m³	m³			
	2015	55,109		18,370	1,102	1,102	73,479				
	2016	52,804		17,601	1,056	1,056	70,405		Phase 2	Phase 2	**46,525**
0	2017	53,411	0	17,804	1,068	1,068	71,214	71,214	Cell 1	Phase 2	
1	2018	54,046	0	18,015	1,081	1,081	72,061	143,275	Cell 1	Cell 1	
2	2019	54,670	0	18,223	1,093	1,093	72,894	216,169	Cell 1	Cell 1	
3	2020	55,294	0	18,431	1,106	1,106	73,725	289,894	Cell 1	Cell 1	
4	2021	3,010	3,298	1,003	60	60	7,311	297,205	Cell 1	Cell 1	
5	2022	3,044	3,334	1,015	61	61	7,393	304,598	Cell 1	Cell 1	
6	2023	3,078	3,372	1,026	62	62	7,476	312,074	Cell 1	Cell 1	
7	2024	5,239	5,740	1,746	105	105	12,726	324,799	Cell 1	Cell 1	
8	2025	5,285	5,790	1,762	106	106	12,836	337,636	Cell 1	Cell 1	
9	2026	5,330	5,839	1,777	107	107	12,946	350,581	Cell 1	Cell 1	
10	2027	5,374	5,887	1,791	107	107	13,053	363,634	Cell 1	Cell 1	
11	2028	5,418	5,935	1,806	108	108	13,159	376,793	Cell 1	Cell 1	
12	2029	5,502	5,978	1,834	110	110	13,314	390,107	Cell 1	Cell 1	
13	2030	6,047	5,978	2,016	121	121	14,041	404,148	Cell 1	Cell 1	
14	2031	6,582	5,978	2,194	132	132	14,754	418,902	Cell 1	Cell 1	
15	2032	7,106	5,978	2,369	142	142	15,453	434,355	Cell 1	Cell 1	
16	2033	7,623	5,978	2,541	152	152	16,143	450,498	Cell 1	Cell 1	
17	2034	8,115	5,978	2,705	162	162	16,798	467,296	Cell 1	Cell 1	
18	2035	8,596	5,978	2,865	172	172	17,440	484,736	Cell 1	Cell 1	
19	2036	9,074	5,978	3,025	181	181	18,077	502,813	Cell 1	Cell 1	
20	2037	9,538	5,978	3,179	191	191	18,695	521,508	Cell 2	Cell 1	**517,470**
21	2038	9,989	5,978	3,330	200	200	19,297	540,805	Cell 2	Cell 2	
22	2039	10,431	5,978	3,477	209	209	19,886	560,691	Cell 2	Cell 2	
23	2040	10,866	5,978	3,622	217	217	20,467	581,158	Cell 2	Cell 2	
24	2041	11,297	5,978	3,766	226	226	21,040	602,198	Cell 2	Cell 2	
25	2042	11,918	5,978	3,973	238	238	21,869	624,068	Cell 2	Cell 2	
26	2043	12,545	5,978	4,182	251	251	22,706	646,773	Cell 2	Cell 2	
27	2044	13,178	5,978	4,393	264	264	23,549	670,322	Cell 2	Cell 2	
28	2045	13,816	5,978	4,605	276	276	24,400	694,722	Cell 2	Cell 2	
29	2046	14,460	5,978	4,820	289	289	25,259	719,981	Cell 2	Cell 2	
30	2047	15,110	5,978	5,037	302	302	26,125	746,106	Cell 2	Cell 2	
31	2048	15,765	5,978	5,255	315	315	26,999	773,105	Cell 2	Cell 2	
32	2049	16,426	5,978	5,475	329	329	27,880	800,985	Cell 2	Cell 2	
33	2050	17,093	5,978	5,698	342	342	28,769	829,754	Cell 2	Cell 2	
34	2051	17,766	5,978	5,922	355	355	29,667	859,421	Cell 2	Cell 2	
35	2052	18,445	5,978	6,148	369	369	30,572	889,993	Cell 2	Cell 2	
36	2053	19,130	5,978	6,377	383	383	31,485	921,478	Cell 2	Cell 2	
37	2054	19,821	5,978	6,607	396	396	32,406	953,884	Cell 2	Cell 2	
38	2055	20,518	5,978	6,839	410	410	33,335	987,219	Cell 2	Cell 2	
39	2056	21,221	5,978	7,074	424	424	34,273	1,021,492	Cell 2	Cell 2	
40	2057	21,931	5,978	7,310	439	439	35,219	1,056,711	Cell 2	Cell 2	
41	2058	22,646	5,978	7,549	453	453	36,173	1,092,885	Cell 2	Cell 2	
42	2059	23,368	5,978	7,789	467	467	37,136	1,130,021	Cell 2	Cell 2	
43	2060	24,097	5,978	8,032	482	482	38,108	1,168,128	Cell 2	Cell 2	
44	2061	24,832	5,978	8,277	497	497	39,087	1,207,216	Cell 2	Cell 2	
45	2062	25,573	5,978	8,524	511	511	40,076	1,247,292	Cell 2	Cell 2	
46	2063	26,322	5,978	8,774	526	526	41,074	1,288,366	Cell 2	Cell 2	
47	2064	27,076	5,978	9,025	542	542	42,080	1,330,446	Cell 2	Cell 2	
48	2065	27,838	5,978	9,279	557	557	43,095	1,373,541	Cell 2	Cell 2	
49	2066	28,606	5,978	9,535	572	572	44,120	1,417,661	Cell 2	Cell 2	
50	2067	29,381	5,978	9,794	588	588	45,153	1,462,814	Cell 2	Cell 2	

CVRD growth rate beyond 2041 = 1%
CVRD disposal rate 2009-2015= 0.60 tonnes per person per year
CVRD disposal rate 2016-20120= 0.57 tonnes per person per year
CVRD disposal rate 2021-2067= 0.40 tonnes per person per year *Reduction by 30%*
SRD growth rate beyond 2041 = 0.50%
SRDdisposal rate 2009-2015= 0.60 tonnes per person per year
SRD disposal rate 2016-20120= 0.57 tonnes per person per year
SRD disposal rate 2021-2067= 0.40 tonnes per person per year *Reduction by 30%*

Days of operation = 337 days per year
Bottom ash/residuals to landfill = 17% % of input

In-situ MSW waste density = 0.7 tonnes per m^3
Operational soil = 2% of waste volume per year
Waste to cover ratio = 3:1
Settlement = 2% of waste volume per year

In-situ ash / residuals waste densitv = 1.3 tonnes per m^3
In-situ MSW waste density = 0.7 tonnes per m^3
Operational soil = 2% of waste volume per year
Waste to cover ratio = 3:1
Settlement = 2% of waste volume per year

Table B5: Long Term Cost Model for Option 2(a) - EWS facility located in Comox Valley

Capital and Operating Costs

	Year	Campbell River TS Capital	Campbell River TS Operating	Campbell River TS Transport	EWS Facility Tipping Fees	CVWMC LF Capital - Expansion	CVWMC LF Capital - Minor Capital	CVWMC LF Capital - Closure	CVWMC LF Operating - Expansion	CVWMC LF Operating - Post-Closure	CRWMC LF Capital	CRWMC LF Operating	Total System	Campbell River TS Notes	Comox Valley TS Notes	EWS Facility Notes	CVWMC LF Notes	CRWMC LF Notes
	2015												$0					
	2016					$16,000,000							$16,000,000	New Transfer station constructed 2012-2013			Construction of leachate management system and Cell 1	
0	2017						$ 860,000	$ 265,000	$1,108,145		$250,868	$1,002,753	$3,487,000				Closure Phase 2	Phase 2 SW mgmt design & partial construction
1	2018						$ 200,000	$ 2,500,000	$1,108,145		$490,358	$1,002,753	$5,301,000				Closure Phase 2	Phase 2 Surface water management construction
2	2019						$ -		$1,108,145	$390,000	$191,695	$1,002,753	$2,693,000					Phase 2 Design and construction
3	2020	$200,000			$1,149,079		$ 1,075,000		$1,108,145	$190,000	$491,790	$1,002,753	$5,217,000	New trailers every 8 years		Permits and land		Phase 2 LFG and final cover design
4	2021				$4,096,005		$ 35,000		$585,536	$190,000	$5,630,329	$1,002,753	$11,540,000			EWS facility begins operating		Phase 2 LFG and final cover construction
5	2022				$4,141,876		$ -		$585,536	$190,000	$218,613	$1,002,753	$6,139,000					Phase 3 LFG and final cover design
6	2023				$4,188,224		$ 35,000		$585,536	$190,000	$3,108,685	$1,002,753	$9,110,000					Phase 3 LFG and final cover construction
7	2024		$651,040	$287,351	$7,129,698		$ -		$585,536	$390,000		$190,000	$9,234,000					
8	2025		$651,040	$288,932	$7,191,675		$ -		$585,536	$190,000		$190,000	$9,097,000					
9	2026		$651,040	$290,459	$7,252,935		$ -		$585,536	$190,000		$190,000	$9,160,000					
10	2027		$651,040	$291,897	$7,312,944		$ 585,000		$585,536	$190,000		$190,000	$9,806,000					
11	2028	$200,000	$651,040	$293,295	$7,372,176		$ -		$585,536	$190,000		$190,000	$9,482,000	New trailers every 8 years				
12	2029		$651,040	$294,656	$7,425,856		$ 385,000		$585,536	$390,000		$190,000	$9,922,000					
13	2030		$651,040	$295,953	$7,425,856		$ 175,000		$585,536	$190,000		$190,000	$9,513,000					
14	2031		$651,040	$297,202	$7,425,856		$ -		$585,536	$190,000		$190,000	$9,340,000					
15	2032	$346,000	$651,040	$298,398	$7,425,856		$ -		$585,536	$190,000		$190,000	$9,687,000	Transfer station - parking and roads (20 yr life) + capital upgrades				
16	2033		$651,040	$299,552	$7,425,856		$ 235,000		$585,536	$190,000		$190,000	$9,577,000					
17	2034		$651,040	$300,588	$7,425,856		$ -		$585,536	$390,000		$190,000	$9,543,000					
18	2035		$651,040	$301,588	$7,425,856		$ 935,000		$585,536	$190,000		$190,000	$10,279,000					
19	2036	$200,000	$651,040	$302,571	$7,425,856		$ -		$585,536	$190,000		$190,000	$9,545,000	New trailers every 8 years				
20	2037		$651,040	$303,489	$7,425,856	$8,850,000	$ 550,000		$710,536	$190,000		$190,000	$18,871,000				Construction Cell 2	
21	2038		$651,040	$304,353	$7,425,856		$ -		$710,536	$190,000		$190,000	$9,472,000					
22	2039		$651,040	$305,182	$7,425,856		$ 35,000	$ 1,350,000	$710,536	$390,000		$190,000	$11,058,000				Closure Cell 1	
23	2040		$651,040	$305,981	$7,425,856		$ 175,000		$710,536	$190,000		$190,000	$9,648,000					
24	2041		$651,040	$306,780	$7,425,856		$ 385,000		$710,536	$190,000		$190,000	$9,859,000					
25	2042		$651,040	$308,314	$7,425,856		$ -		$710,536	$190,000		$190,000	$9,476,000					
26	2043		$651,040	$309,856	$7,425,856		$ 200,000		$710,536	$190,000		$190,000	$9,677,000					
27	2044	$200,000	$651,040	$311,405	$7,425,856		$ -		$710,536	$390,000		$190,000	$9,879,000	New trailers every 8 years				
28	2045		$651,040	$312,962	$7,425,856		$ 35,000		$710,536	$190,000		$190,000	$9,515,000					
29	2046		$651,040	$314,527	$3,866,626		$ -		$710,536	$190,000		$190,000	$5,923,000			Amotization period over		
30	2047		$651,040	$316,100	$3,866,626		$ 585,000		$710,536	$190,000		$190,000	$6,509,000					
31	2048		$651,040	$317,680	$3,866,626		$ -		$710,536	$190,000		$190,000	$5,926,000					
32	2049		$651,040	$319,268	$3,866,626		$ -		$710,536	$390,000		$190,000	$6,127,000					
33	2050		$651,040	$320,865	$3,866,626		$ 1,075,000		$710,536	$190,000		$190,000	$7,004,000					
34	2051	$241,000	$651,040	$322,469	$3,866,626		$ 35,000		$710,536	$190,000		$190,000	$6,207,000	Transfer station permits etc				
35	2052	$2,615,000	$651,040	$324,081	$3,866,626		$ -		$710,536	$190,000		$190,000	$8,547,000	Transfer station - new facility + new trailers	Locate, site and permit perm TS			
36	2053		$651,040	$325,702	$3,866,626		$ 585,000		$710,536	$190,000		$190,000	$6,519,000		Construct perm TS			
37	2054		$651,040	$327,330	$3,866,626		$ -		$710,536	$390,000		$190,000	$6,136,000		Off island export begins @ $100/tonne			
38	2055		$651,040	$328,967	$3,866,626		$ -		$710,536	$190,000		$190,000	$5,937,000					
39	2056		$651,040	$330,612	$3,866,626		$ -		$710,536	$190,000		$190,000	$5,939,000					
40	2057		$651,040	$332,265	$3,866,626		$ 585,000		$710,536	$190,000		$190,000	$6,525,000					
41	2058		$651,040	$333,926	$3,866,626		$ -		$710,536	$190,000		$190,000	$5,942,000					
42	2059		$651,040	$335,596	$3,866,626		$ 35,000		$710,536	$390,000		$190,000	$6,179,000					
43	2060	$200,000	$651,040	$337,274	$3,866,626		$ 175,000		$710,536	$190,000		$190,000	$6,320,000	New trailers every 8 years				
44	2061		$651,040	$338,960	$3,866,626		$ -		$710,536	$190,000		$190,000	$5,947,000		New trailers every 8 years			
45	2062		$651,040	$340,655	$3,866,626		$ -		$710,536	$190,000		$190,000	$5,949,000					
46	2063		$651,040	$342,358	$3,866,626		$ 235,000		$710,536	$190,000		$190,000	$6,186,000					
47	2064		$651,040	$344,070	$3,866,626		$ -		$710,536	$390,000		$190,000	$6,152,000					
48	2065		$651,040	$345,790	$3,866,626		$ 1,285,000		$710,536	$190,000		$190,000	$7,239,000					
49	2066		$651,040	$347,519	$3,866,626		$ -		$710,536	$190,000		$190,000	$5,956,000					
50	2067		$651,040	$349,257	$3,866,626		$ 550,000		$710,536	$190,000		$190,000	$6,507,000					
	Totals	$4,202,000	$28,645,760	$13,906,036	$261,139,928	$8,850,000	$11,045,000	$4,115,000	$35,827,788	$11,310,000	$10,382,338	$15,379,269	$404,803,000					

EWS Facility Tipping Fee (1st 25 years) = *$162* per tonne

EWS Facility Tipping Fee (2nd 25 years) = *$84* per tonne

30 years
$277,559,000 1,651,117 tonnes
$168 per tonne over 30 years

40 years
$342,426,000 2,242,559 tonnes
$153 per tonne over 40 years

50 years
$404,803,000 2,884,138 tonnes
$140 per tonne over 50 years

Table B6: Long Term Cost Model for Option 2(b) - EWS facility located in Campbell River

Population and Disposal Rates

Year		Projected CVRD Population	CVRD Waste	Projected SRD Population	SRD Waste	Total Annual Tonnage	Daily Tonnage	Combined Population	Tonnes to Comox Valley TS	Tonnes to Campbell River TS	Tonnes to EWS Facility	Tonnes per day to EWS facility	Tonnes MSW to CRWMC LF	Tonnes to MSW CVWMC LF	Tonnes Ash/Residuals to CVWMC LF
			tonnes		tonnes	tonnes / yr	tonnes / day		tonnes	tonnes	tonnes	tonnes / day		tonnes	
	2015	64,294	38,576	45,871	27,523	66,099	181	91,817					27,523	38,576	
	2016	64,847	36,963	46,187	26,327	63,289	173	91,174					26,327	36,963	
0	2017	65,592	37,387	46,490	26,499	63,887	175	92,091					26,499	37,387	0
1	2018	66,372	37,832	46,809	26,681	64,513	177	93,053					26,681	37,832	0
2	2019	67,139	38,269	47,116	26,856	65,125	178	93,995					26,856	38,269	0
3	2020	67,905	38,706	47,419	27,029	65,735	180	94,934					27,029	38,706	0
4	2021	68,667	27,467	47,706	19,082	46,549	128	87,749	25,360		25,360	77	19,082	2,107	4,287
5	2022	69,436	27,774	47,986	19,194	46,969	129	88,630	25,644		25,644	78	19,194	2,131	4,335
6	2023	70,213	28,085	48,267	19,307	47,392	130	89,520	25,931	Landfill closure	25,931	79	19,307	2,154	4,383
7	2024	70,986	28,394	48,539	19,416	47,810	131	90,402	24,727		44,142	134		3,668	7,462
8	2025	71,758	28,703	48,806	19,522	48,226	132	91,280	25,004		44,526	135		3,699	7,527
9	2026	72,527	29,011	49,064	19,626	48,636	133	92,153	25,280		44,905	136		3,731	7,591
10	2027	73,290	29,316	49,307	19,723	49,039	134	93,013	25,554		45,277	137		3,762	7,654
11	2028	74,047	29,619	49,543	19,817	49,436	135	93,864	25,826		45,644	138		3,792	7,716
12	2029	74,795	29,918	49,773	19,909	49,827	137	94,704	26,067		45,976	139		3,851	7,772
13	2030	75,531	30,212	49,992	19,997	50,209	138	95,528	25,979		45,976	139		4,233	7,772
14	2031	76,255	30,502	50,203	20,081	50,583	139	96,336	25,895		45,976	139		4,607	7,772
15	2032	76,971	30,788	50,405	20,162	50,950	140	97,133	25,814		45,976	139		4,974	7,772
16	2033	77,681	31,072	50,600	20,240	51,312	141	97,921	25,736		45,976	139		5,336	7,772
17	2034	78,366	31,346	50,775	20,310	51,656	142	98,676	25,666		45,976	139		5,680	7,772
18	2035	79,039	31,616	50,944	20,378	51,993	142	99,417	25,598		45,976	139		6,017	7,772
19	2036	79,710	31,884	51,110	20,444	52,328	143	100,154	25,532		45,976	139		6,352	7,772
20	2037	80,366	32,146	51,265	20,506	52,652	144	100,872	25,470		45,976	139		6,676	7,772
21	2038	81,010	32,404	51,411	20,564	52,968	145	101,574	25,412		45,976	139		6,992	7,772
22	2039	81,643	32,657	51,551	20,620	53,278	146	102,263	25,356		45,976	139		7,302	7,772
23	2040	82,270	32,908	51,686	20,674	53,582	147	102,944	25,302		45,976	139		7,606	7,772
24	2041	82,888	33,155	51,821	20,728	53,884	148	103,616	25,248		45,976	139		7,908	7,772
25	2042	83,717	33,487	52,080	20,832	54,319	149	104,549	25,144		45,976	139		8,343	7,772
26	2043	84,554	33,822	52,341	20,936	54,758	150	105,490	25,040		45,976	139		8,782	7,772
27	2044	85,400	34,160	52,602	21,041	55,201	151	106,440	24,935		45,976	139		9,225	7,772
28	2045	86,254	34,501	52,865	21,146	55,648	152	107,400	24,830		45,976	139		9,672	7,772
29	2046	87,116	34,846	53,130	21,252	56,098	154	108,368	24,724		45,976	139		10,122	7,772
30	2047	87,987	35,195	53,395	21,358	56,553	155	109,345	24,618		45,976	139		10,577	7,772
31	2048	88,867	35,547	53,662	21,465	57,012	156	110,332	24,511		45,976	139		11,036	7,772
32	2049	89,756	35,902	53,930	21,572	57,475	157	111,328	24,404		45,976	139		11,499	7,772
33	2050	90,653	36,261	54,200	21,680	57,941	159	112,333	24,296		45,976	139		11,965	7,772
34	2051	91,560	36,624	54,471	21,788	58,412	160	113,348	24,188		45,976	139		12,436	7,772
35	2052	92,476	36,990	54,743	21,897	58,888	161	114,373	24,079		45,976	139		12,912	7,772
36	2053	93,400	37,360	55,017	22,007	59,367	163	115,407	23,969		45,976	139		13,391	7,772
37	2054	94,334	37,734	55,292	22,117	59,851	164	116,451	23,859		45,976	139		13,875	7,772
38	2055	95,278	38,111	55,569	22,228	60,339	165	117,505	23,748		45,976	139		14,363	7,772
39	2056	96,230	38,492	55,847	22,339	60,831	167	118,569	23,637		45,976	139		14,855	7,772
40	2057	97,193	38,877	56,126	22,450	61,327	168	119,643	23,526		45,976	139		15,351	7,772
41	2058	98,165	39,266	56,406	22,563	61,828	169	120,727	23,413		45,976	139		15,852	7,772
42	2059	99,146	39,659	56,688	22,675	62,334	171	121,822	23,301		45,976	139		16,358	7,772
43	2060	100,138	40,055	56,972	22,789	62,844	172	122,927	23,187		45,976	139		16,868	7,772
44	2061	101,139	40,456	57,257	22,903	63,358	174	124,042	23,073		45,976	139		17,382	7,772
45	2062	102,151	40,860	57,543	23,017	63,877	175	125,168	22,959		45,976	139		17,901	7,772
46	2063	103,172	41,269	57,831	23,132	64,401	176	126,304	22,844		45,976	139		18,425	7,772
47	2064	104,204	41,681	58,120	23,248	64,929	178	127,452	22,728		45,976	139		18,953	7,772
48	2065	105,246	42,098	58,411	23,364	65,463	179	128,610	22,612		45,976	139		19,487	7,772
49	2066	106,298	42,519	58,703	23,481	66,000	181	129,779	22,495		45,976	139		20,024	7,772
50	2067	107,361	42,944	58,996	23,598	66,543	182	130,960	22,378		45,976	139		20,567	7,772
Totals		4,465,392	1,855,431	2,772,844	1,158,095	3,013,526		5,623,487	1,154,896	0	2,094,493		218,498	700,535	354,049

CRWMC LF Fill Rate and Capacity

Year		Volumetric MSW Disposal Rate	Daily Cover Soil	Operational Soil	Settlement	Net Fill Volume	Cumulative Fill Volume	Phase	Volumetric Capacity (m^3)
		m^3	m^3	m^3	m^3	m^3	m^3		
	2015	39,318	13,106	786	786	52,424			
	2016	37,609	12,536	752	752	50,146		Phase 3	
0	2017	37,856	12,619	757	757	50,475	50,475	Phase 3	
1	2018	38,116	12,705	762	762	50,821	101,296	Phase 3	
2	2019	38,366	12,789	767	767	51,155	152,451	Phase 3	
3	2020	38,613	12,871	772	772	51,483	203,934	Phase 3	
4	2021	27,261	9,087	545	545	36,347	240,281	Phase 3	
5	2022	27,421	9,140	548	548	36,561	276,842	Phase 3	
6	2023	27,581	9,194	552	552	36,775	313,617	Closed	**288,480**
7	2024	0	0	0	0	0	313,617	Closed	
8	2025	0	0	0	0	0	313,617	Closed	
9	2026	0	0	0	0	0	313,617	Closed	
10	2027	0	0	0	0	0	313,617	Closed	
11	2028	0	0	0	0	0	313,617	Closed	
12	2029	0	0	0	0	0	313,617	Closed	
13	2030	0	0	0	0	0	313,617	Closed	
14	2031	0	0	0	0	0	313,617	Closed	
15	2032	0	0	0	0	0	313,617	Closed	
16	2033	0	0	0	0	0	313,617	Closed	
17	2034	0	0	0	0	0	313,617	Closed	
18	2035	0	0	0	0	0	313,617	Closed	
19	2036	0	0	0	0	0	313,617	Closed	
20	2037	0	0	0	0	0	313,617	Closed	
21	2038	0	0	0	0	0	313,617	Closed	
22	2039	0	0	0	0	0	313,617	Closed	
23	2040	0	0	0	0	0	313,617	Closed	
24	2041	0	0	0	0	0	313,617	Closed	
25	2042	0	0	0	0	0	313,617	Closed	
26	2043	0	0	0	0	0	313,617	Closed	
27	2044	0	0	0	0	0	313,617	Closed	
28	2045	0	0	0	0	0	313,617	Closed	
29	2046	0	0	0	0	0	313,617	Closed	
30	2047	0	0	0	0	0	313,617	Closed	
31	2048	0	0	0	0	0	313,617	Closed	
32	2049	0	0	0	0	0	313,617	Closed	
33	2050	0	0	0	0	0	313,617	Closed	
34	2051	0	0	0	0	0	313,617	Closed	
35	2052	0	0	0	0	0	313,617	Closed	
36	2053	0	0	0	0	0	313,617	Closed	
37	2054	0	0	0	0	0	313,617	Closed	
38	2055	0	0	0	0	0	313,617	Closed	
39	2056	0	0	0	0	0	313,617	Closed	
40	2057	0	0	0	0	0	313,617	Closed	
41	2058	0	0	0	0	0	313,617	Closed	
42	2059	0	0	0	0	0	313,617	Closed	
43	2060	0	0	0	0	0	313,617	Closed	
44	2061	0	0	0	0	0	313,617	Closed	
45	2062	0	0	0	0	0	313,617	Closed	
46	2063	0	0	0	0	0	313,617	Closed	
47	2064	0	0	0	0	0	313,617	Closed	
48	2065	0	0	0	0	0	313,617	Closed	
49	2066	0	0	0	0	0	313,617	Closed	
50	2067	0	0	0	0	0	313,617	Closed	

CVWMC LF Fill Rate and Capacity

Year		Volumetric MSW Disposal Rate	Volumetric Ash / Residuals Disposal Rate	Daily Cover Soil	Operational Soil	Settlement	Net Fill Volume	Cumulative Fill Volume	Phase / Cell	Phase / Cell	Volumetric Capacity (m^3)
		m^3	m^3	m^3	m^3	m^3	m^3	m^3			
	2015	55,109		18,370	1,102	1,102	73,479				
	2016	52,804		17,601	1,056	1,056	70,405		Phase 2	Phase 2	**46,525**
0	2017	53,411	0	17,804	1,068	1,068	71,214	71,214	Cell 1	Phase 2	
1	2018	54,046	0	18,015	1,081	1,081	72,061	143,275	Cell 1	Cell 1	
2	2019	54,670	0	18,223	1,093	1,093	72,894	216,169	Cell 1	Cell 1	
3	2020	55,294	0	18,431	1,106	1,106	73,725	289,894	Cell 1	Cell 1	
4	2021	3,010	3,298	1,003	60	60	7,311	297,205	Cell 1	Cell 1	
5	2022	3,044	3,334	1,015	61	61	7,393	304,598	Cell 1	Cell 1	
6	2023	3,078	3,372	1,026	62	62	7,476	312,074	Cell 1	Cell 1	
7	2024	5,239	5,740	1,746	105	105	12,726	324,799	Cell 1	Cell 1	
8	2025	5,285	5,790	1,762	106	106	12,836	337,636	Cell 1	Cell 1	
9	2026	5,330	5,839	1,777	107	107	12,946	350,581	Cell 1	Cell 1	
10	2027	5,374	5,887	1,791	107	107	13,053	363,634	Cell 1	Cell 1	
11	2028	5,418	5,935	1,806	108	108	13,159	376,793	Cell 1	Cell 1	
12	2029	5,502	5,978	1,834	110	110	13,314	390,107	Cell 1	Cell 1	
13	2030	6,047	5,978	2,016	121	121	14,041	404,148	Cell 1	Cell 1	
14	2031	6,582	5,978	2,194	132	132	14,754	418,902	Cell 1	Cell 1	
15	2032	7,106	5,978	2,369	142	142	15,453	434,355	Cell 1	Cell 1	
16	2033	7,623	5,978	2,541	152	152	16,143	450,498	Cell 1	Cell 1	
17	2034	8,115	5,978	2,705	162	162	16,798	467,296	Cell 1	Cell 1	
18	2035	8,596	5,978	2,865	172	172	17,440	484,736	Cell 1	Cell 1	
19	2036	9,074	5,978	3,025	181	181	18,077	502,813	Cell 1	Cell 1	
20	2037	9,538	5,978	3,179	191	191	18,695	521,508	Cell 2	Cell 1	**517,470**
21	2038	9,989	5,978	3,330	200	200	19,297	540,805	Cell 2	Cell 2	
22	2039	10,431	5,978	3,477	209	209	19,886	560,691	Cell 2	Cell 2	
23	2040	10,866	5,978	3,622	217	217	20,467	581,158	Cell 2	Cell 2	
24	2041	11,297	5,978	3,766	226	226	21,040	602,198	Cell 2	Cell 2	
25	2042	11,918	5,978	3,973	238	238	21,869	624,068	Cell 2	Cell 2	
26	2043	12,545	5,978	4,182	251	251	22,706	646,773	Cell 2	Cell 2	
27	2044	13,178	5,978	4,393	264	264	23,549	670,322	Cell 2	Cell 2	
28	2045	13,816	5,978	4,605	276	276	24,400	694,722	Cell 2	Cell 2	
29	2046	14,460	5,978	4,820	289	289	25,259	719,981	Cell 2	Cell 2	
30	2047	15,110	5,978	5,037	302	302	26,125	746,106	Cell 2	Cell 2	
31	2048	15,765	5,978	5,255	315	315	26,999	773,105	Cell 2	Cell 2	
32	2049	16,426	5,978	5,475	329	329	27,880	800,985	Cell 2	Cell 2	
33	2050	17,093	5,978	5,698	342	342	28,769	829,754	Cell 2	Cell 2	
34	2051	17,766	5,978	5,922	355	355	29,667	859,421	Cell 2	Cell 2	
35	2052	18,445	5,978	6,148	369	369	30,572	889,993	Cell 2	Cell 2	
36	2053	19,130	5,978	6,377	383	383	31,485	921,478	Cell 2	Cell 2	
37	2054	19,821	5,978	6,607	396	396	32,406	953,884	Cell 2	Cell 2	
38	2055	20,518	5,978	6,839	410	410	33,335	987,219	Cell 2	Cell 2	
39	2056	21,221	5,978	7,074	424	424	34,273	1,021,492	Cell 2	Cell 2	
40	2057	21,931	5,978	7,310	439	439	35,219	1,056,711	Cell 2	Cell 2	
41	2058	22,646	5,978	7,549	453	453	36,173	1,092,885	Cell 2	Cell 2	
42	2059	23,368	5,978	7,789	467	467	37,136	1,130,021	Cell 2	Cell 2	
43	2060	24,097	5,978	8,032	482	482	38,108	1,168,128	Cell 2	Cell 2	
44	2061	24,832	5,978	8,277	497	497	39,087	1,207,216	Cell 2	Cell 2	
45	2062	25,573	5,978	8,524	511	511	40,076	1,247,292	Cell 2	Cell 2	
46	2063	26,322	5,978	8,774	526	526	41,074	1,288,366	Cell 2	Cell 2	
47	2064	27,076	5,978	9,025	542	542	42,080	1,330,446	Cell 2	Cell 2	
48	2065	27,838	5,978	9,279	557	557	43,095	1,373,541	Cell 2	Cell 2	
49	2066	28,606	5,978	9,535	572	572	44,120	1,417,661	Cell 2	Cell 2	
50	2067	29,381	5,978	9,794	588	588	45,153	1,462,814	Cell 2	Cell 2	

CVRD growth rate beyond 2041 = 1%
CVRD disposal rate 2009-2015= 0.60 tonnes per person per year
CVRD disposal rate 2016-20120= 0.57 tonnes per person per year
CVRD disposal rate 2021-2067= 0.40 tonnes per person per year — *Reduction by 30%*
SRD growth rate beyond 2041 = 0.50%
SRDdisposal rate 2009-2015= 0.60 tonnes per person per year
SRD disposal rate 2016-20120= 0.57 tonnes per person per year
SRD disposal rate 2021-2067= 0.40 tonnes per person per year — *Reduction by 30%*
Days of operation = 337 days per year
Bottom ash/residuals to landfill = 17% % of input

In-situ MSW waste density = 0.7 tonnes per m^3
Operational soil = 2% of waste volume per year
Waste to cover ratio = 3:1
Settlement = 2% of waste volume per year

In-situ ash / residuals waste density = 1.3 tonnes per m^3
In-situ MSW waste density = 0.7 tonnes per m^3
Operational soil = 2% of waste volume per year
Waste to cover ratio = 3:1
Settlement = 2% of waste volume per year

Table B6: Long Term Cost Model for Option 2(b) - EWS facility located in Campbell River

Capital and Operating Costs

Year		Comox Valley TS Capital	Comox Valley TS Operating	Comox Valley TS Transport	Campbell River TS Transport	EWS Facility Tipping Fees	CVWMC LF Capital - Expansion	CVWMC LF Capital - Minor Capital	CVWMC LF Capital - Closure	CVWMC LF Operating - Expansion	CVWMC LF Operating - Post-Closure	CRWMC LF Capital	CRWMC LF Operating	Total System	Comox Valley TS Notes	Campbell River TS Notes	EWS Facility Notes	CVWMC LF Notes	CRWMC LF Notes
	2015													$0					
	2016						$16,000,000							$16,000,000		New Transfer station constructed 2012-2013		Construction of leachate management system and Cell 1	
0	2017							$ 860,000	$ 265,000	$1,108,145		$250,868	$1,002,753	$3,487,000				Closure Phase 2	Phase 2 SW mgmt design & partial construction
1	2018							$ 200,000	$ 2,500,000	$1,108,145		$490,358	$1,002,753	$5,301,000				Closure Phase 2	Phase 2 Surface water management construction
2	2019							$ -		$1,108,145	$390,000	$191,695	$1,002,753	$2,693,000					Phase 2 Design and construction
3	2020	$311,025			Ash / residuals	$957,915		$ 1,075,000		$1,108,145	$190,000	$491,790	$1,002,753	$5,137,000	Permits	New trailers every 8 years	Permits and land		Phase 2 LFG and final cover design
4	2021	$3,310,000	$709,508	$375,324	$63,444	$4,096,005		$ 35,000		$585,536	$190,000	$5,630,329	$1,002,753	$15,998,000	New transfer station		EWS facility begins operating		Phase 2 LFG and final cover construction
5	2022		$709,508	$379,528	$64,155	$4,141,876		$ -		$585,536	$190,000	$218,613	$1,002,753	$7,292,000					Phase 3 LFG and final cover design
6	2023		$709,508	$383,775	$64,873	$4,188,224		$ 35,000		$585,536	$190,000	$3,108,685	$1,002,753	$10,268,000					Phase 3 LFG and final cover construction
7	2024		$709,508	$365,956	$110,434	$7,129,698		$ -		$585,536	$390,000		$190,000	$9,481,000					
8	2025		$709,508	$370,055	$111,394	$7,191,675		$ -		$585,536	$190,000		$190,000	$9,348,000					
9	2026		$709,508	$374,141	$112,343	$7,252,935		$ -		$585,536	$190,000		$190,000	$9,414,000					
10	2027		$709,508	$378,201	$113,272	$7,312,944		$ 585,000		$585,536	$190,000		$190,000	$10,064,000					
11	2028		$709,508	$382,231	$114,190	$7,372,176		$ -		$585,536	$190,000		$190,000	$9,544,000		New trailers every 8 years			
12	2029	$200,000	$709,508	$385,789	$115,021	$7,425,856		$ 385,000		$585,536	$390,000		$190,000	$10,387,000	New trailers every 8 years				
13	2030		$709,508	$384,492	$115,021	$7,425,856		$ 175,000		$585,536	$190,000		$190,000	$9,775,000					
14	2031		$709,508	$383,243	$115,021	$7,425,856		$ -		$585,536	$190,000		$190,000	$9,599,000					
15	2032		$709,508	$382,047	$115,021	$7,425,856		$ -		$585,536	$190,000		$190,000	$9,598,000		Transfer station - parking and roads (20 yr life) + capital upgrades			
16	2033		$709,508	$380,893	$115,021	$7,425,856		$ 235,000		$585,536	$190,000		$190,000	$9,832,000					
17	2034		$709,508	$379,857	$115,021	$7,425,856		$ -		$585,536	$390,000		$190,000	$9,796,000					
18	2035		$709,508	$378,856	$115,021	$7,425,856		$ 935,000		$585,536	$190,000		$190,000	$10,530,000					
19	2036		$709,508	$377,874	$115,021	$7,425,856		$ -		$585,536	$190,000		$190,000	$9,594,000		New trailers every 8 years			
20	2037	$200,000	$709,508	$376,956	$115,021	$7,425,856	$8,850,000	$ 550,000		$710,536	$190,000		$190,000	$19,318,000	New trailers every 8 years			Construction Cell 2	
21	2038		$709,508	$376,092	$115,021	$7,425,856		$ -		$710,536	$190,000		$190,000	$9,717,000					
22	2039		$709,508	$375,263	$115,021	$7,425,856		$ 35,000	$ 1,350,000	$710,536	$390,000		$190,000	$11,301,000				Closure Cell 1	
23	2040		$709,508	$374,464	$115,021	$7,425,856		$ 175,000		$710,536	$190,000		$190,000	$9,890,000					
24	2041	$1,555,125	$709,508	$373,664	$115,021	$7,425,856		$ 385,000		$710,536	$190,000		$190,000	$11,655,000	Major capital upgrade every 20 years				
25	2042		$709,508	$372,131	$115,021	$7,425,856		$ -		$710,536	$190,000		$190,000	$9,713,000					
26	2043		$709,508	$370,589	$115,021	$7,425,856		$ 200,000		$710,536	$190,000		$190,000	$9,912,000					
27	2044		$709,508	$369,040	$115,021	$7,425,856		$ -		$710,536	$390,000		$190,000	$9,910,000		New trailers every 8 years			
28	2045	$200,000	$709,508	$367,483	$115,021	$7,425,856		$ 35,000		$710,536	$190,000		$190,000	$9,943,000	New trailers every 8 years				
29	2046		$709,508	$365,918	$115,021	$3,866,626		$ -		$710,536	$190,000		$190,000	$6,148,000			Amotization period over		
30	2047		$709,508	$364,345	$115,021	$3,866,626		$ 585,000		$710,536	$190,000		$190,000	$6,731,000					
31	2048		$709,508	$362,765	$115,021	$3,866,626		$ -		$710,536	$190,000		$190,000	$6,144,000					
32	2049		$709,508	$361,176	$115,021	$3,866,626		$ -		$710,536	$390,000		$190,000	$6,343,000					
33	2050		$709,508	$359,580	$115,021	$3,866,626		$ 1,075,000		$710,536	$190,000		$190,000	$7,216,000					
34	2051		$709,508	$357,976	$115,021	$3,866,626		$ 35,000		$710,536	$190,000		$190,000	$6,175,000		Transfer station permits etc			
35	2052		$709,508	$356,363	$115,021	$3,866,626		$ -		$710,536	$190,000		$190,000	$6,138,000		Transfer station - new facility + new trailers			
36	2053	$200,000	$709,508	$354,743	$115,021	$3,866,626		$ 585,000		$710,536	$190,000		$190,000	$6,921,000	New trailers every 8 years				
37	2054		$709,508	$353,114	$115,021	$3,866,626		$ -		$710,536	$390,000		$190,000	$6,335,000					
38	2055		$709,508	$351,478	$115,021	$3,866,626		$ -		$710,536	$190,000		$190,000	$6,133,000					
39	2056		$709,508	$349,833	$115,021	$3,866,626		$ -		$710,536	$190,000		$190,000	$6,132,000					
40	2057		$709,508	$348,180	$115,021	$3,866,626		$ 585,000		$710,536	$190,000		$190,000	$6,715,000					
41	2058		$709,508	$346,519	$115,021	$3,866,626		$ -		$710,536	$190,000		$190,000	$6,128,000					
42	2059		$709,508	$344,849	$115,021	$3,866,626		$ 35,000		$710,536	$390,000		$190,000	$6,362,000					
43	2060		$709,508	$343,171	$115,021	$3,866,626		$ 175,000		$710,536	$190,000		$190,000	$6,300,000		New trailers every 8 years			
44	2061	$1,755,125	$709,508	$341,485	$115,021	$3,866,626		$ -		$710,536	$190,000		$190,000	$7,878,000	Major capital upgrade every 20 years				
45	2062		$709,508	$339,790	$115,021	$3,866,626		$ -		$710,536	$190,000		$190,000	$6,121,000					
46	2063		$709,508	$338,087	$115,021	$3,866,626		$ 235,000		$710,536	$190,000		$190,000	$6,355,000					
47	2064		$709,508	$336,375	$115,021	$3,866,626		$ -		$710,536	$390,000		$190,000	$6,318,000					
48	2065		$709,508	$334,654	$115,021	$3,866,626		$ 1,285,000		$710,536	$190,000		$190,000	$7,401,000					
49	2066		$709,508	$332,925	$115,021	$3,866,626		$ -		$710,536	$190,000		$190,000	$6,115,000					
50	2067		$709,508	$331,188	$115,021	$3,866,626		$ 550,000		$710,536	$190,000		$190,000	$6,663,000					
Totals		$7,731,275	$33,346,853	$17,092,455	$5,239,930	$260,948,765	$8,850,000	$11,045,000	$4,115,000	$35,827,788	$11,310,000	$10,382,338	$15,379,269	$421,269,000					

EWS Facility Tipping Fee (1st 25 years) = *$162* per tonne

EWS Facility Tipping Fee (2nd 25 years) = *$84* per tonne

30 years
$291,376,000 1,651,117 tonnes
$176 per tonne over 30 years

40 years
$355,628,000 2,242,559 tonnes
$159 per tonne over 40 years

50 years
$421,269,000 2,884,138 tonnes
$146 per tonne over 50 years

Table B7: Long Term Cost Model for Option 2(c) - EWS facility located in Gold River

Population and Disposal Rates

Year		Projected CVRD Population	CVRD Waste	Projected SRD Population	SRD Waste	Total Annual Tonnage	Daily Tonnage	Combined Population	Tonnes to Comox Valley TS	Tonnes to Campbell River TS	Tonnes to EWS Facility	Tonnes per day to EWS facility	Tonnes MSW to CRWMC LF	Tonnes to MSW CVWMC LF	Tonnes Ash/Residuals to CVWMC LF
			tonnes		tonnes	tonnes / yr	tonnes / day		tonnes	tonnes	tonnes	tonnes / day		tonnes	
	2015	64,294	38,576	45,871	27,523	66,099	181	91,817					27,523	38,576	
	2016	64,847	36,963	46,187	26,327	63,289	173	91,174					26,327	36,963	
0	2017	65,592	37,387	46,490	26,499	63,887	175	92,091					26,499	37,387	0
1	2018	66,372	37,832	46,809	26,681	64,513	177	93,053					26,681	37,832	0
2	2019	67,139	38,269	47,116	26,856	65,125	178	93,995					26,856	38,269	0
3	2020	67,905	38,706	47,419	27,029	65,735	180	94,934					27,029	38,706	0
4	2021	68,667	27,467	47,706	19,082	46,549	128	87,749	25,360		25,360	77	19,082	2,107	4,287
5	2022	69,436	27,774	47,986	19,194	46,969	129	88,630	25,644		25,644	78	19,194	2,131	4,335
6	2023	70,213	28,085	48,267	19,307	47,392	130	89,520	25,931	Landfill closure	25,931	79	19,307	2,154	4,383
7	2024	70,986	28,394	48,539	19,416	47,810	131	90,402	24,727	19,416	44,142	134		3,668	7,462
8	2025	71,758	28,703	48,806	19,522	48,226	132	91,280	25,004	19,522	44,526	135		3,699	7,527
9	2026	72,527	29,011	49,064	19,626	48,636	133	92,153	25,280	19,626	44,905	136		3,731	7,591
10	2027	73,290	29,316	49,307	19,723	49,039	134	93,013	25,554	19,723	45,277	137		3,762	7,654
11	2028	74,047	29,619	49,543	19,817	49,436	135	93,864	25,826	19,817	45,644	138		3,792	7,716
12	2029	74,795	29,918	49,773	19,909	49,827	137	94,704	26,067	19,909	45,976	139		3,851	7,772
13	2030	75,531	30,212	49,992	19,997	50,209	138	95,528	25,979	19,997	45,976	139		4,233	7,772
14	2031	76,255	30,502	50,203	20,081	50,583	139	96,336	25,895	20,081	45,976	139		4,607	7,772
15	2032	76,971	30,788	50,405	20,162	50,950	140	97,133	25,814	20,162	45,976	139		4,974	7,772
16	2033	77,681	31,072	50,600	20,240	51,312	141	97,921	25,736	20,240	45,976	139		5,336	7,772
17	2034	78,366	31,346	50,775	20,310	51,656	142	98,676	25,666	20,310	45,976	139		5,680	7,772
18	2035	79,039	31,616	50,944	20,378	51,993	142	99,417	25,598	20,378	45,976	139		6,017	7,772
19	2036	79,710	31,884	51,110	20,444	52,328	143	100,154	25,532	20,444	45,976	139		6,352	7,772
20	2037	80,366	32,146	51,265	20,506	52,652	144	100,872	25,470	20,506	45,976	139		6,676	7,772
21	2038	81,010	32,404	51,411	20,564	52,968	145	101,574	25,412	20,564	45,976	139		6,992	7,772
22	2039	81,643	32,657	51,551	20,620	53,278	146	102,263	25,356	20,620	45,976	139		7,302	7,772
23	2040	82,270	32,908	51,686	20,674	53,582	147	102,944	25,302	20,674	45,976	139		7,606	7,772
24	2041	82,888	33,155	51,821	20,728	53,884	148	103,616	25,248	20,728	45,976	139		7,908	7,772
25	2042	83,717	33,487	52,080	20,832	54,319	149	104,549	25,144	20,832	45,976	139		8,343	7,772
26	2043	84,554	33,822	52,341	20,936	54,758	150	105,490	25,040	20,936	45,976	139		8,782	7,772
27	2044	85,400	34,160	52,602	21,041	55,201	151	106,440	24,935	21,041	45,976	139		9,225	7,772
28	2045	86,254	34,501	52,865	21,146	55,648	152	107,400	24,830	21,146	45,976	139		9,672	7,772
29	2046	87,116	34,846	53,130	21,252	56,098	154	108,368	24,724	21,252	45,976	139		10,122	7,772
30	2047	87,987	35,195	53,395	21,358	56,553	155	109,345	24,618	21,358	45,976	139		10,577	7,772
31	2048	88,867	35,547	53,662	21,465	57,012	156	110,332	24,511	21,465	45,976	139		11,036	7,772
32	2049	89,756	35,902	53,930	21,572	57,475	157	111,328	24,404	21,572	45,976	139		11,499	7,772
33	2050	90,653	36,261	54,200	21,680	57,941	159	112,333	24,296	21,680	45,976	139		11,965	7,772
34	2051	91,560	36,624	54,471	21,788	58,412	160	113,348	24,188	21,788	45,976	139		12,436	7,772
35	2052	92,476	36,990	54,743	21,897	58,888	161	114,373	24,079	21,897	45,976	139		12,912	7,772
36	2053	93,400	37,360	55,017	22,007	59,367	163	115,407	23,969	22,007	45,976	139		13,391	7,772
37	2054	94,334	37,734	55,292	22,117	59,851	164	116,451	23,859	22,117	45,976	139		13,875	7,772
38	2055	95,278	38,111	55,569	22,228	60,339	165	117,505	23,748	22,228	45,976	139		14,363	7,772
39	2056	96,230	38,492	55,847	22,339	60,831	167	118,569	23,637	22,339	45,976	139		14,855	7,772
40	2057	97,193	38,877	56,126	22,450	61,327	168	119,643	23,526	22,450	45,976	139		15,351	7,772
41	2058	98,165	39,266	56,406	22,563	61,828	169	120,727	23,413	22,563	45,976	139		15,852	7,772
42	2059	99,146	39,659	56,688	22,675	62,334	171	121,822	23,301	22,675	45,976	139		16,358	7,772
43	2060	100,138	40,055	56,972	22,789	62,844	172	122,927	23,187	22,789	45,976	139		16,868	7,772
44	2061	101,139	40,456	57,257	22,903	63,358	174	124,042	23,073	22,903	45,976	139		17,382	7,772
45	2062	102,151	40,860	57,543	23,017	63,877	175	125,168	22,959	23,017	45,976	139		17,901	7,772
46	2063	103,172	41,269	57,831	23,132	64,401	176	126,304	22,844	23,132	45,976	139		18,425	7,772
47	2064	104,204	41,681	58,120	23,248	64,929	178	127,452	22,728	23,248	45,976	139		18,953	7,772
48	2065	105,246	42,098	58,411	23,364	65,463	179	128,610	22,612	23,364	45,976	139		19,487	7,772
49	2066	106,298	42,519	58,703	23,481	66,000	181	129,779	22,495	23,481	45,976	139		20,024	7,772
50	2067	107,361	42,944	58,996	23,598	66,543	182	130,960	22,378	23,598	45,976	139		20,567	7,772
Totals		4,465,392	1,855,431	2,772,844	1,158,095	3,013,526		5,623,487	1,154,896	939,597	2,094,493		218,498	700,535	354,049

CRWMC LF Fill Rate and Capacity

Year		Volumetric MSW Disposal Rate	Daily Cover Soil	Operational Soil	Settlement	Net Fill Volume	Cumulative Fill Volume	Phase	Volumetric Capacity (m³)
		m^3	m^3	m^3	m^3	m^3	m^3		
	2015	39,318	13,106	786	786	52,424			
	2016	37,609	12,536	752	752	50,146		Phase 3	
0	2017	37,856	12,619	757	757	50,475	50,475	Phase 3	
1	2018	38,116	12,705	762	762	50,821	101,296	Phase 3	
2	2019	38,366	12,789	767	767	51,155	152,451	Phase 3	
3	2020	38,613	12,871	772	772	51,483	203,934	Phase 3	
4	2021	27,261	9,087	545	545	36,347	240,281	Phase 3	
5	2022	27,421	9,140	548	548	36,561	276,842	Phase 3	
6	2023	27,581	9,194	552	552	36,775	313,617	Closed	**288,480**
7	2024	0	0	0	0	0	313,617	Closed	
8	2025	0	0	0	0	0	313,617	Closed	
9	2026	0	0	0	0	0	313,617	Closed	
10	2027	0	0	0	0	0	313,617	Closed	
11	2028	0	0	0	0	0	313,617	Closed	
12	2029	0	0	0	0	0	313,617	Closed	
13	2030	0	0	0	0	0	313,617	Closed	
14	2031	0	0	0	0	0	313,617	Closed	
15	2032	0	0	0	0	0	313,617	Closed	
16	2033	0	0	0	0	0	313,617	Closed	
17	2034	0	0	0	0	0	313,617	Closed	
18	2035	0	0	0	0	0	313,617	Closed	
19	2036	0	0	0	0	0	313,617	Closed	
20	2037	0	0	0	0	0	313,617	Closed	
21	2038	0	0	0	0	0	313,617	Closed	
22	2039	0	0	0	0	0	313,617	Closed	
23	2040	0	0	0	0	0	313,617	Closed	
24	2041	0	0	0	0	0	313,617	Closed	
25	2042	0	0	0	0	0	313,617	Closed	
26	2043	0	0	0	0	0	313,617	Closed	
27	2044	0	0	0	0	0	313,617	Closed	
28	2045	0	0	0	0	0	313,617	Closed	
29	2046	0	0	0	0	0	313,617	Closed	
30	2047	0	0	0	0	0	313,617	Closed	
31	2048	0	0	0	0	0	313,617	Closed	
32	2049	0	0	0	0	0	313,617	Closed	
33	2050	0	0	0	0	0	313,617	Closed	
34	2051	0	0	0	0	0	313,617	Closed	
35	2052	0	0	0	0	0	313,617	Closed	
36	2053	0	0	0	0	0	313,617	Closed	
37	2054	0	0	0	0	0	313,617	Closed	
38	2055	0	0	0	0	0	313,617	Closed	
39	2056	0	0	0	0	0	313,617	Closed	
40	2057	0	0	0	0	0	313,617	Closed	
41	2058	0	0	0	0	0	313,617	Closed	
42	2059	0	0	0	0	0	313,617	Closed	
43	2060	0	0	0	0	0	313,617	Closed	
44	2061	0	0	0	0	0	313,617	Closed	
45	2062	0	0	0	0	0	313,617	Closed	
46	2063	0	0	0	0	0	313,617	Closed	
47	2064	0	0	0	0	0	313,617	Closed	
48	2065	0	0	0	0	0	313,617	Closed	
49	2066	0	0	0	0	0	313,617	Closed	
50	2067	0	0	0	0	0	313,617	Closed	

CVWMC LF Fill Rate and Capacity

Year		Volumetric MSW Disposal Rate	Volumetric Ash / Residuals Disposal Rate	Daily Cover Soil	Operational Soil	Settlement	Net Fill Volume	Cumulative Fill Volume	Phase / Cell	Phase / Cell	Volumetric Capacity (m³)
		m^3	m^3	m^3	m^3	m^3	m^3	m^3			
	2015	55,109		18,370	1,102	1,102	73,479				
	2016	52,804		17,601	1,056	1,056	70,405		Phase 2	Phase 2	**46,525**
0	2017	53,411	0	17,804	1,068	1,068	71,214	71,214	Cell 1	Phase 2	
1	2018	54,046	0	18,015	1,081	1,081	72,061	143,275	Cell 1	Cell 1	
2	2019	54,670	0	18,223	1,093	1,093	72,894	216,169	Cell 1	Cell 1	
3	2020	55,294	0	18,431	1,106	1,106	73,725	289,894	Cell 1	Cell 1	
4	2021	3,010	3,298	1,003	60	60	7,311	297,205	Cell 1	Cell 1	
5	2022	3,044	3,334	1,015	61	61	7,393	304,598	Cell 1	Cell 1	
6	2023	3,078	3,372	1,026	62	62	7,476	312,074	Cell 1	Cell 1	
7	2024	5,239	5,740	1,746	105	105	12,726	324,799	Cell 1	Cell 1	
8	2025	5,285	5,790	1,762	106	106	12,836	337,636	Cell 1	Cell 1	
9	2026	5,330	5,839	1,777	107	107	12,946	350,581	Cell 1	Cell 1	
10	2027	5,374	5,887	1,791	107	107	13,053	363,634	Cell 1	Cell 1	
11	2028	5,418	5,935	1,806	108	108	13,159	376,793	Cell 1	Cell 1	
12	2029	5,502	5,978	1,834	110	110	13,314	390,107	Cell 1	Cell 1	
13	2030	6,047	5,978	2,016	121	121	14,041	404,148	Cell 1	Cell 1	
14	2031	6,582	5,978	2,194	132	132	14,754	418,902	Cell 1	Cell 1	
15	2032	7,106	5,978	2,369	142	142	15,453	434,355	Cell 1	Cell 1	
16	2033	7,623	5,978	2,541	152	152	16,143	450,498	Cell 1	Cell 1	
17	2034	8,115	5,978	2,705	162	162	16,798	467,296	Cell 1	Cell 1	
18	2035	8,596	5,978	2,865	172	172	17,440	484,736	Cell 1	Cell 1	
19	2036	9,074	5,978	3,025	181	181	18,077	502,813	Cell 1	Cell 1	
20	2037	9,538	5,978	3,179	191	191	18,695	521,508	Cell 2	Cell 1	**517,470**
21	2038	9,989	5,978	3,330	200	200	19,297	540,805	Cell 2	Cell 2	
22	2039	10,431	5,978	3,477	209	209	19,886	560,691	Cell 2	Cell 2	
23	2040	10,866	5,978	3,622	217	217	20,467	581,158	Cell 2	Cell 2	
24	2041	11,297	5,978	3,766	226	226	21,040	602,198	Cell 2	Cell 2	
25	2042	11,918	5,978	3,973	238	238	21,869	624,068	Cell 2	Cell 2	
26	2043	12,545	5,978	4,182	251	251	22,706	646,773	Cell 2	Cell 2	
27	2044	13,178	5,978	4,393	264	264	23,549	670,322	Cell 2	Cell 2	
28	2045	13,816	5,978	4,605	276	276	24,400	694,722	Cell 2	Cell 2	
29	2046	14,460	5,978	4,820	289	289	25,259	719,981	Cell 2	Cell 2	
30	2047	15,110	5,978	5,037	302	302	26,125	746,106	Cell 2	Cell 2	
31	2048	15,765	5,978	5,255	315	315	26,999	773,105	Cell 2	Cell 2	
32	2049	16,426	5,978	5,475	329	329	27,880	800,985	Cell 2	Cell 2	
33	2050	17,093	5,978	5,698	342	342	28,769	829,754	Cell 2	Cell 2	
34	2051	17,766	5,978	5,922	355	355	29,667	859,421	Cell 2	Cell 2	
35	2052	18,445	5,978	6,148	369	369	30,572	889,993	Cell 2	Cell 2	
36	2053	19,130	5,978	6,377	383	383	31,485	921,478	Cell 2	Cell 2	
37	2054	19,821	5,978	6,607	396	396	32,406	953,884	Cell 2	Cell 2	
38	2055	20,518	5,978	6,839	410	410	33,335	987,219	Cell 2	Cell 2	
39	2056	21,221	5,978	7,074	424	424	34,273	1,021,492	Cell 2	Cell 2	
40	2057	21,931	5,978	7,310	439	439	35,219	1,056,711	Cell 2	Cell 2	
41	2058	22,646	5,978	7,549	453	453	36,173	1,092,885	Cell 2	Cell 2	
42	2059	23,368	5,978	7,789	467	467	37,136	1,130,021	Cell 2	Cell 2	
43	2060	24,097	5,978	8,032	482	482	38,108	1,168,128	Cell 2	Cell 2	
44	2061	24,832	5,978	8,277	497	497	39,087	1,207,216	Cell 2	Cell 2	
45	2062	25,573	5,978	8,524	511	511	40,076	1,247,292	Cell 2	Cell 2	
46	2063	26,322	5,978	8,774	526	526	41,074	1,288,366	Cell 2	Cell 2	
47	2064	27,076	5,978	9,025	542	542	42,080	1,330,446	Cell 2	Cell 2	
48	2065	27,838	5,978	9,279	557	557	43,095	1,373,541	Cell 2	Cell 2	
49	2066	28,606	5,978	9,535	572	572	44,120	1,417,661	Cell 2	Cell 2	
50	2067	29,381	5,978	9,794	588	588	45,153	1,462,814	Cell 2	Cell 2	

CVRD growth rate beyond 2041 = 1%
CVRD disposal rate 2009-2015= 0.60 *tonnes per person per year*
CVRD disposal rate 2016-20120= 0.57 *tonnes per person per year*
CVRD disposal rate 2021-2067= 0.40 *tonnes per person per year* *Reduction by 30%*
SRD growth rate beyond 2041 = 0.50%
SRDdisposal rate 2009-2015= 0.60 *tonnes per person per year*
SRD disposal rate 2016-20120= 0.57 *tonnes per person per year*
SRD disposal rate 2021-2067= 0.40 *tonnes per person per year* *Reduction by 30%*
Days of operation = 337 *days per year*
Bottom ash/residuals to landfill = 17% *% of input*

In-situ MSW waste density = 0.7 *tonnes per m^3*
Operational soil = 2% *of waste volume per year*
Waste to cover ratio = 3:1
Settlement = 2% *of waste volume per year*

In-situ ash / residuals waste density = 1.3 *tonnes per m^3*
In-situ MSW waste density = 0.7 *tonnes per m^3*
Operational soil = 2% *of waste volume per year*
Waste to cover ratio = 3:1
Settlement = 2% *of waste volume per year*

Table B7: Long Term Cost Model for Option 2(c) - EWS facility located in Gold River

Capital and Operating Costs

	Year	Comox Valley TS Capital	Comox Valley TS Operating	Comox Valley TS Transport	Campbell River TS Capital	Campbell River TS Operating	Campbell River TS Transport	Ash/residuals Transport from Gold River	EWS Facility Tipping Fees	CVWMC LF Capital - Expansion	CVWMC LF Capital - Minor Capital	CVWMC LF Capital - Closure	CVWMC LF Operating - Expansion	CVWMC LF Operating - Post-Closure	CRWMC LF Capital	CRWMC LF Operating	Total System	Comox Valley TS Notes	Campbell River TS Notes	EWS Facility Notes	CVWMC LF Notes	CRWMC LF Notes
	2015																$0		New Transfer station constructed 2012-2013			
	2016									$16,000,000							$16,000,000				Construction of leachate management system and Cell 1	
0	2017										$ 860,000	$ 265,000	$1,108,145		$250,868	$1,002,753	$3,487,000				Closure Phase 2	Phase 2 SW mgmt design & partial construction
1	2018										$ 200,000	$ 2,500,000	$1,108,145		$490,358	$1,002,753	$5,301,000				Closure Phase 2	Phase 2 Surface water management construction
2	2019										$ -		$1,108,145	$390,000	$191,695	$1,002,753	$2,693,000					Phase 2 Design and construction
3	2020	$311,025			$200,000				$726,800		$ 1,075,000		$1,108,145	$190,000	$491,790	$1,002,753	$4,794,000	Construct TS	New trailers every 8 years	Permits and land		Phase 2 LFG and final cover design
4	2021	$3,310,000	$709,508	$710,073			$0	$120,030	$4,096,005		$ 35,000		$585,536	$190,000	$5,630,329	$1,002,753	$13,079,000	New trailers every 8 years		EWS facility begins operating		Phase 2 LFG and final cover construction
5	2022		$709,508	$718,025			$0	$121,374	$4,141,876		$ -		$585,536	$190,000	$218,613	$1,002,753	$7,688,000					Phase 3 LFG and final cover design
6	2023		$709,508	$726,060			$0	$122,732	$4,188,224		$ 35,000		$585,536	$190,000	$3,108,685	$1,002,753	$10,668,000					Phase 3 LFG and final cover construction
7	2024		$709,508	$692,350		$651,040	$388,312	$208,929	$7,129,698		$ -		$585,536	$390,000		$190,000	$10,945,000					
8	2025		$709,508	$700,104		$651,040	$390,448	$210,745	$7,191,675		$ -		$585,536	$190,000		$190,000	$10,819,000					
9	2026		$709,508	$707,834		$651,040	$392,512	$212,540	$7,252,935		$ -		$585,536	$190,000		$190,000	$10,892,000					
10	2027		$709,508	$715,515		$651,040	$394,456	$214,299	$7,312,944		$ 585,000		$585,536	$190,000		$190,000	$11,548,000					
11	2028		$709,508	$723,141	$200,000	$651,040	$396,344	$216,035	$7,372,176		$ -		$585,536	$190,000		$190,000	$11,234,000		New trailers every 8 years			
12	2029	$200,000	$709,508	$729,870		$651,040	$398,184	$217,608	$7,425,856		$ 385,000		$585,536	$390,000		$190,000	$11,683,000	New trailers every 8 years				
13	2030		$709,508	$727,418		$651,040	$399,936	$217,608	$7,425,856		$ 175,000		$585,536	$190,000		$190,000	$11,272,000					
14	2031		$709,508	$725,054		$651,040	$401,624	$217,608	$7,425,856		$ -		$585,536	$190,000		$190,000	$11,096,000					
15	2032		$709,508	$722,792	$346,000	$651,040	$403,240	$217,608	$7,425,856		$ -		$585,536	$190,000		$190,000	$11,442,000					
16	2033		$709,508	$720,608		$651,040	$404,800	$217,608	$7,425,856		$ 235,000		$585,536	$190,000		$190,000	$11,330,000					
17	2034		$709,508	$718,648		$651,040	$406,200	$217,608	$7,425,856		$ -		$585,536	$390,000		$190,000	$11,294,000					
18	2035		$709,508	$716,755		$651,040	$407,552	$217,608	$7,425,856		$ 935,000		$585,536	$190,000		$190,000	$12,029,000					
19	2036		$709,508	$714,896	$200,000	$651,040	$408,880	$217,608	$7,425,856		$ -		$585,536	$190,000		$190,000	$11,293,000		New trailers every 8 years			
20	2037	$200,000	$709,508	$713,160		$651,040	$410,120	$217,608	$7,425,856	$8,850,000	$ 550,000		$710,536	$190,000		$190,000	$20,618,000	New trailers every 8 years			Construction Cell 2	
21	2038		$709,508	$711,525		$651,040	$411,288	$217,608	$7,425,856		$ -		$710,536	$190,000		$190,000	$11,217,000					
22	2039		$709,508	$709,957		$651,040	$412,408	$217,608	$7,425,856		$ 35,000	$ 1,350,000	$710,536	$390,000		$190,000	$12,802,000				Closure Cell 1	
23	2040		$709,508	$708,445		$651,040	$413,488	$217,608	$7,425,856		$ 175,000		$710,536	$190,000		$190,000	$11,391,000	Major capital upgrade every 20 years				
24	2041	$1,555,125	$709,508	$706,933		$651,040	$414,568	$217,608	$7,425,856		$ 385,000		$710,536	$190,000		$190,000	$11,601,000					
25	2042		$709,508	$704,031		$651,040	$416,641	$217,608	$7,425,856		$ -		$710,536	$190,000		$190,000	$11,215,000					
26	2043		$709,508	$701,114		$651,040	$418,724	$217,608	$7,425,856		$ 200,000		$710,536	$190,000		$190,000	$11,414,000					
27	2044		$709,508	$698,183	$200,000	$651,040	$420,818	$217,608	$7,425,856		$ -		$710,536	$390,000		$190,000	$11,614,000		New trailers every 8 years			
28	2045	$200,000	$709,508	$695,238		$651,040	$422,922	$217,608	$7,425,856		$ 35,000		$710,536	$190,000		$190,000	$11,248,000	New trailers every 8 years				
29	2046		$709,508	$692,277		$651,040	$425,036	$217,608	$3,866,626		$ -		$710,536	$190,000		$190,000	$7,653,000			Amotization period over		
30	2047		$709,508	$689,302		$651,040	$427,162	$217,608	$3,866,626		$ 585,000		$710,536	$190,000		$190,000	$8,237,000					
31	2048		$709,508	$686,312		$651,040	$429,297	$217,608	$3,866,626		$ -		$710,536	$190,000		$190,000	$7,651,000					
32	2049		$709,508	$683,307		$651,040	$431,444	$217,608	$3,866,626		$ -		$710,536	$390,000		$190,000	$7,850,000					
33	2050		$709,508	$680,287		$651,040	$433,601	$217,608	$3,866,626		$ 1,075,000		$710,536	$190,000		$190,000	$8,724,000					
34	2051		$709,508	$677,251	$241,000	$651,040	$435,769	$217,608	$3,866,626		$ 35,000		$710,536	$190,000		$190,000	$7,924,000					
35	2052		$709,508	$674,201	$2,615,000	$651,040	$437,948	$217,608	$3,866,626		$ -		$710,536	$190,000		$190,000	$10,262,000		New trailers every 8 years			
36	2053	$200,000	$709,508	$671,135		$651,040	$440,138	$217,608	$3,866,626		$ 585,000		$710,536	$190,000		$190,000	$8,232,000	New trailers every 8 years				
37	2054		$709,508	$668,054		$651,040	$442,338	$217,608	$3,866,626		$ -		$710,536	$390,000		$190,000	$7,846,000					
38	2055		$709,508	$664,958		$651,040	$444,550	$217,608	$3,866,626		$ -		$710,536	$190,000		$190,000	$7,645,000					
39	2056		$709,508	$661,846		$651,040	$446,773	$217,608	$3,866,626		$ -		$710,536	$190,000		$190,000	$7,644,000					
40	2057		$709,508	$658,719		$651,040	$449,007	$217,608	$3,866,626		$ 585,000		$710,536	$190,000		$190,000	$8,228,000					
41	2058		$709,508	$655,576		$651,040	$451,252	$217,608	$3,866,626		$ -		$710,536	$190,000		$190,000	$7,642,000					
42	2059		$709,508	$652,417		$651,040	$453,508	$217,608	$3,866,626		$ 35,000		$710,536	$390,000		$190,000	$7,876,000					
43	2060		$709,508	$649,242	$200,000	$651,040	$455,775	$217,608	$3,866,626		$ 175,000		$710,536	$190,000		$190,000	$8,015,000	Major capital upgrade every 20 years	New trailers every 8 years			
44	2061	$1,755,125	$709,508	$646,052		$651,040	$458,054	$217,608	$3,866,626		$ -		$710,536	$190,000		$190,000	$7,639,000	New trailers every 8 years				
45	2062		$709,508	$642,846		$651,040	$460,345	$217,608	$3,866,626		$ -		$710,536	$190,000		$190,000	$7,639,000					
46	2063		$709,508	$639,623		$651,040	$462,646	$217,608	$3,866,626		$ 235,000		$710,536	$190,000		$190,000	$7,873,000					
47	2064		$709,508	$636,385		$651,040	$464,960	$217,608	$3,866,626		$ -		$710,536	$390,000		$190,000	$7,837,000					
48	2065		$709,508	$633,130		$651,040	$467,284	$217,608	$3,866,626		$ 1,285,000		$710,536	$190,000		$190,000	$8,921,000					
49	2066		$709,508	$629,859		$651,040	$469,621	$217,608	$3,866,626		$ -		$710,536	$190,000		$190,000	$7,635,000					
50	2067		$709,508	$626,572		$651,040	$471,969	$217,608	$3,866,626		$ 550,000		$710,536	$190,000		$190,000	$8,184,000					
	Totals	$7,731,275	$33,346,853	$32,337,078	$4,202,000	$28,645,760	$18,791,941	$9,913,381	$260,717,650	$8,850,000	$11,045,000	$4,115,000	$35,827,788	$11,310,000	$10,382,338	$15,379,269	$484,864,000					

EWS Facility Tipping Fee (1st 25 years) = *$162* per tonne

EWS Facility Tipping Fee (2nd 25 years) = *$84* per tonne

30 years
$323,597,000 1,651,117 tonnes
$196 per tonne over 30 years

40 years
$405,603,000 2,242,559 tonnes
$181 per tonne over 40 years

50 years
$484,864,000 2,884,138 tonnes
$168 per tonne over 50 years

Table B8: Long Term Cost Model for Option 3(a) - Sustane facility located in Comox Valley

Population and Disposal Rates

	Year	Projected CVRD Population	CVRD Waste	Projected SRD Population	SRD Waste	Total Annual Tonnage	Daily Tonnage	Combined Population	Tonnes to Comox Valley TS	Tonnes to Campbell River TS	Tonnes to Sustane Facility	Tonnes per day to Sustane facility	Tonnes MSW to CRWMC LF	Tonnes to MSW CVWMC LF	Tonnes Ash/Residuals to CVWMC LF
			tonnes		tonnes	tonnes / yr	tonnes / day		tonnes	tonnes	tonnes	tonnes / day		tonnes	
	2015	64,294	38,576	45,871	27,523	66,099	181	91,817					27,523	38,576	
	2016	64,847	36,963	46,187	26,327	63,289	173	91,174					26,327	36,963	
0	2017	65,592	37,387	46,490	26,499	63,887	175	92,091					26,499	37,387	0
1	2018	66,372	37,832	46,809	26,681	64,513	177	93,053					26,681	37,832	0
2	2019	67,139	38,269	47,116	26,856	65,125	178	93,995					26,856	38,269	0
3	2020	67,905	38,706	47,419	27,029	65,735	180	94,934					27,029	38,706	0
4	2021	68,667	27,467	47,706	19,082	46,549	128	87,749			26,338	80	19,082	1,129	2,875
5	2022	69,436	27,774	47,986	19,194	46,969	129	88,630			26,633	81	19,194	1,141	2,907
6	2023	70,213	28,085	48,267	19,307	47,392	130	89,520		Landfill closure	26,931	82	19,307	1,154	2,940
7	2024	70,986	28,394	48,539	19,416	47,810	131	90,402		19,416	45,845	139		1,965	5,004
8	2025	71,758	28,703	48,806	19,522	48,226	132	91,280		19,522	45,976	139		2,250	5,019
9	2026	72,527	29,011	49,064	19,626	48,636	133	92,153		19,626	45,976	139		2,660	5,019
10	2027	73,290	29,316	49,307	19,723	49,039	134	93,013		19,723	45,976	139		3,063	5,019
11	2028	74,047	29,619	49,543	19,817	49,436	135	93,864		19,817	45,976	139		3,460	5,019
12	2029	74,795	29,918	49,773	19,909	49,827	137	94,704		19,909	45,976	139		3,851	5,019
13	2030	75,531	30,212	49,992	19,997	50,209	138	95,528		19,997	45,976	139		4,233	5,019
14	2031	76,255	30,502	50,203	20,081	50,583	139	96,336		20,081	45,976	139		4,607	5,019
15	2032	76,971	30,788	50,405	20,162	50,950	140	97,133		20,162	45,976	139		4,974	5,019
16	2033	77,681	31,072	50,600	20,240	51,312	141	97,921		20,240	45,976	139		5,336	5,019
17	2034	78,366	31,346	50,775	20,310	51,656	142	98,676		20,310	45,976	139		5,680	5,019
18	2035	79,039	31,616	50,944	20,378	51,993	142	99,417		20,378	45,976	139		6,017	5,019
19	2036	79,710	31,884	51,110	20,444	52,328	143	100,154		20,444	45,976	139		6,352	5,019
20	2037	80,366	32,146	51,265	20,506	52,652	144	100,872		20,506	45,976	139		6,676	5,019
21	2038	81,010	32,404	51,411	20,564	52,968	145	101,574		20,564	45,976	139		6,992	5,019
22	2039	81,643	32,657	51,551	20,620	53,278	146	102,263		20,620	45,976	139		7,302	5,019
23	2040	82,270	32,908	51,686	20,674	53,582	147	102,944		20,674	45,976	139		7,606	5,019
24	2041	82,888	33,155	51,821	20,728	53,884	148	103,616		20,728	45,976	139		7,908	5,019
25	2042	83,717	33,487	52,080	20,832	54,319	149	104,549		20,832	45,976	139		8,343	5,019
26	2043	84,554	33,822	52,341	20,936	54,758	150	105,490		20,936	45,976	139		8,782	5,019
27	2044	85,400	34,160	52,602	21,041	55,201	151	106,440		21,041	45,976	139		9,225	5,019
28	2045	86,254	34,501	52,865	21,146	55,648	152	107,400		21,146	45,976	139		9,672	5,019
29	2046	87,116	34,846	53,130	21,252	56,098	154	108,368		21,252	45,976	139		10,122	5,019
30	2047	87,987	35,195	53,395	21,358	56,553	155	109,345		21,358	45,976	139		10,577	5,019
31	2048	88,867	35,547	53,662	21,465	57,012	156	110,332		21,465	45,976	139		11,036	5,019
32	2049	89,756	35,902	53,930	21,572	57,475	157	111,328		21,572	45,976	139		11,499	5,019
33	2050	90,653	36,261	54,200	21,680	57,941	159	112,333		21,680	45,976	139		11,965	5,019
34	2051	91,560	36,624	54,471	21,788	58,412	160	113,348		21,788	45,976	139		12,436	5,019
35	2052	92,476	36,990	54,743	21,897	58,888	161	114,373		21,897	45,976	139		12,912	5,019
36	2053	93,400	37,360	55,017	22,007	59,367	163	115,407		22,007	45,976	139		13,391	5,019
37	2054	94,334	37,734	55,292	22,117	59,851	164	116,451		22,117	45,976	139		13,875	5,019
38	2055	95,278	38,111	55,569	22,228	60,339	165	117,505		22,228	45,976	139		14,363	5,019
39	2056	96,230	38,492	55,847	22,339	60,831	167	118,569		22,339	45,976	139		14,855	5,019
40	2057	97,193	38,877	56,126	22,450	61,327	168	119,643		22,450	45,976	139		15,351	5,019
41	2058	98,165	39,266	56,406	22,563	61,828	169	120,727		22,563	45,976	139		15,852	5,019
42	2059	99,146	39,659	56,688	22,675	62,334	171	121,822		22,675	45,976	139		16,358	5,019
43	2060	100,138	40,055	56,972	22,789	62,844	172	122,927		22,789	45,976	139		16,868	5,019
44	2061	101,139	40,456	57,257	22,903	63,358	174	124,042		22,903	45,976	139		17,382	5,019
45	2062	102,151	40,860	57,543	23,017	63,877	175	125,168		23,017	45,976	139		17,901	5,019
46	2063	103,172	41,269	57,831	23,132	64,401	176	126,304		23,132	45,976	139		18,425	5,019
47	2064	104,204	41,681	58,120	23,248	64,929	178	127,452		23,248	45,976	139		18,953	5,019
48	2065	105,246	41,698	58,411	23,364	65,463	179	128,610		23,364	45,976	139		19,487	5,019
49	2066	106,298	42,519	58,703	23,481	66,000	181	129,779		23,481	45,976	139		20,024	5,019
50	2067	107,361	42,944	58,996	23,598	66,543	182	130,960		23,598	45,976	139		20,567	5,019
	Totals	4,465,392	1,855,431	2,772,844	1,158,095	3,013,526		5,623,487	0	939,597	2,102,715		218,498	692,313	229,525

CRWMC LF Fill Rate and Capacity

	Year	Volumetric MSW Disposal Rate	Daily Cover Soil	Operational Soil	Settlement	Net Fill Volume	Cumulative Fill Volume	Phase	Volumetric Capacity (m³)
		m³	m³	m³	m³	m³	m³		
	2015	39,318	13,106	786	786	52,424			
	2016	37,609	12,536	752	752	50,146		Phase 3	
0	2017	37,856	12,619	757	757	50,475	50,475	Phase 3	
1	2018	38,116	12,705	762	762	50,821	101,296	Phase 3	
2	2019	38,366	12,789	767	767	51,155	152,451	Phase 3	
3	2020	38,613	12,871	772	772	51,483	203,934	Phase 3	
4	2021	27,261	9,087	545	545	36,347	240,281	Phase 3	
5	2022	27,421	9,140	548	548	36,561	276,842	Phase 3	
6	2023	27,581	9,194	552	552	36,775	313,617	Closed	**288,480**
7	2024	0	0	0	0	0	313,617	Closed	
8	2025	0	0	0	0	0	313,617	Closed	
9	2026	0	0	0	0	0	313,617	Closed	
10	2027	0	0	0	0	0	313,617	Closed	
11	2028	0	0	0	0	0	313,617	Closed	
12	2029	0	0	0	0	0	313,617	Closed	
13	2030	0	0	0	0	0	313,617	Closed	
14	2031	0	0	0	0	0	313,617	Closed	
15	2032	0	0	0	0	0	313,617	Closed	
16	2033	0	0	0	0	0	313,617	Closed	
17	2034	0	0	0	0	0	313,617	Closed	
18	2035	0	0	0	0	0	313,617	Closed	
19	2036	0	0	0	0	0	313,617	Closed	
20	2037	0	0	0	0	0	313,617	Closed	
21	2038	0	0	0	0	0	313,617	Closed	
22	2039	0	0	0	0	0	313,617	Closed	
23	2040	0	0	0	0	0	313,617	Closed	
24	2041	0	0	0	0	0	313,617	Closed	
25	2042	0	0	0	0	0	313,617	Closed	
26	2043	0	0	0	0	0	313,617	Closed	
27	2044	0	0	0	0	0	313,617	Closed	
28	2045	0	0	0	0	0	313,617	Closed	
29	2046	0	0	0	0	0	313,617	Closed	
30	2047	0	0	0	0	0	313,617	Closed	
31	2048	0	0	0	0	0	313,617	Closed	
32	2049	0	0	0	0	0	313,617	Closed	
33	2050	0	0	0	0	0	313,617	Closed	
34	2051	0	0	0	0	0	313,617	Closed	
35	2052	0	0	0	0	0	313,617	Closed	
36	2053	0	0	0	0	0	313,617	Closed	
37	2054	0	0	0	0	0	313,617	Closed	
38	2055	0	0	0	0	0	313,617	Closed	
39	2056	0	0	0	0	0	313,617	Closed	
40	2057	0	0	0	0	0	313,617	Closed	
41	2058	0	0	0	0	0	313,617	Closed	
42	2059	0	0	0	0	0	313,617	Closed	
43	2060	0	0	0	0	0	313,617	Closed	
44	2061	0	0	0	0	0	313,617	Closed	
45	2062	0	0	0	0	0	313,617	Closed	
46	2063	0	0	0	0	0	313,617	Closed	
47	2064	0	0	0	0	0	313,617	Closed	
48	2065	0	0	0	0	0	313,617	Closed	
49	2066	0	0	0	0	0	313,617	Closed	
50	2067	0	0	0	0	0	313,617	Closed	

CVWMC LF Fill Rate and Capacity

	Year	Volumetric MSW Disposal Rate	Volumetric Ash / Residuals Disposal Rate	Daily Cover Soil	Operational Soil	Settlement	Net Fill Volume	Cumulative Fill Volume	Phase / Cell	Phase / Cell	Volumetric Capacity (m³)
		m³	m³	m³	m³	m³	m³	m³			
	2015	55,109		18,370	1,102	1,102	73,479				
	2016	52,804		17,601	1,056	1,056	70,405		Phase 2	Phase 2	**46,525**
0	2017	53,411	0	17,804	1,068	1,068	71,214	71,214	Cell 1	Phase 2	
1	2018	54,046	0	18,015	1,081	1,081	72,061	143,275	Cell 1	Cell 1	
2	2019	54,670	0	18,223	1,093	1,093	72,894	216,169	Cell 1	Cell 1	
3	2020	55,294	0	18,431	1,106	1,106	73,725	289,894	Cell 1	Cell 1	
4	2021	1,613	2,875	538	32	32	5,025	294,919	Cell 1	Cell 1	
5	2022	1,631	2,907	544	33	33	5,081	300,001	Cell 1	Cell 1	
6	2023	1,649	2,940	550	33	33	5,138	305,139	Cell 1	Cell 1	
7	2024	2,807	5,004	936	56	56	8,747	313,886	Cell 1	Cell 1	
8	2025	3,214	5,019	1,071	64	64	9,304	323,189	Cell 1	Cell 1	
9	2026	3,801	5,019	1,267	76	76	10,086	333,275	Cell 1	Cell 1	
10	2027	4,375	5,019	1,458	88	88	10,852	344,128	Cell 1	Cell 1	
11	2028	4,943	5,019	1,648	99	99	11,609	355,737	Cell 1	Cell 1	
12	2029	5,502	5,019	1,834	110	110	12,354	368,091	Cell 1	Cell 1	
13	2030	6,047	5,019	2,016	121	121	13,082	381,173	Cell 1	Cell 1	
14	2031	6,582	5,019	2,194	132	132	13,794	394,967	Cell 1	Cell 1	
15	2032	7,106	5,019	2,369	142	142	14,494	409,461	Cell 1	Cell 1	
16	2033	7,623	5,019	2,541	152	152	15,183	424,644	Cell 1	Cell 1	
17	2034	8,115	5,019	2,705	162	162	15,838	440,482	Cell 1	Cell 1	
18	2035	8,596	5,019	2,865	172	172	16,480	456,962	Cell 1	Cell 1	
19	2036	9,074	5,019	3,025	181	181	17,118	474,080	Cell 1	Cell 1	
20	2037	9,538	5,019	3,179	191	191	17,736	491,815	Cell 1	Cell 1	
21	2038	9,989	5,019	3,330	200	200	18,337	510,153	Cell 1	Cell 1	
22	2039	10,431	5,019	3,477	209	209	18,926	529,079	Cell 2	Cell 1	**517,470**
23	2040	10,866	5,019	3,622	217	217	19,507	548,586	Cell 2	Cell 2	
24	2041	11,297	5,019	3,766	226	226	20,081	568,667	Cell 2	Cell 2	
25	2042	11,918	5,019	3,973	238	238	20,910	589,576	Cell 2	Cell 2	
26	2043	12,545	5,019	4,182	251	251	21,746	611,322	Cell 2	Cell 2	
27	2044	13,178	5,019	4,393	264	264	22,589	633,912	Cell 2	Cell 2	
28	2045	13,816	5,019	4,605	276	276	23,441	657,352	Cell 2	Cell 2	
29	2046	14,460	5,019	4,820	289	289	24,299	681,651	Cell 2	Cell 2	
30	2047	15,110	5,019	5,037	302	302	25,165	706,816	Cell 2	Cell 2	
31	2048	15,765	5,019	5,255	315	315	26,039	732,855	Cell 2	Cell 2	
32	2049	16,426	5,019	5,475	329	329	26,921	759,776	Cell 2	Cell 2	
33	2050	17,093	5,019	5,698	342	342	27,810	787,586	Cell 2	Cell 2	
34	2051	17,766	5,019	5,922	355	355	28,707	816,293	Cell 2	Cell 2	
35	2052	18,445	5,019	6,148	369	369	29,612	845,905	Cell 2	Cell 2	
36	2053	19,130	5,019	6,377	383	383	30,525	876,430	Cell 2	Cell 2	
37	2054	19,821	5,019	6,607	396	396	31,446	907,877	Cell 2	Cell 2	
38	2055	20,518	5,019	6,839	410	410	32,376	940,252	Cell 2	Cell 2	
39	2056	21,221	5,019	7,074	424	424	33,313	973,566	Cell 2	Cell 2	
40	2057	21,931	5,019	7,310	439	439	34,259	1,007,825	Cell 2	Cell 2	
41	2058	22,646	5,019	7,549	453	453	35,214	1,043,039	Cell 2	Cell 2	
42	2059	23,368	5,019	7,789	467	467	36,176	1,079,215	Cell 2	Cell 2	
43	2060	24,097	5,019	8,032	482	482	37,148	1,116,363	Cell 2	Cell 2	
44	2061	24,832	5,019	8,277	497	497	38,128	1,154,491	Cell 2	Cell 2	
45	2062	25,573	5,019	8,524	511	511	39,117	1,193,608	Cell 2	Cell 2	
46	2063	26,322	5,019	8,774	526	526	40,114	1,233,722	Cell 2	Cell 2	
47	2064	27,076	5,019	9,025	542	542	41,120	1,274,842	Cell 2	Cell 2	
48	2065	27,838	5,019	9,279	557	557	42,136	1,316,978	Cell 2	Cell 2	
49	2066	28,606	5,019	9,535	572	572	43,160	1,360,138	Cell 2	Cell 2	
50	2067	29,381	5,019	9,794	588	588	44,194	1,404,332	Cell 2	Cell 2	

CVRD growth rate beyond 2041 = 1%
CVRD disposal rate 2009-2015= 0.60 tonnes per person per year
CVRD disposal rate 2016-20120= 0.57 tonnes per person per year
CVRD disposal rate 2021-2067= 0.40 tonnes per person per year *Reduction by 30%*
SRD growth rate beyond 2041 = 0.50%
SRDdisposal rate 2009-2015= 0.60 tonnes per person per year
SRD disposal rate 2016-20120= 0.57 tonnes per person per year
SRD disposal rate 2021-2067= 0.40 tonnes per person per year *Reduction by 30%*
Days of operation = 350 *days per year*
Bottom ash/residuals to landfill = 11% *% of input*

In-situ MSW waste density = 0.7 *tonnes per m³*
Operational soil = 2% *of waste volume per year*
Waste to cover ratio = 3:1
Settlement = 2% *of waste volume per year*

In-situ ash / residuals waste density = 1 *tonnes per m³*
In-situ MSW waste density = 0.7 *tonnes per m³*
Operational soil = 2% *of waste volume per year*
Waste to cover ratio = 3:1
Settlement = 2% *of waste volume per year*

Table B8: Long Term Cost Model for Option 3(a) - Sustane facility located in Comox Valley

Capital and Operating Costs

	Year	Campbell River TS Capital	Campbell River TS Operating	Campbell River TS Transport	Sustane Facility Tipping Fees	CVWMC LF Capital - Expansion	CVWMC LF Capital - Minor Capital	CVWMC LF Capital - Closure	CVWMC LF Operating - Expansion	CVWMC LF Operating - Post-Closure	CRWMC LF Capital	CRWMC LF Operating	Total System	Campbell River TS Notes	Comox Valley TS Notes	Sustane Facility Notes	CVWMC LF Notes	CRWMC LF Notes
	2015												$0					
	2016					$16,000,000							$16,000,000	New Transfer station constructed 2012-2013			Construction of leachate management system and Cell 1	
0	2017						$ 860,000	$ 265,000	$1,108,145		$250,868	$1,002,753	$3,487,000				Closure Phase 2	Phase 2 SW mgmt design & partial construction
1	2018						$ 200,000	$ 2,500,000	$1,108,145		$490,358	$1,002,753	$5,301,000				Closure Phase 2	Phase 2 Surface water management construction
2	2019						$ -		$1,108,145	$390,000	$191,695	$1,002,753	$2,693,000					Phase 2 Design and construction
3	2020	$200,000			$1,805,696		$ 1,075,000		$1,108,145	$190,000	$491,790	$1,002,753	$5,873,000	New trailers every 8 years		Permits and land		Phase 2 LFG and final cover design
4	2021				$2,356,647		$ 35,000		$585,536	$190,000	$5,630,329	$1,002,753	$9,800,000			Sustane facility begins operating		Phase 2 LFG and final cover construction
5	2022				$2,383,039		$ -		$585,536	$190,000	$218,613	$1,002,753	$4,380,000					Phase 3 LFG and final cover design
6	2023				$2,409,706		$ 35,000		$585,536	$190,000	$3,108,685	$1,002,753	$7,332,000					Phase 3 LFG and final cover construction
7	2024		$651,040	$287,351	$4,102,091		$ -		$585,536	$390,000		$190,000	$6,206,000					
8	2025		$651,040	$288,932	$4,113,794		$ -		$585,536	$190,000		$190,000	$6,019,000					
9	2026		$651,040	$290,459	$4,113,794		$ -		$585,536	$190,000		$190,000	$6,021,000					
10	2027		$651,040	$291,897	$4,113,794		$ 585,000		$585,536	$190,000		$190,000	$6,607,000					
11	2028	$200,000	$651,040	$293,295	$4,113,794		$ -		$585,536	$190,000		$190,000	$6,224,000	New trailers every 8 years				
12	2029		$651,040	$294,656	$4,113,794		$ 385,000		$585,536	$390,000		$190,000	$6,610,000					
13	2030		$651,040	$295,953	$4,113,794		$ 175,000		$585,536	$190,000		$190,000	$6,201,000					
14	2031		$651,040	$297,202	$4,113,794		$ -		$585,536	$190,000		$190,000	$6,028,000					
15	2032	$346,000	$651,040	$298,398	$4,113,794		$ -		$585,536	$190,000		$190,000	$6,375,000	Transfer station - parking and roads (20 yr life) + capital upgrades				
16	2033		$651,040	$299,552	$4,113,794		$ 235,000		$585,536	$190,000		$190,000	$6,265,000					
17	2034		$651,040	$300,588	$4,113,794		$ -		$585,536	$390,000		$190,000	$6,231,000					
18	2035		$651,040	$301,588	$4,113,794		$ 935,000		$585,536	$190,000		$190,000	$6,967,000					
19	2036	$200,000	$651,040	$302,571	$4,113,794		$ -		$585,536	$190,000		$190,000	$6,233,000	New trailers every 8 years				
20	2037		$651,040	$303,489	$4,113,794		$ 550,000		$585,536	$190,000		$190,000	$6,584,000					
21	2038		$651,040	$304,353	$4,113,794		$ -		$585,536	$190,000		$190,000	$6,035,000					
22	2039		$651,040	$305,182	$4,113,794	$8,850,000	$ 35,000		$585,536	$390,000		$190,000	$15,121,000				Construction Cell 2	
23	2040		$651,040	$305,981	$4,113,794		$ 175,000		$710,536	$190,000		$190,000	$6,336,000					
24	2041		$651,040	$306,780	$4,113,794		$ 385,000	$ 1,350,000	$710,536	$190,000		$190,000	$7,897,000				Closure Cell 1	
25	2042		$651,040	$308,314	$4,113,794		$ -		$710,536	$190,000		$190,000	$6,164,000					
26	2043		$651,040	$309,856	$4,113,794		$ 200,000		$710,536	$190,000		$190,000	$6,365,000					
27	2044	$200,000	$651,040	$311,405	$4,113,794		$ -		$710,536	$390,000		$190,000	$6,567,000	New trailers every 8 years				
28	2045		$651,040	$312,962	$4,113,794		$ 35,000		$710,536	$190,000		$190,000	$6,203,000			Amotization period over		
29	2046		$651,040	$314,527	$2,424,713		$ -		$710,536	$190,000		$190,000	$4,481,000					
30	2047		$651,040	$316,100	$2,424,713		$ 585,000		$710,536	$190,000		$190,000	$5,067,000					
31	2048		$651,040	$317,680	$2,424,713		$ -		$710,536	$190,000		$190,000	$4,484,000					
32	2049		$651,040	$319,268	$2,424,713		$ -		$710,536	$390,000		$190,000	$4,686,000					
33	2050		$651,040	$320,865	$2,424,713		$ 1,075,000		$710,536	$190,000		$190,000	$5,562,000					
34	2051	$241,000	$651,040	$322,469	$2,424,713		$ 35,000		$710,536	$190,000		$190,000	$4,765,000	Transfer station permits etc				
35	2052	$2,615,000	$651,040	$324,081	$2,424,713		$ -		$710,536	$190,000		$190,000	$7,105,000	Transfer station - new facilty + new trailers	Locate, site and permit perm TS			
36	2053		$651,040	$325,702	$2,424,713		$ 585,000		$710,536	$190,000		$190,000	$5,077,000		Construct perm TS			
37	2054		$651,040	$327,330	$2,424,713		$ -		$710,536	$390,000		$190,000	$4,694,000		Off island export begins @ $100/tonne			
38	2055		$651,040	$328,967	$2,424,713		$ -		$710,536	$190,000		$190,000	$4,495,000					
39	2056		$651,040	$330,612	$2,424,713		$ -		$710,536	$190,000		$190,000	$4,497,000					
40	2057		$651,040	$332,265	$2,424,713		$ 585,000		$710,536	$190,000		$190,000	$5,084,000					
41	2058		$651,040	$333,926	$2,424,713		$ -		$710,536	$190,000		$190,000	$4,500,000					
42	2059		$651,040	$335,596	$2,424,713		$ 35,000		$710,536	$390,000		$190,000	$4,737,000					
43	2060	$200,000	$651,040	$337,274	$2,424,713		$ 175,000		$710,536	$190,000		$190,000	$4,879,000	New trailers every 8 years				
44	2061		$651,040	$338,960	$2,424,713		$ -		$710,536	$190,000		$190,000	$4,505,000		New trailers every 8 years			
45	2062		$651,040	$340,655	$2,424,713		$ -		$710,536	$190,000		$190,000	$4,507,000					
46	2063		$651,040	$342,358	$2,424,713		$ 235,000		$710,536	$190,000		$190,000	$4,744,000					
47	2064		$651,040	$344,070	$2,424,713		$ -		$710,536	$390,000		$190,000	$4,710,000					
48	2065		$651,040	$345,790	$2,424,713		$ 1,285,000		$710,536	$190,000		$190,000	$5,797,000					
49	2066		$651,040	$347,519	$2,424,713		$ -		$710,536	$190,000		$190,000	$4,514,000					
50	2067		$651,040	$349,257	$2,424,713		$ 550,000		$710,536	$190,000		$190,000	$5,066,000					
	Totals	$4,202,000	$28,645,760	$13,906,036	$152,790,551	$8,850,000	$11,045,000	$4,115,000	$35,452,788	$11,310,000	$10,382,338	$15,379,269	$296,081,000					

Sustane Facility Tipping Fee (1st 25 years) = *$89* per tonne

Sustane Facility Tipping Fee (2nd 25 years) = *$53* per tonne

30 years
$197,673,000 1,651,117 tonnes
$120 per tonne over 30 years

40 years
$248,122,000 2,242,559 tonnes
$111 per tonne over 40 years

50 years
$296,081,000 2,884,138 tonnes
$103 per tonne over 50 years

Table B9: Long Term Cost Model for Option 3(b) - Sustane facility located in Campbell River

Population and Disposal Rates

	Year	Projected CVRD Population	CVRD Waste	Projected SRD Population	SRD Waste	Total Annual Tonnage	Daily Tonnage	Combined Population	Tonnes to Comox Valley TS	Tonnes to Campbell River TS	Tonnes to Sustane Facility	Tonnes per day to Sustane facility	Tonnes MSW to CRWMC LF	Tonnes to MSW CVWMC LF	Tonnes Ash/Residuals to CVWMC LF
			tonnes		tonnes	tonnes / yr	tonnes / day		tonnes	tonnes	tonnes	tonnes / day		tonnes	
	2015	64,294	38,576	45,871	27,523	66,099	181	91,817					27,523	38,576	
	2016	64,847	36,963	46,187	26,327	63,289	173	91,174					26,327	36,963	
0	2017	65,592	37,387	46,490	26,499	63,887	175	92,091					26,499	37,387	0
1	2018	66,372	37,832	46,809	26,681	64,513	177	93,053					26,681	37,832	0
2	2019	67,139	38,269	47,116	26,856	65,125	178	93,995					26,856	38,269	0
3	2020	67,905	38,706	47,419	27,029	65,735	180	94,934					27,029	38,706	0
4	2021	68,667	27,467	47,706	19,082	46,549	128	87,749	26,413		26,413	80	19,082	1,054	2,883
5	2022	69,436	27,774	47,986	19,194	46,969	129	88,630	26,709		26,709	81	19,194	1,065	2,915
6	2023	70,213	28,085	48,267	19,307	47,392	130	89,520	27,008	Landfill closur	27,008	82	19,307	1,077	2,948
7	2024	70,986	28,394	48,539	19,416	47,810	131	90,402	26,561		45,976	139		1,834	5,019
8	2025	71,758	28,703	48,806	19,522	48,226	132	91,280	26,454		45,976	139		2,249	5,019
9	2026	72,527	29,011	49,064	19,626	48,636	133	92,153	26,351		45,976	139		2,660	5,019
10	2027	73,290	29,316	49,307	19,723	49,039	134	93,013	26,253		45,976	139		3,063	5,019
11	2028	74,047	29,619	49,543	19,817	49,436	135	93,864	26,159		45,976	139		3,460	5,019
12	2029	74,795	29,918	49,773	19,909	49,827	137	94,704	26,067		45,976	139		3,851	5,019
13	2030	75,531	30,212	49,992	19,997	50,209	138	95,528	25,979		45,976	139		4,233	5,019
14	2031	76,255	30,502	50,203	20,081	50,583	139	96,336	25,895		45,976	139		4,607	5,019
15	2032	76,971	30,788	50,405	20,162	50,950	140	97,133	25,814		45,976	139		4,974	5,019
16	2033	77,681	31,072	50,600	20,240	51,312	141	97,921	25,736		45,976	139		5,336	5,019
17	2034	78,366	31,346	50,775	20,310	51,656	142	98,676	25,666		45,976	139		5,680	5,019
18	2035	79,039	31,616	50,944	20,378	51,993	142	99,417	25,599		45,976	139		6,017	5,019
19	2036	79,710	31,884	51,110	20,444	52,328	143	100,154	25,532		45,976	139		6,352	5,019
20	2037	80,366	32,146	51,265	20,506	52,652	144	100,872	25,470		45,976	139		6,676	5,019
21	2038	81,010	32,404	51,411	20,564	52,968	145	101,574	25,412		45,976	139		6,992	5,019
22	2039	81,643	32,657	51,551	20,620	53,278	146	102,263	25,356		45,976	139		7,301	5,019
23	2040	82,270	32,908	51,686	20,674	53,582	147	102,944	25,302		45,976	139		7,606	5,019
24	2041	82,888	33,155	51,821	20,728	53,884	148	103,616	25,248		45,976	139		7,907	5,019
25	2042	83,717	33,487	52,080	20,832	54,319	149	104,549	25,144		45,976	139		8,343	5,019
26	2043	84,554	33,822	52,341	20,936	54,758	150	105,490	25,040		45,976	139		8,782	5,019
27	2044	85,400	34,160	52,602	21,041	55,201	151	106,440	24,935		45,976	139		9,225	5,019
28	2045	86,254	34,501	52,865	21,146	55,648	152	107,400	24,830		45,976	139		9,671	5,019
29	2046	87,116	34,846	53,130	21,252	56,098	154	108,368	24,724		45,976	139		10,122	5,019
30	2047	87,987	35,195	53,395	21,358	56,553	155	109,345	24,618		45,976	139		10,577	5,019
31	2048	88,867	35,547	53,662	21,465	57,012	156	110,332	24,511		45,976	139		11,036	5,019
32	2049	89,756	35,902	53,930	21,572	57,475	157	111,328	24,404		45,976	139		11,498	5,019
33	2050	90,653	36,261	54,200	21,680	57,941	159	112,333	24,296		45,976	139		11,965	5,019
34	2051	91,560	36,624	54,471	21,788	58,412	160	113,348	24,188		45,976	139		12,436	5,019
35	2052	92,476	36,990	54,743	21,897	58,888	161	114,373	24,079		45,976	139		12,911	5,019
36	2053	93,400	37,360	55,017	22,007	59,367	163	115,407	23,969		45,976	139		13,391	5,019
37	2054	94,334	37,734	55,292	22,117	59,851	164	116,451	23,859		45,976	139		13,874	5,019
38	2055	95,278	38,111	55,569	22,228	60,339	165	117,505	23,749		45,976	139		14,362	5,019
39	2056	96,230	38,492	55,847	22,339	60,831	167	118,569	23,638		45,976	139		14,855	5,019
40	2057	97,193	38,877	56,126	22,450	61,327	168	119,643	23,526		45,976	139		15,351	5,019
41	2058	98,165	39,266	56,406	22,563	61,828	169	120,727	23,414		45,976	139		15,852	5,019
42	2059	99,146	39,659	56,688	22,675	62,334	171	121,822	23,301		45,976	139		16,358	5,019
43	2060	100,138	40,056	56,972	22,789	62,844	172	122,927	23,187		45,976	139		16,868	5,019
44	2061	101,139	40,456	57,257	22,903	63,358	174	124,042	23,073		45,976	139		17,382	5,019
45	2062	102,151	40,860	57,543	23,017	63,877	175	125,168	22,959		45,976	139		17,901	5,019
46	2063	103,172	41,269	57,831	23,132	64,401	176	126,304	22,844		45,976	139		18,425	5,019
47	2064	104,204	41,681	58,120	23,248	64,929	178	127,452	22,728		45,976	139		18,953	5,019
48	2065	105,246	42,098	58,411	23,364	65,463	179	128,610	22,612		45,976	139		19,486	5,019
49	2066	106,298	42,519	58,703	23,481	66,000	181	129,779	22,495		45,976	139		20,024	5,019
50	2067	107,361	42,944	58,996	23,598	66,543	182	130,960	22,378		45,976	139		20,567	5,019
	Totals	4,465,392	1,855,431	2,772,844	1,158,095	3,013,526		5,623,487	1,163,486	0	2,103,083		218,498	691,945	229,565

CRWMC LF Fill Rate and Capacity

	Year	Volumetric MSW Disposal Rate	Daily Cover Soil	Operational Soil	Settlement	Net Fill Volume	Cumulative Fill Volume	Phase	Volumetric Capacity (m³)
		m³	m³	m³	m³	m³	m³		
	2015	39,318	13,106	786	786	52,424			
	2016	37,609	12,536	752	752	50,146		Phase 3	
0	2017	37,856	12,619	757	757	50,475	50,475	Phase 3	
1	2018	38,116	12,705	762	762	50,821	101,296	Phase 3	
2	2019	38,366	12,789	767	767	51,155	152,451	Phase 3	
3	2020	38,613	12,871	772	772	51,483	203,934	Phase 3	
4	2021	27,261	9,087	545	545	36,347	240,281	Phase 3	
5	2022	27,421	9,140	548	548	36,561	276,842	Phase 3	
6	2023	27,581	9,194	552	552	36,775	313,617	Closed	**288,480**
7	2024	0	0	0	0	0	313,617	Closed	
8	2025	0	0	0	0	0	313,617	Closed	
9	2026	0	0	0	0	0	313,617	Closed	
10	2027	0	0	0	0	0	313,617	Closed	
11	2028	0	0	0	0	0	313,617	Closed	
12	2029	0	0	0	0	0	313,617	Closed	
13	2030	0	0	0	0	0	313,617	Closed	
14	2031	0	0	0	0	0	313,617	Closed	
15	2032	0	0	0	0	0	313,617	Closed	
16	2033	0	0	0	0	0	313,617	Closed	
17	2034	0	0	0	0	0	313,617	Closed	
18	2035	0	0	0	0	0	313,617	Closed	
19	2036	0	0	0	0	0	313,617	Closed	
20	2037	0	0	0	0	0	313,617	Closed	
21	2038	0	0	0	0	0	313,617	Closed	
22	2039	0	0	0	0	0	313,617	Closed	
23	2040	0	0	0	0	0	313,617	Closed	
24	2041	0	0	0	0	0	313,617	Closed	
25	2042	0	0	0	0	0	313,617	Closed	
26	2043	0	0	0	0	0	313,617	Closed	
27	2044	0	0	0	0	0	313,617	Closed	
28	2045	0	0	0	0	0	313,617	Closed	
29	2046	0	0	0	0	0	313,617	Closed	
30	2047	0	0	0	0	0	313,617	Closed	
31	2048	0	0	0	0	0	313,617	Closed	
32	2049	0	0	0	0	0	313,617	Closed	
33	2050	0	0	0	0	0	313,617	Closed	
34	2051	0	0	0	0	0	313,617	Closed	
35	2052	0	0	0	0	0	313,617	Closed	
36	2053	0	0	0	0	0	313,617	Closed	
37	2054	0	0	0	0	0	313,617	Closed	
38	2055	0	0	0	0	0	313,617	Closed	
39	2056	0	0	0	0	0	313,617	Closed	
40	2057	0	0	0	0	0	313,617	Closed	
41	2058	0	0	0	0	0	313,617	Closed	
42	2059	0	0	0	0	0	313,617	Closed	
43	2060	0	0	0	0	0	313,617	Closed	
44	2061	0	0	0	0	0	313,617	Closed	
45	2062	0	0	0	0	0	313,617	Closed	
46	2063	0	0	0	0	0	313,617	Closed	
47	2064	0	0	0	0	0	313,617	Closed	
48	2065	0	0	0	0	0	313,617	Closed	
49	2066	0	0	0	0	0	313,617	Closed	
50	2067	0	0	0	0	0	313,617	Closed	

CVWMC LF Fill Rate and Capacity

	Year	Volumetric MSW Disposal Rate	Volumetric Ash / Residuals Disposal Rate	Daily Cover Soil	Operational Soil	Settlement	Net Fill Volume	Cumulative Fill Volume	Phase / Cell	Phase / Cell	Volumetric Capacity (m³)
		m³	m³	m³	m³	m³	m³	m³			
	2015	55,109		18,370	1,102	1,102	73,479				
	2016	52,804		17,601	1,056	1,056	70,405		Phase 2	Phase 2	**46,525**
0	2017	53,411	0	17,804	1,068	1,068	71,214	71,214	Cell 1	Phase 2	
1	2018	54,046	0	18,015	1,081	1,081	72,061	143,275	Cell 1	Cell 1	
2	2019	54,670	0	18,223	1,093	1,093	72,894	216,169	Cell 1	Cell 1	
3	2020	55,294	0	18,431	1,106	1,106	73,725	289,894	Cell 1	Cell 1	
4	2021	1,505	2,883	502	30	30	4,890	294,784	Cell 1	Cell 1	
5	2022	1,522	2,915	507	30	30	4,945	299,729	Cell 1	Cell 1	
6	2023	1,539	2,948	513	31	31	5,000	304,729	Cell 1	Cell 1	
7	2024	2,620	5,019	873	52	52	8,512	313,240	Cell 1	Cell 1	
8	2025	3,213	5,019	1,071	64	64	9,303	322,544	Cell 1	Cell 1	
9	2026	3,800	5,019	1,267	76	76	10,086	332,629	Cell 1	Cell 1	
10	2027	4,375	5,019	1,458	88	88	10,852	343,481	Cell 1	Cell 1	
11	2028	4,943	5,019	1,648	99	99	11,609	355,090	Cell 1	Cell 1	
12	2029	5,501	5,019	1,834	110	110	12,354	367,444	Cell 1	Cell 1	
13	2030	6,047	5,019	2,016	121	121	13,081	380,526	Cell 1	Cell 1	
14	2031	6,581	5,019	2,194	132	132	13,794	394,319	Cell 1	Cell 1	
15	2032	7,106	5,019	2,369	142	142	14,493	408,813	Cell 1	Cell 1	
16	2033	7,623	5,019	2,541	152	152	15,183	423,995	Cell 1	Cell 1	
17	2034	8,115	5,019	2,705	162	162	15,838	439,834	Cell 1	Cell 1	
18	2035	8,596	5,019	2,865	172	172	16,480	456,313	Cell 1	Cell 1	
19	2036	9,074	5,019	3,025	181	181	17,117	473,430	Cell 1	Cell 1	
20	2037	9,537	5,019	3,179	191	191	17,735	491,166	Cell 1	Cell 1	
21	2038	9,989	5,019	3,330	200	200	18,337	509,503	Cell 1	Cell 1	
22	2039	10,431	5,019	3,477	209	209	18,926	528,429	Cell 2	Cell 1	**517,470**
23	2040	10,866	5,019	3,622	217	217	19,507	547,935	Cell 2	Cell 2	
24	2041	11,296	5,019	3,765	226	226	20,080	568,016	Cell 2	Cell 2	
25	2042	11,918	5,019	3,973	238	238	20,909	588,925	Cell 2	Cell 2	
26	2043	12,545	5,019	4,182	251	251	21,746	610,670	Cell 2	Cell 2	
27	2044	13,178	5,019	4,393	264	264	22,589	633,260	Cell 2	Cell 2	
28	2045	13,816	5,019	4,605	276	276	23,440	656,700	Cell 2	Cell 2	
29	2046	14,460	5,019	4,820	289	289	24,299	680,998	Cell 2	Cell 2	
30	2047	15,110	5,019	5,037	302	302	25,165	706,163	Cell 2	Cell 2	
31	2048	15,765	5,019	5,255	315	315	26,039	732,202	Cell 2	Cell 2	
32	2049	16,426	5,019	5,475	329	329	26,920	759,122	Cell 2	Cell 2	
33	2050	17,093	5,019	5,698	342	342	27,809	786,932	Cell 2	Cell 2	
34	2051	17,766	5,019	5,922	355	355	28,707	815,638	Cell 2	Cell 2	
35	2052	18,445	5,019	6,148	369	369	29,612	845,250	Cell 2	Cell 2	
36	2053	19,130	5,019	6,377	383	383	30,525	875,775	Cell 2	Cell 2	
37	2054	19,821	5,019	6,607	396	396	31,446	907,221	Cell 2	Cell 2	
38	2055	20,518	5,019	6,839	410	410	32,375	939,597	Cell 2	Cell 2	
39	2056	21,221	5,019	7,074	424	424	33,313	972,910	Cell 2	Cell 2	
40	2057	21,930	5,019	7,310	439	439	34,259	1,007,169	Cell 2	Cell 2	
41	2058	22,646	5,019	7,549	453	453	35,213	1,042,382	Cell 2	Cell 2	
42	2059	23,368	5,019	7,789	467	467	36,176	1,078,558	Cell 2	Cell 2	
43	2060	24,097	5,019	8,032	482	482	37,148	1,115,706	Cell 2	Cell 2	
44	2061	24,832	5,019	8,277	497	497	38,127	1,153,833	Cell 2	Cell 2	
45	2062	25,573	5,019	8,524	511	511	39,116	1,192,949	Cell 2	Cell 2	
46	2063	26,321	5,019	8,774	526	526	40,114	1,233,063	Cell 2	Cell 2	
47	2064	27,076	5,019	9,025	542	542	41,120	1,274,183	Cell 2	Cell 2	
48	2065	27,838	5,019	9,279	557	557	42,135	1,316,319	Cell 2	Cell 2	
49	2066	28,606	5,019	9,535	572	572	43,160	1,359,478	Cell 2	Cell 2	
50	2067	29,381	5,019	9,794	588	588	44,193	1,403,672	Cell 2	Cell 2	

CVRD growth rate beyond 2041 = 1%
CVRD disposal rate 2009-2015= 0.60 *tonnes per person per year*
CVRD disposal rate 2016-20120= 0.57 *tonnes per person per year*
CVRD disposal rate 2021-2067= 0.40 *tonnes per person per year* *Reduction by 30%*
SRD growth rate beyond 2041 = 0.50%
SRDdisposal rate 2009-2015= 0.60 *tonnes per person per year*
SRD disposal rate 2016-20120= 0.57 *tonnes per person per year*
SRD disposal rate 2021-2067= 0.40 *tonnes per person per year* *Reduction by 30%*
Days of operation = 351 *days per year*
Bottom ash/residuals to landfill = 11% *% of input*

In-situ MSW waste density = 0.7 *tonnes per m³*
Operational soil = 2% *of waste volume per year*
Waste to cover ratio = 3:1
Settlement = 2% *of waste volume per year*

In-situ ash / residuals waste density = 1 *tonnes per m³*
In-situ MSW waste density = 0.7 *tonnes per m³*
Operational soil = 2% *of waste volume per year*
Waste to cover ratio = 3:1
Settlement = 2% *of waste volume per year*

Table B9: Long Term Cost Model for Option 3(b) - Sustane facility located in Campbell River

Capital and Operating Costs

	Year	Comox Valley TS Capital	Comox Valley TS Operating	Comox Valley TS Transport	Campbell River TS Transport	Sustane Facility Tipping Fees	CVWMC LF Capital - Expansion	CVWMC LF Capital - Minor Capital	CVWMC LF Capital - Closure	CVWMC LF Operating - Expansion	CVWMC LF Operating - Post-Closure	CRWMC LF Capital	CRWMC LF Operating	Total System	Comox Valley TS Notes	Campbell River TS Notes	Sustane Facility Notes	CVWMC LF Notes	CRWMC LF Notes
	2015													$0					
	2016						$16,000,000							$16,000,000		New Transfer station constructed 2012-2013		Construction of leachate management system and Cell 1	
0	2017							$ 860,000	$ 265,000	$1,108,145		$250,868	$1,002,753	$3,487,000				Closure Phase 2	Phase 2 SW mgmt design & partial construction
1	2018							$ 200,000	$ 2,500,000	$1,108,145		$490,358	$1,002,753	$5,301,000				Closure Phase 2	Phase 2 Surface water management construction
2	2019							$ -		$1,108,145	$390,000	$191,695	$1,002,753	$2,693,000					Phase 2 Design and construction
3	2020	$311,025			Ash / residuals	$1,327,789		$ 1,075,000		$1,108,145	$190,000	$491,790	$1,002,753	$5,507,000	Permits		Permits and land		Phase 2 LFG and final cover design
4	2021	$3,310,000	$709,508	$390,917	$43,000	$2,363,381		$ 35,000		$585,536	$190,000	$5,630,329	$1,002,753	$14,260,000	New transfer station		Sustane facility begins operating		Phase 2 LFG and final cover construction
5	2022		$709,508	$395,294	$43,000	$2,389,848		$ -		$585,536	$190,000	$218,613	$1,002,753	$5,535,000					Phase 3 LFG and final cover design
6	2023		$709,508	$399,718	$44,000	$2,416,591		$ 35,000		$585,536	$190,000	$3,108,685	$1,002,753	$8,492,000					Phase 3 LFG and final cover construction
7	2024		$709,508	$393,097	$74,000	$4,113,811		$ -		$585,536	$390,000		$190,000	$6,456,000					
8	2025		$709,508	$391,516	$74,000	$4,113,811		$ -		$585,536	$190,000		$190,000	$6,254,000					
9	2026		$709,508	$389,989	$74,000	$4,113,811		$ -		$585,536	$190,000		$190,000	$6,253,000					
10	2027		$709,508	$388,550	$74,000	$4,113,811		$ 585,000		$585,536	$190,000		$190,000	$6,836,000					
11	2028		$709,508	$387,153	$74,000	$4,113,811		$ -		$585,536	$190,000		$190,000	$6,250,000					
12	2029	$200,000	$709,508	$385,791	$74,000	$4,113,811		$ 385,000		$585,536	$390,000		$190,000	$7,034,000	New trailers every 8 years				
13	2030		$709,508	$384,495	$74,000	$4,113,811		$ 175,000		$585,536	$190,000		$190,000	$6,422,000					
14	2031		$709,508	$383,246	$74,000	$4,113,811		$ -		$585,536	$190,000		$190,000	$6,246,000					
15	2032		$709,508	$382,050	$74,000	$4,113,811		$ -		$585,536	$190,000		$190,000	$6,245,000					
16	2033		$709,508	$380,896	$74,000	$4,113,811		$ 235,000		$585,536	$190,000		$190,000	$6,479,000					
17	2034		$709,508	$379,860	$74,000	$4,113,811		$ -		$585,536	$390,000		$190,000	$6,443,000					
18	2035		$709,508	$378,859	$74,000	$4,113,811		$ 935,000		$585,536	$190,000		$190,000	$7,177,000				Construction Cell 2	
19	2036		$709,508	$377,876	$74,000	$4,113,811		$ -		$585,536	$190,000		$190,000	$6,241,000					
20	2037	$200,000	$709,508	$376,959	$74,000	$4,113,811		$ 550,000		$585,536	$190,000		$190,000	$6,990,000	New trailers every 8 years			Closure Cell 1	
21	2038		$709,508	$376,095	$74,000	$4,113,811		$ -		$585,536	$190,000		$190,000	$6,239,000					
22	2039		$709,508	$375,266	$74,000	$4,113,811	$8,850,000	$ 35,000		$585,536	$390,000		$190,000	$15,323,000					
23	2040		$709,508	$374,467	$74,000	$4,113,811		$ 175,000		$710,536	$190,000		$190,000	$6,537,000					
24	2041	$1,555,125	$709,508	$373,667	$74,000	$4,113,811		$ 385,000	$ 1,350,000	$710,536	$190,000		$190,000	$9,652,000	Major capital upgrade every 20 years				
25	2042		$709,508	$372,133	$74,000	$4,113,811		$ -		$710,536	$190,000		$190,000	$6,360,000					
26	2043		$709,508	$370,592	$74,000	$4,113,811		$ 200,000		$710,536	$190,000		$190,000	$6,558,000					
27	2044		$709,508	$369,043	$74,000	$4,113,811		$ -		$710,536	$390,000		$190,000	$6,557,000					
28	2045	$200,000	$709,508	$367,486	$74,000	$2,424,724		$ 35,000		$710,536	$190,000		$190,000	$4,901,000	New trailers every 8 years		Amortization period over		
29	2046		$709,508	$365,921	$74,000	$2,424,724		$ -		$710,536	$190,000		$190,000	$4,665,000					
30	2047		$709,508	$364,348	$74,000	$2,424,724		$ 585,000		$710,536	$190,000		$190,000	$5,248,000					
31	2048		$709,508	$362,768	$74,000	$2,424,724		$ -		$710,536	$190,000		$190,000	$4,662,000					
32	2049		$709,508	$361,179	$74,000	$2,424,724		$ -		$710,536	$390,000		$190,000	$4,860,000					
33	2050		$709,508	$359,583	$74,000	$2,424,724		$ 1,075,000		$710,536	$190,000		$190,000	$5,733,000					
34	2051		$709,508	$357,979	$74,000	$2,424,724		$ 35,000		$710,536	$190,000		$190,000	$4,692,000					
35	2052		$709,508	$356,366	$74,000	$2,424,724		$ -		$710,536	$190,000		$190,000	$4,655,000					
36	2053	$200,000	$709,508	$354,746	$74,000	$2,424,724		$ 585,000		$710,536	$190,000		$190,000	$5,439,000	New trailers every 8 years				
37	2054		$709,508	$353,117	$74,000	$2,424,724		$ -		$710,536	$390,000		$190,000	$4,852,000					
38	2055		$709,508	$351,481	$74,000	$2,424,724		$ -		$710,536	$190,000		$190,000	$4,650,000					
39	2056		$709,508	$349,836	$74,000	$2,424,724		$ -		$710,536	$190,000		$190,000	$4,649,000					
40	2057		$709,508	$348,183	$74,000	$2,424,724		$ 585,000		$710,536	$190,000		$190,000	$5,232,000					
41	2058		$709,508	$346,521	$74,000	$2,424,724		$ -		$710,536	$190,000		$190,000	$4,645,000					
42	2059		$709,508	$344,852	$74,000	$2,424,724		$ 35,000		$710,536	$390,000		$190,000	$4,879,000					
43	2060		$709,508	$343,174	$74,000	$2,424,724		$ 175,000		$710,536	$190,000		$190,000	$4,817,000					
44	2061	$1,755,125	$709,508	$341,487	$74,000	$2,424,724		$ -		$710,536	$190,000		$190,000	$6,395,000	Major capital upgrade every 20 years				
45	2062		$709,508	$339,793	$74,000	$2,424,724		$ -		$710,536	$190,000		$190,000	$4,639,000					
46	2063		$709,508	$338,089	$74,000	$2,424,724		$ 235,000		$710,536	$190,000		$190,000	$4,872,000					
47	2064		$709,508	$336,378	$74,000	$2,424,724		$ -		$710,536	$390,000		$190,000	$4,835,000					
48	2065		$709,508	$334,657	$74,000	$2,424,724		$ 1,285,000		$710,536	$190,000		$190,000	$5,918,000					
49	2066		$709,508	$332,928	$74,000	$2,424,724		$ -		$710,536	$190,000		$190,000	$4,632,000					
50	2067		$709,508	$331,191	$74,000	$2,424,724		$ 550,000		$710,536	$190,000		$190,000	$5,180,000					
	Totals	$7,731,275	$33,346,853	$17,219,589	$3,386,000	$150,656,286	$8,850,000	$11,045,000	$4,115,000	$35,452,788	$11,310,000	$10,382,338	$15,379,269	$308,877,000					

Sustane Facility Tipping Fee (1st 25 years) = *$89* per tonne

Sustane Facility Tipping Fee (2nd 25 years) = *$53* per tonne

30 years
$208,641,000 1,651,117 tonnes
$126 per tonne over 30 years

40 years
$258,065,000 2,242,559
$115 per tonne over 40 years

50 years
$308,877,000 2,884,138
$107 per tonne over 50 years

Table B10: Long Term Cost Model for Option 3(c) - Sustane facility located in Gold River

Population and Disposal Rates

	Year	Projected CVRD Population	CVRD Waste	Projected SRD Population	SRD Waste	Total Annual Tonnage	Daily Tonnage	Combined Population	Tonnes to Comox Valley TS	Tonnes to Campbell River TS	Tonnes to Sustane Facility	Tonnes per day to Sustane facility	Tonnes MSW to CRWMC LF	Tonnes to MSW CVWMC LF	Tonnes Ash/Residuals to CVWMC LF
			tonnes		tonnes	tonnes / yr	tonnes / day		tonnes	tonnes	tonnes	tonnes / day		tonnes	
	2015	64,294	38,576	45,871	27,523	66,099	181	91,817					27,523	38,576	
	2016	64,847	36,963	46,187	26,327	63,289	173	91,174					26,327	36,963	
0	2017	65,592	37,387	46,490	26,499	63,887	175	92,091					26,499	37,387	0
1	2018	66,372	37,832	46,809	26,681	64,513	177	93,053					26,681	37,832	0
2	2019	67,139	38,269	47,116	26,856	65,125	178	93,995					26,856	38,269	0
3	2020	67,905	38,706	47,419	27,029	65,735	180	94,934					27,029	38,706	0
4	2021	68,667	27,467	47,706	19,082	46,549	128	87,749	26,413		26,413	80	19,082	1,054	2,883
5	2022	69,436	27,774	47,986	19,194	46,969	129	88,630	26,709		26,709	81	19,194	1,065	2,915
6	2023	70,213	28,085	48,267	19,307	47,392	130	89,520	27,008	Landfill closure	27,008	82	19,307	1,077	2,948
7	2024	70,986	28,394	48,539	19,416	47,810	131	90,402	26,561	19,416	45,976	139		1,834	5,019
8	2025	71,758	28,703	48,806	19,522	48,226	132	91,280	26,454	19,522	45,976	139		2,249	5,019
9	2026	72,527	29,011	49,064	19,626	48,636	133	92,153	26,351	19,626	45,976	139		2,660	5,019
10	2027	73,290	29,316	49,307	19,723	49,039	134	93,013	26,253	19,723	45,976	139		3,063	5,019
11	2028	74,047	29,619	49,543	19,817	49,436	135	93,864	26,159	19,817	45,976	139		3,460	5,019
12	2029	74,795	29,918	49,773	19,909	49,827	137	94,704	26,067	19,909	45,976	139		3,851	5,019
13	2030	75,531	30,212	49,992	19,997	50,209	138	95,528	25,979	19,997	45,976	139		4,233	5,019
14	2031	76,255	30,502	50,203	20,081	50,583	139	96,336	25,895	20,081	45,976	139		4,607	5,019
15	2032	76,971	30,788	50,405	20,162	50,950	140	97,133	25,814	20,162	45,976	139		4,974	5,019
16	2033	77,681	31,072	50,600	20,240	51,312	141	97,921	25,736	20,240	45,976	139		5,336	5,019
17	2034	78,366	31,346	50,775	20,310	51,656	142	98,676	25,666	20,310	45,976	139		5,680	5,019
18	2035	79,039	31,616	50,944	20,378	51,993	142	99,417	25,599	20,378	45,976	139		6,017	5,019
19	2036	79,710	31,884	51,110	20,444	52,328	143	100,154	25,532	20,444	45,976	139		6,352	5,019
20	2037	80,366	32,146	51,265	20,506	52,652	144	100,872	25,470	20,506	45,976	139		6,676	5,019
21	2038	81,010	32,404	51,411	20,564	52,968	145	101,574	25,412	20,564	45,976	139		6,992	5,019
22	2039	81,643	32,657	51,551	20,620	53,278	146	102,263	25,356	20,620	45,976	139		7,301	5,019
23	2040	82,270	32,908	51,686	20,674	53,582	147	102,944	25,302	20,674	45,976	139		7,606	5,019
24	2041	82,888	33,155	51,821	20,728	53,884	148	103,616	25,248	20,728	45,976	139		7,907	5,019
25	2042	83,717	33,487	52,080	20,832	54,319	149	104,549	25,144	20,832	45,976	139		8,343	5,019
26	2043	84,554	33,822	52,341	20,936	54,758	150	105,490	25,040	20,936	45,976	139		8,782	5,019
27	2044	85,400	34,160	52,602	21,041	55,201	151	106,440	24,935	21,041	45,976	139		9,225	5,019
28	2045	86,254	34,501	52,865	21,146	55,648	152	107,400	24,830	21,146	45,976	139		9,671	5,019
29	2046	87,116	34,846	53,130	21,252	56,098	154	108,368	24,724	21,252	45,976	139		10,122	5,019
30	2047	87,987	35,195	53,395	21,358	56,553	155	109,345	24,618	21,358	45,976	139		10,577	5,019
31	2048	88,867	35,547	53,662	21,465	57,012	156	110,332	24,511	21,465	45,976	139		11,036	5,019
32	2049	89,756	35,902	53,930	21,572	57,475	157	111,328	24,404	21,572	45,976	139		11,498	5,019
33	2050	90,653	36,261	54,200	21,680	57,941	159	112,333	24,296	21,680	45,976	139		11,965	5,019
34	2051	91,560	36,624	54,471	21,788	58,412	160	113,348	24,188	21,788	45,976	139		12,436	5,019
35	2052	92,476	36,990	54,743	21,897	58,888	161	114,373	24,079	21,897	45,976	139		12,911	5,019
36	2053	93,400	37,360	55,017	22,007	59,367	163	115,407	23,969	22,007	45,976	139		13,391	5,019
37	2054	94,334	37,734	55,292	22,117	59,851	164	116,451	23,859	22,117	45,976	139		13,874	5,019
38	2055	95,278	38,111	55,569	22,228	60,339	165	117,505	23,749	22,228	45,976	139		14,362	5,019
39	2056	96,230	38,492	55,847	22,339	60,831	167	118,569	23,638	22,339	45,976	139		14,855	5,019
40	2057	97,193	38,877	56,126	22,450	61,327	168	119,643	23,526	22,450	45,976	139		15,351	5,019
41	2058	98,165	39,266	56,406	22,563	61,828	169	120,727	23,414	22,563	45,976	139		15,852	5,019
42	2059	99,146	39,659	56,688	22,675	62,334	171	121,822	23,301	22,675	45,976	139		16,358	5,019
43	2060	100,138	40,056	56,972	22,789	62,844	172	122,927	23,187	22,789	45,976	139		16,868	5,019
44	2061	101,139	40,456	57,257	22,903	63,358	174	124,042	23,073	22,903	45,976	139		17,382	5,019
45	2062	102,151	40,860	57,543	23,017	63,877	175	125,168	22,959	23,017	45,976	139		17,901	5,019
46	2063	103,172	41,269	57,831	23,132	64,401	176	126,304	22,844	23,132	45,976	139		18,425	5,019
47	2064	104,204	41,681	58,120	23,248	64,929	178	127,452	22,728	23,248	45,976	139		18,953	5,019
48	2065	105,246	42,098	58,411	23,364	65,463	179	128,610	22,612	23,364	45,976	139		19,486	5,019
49	2066	106,298	42,519	58,703	23,481	66,000	181	129,779	22,495	23,481	45,976	139		20,024	5,019
50	2067	107,361	42,944	58,996	23,598	66,543	182	130,960	22,378	23,598	45,976	139		20,567	5,019
	Totals	4,465,392	1,855,431	2,772,844	1,158,095	3,013,526		5,623,487	1,163,486	939,597	2,103,083		218,498	691,945	229,565

CRWMC LF Fill Rate and Capacity

	Year	Volumetric MSW Disposal Rate	Daily Cover Soil	Operational Soil	Settlement	Net Fill Volume	Cumulative Fill Volume	Phase	Volumetric Capacity (m³)
		m³	m³	m³	m³	m³	m³		
	2015	39,318	13,106	786	786	52,424			
	2016	37,609	12,536	752	752	50,146		Phase 3	
0	2017	37,856	12,619	757	757	50,475	50,475	Phase 3	
1	2018	38,116	12,705	762	762	50,821	101,296	Phase 3	
2	2019	38,366	12,789	767	767	51,155	152,451	Phase 3	
3	2020	38,613	12,871	772	772	51,483	203,934	Phase 3	
4	2021	27,261	9,087	545	545	36,347	240,281	Phase 3	
5	2022	27,421	9,140	548	548	36,561	276,842	Phase 3	
6	2023	27,581	9,194	552	552	36,775	313,617	Closed	**288,480**
7	2024	0	0	0	0	0	313,617	Closed	
8	2025	0	0	0	0	0	313,617	Closed	
9	2026	0	0	0	0	0	313,617	Closed	
10	2027	0	0	0	0	0	313,617	Closed	
11	2028	0	0	0	0	0	313,617	Closed	
12	2029	0	0	0	0	0	313,617	Closed	
13	2030	0	0	0	0	0	313,617	Closed	
14	2031	0	0	0	0	0	313,617	Closed	
15	2032	0	0	0	0	0	313,617	Closed	
16	2033	0	0	0	0	0	313,617	Closed	
17	2034	0	0	0	0	0	313,617	Closed	
18	2035	0	0	0	0	0	313,617	Closed	
19	2036	0	0	0	0	0	313,617	Closed	
20	2037	0	0	0	0	0	313,617	Closed	
21	2038	0	0	0	0	0	313,617	Closed	
22	2039	0	0	0	0	0	313,617	Closed	
23	2040	0	0	0	0	0	313,617	Closed	
24	2041	0	0	0	0	0	313,617	Closed	
25	2042	0	0	0	0	0	313,617	Closed	
26	2043	0	0	0	0	0	313,617	Closed	
27	2044	0	0	0	0	0	313,617	Closed	
28	2045	0	0	0	0	0	313,617	Closed	
29	2046	0	0	0	0	0	313,617	Closed	
30	2047	0	0	0	0	0	313,617	Closed	
31	2048	0	0	0	0	0	313,617	Closed	
32	2049	0	0	0	0	0	313,617	Closed	
33	2050	0	0	0	0	0	313,617	Closed	
34	2051	0	0	0	0	0	313,617	Closed	
35	2052	0	0	0	0	0	313,617	Closed	
36	2053	0	0	0	0	0	313,617	Closed	
37	2054	0	0	0	0	0	313,617	Closed	
38	2055	0	0	0	0	0	313,617	Closed	
39	2056	0	0	0	0	0	313,617	Closed	
40	2057	0	0	0	0	0	313,617	Closed	
41	2058	0	0	0	0	0	313,617	Closed	
42	2059	0	0	0	0	0	313,617	Closed	
43	2060	0	0	0	0	0	313,617	Closed	
44	2061	0	0	0	0	0	313,617	Closed	
45	2062	0	0	0	0	0	313,617	Closed	
46	2063	0	0	0	0	0	313,617	Closed	
47	2064	0	0	0	0	0	313,617	Closed	
48	2065	0	0	0	0	0	313,617	Closed	
49	2066	0	0	0	0	0	313,617	Closed	
50	2067	0	0	0	0	0	313,617	Closed	

CVWMC LF Fill Rate and Capacity

	Year	Volumetric MSW Disposal Rate	Volumetric Ash / Residuals Disposal Rate	Daily Cover Soil	Operational Soil	Settlement	Net Fill Volume	Cumulative Fill Volume	Phase / Cell	Phase / Cell	Volumetric Capacity (m³)
		m³	m³	m³	m³	m³	m³	m³			
	2015	55,109		18,370	1,102	1,102	73,479				
	2016	52,804		17,601	1,056	1,056	70,405		Phase 2	Phase 2	**46,525**
0	2017	53,411	0	17,804	1,068	1,068	71,214	71,214	Cell 1	Phase 2	
1	2018	54,046	0	18,015	1,081	1,081	72,061	143,275	Cell 1	Cell 1	
2	2019	54,670	0	18,223	1,093	1,093	72,894	216,169	Cell 1	Cell 1	
3	2020	55,294	0	18,431	1,106	1,106	73,725	289,894	Cell 1	Cell 1	
4	2021	1,505	2,883	502	30	30	4,890	294,784	Cell 1	Cell 1	
5	2022	1,522	2,915	507	30	30	4,945	299,729	Cell 1	Cell 1	
6	2023	1,539	2,948	513	31	31	5,000	304,729	Cell 1	Cell 1	
7	2024	2,620	5,019	873	52	52	8,512	313,240	Cell 1	Cell 1	
8	2025	3,213	5,019	1,071	64	64	9,303	322,544	Cell 1	Cell 1	
9	2026	3,800	5,019	1,267	76	76	10,086	332,629	Cell 1	Cell 1	
10	2027	4,375	5,019	1,458	88	88	10,852	343,481	Cell 1	Cell 1	
11	2028	4,943	5,019	1,648	99	99	11,609	355,090	Cell 1	Cell 1	
12	2029	5,501	5,019	1,834	110	110	12,354	367,444	Cell 1	Cell 1	
13	2030	6,047	5,019	2,016	121	121	13,081	380,526	Cell 1	Cell 1	
14	2031	6,581	5,019	2,194	132	132	13,794	394,319	Cell 1	Cell 1	
15	2032	7,106	5,019	2,369	142	142	14,493	408,813	Cell 1	Cell 1	
16	2033	7,623	5,019	2,541	152	152	15,183	423,995	Cell 1	Cell 1	
17	2034	8,115	5,019	2,705	162	162	15,838	439,834	Cell 1	Cell 1	
18	2035	8,596	5,019	2,865	172	172	16,480	456,313	Cell 1	Cell 1	
19	2036	9,074	5,019	3,025	181	181	17,117	473,430	Cell 1	Cell 1	
20	2037	9,537	5,019	3,179	191	191	17,735	491,166	Cell 1	Cell 1	
21	2038	9,989	5,019	3,330	200	200	18,337	509,503	Cell 1	Cell 1	
22	2039	10,431	5,019	3,477	209	209	18,926	528,429	Cell 2	Cell 1	**517,470**
23	2040	10,866	5,019	3,622	217	217	19,507	547,935	Cell 2	Cell 2	
24	2041	11,296	5,019	3,765	226	226	20,080	568,016	Cell 2	Cell 2	
25	2042	11,918	5,019	3,973	238	238	20,909	588,925	Cell 2	Cell 2	
26	2043	12,545	5,019	4,182	251	251	21,746	610,670	Cell 2	Cell 2	
27	2044	13,178	5,019	4,393	264	264	22,589	633,260	Cell 2	Cell 2	
28	2045	13,816	5,019	4,605	276	276	23,440	656,700	Cell 2	Cell 2	
29	2046	14,460	5,019	4,820	289	289	24,299	680,998	Cell 2	Cell 2	
30	2047	15,110	5,019	5,037	302	302	25,165	706,163	Cell 2	Cell 2	
31	2048	15,765	5,019	5,255	315	315	26,039	732,202	Cell 2	Cell 2	
32	2049	16,426	5,019	5,475	329	329	26,920	759,122	Cell 2	Cell 2	
33	2050	17,093	5,019	5,698	342	342	27,809	786,932	Cell 2	Cell 2	
34	2051	17,766	5,019	5,922	355	355	28,707	815,638	Cell 2	Cell 2	
35	2052	18,445	5,019	6,148	369	369	29,612	845,250	Cell 2	Cell 2	
36	2053	19,130	5,019	6,377	383	383	30,525	875,775	Cell 2	Cell 2	
37	2054	19,821	5,019	6,607	396	396	31,446	907,221	Cell 2	Cell 2	
38	2055	20,518	5,019	6,839	410	410	32,375	939,597	Cell 2	Cell 2	
39	2056	21,221	5,019	7,074	424	424	33,313	972,910	Cell 2	Cell 2	
40	2057	21,930	5,019	7,310	439	439	34,259	1,007,169	Cell 2	Cell 2	
41	2058	22,646	5,019	7,549	453	453	35,213	1,042,382	Cell 2	Cell 2	
42	2059	23,368	5,019	7,789	467	467	36,176	1,078,558	Cell 2	Cell 2	
43	2060	24,097	5,019	8,032	482	482	37,148	1,115,706	Cell 2	Cell 2	
44	2061	24,832	5,019	8,277	497	497	38,127	1,153,833	Cell 2	Cell 2	
45	2062	25,573	5,019	8,524	511	511	39,116	1,192,949	Cell 2	Cell 2	
46	2063	26,321	5,019	8,774	526	526	40,114	1,233,063	Cell 2	Cell 2	
47	2064	27,076	5,019	9,025	542	542	41,120	1,274,183	Cell 2	Cell 2	
48	2065	27,838	5,019	9,279	557	557	42,135	1,316,319	Cell 2	Cell 2	
49	2066	28,606	5,019	9,535	572	572	43,160	1,359,478	Cell 2	Cell 2	
50	2067	29,381	5,019	9,794	588	588	44,193	1,403,672	Cell 2	Cell 2	

CVRD growth rate beyond 2041 = 1%
CVRD disposal rate 2009-2015= 0.60 tonnes per person per year
CVRD disposal rate 2016-20120= 0.57 tonnes per person per year
CVRD disposal rate 2021-2067= 0.40 tonnes per person per year *Reduction by 30%*
SRD growth rate beyond 2041 = 0.50%
SRDdisposal rate 2009-2015= 0.60 tonnes per person per year
SRD disposal rate 2016-20120= 0.57 tonnes per person per year
SRD disposal rate 2021-2067= 0.40 tonnes per person per year *Reduction by 30%*
Days of operation = 351 days per year
Bottom ash/residuals to landfill = 11% % of input

In-situ MSW waste density = 0.7 tonnes per m^3
Operational soil = 2% of waste volume per year
Waste to cover ratio = 3:1
Settlement = 2% of waste volume per year

In-situ ash / residuals waste density = 1 tonnes per m^3
In-situ MSW waste density = 0.7 tonnes per m^3
Operational soil = 2% of waste volume per year
Waste to cover ratio = 3:1
Settlement = 2% of waste volume per year

Table B10: Long Term Cost Model for Option 3(c) - Sustane facility located in Gold River

Capital and Operating Costs

	Year	Comox Valley TS Capital	Comox Valley TS Operating	Comox Valley TS Transport	Campbell River TS Capital	Campbell River TS Operating	Campbell River TS Transport	Ash/residuals Transport from Gold River	Sustane Facility Tipping Fees	CVWMC LF Capital - Expansion	CVWMC LF Capital - Minor Capital	CVWMC LF Capital - Closure	CVWMC LF Operating - Expansion	CVWMC LF Operating - Post-Closure	CRWMC LF Capital	CRWMC LF Operating	Total System	Comox Valley TS Notes	Campbell River TS Notes	Sustane Facility Notes	CVWMC LF Notes	CRWMC LF Notes
	2015																$0		New Transfer station constructed 2012-2013			
	2016									$16,000,000							$16,000,000				Construction of leachate management system and Cell 1	
0	2017										$ 860,000	$ 265,000	$1,108,145		$250,868	$1,002,753	$3,487,000				Closure Phase 2	Phase 2 SW mgmt design & partial construction
1	2018										$ 200,000	$ 2,500,000	$1,108,145		$490,358	$1,002,753	$5,301,000				Closure Phase 2	Phase 2 Surface water management construction
2	2019										$ -		$1,108,145	$390,000	$191,695	$1,002,753	$2,693,000					Phase 2 Design and construction
3	2020	$311,025			$200,000				$750,000		$ 1,075,000		$1,108,145	$190,000	$491,790	$1,002,753	$5,129,000	Construct TS	New trailers every 8 years	Permits and land		Phase 2 LFG and final cover design
4	2021	$3,310,000	$709,508	$739,572				$80,729	$2,363,381		$ 35,000		$585,536	$190,000	$5,630,329	$1,002,753	$14,647,000	New trailers every 8 years		Sustane facility begins operating		Phase 2 LFG and final cover construction
5	2022		$709,508	$747,854				$81,633	$2,389,848		$ -		$585,536	$190,000	$218,613	$1,002,753	$5,926,000					Phase 3 LFG and final cover design
6	2023		$709,508	$756,223				$82,547	$2,416,591		$ 35,000		$585,536	$190,000	$3,108,685	$1,002,753	$8,887,000					Phase 3 LFG and final cover construction
7	2024		$709,508	$743,697		$651,040	$388,312	$140,521	$4,113,811		$ -		$585,536	$390,000		$190,000	$7,912,000					
8	2025		$709,508	$740,706		$651,040	$390,448	$140,521	$4,113,811		$ -		$585,536	$190,000		$190,000	$7,712,000					
9	2026		$709,508	$737,817		$651,040	$392,512	$140,521	$4,113,811		$ -		$585,536	$190,000		$190,000	$7,711,000					
10	2027		$709,508	$735,095		$651,040	$394,456	$140,521	$4,113,811		$ 585,000		$585,536	$190,000		$190,000	$8,295,000					
11	2028		$709,508	$732,452	$200,000	$651,040	$396,344	$140,521	$4,113,811		$ -		$585,536	$190,000		$190,000	$7,909,000		New trailers every 8 years			
12	2029	$200,000	$709,508	$729,876		$651,040	$398,184	$140,521	$4,113,811		$ 385,000		$585,536	$390,000		$190,000	$8,493,000	New trailers every 8 years				
13	2030		$709,508	$727,423		$651,040	$399,936	$140,521	$4,113,811		$ 175,000		$585,536	$190,000		$190,000	$7,883,000					
14	2031		$709,508	$725,060		$651,040	$401,624	$140,521	$4,113,811		$ -		$585,536	$190,000		$190,000	$7,707,000					
15	2032		$709,508	$722,797	$346,000	$651,040	$403,240	$140,521	$4,113,811		$ -		$585,536	$190,000		$190,000	$8,052,000					
16	2033		$709,508	$720,613		$651,040	$404,800	$140,521	$4,113,811		$ 235,000		$585,536	$190,000		$190,000	$7,941,000					
17	2034		$709,508	$718,653		$651,040	$406,200	$140,521	$4,113,811		$ -		$585,536	$390,000		$190,000	$7,905,000					
18	2035		$709,508	$716,761		$651,040	$407,552	$140,521	$4,113,811		$ 935,000		$585,536	$190,000		$190,000	$8,640,000				Construction Cell 2	
19	2036		$709,508	$714,901	$200,000	$651,040	$408,880	$140,521	$4,113,811		$ -		$585,536	$190,000		$190,000	$7,904,000		New trailers every 8 years			
20	2037	$200,000	$709,508	$713,165		$651,040	$410,120	$140,521	$4,113,811		$ 550,000		$585,536	$190,000		$190,000	$8,454,000	New trailers every 8 years			Closure Cell 1	
21	2038		$709,508	$711,530		$651,040	$411,288	$140,521	$4,113,811		$ -		$585,536	$190,000		$190,000	$7,703,000					
22	2039		$709,508	$709,962		$651,040	$412,408	$140,521	$4,113,811	$8,850,000	$ 35,000		$585,536	$390,000		$190,000	$16,788,000					
23	2040		$709,508	$708,450		$651,040	$413,488	$140,521	$4,113,811		$ 175,000		$710,536	$190,000		$190,000	$8,002,000	Major capital upgrade every 20 years				
24	2041	$1,555,125	$709,508	$706,938		$651,040	$414,568	$140,521	$4,113,811		$ 385,000	$ 1,350,000	$710,536	$190,000		$190,000	$11,117,000					
25	2042		$709,508	$704,036		$651,040	$416,641	$140,521	$4,113,811		$ -		$710,536	$190,000		$190,000	$7,826,000					
26	2043		$709,508	$701,120		$651,040	$418,724	$140,521	$4,113,811		$ 200,000		$710,536	$190,000		$190,000	$8,025,000					
27	2044		$709,508	$698,189	$200,000	$651,040	$420,818	$140,521	$4,113,811		$ -		$710,536	$390,000		$190,000	$8,224,000		New trailers every 8 years			
28	2045	$200,000	$709,508	$695,243		$651,040	$422,922	$140,521	$4,113,811		$ 35,000		$710,536	$190,000		$190,000	$8,059,000	New trailers every 8 years		Amotization period over		
29	2046		$709,508	$692,282		$651,040	$425,036	$140,521	$2,424,724		$ -		$710,536	$190,000		$190,000	$6,134,000					
30	2047		$709,508	$689,307		$651,040	$427,162	$140,521	$2,424,724		$ 585,000		$710,536	$190,000		$190,000	$6,718,000					
31	2048		$709,508	$686,317		$651,040	$429,297	$140,521	$2,424,724		$ -		$710,536	$190,000		$190,000	$6,132,000					
32	2049		$709,508	$683,312		$651,040	$431,444	$140,521	$2,424,724		$ -		$710,536	$390,000		$190,000	$6,331,000					
33	2050		$709,508	$680,292		$651,040	$433,601	$140,521	$2,424,724		$ 1,075,000		$710,536	$190,000		$190,000	$7,205,000					
34	2051		$709,508	$677,257	$241,000	$651,040	$435,769	$140,521	$2,424,724		$ 35,000		$710,536	$190,000		$190,000	$6,405,000					
35	2052		$709,508	$674,206	$2,615,000	$651,040	$437,948	$140,521	$2,424,724		$ -		$710,536	$190,000		$190,000	$8,743,000		New trailers every 8 years			
36	2053	$200,000	$709,508	$671,141		$651,040	$440,138	$140,521	$2,424,724		$ 585,000		$710,536	$190,000		$190,000	$6,913,000	New trailers every 8 years				
37	2054		$709,508	$668,060		$651,040	$442,338	$140,521	$2,424,724		$ -		$710,536	$390,000		$190,000	$6,327,000					
38	2055		$709,508	$664,963		$651,040	$444,550	$140,521	$2,424,724		$ -		$710,536	$190,000		$190,000	$6,126,000					
39	2056		$709,508	$661,851		$651,040	$446,773	$140,521	$2,424,724		$ -		$710,536	$190,000		$190,000	$6,125,000					
40	2057		$709,508	$658,724		$651,040	$449,007	$140,521	$2,424,724		$ 585,000		$710,536	$190,000		$190,000	$6,709,000					
41	2058		$709,508	$655,581		$651,040	$451,252	$140,521	$2,424,724		$ -		$710,536	$190,000		$190,000	$6,123,000					
42	2059		$709,508	$652,422		$651,040	$453,508	$140,521	$2,424,724		$ 35,000		$710,536	$390,000		$190,000	$6,357,000					
43	2060		$709,508	$649,248	$200,000	$651,040	$455,775	$140,521	$2,424,724		$ 175,000		$710,536	$190,000		$190,000	$6,496,000	Major capital upgrade every 20 years	New trailers every 8 years			
44	2061	$1,755,125	$709,508	$646,057		$651,040	$458,054	$140,521	$2,424,724		$ -		$710,536	$190,000		$190,000	$7,876,000	New trailers every 8 years				
45	2062		$709,508	$642,851		$651,040	$460,345	$140,521	$2,424,724		$ -		$710,536	$190,000		$190,000	$6,120,000					
46	2063		$709,508	$639,628		$651,040	$462,646	$140,521	$2,424,724		$ 235,000		$710,536	$190,000		$190,000	$6,354,000					
47	2064		$709,508	$636,390		$651,040	$464,960	$140,521	$2,424,724		$ -		$710,536	$390,000		$190,000	$6,318,000					
48	2065		$709,508	$633,135		$651,040	$467,284	$140,521	$2,424,724		$ 1,285,000		$710,536	$190,000		$190,000	$7,402,000					
49	2066		$709,508	$629,864		$651,040	$469,621	$140,521	$2,424,724		$ -		$710,536	$190,000		$190,000	$6,116,000					
50	2067		$709,508	$626,577		$651,040	$471,969	$140,521	$2,424,724		$ 550,000		$710,536	$190,000		$190,000	$6,665,000					
	Totals	$7,731,275	$33,346,853	$32,577,600	$4,202,000	$28,645,760	$18,791,941	$6,427,825	$151,767,585	$8,850,000	$11,045,000	$4,115,000	$35,452,788	$11,310,000	$10,382,338	$15,379,269	$380,027,000					

Sustane Facility Tipping Fee (1st 25 years) = *$89* per tonne

Sustane Facility Tipping Fee (2nd 25 years) = *$53* per tonne

30 years
$247,184,000 1,651,117 tonnes
$150 per tonne over 30 years

40 years
$314,200,000 2,242,559 tonnes
$140 per tonne over 40 years

50 years
$380,027,000 2,884,138 tonnes
$132 per tonne over 50 years

APPENDIX C: GHG Emissions Assessment

Table 22: GHG assessment of Option 0 - Status Quo

Year		Methane Captured, Destroyed, Oxidized and Emitted - CVWMC							
		Methane Volume	Methane Collected	Methane Destroyed	Methane not Collected & Destroyed	Methane Oxidized	Total Methane Emitted	Tonnes Methane Emitted	Tonnes Methane Destroyed
		From LandGem	75% Collection Efficiency	99% of Collected Methane	Total - Destroyed	10% of Methane not Collected	Total - Destroyed - Oxidized	0.000667 Tonnes/m^3	0.000667 Tonnes/m^3
		m^3/year	m^3/year	m^3/year	m^3/year	m^3/year	m^3/year	tonnes CH_4	tonnes CH_4
0	2017								
1	2018	626,553	469,914	465,215	161,337	15,664	145,673	97	310
2	2019	1,195,291	896,468	887,503	307,787	29,882	277,905	185	592
3	2020	1,712,112	1,284,084	1,271,243	440,869	42,803	398,066	266	848
4	2021	2,182,416	1,636,812	1,620,444	561,972	54,560	507,412	338	1,081
5	2022	2,415,381	1,811,536	1,793,421	621,961	60,385	561,576	375	1,196
6	2023	2,629,235	1,971,926	1,952,207	677,028	65,731	611,297	408	1,302
7	2024	2,826,020	2,119,515	2,098,320	727,700	70,651	657,050	438	1,400
8	2025	3,332,863	2,499,648	2,474,651	858,212	83,322	774,891	517	1,651
9	2026	3,793,875	2,845,406	2,816,952	976,923	94,847	882,076	588	1,879
10	2027	4,213,750	3,160,312	3,128,709	1,085,041	105,344	979,697	653	2,087
11	2028	4,596,631	3,447,474	3,412,999	1,183,633	114,916	1,068,717	713	2,276
12	2029	4,946,286	3,709,715	3,672,618	1,273,669	123,657	1,150,012	767	2,450
13	2030	5,266,075	3,949,556	3,910,061	1,356,014	131,652	1,224,362	817	2,608
14	2031	5,558,954	4,169,216	4,127,523	1,431,431	138,974	1,292,457	862	2,753
15	2032	5,827,593	4,370,695	4,326,988	1,500,605	145,690	1,354,915	904	2,886
16	2033	6,074,402	4,555,802	4,510,244	1,564,159	151,860	1,412,299	942	3,008
17	2034	6,301,569	4,726,177	4,678,915	1,622,654	157,539	1,465,115	977	3,121
18	2035	6,510,838	4,883,129	4,834,297	1,676,541	162,771	1,513,770	1,010	3,224
19	2036	6,703,952	5,027,964	4,977,685	1,726,268	167,599	1,558,669	1,040	3,320
20	2037	6,882,562	5,161,921	5,110,302	1,772,260	172,064	1,600,196	1,067	3,409
21	2038	7,048,002	5,286,002	5,233,142	1,814,861	176,200	1,638,660	1,093	3,491
22	2039	7,201,505	5,401,129	5,347,118	1,854,388	180,038	1,674,350	1,117	3,567
23	2040	7,344,200	5,508,150	5,453,068	1,891,131	183,605	1,707,526	1,139	3,637
24	2041	7,477,139	5,607,854	5,551,776	1,925,363	186,928	1,738,435	1,160	3,703
25	2042	7,601,278	5,700,958	5,643,949	1,957,329	190,032	1,767,297	1,179	3,765
26	2043	7,719,779	5,789,834	5,731,936	1,987,843	192,994	1,794,849	1,197	3,823
27	2044	7,833,293	5,874,970	5,816,220	2,017,073	195,832	1,821,241	1,215	3,879
28	2045	7,942,406	5,956,804	5,897,236	2,045,169	198,560	1,846,609	1,232	3,933
29	2046	8,047,640	6,035,730	5,975,373	2,072,267	201,191	1,871,076	1,248	3,986
30	2047	8,149,466	6,112,100	6,050,979	2,098,488	203,737	1,894,751	1,264	4,036
31	2048	8,248,306	6,186,230	6,124,367	2,123,939	206,208	1,917,731	1,279	4,085
32	2049	8,344,538	6,258,403	6,195,819	2,148,719	208,613	1,940,105	1,294	4,133
33	2050	8,438,501	6,328,876	6,265,587	2,172,914	210,963	1,961,952	1,309	4,179
34	2051	8,530,501	6,397,876	6,333,897	2,196,604	213,263	1,983,342	1,323	4,225
35	2052	8,620,811	6,465,608	6,400,952	2,219,859	215,520	2,004,339	1,337	4,269
36	2053	8,709,677	6,532,258	6,466,935	2,242,742	217,742	2,025,000	1,351	4,313
37	2054	8,797,320	6,597,990	6,532,010	2,265,310	219,933	2,045,377	1,364	4,357
38	2055	8,883,939	6,662,954	6,596,325	2,287,614	222,098	2,065,516	1,378	4,400
39	2056	8,969,712	6,727,284	6,660,011	2,309,701	224,243	2,085,458	1,391	4,442
40	2057	9,054,799	6,791,099	6,723,188	2,331,611	226,370	2,105,241	1,404	4,484

LFG GHG Emissions Summary - CVWMC			
CO_2e Methane Emitted	CO_2 from Methane Destruction	CO_2 from Oxidized Methane	Total GHG Emissions from LFG
21 x Tonnes Emmitted	1 Tonne for Every Tonne Destroyed	1 Tonne for Every Tonne Oxidized	Sum of GHG Emissions
tonnes CO_2e	tonnes CO_2	tonnes CO_2	tonnes CO_2e
2,040	310	10	2,040
3,893	592	20	3,893
5,576	848	29	5,576
7,107	1,081	36	7,107
7,866	1,196	40	7,866
8,562	1,302	44	8,562
9,203	1,400	47	9,203
10,854	1,651	56	10,854
12,355	1,879	63	12,355
13,723	2,087	70	13,723
14,970	2,276	77	14,970
16,108	2,450	82	16,108
17,150	2,608	88	17,150
18,103	2,753	93	18,103
18,978	2,886	97	18,978
19,782	3,008	101	19,782
20,522	3,121	105	20,522
21,203	3,224	109	21,203
21,832	3,320	112	21,832
22,414	3,409	115	22,414
22,953	3,491	118	22,953
23,453	3,567	120	23,453
23,917	3,637	122	23,917
24,350	3,703	125	24,350
24,755	3,765	127	24,755
25,140	3,823	129	25,140
25,510	3,879	131	25,510
25,865	3,933	132	25,865
26,208	3,986	134	26,208
26,540	4,036	136	26,540
26,862	4,085	138	26,862
27,175	4,133	139	27,175
27,481	4,179	141	27,481
27,781	4,225	142	27,781
28,075	4,269	144	28,075
28,364	4,313	145	28,364
28,650	4,357	147	28,650
28,932	4,400	148	28,932
29,211	4,442	150	29,211
29,488	4,484	151	29,488

Electricity Generation and Offsets - CVWMC LF			
Total Gas Collected	Potential Power	Energy Generation	BC Electricity Offset
From LandGEM	200 kW per 100 ft^3/min	Based on Operation 91% of the Year	BC Hydro Offset of 22 Tonnes CO_2e per GWh
ft^3/min	kW	GWh / year	tonnes CO_2e
0	0	0	0
32	63	0	0
60	120	0	0
86	173	0	0
110	220	0	0
122	243	0	0
132	265	0	0
142	285	0	0
168	336	0	0
191	382	0	0
212	425	0	0
232	463	0	0
249	499	0	0
265	531	0	0
280	560	0	0
294	587	0	0
306	612	0	0
318	635	0	0
328	656	0	0
338	676	0	0
347	694	0	0
355	710	0	0
363	726	0	0
370	740	0	0
377	754	0	0
383	766	0	0
389	778	0	0
395	789	0	0
400	800	0	0
406	811	0	0
411	821	0	0
416	831	0	0
421	841	0	0
425	850	0	0
430	860	0	0
434	869	0	0
439	878	0	0
443	887	0	0
448	895	0	0
452	904	0	0
456	913	0	0

Table C1: GHG assessment of Option 0 - Status Quo

Landfill Operations - CVWMC LF			CVWMC LF Emissions	Transfer Station Hauling and Operations			Net Transfer Station Emissions	Year	
Buildings - Fuel and Electricity	Landfill Equipment	GHGs from Landfill Operations		Fuel Consumption	Waste Hauling	Transfer Station Operations			
0.001 Tonnes CO_2e per Tonne Waste	0.004 Tonnes CO_2e per Tonne Waste	Buildings and Equipment	LFG - Electricity Offset + Operations	2.4 L/tonne	0.00269 Tonnes CO_2e / L	0.0044 Tonnes CO_2e / Tonne Waste	Hauling + Operations		
tonnes CO_2e	tonnes CO_2e	tonnes CO_2e	tonnes CO_2e	L	tonnes CO_2e	tonnes CO_2e	tonnes CO_2e		
37	150	187	187	0	0	0		0	2011
38	151	189	2,230	0	0	0	0	1	2012
38	153	191	4,084	0	0	0	0	2	2013
39	155	194	5,769	0	0	0	0	3	2014
27	110	137	7,245	0	0	0	0	4	2015
28	111	139	8,005	0	0	0	0	5	2016
28	112	140	8,703	0	0	0	0	6	2017
48	191	239	9,442	46,597	125	85	211	7	2018
48	193	241	11,095	46,854	126	86	212	8	2019
49	195	243	12,598	47,101	127	86	213	9	2020
49	196	245	13,968	47,335	127	87	214	10	2021
49	198	247	15,217	47,561	128	87	215	11	2022
50	199	249	16,357	47,782	129	88	216	12	2023
50	201	251	17,401	47,992	129	88	217	13	2024
51	202	253	18,356	48,195	130	88	218	14	2025
51	204	255	19,233	48,389	130	89	219	15	2026
51	205	257	20,039	48,576	131	89	220	16	2027
52	207	258	20,780	48,744	131	89	220	17	2028
52	208	260	21,463	48,906	132	90	221	18	2029
52	209	262	22,094	49,066	132	90	222	19	2030
53	211	263	22,677	49,214	132	90	223	20	2031
53	212	265	23,218	49,355	133	90	223	21	2032
53	213	266	23,719	49,489	133	91	224	22	2033
54	214	268	24,185	49,619	133	91	224	23	2034
54	216	269	24,620	49,748	134	91	225	24	2035
54	217	272	25,026	49,997	134	92	226	25	2036
55	219	274	25,414	50,247	135	92	227	26	2037
55	221	276	25,786	50,498	136	93	228	27	2038
56	223	278	26,144	50,751	137	93	230	28	2039
56	224	280	26,489	51,004	137	94	231	29	2040
57	226	283	26,823	51,259	138	94	232	30	2041
57	228	285	27,147	51,516	139	94	233	31	2042
57	230	287	27,462	51,773	139	95	234	32	2043
58	232	290	27,771	52,032	140	95	235	33	2044
58	234	292	28,073	52,292	141	96	237	34	2045
59	236	294	28,369	52,554	141	96	238	35	2046
59	237	297	28,661	52,817	142	97	239	36	2047
60	239	299	28,949	53,081	143	97	240	37	2048
60	241	302	29,233	53,346	144	98	241	38	2049
61	243	304	29,515	53,613	144	98	243	39	2050
61	245	307	29,795	53,881	145	99	244	40	2051

Total CVWMC LF GHGs - 40 years **813,341** **tonnes CO_2e**

Total TS GHGs - 40 years **7,695** **tonnes CO_2e**

Table C2: GHG assessment of Option 1(a) - WTT located in Comox Valley

RDF GHG						Electricity Generation and Offsets - WTT					Net WTT Emissions	Methane Captured, Destroyed, Oxidized and Emitted - CVWMC							
Year		RDF Combustion GHG				Metal - ferrous	Metal - Non-Ferrous	Cardboard	Bio-gas to electricity	BC Electricity Offset		Methane Volume	Methane Collected	Methane Destroyed	Methane not Collected & Destroyed	Methane Oxidized	Total Methane Emitted	Tonnes Methane Emitted	Tonnes Methane Destroyed
		CO_2	CH_4 as CO_2e	N_2O as CO_2e	Total GHG CO_2e	3% of Throughput CO_2e Offset	1.8% of throughput CO2e Offset	7% of Throughout CO_2e Offset	200 kWh/tonne organics	BC Hydro Offset of 22 Tonnes CO_2e per GWh	Combustion - Electricity Offset	From LandGem	75% Collection Efficiency	99% of Collected Methane	Total - Destroyed	10% of Methane not Collected	Total - Destroyed - Oxidized	0.000667 Tonnes/m^3	0.000667 Tonnes/m^3
		tonnes CO_2	tonnes CO_2e	tonnes CO_2e	tonnes CO_2e	tonnes	tonnes	tonnes	GWh	tonnes	tonnes	m^3/year	m^3/year	m^3/year	m^3/year	m^3/year	m^3/year	tonnes CH_4	tonnes CH_4
0	2017	0	0	0	0	0	0	0	0	0	0								
1	2018	0	0	0	0	0	0	0	0	0	0	626,553	469,914	465,215	161,337	15,664	145,673	97	310
2	2019	0	0	0	0	0	0	0	0	0	0	1,195,291	896,468	887,503	307,787	29,882	277,905	185	592
3	2020	0	0	0	0	0	0	0	0	0	0	1,712,112	1,284,084	1,271,243	440,869	42,803	398,066	266	848
4	2021	2,257	0	113	2,370	1,569	4,759	11,371	2	41	-15,370	2,182,416	1,636,812	1,620,444	561,972	54,560	507,412	338	1,081
5	2022	2,282	0	114	2,396	1,587	4,812	11,498	2	41	-15,542	1,972,738	1,479,553	1,464,758	507,980	49,318	458,662	306	977
6	2023	2,308	0	115	2,423	1,604	4,866	11,627	2	42	-15,716	1,785,099	1,338,824	1,325,436	459,663	44,627	415,035	277	884
7	2024	3,928	0	196	4,125	2,731	8,284	19,793	3	71	-26,754	1,617,205	1,212,904	1,200,775	416,430	40,430	376,000	251	801
8	2025	3,928	0	196	4,125	2,731	8,284	19,793	3	71	-26,754	1,479,482	1,109,612	1,098,516	380,967	36,987	343,980	229	733
9	2026	3,928	0	196	4,125	2,731	8,284	19,793	3	71	-26,754	1,363,071	1,022,303	1,012,080	350,991	34,077	316,914	211	675
10	2027	3,928	0	196	4,125	2,731	8,284	19,793	3	71	-26,754	1,265,669	949,252	939,759	325,910	31,642	294,268	196	627
11	2028	3,928	0	196	4,125	2,731	8,284	19,793	3	71	-26,754	1,185,157	888,868	879,979	305,178	29,629	275,549	184	587
12	2029	3,928	0	196	4,125	2,731	8,284	19,793	3	71	-26,754	1,119,688	839,766	831,368	288,320	27,992	260,328	174	555
13	2030	3,928	0	196	4,125	2,731	8,284	19,793	3	71	-26,754	1,067,595	800,696	792,689	274,906	26,690	248,216	166	529
14	2031	3,928	0	196	4,125	2,731	8,284	19,793	3	71	-26,754	1,027,329	770,497	762,792	264,537	25,683	238,854	159	509
15	2032	3,928	0	196	4,125	2,731	8,284	19,793	3	71	-26,754	997,526	748,144	740,663	256,863	24,938	231,925	155	494
16	2033	3,928	0	196	4,125	2,731	8,284	19,793	3	71	-26,754	976,981	732,735	725,408	251,572	24,425	227,148	152	484
17	2034	3,928	0	196	4,125	2,731	8,284	19,793	3	71	-26,754	964,642	723,481	716,247	248,395	24,116	224,279	150	478
18	2035	3,928	0	196	4,125	2,731	8,284	19,793	3	71	-26,754	959,353	719,515	712,320	247,034	23,984	223,050	149	475
19	2036	3,928	0	196	4,125	2,731	8,284	19,793	3	71	-26,754	960,260	720,195	712,993	247,267	24,007	223,260	149	476
20	2037	3,928	0	196	4,125	2,731	8,284	19,793	3	71	-26,754	966,683	725,012	717,762	248,921	24,167	224,754	150	479
21	2038	3,928	0	196	4,125	2,731	8,284	19,793	3	71	-26,754	977,873	733,405	726,071	251,802	24,447	227,356	152	484
22	2039	3,928	0	196	4,125	2,731	8,284	19,793	3	71	-26,754	993,193	744,895	737,446	255,747	24,830	230,917	154	492
23	2040	3,928	0	196	4,125	2,731	8,284	19,793	3	71	-26,754	1,012,099	759,075	751,484	260,616	25,302	235,313	157	501
24	2041	3,928	0	196	4,125	2,731	8,284	19,793	3	71	-26,754	1,034,144	775,608	767,852	266,292	25,854	240,439	160	512
25	2042	3,928	0	196	4,125	2,731	8,284	19,793	3	71	-26,754	1,058,940	794,205	786,263	272,677	26,474	246,204	164	524
26	2043	3,928	0	196	4,125	2,731	8,284	19,793	3	71	-26,754	1,088,446	816,335	808,171	280,275	27,211	253,064	169	539
27	2044	3,928	0	196	4,125	2,731	8,284	19,793	3	71	-26,754	1,122,236	841,677	833,261	288,976	28,056	260,920	174	556
28	2045	3,928	0	196	4,125	2,731	8,284	19,793	3	71	-26,754	1,159,929	869,947	861,247	298,682	28,998	269,683	180	574
29	2046	3,928	0	196	4,125	2,731	8,284	19,793	3	71	-26,754	1,201,183	900,887	891,878	309,305	30,030	279,275	186	595
30	2047	3,928	0	196	4,125	2,731	8,284	19,793	3	71	-26,754	1,245,693	934,270	924,927	320,766	31,142	289,624	193	617
31	2048	3,928	0	196	4,125	2,731	8,284	19,793	3	71	-26,754	1,293,188	969,891	960,192	332,996	32,330	300,666	201	640
32	2049	3,928	0	196	4,125	2,731	8,284	19,793	3	71	-26,754	1,343,423	1,007,567	997,491	345,931	33,586	312,346	208	665
33	2050	3,928	0	196	4,125	2,731	8,284	19,793	3	71	-26,754	1,396,180	1,047,135	1,036,664	359,516	34,905	324,612	217	691
34	2051	3,928	0	196	4,125	2,731	8,284	19,793	3	71	-26,754	1,451,267	1,088,450	1,077,566	373,701	36,282	337,420	225	719
35	2052	3,928	0	196	4,125	2,731	8,284	19,793	3	71	-26,754	1,508,508	1,131,381	1,120,068	388,441	37,713	350,728	234	747
36	2053	3,928	0	196	4,125	2,731	8,284	19,793	3	71	-26,754	1,567,751	1,175,813	1,164,055	403,696	39,194	364,502	243	776
37	2054	3,928	0	196	4,125	2,731	8,284	19,793	3	71	-26,754	1,628,856	1,221,642	1,209,426	419,430	40,721	378,709	253	807
38	2055	3,928	0	196	4,125	2,731	8,284	19,793	3	71	-26,754	1,691,701	1,268,776	1,256,088	435,613	42,293	393,320	262	838
39	2056	3,928	0	196	4,125	2,731	8,284	19,793	3	71	-26,754	1,756,176	1,317,132	1,303,961	452,215	43,904	408,311	272	870
40	2057	3,928	0	196	4,125	2,731	8,284	19,793	3	71	-26,754	1,822,185	1,366,639	1,352,972	469,213	45,555	423,658	283	902

Total Technology GHGs - 40 years **-956,256** **tonnes CO_2e**

RDF per tonne waste throughput: 27%

WTE Emissions Factors

CO_2 =	0.32	tonnes / tonne MSW
CH_4 =	0.0000031	tonnes CO_2e / tonne MSW
N_2O =	0.016	tones CO_2e / tonne MSW

Based on calculations for Vancouver waste for WTE at 70% diversion
Source: CH2M HILL (2009) Technical Memorandum Comparison of Greenhouse Gas Emissions from Waste-to-Energy Facilities and the Vancouver Landfill.

LHV MSW =	10.5	GJ/tonne
	2917	kWh/tonne
Electrical Conversion Efficiency =	16%	

Table C2: GHG assessment of Option 1(a) - WTT located in Comox Valley

LFG GHG Emissions Summary - CVWMC			
CO_2e Methane Emitted	CO_2 from Methane Destruction	CO_2 from Oxidized Methane	Total GHG Emissions from LFG
21 x Tonnes Emmitted	1 Tonne for Every Tonne Destroyed	1 Tonne for Every Tonne Oxidized	Sum of GHG Emissions
tonnes CO_2e	tonnes CO_2	tonnes CO_2	tonnes CO_2e
2,040	310	10	2,040
3,893	592	20	3,893
5,576	848	29	5,576
7,107	1,081	36	7,107
6,424	977	33	6,424
5,813	884	30	5,813
5,267	801	27	5,267
4,818	733	25	4,818
4,439	675	23	4,439
4,122	627	21	4,122
3,860	587	20	3,860
3,646	555	19	3,646
3,477	529	18	3,477
3,346	509	17	3,346
3,249	494	17	3,249
3,182	484	16	3,182
3,141	478	16	3,141
3,124	475	16	3,124
3,127	476	16	3,127
3,148	479	16	3,148
3,185	484	16	3,185
3,234	492	17	3,234
3,296	501	17	3,296
3,368	512	17	3,368
3,449	524	18	3,449
3,545	539	18	3,545
3,655	556	19	3,655
3,777	574	19	3,777
3,912	595	20	3,912
4,057	617	21	4,057
4,211	640	22	4,211
4,375	665	22	4,375
4,547	691	23	4,547
4,726	719	24	4,726
4,913	747	25	4,913
5,106	776	26	5,106
5,305	807	27	5,305
5,509	838	28	5,509
5,719	870	29	5,719
5,934	902	30	5,934

Electricity Generation and Offsets - CVWMC LF			
Total Gas Collected	Potential Power	Energy Generation	BC Electricity Offset
From LandGEM	200 kW per 100 ft^3/min	Based on Operation 91% of the Year	BC Hydro Offset of 22 Tonnes CO_2e per GWh
ft^3/min	kW	GWh / year	tonnes CO_2e
0	0	0	0
32	63	0	0
60	120	0	0
86	173	0	0
110	220	0	0
99	199	0	0
90	180	0	0
81	163	0	0
75	149	0	0
69	137	0	0
64	128	0	0
60	119	0	0
56	113	0	0
54	108	0	0
52	104	0	0
50	101	0	0
49	98	0	0
49	97	0	0
48	97	0	0
48	97	0	0
49	97	0	0
49	99	0	0
50	100	0	0
51	102	0	0
52	104	0	0
53	107	0	0
55	110	0	0
57	113	0	0
58	117	0	0
61	121	0	0
63	126	0	0
65	130	0	0
68	135	0	0
70	141	0	0
73	146	0	0
76	152	0	0
79	158	0	0
82	164	0	0
85	170	0	0
88	177	0	0
92	184	0	0

Landfill Operations - CVWMC LF		
Buildings - Fuel and Electricity	Landfill Equipment	GHGs from Landfill Operations
0.001 Tonnes CO_2e per Tonne Waste	0.004 Tonnes CO_2e per Tonne Waste	Buildings and Equipment
tonnes CO_2e	tonnes CO_2e	tonnes CO_2e
37	150	187
38	151	189
38	153	191
39	155	194
1	4	5
1	4	5
1	4	5
2	7	9
2	9	11
3	11	13
3	12	15
3	14	17
4	15	19
4	17	21
5	18	23
5	20	25
5	21	27
6	23	28
6	24	30
6	25	32
7	27	33
7	28	35
7	29	37
8	30	38
8	32	40
8	33	42
9	35	44
9	37	46
10	39	48
10	40	51
11	42	53
11	44	55
11	46	57
12	48	60
12	50	62
13	52	65
13	54	67
14	55	69
14	57	72
15	59	74
15	61	77

CVWMC LF Emissions
LFG - Electricity Offset + Operations
tonnes CO_2e
187
2,230
4,084
5,769
7,113
6,430
5,819
5,276
4,829
4,452
4,137
3,877
3,666
3,498
3,369
3,273
3,208
3,170
3,154
3,159
3,182
3,220
3,271
3,334
3,407
3,490
3,589
3,701
3,826
3,962
4,110
4,267
4,433
4,607
4,788
4,977
5,173
5,374
5,581
5,793
6,011

Transfer Station Hauling and Operations		
Fuel Consumption	Waste Hauling	Transfer Station Operations
2.4 L/tonne	0.00269 Tonnes CO_2e / L	0.0044 Tonnes CO_2e / Tonne Waste
L	tonnes CO_2e	tonnes CO_2e
0	0	0
0	0	0
0	0	0
0	0	0
0	0	0
0	0	0
0	0	0
46,597	125	85
46,854	126	86
47,101	127	86
47,335	127	87
47,561	128	87
47,782	129	88
47,992	129	88
48,195	130	88
48,389	130	89
48,576	131	89
48,744	131	89
48,906	132	90
49,066	132	90
49,214	132	90
49,355	133	90
49,489	133	91
49,619	133	91
49,748	134	91
49,997	134	92
50,247	135	92
50,498	136	93
50,751	137	93
51,004	137	94
51,259	138	94
51,516	139	94
51,773	139	95
52,032	140	95
52,292	141	96
52,554	141	96
52,817	142	97
53,081	143	97
53,346	144	98
53,613	144	98
53,881	145	99

Net Transfer Station Emissions	Year	
Hauling + Operations		
tonnes CO_2e		
	0	2011
0	1	2012
0	2	2013
0	3	2014
0	4	2015
0	5	2016
0	6	2017
211	7	2018
212	8	2019
213	9	2020
214	10	2021
215	11	2022
216	12	2023
217	13	2024
218	14	2025
219	15	2026
220	16	2027
220	17	2028
221	18	2029
222	19	2030
223	20	2031
223	21	2032
224	22	2033
224	23	2034
225	24	2035
226	25	2036
227	26	2037
228	27	2038
230	28	2039
231	29	2040
232	30	2041
233	31	2042
234	32	2043
235	33	2044
237	34	2045
238	35	2046
239	36	2047
240	37	2048
241	38	2049
243	39	2050
244	40	2051

Total CVWMC LF GHGs - 40 years **170,794** **tonnes CO_2e**

Total TS GHGs - 40 years **7,695** **tonnes CO_2e**

Table C3: GHG assessment of Option 1(b) - WTT located in Campbell River

RDF GHG						Electricity Generation and Offsets - WTT					Net WTT Emissions	Methane Captured, Destroyed, Oxidized and Emitted - CVWMC							
Year		RDF Combustion GHG				Metal - ferrous	Metal - Non-Ferrous	Cardboard	Bio-gas to electricity	BC Electricity Offset		Methane Volume	Methane Collected	Methane Destroyed	Methane not Collected & Destroyed	Methane Oxidized	Total Methane Emitted	Tonnes Methane Emitted	Tonnes Methane Destroyed
		CO_2	CH_4 as CO_2e	N_2O as CO_2e	Total GHG CO_2e	3% of Throughput CO_2e Offset	1.8% of throughput CO2e Offset	7% of Throughout CO_2e Offset	200 kWh/tonne organics	BC Hydro Offset of 22 Tonnes CO_2e per GWh	Combustion - Electricity Offset	From LandGem	75% Collection Efficiency	99% of Collected Methane	Total - Destroyed	10% of Methane not Collected	Total - Destroyed - Oxidized	0.000667 Tonnes/m^3	0.000667 Tonnes/m^3
		tonnes CO_2	tonnes CO_2e	tonnes CO_2e	tonnes CO_2e	tonnes	tonnes	tonnes	GWh	tonnes	tonnes	m^3/year	m^3/year	m^3/year	m^3/year	m^3/year	m^3/year	tonnes CH_4	tonnes CH_4
0	2017	0	0	0	0	0	0	0	0	0	0								
1	2018	0	0	0	0	0	0	0	0	0	0	626,553	469,914	465,215	161,337	15,664	145,673	97	310
2	2019	0	0	0	0	0	0	0	0	0	0	1,195,291	896,468	887,503	307,787	29,882	277,905	185	592
3	2020	0	0	0	0	0	0	0	0	0	0	1,712,112	1,284,084	1,271,243	440,869	42,803	398,066	266	848
4	2021	2,257	0	113	2,370	1,569	4,759	11,371	2	41	-15,370	2,182,416	1,636,812	1,620,444	561,972	54,560	507,412	338	1,081
5	2022	2,282	0	114	2,396	1,587	4,812	11,498	2	41	-15,542	1,972,738	1,479,553	1,464,758	507,980	49,318	458,662	306	977
6	2023	2,308	0	115	2,423	1,604	4,866	11,627	2	42	-15,716	1,785,099	1,338,824	1,325,436	459,663	44,627	415,035	277	884
7	2024	3,928	0	196	4,125	2,731	8,284	19,793	3	71	-26,754	1,617,205	1,212,904	1,200,775	416,430	40,430	376,000	251	801
8	2025	3,928	0	196	4,125	2,731	8,284	19,793	3	71	-26,754	1,479,482	1,109,612	1,098,516	380,967	36,987	343,980	229	733
9	2026	3,928	0	196	4,125	2,731	8,284	19,793	3	71	-26,754	1,363,071	1,022,303	1,012,080	350,991	34,077	316,914	211	675
10	2027	3,928	0	196	4,125	2,731	8,284	19,793	3	71	-26,754	1,265,669	949,252	939,759	325,910	31,642	294,268	196	627
11	2028	3,928	0	196	4,125	2,731	8,284	19,793	3	71	-26,754	1,185,157	888,868	879,979	305,178	29,629	275,549	184	587
12	2029	3,928	0	196	4,125	2,731	8,284	19,793	3	71	-26,754	1,119,688	839,766	831,368	288,320	27,992	260,328	174	555
13	2030	3,928	0	196	4,125	2,731	8,284	19,793	3	71	-26,754	1,067,595	800,696	792,689	274,906	26,690	248,216	166	529
14	2031	3,928	0	196	4,125	2,731	8,284	19,793	3	71	-26,754	1,027,329	770,497	762,792	264,537	25,683	238,854	159	509
15	2032	3,928	0	196	4,125	2,731	8,284	19,793	3	71	-26,754	997,526	748,144	740,663	256,863	24,938	231,925	155	494
16	2033	3,928	0	196	4,125	2,731	8,284	19,793	3	71	-26,754	976,981	732,735	725,408	251,572	24,425	227,148	152	484
17	2034	3,928	0	196	4,125	2,731	8,284	19,793	3	71	-26,754	964,642	723,481	716,247	248,395	24,116	224,279	150	478
18	2035	3,928	0	196	4,125	2,731	8,284	19,793	3	71	-26,754	959,353	719,515	712,320	247,034	23,984	223,050	149	475
19	2036	3,928	0	196	4,125	2,731	8,284	19,793	3	71	-26,754	960,260	720,195	712,993	247,267	24,007	223,260	149	476
20	2037	3,928	0	196	4,125	2,731	8,284	19,793	3	71	-26,754	966,683	725,012	717,762	248,921	24,167	224,754	150	479
21	2038	3,928	0	196	4,125	2,731	8,284	19,793	3	71	-26,754	977,873	733,405	726,071	251,802	24,447	227,356	152	484
22	2039	3,928	0	196	4,125	2,731	8,284	19,793	3	71	-26,754	993,193	744,895	737,446	255,747	24,830	230,917	154	492
23	2040	3,928	0	196	4,125	2,731	8,284	19,793	3	71	-26,754	1,012,099	759,075	751,484	260,616	25,302	235,313	157	501
24	2041	3,928	0	196	4,125	2,731	8,284	19,793	3	71	-26,754	1,034,144	775,608	767,852	266,292	25,854	240,439	160	512
25	2042	3,928	0	196	4,125	2,731	8,284	19,793	3	71	-26,754	1,058,940	794,205	786,263	272,677	26,474	246,204	164	524
26	2043	3,928	0	196	4,125	2,731	8,284	19,793	3	71	-26,754	1,088,446	816,335	808,171	280,275	27,211	253,064	169	539
27	2044	3,928	0	196	4,125	2,731	8,284	19,793	3	71	-26,754	1,122,236	841,677	833,261	288,976	28,056	260,920	174	556
28	2045	3,928	0	196	4,125	2,731	8,284	19,793	3	71	-26,754	1,159,929	869,947	861,247	298,682	28,998	269,683	180	574
29	2046	3,928	0	196	4,125	2,731	8,284	19,793	3	71	-26,754	1,201,183	900,887	891,878	309,305	30,030	279,275	186	595
30	2047	3,928	0	196	4,125	2,731	8,284	19,793	3	71	-26,754	1,245,693	934,270	924,927	320,766	31,142	289,624	193	617
31	2048	3,928	0	196	4,125	2,731	8,284	19,793	3	71	-26,754	1,293,188	969,891	960,192	332,996	32,330	300,666	201	640
32	2049	3,928	0	196	4,125	2,731	8,284	19,793	3	71	-26,754	1,343,423	1,007,567	997,491	345,931	33,586	312,346	208	665
33	2050	3,928	0	196	4,125	2,731	8,284	19,793	3	71	-26,754	1,396,180	1,047,135	1,036,664	359,516	34,905	324,612	217	691
34	2051	3,928	0	196	4,125	2,731	8,284	19,793	3	71	-26,754	1,451,267	1,088,450	1,077,566	373,701	36,282	337,420	225	719
35	2052	3,928	0	196	4,125	2,731	8,284	19,793	3	71	-26,754	1,508,508	1,131,381	1,120,068	388,441	37,713	350,728	234	747
36	2053	3,928	0	196	4,125	2,731	8,284	19,793	3	71	-26,754	1,567,751	1,175,813	1,164,055	403,696	39,194	364,502	243	776
37	2054	3,928	0	196	4,125	2,731	8,284	19,793	3	71	-26,754	1,628,856	1,221,642	1,209,426	419,430	40,721	378,709	253	807
38	2055	3,928	0	196	4,125	2,731	8,284	19,793	3	71	-26,754	1,691,701	1,268,776	1,256,088	435,613	42,293	393,320	262	838
39	2056	3,928	0	196	4,125	2,731	8,284	19,793	3	71	-26,754	1,756,176	1,317,132	1,303,961	452,215	43,904	408,311	272	870
40	2057	3,928	0	196	4,125	2,731	8,284	19,793	3	71	-26,754	1,822,185	1,366,639	1,352,972	469,213	45,555	423,658	283	902

Total Technology GHGs - 40 years **-956,260** **tonnes CO_2e**

RDF per tonne waste throughput: 27%

WTE Emissions Factors

CO_2 =	0.32	tonnes / tonne MSW
CH_4 =	0.0000031	tonnes CO_2e / tonne MSW
N_2O =	0.016	tones CO_2e / tonne MSW

Based on calculations for Vancouver waste for WTE at 70% diversion
Source: CH2M HILL (2009) Technical Memorandum Comparison of Greenhouse Gas Emissions from Waste-to-Energy Facilities and the Vancouver Landfill.

LHV MSW =	10.5	GJ/tonne
	2917	kWh/tonne
Electrical Conversion Efficiency =	16%	

Table C3: GHG assessment of Option 1(b) - WTT located in Campbell River

LFG GHG Emissions Summary - CVWMC			
CO_2e Methane Emitted	CO_2 from Methane Destruction	CO_2 from Oxidized Methane	Total GHG Emissions from LFG
21 x Tonnes Emmitted	1 Tonne for Every Tonne Destroyed	1 Tonne for Every Tonne Oxidized	Sum of GHG Emissions
tonnes CO_2e	tonnes CO_2	tonnes CO_2	tonnes CO_2e
2,040	310	10	2,040
3,893	592	20	3,893
5,576	848	29	5,576
7,107	1,081	36	7,107
6,424	977	33	6,424
5,813	884	30	5,813
5,267	801	27	5,267
4,818	733	25	4,818
4,439	675	23	4,439
4,122	627	21	4,122
3,860	587	20	3,860
3,646	555	19	3,646
3,477	529	18	3,477
3,346	509	17	3,346
3,249	494	17	3,249
3,182	484	16	3,182
3,141	478	16	3,141
3,124	475	16	3,124
3,127	476	16	3,127
3,148	479	16	3,148
3,185	484	16	3,185
3,234	492	17	3,234
3,296	501	17	3,296
3,368	512	17	3,368
3,449	524	18	3,449
3,545	539	18	3,545
3,655	556	19	3,655
3,777	574	19	3,777
3,912	595	20	3,912
4,057	617	21	4,057
4,211	640	22	4,211
4,375	665	22	4,375
4,547	691	23	4,547
4,726	719	24	4,726
4,913	747	25	4,913
5,106	776	26	5,106
5,305	807	27	5,305
5,509	838	28	5,509
5,719	870	29	5,719
5,934	902	30	5,934

Electricity Generation and Offsets - CVWMC LF			
Total Gas Collected	Potential Power	Energy Generation	BC Electricity Offset
From LandGEM	200 kW per 100 ft^3/min	Based on Operation 91% of the Year	BC Hydro Offset of 22 Tonnes CO_2e per GWh
ft^3/min	kW	GWh / year	tonnes CO_2e
0	0	0	0
32	63	0	0
60	120	0	0
86	173	0	0
110	220	0	0
99	199	0	0
90	180	0	0
81	163	0	0
75	149	0	0
69	137	0	0
64	128	0	0
60	119	0	0
56	113	0	0
54	108	0	0
52	104	0	0
50	101	0	0
49	98	0	0
49	97	0	0
48	97	0	0
48	97	0	0
49	97	0	0
49	99	0	0
50	100	0	0
51	102	0	0
52	104	0	0
53	107	0	0
55	110	0	0
57	113	0	0
58	117	0	0
61	121	0	0
63	126	0	0
65	130	0	0
68	135	0	0
70	141	0	0
73	146	0	0
76	152	0	0
79	158	0	0
82	164	0	0
85	170	0	0
88	177	0	0
92	184	0	0

Landfill Operations - CVWMC LF		
Buildings - Fuel and Electricity	Landfill Equipment	GHGs from Landfill Operations
0.001 Tonnes CO_2e per Tonne Waste	0.004 Tonnes CO_2e per Tonne Waste	Buildings and Equipment
tonnes CO_2e	tonnes CO_2e	tonnes CO_2e
37	150	187
38	151	189
38	153	191
39	155	194
1	4	5
1	4	5
1	4	5
2	7	9
2	9	11
3	11	13
3	12	15
3	14	17
4	15	19
4	17	21
5	18	23
5	20	25
5	21	27
6	23	28
6	24	30
6	25	32
7	27	33
7	28	35
7	29	37
8	30	38
8	32	40
8	33	42
9	35	44
9	37	46
10	39	48
10	40	51
11	42	53
11	44	55
11	46	57
12	48	60
12	50	62
13	52	65
13	54	67
14	55	69
14	57	72
15	59	74
15	61	77

CVWMC LF Emissions
LFG - Electricity Offset + Operations
tonnes CO_2e
187
2,230
4,084
5,769
7,113
6,430
5,819
5,276
4,829
4,452
4,137
3,877
3,666
3,498
3,369
3,273
3,208
3,170
3,154
3,159
3,182
3,220
3,271
3,334
3,407
3,490
3,589
3,701
3,826
3,962
4,110
4,267
4,433
4,607
4,788
4,977
5,173
5,374
5,581
5,793
6,011

Transfer Station Hauling and Operations		
Fuel Consumption	Waste Hauling	Transfer Station Operations
2.4 L/tonne	0.00269 Tonnes CO_2e / L	0.0044 Tonnes CO_2e / Tonne Waste
L	tonnes CO_2e	tonnes CO_2e
0	0	0
84,628	228	116
85,576	230	118
86,534	233	119
100,710	271	117
100,454	270	116
100,206	270	116
99,973	269	116
99,746	268	115
99,526	268	115
99,315	267	114
99,113	267	114
98,919	266	114
98,732	266	113
98,564	265	113
98,401	265	113
98,242	264	112
98,093	264	112
97,953	263	112
97,819	263	112
97,689	263	111
97,560	262	111
97,311	262	111
97,061	261	110
96,810	260	110
96,557	260	109
96,303	259	109
96,048	258	108
95,792	258	108
95,534	257	107
95,276	256	107
95,015	256	106
94,754	255	106
94,491	254	105
94,227	253	105
93,962	253	104
93,695	252	104
93,427	251	104

Net Transfer Station Emissions	Year	
Hauling + Operations		
tonnes CO_2e		
	0	2011
0	1	2012
0	2	2013
0	3	2014
344	4	2015
348	5	2016
352	6	2017
388	7	2018
387	8	2019
385	9	2020
384	10	2021
383	11	2022
382	12	2023
381	13	2024
381	14	2025
380	15	2026
379	16	2027
378	17	2028
377	18	2029
377	19	2030
376	20	2031
375	21	2032
375	22	2033
374	23	2034
374	24	2035
372	25	2036
371	26	2037
370	27	2038
369	28	2039
368	29	2040
367	30	2041
366	31	2042
364	32	2043
363	33	2044
362	34	2045
361	35	2046
360	36	2047
358	37	2048
357	38	2049
356	39	2050
355	40	2051

Total CVWMC LF GHGs - 40 years **170,794** **tonnes CO_2e**

Total TS GHGs - 40 years **13,699** **tonnes CO_2e**

Table C4: GHG assessment of Option 1(c) - WTT located in Gold River

RDF GHG						Electricity Generation and Offsets - WTT					Net WTT Emissions	Methane Captured, Destroyed, Oxidized and Emitted - CVWMC							
Year		RDF Combustion GHG				Metal - ferrous	Metal - Non-Ferrous	Cardboard	Bio-gas to electricity	BC Electricity Offset		Methane Volume	Methane Collected	Methane Destroyed	Methane not Collected & Destroyed	Methane Oxidized	Total Methane Emitted	Tonnes Methane Emitted	Tonnes Methane Destroyed
		CO_2	CH_4 as CO_2e	N_2O as CO_2e	Total GHG CO_2e	3% of Throughput CO_2e Offset	1.8% of throughput CO2e Offset	7% of Throughout CO_2e Offset	200 kWh/tonne organics	BC Hydro Offset of 22 Tonnes CO_2e per GWh	Combustion - Electricity Offset	From LandGem	75% Collection Efficiency	99% of Collected Methane	Total - Destroyed	10% of Methane not Collected	Total - Destroyed - Oxidized	0.000667 Tonnes/m^3	0.000667 Tonnes/m^3
		tonnes CO_2	tonnes CO_2e	tonnes CO_2e	tonnes CO_2e	tonnes	tonnes	tonnes	GWh	tonnes	tonnes	m^3/year	m^3/year	m^3/year	m^3/year	m^3/year	m^3/year	tonnes CH_4	tonnes CH_4
0	2017	0	0	0	0	0	0	0	0	0	0								
1	2018	0	0	0	0	0	0	0	0	0	0	626,553	469,914	465,215	161,337	15,664	145,673	97	310
2	2019	0	0	0	0	0	0	0	0	0	0	1,195,291	896,468	887,503	307,787	29,882	277,905	185	592
3	2020	0	0	0	0	0	0	0	0	0	0	1,712,112	1,284,084	1,271,243	440,869	42,803	398,066	266	848
4	2021	2,257	0	113	2,370	1,569	4,759	11,371	2	41	-15,370	2,182,416	1,636,812	1,620,444	561,972	54,560	507,412	338	1,081
5	2022	2,282	0	114	2,396	1,587	4,812	11,498	2	41	-15,542	1,972,738	1,479,553	1,464,758	507,980	49,318	458,662	306	977
6	2023	2,308	0	115	2,423	1,604	4,866	11,627	2	42	-15,716	1,785,099	1,338,824	1,325,436	459,663	44,627	415,035	277	884
7	2024	3,928	0	196	4,125	2,731	8,284	19,793	3	71	-26,754	1,617,205	1,212,904	1,200,775	416,430	40,430	376,000	251	801
8	2025	3,928	0	196	4,125	2,731	8,284	19,793	3	71	-26,754	1,479,482	1,109,612	1,098,516	380,967	36,987	343,980	229	733
9	2026	3,928	0	196	4,125	2,731	8,284	19,793	3	71	-26,754	1,363,071	1,022,303	1,012,080	350,991	34,077	316,914	211	675
10	2027	3,928	0	196	4,125	2,731	8,284	19,793	3	71	-26,754	1,265,669	949,252	939,759	325,910	31,642	294,268	196	627
11	2028	3,928	0	196	4,125	2,731	8,284	19,793	3	71	-26,754	1,185,157	888,868	879,979	305,178	29,629	275,549	184	587
12	2029	3,928	0	196	4,125	2,731	8,284	19,793	3	71	-26,754	1,119,688	839,766	831,368	288,320	27,992	260,328	174	555
13	2030	3,928	0	196	4,125	2,731	8,284	19,793	3	71	-26,754	1,067,595	800,696	792,689	274,906	26,690	248,216	166	529
14	2031	3,928	0	196	4,125	2,731	8,284	19,793	3	71	-26,754	1,027,329	770,497	762,792	264,537	25,683	238,854	159	509
15	2032	3,928	0	196	4,125	2,731	8,284	19,793	3	71	-26,754	997,526	748,144	740,663	256,863	24,938	231,925	155	494
16	2033	3,928	0	196	4,125	2,731	8,284	19,793	3	71	-26,754	976,981	732,735	725,408	251,572	24,425	227,148	152	484
17	2034	3,928	0	196	4,125	2,731	8,284	19,793	3	71	-26,754	964,642	723,481	716,247	248,395	24,116	224,279	150	478
18	2035	3,928	0	196	4,125	2,731	8,284	19,793	3	71	-26,754	959,353	719,515	712,320	247,034	23,984	223,050	149	475
19	2036	3,928	0	196	4,125	2,731	8,284	19,793	3	71	-26,754	960,260	720,195	712,993	247,267	24,007	223,260	149	476
20	2037	3,928	0	196	4,125	2,731	8,284	19,793	3	71	-26,754	966,683	725,012	717,762	248,921	24,167	224,754	150	479
21	2038	3,928	0	196	4,125	2,731	8,284	19,793	3	71	-26,754	977,873	733,405	726,071	251,802	24,447	227,356	152	484
22	2039	3,928	0	196	4,125	2,731	8,284	19,793	3	71	-26,754	993,193	744,895	737,446	255,747	24,830	230,917	154	492
23	2040	3,928	0	196	4,125	2,731	8,284	19,793	3	71	-26,754	1,012,099	759,075	751,484	260,616	25,302	235,313	157	501
24	2041	3,928	0	196	4,125	2,731	8,284	19,793	3	71	-26,754	1,034,144	775,608	767,852	266,292	25,854	240,439	160	512
25	2042	3,928	0	196	4,125	2,731	8,284	19,793	3	71	-26,754	1,058,940	794,205	786,263	272,677	26,474	246,204	164	524
26	2043	3,928	0	196	4,125	2,731	8,284	19,793	3	71	-26,754	1,088,446	816,335	808,171	280,275	27,211	253,064	169	539
27	2044	3,928	0	196	4,125	2,731	8,284	19,793	3	71	-26,754	1,122,236	841,677	833,261	288,976	28,056	260,920	174	556
28	2045	3,928	0	196	4,125	2,731	8,284	19,793	3	71	-26,754	1,159,929	869,947	861,247	298,682	28,998	269,683	180	574
29	2046	3,928	0	196	4,125	2,731	8,284	19,793	3	71	-26,754	1,201,183	900,887	891,878	309,305	30,030	279,275	186	595
30	2047	3,928	0	196	4,125	2,731	8,284	19,793	3	71	-26,754	1,245,693	934,270	924,927	320,766	31,142	289,624	193	617
31	2048	3,928	0	196	4,125	2,731	8,284	19,793	3	71	-26,754	1,293,188	969,891	960,192	332,996	32,330	300,666	201	640
32	2049	3,928	0	196	4,125	2,731	8,284	19,793	3	71	-26,754	1,343,423	1,007,567	997,491	345,931	33,586	312,346	208	665
33	2050	3,928	0	196	4,125	2,731	8,284	19,793	3	71	-26,754	1,396,180	1,047,135	1,036,664	359,516	34,905	324,612	217	691
34	2051	3,928	0	196	4,125	2,731	8,284	19,793	3	71	-26,754	1,451,267	1,088,450	1,077,566	373,701	36,282	337,420	225	719
35	2052	3,928	0	196	4,125	2,731	8,284	19,793	3	71	-26,754	1,508,508	1,131,381	1,120,068	388,441	37,713	350,728	234	747
36	2053	3,928	0	196	4,125	2,731	8,284	19,793	3	71	-26,754	1,567,751	1,175,813	1,164,055	403,696	39,194	364,502	243	776
37	2054	3,928	0	196	4,125	2,731	8,284	19,793	3	71	-26,754	1,628,856	1,221,642	1,209,426	419,430	40,721	378,709	253	807
38	2055	3,928	0	196	4,125	2,731	8,284	19,793	3	71	-26,754	1,691,701	1,268,776	1,256,088	435,613	42,293	393,320	262	838
39	2056	3,928	0	196	4,125	2,731	8,284	19,793	3	71	-26,754	1,756,176	1,317,132	1,303,961	452,215	43,904	408,311	272	870
40	2057	3,928	0	196	4,125	2,731	8,284	19,793	3	71	-26,754	1,822,185	1,366,639	1,352,972	469,213	45,555	423,658	283	902

Total Technology GHGs - 40 years **-956,260** **tonnes CO_2e**

RDF per tonne waste throughput: 27%

WTE Emissions Factors

CO_2 =	0.32	tonnes / tonne MSW
CH_4 =	0.0000031	tonnes CO_2e / tonne MSW
N_2O =	0.016	tones CO_2e / tonne MSW

Based on calculations for Vancouver waste for WTE at 70% diversion
Source: CH2M HILL (2009) Technical Memorandum Comparison of Greenhouse Gas Emissions from Waste-to-Energy Facilities and the Vancouver Landfill.

LHV MSW =	10.5	GJ/tonne
	2917	kWh/tonne
Electrical Conversion Efficiency =	16%	

Table C4: GHG assessment of Option 1(c) - WTT located in Gold River

LFG GHG Emissions Summary - CVWMC			
CO_2e Methane Emitted	CO_2 from Methane Destruction	CO_2 from Oxidized Methane	Total GHG Emissions from LFG
21 x Tonnes Emmitted	1 Tonne for Every Tonne Destroyed	1 Tonne for Every Tonne Oxidized	Sum of GHG Emissions
tonnes CO_2e	tonnes CO_2	tonnes CO_2	tonnes CO_2e
2,040	310	10	2,040
3,893	592	20	3,893
5,576	848	29	5,576
7,107	1,081	36	7,107
6,424	977	33	6,424
5,813	884	30	5,813
5,267	801	27	5,267
4,818	733	25	4,818
4,439	675	23	4,439
4,122	627	21	4,122
3,860	587	20	3,860
3,646	555	19	3,646
3,477	529	18	3,477
3,346	509	17	3,346
3,249	494	17	3,249
3,182	484	16	3,182
3,141	478	16	3,141
3,124	475	16	3,124
3,127	476	16	3,127
3,148	479	16	3,148
3,185	484	16	3,185
3,234	492	17	3,234
3,296	501	17	3,296
3,368	512	17	3,368
3,449	524	18	3,449
3,545	539	18	3,545
3,655	556	19	3,655
3,777	574	19	3,777
3,912	595	20	3,912
4,057	617	21	4,057
4,211	640	22	4,211
4,375	665	22	4,375
4,547	691	23	4,547
4,726	719	24	4,726
4,913	747	25	4,913
5,106	776	26	5,106
5,305	807	27	5,305
5,509	838	28	5,509
5,719	870	29	5,719
5,934	902	30	5,934

Electricity Generation and Offsets - CVWMC LF			
Total Gas Collected	Potential Power	Energy Generation	BC Electricity Offset
From LandGEM	200 kW per 100 ft^3/min	Based on Operation 91% of the Year	BC Hydro Offset of 22 Tonnes CO_2e per GWh
ft^3/min	kW	GWh / year	tonnes CO_2e
0	0	0	0
32	63	0	0
60	120	0	0
86	173	0	0
110	220	0	0
99	199	0	0
90	180	0	0
81	163	0	0
75	149	0	0
69	137	0	0
64	128	0	0
60	119	0	0
56	113	0	0
54	108	0	0
52	104	0	0
50	101	0	0
49	98	0	0
49	97	0	0
48	97	0	0
48	97	0	0
49	97	0	0
49	99	0	0
50	100	0	0
51	102	0	0
52	104	0	0
53	107	0	0
55	110	0	0
57	113	0	0
58	117	0	0
61	121	0	0
63	126	0	0
65	130	0	0
68	135	0	0
70	141	0	0
73	146	0	0
76	152	0	0
79	158	0	0
82	164	0	0
85	170	0	0
88	177	0	0
92	184	0	0

Landfill Operations - CVWMC LF		
Buildings - Fuel and Electricity	Landfill Equipment	GHGs from Landfill Operations
0.001 Tonnes CO_2e per Tonne Waste	0.004 Tonnes CO_2e per Tonne Waste	Buildings and Equipment
tonnes CO_2e	tonnes CO_2e	tonnes CO_2e
37	150	187
38	151	189
38	153	191
39	155	194
1	4	5
1	4	5
1	4	5
2	7	9
2	9	11
3	11	13
3	12	15
3	14	17
4	15	19
4	17	21
5	18	23
5	20	25
5	21	27
6	23	28
6	24	30
6	25	32
7	27	33
7	28	35
7	29	37
8	30	38
8	32	40
8	33	42
9	35	44
9	37	46
10	39	48
10	40	51
11	42	53
11	44	55
11	46	57
12	48	60
12	50	62
13	52	65
13	54	67
14	55	69
14	57	72
15	59	74
15	61	77

CVWMC LF Emissions
LFG - Electricity Offset + Operations
tonnes CO_2e
187
2,230
4,084
5,769
7,113
6,430
5,819
5,276
4,829
4,452
4,137
3,877
3,666
3,498
3,369
3,273
3,208
3,170
3,154
3,159
3,182
3,220
3,271
3,334
3,407
3,490
3,589
3,701
3,826
3,962
4,110
4,267
4,433
4,607
4,788
4,977
5,173
5,374
5,581
5,793
6,011

Transfer Station Hauling and Operations		
Fuel Consumption	Waste Hauling	Transfer Station Operations
2.4 L/tonne	0.00269 Tonnes CO_2e / L	0.0044 Tonnes CO_2e / Tonne Waste
L	tonnes CO_2e	tonnes CO_2e
0	0	0
225,675	607	116
228,202	614	118
230,756	621	119
346,223	931	202
345,967	931	202
345,719	930	202
345,486	929	202
345,259	929	202
345,039	928	202
344,828	928	202
344,626	927	202
344,432	927	202
344,245	926	202
344,077	926	202
343,914	925	202
343,755	925	202
343,606	924	202
343,466	924	202
343,332	924	202
343,202	923	202
343,072	923	202
342,824	922	202
342,574	922	202
342,322	921	202
342,070	920	202
341,816	919	202
341,561	919	202
341,305	918	202
341,047	917	202
340,788	917	202
340,528	916	202
340,267	915	202
340,004	915	202
339,740	914	202
339,475	913	202
339,208	912	202
338,940	912	202

Net Transfer Station Emissions	Year	
Hauling + Operations		
tonnes CO_2e		
	0	2011
0	1	2012
0	2	2013
0	3	2014
723	4	2015
731	5	2016
740	6	2017
1,134	7	2018
1,133	8	2019
1,132	9	2020
1,132	10	2021
1,131	11	2022
1,130	12	2023
1,130	13	2024
1,129	14	2025
1,129	15	2026
1,128	16	2027
1,128	17	2028
1,127	18	2029
1,127	19	2030
1,127	20	2031
1,126	21	2032
1,126	22	2033
1,126	23	2034
1,125	24	2035
1,124	25	2036
1,124	26	2037
1,123	27	2038
1,122	28	2039
1,122	29	2040
1,121	30	2041
1,120	31	2042
1,120	32	2043
1,119	33	2044
1,118	34	2045
1,118	35	2046
1,117	36	2047
1,116	37	2048
1,115	38	2049
1,115	39	2050
1,114	40	2051

Total CVWMC LF GHGs - 40 years **170,794** **tonnes CO_2e**

Total TS GHGs - 40 years **40,423** **tonnes CO_2e**

Table C5: GHG assessment of Option 2(a) -EWS located in Comox Valley

EWS GHG						Electricity Generation and Offsets - EWS				Net EWS Emissions	Methane Captured, Destroyed, Oxidized and Emitted - CVWMC							
Year		WTE Combustion GHG				Metal - ferrous	LHV of Waste	Potential Power	BC Electricity Offset		Methane Volume	Methane Collected	Methane Destroyed	Methane not Collected & Destroyed	Methane Oxidized	Total Methane Emitted	Tonnes Methane Emitted	Tonnes Methane Destroyed
		CO_2	CH_4 as CO_2e	N_2O as CO_2e	Total GHG CO_2e	3% of Throughput CO_2e Offset	10.5 GJ/tonne	at 16% Net Coversion Efficiency	BC Hydro Offset of 22 Tonnes CO_2e per GWh	Combustion - Electricity Offset	From LandGem	75% Collection Efficiency	99% of Collected Methane	Total - Destroyed	10% of Methane not Collected	Total - Destroyed - Oxidized	0.000667 Tonnes/m^3	0.000667 Tonnes/m^3
		tonnes CO_2	tonnes CO_2e	tonnes CO_2e	tonnes CO_2e	tonnes	GWh	GWh	tonnes	tonnes	m^3/year	m^3/year	m^3/year	m^3/year	m^3/year	m^3/year	tonnes CH_4	tonnes CH_4
0	2017	0	0	0	0	0	0	0	0	0								
1	2018	0	0	0	0	0	0	0	0	0	626,553	469,914	465,215	161,337	15,664	145,673	97	310
2	2019	0	0	0	0	0	0	0	0	0	1,195,291	896,468	887,503	307,787	29,882	277,905	185	592
3	2020	0	0	0	0	0	0	0	0	0	1,712,112	1,284,084	1,271,243	440,869	42,803	398,066	266	848
4	2021	8,115	0	406	8,521	1,316	74	12	260	6,870	2,182,416	1,636,812	1,620,444	561,972	54,560	507,412	338	1,081
5	2022	8,206	0	410	8,616	1,331	75	12	263	6,947	1,972,738	1,479,553	1,464,758	507,980	49,318	458,662	306	977
6	2023	8,298	0	415	8,713	1,346	76	12	266	7,025	1,785,099	1,338,824	1,325,436	459,663	44,627	415,035	277	884
7	2024	14,126	0	706	14,832	2,291	129	21	453	11,959	1,617,205	1,212,904	1,200,775	416,430	40,430	376,000	251	801
8	2025	14,248	0	712	14,961	2,311	130	21	457	12,063	1,479,482	1,109,612	1,098,516	380,967	36,987	343,980	229	733
9	2026	14,370	0	718	15,088	2,331	131	21	461	12,166	1,363,071	1,022,303	1,012,080	350,991	34,077	316,914	211	675
10	2027	14,489	0	724	15,213	2,350	132	21	465	12,266	1,265,669	949,252	939,759	325,910	31,642	294,268	196	627
11	2028	14,606	0	730	15,336	2,369	133	21	469	12,366	1,185,157	888,868	879,979	305,178	29,629	275,549	184	587
12	2029	14,712	0	736	15,448	2,386	134	21	472	12,456	1,119,688	839,766	831,368	288,320	27,992	260,328	174	555
13	2030	14,712	0	736	15,448	2,386	134	21	472	12,456	1,067,595	800,696	792,689	274,906	26,690	248,216	166	529
14	2031	14,712	0	736	15,448	2,386	134	21	472	12,456	1,027,329	770,497	762,792	264,537	25,683	238,854	159	509
15	2032	14,712	0	736	15,448	2,386	134	21	472	12,456	997,526	748,144	740,663	256,863	24,938	231,925	155	494
16	2033	14,712	0	736	15,448	2,386	134	21	472	12,456	976,981	732,735	725,408	251,572	24,425	227,148	152	484
17	2034	14,712	0	736	15,448	2,386	134	21	472	12,456	964,642	723,481	716,247	248,395	24,116	224,279	150	478
18	2035	14,712	0	736	15,448	2,386	134	21	472	12,456	959,353	719,515	712,320	247,034	23,984	223,050	149	475
19	2036	14,712	0	736	15,448	2,386	134	21	472	12,456	960,260	720,195	712,993	247,267	24,007	223,260	149	476
20	2037	14,712	0	736	15,448	2,386	134	21	472	12,456	966,683	725,012	717,762	248,921	24,167	224,754	150	479
21	2038	14,712	0	736	15,448	2,386	134	21	472	12,456	977,873	733,405	726,071	251,802	24,447	227,356	152	484
22	2039	14,712	0	736	15,448	2,386	134	21	472	12,456	993,193	744,895	737,446	255,747	24,830	230,917	154	492
23	2040	14,712	0	736	15,448	2,386	134	21	472	12,456	1,012,099	759,075	751,484	260,616	25,302	235,313	157	501
24	2041	14,712	0	736	15,448	2,386	134	21	472	12,456	1,034,144	775,608	767,852	266,292	25,854	240,439	160	512
25	2042	14,712	0	736	15,448	2,386	134	21	472	12,456	1,058,940	794,205	786,263	272,677	26,474	246,204	164	524
26	2043	14,712	0	736	15,448	2,386	134	21	472	12,456	1,088,446	816,335	808,171	280,275	27,211	253,064	169	539
27	2044	14,712	0	736	15,448	2,386	134	21	472	12,456	1,122,236	841,677	833,261	288,976	28,056	260,920	174	556
28	2045	14,712	0	736	15,448	2,386	134	21	472	12,456	1,159,929	869,947	861,247	298,682	28,998	269,683	180	574
29	2046	14,712	0	736	15,448	2,386	134	21	472	12,456	1,201,183	900,887	891,878	309,305	30,030	279,275	186	595
30	2047	14,712	0	736	15,448	2,386	134	21	472	12,456	1,245,693	934,270	924,927	320,766	31,142	289,624	193	617
31	2048	14,712	0	736	15,448	2,386	134	21	472	12,456	1,293,188	969,891	960,192	332,996	32,330	300,666	201	640
32	2049	14,712	0	736	15,448	2,386	134	21	472	12,456	1,343,423	1,007,567	997,491	345,931	33,586	312,346	208	665
33	2050	14,712	0	736	15,448	2,386	134	21	472	12,456	1,396,180	1,047,135	1,036,664	359,516	34,905	324,612	217	691
34	2051	14,712	0	736	15,448	2,386	134	21	472	12,456	1,451,267	1,088,450	1,077,566	373,701	36,282	337,420	225	719
35	2052	14,712	0	736	15,448	2,386	134	21	472	12,456	1,508,508	1,131,381	1,120,068	388,441	37,713	350,728	234	747
36	2053	14,712	0	736	15,448	2,386	134	21	472	12,456	1,567,751	1,175,813	1,164,055	403,696	39,194	364,502	243	776
37	2054	14,712	0	736	15,448	2,386	134	21	472	12,456	1,628,856	1,221,642	1,209,426	419,430	40,721	378,709	253	807
38	2055	14,712	0	736	15,448	2,386	134	21	472	12,456	1,691,701	1,268,776	1,256,088	435,613	42,293	393,320	262	838
39	2056	14,712	0	736	15,448	2,386	134	21	472	12,456	1,756,176	1,317,132	1,303,961	452,215	43,904	408,311	272	870
40	2057	14,712	0	736	15,448	2,386	134	21	472	12,456	1,822,185	1,366,639	1,352,972	469,213	45,555	423,658	283	902

Total Technology GHGs - 40 years **442,881** **tonnes CO_2e**

WTE Emissions Factors

CO_2 =	0.32	tonnes / tonne MSW
CH_4 =	0.0000031	tonnes CO_2e / tonne MSW
N_2O =	0.016	tones CO_2e / tonne MSW

Based on calculations for Vancouver waste for WTE at 70% diversion
Source: CH2M HILL (2009) Technical Memorandum Comparison of Greenhouse Gas Emissions from Waste-to-Energy Facilities and the Vancouver Landfill.

LHV MSW =	10.5	GJ/tonne
	2917	kWh/tonne
Electrical Conversion Efficiency =	16%	

Table C5: GHG assessment of Option 2(a) -EWS located in Comox Valley

LFG GHG Emissions Summary - CVWMC			
CO_2e Methane Emitted	CO_2 from Methane Destruction	CO_2 from Oxidized Methane	Total GHG Emissions from LFG
21 x Tonnes Emmitted	1 Tonne for Every Tonne Destroyed	1 Tonne for Every Tonne Oxidized	Sum of GHG Emissions
tonnes CO_2e	tonnes CO_2	tonnes CO_2	tonnes CO_2e
2,040	310	10	2,040
3,893	592	20	3,893
5,576	848	29	5,576
7,107	1,081	36	7,107
6,424	977	33	6,424
5,813	884	30	5,813
5,267	801	27	5,267
4,818	733	25	4,818
4,439	675	23	4,439
4,122	627	21	4,122
3,860	587	20	3,860
3,646	555	19	3,646
3,477	529	18	3,477
3,346	509	17	3,346
3,249	494	17	3,249
3,182	484	16	3,182
3,141	478	16	3,141
3,124	475	16	3,124
3,127	476	16	3,127
3,148	479	16	3,148
3,185	484	16	3,185
3,234	492	17	3,234
3,296	501	17	3,296
3,368	512	17	3,368
3,449	524	18	3,449
3,545	539	18	3,545
3,655	556	19	3,655
3,777	574	19	3,777
3,912	595	20	3,912
4,057	617	21	4,057
4,211	640	22	4,211
4,375	665	22	4,375
4,547	691	23	4,547
4,726	719	24	4,726
4,913	747	25	4,913
5,106	776	26	5,106
5,305	807	27	5,305
5,509	838	28	5,509
5,719	870	29	5,719
5,934	902	30	5,934

Electricity Generation and Offsets - CVWMC LF			
Total Gas Collected	Potential Power	Energy Generation	BC Electricity Offset
From LandGEM	200 kW per 100 ft^3/min	Based on Operation 91% of the Year	BC Hydro Offset of 22 Tonnes CO_2e per GWh
ft^3/min	kW	GWh / year	tonnes CO_2e
0	0	0	0
32	63	0	0
60	120	0	0
86	173	0	0
110	220	0	0
99	199	0	0
90	180	0	0
81	163	0	0
75	149	0	0
69	137	0	0
64	128	0	0
60	119	0	0
56	113	0	0
54	108	0	0
52	104	0	0
50	101	0	0
49	98	0	0
49	97	0	0
48	97	0	0
48	97	0	0
49	97	0	0
49	99	0	0
50	100	0	0
51	102	0	0
52	104	0	0
53	107	0	0
55	110	0	0
57	113	0	0
58	117	0	0
61	121	0	0
63	126	0	0
65	130	0	0
68	135	0	0
70	141	0	0
73	146	0	0
76	152	0	0
79	158	0	0
82	164	0	0
85	170	0	0
88	177	0	0
92	184	0	0

Landfill Operations - CVWMC LF		
Buildings - Fuel and Electricity	Landfill Equipment	GHGs from Landfill Operations
0.001 Tonnes CO_2e per Tonne Waste	0.004 Tonnes CO_2e per Tonne Waste	Buildings and Equipment
tonnes CO_2e	tonnes CO_2e	tonnes CO_2e
37	150	187
38	151	189
38	153	191
39	155	194
2	8	11
2	9	11
2	9	11
4	15	18
4	15	18
4	15	19
4	15	19
4	15	19
4	15	19
4	17	21
5	18	23
5	20	25
5	21	27
6	23	28
6	24	30
6	25	32
7	27	33
7	28	35
7	29	37
8	30	38
8	32	40
8	33	42
9	35	44
9	37	46
10	39	48
10	40	51
11	42	53
11	44	55
11	46	57
12	48	60
12	50	62
13	52	65
13	54	67
14	55	69
14	57	72
15	59	74
15	61	77

CVWMC LF Emissions
LFG - Electricity Offset + Operations
tonnes CO_2e
187
2,230
4,084
5,769
7,118
6,435
5,824
5,285
4,837
4,458
4,141
3,879
3,666
3,498
3,369
3,273
3,208
3,170
3,154
3,159
3,182
3,220
3,271
3,334
3,407
3,490
3,589
3,701
3,826
3,962
4,110
4,267
4,433
4,607
4,788
4,977
5,173
5,374
5,581
5,793
6,011

Transfer Station Hauling and Operations		
Fuel Consumption	Waste Hauling	Transfer Station Operations
2.4 L/tonne	0.00269 Tonnes CO_2e / L	0.0044 Tonnes CO_2e / Tonne Waste
L	tonnes CO_2e	tonnes CO_2e
0	0	0
0	0	0
0	0	0
0	0	0
0	0	0
0	0	0
0	0	0
46,597	125	85
46,854	126	86
47,101	127	86
47,335	127	87
47,561	128	87
47,782	129	88
47,992	129	88
48,195	130	88
48,389	130	89
48,576	131	89
48,744	131	89
48,906	132	90
49,066	132	90
49,214	132	90
49,355	133	90
49,489	133	91
49,619	133	91
49,748	134	91
49,997	134	92
50,247	135	92
50,498	136	93
50,751	137	93
51,004	137	94
51,259	138	94
51,516	139	94
51,773	139	95
52,032	140	95
52,292	141	96
52,554	141	96
52,817	142	97
53,081	143	97
53,346	144	98
53,613	144	98
53,881	145	99

Net Transfer Station Emissions	Year	
Hauling + Operations		
tonnes CO_2e		
	0	2011
0	1	2012
0	2	2013
0	3	2014
0	4	2015
0	5	2016
0	6	2017
211	7	2018
212	8	2019
213	9	2020
214	10	2021
215	11	2022
216	12	2023
217	13	2024
218	14	2025
219	15	2026
220	16	2027
220	17	2028
221	18	2029
222	19	2030
223	20	2031
223	21	2032
224	22	2033
224	23	2034
225	24	2035
226	25	2036
227	26	2037
228	27	2038
230	28	2039
231	29	2040
232	30	2041
233	31	2042
234	32	2043
235	33	2044
237	34	2045
238	35	2046
239	36	2047
240	37	2048
241	38	2049
243	39	2050
244	40	2051

Total CVWMC LF GHGs - 40 years **170,837** **tonnes CO_2e**

Total TS GHGs - 40 years **7,695** **tonnes CO_2e**

Table C6: GHG assessment of Option 2(b) - EWS located in Campbell River

EWS GHG						Electricity Generation and Offsets - EWS				Net EWS Emissions	Methane Captured, Destroyed, Oxidized and Emitted - CVWMC							
Year		WTE Combustion GHG				Metal - ferrous	LHV of Waste	Potential Power	BC Electricity Offset		Methane Volume	Methane Collected	Methane Destroyed	Methane not Collected & Destroyed	Methane Oxidized	Total Methane Emitted	Tonnes Methane Emitted	Tonnes Methane Destroyed
		CO_2	CH_4 as CO_2e	N_2O as CO_2e	Total GHG CO_2e	3% of Throughput CO_2e Offset	10.5 GJ/tonne	at 16% Net Coversion Efficiency	BC Hydro Offset of 22 Tonnes CO_2e per GWh	Combustion - Electricity Offset	From LandGem	75% Collection Efficiency	99% of Collected Methane	Total - Destroyed	10% of Methane not Collected	Total - Destroyed - Oxidized	0.000667 Tonnes/m^3	0.000667 Tonnes/m^3
		tonnes CO_2	tonnes CO_2e	tonnes CO_2e	tonnes CO_2e	tonnes	GWh	GWh	tonnes	tonnes	m^3/year	m^3/year	m^3/year	m^3/year	m^3/year	m^3/year	tonnes CH_4	tonnes CH_4
0	2017	0	0	0	0	0	0	0	0	0								
1	2018	0	0	0	0	0	0	0	0	0	626,553	469,914	465,215	161,337	15,664	145,673	97	310
2	2019	0	0	0	0	0	0	0	0	0	1,195,291	896,468	887,503	307,787	29,882	277,905	185	592
3	2020	0	0	0	0	0	0	0	0	0	1,712,112	1,284,084	1,271,243	440,869	42,803	398,066	266	848
4	2021	8,115	0	406	8,521	1,316	74	12	260	6,870	2,182,416	1,636,812	1,620,444	561,972	54,560	507,412	338	1,081
5	2022	8,206	0	410	8,616	1,331	75	12	263	6,947	1,972,738	1,479,553	1,464,758	507,980	49,318	458,662	306	977
6	2023	8,298	0	415	8,713	1,346	76	12	266	7,025	1,785,099	1,338,824	1,325,436	459,663	44,627	415,035	277	884
7	2024	14,126	0	706	14,832	2,291	129	21	453	11,959	1,617,205	1,212,904	1,200,775	416,430	40,430	376,000	251	801
8	2025	14,248	0	712	14,961	2,311	130	21	457	12,063	1,479,482	1,109,612	1,098,516	380,967	36,987	343,980	229	733
9	2026	14,370	0	718	15,088	2,331	131	21	461	12,166	1,363,071	1,022,303	1,012,080	350,991	34,077	316,914	211	675
10	2027	14,489	0	724	15,213	2,350	132	21	465	12,266	1,265,669	949,252	939,759	325,910	31,642	294,268	196	627
11	2028	14,606	0	730	15,336	2,369	133	21	469	12,366	1,185,157	888,868	879,979	305,178	29,629	275,549	184	587
12	2029	14,712	0	736	15,448	2,386	134	21	472	12,456	1,119,688	839,766	831,368	288,320	27,992	260,328	174	555
13	2030	14,712	0	736	15,448	2,386	134	21	472	12,456	1,067,595	800,696	792,689	274,906	26,690	248,216	166	529
14	2031	14,712	0	736	15,448	2,386	134	21	472	12,456	1,027,329	770,497	762,792	264,537	25,683	238,854	159	509
15	2032	14,712	0	736	15,448	2,386	134	21	472	12,456	997,526	748,144	740,663	256,863	24,938	231,925	155	494
16	2033	14,712	0	736	15,448	2,386	134	21	472	12,456	976,981	732,735	725,408	251,572	24,425	227,148	152	484
17	2034	14,712	0	736	15,448	2,386	134	21	472	12,456	964,642	723,481	716,247	248,395	24,116	224,279	150	478
18	2035	14,712	0	736	15,448	2,386	134	21	472	12,456	959,353	719,515	712,320	247,034	23,984	223,050	149	475
19	2036	14,712	0	736	15,448	2,386	134	21	472	12,456	960,260	720,195	712,993	247,267	24,007	223,260	149	476
20	2037	14,712	0	736	15,448	2,386	134	21	472	12,456	966,683	725,012	717,762	248,921	24,167	224,754	150	479
21	2038	14,712	0	736	15,448	2,386	134	21	472	12,456	977,873	733,405	726,071	251,802	24,447	227,356	152	484
22	2039	14,712	0	736	15,448	2,386	134	21	472	12,456	993,193	744,895	737,446	255,747	24,830	230,917	154	492
23	2040	14,712	0	736	15,448	2,386	134	21	472	12,456	1,012,099	759,075	751,484	260,616	25,302	235,313	157	501
24	2041	14,712	0	736	15,448	2,386	134	21	472	12,456	1,034,144	775,608	767,852	266,292	25,854	240,439	160	512
25	2042	14,712	0	736	15,448	2,386	134	21	472	12,456	1,058,940	794,205	786,263	272,677	26,474	246,204	164	524
26	2043	14,712	0	736	15,448	2,386	134	21	472	12,456	1,088,446	816,335	808,171	280,275	27,211	253,064	169	539
27	2044	14,712	0	736	15,448	2,386	134	21	472	12,456	1,122,236	841,677	833,261	288,976	28,056	260,920	174	556
28	2045	14,712	0	736	15,448	2,386	134	21	472	12,456	1,159,929	869,947	861,247	298,682	28,998	269,683	180	574
29	2046	14,712	0	736	15,448	2,386	134	21	472	12,456	1,201,183	900,887	891,878	309,305	30,030	279,275	186	595
30	2047	14,712	0	736	15,448	2,386	134	21	472	12,456	1,245,693	934,270	924,927	320,766	31,142	289,624	193	617
31	2048	14,712	0	736	15,448	2,386	134	21	472	12,456	1,293,188	969,891	960,192	332,996	32,330	300,666	201	640
32	2049	14,712	0	736	15,448	2,386	134	21	472	12,456	1,343,423	1,007,567	997,491	345,931	33,586	312,346	208	665
33	2050	14,712	0	736	15,448	2,386	134	21	472	12,456	1,396,180	1,047,135	1,036,664	359,516	34,905	324,612	217	691
34	2051	14,712	0	736	15,448	2,386	134	21	472	12,456	1,451,267	1,088,450	1,077,566	373,701	36,282	337,420	225	719
35	2052	14,712	0	736	15,448	2,386	134	21	472	12,456	1,508,508	1,131,381	1,120,068	388,441	37,713	350,728	234	747
36	2053	14,712	0	736	15,448	2,386	134	21	472	12,456	1,567,751	1,175,813	1,164,055	403,696	39,194	364,502	243	776
37	2054	14,712	0	736	15,448	2,386	134	21	472	12,456	1,628,856	1,221,642	1,209,426	419,430	40,721	378,709	253	807
38	2055	14,712	0	736	15,448	2,386	134	21	472	12,456	1,691,701	1,268,776	1,256,088	435,613	42,293	393,320	262	838
39	2056	14,712	0	736	15,448	2,386	134	21	472	12,456	1,756,176	1,317,132	1,303,961	452,215	43,904	408,311	272	870
40	2057	14,712	0	736	15,448	2,386	134	21	472	12,456	1,822,185	1,366,639	1,352,972	469,213	45,555	423,658	283	902

Total Technology GHGs - 40 years **442,881** **tonnes CO_2e**

WTE Emissions Factors

CO_2 =	0.32	tonnes / tonne MSW
CH_4 =	0.0000031	tonnes CO_2e / tonne MSW
N_2O =	0.016	tones CO_2e / tonne MSW

Based on calculations for Vancouver waste for WTE at 70% diversion
Source: CH2M HILL (2009) Technical Memorandum Comparison of Greenhouse Gas Emissions from Waste-to-Energy Facilities and the Vancouver Landfill.

LHV MSW =	10.5	GJ/tonne
	2917	kWh/tonne
Electrical Conversion Efficiency =	16%	

Table C6: GHG assessment of Option 2(b) - EWS located in Campbell River

LFG GHG Emissions Summary - CVWMC			
CO_2e Methane Emitted	CO_2 from Methane Destruction	CO_2 from Oxidized Methane	Total GHG Emissions from LFG
21 x Tonnes Emmitted	1 Tonne for Every Tonne Destroyed	1 Tonne for Every Tonne Oxidized	Sum of GHG Emissions
tonnes CO_2e	tonnes CO_2	tonnes CO_2	tonnes CO_2e
2,040	310	10	2,040
3,893	592	20	3,893
5,576	848	29	5,576
7,107	1,081	36	7,107
6,424	977	33	6,424
5,813	884	30	5,813
5,267	801	27	5,267
4,818	733	25	4,818
4,439	675	23	4,439
4,122	627	21	4,122
3,860	587	20	3,860
3,646	555	19	3,646
3,477	529	18	3,477
3,346	509	17	3,346
3,249	494	17	3,249
3,182	484	16	3,182
3,141	478	16	3,141
3,124	475	16	3,124
3,127	476	16	3,127
3,148	479	16	3,148
3,185	484	16	3,185
3,234	492	17	3,234
3,296	501	17	3,296
3,368	512	17	3,368
3,449	524	18	3,449
3,545	539	18	3,545
3,655	556	19	3,655
3,777	574	19	3,777
3,912	595	20	3,912
4,057	617	21	4,057
4,211	640	22	4,211
4,375	665	22	4,375
4,547	691	23	4,547
4,726	719	24	4,726
4,913	747	25	4,913
5,106	776	26	5,106
5,305	807	27	5,305
5,509	838	28	5,509
5,719	870	29	5,719
5,934	902	30	5,934

Electricity Generation and Offsets - CVWMC LF			
Total Gas Collected	Potential Power	Energy Generation	BC Electricity Offset
From LandGEM	200 kW per 100 ft^3/min	Based on Operation 91% of the Year	BC Hydro Offset of 22 Tonnes CO_2e per GWh
ft^3/min	kW	GWh / year	tonnes CO_2e
0	0	0	0
32	63	0	0
60	120	0	0
86	173	0	0
110	220	0	0
99	199	0	0
90	180	0	0
81	163	0	0
75	149	0	0
69	137	0	0
64	128	0	0
60	119	0	0
56	113	0	0
54	108	0	0
52	104	0	0
50	101	0	0
49	98	0	0
49	97	0	0
48	97	0	0
48	97	0	0
49	97	0	0
49	99	0	0
50	100	0	0
51	102	0	0
52	104	0	0
53	107	0	0
55	110	0	0
57	113	0	0
58	117	0	0
61	121	0	0
63	126	0	0
65	130	0	0
68	135	0	0
70	141	0	0
73	146	0	0
76	152	0	0
79	158	0	0
82	164	0	0
85	170	0	0
88	177	0	0
92	184	0	0

Landfill Operations - CVWMC LF		
Buildings - Fuel and Electricity	Landfill Equipment	GHGs from Landfill Operations
0.001 Tonnes CO_2e per Tonne Waste	0.004 Tonnes CO_2e per Tonne Waste	Buildings and Equipment
tonnes CO_2e	tonnes CO_2e	tonnes CO_2e
37	150	187
38	151	189
38	153	191
39	155	194
2	8	11
2	9	11
2	9	11
4	15	18
4	15	18
4	15	19
4	15	19
4	15	19
4	15	19
4	17	21
5	18	23
5	20	25
5	21	27
6	23	28
6	24	30
6	25	32
7	27	33
7	28	35
7	29	37
8	30	38
8	32	40
8	33	42
9	35	44
9	37	46
10	39	48
10	40	51
11	42	53
11	44	55
12	48	60
12	50	62
13	52	65
13	54	67
14	55	69
14	57	72
15	59	74
15	61	77

CVWMC LF Emissions
LFG - Electricity Offset + Operations
tonnes CO_2e
187
2,230
4,084
5,769
7,118
6,435
5,824
5,285
4,837
4,458
4,141
3,879
3,666
3,498
3,369
3,273
3,208
3,170
3,154
3,159
3,182
3,220
3,271
3,334
3,407
3,490
3,589
3,701
3,826
3,962
4,110
4,267
4,433
4,607
4,788
4,977
5,173
5,374
5,581
5,793
6,011

Transfer Station Hauling and Operations		
Fuel Consumption	Waste Hauling	Transfer Station Operations
2.4 L/tonne	0.00269 Tonnes CO_2e / L	0.0044 Tonnes CO_2e / Tonne Waste
L	tonnes CO_2e	tonnes CO_2e
0	0	0
71,152	191	112
71,948	194	113
72,754	196	114
77,252	208	109
78,073	210	110
78,889	212	111
79,698	214	112
80,501	217	114
81,212	218	115
81,002	218	114
80,800	217	114
80,606	217	114
80,418	216	113
80,250	216	113
80,088	215	113
79,929	215	112
79,780	215	112
79,640	214	112
79,506	214	112
79,376	214	111
79,246	213	111
78,998	213	111
78,748	212	110
78,496	211	110
78,244	210	109
77,990	210	109
77,735	209	108
77,479	208	108
77,221	208	107
76,962	207	107
76,702	206	106
76,441	206	106
76,178	205	105
75,914	204	105
75,648	203	104
75,382	203	104
75,114	202	104

Net Transfer Station Emissions	Year	
Hauling + Operations		
tonnes CO_2e		
	0	2011
0	1	2012
0	2	2013
0	3	2014
303	4	2015
306	5	2016
310	6	2017
317	7	2018
320	8	2019
323	9	2020
327	10	2021
330	11	2022
333	12	2023
332	13	2024
331	14	2025
330	15	2026
330	16	2027
329	17	2028
328	18	2029
327	19	2030
327	20	2031
326	21	2032
325	22	2033
325	23	2034
324	24	2035
323	25	2036
322	26	2037
321	27	2038
320	28	2039
319	29	2040
317	30	2041
316	31	2042
315	32	2043
314	33	2044
313	34	2045
312	35	2046
310	36	2047
309	37	2048
308	38	2049
307	39	2050
306	40	2051

Total CVWMC LF GHGs - 40 years **170,837** **tonnes CO_2e**

Total TS GHGs - 40 years **11,836** **tonnes CO_2e**

Table C7: GHG assessment of Option 2(c) - EWS located in Gold River

EWS GHG						Electricity Generation and Offsets - EWS				Net EWS Emissions	Methane Captured, Destroyed, Oxidized and Emitted - CVWMC							
Year		WTE Combustion GHG				Metal - ferrous	LHV of Waste	Potential Power	BC Electricity Offset		Methane Volume	Methane Collected	Methane Destroyed	Methane not Collected & Destroyed	Methane Oxidized	Total Methane Emitted	Tonnes Methane Emitted	Tonnes Methane Destroyed
		CO_2	CH_4 as CO_2e	N_2O as CO_2e	Total GHG CO_2e	3% of Throughput CO_2e Offset	10.5 GJ/tonne	at 16% Net Coversion Efficiency	BC Hydro Offset of 22 Tonnes CO_2e per GWh	Combustion - Electricity Offset	From LandGem	75% Collection Efficiency	99% of Collected Methane	Total - Destroyed	10% of Methane not Collected	Total - Destroyed - Oxidized	0.000667 Tonnes/m^3	0.000667 Tonnes/m^3
		tonnes CO_2	tonnes CO_2e	tonnes CO_2e	tonnes CO_2e	tonnes	GWh	GWh	tonnes	tonnes	m^3/year	m^3/year	m^3/year	m^3/year	m^3/year	m^3/year	tonnes CH_4	tonnes CH_4
0	2017	0	0	0	0	0	0	0	0	0								
1	2018	0	0	0	0	0	0	0	0	0	626,553	469,914	465,215	161,337	15,664	145,673	97	310
2	2019	0	0	0	0	0	0	0	0	0	1,195,291	896,468	887,503	307,787	29,882	277,905	185	592
3	2020	0	0	0	0	0	0	0	0	0	1,712,112	1,284,084	1,271,243	440,869	42,803	398,066	266	848
4	2021	8,115	0	406	8,521	1,316	74	12	260	6,870	2,182,416	1,636,812	1,620,444	561,972	54,560	507,412	338	1,081
5	2022	8,206	0	410	8,616	1,331	75	12	263	6,947	1,972,738	1,479,553	1,464,758	507,980	49,318	458,662	306	977
6	2023	8,298	0	415	8,713	1,346	76	12	266	7,025	1,785,099	1,338,824	1,325,436	459,663	44,627	415,035	277	884
7	2024	14,126	0	706	14,832	2,291	129	21	453	11,959	1,617,205	1,212,904	1,200,775	416,430	40,430	376,000	251	801
8	2025	14,248	0	712	14,961	2,311	130	21	457	12,063	1,479,482	1,109,612	1,098,516	380,967	36,987	343,980	229	733
9	2026	14,370	0	718	15,088	2,331	131	21	461	12,166	1,363,071	1,022,303	1,012,080	350,991	34,077	316,914	211	675
10	2027	14,489	0	724	15,213	2,350	132	21	465	12,266	1,265,669	949,252	939,759	325,910	31,642	294,268	196	627
11	2028	14,606	0	730	15,336	2,369	133	21	469	12,366	1,185,157	888,868	879,979	305,178	29,629	275,549	184	587
12	2029	14,712	0	736	15,448	2,386	134	21	472	12,456	1,119,688	839,766	831,368	288,320	27,992	260,328	174	555
13	2030	14,712	0	736	15,448	2,386	134	21	472	12,456	1,067,595	800,696	792,689	274,906	26,690	248,216	166	529
14	2031	14,712	0	736	15,448	2,386	134	21	472	12,456	1,027,329	770,497	762,792	264,537	25,683	238,854	159	509
15	2032	14,712	0	736	15,448	2,386	134	21	472	12,456	997,526	748,144	740,663	256,863	24,938	231,925	155	494
16	2033	14,712	0	736	15,448	2,386	134	21	472	12,456	976,981	732,735	725,408	251,572	24,425	227,148	152	484
17	2034	14,712	0	736	15,448	2,386	134	21	472	12,456	964,642	723,481	716,247	248,395	24,116	224,279	150	478
18	2035	14,712	0	736	15,448	2,386	134	21	472	12,456	959,353	719,515	712,320	247,034	23,984	223,050	149	475
19	2036	14,712	0	736	15,448	2,386	134	21	472	12,456	960,260	720,195	712,993	247,267	24,007	223,260	149	476
20	2037	14,712	0	736	15,448	2,386	134	21	472	12,456	966,683	725,012	717,762	248,921	24,167	224,754	150	479
21	2038	14,712	0	736	15,448	2,386	134	21	472	12,456	977,873	733,405	726,071	251,802	24,447	227,356	152	484
22	2039	14,712	0	736	15,448	2,386	134	21	472	12,456	993,193	744,895	737,446	255,747	24,830	230,917	154	492
23	2040	14,712	0	736	15,448	2,386	134	21	472	12,456	1,012,099	759,075	751,484	260,616	25,302	235,313	157	501
24	2041	14,712	0	736	15,448	2,386	134	21	472	12,456	1,034,144	775,608	767,852	266,292	25,854	240,439	160	512
25	2042	14,712	0	736	15,448	2,386	134	21	472	12,456	1,058,940	794,205	786,263	272,677	26,474	246,204	164	524
26	2043	14,712	0	736	15,448	2,386	134	21	472	12,456	1,088,446	816,335	808,171	280,275	27,211	253,064	169	539
27	2044	14,712	0	736	15,448	2,386	134	21	472	12,456	1,122,236	841,677	833,261	288,976	28,056	260,920	174	556
28	2045	14,712	0	736	15,448	2,386	134	21	472	12,456	1,159,929	869,947	861,247	298,682	28,998	269,683	180	574
29	2046	14,712	0	736	15,448	2,386	134	21	472	12,456	1,201,183	900,887	891,878	309,305	30,030	279,275	186	595
30	2047	14,712	0	736	15,448	2,386	134	21	472	12,456	1,245,693	934,270	924,927	320,766	31,142	289,624	193	617
31	2048	14,712	0	736	15,448	2,386	134	21	472	12,456	1,293,188	969,891	960,192	332,996	32,330	300,666	201	640
32	2049	14,712	0	736	15,448	2,386	134	21	472	12,456	1,343,423	1,007,567	997,491	345,931	33,586	312,346	208	665
33	2050	14,712	0	736	15,448	2,386	134	21	472	12,456	1,396,180	1,047,135	1,036,664	359,516	34,905	324,612	217	691
34	2051	14,712	0	736	15,448	2,386	134	21	472	12,456	1,451,267	1,088,450	1,077,566	373,701	36,282	337,420	225	719
35	2052	14,712	0	736	15,448	2,386	134	21	472	12,456	1,508,508	1,131,381	1,120,068	388,441	37,713	350,728	234	747
36	2053	14,712	0	736	15,448	2,386	134	21	472	12,456	1,567,751	1,175,813	1,164,055	403,696	39,194	364,502	243	776
37	2054	14,712	0	736	15,448	2,386	134	21	472	12,456	1,628,856	1,221,642	1,209,426	419,430	40,721	378,709	253	807
38	2055	14,712	0	736	15,448	2,386	134	21	472	12,456	1,691,701	1,268,776	1,256,088	435,613	42,293	393,320	262	838
39	2056	14,712	0	736	15,448	2,386	134	21	472	12,456	1,756,176	1,317,132	1,303,961	452,215	43,904	408,311	272	870
40	2057	14,712	0	736	15,448	2,386	134	21	472	12,456	1,822,185	1,366,639	1,352,972	469,213	45,555	423,658	283	902

Total Technology GHGs - 40 years **442,881** **tonnes CO_2e**

WTE Emissions Factors

CO_2 =	0.32	tonnes / tonne MSW
CH_4 =	0.0000031	tonnes CO_2e / tonne MSW
N_2O =	0.016	tones CO_2e / tonne MSW

Based on calculations for Vancouver waste for WTE at 70% diversion
Source: CH2M HILL (2009) Technical Memorandum Comparison of Greenhouse Gas Emissions from Waste-to-Energy Facilities and the Vancouver Landfill.

LHV MSW =	10.5	GJ/tonne
	2917	kWh/tonne
Electrical Conversion Efficiency =	16%	

Table C7: GHG assessment of Option 2(c) - EWS located in Gold River

LFG GHG Emissions Summary - CVWMC			
CO_2e Methane Emitted	CO_2 from Methane Destruction	CO_2 from Oxidized Methane	Total GHG Emissions from LFG
21 x Tonnes Emmitted	1 Tonne for Every Tonne Destroyed	1 Tonne for Every Tonne Oxidized	Sum of GHG Emissions
tonnes CO_2e	tonnes CO_2	tonnes CO_2	tonnes CO_2e
2,040	310	10	2,040
3,893	592	20	3,893
5,576	848	29	5,576
7,107	1,081	36	7,107
6,424	977	33	6,424
5,813	884	30	5,813
5,267	801	27	5,267
4,818	733	25	4,818
4,439	675	23	4,439
4,122	627	21	4,122
3,860	587	20	3,860
3,646	555	19	3,646
3,477	529	18	3,477
3,346	509	17	3,346
3,249	494	17	3,249
3,182	484	16	3,182
3,141	478	16	3,141
3,124	475	16	3,124
3,127	476	16	3,127
3,148	479	16	3,148
3,185	484	16	3,185
3,234	492	17	3,234
3,296	501	17	3,296
3,368	512	17	3,368
3,449	524	18	3,449
3,545	539	18	3,545
3,655	556	19	3,655
3,777	574	19	3,777
3,912	595	20	3,912
4,057	617	21	4,057
4,211	640	22	4,211
4,375	665	22	4,375
4,547	691	23	4,547
4,726	719	24	4,726
4,913	747	25	4,913
5,106	776	26	5,106
5,305	807	27	5,305
5,509	838	28	5,509
5,719	870	29	5,719
5,934	902	30	5,934

Electricity Generation and Offsets - CVWMC LF			
Total Gas Collected	Potential Power	Energy Generation	BC Electricity Offset
From LandGEM	200 kW per 100 ft^3/min	Based on Operation 91% of the Year	BC Hydro Offset of 22 Tonnes CO_2e per GWh
ft^3/min	kW	GWh / year	tonnes CO_2e
0	0	0	0
32	63	0	0
60	120	0	0
86	173	0	0
110	220	0	0
99	199	0	0
90	180	0	0
81	163	0	0
75	149	0	0
69	137	0	0
64	128	0	0
60	119	0	0
56	113	0	0
54	108	0	0
52	104	0	0
50	101	0	0
49	98	0	0
49	97	0	0
48	97	0	0
48	97	0	0
49	97	0	0
49	99	0	0
50	100	0	0
51	102	0	0
52	104	0	0
53	107	0	0
55	110	0	0
57	113	0	0
58	117	0	0
61	121	0	0
63	126	0	0
65	130	0	0
68	135	0	0
70	141	0	0
73	146	0	0
76	152	0	0
79	158	0	0
82	164	0	0
85	170	0	0
88	177	0	0
92	184	0	0

Landfill Operations - CVWMC LF		
Buildings - Fuel and Electricity	Landfill Equipment	GHGs from Landfill Operations
0.001 Tonnes CO_2e per Tonne Waste	0.004 Tonnes CO_2e per Tonne Waste	Buildings and Equipment
tonnes CO_2e	tonnes CO_2e	tonnes CO_2e
37	150	187
38	151	189
38	153	191
39	155	194
2	8	11
2	9	11
2	9	11
4	15	18
4	15	18
4	15	19
4	15	19
4	15	19
4	15	19
4	17	21
5	18	23
5	20	25
5	21	27
6	23	28
6	24	30
6	25	32
7	27	33
7	28	35
7	29	37
8	30	38
8	32	40
8	33	42
9	35	44
9	37	46
10	39	48
10	40	51
11	42	53
11	44	55
11	46	57
12	48	60
12	50	62
13	52	65
13	54	67
14	55	69
14	57	72
15	59	74
15	61	77

CVWMC LF Emissions
LFG - Electricity Offset + Operations
tonnes CO_2e
187
2,230
4,084
5,769
7,118
6,435
5,824
5,285
4,837
4,458
4,141
3,879
3,666
3,498
3,369
3,273
3,208
3,170
3,154
3,159
3,182
3,220
3,271
3,334
3,407
3,490
3,589
3,701
3,826
3,962
4,110
4,267
4,433
4,607
4,788
4,977
5,173
5,374
5,581
5,793
6,011

Transfer Station Hauling and Operations		
Fuel Consumption	Waste Hauling	Transfer Station Operations
2.4 L/tonne	0.00269 Tonnes CO_2e / L	0.0044 Tonnes CO_2e / Tonne Waste
L	tonnes CO_2e	tonnes CO_2e
0	0	0
0	0	0
0	0	0
0	0	0
189,738	510	112
191,863	516	113
194,010	522	114
283,669	763	194
286,284	770	196
288,874	777	198
291,420	784	199
293,937	791	201
296,203	797	202
295,993	796	202
295,790	796	202
295,596	795	202
295,409	795	202
295,241	794	202
295,079	794	202
294,920	793	202
294,771	793	202
294,631	793	202
294,496	792	202
294,367	792	202
294,237	791	202
293,988	791	202
293,738	790	202
293,487	789	202
293,235	789	202
292,981	788	202
292,726	787	202
292,470	787	202
292,212	786	202
291,953	785	202
291,693	785	202
291,432	784	202
291,169	783	202
290,905	783	202
290,639	782	202
290,373	781	202
290,104	780	202

Net Transfer Station Emissions	Year	
Hauling + Operations		
tonnes CO_2e		
	0	2011
0	1	2012
0	2	2013
0	3	2014
622	4	2015
629	5	2016
636	6	2017
957	7	2018
966	8	2019
975	9	2020
983	10	2021
992	11	2022
999	12	2023
999	13	2024
998	14	2025
997	15	2026
997	16	2027
996	17	2028
996	18	2029
996	19	2030
995	20	2031
995	21	2032
994	22	2033
994	23	2034
994	24	2035
993	25	2036
992	26	2037
992	27	2038
991	28	2039
990	29	2040
990	30	2041
989	31	2042
988	32	2043
988	33	2044
987	34	2045
986	35	2046
986	36	2047
985	37	2048
984	38	2049
983	39	2050
983	40	2051

Total CVWMC LF GHGs - 40 years **170,837** **tonnes CO_2e**

Total TS GHGs - 40 years **35,518** **tonnes CO_2e**

Table C8: GHG assessment of Option 3(a) - Sustane located in Comox Valley

Bio-diesel GHG				Electricity Generation and Offsets - Sustane			Net Sustane Emissions	Methane Captured, Destroyed, Oxidized and Emitted - CVWMC							
Year		Bio-diesel Combustion GHG		Metal - ferrous	Metal - Non-Ferrous	Plastics		Methane Volume	Methane Collected	Methane Destroyed	Methane not Collected & Destroyed	Methane Oxidized	Total Methane Emitted	Tonnes Methane Emitted	Tonnes Methane Destroyed
		0.12 tonnes CO_2e per tonne throughput	Total GHG CO_2e	3% of Throughput CO_2e Offset	1.8% of throughput CO2e Offset	7% of Throughout CO_2e Offset	Combustion - Electricity Offset	From LandGem	75% Collection Efficiency	99% of Collected Methane	Total - Destroyed	10% of Methane not Collected	Total - Destroyed - Oxidized	0.000667 Tonnes/m^3	0.000667 Tonnes/m^3
		tonnes CO_2	tonnes CO_2e	tonnes	tonnes	tonnes	tonnes	m^3/year	m^3/year	m^3/year	m^3/year	m^3/year	m^3/year	tonnes CH_4	tonnes CH_4
0	2017	0	0	0	0	0	0								
1	2018	0	0	0	0	0	0	626,553	469,914	465,215	161,337	15,664	145,673	97	310
2	2019	0	0	0	0	0	0	1,195,291	896,468	887,503	307,787	29,882	277,905	185	592
3	2020	0	0	0	0	0	0	1,712,112	1,284,084	1,271,243	440,869	42,803	398,066	266	848
4	2021	3,161	3,161	1,564	4,746	1,751	-4,901	2,182,416	1,636,812	1,620,444	561,972	54,560	507,412	338	1,081
5	2022	3,196	3,196	1,582	4,799	1,771	-4,956	1,972,738	1,479,553	1,464,758	507,980	49,318	458,662	306	977
6	2023	3,232	3,232	1,600	4,852	1,791	-5,011	1,785,099	1,338,824	1,325,436	459,663	44,627	415,035	277	884
7	2024	5,501	5,501	2,723	8,260	3,049	-8,531	1,617,205	1,212,904	1,200,775	416,430	40,430	376,000	251	801
8	2025	5,517	5,517	2,731	8,284	3,057	-8,555	1,479,482	1,109,612	1,098,516	380,967	36,987	343,980	229	733
9	2026	5,517	5,517	2,731	8,284	3,057	-8,555	1,363,071	1,022,303	1,012,080	350,991	34,077	316,914	211	675
10	2027	5,517	5,517	2,731	8,284	3,057	-8,555	1,265,669	949,252	939,759	325,910	31,642	294,268	196	627
11	2028	5,517	5,517	2,731	8,284	3,057	-8,555	1,185,157	888,868	879,979	305,178	29,629	275,549	184	587
12	2029	5,517	5,517	2,731	8,284	3,057	-8,555	1,119,688	839,766	831,368	288,320	27,992	260,328	174	555
13	2030	5,517	5,517	2,731	8,284	3,057	-8,555	1,067,595	800,696	792,689	274,906	26,690	248,216	166	529
14	2031	5,517	5,517	2,731	8,284	3,057	-8,555	1,027,329	770,497	762,792	264,537	25,683	238,854	159	509
15	2032	5,517	5,517	2,731	8,284	3,057	-8,555	997,526	748,144	740,663	256,863	24,938	231,925	155	494
16	2033	5,517	5,517	2,731	8,284	3,057	-8,555	976,981	732,735	725,408	251,572	24,425	227,148	152	484
17	2034	5,517	5,517	2,731	8,284	3,057	-8,555	964,642	723,481	716,247	248,395	24,116	224,279	150	478
18	2035	5,517	5,517	2,731	8,284	3,057	-8,555	959,353	719,515	712,320	247,034	23,984	223,050	149	475
19	2036	5,517	5,517	2,731	8,284	3,057	-8,555	960,260	720,195	712,993	247,267	24,007	223,260	149	476
20	2037	5,517	5,517	2,731	8,284	3,057	-8,555	966,683	725,012	717,762	248,921	24,167	224,754	150	479
21	2038	5,517	5,517	2,731	8,284	3,057	-8,555	977,873	733,405	726,071	251,802	24,447	227,356	152	484
22	2039	5,517	5,517	2,731	8,284	3,057	-8,555	993,193	744,895	737,446	255,747	24,830	230,917	154	492
23	2040	5,517	5,517	2,731	8,284	3,057	-8,555	1,012,099	759,075	751,484	260,616	25,302	235,313	157	501
24	2041	5,517	5,517	2,731	8,284	3,057	-8,555	1,034,144	775,608	767,852	266,292	25,854	240,439	160	512
25	2042	5,517	5,517	2,731	8,284	3,057	-8,555	1,058,940	794,205	786,263	272,677	26,474	246,204	164	524
26	2043	5,517	5,517	2,731	8,284	3,057	-8,555	1,088,446	816,335	808,171	280,275	27,211	253,064	169	539
27	2044	5,517	5,517	2,731	8,284	3,057	-8,555	1,122,236	841,677	833,261	288,976	28,056	260,920	174	556
28	2045	5,517	5,517	2,731	8,284	3,057	-8,555	1,159,929	869,947	861,247	298,682	28,998	269,683	180	574
29	2046	5,517	5,517	2,731	8,284	3,057	-8,555	1,201,183	900,887	891,878	309,305	30,030	279,275	186	595
30	2047	5,517	5,517	2,731	8,284	3,057	-8,555	1,245,693	934,270	924,927	320,766	31,142	289,624	193	617
31	2048	5,517	5,517	2,731	8,284	3,057	-8,555	1,293,188	969,891	960,192	332,996	32,330	300,666	201	640
32	2049	5,517	5,517	2,731	8,284	3,057	-8,555	1,343,423	1,007,567	997,491	345,931	33,586	312,346	208	665
33	2050	5,517	5,517	2,731	8,284	3,057	-8,555	1,396,180	1,047,135	1,036,664	359,516	34,905	324,612	217	691
34	2051	5,517	5,517	2,731	8,284	3,057	-8,555	1,451,267	1,088,450	1,077,566	373,701	36,282	337,420	225	719
35	2052	5,517	5,517	2,731	8,284	3,057	-8,555	1,508,508	1,131,381	1,120,068	388,441	37,713	350,728	234	747
36	2053	5,517	5,517	2,731	8,284	3,057	-8,555	1,567,751	1,175,813	1,164,055	403,696	39,194	364,502	243	776
37	2054	5,517	5,517	2,731	8,284	3,057	-8,555	1,628,856	1,221,642	1,209,426	419,430	40,721	378,709	253	807
38	2055	5,517	5,517	2,731	8,284	3,057	-8,555	1,691,701	1,268,776	1,256,088	435,613	42,293	393,320	262	838
39	2056	5,517	5,517	2,731	8,284	3,057	-8,555	1,756,176	1,317,132	1,303,961	452,215	43,904	408,311	272	870
40	2057	5,517	5,517	2,731	8,284	3,057	-8,555	1,822,185	1,366,639	1,352,972	469,213	45,555	423,658	283	902

Total Technology GHGs - 40 years **-305,721** **tonnes CO_2e**

Table C8: GHG assessment of Option 3(a) - Sustane located in Comox Valley

LFG GHG Emissions Summary - CVWMC			
CO_2e Methane Emitted	CO_2 from Methane Destruction	CO_2 from Oxidized Methane	Total GHG Emissions from LFG
21 x Tonnes Emmitted	1 Tonne for Every Tonne Destroyed	1 Tonne for Every Tonne Oxidized	Sum of GHG Emissions
tonnes CO_2e	tonnes CO_2	tonnes CO_2	tonnes CO_2e
2,040	310	10	2,040
3,893	592	20	3,893
5,576	848	29	5,576
7,107	1,081	36	7,107
6,424	977	33	6,424
5,813	884	30	5,813
5,267	801	27	5,267
4,818	733	25	4,818
4,439	675	23	4,439
4,122	627	21	4,122
3,860	587	20	3,860
3,646	555	19	3,646
3,477	529	18	3,477
3,346	509	17	3,346
3,249	494	17	3,249
3,182	484	16	3,182
3,141	478	16	3,141
3,124	475	16	3,124
3,127	476	16	3,127
3,148	479	16	3,148
3,185	484	16	3,185
3,234	492	17	3,234
3,296	501	17	3,296
3,368	512	17	3,368
3,449	524	18	3,449
3,545	539	18	3,545
3,655	556	19	3,655
3,777	574	19	3,777
3,912	595	20	3,912
4,057	617	21	4,057
4,211	640	22	4,211
4,375	665	22	4,375
4,547	691	23	4,547
4,726	719	24	4,726
4,913	747	25	4,913
5,106	776	26	5,106
5,305	807	27	5,305
5,509	838	28	5,509
5,719	870	29	5,719
5,934	902	30	5,934

Electricity Generation and Offsets - CVWMC LF			
Total Gas Collected	Potential Power	Energy Generation	BC Electricity Offset
From LandGEM	200 kW per 100 ft^3/min	Based on Operation 91% of the Year	BC Hydro Offset of 22 Tonnes CO_2e per GWh
ft^3/min	kW	GWh / year	tonnes CO_2e
0	0	0	0
32	63	0	0
60	120	0	0
86	173	0	0
110	220	0	0
99	199	0	0
90	180	0	0
81	163	0	0
75	149	0	0
69	137	0	0
64	128	0	0
60	119	0	0
56	113	0	0
54	108	0	0
52	104	0	0
50	101	0	0
49	98	0	0
49	97	0	0
48	97	0	0
48	97	0	0
49	97	0	0
49	99	0	0
50	100	0	0
51	102	0	0
52	104	0	0
53	107	0	0
55	110	0	0
57	113	0	0
58	117	0	0
61	121	0	0
63	126	0	0
65	130	0	0
68	135	0	0
70	141	0	0
73	146	0	0
76	152	0	0
79	158	0	0
82	164	0	0
85	170	0	0
88	177	0	0
92	184	0	0

Landfill Operations - CVWMC LF		
Buildings - Fuel and Electricity	Landfill Equipment	GHGs from Landfill Operations
0.001 Tonnes CO_2e per Tonne Waste	0.004 Tonnes CO_2e per Tonne Waste	Buildings and Equipment
tonnes CO_2e	tonnes CO_2e	tonnes CO_2e
37	150	187
38	151	189
38	153	191
39	155	194
1	5	6
1	5	6
1	5	6
2	8	10
2	9	11
3	11	13
3	12	15
3	14	17
4	15	19
4	17	21
5	18	23
5	20	25
5	21	27
6	23	28
6	24	30
6	25	32
7	27	33
7	28	35
7	29	37
8	30	38
8	32	40
8	33	42
9	35	44
9	37	46
10	39	48
10	40	51
11	42	53
11	44	55
11	46	57
12	48	60
12	50	62
13	52	65
13	54	67
14	55	69
14	57	72
15	59	74
15	61	77

CVWMC LF Emissions
LFG - Electricity Offset + Operations
tonnes CO_2e
187
2,230
4,084
5,769
7,113
6,430
5,819
5,276
4,829
4,452
4,137
3,877
3,666
3,498
3,369
3,273
3,208
3,170
3,154
3,159
3,182
3,220
3,271
3,334
3,407
3,490
3,589
3,701
3,826
3,962
4,110
4,267
4,433
4,607
4,788
4,977
5,173
5,374
5,581
5,793
6,011

Transfer Station Hauling and Operations		
Fuel Consumption	Waste Hauling	Transfer Station Operations
2.4 L/tonne	0.00269 Tonnes CO_2e / L	0.0044 Tonnes CO_2e / Tonne Waste
L	tonnes CO_2e	tonnes CO_2e
0	0	0
0	0	0
0	0	0
0	0	0
0	0	0
0	0	0
0	0	0
46,597	125	85
46,854	126	86
47,101	127	86
47,335	127	87
47,561	128	87
47,782	129	88
47,992	129	88
48,195	130	88
48,389	130	89
48,576	131	89
48,744	131	89
48,906	132	90
49,066	132	90
49,214	132	90
49,355	133	90
49,489	133	91
49,619	133	91
49,748	134	91
49,997	134	92
50,247	135	92
50,498	136	93
50,751	137	93
51,004	137	94
51,259	138	94
51,516	139	94
51,773	139	95
52,032	140	95
52,292	141	96
52,554	141	96
52,817	142	97
53,081	143	97
53,346	144	98
53,613	144	98
53,881	145	99

Net Transfer Station Emissions	Year	
Hauling + Operations		
tonnes CO_2e		
	0	2011
0	1	2012
0	2	2013
0	3	2014
0	4	2015
0	5	2016
0	6	2017
211	7	2018
212	8	2019
213	9	2020
214	10	2021
215	11	2022
216	12	2023
217	13	2024
218	14	2025
219	15	2026
220	16	2027
220	17	2028
221	18	2029
222	19	2030
223	20	2031
223	21	2032
224	22	2033
224	23	2034
225	24	2035
226	25	2036
227	26	2037
228	27	2038
230	28	2039
231	29	2040
232	30	2041
233	31	2042
234	32	2043
235	33	2044
237	34	2045
238	35	2046
239	36	2047
240	37	2048
241	38	2049
243	39	2050
244	40	2051

Total CVWMC LF GHGs - 40 years **170,796** **tonnes CO_2e**

Total TS GHGs - 40 years **7,695** **tonnes CO_2e**

Table C9: GHG assessment of Option 3(b) - Sustane located in Campbell River

Year		Bio-diesel GHG: Bio-diesel Combustion GHG: 0.12 tonnes CO_2e per tonne throughput (tonnes CO_2)	Bio-diesel GHG: Total GHG CO_2e (tonnes CO_2e)	Electricity Generation and Offsets - Sustane: Metal - ferrous: 3% of Throughput CO_2e Offset (tonnes)	Metal - Non-Ferrous: 1.8% of throughput CO2e Offset (tonnes)	Plastics: 7% of Throughput CO_2e Offset (tonnes)	Net Sustane Emissions: Combustion - Electricity Offset (tonnes)	Methane Captured, Destroyed, Oxidized and Emitted - CVWMC: Methane Volume: From LandGem (m^3/year)	Methane Collected: 75% Collection Efficiency (m^3/year)	Methane Destroyed: 99% of Collected Methane (m^3/year)	Methane not Collected & Destroyed: Total - Destroyed (m^3/year)	Methane Oxidized: 10% of Methane not Collected (m^3/year)	Total Methane Emitted: Total - Destroyed - Oxidized (m^3/year)	Tonnes Methane Emitted: 0.000667 Tonnes/m^3 (tonnes CH_4)	Tonnes Methane Destroyed: 0.000667 Tonnes/m^3 (tonnes CH_4)
0	2017	0	0	0	0	0	0								
1	2018	0	0	0	0	0	0	626,553	469,914	465,215	161,337	15,664	145,673	97	310
2	2019	0	0	0	0	0	0	1,195,291	896,468	887,503	307,787	29,882	277,905	185	592
3	2020	0	0	0	0	0	0	1,712,112	1,284,084	1,271,243	440,869	42,803	398,066	266	848
4	2021	3,170	3,170	1,569	4,759	1,756	-4,915	2,182,416	1,636,812	1,620,444	561,972	54,560	507,412	338	1,081
5	2022	3,205	3,205	1,587	4,812	1,776	-4,970	1,972,738	1,479,553	1,464,758	507,980	49,318	458,662	306	977
6	2023	3,241	3,241	1,604	4,866	1,796	-5,026	1,785,099	1,338,824	1,325,436	459,663	44,627	415,035	277	884
7	2024	5,517	5,517	2,731	8,284	3,057	-8,555	1,617,205	1,212,904	1,200,775	416,430	40,430	376,000	251	801
8	2025	5,517	5,517	2,731	8,284	3,057	-8,555	1,479,482	1,109,612	1,098,516	380,967	36,987	343,980	229	733
9	2026	5,517	5,517	2,731	8,284	3,057	-8,555	1,363,071	1,022,303	1,012,080	350,991	34,077	316,914	211	675
10	2027	5,517	5,517	2,731	8,284	3,057	-8,555	1,265,669	949,252	939,759	325,910	31,642	294,268	196	627
11	2028	5,517	5,517	2,731	8,284	3,057	-8,555	1,185,157	888,868	879,979	305,178	29,629	275,549	184	587
12	2029	5,517	5,517	2,731	8,284	3,057	-8,555	1,119,688	839,766	831,368	288,320	27,992	260,328	174	555
13	2030	5,517	5,517	2,731	8,284	3,057	-8,555	1,067,595	800,696	792,689	274,906	26,690	248,216	166	529
14	2031	5,517	5,517	2,731	8,284	3,057	-8,555	1,027,329	770,497	762,792	264,537	25,683	238,854	159	509
15	2032	5,517	5,517	2,731	8,284	3,057	-8,555	997,526	748,144	740,663	256,863	24,938	231,925	155	494
16	2033	5,517	5,517	2,731	8,284	3,057	-8,555	976,981	732,735	725,408	251,572	24,425	227,148	152	484
17	2034	5,517	5,517	2,731	8,284	3,057	-8,555	964,642	723,481	716,247	248,395	24,116	224,279	150	478
18	2035	5,517	5,517	2,731	8,284	3,057	-8,555	959,353	719,515	712,320	247,034	23,984	223,050	149	475
19	2036	5,517	5,517	2,731	8,284	3,057	-8,555	960,260	720,195	712,993	247,267	24,007	223,260	149	476
20	2037	5,517	5,517	2,731	8,284	3,057	-8,555	966,683	725,012	717,762	248,921	24,167	224,754	150	479
21	2038	5,517	5,517	2,731	8,284	3,057	-8,555	977,873	733,405	726,071	251,802	24,447	227,356	152	484
22	2039	5,517	5,517	2,731	8,284	3,057	-8,555	993,193	744,895	737,446	255,747	24,830	230,917	154	492
23	2040	5,517	5,517	2,731	8,284	3,057	-8,555	1,012,099	759,075	751,484	260,616	25,302	235,313	157	501
24	2041	5,517	5,517	2,731	8,284	3,057	-8,555	1,034,144	775,608	767,852	266,292	25,854	240,439	160	512
25	2042	5,517	5,517	2,731	8,284	3,057	-8,555	1,058,940	794,205	786,263	272,677	26,474	246,204	164	524
26	2043	5,517	5,517	2,731	8,284	3,057	-8,555	1,088,446	816,335	808,171	280,275	27,211	253,064	169	539
27	2044	5,517	5,517	2,731	8,284	3,057	-8,555	1,122,236	841,677	833,261	288,976	28,056	260,920	174	556
28	2045	5,517	5,517	2,731	8,284	3,057	-8,555	1,159,929	869,947	861,247	298,682	28,998	269,683	180	574
29	2046	5,517	5,517	2,731	8,284	3,057	-8,555	1,201,183	900,887	891,878	309,305	30,030	279,275	186	595
30	2047	5,517	5,517	2,731	8,284	3,057	-8,555	1,245,693	934,270	924,927	320,766	31,142	289,624	193	617
31	2048	5,517	5,517	2,731	8,284	3,057	-8,555	1,293,188	969,891	960,192	332,996	32,330	300,666	201	640
32	2049	5,517	5,517	2,731	8,284	3,057	-8,555	1,343,423	1,007,567	997,491	345,931	33,586	312,346	208	665
33	2050	5,517	5,517	2,731	8,284	3,057	-8,555	1,396,180	1,047,135	1,036,664	359,516	34,905	324,612	217	691
34	2051	5,517	5,517	2,731	8,284	3,057	-8,555	1,451,267	1,088,450	1,077,566	373,701	36,282	337,420	225	719
35	2052	5,517	5,517	2,731	8,284	3,057	-8,555	1,508,508	1,131,381	1,120,068	388,441	37,713	350,728	234	747
36	2053	5,517	5,517	2,731	8,284	3,057	-8,555	1,567,751	1,175,813	1,164,055	403,696	39,194	364,502	243	776
37	2054	5,517	5,517	2,731	8,284	3,057	-8,555	1,628,856	1,221,642	1,209,426	419,430	40,721	378,709	253	807
38	2055	5,517	5,517	2,731	8,284	3,057	-8,555	1,691,701	1,268,776	1,256,088	435,613	42,293	393,320	262	838
39	2056	5,517	5,517	2,731	8,284	3,057	-8,555	1,756,176	1,317,132	1,303,961	452,215	43,904	408,311	272	870
40	2057	5,517	5,517	2,731	8,284	3,057	-8,555	1,822,185	1,366,639	1,352,972	469,213	45,555	423,658	283	902

Total Technology GHGs - 40 years **-305,789** **tonnes CO_2e**

Table C9: GHG assessment of Option 3(b) - Sustane located in Campbell River

LFG GHG Emissions Summary - CVWMC			
CO_2e Methane Emitted	CO_2 from Methane Destruction	CO_2 from Oxidized Methane	Total GHG Emissions from LFG
21 x Tonnes Emmitted	1 Tonne for Every Tonne Destroyed	1 Tonne for Every Tonne Oxidized	Sum of GHG Emissions
tonnes CO_2e	tonnes CO_2	tonnes CO_2	tonnes CO_2e
2,040	310	10	2,040
3,893	592	20	3,893
5,576	848	29	5,576
7,107	1,081	36	7,107
6,424	977	33	6,424
5,813	884	30	5,813
5,267	801	27	5,267
4,818	733	25	4,818
4,439	675	23	4,439
4,122	627	21	4,122
3,860	587	20	3,860
3,646	555	19	3,646
3,477	529	18	3,477
3,346	509	17	3,346
3,249	494	17	3,249
3,182	484	16	3,182
3,141	478	16	3,141
3,124	475	16	3,124
3,127	476	16	3,127
3,148	479	16	3,148
3,185	484	16	3,185
3,234	492	17	3,234
3,296	501	17	3,296
3,368	512	17	3,368
3,449	524	18	3,449
3,545	539	18	3,545
3,655	556	19	3,655
3,777	574	19	3,777
3,912	595	20	3,912
4,057	617	21	4,057
4,211	640	22	4,211
4,375	665	22	4,375
4,547	691	23	4,547
4,726	719	24	4,726
4,913	747	25	4,913
5,106	776	26	5,106
5,305	807	27	5,305
5,509	838	28	5,509
5,719	870	29	5,719
5,934	902	30	5,934

Electricity Generation and Offsets - CVWMC LF			
Total Gas Collected	Potential Power	Energy Generation	BC Electricity Offset
From LandGEM	200 kW per 100 ft^3/min	Based on Operation 91% of the Year	BC Hydro Offset of 22 Tonnes CO_2e per GWh
ft^3/min	kW	GWh / year	tonnes CO_2e
0	0	0	0
32	63	0	0
60	120	0	0
86	173	0	0
110	220	0	0
99	199	0	0
90	180	0	0
81	163	0	0
75	149	0	0
69	137	0	0
64	128	0	0
60	119	0	0
56	113	0	0
54	108	0	0
52	104	0	0
50	101	0	0
49	98	0	0
49	97	0	0
48	97	0	0
48	97	0	0
49	97	0	0
49	99	0	0
50	100	0	0
51	102	0	0
52	104	0	0
53	107	0	0
55	110	0	0
57	113	0	0
58	117	0	0
61	121	0	0
63	126	0	0
65	130	0	0
68	135	0	0
70	141	0	0
73	146	0	0
76	152	0	0
79	158	0	0
82	164	0	0
85	170	0	0
88	177	0	0
92	184	0	0

Landfill Operations - CVWMC LF		
Buildings - Fuel and Electricity	Landfill Equipment	GHGs from Landfill Operations
0.001 Tonnes CO_2e per Tonne Waste	0.004 Tonnes CO_2e per Tonne Waste	Buildings and Equipment
tonnes CO_2e	tonnes CO_2e	tonnes CO_2e
37	150	187
38	151	189
38	153	191
39	155	194
1	4	5
1	4	5
1	4	5
2	7	9
2	9	11
3	11	13
3	12	15
3	14	17
4	15	19
4	17	21
5	18	23
5	20	25
5	21	27
6	23	28
6	24	30
6	25	32
7	27	33
7	28	35
7	29	37
8	30	38
8	32	40
8	33	42
9	35	44
9	37	46
10	39	48
10	40	51
11	42	53
11	44	55
11	46	57
12	48	60
12	50	62
13	52	65
13	54	67
14	55	69
14	57	72
15	59	74
15	61	77

CVWMC LF Emissions
LFG - Electricity Offset + Operations
tonnes CO_2e
187
2,230
4,084
5,769
7,113
6,430
5,819
5,276
4,829
4,452
4,137
3,877
3,666
3,498
3,369
3,273
3,208
3,170
3,154
3,159
3,182
3,220
3,271
3,334
3,407
3,490
3,589
3,701
3,826
3,962
4,110
4,267
4,433
4,607
4,788
4,977
5,173
5,374
5,581
5,793
6,011

Transfer Station Hauling and Operations		
Fuel Consumption	Waste Hauling	Transfer Station Operations
2.4 L/tonne	0.00269 Tonnes CO_2e / L	0.0044 Tonnes CO_2e / Tonne Waste
L	tonnes CO_2e	tonnes CO_2e
0	0	0
70,312	189	116
71,099	191	118
71,895	193	119
75,790	204	117
75,534	203	116
75,286	203	116
75,053	202	116
74,826	201	115
74,605	201	115
74,395	200	114
74,193	200	114
73,999	199	114
73,812	199	113
73,644	198	113
73,481	198	113
73,322	197	112
73,173	197	112
73,033	196	112
72,899	196	112
72,769	196	111
72,639	195	111
72,391	195	111
72,141	194	110
71,889	193	110
71,637	193	109
71,383	192	109
71,128	191	108
70,872	191	108
70,614	190	107
70,355	189	107
70,095	189	106
69,834	188	106
69,571	187	105
69,307	186	105
69,041	186	104
68,775	185	104
68,507	184	104

Net Transfer Station Emissions	Year	
Hauling + Operations		
tonnes CO_2e		
	0	2011
0	1	2012
0	2	2013
0	3	2014
305	4	2015
309	5	2016
312	6	2017
321	7	2018
320	8	2019
318	9	2020
317	10	2021
316	11	2022
315	12	2023
314	13	2024
314	14	2025
313	15	2026
312	16	2027
311	17	2028
310	18	2029
310	19	2030
309	20	2031
308	21	2032
308	22	2033
307	23	2034
306	24	2035
305	25	2036
304	26	2037
303	27	2038
302	28	2039
301	29	2040
300	30	2041
298	31	2042
297	32	2043
296	33	2044
295	34	2045
294	35	2046
293	36	2047
291	37	2048
290	38	2049
289	39	2050
288	40	2051

Total CVWMC LF GHGs - 40 years **170,794** **tonnes CO_2e**

Total TS GHGs - 40 years **11,303** **tonnes CO_2e**

Table C10: GHG assessment of Option 3(c) - Sustane located in Gold River

Year		Bio-diesel GHG: Bio-diesel Combustion GHG – 0.12 tonnes CO_2e per tonne throughput (tonnes CO_2)	Bio-diesel GHG: Total GHG CO_2e (tonnes CO_2e)	Electricity Generation and Offsets - Sustane: Metal - ferrous – 3% of Throughput CO_2e Offset (tonnes)	Electricity Generation and Offsets - Sustane: Metal - Non-Ferrous – 1.8% of throughput CO2e Offset (tonnes)	Electricity Generation and Offsets - Sustane: Plastics – 7% of Throughput CO_2e Offset (tonnes)	Net Sustane Emissions: Combustion - Electricity Offset (tonnes)
0	2017	0	0	0	0	0	0
1	2018	0	0	0	0	0	0
2	2019	0	0	0	0	0	0
3	2020	0	0	0	0	0	0
4	2021	3,170	3,170	1,569	4,759	1,756	-4,915
5	2022	3,205	3,205	1,587	4,812	1,776	-4,970
6	2023	3,241	3,241	1,604	4,866	1,796	-5,026
7	2024	5,517	5,517	2,731	8,284	3,057	-8,555
8	2025	5,517	5,517	2,731	8,284	3,057	-8,555
9	2026	5,517	5,517	2,731	8,284	3,057	-8,555
10	2027	5,517	5,517	2,731	8,284	3,057	-8,555
11	2028	5,517	5,517	2,731	8,284	3,057	-8,555
12	2029	5,517	5,517	2,731	8,284	3,057	-8,555
13	2030	5,517	5,517	2,731	8,284	3,057	-8,555
14	2031	5,517	5,517	2,731	8,284	3,057	-8,555
15	2032	5,517	5,517	2,731	8,284	3,057	-8,555
16	2033	5,517	5,517	2,731	8,284	3,057	-8,555
17	2034	5,517	5,517	2,731	8,284	3,057	-8,555
18	2035	5,517	5,517	2,731	8,284	3,057	-8,555
19	2036	5,517	5,517	2,731	8,284	3,057	-8,555
20	2037	5,517	5,517	2,731	8,284	3,057	-8,555
21	2038	5,517	5,517	2,731	8,284	3,057	-8,555
22	2039	5,517	5,517	2,731	8,284	3,057	-8,555
23	2040	5,517	5,517	2,731	8,284	3,057	-8,555
24	2041	5,517	5,517	2,731	8,284	3,057	-8,555
25	2042	5,517	5,517	2,731	8,284	3,057	-8,555
26	2043	5,517	5,517	2,731	8,284	3,057	-8,555
27	2044	5,517	5,517	2,731	8,284	3,057	-8,555
28	2045	5,517	5,517	2,731	8,284	3,057	-8,555
29	2046	5,517	5,517	2,731	8,284	3,057	-8,555
30	2047	5,517	5,517	2,731	8,284	3,057	-8,555
31	2048	5,517	5,517	2,731	8,284	3,057	-8,555
32	2049	5,517	5,517	2,731	8,284	3,057	-8,555
33	2050	5,517	5,517	2,731	8,284	3,057	-8,555
34	2051	5,517	5,517	2,731	8,284	3,057	-8,555
35	2052	5,517	5,517	2,731	8,284	3,057	-8,555
36	2053	5,517	5,517	2,731	8,284	3,057	-8,555
37	2054	5,517	5,517	2,731	8,284	3,057	-8,555
38	2055	5,517	5,517	2,731	8,284	3,057	-8,555
39	2056	5,517	5,517	2,731	8,284	3,057	-8,555
40	2057	5,517	5,517	2,731	8,284	3,057	-8,555

Methane Captured, Destroyed, Oxidized and Emitted - CVWMC

Year		Methane Volume – From LandGem (m^3/year)	Methane Collected – 75% Collection Efficiency (m^3/year)	Methane Destroyed – 99% of Collected Methane (m^3/year)	Methane not Collected & Destroyed – Total - Destroyed (m^3/year)	Methane Oxidized – 10% of Methane not Collected (m^3/year)	Total Methane Emitted – Total - Destroyed - Oxidized (m^3/year)	Tonnes Methane Emitted – 0.000667 Tonnes/m^3 (tonnes CH_4)	Tonnes Methane Destroyed – 0.000667 Tonnes/m^3 (tonnes CH_4)
0	2017								
1	2018	626,553	469,914	465,215	161,337	15,664	145,673	97	310
2	2019	1,195,291	896,468	887,503	307,787	29,882	277,905	185	592
3	2020	1,712,112	1,284,084	1,271,243	440,869	42,803	398,066	266	848
4	2021	2,182,416	1,636,812	1,620,444	561,972	54,560	507,412	338	1,081
5	2022	1,972,738	1,479,553	1,464,758	507,980	49,318	458,662	306	977
6	2023	1,785,099	1,338,824	1,325,436	459,663	44,627	415,035	277	884
7	2024	1,617,205	1,212,904	1,200,775	416,430	40,430	376,000	251	801
8	2025	1,479,482	1,109,612	1,098,516	380,967	36,987	343,980	229	733
9	2026	1,363,071	1,022,303	1,012,080	350,991	34,077	316,914	211	675
10	2027	1,265,669	949,252	939,759	325,910	31,642	294,268	196	627
11	2028	1,185,157	888,868	879,979	305,178	29,629	275,549	184	587
12	2029	1,119,688	839,766	831,368	288,320	27,992	260,328	174	555
13	2030	1,067,595	800,696	792,689	274,906	26,690	248,216	166	529
14	2031	1,027,329	770,497	762,792	264,537	25,683	238,854	159	509
15	2032	997,526	748,144	740,663	256,863	24,938	231,925	155	494
16	2033	976,981	732,735	725,408	251,572	24,425	227,148	152	484
17	2034	964,642	723,481	716,247	248,395	24,116	224,279	150	478
18	2035	959,353	719,515	712,320	247,034	23,984	223,050	149	475
19	2036	960,260	720,195	712,993	247,267	24,007	223,260	149	476
20	2037	966,683	725,012	717,762	248,921	24,167	224,754	150	479
21	2038	977,873	733,405	726,071	251,802	24,447	227,356	152	484
22	2039	993,193	744,895	737,446	255,747	24,830	230,917	154	492
23	2040	1,012,099	759,075	751,484	260,616	25,302	235,313	157	501
24	2041	1,034,144	775,608	767,852	266,292	25,854	240,439	160	512
25	2042	1,058,940	794,205	786,263	272,677	26,474	246,204	164	524
26	2043	1,088,446	816,335	808,171	280,275	27,211	253,064	169	539
27	2044	1,122,236	841,677	833,261	288,976	28,056	260,920	174	556
28	2045	1,159,929	869,947	861,247	298,682	28,998	269,683	180	574
29	2046	1,201,183	900,887	891,878	309,305	30,030	279,275	186	595
30	2047	1,245,693	934,270	924,927	320,766	31,142	289,624	193	617
31	2048	1,293,188	969,891	960,192	332,996	32,330	300,666	201	640
32	2049	1,343,423	1,007,567	997,491	345,931	33,586	312,346	208	665
33	2050	1,396,180	1,047,135	1,036,664	359,516	34,905	324,612	217	691
34	2051	1,451,267	1,088,450	1,077,566	373,701	36,282	337,420	225	719
35	2052	1,508,508	1,131,381	1,120,068	388,441	37,713	350,728	234	747
36	2053	1,567,751	1,175,813	1,164,055	403,696	39,194	364,502	243	776
37	2054	1,628,856	1,221,642	1,209,426	419,430	40,721	378,709	253	807
38	2055	1,691,701	1,268,776	1,256,088	435,613	42,293	393,320	262	838
39	2056	1,756,176	1,317,132	1,303,961	452,215	43,904	408,311	272	870
40	2057	1,822,185	1,366,639	1,352,972	469,213	45,555	423,658	283	902

Total Technology GHGs - 40 years **-305,789** **tonnes CO_2e**

Table C10: GHG assessment of Option 3(c) - Sustane located in Gold River

LFG GHG Emissions Summary - CVWMC			
CO_2e Methane Emitted	CO_2 from Methane Destruction	CO_2 from Oxidized Methane	Total GHG Emissions from LFG
21 x Tonnes Emmitted	1 Tonne for Every Tonne Destroyed	1 Tonne for Every Tonne Oxidized	Sum of GHG Emissions
tonnes CO_2e	tonnes CO_2	tonnes CO_2	tonnes CO_2e
2,040	310	10	2,040
3,893	592	20	3,893
5,576	848	29	5,576
7,107	1,081	36	7,107
6,424	977	33	6,424
5,813	884	30	5,813
5,267	801	27	5,267
4,818	733	25	4,818
4,439	675	23	4,439
4,122	627	21	4,122
3,860	587	20	3,860
3,646	555	19	3,646
3,477	529	18	3,477
3,346	509	17	3,346
3,249	494	17	3,249
3,182	484	16	3,182
3,141	478	16	3,141
3,124	475	16	3,124
3,127	476	16	3,127
3,148	479	16	3,148
3,185	484	16	3,185
3,234	492	17	3,234
3,296	501	17	3,296
3,368	512	17	3,368
3,449	524	18	3,449
3,545	539	18	3,545
3,655	556	19	3,655
3,777	574	19	3,777
3,912	595	20	3,912
4,057	617	21	4,057
4,211	640	22	4,211
4,375	665	22	4,375
4,547	691	23	4,547
4,726	719	24	4,726
4,913	747	25	4,913
5,106	776	26	5,106
5,305	807	27	5,305
5,509	838	28	5,509
5,719	870	29	5,719
5,934	902	30	5,934

Electricity Generation and Offsets - CVWMC LF			
Total Gas Collected	Potential Power	Energy Generation	BC Electricity Offset
From LandGEM	200 kW per 100 ft^3/min	Based on Operation 91% of the Year	BC Hydro Offset of 22 Tonnes CO_2e per GWh
ft^3/min	kW	GWh / year	tonnes CO_2e
0	0	0	0
32	63	0	0
60	120	0	0
86	173	0	0
110	220	0	0
99	199	0	0
90	180	0	0
81	163	0	0
75	149	0	0
69	137	0	0
64	128	0	0
60	119	0	0
56	113	0	0
54	108	0	0
52	104	0	0
50	101	0	0
49	98	0	0
49	97	0	0
48	97	0	0
48	97	0	0
49	97	0	0
49	99	0	0
50	100	0	0
51	102	0	0
52	104	0	0
53	107	0	0
55	110	0	0
57	113	0	0
58	117	0	0
61	121	0	0
63	126	0	0
65	130	0	0
68	135	0	0
70	141	0	0
73	146	0	0
76	152	0	0
79	158	0	0
82	164	0	0
85	170	0	0
88	177	0	0
92	184	0	0

Landfill Operations - CVWMC LF		
Buildings - Fuel and Electricity	Landfill Equipment	GHGs from Landfill Operations
0.001 Tonnes CO_2e per Tonne Waste	0.004 Tonnes CO_2e per Tonne Waste	Buildings and Equipment
tonnes CO_2e	tonnes CO_2e	tonnes CO_2e
37	150	187
38	151	189
38	153	191
39	155	194
1	4	5
1	4	5
1	4	5
2	7	9
2	9	11
3	11	13
3	12	15
3	14	17
4	15	19
4	17	21
5	18	23
5	20	25
5	21	27
6	23	28
6	24	30
6	25	32
7	27	33
7	28	35
7	29	37
8	30	38
8	32	40
8	33	42
9	35	44
9	37	46
10	39	48
10	40	51
11	42	53
11	44	55
11	46	57
12	48	60
12	50	62
13	52	65
13	54	67
14	55	69
14	57	72
15	59	74
15	61	77

CVWMC LF Emissions
LFG - Electricity Offset + Operations
tonnes CO_2e
187
2,230
4,084
5,769
7,113
6,430
5,819
5,276
4,829
4,452
4,137
3,877
3,666
3,498
3,369
3,273
3,208
3,170
3,154
3,159
3,182
3,220
3,271
3,334
3,407
3,490
3,589
3,701
3,826
3,962
4,110
4,267
4,433
4,607
4,788
4,977
5,173
5,374
5,581
5,793
6,011

Transfer Station Hauling and Operations		
Fuel Consumption	Waste Hauling	Transfer Station Operations
2.4 L/tonne	0.00269 Tonnes CO_2e / L	0.0044 Tonnes CO_2e / Tonne Waste
L	tonnes CO_2e	tonnes CO_2e
0	0	0
187,497	504	116
189,597	510	118
191,719	516	119
279,769	753	202
279,513	752	202
279,265	751	202
279,032	751	202
278,805	750	202
278,585	749	202
278,374	749	202
278,172	748	202
277,978	748	202
277,791	747	202
277,623	747	202
277,460	746	202
277,301	746	202
277,152	746	202
277,012	745	202
276,878	745	202
276,748	744	202
276,619	744	202
276,370	743	202
276,120	743	202
275,869	742	202
275,616	741	202
275,362	741	202
275,107	740	202
274,851	739	202
274,593	739	202
274,335	738	202
274,074	737	202
273,813	737	202
273,550	736	202
273,286	735	202
273,021	734	202
272,754	734	202
272,486	733	202

Net Transfer Station Emissions	Year	
Hauling + Operations		
tonnes CO_2e		
	0	2011
0	1	2012
0	2	2013
0	3	2014
621	4	2015
628	5	2016
635	6	2017
955	7	2018
954	8	2019
954	9	2020
953	10	2021
952	11	2022
952	12	2023
951	13	2024
951	14	2025
950	15	2026
950	16	2027
949	17	2028
949	18	2029
948	19	2030
948	20	2031
947	21	2032
947	22	2033
947	23	2034
946	24	2035
946	25	2036
945	26	2037
944	27	2038
944	28	2039
943	29	2040
942	30	2041
942	31	2042
941	32	2043
940	33	2044
940	34	2045
939	35	2046
938	36	2047
937	37	2048
937	38	2049
936	39	2050
935	40	2051

Total CVWMC LF GHGs - 40 years **170,794** **tonnes CO_2e**

Total TS GHGs - 40 years **34,034** **tonnes CO_2e**