

Staff report

DATE:	March 26, 2018	
TO:	Chair and Directors Comox Valley Regional District (Comox Strathcona Wa	FILE: 5360-60 aste Management Board)
FROM:	Russell Dyson Chief Administrative Officer	Supported by Russell Dyson Chief Administrative Officer
		R. Dyson
RE:	Waste to Energy Business Case Assessment – Scope Cl	nange #2 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.

Recommendation 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 March 16, 2018;

AND FURTHER THAT the Comox Valley Regional District (Comox Strathcona Waste Management) Board support initiatives that allow the Comox Strathcona Waste Management service to achieve 70 per cent rate of diversion to allow for the ability to 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 (RFI) 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.

The draft report and presentation was provided to the WTE Select Committee on November 27, 2018. Eco Waste Solutions technology was removed from further investigation and the committee requested further analysis of the impact of costs should the remaining technologies be provided additional volumes of waste. In addition, the committee also requested that the final results be presented as a full system cost assessment of all waste stream costs in order to better understand the implications of WTE on total system costs.

Waste to Energy Technology Assessment:

The second version of the WTE technologies evaluation includes further analysis of the following technologies:

1. Sustane – which produces biomass fuel pellets, synthetic diesel and metals; and

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2. WTT – which produces refuse derived fuel and biogas (from anaerobic digestion) These technologies have been further analyzed for increased capacity to determine how higher waste throughputs might affect long term capital and operating costs. The following key points summarize the results.

- Four potential sites were considered and evaluated for siting a WTE facility. It was concluded that all sites could theoretically be used and that future transportation and site servicing costs will be important factors in any final siting. Siting at the Comox Valley Waste Management Center (CVWMC) was shown most cost effective.
- 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.
- Guidelines released by the BC Ministry of Environment indicate that a SWMP must have plans for 70 per cent diversion before WTE should be considered for the remaining residuals. The 70 per cent target is calculated only from *Reduce, Reuse, and Recycle* (3R's) initiatives.
- BC Ministry of Environment stated that each regional district must show that they have maximized the amount of diversion from the 3 Rs (Reduce, re-use and recycle) before they start looking at energy recovery and WTE.
- Further, it is highly likely that recyclables recovered in a mixed waste processing facility will not be considered recycled under 3R's but would be considered recovery.
- The assessment compares the cost of conventional landfilling (status quo) to modeled scenarios for two WTE technologies over 10, 30, 40 and 50 year time periods to determine the most cost effective solution. Currently landfilling costs for final disposal are approximately \$75/tonne.
- Conventional landfilling as per the 2012 SWMP continues to be the most cost effective final disposal solution by approximately \$29 to \$110 per tonne or \$89M to \$347M over a 50 year period than WTE.
- Of the WTE technologies evaluated, Sustane offers lower costs than WTT, however they attract greater risk for the Comox Valley Regional District due to lack of installed infrastructure and untested technology. This risk will be addressed in the near future with the installation of the first full scale facility in eastern Canada.
- Creating a solid fuel (RDF or bio-pellets) is substantially less expensive than traditional WTE, however the risk with RDF or bio-pellets is finding long term markets for the product.
- Within the local market, the bio pellet is assumed to not have value and the current wood waste processing environment could be disrupted with additional material in the market place.
- WTE can provide an approximate 78.20 per cent to 197.11 per cent reduction in Green House Gas (GHG) emissions over landfilling.

Increasing Waste Volumes Assessment:

Increasing the WTE technology capacity by providing more waste for processing was presented to the two remaining technology providers – WTT and Sustane. Both providers updated their cost structure to accept all Municipal Solid Waste (MSW) available given the current volumes within the CSWM service and assuming that no additional diversion, beyond the removal of organics, takes place. This equates to an estimated 52,000 tonnes in 2021 increasing to 70,000 tonnes in 2067.

• The WTE technologies provide an estimated increase in landfill life, benefiting the future resident of the service area.

- o 69 years for WTT
- o 160 years for Sustane
- The higher amounts of MSW for processing increases capital costs for each technology.
 - o WTT originally at \$26.0M now increased to \$28.4M with increasing capacity.
 - o Sustane originally at \$25.0M now increased to \$27.5M with increasing capacity.
- Reduced landfill costs were considered in the financial model, including:
 - o Elimination of some equipment plus reduced equipment replacement frequency
 - o Staffing reductions for both operations and management staff
 - Extended life of the landfill cells

For the lowest cost WTE technology – Sustane, the impact on taxpayers over the first 30 years is an increase of \$40 per tonne to tip MSW, or a possible \$2.0M to \$2.5M annual taxation increase. Comparing the status quo against the best cost option for waste to energy (Sustane in Comox Valley), the potential impact on the tax payer is an additional 87.1 million dollars over the next 50 years.

Full System Cost Assessment:

Full system costs for the solid waste service were analyzed and prepared by CVRD staff by reviewing each line item within the service's financial plan, determining the purpose for the costs being incurred, evaluating whether or not the costs remain after implementation of WTE and then allocating to one of ten cost categories. The following seven categories are <u>not</u> affected by the future implementation of WTE and continue to be incurred by the service regardless of the final waste disposal option:

- 1. Host community agreements operational costs
- 2. Diversion programs capital and operational costs
- 3. Illegal dumping operational costs
- 4. Organics processing capital and operational costs
- 5. Solid waste corporate support services operational costs
- 6. Transfer stations and remote landfills capital and operational costs
- 7. Landfilling costs unaffected by WTE capital and operational costs

The following three categories of costs are affected by the installation of WTE and vary depending on the technology selected and the location installed:

- 8. Landfill costs landfill operation, development and closure costs are reduced as a result of the implementation of WTE
- 9. Transfer stations and waste transfer the cost of transferring waste is highly dependent on the final location of the waste to energy facility
- 10. WTE capital and operating cost this category includes the combined capital and operating cost of the specific waste to energy technology selected

The select committee requested full itemization of all existing programs and costs including accurate cost per tonne comparison to the status quo. These amounts are based on a ten year model for expected costs and form the base case for comparison to the WTE options. The base case cost breakdown for the service, is as follows and equates to \$243 per tonne total:

- Host community agreements \$7
- Diversion programs \$78
- Illegal dumping \$4
- Organics processing (future estimate in model) \$21
- Solid waste corporate support services \$9

- Transfer stations and remote landfills \$34
- Landfilling \$77
- Transfer of waste received at CV & CR waste management centres \$13

The status quo is then compared to WTE for each of the technology and location options. Results are summarized in Morrison Hershfield's report over several stacked bar graphs.

Although WTE can provide benefits in terms of reduced GHG emissions and the further use and re-purposing 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 theSWMP and prior to expansion of the Comox Valley Waste Management Centre landfill. The Nova Scotia facility will be toured by directors in June of 2018 through the FCM conference. This installation can provide a possible option when the SWMP is updated in 2022.

It is also recommended 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.

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Attachments: Appendix A – "Comox Strathcona Waste Management Waste to Energy Assessment, dated March 16, 2018"



REPORT

COMOX STRATHCONA WASTE MANAGEMENT

Waste to Energy Assessment

Version II

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Project No. 5170574.00

March 16, 2018

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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% may be required prior to the consideration of WTE under BC MOE policy.

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.



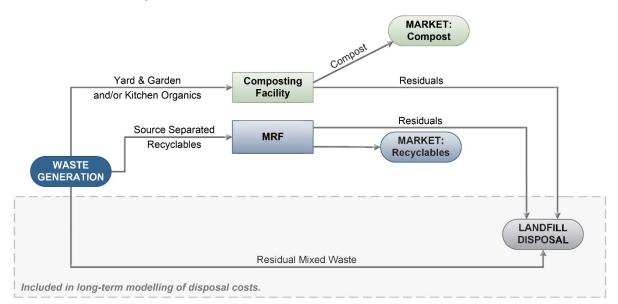
Three locations were considered for the potential facility; Comox Valley, Campbell River and Gold River. Four potential sites in these areas were reviewed in detail looking at zoning, transportation, proximity to waste sources, access to utilities, buffers, air-shed, and site suitability. Essentially, 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:

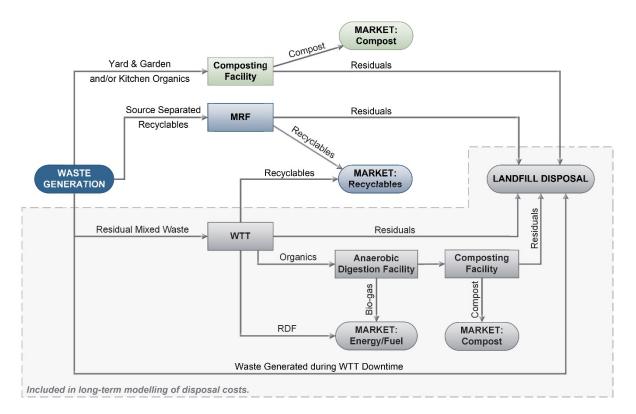
Option 0 – Status Quo

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 long-term disposal cost model options. The entire CSWM system, including the grey-shaded areas, are included and considered in the full system cost assessment.



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

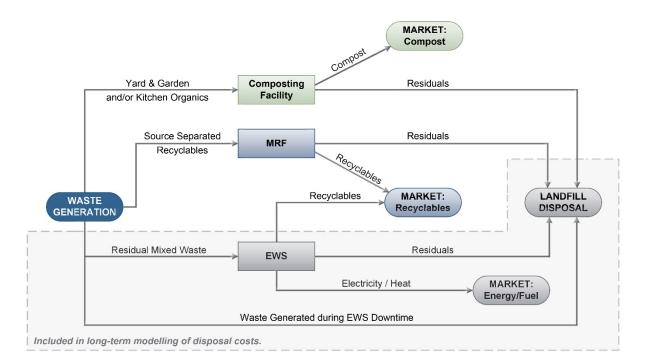
Under this option a WTT facility would be added into the system and constructed in either of the three locations under consideration. The facility would divert organics, metal and cardboard and generate biogas and RDF. The residual stream is estimated to 33.5% of the input waste tonnages. A flow diagram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



Option 2 - EWS (Conventional combustion WTE technology)

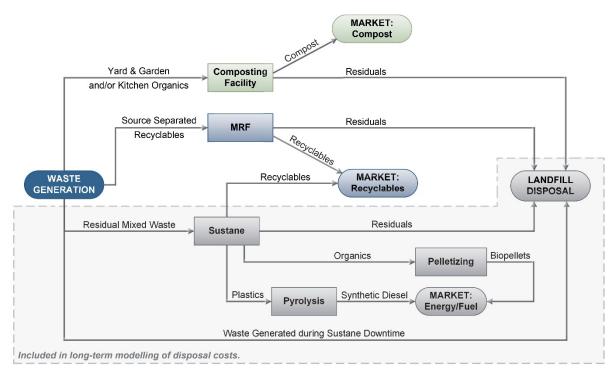
Under this option an EWS facility would be added into the system and constructed in either of the three locations under consideration. The received waste would be incinerated without prior sorting or diversion, however metals could be recycled from the bottom ash. The residual ash is estimated to be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

The model was run for two waste capacity scenarios. First, the model was run assuming the throughput is constant over time, since conventional WTE facilities have a set capacity. This means that a larger portion of the generated waste is landfilled over time, as the annual waste generation is expected to increase over time. In the first model run, the landfill disposal costs were compared with the processing costs (including capital) provided by the WTE vendors. It was determined that the status quo of landfilling remains the lowest cost option.

These results were presented at an interim meeting with the CVRD. It was requested that the investigation be expanded in the following manner:

- 1. EWS be excluded from further consideration;
- 2. The remaining two vendors Sustane and WTT would be requested to provide costs to provide facilities that could expand along with increasing waste quantities over the next 50 years; and
- 3. All costs would be shown in comparison to the full cost of waste management at the CVRD, including costs for recycling, composting, planning, long term landfill care and management

Subsequently, in the second model run, the technology capacity and annual throughput was increased over time at the same rate as population growth and waste generation. This way the WTE to landfill ratio for accepted waste remains constant. Increased capital and operating costs as a result of the increasing capacity, as reported by the vendors, were taken into considerations as well as consequent reduction in landfill operating costs and prolonged life of landfill cells at the CVWMC Landfill.



Full System Cost Assessment

As requested by the CSWM, the results from the long-term modelling presented above were presented as a part of the full CSWM cost. The costs included in the long-term cost modelling for disposal cost was broken into four categories:

- Landfill operation, development and closure cost reduced as result of the WTE facility.
- Landfill operation, development and closure cost unaffected by the WTE facility.
- Transfer stations and waste transfer.
- WTE capital and operating cost.

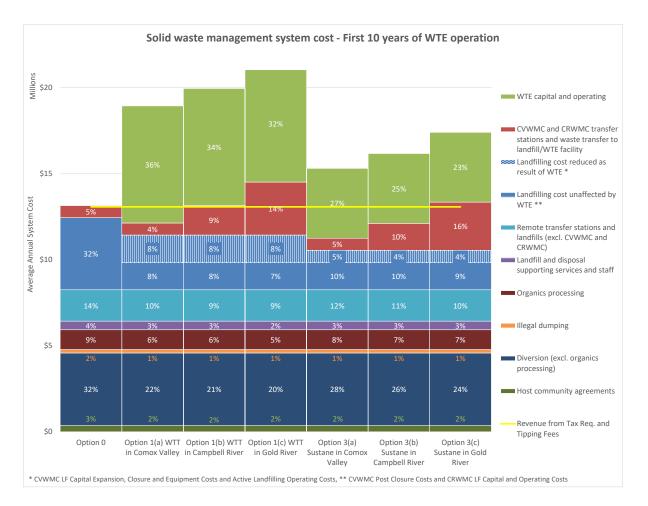
The CWMS budgets were reviewed in detail and broken into an additional six categories:

- Organics processing.
- Transfer stations and remote landfills.
- Host community agreements.
- Diversion (excl. organics).
- Disposal support services and staff (costs not affected by changes in disposal option).
- Illegal dumping.

The analysis also includes a comparison of the cost toward the current tax requisition of \$4.0M (2017-2018) and \$6.0M (2019-2067) plus the revenue generated by tipping fees.

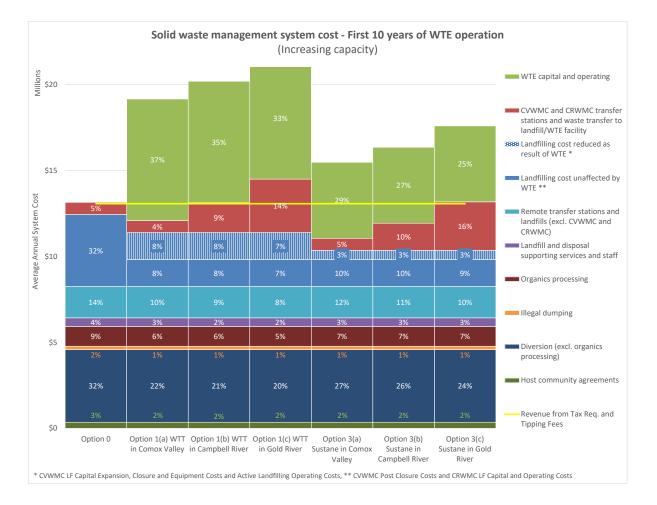
The two figures below show the annual average full system costs for the first 10 years of operating the facility at fixed and increasing capacity. As can be noted, the total system cost is higher for the WTE options though the landfilling cost is reduced as a result of in the inclusion of a WTE facility. Note that the lower landfilling cost for Sustane is a result of extended life of the active landfill cell and that not capital investment in the subsequent cell is required during the 10 year period.







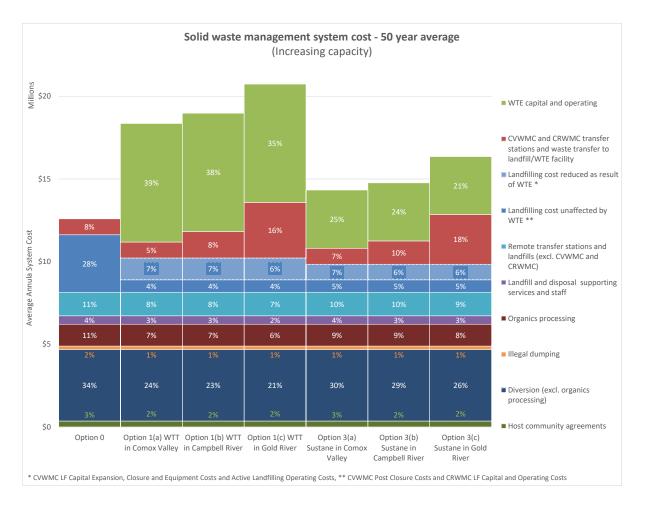






Solid waste management system cost - 50 year average suo \$20 WTE capital and operating CVWMC and CRWMC transfer stations and waste transfer to landfill/WTE facility Landfilling cost reduced as result \$15 of WTE * Landfilling cost unaffected by WTE Average Annula System Cost Remote transfer stations and landfills (excl. CVWMC and \$10 CRWMC) 8% Landfill and disposal supporting 4% services and staff Organics processing 4% 3% 3% 3% 4% 3% 3% \$5 Illegal dumping 1% 34% 24% Diversion (excl. organics processing) Host community agreements \$0 Option 1(a) WTT Option 1(b) WTT Option 1(c) WTT Option 3(c) Option 0 Option 3(a) Option 3(b) in Comox Valley in Campbell River in Gold River Sustane in Comox Sustane in Gold Sustane in Campbell River River Valley * CVWMC LF Capital Expansion, Closure and Equipment Costs and Active Landfilling Operating Costs, ** CVWMC Post Closure Costs and CRWMC LF Capital and Operating Costs

The two figures below show the annual average full system costs over the 50 years modelling period for the facilities operated at fixed and increasing capacity. When calculated over the longer time period the difference in landfilling cost between the two technologies is reduced.



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 -873 tonnes CO₂e (Option 1(a)) to 899 tonnes CO₂e (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 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 \$75/tonne. The respective cost was estimated to approximately \$80/tonne in Version I of this report (November, 2017). In Version II, a decreased diversion rate is assumed for the regions based on updated diversion estimates. Consequently an increased disposal rate is applied to the fixed landfilling cost which results in a decreased cost per tonne. Waste processing through one of the assessed WTE technology options would increase this



cost by \$29 to \$110 per tonne, or \$89M-\$347M over a 50 year period. This cost per tonne represents the total disposal 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 WTE revenue from diverted materials or generated product or energy.

The lowest cost option that incorporates WTE would utilize the technology provided by Sustane located at in the Comox Valley area with system costs of \$117 per tonne for the first 30 years, which drops to \$99 per tonne at 50 years of operation. This cost per tonne remains higher than the status quo landfill operation. 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. There is therefore a technical and commercial risk associated with this technology which may impact its feasibility and cost. A full scale system is being built in Nova Scotia which could provide performance data in the near future for further evaluation.

The costs presented above are based on WTE facilities run at fixed capacity. If the technologies are accepting increasing tonnages from year to year the average cost per tonne waste requiring disposal will generally increase. The reason for the increased cost is that more waste is processed at a higher cost, i.e. through one of the WTE technologies instead of through landfilling.

The two main factors affecting the overall system cost for the options is the facility capital and operations cost, along with transportation cost of waste, ash and residuals. Once new facilities are in operation, landfill operational costs are reduced by up to 34% and the landfill capital cost by up to 57% over the 50 year projection period. The respective numbers are 44% and 60% if the facilities were to accept increasing amounts of waste. 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. Anecdotally, it is known that there are large supplies of wood waste available in the region. Creating additional organic product could disrupt current wood waste recovery and utilization operations by adding more product into an already well supplied market.

WTE offers many benefits, however, 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 tonnes¹.

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.

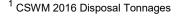
1.2 Scope and Timeline

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.

1.3 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.

	5	
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%

Table 1:	Ranking	of submissions.
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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 2023, 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 Table 2 through 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.
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).



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Location	Comox Valley - CVWMC	
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.
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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)
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.

Location	Campbell River - CRWMC			
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.	
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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	 ng suitability The following factors should be considered when assessing this as a potential si a WTE facility: The site is not currently used for waste management and would require rezore 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 s 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 proximit residences. 				

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

Location	Gold River – Former Pulp Mill Site
	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.



Gold River – Former Pulp Mill Site					
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.					
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.					
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.					
Large buffer with over 10 km to the closest residential dwellings.					
Not confirmed					
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.					
 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; therefore, it 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 River 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 <u>consideration</u> 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.

Recent conversations with the MOE (from the Clean Communities department) indicated that the MOE is not intending to update their guidelines from 2010 on resource recovery and WTE. They said that each Regional District (RD) will need to show that they have maximized the amount of diversion from the 3 Rs (Reduce, Re-use and Recycle) before they start looking at energy recovery and WTE. If a RD is not able to achieve a 70% diversion rate, the RD needs to justify why. The MOE recognizes that some RDs face greater challenges than others in achieving 70% (or equivalent) diversion through the 3R's and will deal with each RD's wishes to utilize energy recovery and WTE, on a case-by-case basis.

It is highly likely that recyclables recovered in a mixed waste processing facility will not be considered recycled under 3R's but would be considered recovery. Any form of energy recovery, including anaerobic digestion, as well as the making of fuel from waste would be considered recovery. Composting is considered recycling.

As the MOE seems to understand the challenges in measuring diversion performance, they are discussing the potential to move to a kg/capita disposal target rather than the 70% diversion target. However this policy shift is unlikely to take place in the near future.

- 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

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.

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.

 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 0 - 4.6.

4.2 Facility Location

For the purpose of the long-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 2023, 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 identifie		Hauling of Waste	Hauling of Residuals/Ash	Transfer station required	Ash, residual and excess waste disposal location
а	Comox Valley area	SRD waste to Comox Valley	N/A	Campbell River	CVWMC Landfill
b	Campbell River area	CVRD waste to Campbell River	Campbell River to Comox Valley	Comox Valley	CVWMC Landfill
с	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 m³ to 5,700,000 m³ 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 m³ 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 51,000 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 module system would allow for continuous operations, where one module would be run at increased capacity while the other is serviced. However, 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 the waste would be temporarily stockpiled.



The permitting process may be longer than for the other two WTE options assessed, due the nature of the technology. However, this could be balanced out 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 by 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 biopellets 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 a 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

Population was projected over the evaluation period to determine annual waste generation. 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, based on the average growth of the projection period 2009-2041. The average annual waste generation rate was assumed to be 0.57 tonnes/capita (46% diversion) for the 2015-2016 time period, 0.55 tonnes/capita (48% diversion) for the 2017-2020 time period and reduced to 0.44 tonnes/capita (58% diversion) thereafter. Implementation of a regional organics processing facility is assumed to result in a boost to the diversion rate by 10%.

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 51,000 tonnes. For the purpose of this assessment, it was assumed that the estimated waste generation in the SRD and CVRD does not warrant for the facility to be expanded over the 50-year projection period. Therefore, annual throughput has been projected as constant over the period. All technology options were expected to operate at reduced capacity for the first 3 years until the CRWMC Landfill is closed and waste transferred to the new facility. In addition, due to facility 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 tipping fee for the different technologies was determined based on operating costs provided by the vendors, then assessed and compared to similar facilities and adjusted as required, as well as revenue from sale of recyclables and/or energy. 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 after 25 years 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. As the capital cost provided by WTT does not include the cost for HDPE and PET separation nor a drum dryer, it was 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, 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 were 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 annual break-even tipping fees for the three WTE technology options are also presented. Note that the facilities are run at lower capacity until CRWMC Landfill is closed hence the range in the first 25 years.

 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 Annual Payment (\$/year)	Operating Cost (\$/tonne)	Revenue (\$/tonne)	Total Break- Even Tipping Fee (\$/tonne)
-25	WTT	\$26.00M	\$1,778,766	\$120.00	-\$7.20	\$147.70-\$173.55
Year 1-2	EWS	\$52.68M	\$3,604,054	\$116.00	-\$31.90	\$154.82-\$212.31
Ye	Sustane	\$25.00M	\$1,710,3352	\$82.07	-\$29.33	\$86.30-\$111.32
-50	WTT	N/A	N/A	\$120.00	-\$7.20	\$112.80
rs 26-	EWS	N/A	N/A	\$116.00	-\$31.90	\$84.10
Years	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 where 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 m³, 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. Under status quo conditions, it is projected the landfill capacity at the CVWMC will be reached 4 years prior to the end of the modelling period. It was assumed that Cell 6 would be expanded to accommodate an additional 4 years of disposal and a capital expansion cost was estimated based on the average capital expansion cost per tonne for Cell 2-6. This was done to allow a fair comparison between status quo and the technology options.

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 and 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.
- 50% of the \$100,000 allowance for CRWMC operating contract.
- 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 2017 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 repaying 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, 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 related to disposal activities 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 disposal 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.

Option		30 years	40 years	50 years
1(a)	WTT in Comox Valley	\$289,603,000	\$384,813,000	\$467,777,000
1(b)	WTT in Campbell River	\$307,442,000	\$403,446,000	\$491,048,000
1(c)	WTT in Gold River	\$350,784,000	\$466,790,000	\$571,820,000
2(a)	EWS in Comox Valley	\$296,299,000	\$365,859,000	\$432,946,000
2(b)	EWS in Campbell River	\$310,749,000	\$379,852,000	\$450,325,000
2(c)	EWS in Gold River	\$345,297,000	\$433,088,000	\$518,123,000
3(a)	Sustane in Comox Valley	\$208,998,000	\$262,575,000	\$313,679,000
3(b)	Sustane in Campbell River	\$220,442,000	\$273,106,000	\$327,140,000
3(c)	Sustane in Gold River	\$261,241,000	\$332,392,000	\$402,342,000

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

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 \$40 per tonne if calculated over 30 years. The difference decreases to \$28 per tonne when calculated over 50 years. The cost per tonne is calculated by dividing the total disposal 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.

	Estimated average disposal cost per tonne						
Option		30 years	40 years	50 years			
2017 Lo	ong-Term Cost Model						
0	Status Quo*	\$77	\$75	\$71			
1(a)	WTT in Comox Valley	\$162	\$157	\$148			
1(b)	WTT in Campbell River	\$172	\$165	\$155			
1(c)	WTT in Gold River	\$196	\$191	\$181			
2(a)	EWS in Comox Valley	\$165	\$149	\$137			
2(b)	EWS in Campbell River	\$173	\$155	\$143			
2(c)	EWS in Gold River	\$193	\$177	\$164			
3(a)	Sustane in Comox Valley	\$117	\$107	\$99			
3(b)	Sustane in Campbell River	\$123	\$112	\$104			
3(c)	Sustane in Gold River	\$146	\$136	\$127			

 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.



	Estimated average disposal cost per tonne					
Option		30 years	40 years	50 years		
2011 Lo	ong-Term Cost Model (AECOM, 20	11)				
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		
В	Campbell River – one regional landfill	\$74	\$71	\$83		
С	CVWMC and CRWMC Landfills – two regional landfills	\$73	\$68	\$65		

*Note: The respective cost was estimated to \$80/tonne in Version I of this report (November, 2017). In Version II, a decreased diversion rate is assumed for the regions. Consequently, an increased disposal rate is applied to the fixed landfilling cost which results in a decreased cost per tonne.

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 \$75/tonne. Waste processing through one of the assessed WTE technology options would increase this cost by \$29 to \$110 per tonne, or \$89M-\$347M 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 in the paragraph 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. Inclusion of these costs are presented and discussed in Section 6.

The two main factors affecting the overall disposal system cost for the options is the facility breakeven 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 34% and the landfill capital cost by up to 57% 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 m³. This capacity of planned Cell 1-6 at the CVWMC Landfill is projected to be reached in 2064, should landfilling remain the only waste disposal option. For modelling purposed it was assumed that Cell 6 will be expanded provide airspace throughout the modelling period. The approximate available airspace at the CVWMC Landfill at the end of 2067 for the WTE technology options are as follow:

- WTT 2,845,000 m³
- EWS 3,641,000 m³
- Sustane 3,706,000 m³

This would increase the life of the CVWMC Landfill by 36 years (WTT), 49 years (EWS) and 50 years (Sustane), assuming the capacity of the WTE facilities remain unchanged over time and the, by the vendors, reported diversion is reached. There are some technical risks associated with the Sustane technology which are not factored into these figures; refer to Section 8 for further discussion.

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 reuse 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. INCREASING TECHNOLOGY CAPACITY

5.1 Introduction

Traditional WTE incineration facilities are built to a process a specific tonnage of waste and are limited to that capacity. The model and analysis was completed with the assumption that the WTE facilities would accept a fixed amount of waste generated by the CSWM in 2024. The technology vendors WTT and Sustane do not incinerate waste and therefore have flexibility in capacity to accept increasing waste tonnages.

At the request of the CSWM, the technology vendors WTT (Option 1) and Sustane (Option 3) were approached for additional information, which included the capital and operation expenses for accepting an increasing amount of waste over the next 50 years. The estimated tonnages are shown in Table 10 below.

Year	Tonnes processed
2021	29,000
2026	52,000
2031	54,000
2036	56,000
2041	57,000
2046	60,000
2051	62,000
2056	65,000
2061	68,000
2066	70,000

Table 10: Estimate of increasing tonnages accepted for processing at WTT and Sustane over the modelling period.

5.2 Vendor Responses

The updated vendor questions were developed by SLR Consulting and the responses reviewed. The memo from SLR can be found in Appendix C. A summary of the memo is presented below.

WTT and Sustane were requested to elaborate on how they would handle the proposed growth of the waste stream over time and how this would affect costs.

Sustane indicated that an increase of feedstock inputs from 29,000 to 70,000 tonnes per year (over the 50 year planning period) could be accommodated by the proposed design with minor adjustments. The change would increase the capital costs from around \$25M to \$27.5M, as set out in their original RFI submission. In addition, an annual allowance of \$150,000 was added for unspecified capital works for future improvements and upgrades of the plant. This allowance is equivalent to adding a further \$2 per tonne to the operations costs (at full capacity).

Operating costs for Sustane would benefit from economies of scale and would decrease incrementally from \$75.42 per tonne at the lower throughput to \$54.45 per tonne at 70,000 tonnes per year (before the \$2 per tonne capital works allowance).

WTT indicated that an increase in feedstock inputs from 29,000 to 70,000 tonnes per year could be accommodated. For the mechanical separation part of the process, this would only require



implementation of a third shift. For the other plant components, the capital costs would change as follows:

- Anaerobic digestion
 Additional \$1.4 1.6 million;
- Composting Additional \$0.8 1.0 million.

Operational costs for the WTT technology are expected to increase in proportion with increased throughput.

At this time, WTT is recommending that HDPE and PET not be separated for recycling due to poor markets for these materials, which would negatively affect overall economics. The materials would still be utilized, but would comprise part of the refused derived fuel. Should secondary markets for these two plastic materials improve, a separate extraction could be installed once it is deemed economical.

5.3 Increasing Technology Capacity and Associated Costs

The impact of increasing the capacity of the WTE technologies resulted in less waste to landfill and an increase in life span of the landfill cells. The proportion of residual waste from the technology processing was assumed to remain constant.

The vendors provided updated capital costs associated with an increasing capacity, which were used to update the model. The adjustment in capital costs are shown in Table 11 below. In their original response to the RFI, WTT included a capital estimate to separate PET and HDPE from the waste stream. Separating out these materials does not impact the waste to landfill proportion as these materials would be included in the RDF. Therefore, it was assumed that the separation of these materials is an increase in cost and at this point a cost-prohibitive investment as it has no impact on residuals to landfill.

Technology	Capital Cost – Fixed Capacity	Capital Cost – Increasing Capacity
WTT	\$26,000,000	\$28,400,000
Sustane	\$25,000,000	\$27,500,000

Table 11: Increase in capital cost as result of increasing waste throughput.

Operating costs per tonne for the WTT was assumed to remain at \$120 per tonne, as the vendor indicated that a third shift would need to be added to manage the additional incoming tonnages. WTT did not indicate whether the addition of one shift would affect the processing cost per tonne and have therefore been assumed as unaffected. Sustane provided decreasing costs per tonne as the tonnages increased. The costs per tonne were reviewed and the labour costs increasing slightly to reflect realistic costs in the region. The operating costs used for the Sustane technology are shown in Table 12 below. Sustane indicated that an additional \$150,000 would be required annually for unspecified capital works related to future improvements and upgrades of the plant.

Table 12: Operating cost per tonne related to facility throughput at the Sustane facility.

Year	Tonnage Processed Annually	Sustane Operating Cost per Tonne (excl. Capital Costs)
2021-2046	29,000 to 59,800	\$82.07
2047-2065	60,000 to 69,800	\$65.39
2066-2067	70,000 to 70,900	\$58.88

Adjustments were made to the landfilling costs to reflect the increasing technology capacity and resulting decrease in landfilling required compared to current conditions, as well as technology



operations with constant throughput (resulting in increasing tonnes of waste requiring landfilling as a result of increasing population and waste generation). Consideration was also given to the reported diversion achieved by the two technologies. The different adjustments made are summarized below.

CVWMC Landfill - Minor Capital

- Increase life (2 times) of dozer, gravel truck and excavator (compared to current conditions).
- Compactor and front-end loader shared with recycling activities considered redundant for the small amounts landfilled on an annual basis, and no replacements were included post 2020.

CVWMC Landfill - Operating Cost

- Sustane:
 - Operator: 25% compared to current conditions
 - Landfill analyst: 80% compared to current conditions
 - Landfill manager: 40% compared to current conditions
 - Other operating expenses: 15% compared to current conditions
 - Leachate treatment cost: \$200K Cell 1, \$300K Cell 2, \$375 Cell 3 and following cells
- WTT
 - Operator: 50% compared to current conditions
 - Landfill analyst: 100% compared to current conditions
 - Landfill manager: 50% compared to current conditions
 - Other operating expenses: 25% compared to current conditions
 - Leachate treatment cost: \$225K Cell 1, \$300K Cell 2, \$375 Cell 3 and following cells

CVWMC Landfill - Capital Expansion and Closure

The total cost for each cell expansion and closure remains the same, but the average annual cost is reduced, as the cell life is prolonged as a result of reduced landfilling. Over the 50 year projection period capital investment is required for:

- Construction of Cell 1 and 2, and closure of Phase 2 and Cell 1 if WTT is selected, and
- Construction of Cell 1 and closure of Phase 2 if Sustane is selected.

No adjustments were made to the capital and operating costs associated with transfer stations although it can be expected that these cost increase slightly as the accepted tonnes increase.

5.4 Summary of Results and Discussion

The long-term cost model was run applying the adjustments presented in Section 5.1 - 5.3. The results are summarized below and detailed long-term cost model tables are presented in Appendix D.

The total disposal cost over 30, 40 and 50 years associated with the WTT and the Sustane technology options and sub-options are presented Table 13 below.

Option		30 years 40 years		50 years	
1(a)	WTT in Comox Valley	\$303,298,000	\$399,286,000	\$509,931,000	
1(b)	WTT in Campbell River	\$323,319,000	\$422,490,000	\$541,216,000	
1(c)	WTT in Gold River	\$368,611,000	\$489,912,000	\$629,138,000	
3(a)	Sustane in Comox Valley	\$214,839,000	\$262,617,000	\$308,930,000	
3(b)	Sustane in Campbell River	\$229,749,000	\$278,570,000	\$330,644,000	
3(c)	Sustane in Gold River	\$270,394,000	\$339,443,000	\$409,949,000	

Table 13: Summary of total disposal cost over 30, 40, and 50 years – increasing technology capacity.

The cost per tonne waste for each option (including Option 0) over 30, 40 and 50 years is presented in Table 14. The difference compared to cost associated with running the technology at constant capacity is presented within brackets. The cost per tonne increases with increasing technology throughout for almost all options and modelling periods (except 40 and 50 average for Sustane in Comox Valley). The main reason for the increasing cost is that more waste is being processed by the technology which is more expensive per tonne than disposal through landfill.

 Table 14: 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.

Estimated average disposal cost per tonne						
Option		30 years	40 years	50 years		
2017 L	ong-Term Cost Model					
0	Status Quo	\$77	\$75	\$71		
1(a)	WTT in Comox Valley	\$169 (+\$8)	\$163 (+\$6)	\$161 (+\$13)		
1(b)	WTT in Campbell River	\$180 (+\$9)	\$173 (+\$8)	\$171 (+\$16)		
1(c)	WTT in Gold River	\$206 (+\$10)	\$200 (+\$9)	\$199 (+\$18)		
3(a)	Sustane in Comox Valley	\$120 (+\$3)	\$107 (\$0)	\$98 (-\$2)		
3(b)	Sustane in Campbell River	\$128 (+\$5)	\$114 (+\$2)	\$105 (+\$1)		
3(c)	Sustane in Gold River	\$151 (+\$5)	\$139 (+\$3)	\$130 (+\$2)		

The difference between status quo and the least expensive technology option is \$43 per tonne if calculated over 30 years. The difference decreases to \$28 per tonne when calculated over 50 years. The cost per tonne is calculated by dividing the total disposal 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.

The increasing technology capacity increases the landfill life by 69 years (WTT) and 160 years (Sustane), compared to continued landfilling without adding new technologies.

6. FULL SYSTEM COST ASSESSMENT

6.1 Introduction

The System Options and Cost Assessment was presented originally to the CSWM as a comparison of transfer and landfilling costs between the Status-Quo landfill scenario and the WTE scenarios. At the request of the CSWM, an additional assessment was completed to present the technology cost for WTT (Option 1) and Sustane (Option 3) as part of the full CSWM system cost and compare this to continued landfilling under Option 0 – Status Quo.

The analysis is built on capital and operating costs for the current service, divided into categories representing the main cost drivers. The costs were provided by the CSWM and categorized in collaboration with the Morrison Hershfield team. The analysis also includes a comparison of the cost toward the current tax requisition of \$4.0M (2017-2018) and \$6.0M (2019-2067) plus the revenue generated by tipping fees. The costs that remain unaffected by the applied disposal options were identified.

6.2 Cost Break-Down and Assumptions

To capture the full cost of the CSWM solid waste management system, ten cost categories were developed. Thereof, six categories were developed, including waste management costs associated with activities not affected by potential inclusion of a WTE technology. These categories are based on the categorized costs provided by the CSWM staff, which in turn were developed based on the approved 2018 operating budget and an updated 10-year capital projects plan. In addition, an estimate of the operating cost of the planned organics facility in Campbell River was developed and included. The seven categories are:

Organics Processing

- Capital cost Processing facility in Campbell River and transfer station in Comox Valley.
- Operating cost Processing facility, transfer station and transfer of waste from Comox Valley to Campbell River.
- Remote Transfer Stations and Landfills
 - Capital cost Development of transfer stations (excl. Comox Valley and Campbell River) and closure of remote landfills.
 - Operating cost Operation of landfills until closure, post-closure costs and operations of transfer stations³.
- Host Community Agreements
 - Operating cost.
- Diversion (excl. organics)
 - Capital cost Regular capital upgrades and equipment replacement schedule.



³ Assuming the 2018 operating cost of remote landfills will be the same as the post-closure costs and transfer stations operating cost, post landfill closures.

- Operating cost 2018 operating costs associated with diversion activities. No adjustment to increased generation of recyclables.
- One-time cost included in 2018 budget, only applied to 2018 in the long-term model.
- Disposal Support Services and Staff (costs not affected by changes in disposal option)
 - Operating cost cost associated with disposal but not directly tied to facility or affected by applied disposal technology.
- Illegal Dumping
 - Operating cost.

Note that interest and capital contributions (included in the annual operating budget) are not included, as the model includes only capital project costs.

The remaining four categories include the disposal-related cost presented in Section 4, which was divided into three categories to easier identify costs affected by the scenario applied and to what extent. The categories include both capital and operating costs:

- Landfill operation, development and closure cost reduced as result of the WTE facility.
- Landfill operation, development and closure cost unaffected by the WTE facility.
- CVWMC and CRWMC transfer stations and waste transfer to WTE facility.
- WTE capital and operating cost.

All cost categories were projected over the 50 year long-term cost model project period and compared to the revenue collected through tax requisition (\$4M 2017-2018, \$6M 2019-2067) and tipping fees (\$130/tonne MSW). The results of the full system cost assessment is presented in Section 6.3 below.

6.3 Results

6.3.1 Full System Costs – Fixed Technology Capacity

A summary of the full system cost for the CSWM system is presented in Figure 1 through Figure 5 below. Detailed long-term cost model for the full system cost (excl. the disposal costs) is presented in Appendix E.

Figure 1 shows the full system cost per tonne waste requiring disposal as an average over the first 10 years of operation of the WTE facility (2021-2030). As shown in the figure, costs associated with host community agreements, organics processing, landfill and disposal supporting services and staff as well as transfer stations and remote landfills (excl. CRWMC and CVWMC) remain unaffected by the inclusion of a WTE facility in the CSWM system.

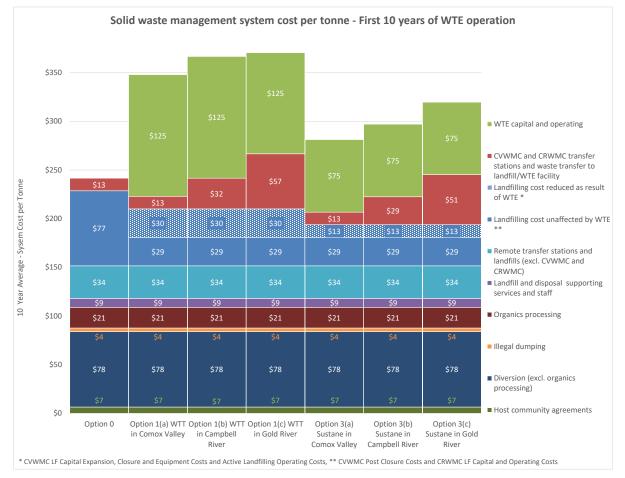
The overall landfilling cost is reduced compared to current conditions but not enough to cover the additional cost of a new facility. A portion of the landfilling cost is fixed and not affected by the introduction of WTE; this cost include CRWMC Landfill capital and operating costs (incl. post-closure costs) and CVWMC Landfill post-closure costs. The capital cost for expansion and closure work at the CVWMC Landfill remains the same, however the scheduling of the projects are shifted due to reduced tonnes (MSW and processing residuals) requiring landfilling. As Sustane reports higher diversion than WTT the CVWMC Landfill will fill at a slower rate and the capital investment of Cell 2 will occur later in time. This explains why the landfilling cost reduced as a result of WTE is lower for Option 3(a)-(c) compared to Option 1(a)-(c); Cell 2 development is required within the first 10 years of WTE operation of a WTT facility but not until 15 years later for operation of a Sustane facility.



The total average annual full system cost and the percent each cost category is represented for the first 10 years of operation of a WTE facility as shown in Figure 2. The yellow line shows the average annual revenue collected and includes \$6M tax requisition as well as revenue collected from tipping fees. Additional revenue sources would be required to cover the increased cost resulting from the introduction of a new waste processing facility (sale of recyclables and energy from the process is taken into consideration).

The average annual costs calculated over 30, 40 and 50 years are shown in Figure 3 through Figure 5 and include the percent of cost that each category represents. There are no major differences between the three averages, however one can note that:

- The landfilling costs represent a smaller portion of the full system cost if averaged over 50 years compared to 30 years.
- The transfer stations and waste transfer cost represent a larger portion of the full system cost if averaged over 50 years compared to 30 years.



• The average annual full system cost is lower if calculated over a 50 year period compared to a 30 year period.

Figure 1: Average full system cost per tonne waste requiring disposal calculated over the first 10 years of WTE facility operations with fixed capacity.





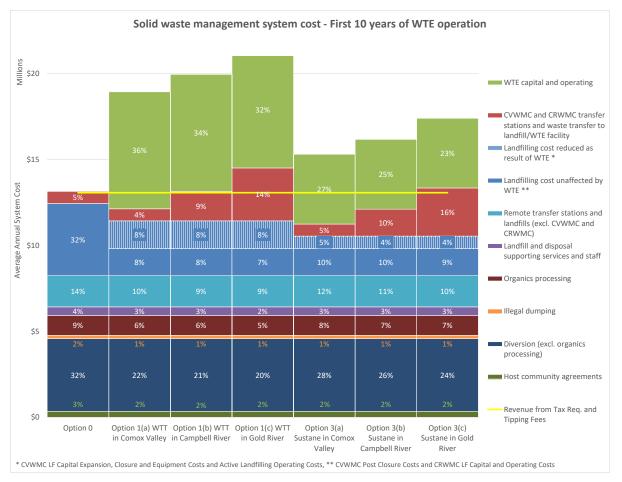


Figure 2: Average annual full waste management system cost and percent each cost category represents. Average is calculated over the first 10 years of WTE facility operations with fixed capacity.



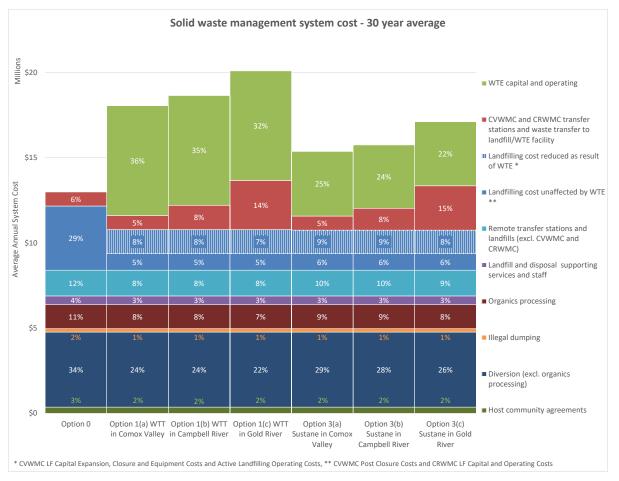


Figure 3: Average annual full waste management system cost and percent each cost category represents. Average is calculated over the first 30 years of the modelling period and facility operations with fixed capacity.





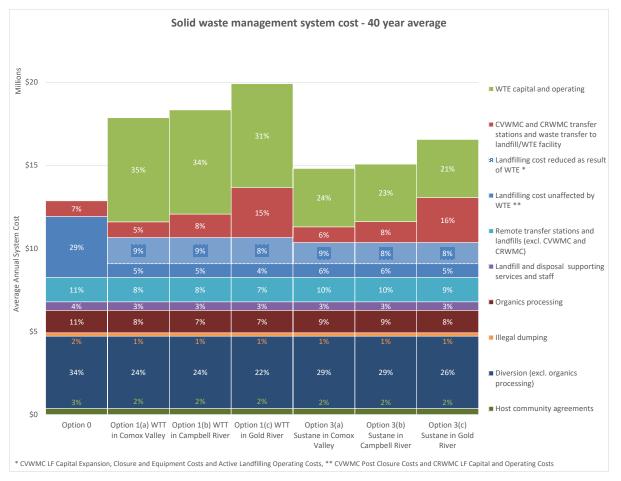


Figure 4: Average annual full waste management system cost and percent each cost category represents. Average is calculated over the first 40 years of the modelling period and facility operations with fixed capacity.



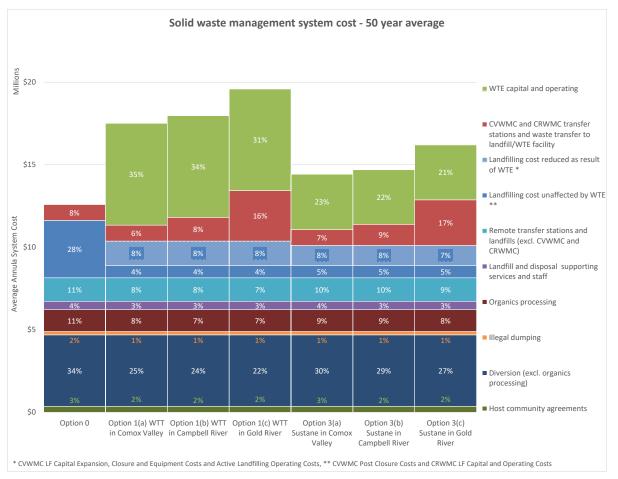


Figure 5: Average annual full waste management system cost and percent each cost category represents. Average is calculated over the first 50 years of the modelling period and facility operations with fixed capacity.

6.3.2 Full System Costs – Increasing Technology Capacity

Full system cost for the technologies with increasing technology capacity is presented in Figure 6 through Figure 10 below. The comparative results are very similar to those presented in Section 6.3.1. Notable differences include:

- The portion of the full cost represented by landfilling is reduced with increasing technology capacity, especially for the Sustane technology as less residuals are generated and landfilled compared to WTT.
- The average annual full system cost is higher with increasing technology capacity for all options except the 50 year average for Sustane located in Comox Valley. As a result the capital and operating cost for the WTE facility with increasing capacity represent a larger portion of the full system cost than for that with fixed processing capacity.
- The reduced landfilling costs and potential increased WTE processing efficiencies do not offset the higher disposal cost through WTE compared to landfilling and current operations.

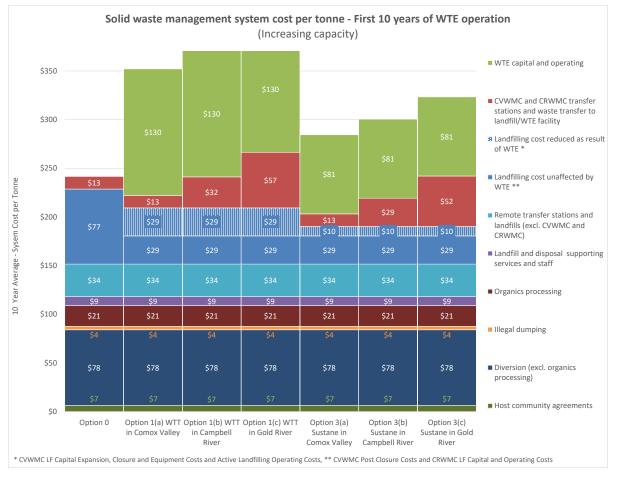


Figure 6: Average full system cost per tonne waste requiring disposal calculated over the first 10 years of WTE facility operations with increasing capacity.



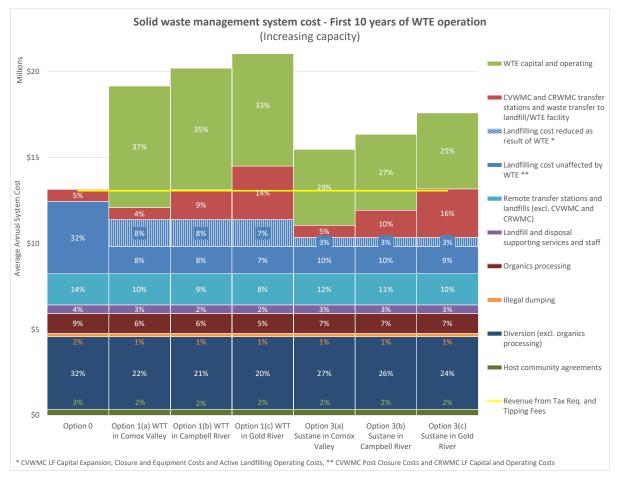


Figure 7: Average annual full waste management system cost and percent each cost category represents. Average is calculated over the first 10 years of WTE facility operations with increasing capacity.



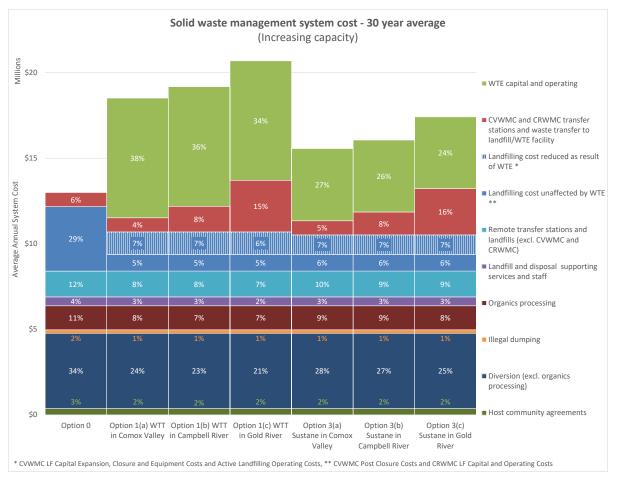


Figure 8: Average annual full waste management system cost and percent each cost category represents. Average is calculated over the first 30 years of the modelling period and facility operations with increasing capacity.



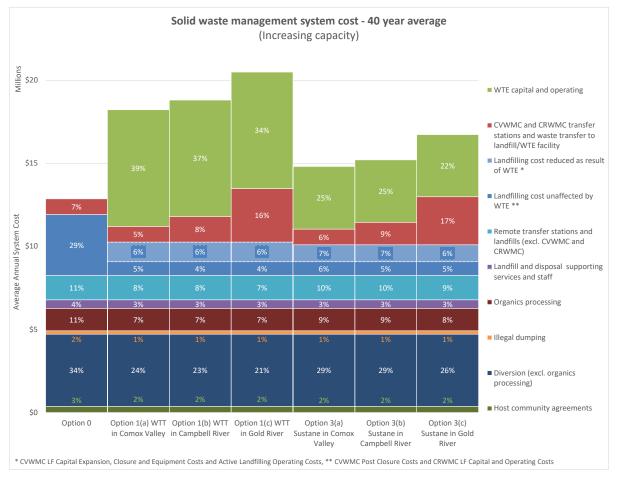
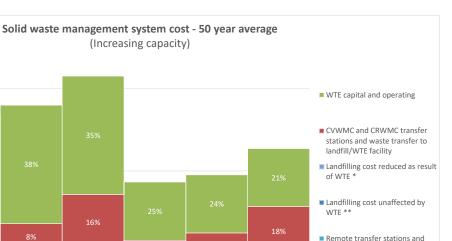
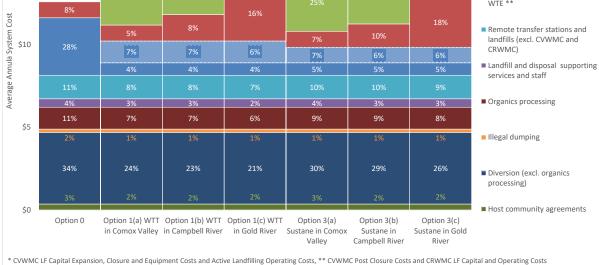


Figure 9: Average annual full waste management system cost and percent each cost category represents. Average is calculated over the first 40 years of the modelling period and facility operations with increasing capacity.









suo \$20

\$15

Figure 10: Average annual full waste management system cost and percent each cost category represents. Average is calculated over the first 50 years of the modelling period and facility operations with increasing capacity.





7. GREENHOUSE GAS EMISSIONS ASSESSMENT

7.1 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 11 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.

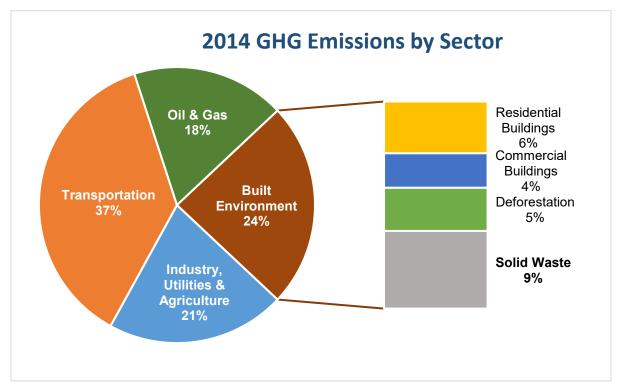


Figure 11: 2014 GHG Emissions by Sector (Adapted from: BC Government, 2016).

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.

7.2 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 16; the detailed analysis is presented in Appendix F.

7.2.1 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 CO₂, N₂O and CH₄ 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 CO₂ emissions. The combustion of biogenic portion of the waste stream is considered to be CO₂ 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 (N₂O) emissions from waste combustion originate from components of the waste stream that contain nitrogen. In addition to waste composition, N₂O 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 CH₄ 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.

- CO₂ 0.320 tonnes CO₂e / tonne MSW;
- CH₄ 0.0000031 tonnes CO₂e / tonne MSW; and
- N₂O 0.016 tonnes CO₂e / 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 m³ 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 CO₂e/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 CO₂e per tonne metal Ferrous metal (steel) – recycling: 1.99 tonnes CO₂e per tonne metal
- Non-ferrous metal (assumed aluminium): 10.01 CO2e per tonne metal
- PET plastics: 1.23 CO₂e per tonne plastics
- HDPE plastics: 0.96 CO₂e per tonne plastics
- Low density plastics: 0
- Cardboard: 6.15 CO₂e 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 15 below.

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

 Table 15
 Summary of GHG contributions and offsets associated with the three technology options.

7.2.2 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 CO₂e. 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 CO₂e 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.

7.2.3 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.

7.3 Summary of Results

The net GHG emissions estimated for the 10 assessed options are presented in Table 16. 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 16. 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 -873 tonnes CO_2e (option 1(a)) to 899 tonnes CO_2e (option 0) over the assessed 40-year period.

Options		Technology	Landfill	Transfer Station(s)	Total
		tonnes CO ₂ e	tonnes CO ₂ e	tonnes CO2e	tonnes CO2e
0	Status Quo	0	890,000	9,000	899,000
1(a)	WTT in Comox Valley	-1,060,000	178,000	9,000	-873,000
1(b)	WTT in Campbell River	-1,060,000	178,000	15,000	-867,000
1(c)	WTT in Gold River	-1,060,000	178,000	45,000	-837,000
2(a)	EWS in Comox Valley	491,000	183,000	9,000	192,000
2(b)	EWS in Campbell River	491,000	183,000	13,000	196,000
2(c)	EWS in Gold River	491,000	183,000	39,000	222,000
3(a)	Sustane in Comox Valley	-339,000	178,000	9,000	187,000
3(b)	Sustane in Campbell River	-339,000	178,000	13,000	191,000
3(c)	Sustane in Gold River	-339,000	178,000	38,000	216,000

Table 16: GHG emission summary over 40 years.

7.4 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 WTT and Sustane options and slightly higher for EWS. The facilities are assumed to have the same capacity resulting in equal amounts of waste in excess of the capacity being landfilled, however EWS will receive waste slightly below capacity for three years as a result of longer downtime periods for repairs. 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.



8. 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.

8.1 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 start-up issues 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.

8.2 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.

8.3 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.

8.4 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 8.4.1 below.

8.4.1 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 online 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 (online, 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.

8.5 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.

8.6 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.

9. 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 \$75/tonne. The cost was estimated to be approximately \$80/tonne in Version I of this report (November, 2017). In Version II, a decreased diversion rate is assumed for the regions based on updated diversion estimates. Consequently an increased disposal rate is applied to the fixed landfilling cost, which results in a decreased cost per tonne. Waste processing through one of the assessed WTE technology options would increase this cost by \$29 to \$110 per tonne, or \$89M-\$347M over a 50-year period. This cost per tonne represents the total disposal cost and includes capital and operational costs related to waste disposal (WTE and/or landfilling) and waste transfer (transfer station and waste hauling), as well as any WTE revenue from diverted materials or generated product or energy.

The lowest-cost option would be a WTE facility using the technology provided by Sustane (or equal), located in the Comox Valley area, with system costs of \$117 per tonne for the first 30 years and dropping to \$99 per tonne at 50 years in operation. This cost per tonne is still higher than the status quo landfill operation. 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. There is therefore a technical and commercial risk associated with this technology that may impact its feasibility and cost.

The costs presented above are based on WTE facilities run at fixed capacity. If the technologies are accepting increasing tonnages from year to year, the average cost per tonne waste requiring disposal will generally increase. The reason for the increased cost is that more waste is processed at a higher cost, i.e. through one of the WTE technologies instead of through landfilling.

The two main factors affecting the overall system cost for the options is the facility capital and operating costs, along with transportation cost of waste, ash and residuals. Once new facilities are in operation, landfill operational costs are reduced by up to 34% and the landfill capital cost by up to 57% over the 50-year projection period. The respective numbers are 44% and 60% if the facilities were to accept increasing amounts of waste. 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 and 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 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.

If the project proceeds to a formal public procurement process, it is recommended the RFP be written with very specific performance outputs based on realistic targets and attainable performance criteria. Appropriate safeguards will be required to manage performance liability and performance achievement.

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. Anecdotally, it is known that there are large supplies of wood waste available in the region. Creating additional organic product could disrupt current wood waste recovery and utilization operations by adding more product into an already well supplied market. 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. While 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







TO:	Lisa Butler, P.Eng., Engineering Analyst, CVRD	ACTION BY:	NA
FROM:	Konrad Fichtner, P.Eng.	FOR INFO OF:	The CSWM Select Committee
PLEASE F	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.

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%

Table ES1: Ranking of Submissions

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).

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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

DESIRABL	E CRITERIA (WEIGHTING)	GUIDANCE ON EVALUATION RATING
Innovation and Risk (25%)	Technology readiness	 No commercially operating plant, only pilot scale or demonstration facilities. At least one full scale demonstration facility operating successfully for a year or more. One or more commercially operating facilities for one+ years.
	Energy recovery efficiency/ potential	 Low energy production (up to 100kWh per tonne of feedstock) or unlikely to find markets as fuel. Moderate energy recovery (100 to 250 kWh per tonne of feedstock) or questionable markets for fuel. High energy recovery (over 250 kWh per tonne of feedstock) or firm markets for fuel.
	Technology risk	 Emerging technology, can be commercialized but scale-up factor greater than 3 forms significant risk. Emerging technology, full scale systems have been trialed but may be difficult to get bank funding. Proven technology, easy to commercialize, commercial funding should be available with good business case.
Technology (25%)	Operational flexibility	 Modules can accept only designed throughput, no flexibility for higher or lower volumes of feedstock. Moderate flexibility, can operate efficiently with plus/minus 20% of design capacity. 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. 3.	Can be operated with common industrial technical skills; requires regular maintenance and replacement of worn parts. Simple and robust process which can be operated with basic trainable skills.
	Feedstock quality requirements	1. 2. 3.	Very strict quality requirements requiring extra processing. Moderate processing required. Can take waste with minimal processing.
	Utility requirements	1. 2. 3.	Requires full access to utilities, gas, water, power, and sewer. Requires access to power and water. Power access is all that is required.
	Expected availability and reliability	1. 2. 3.	Questionable reliance, unproven. Moderate reliance, availability of 80% expected. Proven High reliability and availability of 90% achievable.
	Suitability for CSWM waste volumes and types	1. 2. 3.	Technology modules too large for waste volumes expected. Modules too small and many smaller modules must be used. Well suited for CSWM waste volumes and types.
Environmental and Social (25%)	Emission control	1. 2. 3.	Questionable ability to treat all emissions to best achievable standard. Emission control systems fully proven. No stack emissions from this process.
	Greenhouse gas (GHG) emissions	1. 2. 3.	Questionable ability to reduce emissions in the local context. GHG reduction likely but depends on end product. GHG reduction guaranteed.
	Social benefits	1. 2. 3.	Marginal benefits to the local community (small employment opportunities or limited opportunities for local use of end products, etc.). Some social benefits High potential for social benefits (many employment opportunities or opportunities for local use of end products, etc.).
	Residue to landfill (per tonne input)	4. 5. 6.	High (more than 20% by weight). Medium (5% to 20% by weight). Low (under 5% by weight).
Economics and Affordability (25%)	Capital costs (\$/tonne of installed annual capacity)	1. 2. 3.	High, more than \$800 per tonne. Medium, \$400 - \$799 per tonne. Low, under \$400 per tonne.
	Operating costs (\$/tonne), excluding capital but including profits from product or energy sales	1. 2. 3.	High, over \$100 per tonne. Medium, \$50 - \$99 per tonne. Low, under \$50 per tonne.
	Quality of end products	1. 2. 3.	Quality product moderate with questionable markets. Good market potential but not yet established. 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.

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%

Table 3: Ranking of Submissions

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.

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%

Table 4: Submission Rankings with Emphasis on Economics/Affordability

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.



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

Table 5: Submission Ranking with Emphasis on Social/Environmental

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





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 <u>nmaurer@morrisonhershfield.com</u>

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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 <u>nmaurer@morrisonhershfield.com</u> 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 km² and the SRD covers approximately 20,000 km². 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.

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

Table 1 Projected Population for next 50 years¹

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 tonnes². 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 <u>http://www2.gov.bc.ca/gov/content/environment/air-land-water/air/air-quality-management/regulatory-framework/objectives-standards</u>. All new facilities must meet the standards set out in the MOE document.

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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 <u>nmaurer@morrisonhershfield.com</u>.

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: <u>nmaurer@morrisonhershfield.com</u> 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
 - Provide estimate (and basis of that estimate) of what typical emissions will be of the following during normal operations in mg/Rm³ (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 m².
 - 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 wasteto-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: <u>nmaurer@morrisonhershfield.com</u> 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



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: maurer@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



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: <u>nmaurer@morrisonhershfield.com</u>. 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: Option 0 - Status Quo Table B2: Option 1(a) - WTT facility located in Comox Valley Table B3: Option 1(b) - WTT facility located in Campbell River Table B4: Option 1(c) - WTT facility located in Gold River Table B5: Option 2(a) - EWS facility located in Comox Valley Table B6: Option 2(b) - EWS facility located in Campbell River Table B7: Option 2(c) - EWS facility located in Gold River Table B8: Option 3(a) - Sustane facility located in Comox Valley Table B9: Option 3(b) - Sustane facility located in Campbell River Table B10: Option 3(c) - Sustane facility located in Gold River



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

				Populat	tion and Disp	osal Rates			1					CRWMC LF	Fill Rate and C	apacity							CVWM	LF Fill Rate a	and Capacity				
ar	Projected CVRD Population	CVRD Waste	Projected SRD Population	SRD Waste	Total Annua Tonnage	l Daily Tonnage	Combined Population	Tonnes to Campbell River TS	Tonnes MSW to CRWMC LF	Tonnes to MSW CVWMC LF	Year	Volum MS Dispo Rat	W Daily osal Cover Sc	Operational il Soil	Settlement	Net Fill Volume	Cumulative Fill Volume	Phase	Volumetric Capacity (m ³)	Year	Volumetric MSW Disposal Rate	Daily Cover Soil	Operational Soil	Settlement	Net Fill Volume	Cumulative Fill Volume	Phase / Cell	Phase / Cell	/ Vol Capa
		tonnes		tonnes	tonnes / yr	tonnes / day	x	tonnes		tonnes		m	³ m ³	m ³	m ³	m ³	m ³				m ³	m ³	m ³	m ³	m ³	m ³			
2015	64,294	36,652	45,871	26,149	62,80				26,149	36,652			37,356 12,4							20		17,453	1,047	1,047	69,813				
2016 2017	64,847 65,592	36,967 36.007	46,187 46,490	26,330 25,521	63,297 61,527				26,330 25,521	36,967 36,007			37,614 12,5 36,458 12,1				48.611	Phase 3 Phase 3		0 20			1,056			68.584	Phase 2 Cell 1	Phase 2 Phase 2	
2018	66,372	36,435	46,809	25,696	62,13	1 17	0 92,06	8	25,696	36,435	1	2018 3	36,708 12,2	6 73	4 734	4 48,944	97,555	Phase 3		1 20	18 52,05	17,350	1,041	1,041	69,400	137,984	Cell 1	Cell 1	
2019 2020	67,139 67,905	36,856 37,276	47,116	25,864 26,031	62,720 63.307				25,864 26.031	36,856 37,276			36,949 12,3 37,187 12,3				146,821 196,403			2 20			1,053			208,186 279,189		Cell 1 Cell 1	
2020	68,667	30,446	47,419						20,031	30,446			30,217 10,0				236,693			4 20			870			337,181		Cell 1	
2022	69,436	30,787	47,986	21,276	52,063				21,276	30,787		2022 3	30,395 10,1			8 40,526	277,219			5 20	22 43,98	1 14,660	880			395,822		Cell 1	
2023 2024	70,213 70,986	31,131 31,474	48,267 48,539	21,401 21,521	52,532 52,995				21,401	31,131 52,995		2023 3	30,573 10,1	61	1 611	1 40,763	317,982 317,982		288,480	6 20 7 20			889			455,120 556,064		Cell 1 Cell 1	
2024	71,758	31,474	48,806)	53,456		2025	0	0	0 0	0 0	317,982				25 76,36		1,512			657,885		Cell 2	
2026	72,527	32,157	49,064							53,911		2026	0	0	0 0	0 0	317,982			9 20			1,540			760,573		Cell 2	
2027	73,290	32,496	49,307							54,357		2027	0	0	0 0	0 0	317,982			10 20			1,553			864,111		Cell 2	
2028	74,047 74,795	32,831 33,163	49,543	21,967 22,069	54,798 55,23					54,798 55,231		2028	0	0			317,982 317,982			11 20	28 78,28 29 78,90		1,566			968,488		Cell 2 Cell 2	
2030	75,531	33,489	49,992	22,166		5 15	2 97,69			55,655	13	2030	0	0	0 0	0 0	317,982			13 20	30 79,50	7 26,502	1,590	1,590	106,009	1,179,700		Cell 2	
2031	76,255	33,810	50,203	22,259						56,069		2031	0	0	0 0	0 0	317,982			14 20			1,602			1,286,498		Cell 2	
2032 2033	76,971 77,681	34,128 34,442	50,405 50,600							56,476 56,878		2032	0	0	0 0	0 0	317,982 317,982			15 20	32 80,68 33 81,25		1,614			1,394,072		Cell 2 Cell 2	
2033	78,366	34,442	50,600							57,259		2033	0	0		0 0	317,982			17 20			1,620			1,502,411		Cell 2 Cell 2	
2035	79,039	35,045	50,944					7 22,588		57,632		2035	0	0	0 0	0 0	317,982			18 20			1,647			1,721,251		Cell 3	
2036 2037	79,710 80,366	35,342 35,633	51,110 51,265	22,661 22,730	58,003 58,363					58,003 58,363		2036 2037	0	0	0 0	0 0	317,982 317,982			19 20 20 20	36 82,86 37 83,37	2 27,621 5 27,792	1,657			1,831,734		Cell 3 Cell 3	
2037	81.010	35,633	51,205	22,730						58,713		2037	0	0			317,982			20 20 20			1,600			2.054.736		Cell 3	
2039	81,643	36,199	51,551	22,857	59,056	6 16	2 104,50		•	59,056		2039	0	0	0 0	0 0	317,982	Closed		22 20			1,687	1,687	112,488	2,167,224		Cell 3	
2040	82,270	36,477	51,686		59,394				•	59,394		2040	0	0	0 0	0 0	317,982				40 84,84		1,697			2,280,355		Cell 3	
2041	82,888 83,717	36,751 37,119	51,821 52,080	22,977 23,091	59,728 60,210					59,728 60,210		2041	0	0		0 0	317,982 317,982			24 20 25 20			1,707			2,394,122 2,508,808		Cell 3 Cell 3	
2043	84,554	37,490	52,341	23,207	60,697	7 16	6 107,76		,	60,697		2043	Ő	0	0 0	0 0	317,982			26 20		28,903	1,734	1,734	115,613	2,624,421		Cell 3	
2044	85,400	37,865	52,602							61,188		2044	0	0	0 0	0 0	317,982			27 20		1 29,137	1,748			2,740,969		Cell 4	
2045	86,254 87,116	38,243 38,626	52,865 53,130	23,440 23,557	61,683 62,183				•	61,683 62,183		2045	0	0			317,982 317,982			28 20		29,373 2 29,611	1,762	1,762		2,858,460 2,976,903		Cell 4 Cell 4	
2047	87,987	39,012	53,395	23,675					i	62,687		2047	Ő	0	0 0	D O	317,982			30 20			1,791	1,791		3,096,306		Cell 4	
2048	88,867	39,402	53,662	23,793						63,195		2048	0	0	0 0	0 0	317,982				48 90,27		1,806			3,216,678		Cell 4	
049	89,756 90.653	39,796 40,194	53,930 54,200		63,708 64,226					63,708 64,226		2049	0	0	0 0	0 0	317,982 317,982				49 91,01 50 91.75	2 30,337 1 30,584	1,820			3,338,027 3,460,361		Cell 4 Cell 4	
050	90,653	40,194	54,200	24,031						64,226		2050	0	0		0 0	317,982			34 20			1,850			3,583,690		Cell 4 Cell 4	
2052	92,476	41,002	54,743	24,272	65,274	4 17	9 116,74	8 24,272		65,274	35	2052	0	0	0 0	0 O	317,982	Closed		35 20	52 93,24	31,083	1,865	1,865	124,332	3,708,023	Cell 5a	Cell 5a	
053	93,400 94,334	41,412 41,826	55,017 55,292	24,394 24,516						65,806 66,342		2053 2054	0	0	0 0	0 0	317,982 317,982			36 20 37 20	53 94,00 54 94,77		1,880			3,833,367 3,959,733		Cell 5a Cell 5a	
2055	95,278	41,820	55,569	24,510						66,883		2055	0	0		0 0	317,982			38 20		7 31,849	1,090	1,053		4,087,128		Cell 5a	
2056	96,230	42,667	55,847	24,761	67,428	8 18	5 120,99	2 24,761		67,428		2056	0	0	0 0	0 0	317,982			39 20			1,927	1,927	128,435	4,215,563		Cell 5a	
2057	97,193	43,094	56,126							67,979		2057	0	0	0 0	0 0	317,982			40 20			1,942			4,345,047		Cell 5a	
2058	98,165 99,146	43,525 43,960	56,406 56,688		68,534 69.095					68,534 69,095		2058	0	0		0 0	317,982 317,982				58 97,90 59 98,70		1,958			4,475,588 4,607,197		Cell 6 Cell 6	
2060	100,138	44,399	56,972							69,660		2060	0	0	0 0	0 0	317,982			43 20			1,990			4,007,197		Cell 6	
061	101,139	44,843	57,257	25,387	70,230				•	70,230		2061	0	0	0 0	0 C	317,982			44 20			2,007			4,873,654		Cell 6	
2062	102,151	45,292	57,543							70,805		2062	0	0	0 0	0 0	317,982			45 20		33,717	2,023			5,008,521		Cell 6	
2063	103,172 104,204	45,745 46,202	57,831 58,120	25,641 25,769	71,386					71,386 71,972		2063 2064	0	0		0 0	317,982 317,982			46 20		33,993 34,272	2,040			5,144,495	Cell 6 Cell 6 expa	Cell 6	
2065	104,204	46,202	58,411	25,769						72,562		2064	0	0	0 0		317,982			47 20		34,272	2,050				Cell 6 expa		pa
2066	106,298	47,131	58,703	26,028	73,159	9 20	0 132,32	6 26,028	1	73,159	49	2066	ō	0	0 0	o o	317,982	Closed		49 20	66 104,51	2 34,837	2,090	2,090	139,350	5,281,583	Cell 6 expa	Cell 6 exp	pand
067	107,361	47,602	58,996	26,158	73,760	20:	2 133,51	9 26,158		73,760	50	2067	0	0	0 0	0 0	317,982	Closed		50 20	67 105,37	2 35,124	2,107	2,107	140,495	5,281,583	Cell 6 expa	a Cell 6 exp	pan
-	4,336,251	1,950,808	2,680,786	1,208,445	3,159,253	3	5,544,69	5 1,041,504	166,941	2,992,312			I	1	1		II			L		1		1	1			1	

 CVRD disposal rate 2015-2016=
 0.57
 tonnes per person per year (46% diversion)

 CVRD disposal rate 2017-2020=
 0.55
 tonnes per person per year (46% diversion)

 SRD growth rate beyond 2041 =
 0.57
 tonnes per person per year (46% diversion)

 SRD disposal rate 2015-2016=
 0.57
 tonnes per person per year (46% diversion)

 SRD disposal rate 2015-2016=
 0.57
 tonnes per person per year (46% diversion)

 SRD disposal rate 2015-2016=
 0.57
 tonnes per person per year (46% diversion)

 SRD disposal rate 2021-2067=
 0.44
 tonnes per person per year (58% diversion)

Waste to cover ratio = 3:1 Settlement = 2% of waste volume per year

TBL-2018-03-05-CVRD WTE Assessment Long Term Cost Model Task 8 -5170574:Option 0 - Current State

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

						Capital and O	perating Costs								
Ye	ar	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
	0045											* 0			
	2015 2016				\$16.000.000							\$0 \$16,000,000	New Transfer station constructed 2012-2013	Construction of leachate management system and Cell 1	
0	2010				\$10,000,000	\$ 860,000	\$ 265,000	\$1,166,495		\$250,868	\$1,052,753	\$3,595,000		Closure Phase 2	Phase 2 SW mgmt design & partial construction
1	2018						\$ 2,500,000	\$1,166,495		\$490,358	\$1,052,753	\$5,410,000		Closure Phase 2	Phase 2 Surface water management construction
2	2019					\$ -		\$1,166,495	\$390,000	\$191,695	\$1,052,753	\$2,801,000			Phase 2 Design and construction
3	2020	\$200,000				\$ 1,075,000		\$1,166,495	\$190,000	\$491,790	\$1,052,753	\$4,176,000	New trailers every 8 years		Phase 2 LFG and final cover design
4	2021					\$ 35,000		\$1,166,495	\$190,000	\$5,630,329	\$1,052,753	\$8,075,000			Phase 2 LFG and final cover construction
5 6	2022 2023					\$ 550,000		\$1,166,495	\$190,000	\$0	\$1,052,753	\$2,959,000			Phase 21 EC and final serves design
7	2023		\$651,040	\$318,516	\$8,850,000	\$ 585,000		\$1,166,495 \$1,166,495	\$190,000 \$390,000	\$218,613 \$3,108,685	\$1,052,753 \$190,000	\$3,213,000 \$14,675,000		Construction Cell 2	Phase 3 LFG and final cover design Phase 3 LFG and final cover construction
8	2024		\$651,040	\$320,269	\$0,030,000	\$ 175,000		\$1,291,495	\$190,000	\$3,100,005	\$190,000	\$2,818,000		Construction Cell 2	Fridse 3 EF G and Inial cover construction
9	2026		\$651,040	\$321,962		\$ -	\$ 1,350,000	\$1,291,495	\$190,000		\$190,000	\$3,994,000		Closure Cell 1	
10	2027		\$651,040	\$323,556		\$ 585,000	\$ 1,000,000	\$1,291,495	\$190,000		\$190,000	\$3,231,000			
11	2028	\$200.000	\$651,040	\$325,105		\$ 200,000		\$1,291,495	\$190,000		\$190.000	\$3,048,000	New trailers every 8 years		
12	2029		\$651.040	\$326.614		\$ 385,000		\$1,291,495	\$390,000		\$190.000	\$3,234,000			
13	2030		\$651,040	\$328,051		\$ 1,075,000		\$1,291,495	\$190,000		\$190,000	\$3,726,000			
14	2031		\$651,040	\$329,436		\$ -		\$1,291,495	\$190,000		\$190,000	\$2,652,000			
15	2032	\$346,000	\$651,040	\$330,761		\$ 550,000		\$1,291,495	\$190,000		\$190,000	\$3,549,000	Transfer station - parking and roads (20 yr life) + capital upgrades		
16	2033		\$651,040	\$332,041		\$ 235,000		\$1,291,495	\$190,000		\$190,000	\$2,890,000			
17	2034		\$651,040	\$333,189	\$7,800,000	\$ -		\$1,291,495	\$390,000		\$190,000	\$10,656,000		Construction Cell 3	
18	2035		\$651,040	\$334,298		\$ 560,000		\$1,416,495	\$190,000		\$190,000	\$3,342,000			
19 20	2036	\$200,000	\$651,040	\$335,388		\$ - \$ 550.000	\$ 2,850,000	\$1,416,495 \$1,416,495	\$190,000 \$190,000		\$190,000 \$190,000	\$5,833,000	New trailers every 8 years	Closure Cell 2	
20 21	2037 2038		\$651,040 \$651,040	\$336,405 \$337,363		\$ 550,000 \$ 200,000		\$1,416,495	\$190,000 \$190,000		\$190,000	\$3,334,000 \$2,985,000			
21	2038		\$651,040	\$338,281		\$ 200,000		\$1,416,495	\$390,000		\$190,000	\$3.021.000			
23	2039		\$651,040	\$339,167		\$ 1,075,000		\$1,416,495	\$190.000		\$190,000	\$3,862,000			
24	2041		\$651.040	\$340.053		\$ 385.000		\$1,416,495	\$190,000		\$190,000	\$3,173,000			
25	2042		\$651,040	\$341,753		\$ 550,000		\$1,416,495	\$190,000		\$190,000	\$3,339,000			
26	2043		\$651,040	\$343,462	\$5,440,000	\$ 200,000		\$1,416,495	\$190,000		\$190,000	\$8,431,000		Construction Cell 4	
27	2044	\$200,000	\$651,040	\$345,180		\$ -		\$1,416,495	\$390,000		\$190,000	\$3,193,000	New trailers every 8 years		
28	2045		\$651,040	\$346,905		\$ 210,000	\$ 3,010,000	\$1,416,495	\$190,000		\$190,000	\$6,014,000		Closure Cell 3	
29 30	2046 2047		\$651,040	\$348,640		\$ -		\$1,416,495	\$190,000		\$190,000	\$2,796,000			
31	2047		\$651,040 \$651,040	\$350,383 \$352,135		\$ 935,000 \$ 200,000		\$1,416,495 \$1,416,495	\$190,000 \$190.000		\$190,000 \$190.000	\$3,733,000 \$3,000,000			
32	2048		\$651,040	\$352,135		\$ 200,000		\$1,416,495	\$190,000		\$190,000	\$3,000,000			
32 33	2049		\$651,040	\$353,896		\$ 1,075,000		\$1,416,495	\$390,000 \$190,000		\$190,000	\$3,001,000 \$3,878,000			
34	2050	\$241,000	\$651,040	\$355,665	\$4,450,000	\$ 35,000		\$1,416,495	\$190,000		\$190,000	\$7,531,000	Transfer station permits etc	Construction Cell 5a	
34 35	2052	\$2,615,000	\$651,040	\$359,231	÷.,	\$ 550,000		\$1,416,495	\$190,000		\$190,000	\$5,972,000	Transfer station - new facility + new trailers		
36	2053		\$651,040	\$361,027	1	\$ 585,000	\$ 2,530,000	\$1,416,495	\$190,000		\$190,000	\$5,924,000		Closure Cell 4	
37	2054		\$651,040	\$362,832		\$ -		\$1,416,495	\$390,000		\$190,000	\$3,010,000			
38	2055		\$651,040	\$364,646		\$ 175,000		\$1,416,495	\$190,000		\$190,000	\$2,987,000			
39	2056		\$651,040	\$366,469		s -		\$1,416,495	\$190,000		\$190,000	\$2,814,000			
40	2057		\$651,040	\$368,302	\$5,330,000	\$ 585,000		\$1,416,495	\$190,000		\$190,000	\$8,731,000		Construction Cell 6	
41	2058		\$651,040	\$370,143		\$ 200,000		\$1,416,495	\$190,000		\$190,000	\$3,018,000			
42	2059	0000.000	\$651,040	\$371,994		\$ 385,000	\$ 4,400,000	\$1,416,495	\$390,000		\$190,000	\$7,805,000	No. to llos and American	Closure Cell 5a	
43	2060	\$200,000	\$651,040	\$373,854	1	\$ 1,075,000		\$1,416,495	\$190,000		\$190,000	\$4,096,000	New trailers every 8 years		
44 45	2061 2062		\$651,040 \$651,040	\$375,723		\$ - \$ 550.000		\$1,416,495 \$1,416,495	\$190,000 \$190.000		\$190,000 \$190.000	\$2,823,000 \$3.375.000			
45 46	2062		\$651,040 \$651,040	\$377,602 \$379,490		\$ 550,000 \$ 235,000		\$1,416,495	\$190,000 \$190,000		\$190,000	\$3,375,000 \$3,062,000			
+0 17	2063		\$651,040	\$379,490 \$381,387	\$424,134	\$ 235,000		\$1,416,495	\$190,000 \$390,000		\$190,000	\$3,062,000 \$3,453,000		Cell 6 expansion	
F7 F8	2064		\$651,040 \$651,040	\$381,387 \$383,294	φ4∠4,154	\$ 560,000		\$1,416,495	\$390,000 \$190,000		\$190,000	\$3,391,000		Cell C Expansion	
+o 49	2065		\$651.040	\$385,211		\$ 000,000		\$1,416,495	\$190,000		\$190,000	\$2,833,000			
50	2000		\$651,040	\$387,137		\$ 550,000		\$1,416,495	\$190,000		\$190,000	\$3,385,000			
					1		1	,,			,,	,.,,,			
T - 1	tals	\$4 202 000	\$28.645.760	\$15.414.260	\$32,204,134	\$17,970,000	\$16,905,000	\$68,001,258	\$11.310.000	\$10 382 338	\$15,729,269	\$221,847,000			

30 years \$137,758,000 1,792,501 tonnes \$77 per tonne over 30 years

40 years \$184,606,000 2,448,090 tonnes \$75 per tonne over 40 years

50 years \$221,847,000 3,159,253 tonnes \$70 per tonne over 50 years

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

					P	opulation and	Disposal Rates											c	CRWMC LF Fil	II Rate and Ca	apacity								CVWMC LF Fill	Rate and Cap	acity			
Year	Projected CVRD Population	CVRD Waste	Projected SRD Population	SRD Waste	Total Annual Tonnage	Daily Tonnage	Combined Population	Comox	Tonnes to Campbell River TS	Tonnes to WTT Facility	Tonnes per day to WTT facility	Tonnes MSW to CRWMC LF		Tonnes sh/Residual to CVWMC LF	Yea	r Dis		iily O r Soil	Operational Soil	Settlement	Net Fill Volume	Cumulative Fill Volume F	Phase	/olumetric apacity (m³)	Year	Volumetric MSW Disposal Rate	Volumetric Ash / Residuals Disposal Rate	Daily Cover Seil	Operational Soil	Settlement		Cumulative Fill Volume Cel		Volumetric Capacity (m³)
		tonnes		tonnes	tonnes / yr	tonnes / day		tonnes	tonnes	tonnes	tonnes / day		tonnes				m ³ m	1 ³	m ³	m ³	m ³	m ³				m ³	m ³	m ³	m ³	m ³	m ³	m³		
201		36,652	45,871	26,149	62,801	172	90,443					26,149	36,652			2015		2,452	747	747	49,808				201	5 52,36		17,453		1,047	69,813			
201		36,967	46,187	26,330	63,297	173	91,177					26,330	36,967	0		2016		2,538	752	752	50,152		nase 3		201			17,603				Phase		
0 201		36,007 36,435	46,490 46,809	25,521 25,696	61,527 62,131		91,113 92,068					25,521 25,696	36,007 36,435	0	0	2017 2018		2,153	729	729 734	48,611 48,944	48,611 Ph 97,555 Ph			0 201			0 17,146 0 17,350			68,584 69,400	68,584 Cell 1 137,984 Cell 1	Phase 2 Cell 1	
2 201	9 67,139	36,856	47,116	25,864	62,720	172	93,003					25,864	36,856	Ō	2	2019	36,949 1	2,316	734 739	739	49,265	146,821 Ph	nase 3		2 201	19 52,65	1 C	17,550	1,053	1,053	70,202	208,186 Cell 1	Cell 1	
3 202 4 202		37,276 30,446	47,419 47,706	26,031 21,152	63,307 51,598	173 141	93,936 89,819			29.278	02	26,031 21,152	37,276	0	3	2020 2021		12,396	744 604	744 604	49,582 40,290	196,403 Ph 236,693 Ph			3 202	20 53,25		17,751	1,065	1,065	71,003 16,236	279,189 Cell 1 295,425 Cell 1	Cell 1 Cell 1	
5 202		30,446	47,706	21,152	52 063					29,278	84	21,152	1,100	9,000	4	2021		0.132	608	608	40,290	277.219 Ph			5 202			562	33	33	16,230	311.843 Cell 1	Cell 1	
6 202	3 70,213	31,131	48,267	21,401	52,532			L	Landfill closure	29,937	85	21,401		10,029	6	2023		10,191	611	611	40,763	317,982 Clo	osed	288,480	6 202	23 1,70			34	34	16,602	328,444 Cell 1	Cell 1	
7 202- 8 202		31,474 31,816	48,539 48,806	21,521 21,640	52,995 53,456	145	92,507 93,398		21,521 21,640	50,963 50,963	145		2,032	17,073	7	2024 2025	0	0	0	0	0	317,982 Clo 317,982 Clo			7 202				58	58	28,261 29,138	356,705 Cell 1 385,843 Cell 1	Cell 1 Cell 1	
9 202	6 72,527	32,157	49,000	21,040		146			21,640	50,963	145		2,493	17,073	9	2025	0	0	0	0	0	317,982 Cld			9 202					84	30.005	415,849 Cell 1	Cell 1	
10 202	7 73,290	32,496	49,307	21,862		149	95,152		21,862	50,963	145		3,394	17,073	10	2027	0	0	0	0	0	317,982 Clo	osed		10 202			1,616		97	30,855	446,704 Cell 1	Cell 1	
11 202		32,831	49,543	21,967	54,798	150	96,014		21,967	50,963	145		3,835	17,073	11	2028 2029	0	0	0	0	0	317,982 Clo			11 202					110	31,694	478,397 Cell 1	Cell 1	
12 202 13 203		33,163 33,489	49,773 49,992	22,069 22,166	55,231 55,655	151 152	96,864 97,697		22,069 22,166	50,963 50,963	145		4,268 4,692	17,073 17,073	12	2029	0	0	0	0	0	317,982 Clo 317,982 Clo			12 202					122	32,520 33,326	510,917 Cell 1 544,243 Cell 2	Cell 1 Cell 1	
14 203		33,810	50,203	22,259					22,259	50,963	145		5,106	17,073	14	2031	Ő	0	0	0	0	317,982 Clc			14 203					146	34,116	578,359 Cell 2	Cell 2	517,470
15 203		34,128	50,405	22,349			99,320		22,349	50,963	145		5,513	17,073	15	2032	0	0	0	0	0	317,982 Clo			15 203					158	34,891	613,250 Cell 2	Cell 2	
16 203 17 203		34,442 34,746	50,600 50,775	22,435 22,513		156 157			22,435 22,513	50,963 50,963	145		5,915 6,296	17,073	16	2033 2034	0	0	0	0	0	317,982 Clo 317,982 Clo			16 203 17 203		,			169	35,655 36,382	648,906 Cell 2 685,287 Cell 2	Cell 2 Cell 2	
18 203		35,045	50,944	22,513					22,513	50,963	145		6,669	17,073	17	2034	0	0	0	0	0	317,982 Cld			18 203				191	180	30,362	722,380 Cell 2	Cell 2	
19 203	6 79,710	35,342	51,110	22,661	58,003		102,371		22,661	50,963	145		7,040	17,073	19	2036	0	0	0	0	0	317,982 Clo	osed		19 203	36 10,05				201	37,800	760,180 Cell 2	Cell 2	
20 203		35,633	51,265	22,730			103,096		22,730	50,963	145		7,400 7,750	17,073	20	2037 2038	0	0	0	0	0	317,982 Clo			20 203					211	38,485	798,665 Cell 2	Cell 2	
21 203 22 203		35,918 36,199	51,411 51,551	22,795 22.857	58,713 59,056	161	103,805 104,500		22,795 22,857	50,963 50,963	145		8.093	17,073	21	2038	0	0	0	0	0	317,982 Clo 317,982 Clo			21 203					221	39,152 39,805	837,816 Cell 2 877,621 Cell 2	Cell 2 Cell 2	
23 204	0 82,270	36,477	51,686	22,917	59,394		105,187		22,917	50,963	145		8,431	17,073	23	2040	Ő	0	0	0	0	317,982 Clo	osed		23 204	12,04	4 24,389			241	40,448	918,069 Cell 2	Cell 2	
24 204		36,751	51,821	22,977					22,977	50,963	145		8,765	17,073	24	2041	0	0	0	0	0	317,982 Clo			24 204				250	250	41,084	959,153 Cell 2	Cell 2	
25 204 26 204		37,119 37,490	52,080 52,341	23,091 23,207	60,210 60,697	165 166	106,808 107,761		23,091 23,207	50,963 50,963	145		9,247 9,734	17,073 17,073	25 26	2042 2043	0	0	0	0	0	317,982 Clo 317,982 Clo			25 204 26 204					264	42,003 42,930	1,001,156 Cell 2 1,044,086 Cell 2	Cell 2 Cell 2	
27 204		37,865	52,602	23,323		168			23,323	50,963	145		10,225	17,073	27	2043	0	0	0	0	0	317,982 Clo			27 204					292	43,865	1,087,951 Cell 2	Cell 2	-
28 204		38,243	52,865	23,440					23,440	50,963	145		10,720	17,073	28	2045	0	0	0	0	0	317,982 Clo			28 204						44,808	1,132,760 Cell 2	Cell 2	
29 204 30 204		38,626 39,012	53,130 53,395	23,557 23,675					23,557 23.675	50,963 50,963	145		11,220 11,724	17,073 17,073	29 30	2046 2047	0	0	0	0	0	317,982 Clo 317,982 Clo			29 204 30 204						45,760 46,720	1,178,520 Cell 2 1,225,240 Cell 2	Cell 2 Cell 2	
31 204		39,012	53,662	23,073			,		23,073	50,903	145		12,232	17,073	31	2047	0	0	0	0	0	317,982 Cld			31 204					349	40,720	1.272.929 Cell 2	Cell 2	
32 204		39,796	53,930	23,912			113,668		23,912	50,963	145		12,745	17,073	32	2049	0	0	0	0	0	317,982 Clo	osed		32 204					364	48,666	1,321,594 Cell 2	Cell 2	
33 205		40,194	54,200	24,031	64,226	176	114,685		24,031	50,963	145		13,263	17,073	33	2050	0	0	0	0	0	317,982 Clo			33 205					379	49,652	1,371,246 Cell 2	Cell 2	
34 205 35 205		40,596 41,002	54,471 54,743	24,152 24,272		177 179	115,712 116,748		24,152 24,272	50,963 50,963	145		13,785 14,311	17,073 17,073	34 35	2051 2052	0	0	0	0	0	317,982 Clo 317,982 Clo			34 205 35 205					394	50,646 51,649	1,421,892 Cell 2 1,473,541 Cell 2	Cell 2 Cell 2	
36 205		41,002	55.017	24,272			110,740		24,272	50,963	145		14,311	17,073	36	2052	0	0	0	0	0	317,982 Cld			36 205				403	403	51,649	1,526,203 Cell 2	Cell 2	
37 205	4 94,334	41,826	55,292	24,516					24,516	50,963	145		15,379	17,073	37	2054	0	0	0	0	0	317,982 Clo	osed		37 205	54 21,97	0 24,389		439	439	53,683	1,579,885 Cell 3	Cell 2	1.563.942
38 205		42,245	55,569	24,638					24,638	50,963	145		15,920	17,073	38	2055 2056	0	0	0	0	0	317,982 Clo			38 205				455	455	54,713	1,634,598 Cell 3	Cell 3	1,000,042
39 205 40 205		42,667 43,094	55,847 56,126	24,761 24,885	67,428 67,979		120,992 122,078		24,761 24.885	50,963 50,963	145		16,465 17,016	17,073 17,073	39 40	2056	0	0	0	0	0	317,982 Clo 317,982 Clo			39 205 40 205				470	470	55,752 56,801	1,690,350 Cell 3 1,747,151 Cell 3	Cell 3 Cell 3	
41 205		43,525	56,406	25,010					25,010	50,963	145		17,571	17,073	40	2058	0	0	0	0	0	317,982 Clo			40 205					502	57.858	1,805,009 Cell 3	Cell 3	
42 205		43,960	56,688	25,135		189	124,281		25,135	50,963	145		18,132	17,073	42	2059	0	0	0	0	0	317,982 Clo			42 205					518	58,926	1,863,935 Cell 3	Cell 3	
43 206		44,399	56,972	25,260	69,660	191	125,398		25,260	50,963	145		18,697	17,073	43	2060	0	0	0	0	0	317,982 Clo			43 206					534	60,002	1,923,938 Cell 3	Cell 3	
44 206 45 206		44,843 45,292	57,257 57,543	25,387 25,514	70,230 70,805		126,526 127,664	-	25,387 25,514	50,963 50,963	145		19,267 19,842	17,073 17,073	44	2061 2062	0	0	0	0	0	317,982 Clo 317,982 Clo			44 206 45 206					550	61,089 62,185	1,985,026 Cell 3 2,047,211 Cell 3	Cell 3 Cell 3	
45 206	3 103,172	45,292	57,831	25,514	70,805				25,514	50,963	145		20,423	17,073	45	2062	0	0	0	0	0	317,982 Cld			46 206					584	63,290	2,110,501 Cell 3	Cell 3	
47 206	4 104,204	46,202	58,120	25,769	71,972				25,769	50,963	145		21,009	17,073	47	2064	0	0	0	0	0	317,982 Clo			47 206					600	64,406	2,174,907 Cell 3	Cell 3	
48 206 49 206		46,664 47,131	58,411 58,703	25,898 26,028		199 200	131,144 132,326		25,898 26,028	50,963 50,963	145		21,599 22,196	17,073 17,073	48 49	2065 2066	0	0	0	0	0	317,982 Clo 317,982 Clo			48 206					617	65,531 66,667	2,240,438 Cell 3 2,307,105 Cell 3	Cell 3 Cell 3	
50 206		47,131 47,602	58,703	26,028				-	26,028	50,963	145		22,196	17,073	49	2066	0	0	0	0	0	317,982 Cld 317,982 Cld			50 206					651	67,812	2,374,917 Cell 3	Cell 3 Cell 3	
																											_ 1,000	,500				,,		
Totals	4,465,392	2,024,427	2,772,844	1,260,924	3,285,351		5,726,315	0	1,041,504	2,331,193			734,738	780,950																				

CVRD growth rate beyond 2041 =	1%	
CVRD disposal rate 2015-2016=	0.57	tonnes per person per year (46% diversion)
CVRD disposal rate 2017-2020=	0.55	tonnes per person per year (48% diversion)
CVRD disposal rate 2021-2067=	0.44	tonnes per person per year (58% diversion)
SRD growth rate beyond 2041 =	0.50%	
SRD disposal rate 2015-2016=	0.57	tonnes per person per year (46% diversion)
SRD disposal rate 2017-2020=	0.55	tonnes per person per year (48% diversion)
SRD disposal rate 2021-2067=	0.44	tonnes per person per year (58% diversion)

Days of operation = 351 days per year Bottom ash/residuals to landfill = 34% % 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 = 0.7 tonnes per m³ In-situ MSW waste density = 0.7 tonnes per m³ Operational soli = 2% of waste volume per year Waste to cover ratio = 3:1 Settlement = 2% of waste volume per year

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-	0.7	10
=	0.7	to

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

						Capital	and Operating	Costs									
Ņ	'ear	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
	0045																
	2015 2016			1		\$16,000,000							\$0 \$16,000,000	New Transfer station constructed 2012-2013		Construction of leachate management system and Cell 1	
0	2010					\$10,000,000	\$ 860,000	\$ 265,000	\$1,166,495		\$250,868	\$1,052,753	\$3,595,000			Closure Phase 2	Phase 2 SW mgmt design & partial construction
1	2018							\$ 2,500,000			\$490,358	\$1,052,753	\$5,410,000			Closure Phase 2	Phase 2 Surface water management construction
2	2019						\$-		\$1,166,495	\$390,000	\$191,695	\$1,052,753	\$2,801,000				Phase 2 Design and construction
3	2020	\$200,000			\$882,279		\$ 1,075,000		\$1,166,495	\$190,000	\$491,790	\$1,052,753	\$5,058,000	New trailers every 8 years	Permits and land		Phase 2 LFG and final cover design
4	2021				\$5,081,326		\$ 35,000 \$ -		\$600,124 \$600,124	\$190,000 \$190.000	\$5,630,329 \$0	\$1,052,753	\$12,590,000 \$6,961,000		WTT facility begins operating		Phase 2 LFG and final cover construction
5	2022 2023				\$5,118,312 \$5,155,682		\$ 35,000		\$600,124	\$190,000	\$218.613	\$1,052,753 \$1,052,753	\$7,252,000				Phase 3 LFG and final cover design
7	2024		\$651.040	\$318.516	\$7,527,393		\$ -		\$600,124	\$390,000	\$3,108,685	\$190,000	\$12,786,000				Phase 3 LFG and final cover construction
8	2025		\$651,040	\$320,269	\$7,527,393		\$ -		\$600,124	\$190,000		\$190,000	\$9,479,000				
9	2026		\$651,040	\$321,962	\$7,527,393		\$ -		\$600,124	\$190,000		\$190,000	\$9,481,000				
10	2027		\$651,040	\$323,556	\$7,527,393		\$ 585,000		\$600,124	\$190,000		\$190,000	\$10,067,000				
11	2028	\$200,000	\$651,040	\$325,105	\$7,527,393		\$ -		\$600,124	\$190,000		\$190,000	\$9,684,000	New trailers every 8 years			
12 13	2029 2030		\$651,040 \$651,040	\$326,614 \$328,051	\$7,527,393 \$7,527,393	\$8,850,000	\$ 385,000 \$ 175,000		\$600,124 \$600,124	\$390,000 \$190,000		\$190,000 \$190,000	\$10,070,000 \$18,512,000			Construction Cell 2	
14	2030		\$651,040	\$329,436	\$7,527,393	\$6,650,000	\$ 175,000		\$725,124	\$190,000		\$190,000	\$9,613,000			Construction Cell 2	
15	2032	\$346.000	\$651.040	\$330,761	\$7,527,393		\$ -	\$ 1.350.000		\$190,000		\$190,000	\$11,310,000	Transfer station - parking and roads (20 yr life) + capital upgrades		Closure Cell 1	
16	2033		\$651.040	\$332.041	\$7.527.393		\$ 235.000		\$725.124	\$190,000		\$190.000	\$9.851.000	Transfor station - parking and roads (25 yr ino) - capital apgrados			
17	2034		\$651,040	\$333,189	\$7,527,393		\$ -		\$725,124	\$390,000		\$190,000	\$9,817,000				
18	2035		\$651,040	\$334,298	\$7,527,393		\$ 935,000		\$725,124	\$190,000		\$190,000	\$10,553,000				
19	2036	\$200,000	\$651,040	\$335,388	\$7,527,393		\$ -		\$725,124	\$190,000		\$190,000	\$9,819,000	New trailers every 8 years			
20 21	2037 2038		\$651,040 \$651.040	\$336,405 \$337,363	\$7,527,393 \$7,527,393		\$ 550,000		\$725,124 \$725,124	\$190,000 \$190.000	-	\$190,000 \$190.000	\$10,170,000 \$9.621.000				
21	2038		\$651,040	\$338,281	\$7,527,393		\$ 35,000		\$725,124 \$725,124	\$190,000		\$190,000	\$9,857,000				
22 23	2033		\$651,040	\$339,167	\$7,527,393		\$ 175,000		\$725,124	\$190,000		\$190,000	\$9,798,000				
24	2041		\$651,040	\$340,053	\$7,527,393		\$ 385,000		\$725,124	\$190,000		\$190,000	\$10,009,000				
25	2042		\$651,040	\$341,753	\$7,527,393		\$ -		\$725,124	\$190,000		\$190,000	\$9,625,000				
26	2043		\$651,040	\$343,462	\$7,527,393		\$ 200,000		\$725,124	\$190,000		\$190,000	\$9,827,000				
27	2044	\$200,000	\$651,040	\$345,180	\$7,527,393		\$ -		\$725,124	\$390,000		\$190,000	\$10,029,000	New trailers every 8 years			
28	2045 2046		\$651,040 \$651.040	\$346,905 \$348,640	\$7,527,393 \$5,748.626		\$ 35,000		\$725,124 \$725,124	\$190,000 \$190.000		\$190,000 \$190.000	\$9,665,000 \$7.853.000		Amotization period over		
29 30	2040		\$651,040	\$350,383	\$5,748,626		\$ 585,000		\$725,124	\$190,000		\$190,000	\$8,440,000		Amouzation period over		
31	2048		\$651,040	\$352,135	\$5,748,626		\$ -		\$725,124	\$190,000		\$190,000	\$7,857,000				
32	2049		\$651,040	\$353,896	\$5,748,626		\$ -		\$725,124	\$390,000		\$190,000	\$8,059,000				
33 34	2050		\$651,040	\$355,665	\$5,748,626		\$ 1,075,000		\$725,124	\$190,000		\$190,000	\$8,935,000				
34	2051	\$241,000	\$651,040	\$357,444	\$5,748,626		\$ 35,000		\$725,124	\$190,000		\$190,000	\$8,138,000	Transfer station permits etc			
35 36	2052 2053	\$2,615,000	\$651,040 \$651.040	\$359,231 \$361,027	\$5,748,626 \$5,748,626		\$ - \$ 585,000		\$725,124 \$725,124	\$190,000		\$190,000	\$10,479,000	Transfer station - new facility + new trailer:			
36	2053		\$651,040 \$651.040	\$361,027 \$362,832	\$5,748,626	\$7,800,000	\$ 585,000		\$725,124 \$725,124	\$190,000 \$390,000		\$190,000 \$190,000	\$8,451,000 \$15,868,000			Construction Cell 3	
38	2055		\$651,040	\$364,646	\$5,748,626	\$1,000,000	s -	-	\$850,124	\$190,000	1	\$190,000	\$7,994,000				
39	2056		\$651,040	\$366,469	\$5,748,626		\$ -	\$ 2,850,000		\$190,000	1	\$190,000	\$10,846,000			Closure Cell 2	
40	2057		\$651,040	\$368,302	\$5,748,626		\$ 585,000		\$850,124	\$190,000		\$190,000	\$8,583,000				
41	2058		\$651,040	\$370,143	\$5,748,626		\$-		\$850,124	\$190,000		\$190,000	\$8,000,000				
42	2059		\$651,040	\$371,994	\$5,748,626		\$ 35,000		\$850,124	\$390,000		\$190,000	\$8,237,000				
43	2060	\$200,000	\$651,040	\$373,854	\$5,748,626		\$ 175,000		\$850,124	\$190,000		\$190,000	\$8,379,000	New trailers every 8 years			
44 45	2061 2062		\$651,040 \$651.040	\$375,723 \$377,602	\$5,748,626		\$ -		\$850,124 \$850,124	\$190,000	1	\$190,000	\$8,006,000				
45	2062		\$651,040	\$379,490	\$5,748,626 \$5,748,626		\$ - \$ 235,000	-	\$850,124	\$190,000 \$190,000		\$190,000 \$190,000	\$8,007,000 \$8,244,000				
46 47	2003		\$651,040	\$381,387	\$5,748,626		\$ 233,000		\$850,124	\$390,000		\$190,000	\$8,211,000				
48	2065		\$651,040	\$383,294	\$5,748,626		\$ 1,285,000		\$850,124	\$190,000		\$190,000	\$9,298,000				
49	2066		\$651,040	\$385,211	\$5,748,626		\$ -		\$850,124	\$190,000		\$190,000	\$8,015,000				
50	2067		\$651,040	\$387,137	\$5,748,626		\$ 550,000		\$850,124	\$190,000		\$190,000	\$8,567,000				
		64 202 000	600 CAE 700	64E 444 000	£208 240 C1F	\$40 CEO COO	644 04E 000	\$6 06E 000	620 404 000	644 340 000	640 200 200	E4E 700 000	£ 407 777 000				
10	otals	\$4,202,000	\$28,645,760	\$15,414,260	\$308,310,015	\$16,650,000	\$11,045,000	\$6,965,000	\$39,121,800	\$11,310,000	\$10,382,338	\$15,729,269	\$467,777,000				

WTT Facility Tipping Fee (operating cost & revenue) = \$113 per tonne Capital cost annual payment = \$1,778,766 per year

30 years \$289,603,000 1,792,501 tonnes \$162 per tonne over 30 years

40 years \$384,813,000 2,448,090 tonnes \$157 per tonne over 40 years

50 years \$467,777,000 3,159,253 tonnes \$148 per tonne over 50 years



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

							Population	and Disposal R	Rates											CRWMC LF	Fill Rate and C	apacity							c	CVWMC LF Fi	II Rate and Cap	acity			
Year	Project CVRD Populati	Waste		SRD pulation	Waste	Total Annual Tonnage	Tonnage	Population	on Valley	OX C TS F	River 15	Tonnes to WTT Facility	day to WTT facility	Tonnes MSW to CRWMC LF	MSW CVWMC LF	Tonnes Ash/Residual s to CVWMC LF	Year	Volumetric MSW Disposal Rate	Daily Cover Soi		Settlement	Net Fill Volume	Cumulative Fill Volume	Phase	Volumetric Capacity (m ³)	Year	Volumetric MSW Disposal Rate	Volumetric Ash / Residuals Disposal Rate	Cover Soil	Operational Soil	Settlement	Net Fill Volume	Cumulative Fill Volume Phase / Cell	Phase / Cell	Volumetric Capacity (m³)
		tonnes	•	to	nnes	tonnes / yr	tonnes / d	ay	tonn	es	tonnes	tonnes	tonnes / day		tonnes			m-	m-	m	m-	m-	m-				m	m-	m ²	m-	m-	m-	m		
201 201 201 1 201 3 200 5 200 6 200 5 200 6 200 7 200 8 200 10 200 11 200 12 200 12 200 14 200 15 200 14 200 15 200 14 200 15 200 14 200 18 200 19 200 19 200 20 200 21 200 20 200 21 200 20 200 21 200 20 200 200	16 644 64 644 818 66 818 66 819 67 920 67 921 68 923 702 933 702 925 711 926 722 928 74 929 743 75 733 77 733 77 733 77 733 93 71 936 793 936 793 93 84 440 82 844 85	tonnes 4,294 36,65 8,847 36,95 5,592 36,06 3,372 36,43 7,905 37,27 3,42 36,43 9,055 37,27 3,221 31,13 3,667 30,44 9,366 31,47 3,265 33,81 3,255 33,81 3,255 33,81 3,265 33,84 3,366 35,63 0,039 35,64 0,336 35,63 0,101 35,93 1,643 36,61 2,270 36,47 2,888 36,77 3,717 37,111 3,540 37,86	67 77 555 556 576 446 46 47 47 47 46 57 57 57 57 57 57 57 57 57 57	45.871 46.499 46.809 46.809 47,116 47,7419 47,706 48,539 48,539 48,806 49,064 49,074 49,064 49,074 49,064 49,073 49,054 30,020 50,405 50,203 50,405 50,203 50,405 50,094 41,110 51,265 51,481 51,686 51,821 52,200	nnnes 26,149 26,330 25,521 25,525 25,526 25,626 25,864 21,1276 21,276 21,271 21,272 21,271 21,272 21,272 21,272 21,272 22,182 22,209 22,182 22,239 22,249 22,2513 22,287 22,287 22,297 23,021 23,021	62,131 62,720 63,307 51,588 52,063 52,063 52,925 53,456 53,911 54,789 55,231 55,655 56,678 55,263 55,655 56,678 57,7259 56,678 57,7259 56,878 57,7259 56,878 57,7259 56,878 57,7259 56,878 57,7259 56,878 57,7259 56,878 57,7259 56,878 57,7259 56,878 57,7259 56,878 57,7259 56,878 57,7259 56,878 57,7259 56,878 57,7259 56,878 57,7259 56,878 57,7259 56,878 57,7259 56,878 57,7259 56,878 57,7259 56,878 57,7259 56,878 57,7259 57,7259 56,878 57,7259 56,978 56,978 56,978 56,978 56,978 56,978 56,978 56,978 56,978 56,978 56,978 56,978 56,978 56,978 56,978 56,978 56,978 56,978 57,978 56,9795 56,9795 56,9755 56,97555 56,9755555555555555555555555555555555		72 90,4 73 91,1 69 91,1 70 92,2 72 93,3 41 88,6 43 90,7 44 91,6 45 92,2 44 91,6 50 96,6 51 96,6 52 97,6 54 98,3 55 90,3 56 100,1 57 100,8 58 101,6 59 103,2 60 103,2 61 103,2 62 104,2 63 105,1 64 105,6 65 106,6 66 107,7 68 108,7	1777 113 068 003 936 937 938 939 939 939 939 939 939 939	9.278 9.606 9.937 Lar 9.441 9.209 9.209 9.101 8.996 8.894 8.797 8.704 8.527 8.704 8.527 8.301 8.527 8.301 8.233 8.168 8.233 8.168 8.233 8.168 8.243 8.234 8.797 8.796 7.871 7.756	ndfill closur	tonnes 29,278 29,278 29,600 29,937 50,963 50,96 50,96 50,96 50,96 50,96	85 146 145 145 145 145 145 145 145 145 145 145	26,149 26,330 25,521 25,690 25,864 26,031 21,152 21,276 21,401	36,000 36,434 36,866 37,272 1,166 1,168 1,19 2,033 2,434 2,033 3,833 3,833 3,833 4,2626 4,653 5,515 5,515 5,515 6,677 7,040 7,705 8,033 8,735 8,735 8,735 8,735 8,735 8,735 8,735 8,735 8,735 8,735 8,735 8,735 8,735 8,735 8,735 8,735 8,735 8,735 8,755 8,	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 17,072	2015 2016 2017 2017 2017 3 2027 3 2027 5 2022 5 2022 7 2024 8 2027 9 2026 10 2027 11 2026 10 2027 11 2026 13 2030 14 2031 15 2033 16 2033 16 2033 17 2034 18 2035 19 2036 20 2037 21 2038 22 2035 22 2044 24 2041 25 2044 26 2044 27 2044	30.57	4 12,53 8 12,15 9 12,31 9 12,31 7 12,39 7 10,07 5 10,13	8 75 3 72 6 73 6 73 6 73 6 74 2 60 2 60	2 752 9 729 4 734 9 739 4 744	48,944 49,265	317,982 317,982	Phase 3 Phase 3 Phase 3 Phase 3 Phase 3 Phase 3 Closed Clo	288,480	2011 2011 2011 2011 2011 2011 3 2020 5 2022 5 2022 7 2022 9 2022 9 2022 10 2022 11 2022 13 2033 14 2033 15 2033 16 2033 17 2034 18 2033 18 2033 19 2033 21 2033 22 2033 22 2033 22 2033 22 2034 23 2044 24 2044 25 2044 26 2044 26 2044 27 2044	51.438 52.050 52.651 53.252 1.53.252 1.687 1.1706 2.904 2.904 3.562 3.542 4.212 4.850 6.098 0.6,098 7.295 2.904 10.572 3.542 7.877 3.642 11.052 3.10.572 11.052 3.11,562 12.241 1.13,906 13.201 3.13,201 13.201	m ³ 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	968 1,187 1,404 1,617 1,826 2,033 2,234 2,432 2,432 2,432 2,432 2,432 2,432 2,432 3,353 3,353 3,353 3,3524 3,3651 4,174 4,404 4,405 4,869	m³ 1,047 1,056 1,029 1,041 1,055 1,065 1,065 1,063 3,33 3,4 58 711 84 97 1101 122 150 169 169 169 169 191 191 201 211 221 233 241 278 292 292	1,029 1,041 1,041 1,063 3,03 3,3 3,4 3,4 3,4 3,4 3,4 3,4 3,4 3,4 3,	m³ 69,813 70,413 86,584 69,400 70,202 71,003 16,236 16,236 30,006 33,327 33,327 33,327 33,327 33,384 36,565 36,382 37,093 38,485 39,805 40,449 41,005 42,930 43,865	m³ Phase 2 68,584 Cell 1 137,984 Cell 1 208,186 Cell 1 279,189 Cell 1 259,425 Cell 1 259,425 Cell 1 311,843 Cell 1 338,844 Cell 1 338,844 Cell 1 338,705 Cell 1 446,705 Cell 1 510,920 Cell 1 542,466 Cell 2 613,254 Cell 2 613,254 Cell 2 614,254 Cell 2 615,252 Cell 2 616,252 Cell 2 760,186 Cell 2 877,623 Cell 2 918,077 Cell 2 919,077 Cell 2 910,0165 Cell 2 1,044,095 Cell 2 1,044,095 Cell 2	Phase 2 Phase 2 Cell 1 Cell 2	517,470
28 204 29 204 30 204 31 204 32 204 33 205 34 205 35 205 36 205 37 205 38 205 39 206 41 206 42 205 43 206 44 206 45 206 46 206 47 206 48 206 50 206	45 8645 86 87 87 87 87 87 89 89 90 900 51 91 52 92 53 93 55 95 66 96 90 99 99 99 99 99 51 1010 52 1020 53 103 54 94 99 99 99 99 99 99 99 99 99 99 93 1000 55 100 56 106 56 106 66 106 66 106 66 106	3,200 37,20 2,254 38,24 1,116 38,62 9,867 39,40 3,867 39,40 3,867 39,40 1,560 40,55 2,476 41,00 4,400 41,41 1,560 40,55 2,476 41,00 4,400 41,41 1,520 42,66 1,133 44,05 2,230 42,66 1,138 44,93 1,139 44,94 2,151 45,22 1,124 5,74 4,204 46,20 2,246 46,66 2,246 47,16 3,392 2,024,42 2,024,42 2,024,42 1,024 44,00 3,020 47,00 3,020 47,00 4,000 47,000 4,000 47,0000 4,000 47,0000 4,000 47,000 4,000 47,000 4,000 47,0	43 26 12 02 96 94 96 02 12 26 45 67 94 25 60 99 43 92 43 92 64 31 02	22,865 53,130 53,130 53,895 53,682 53,930 54,270 54,471 55,017 55,509 55,509 55,569 56,267 57,267 57,267 57,267 57,267 57,267 57,267 57,267 57,267 57,267 57,267 56,26956,269 56,269 56,269 56,26956,269 56	23,440 23,675 23,675 23,675 24,031 24,051 24,051 24,051 24,516 24,638 24,761 24,885 25,010 25,135 25,260 25,387 25,514 25,641 25,569 25,888 26,028 26,028 26,028	61,683 62,183 62,287 63,195 63,708 64,748 65,274 65,806 64,748 65,806 66,342 66,833 67,428 66,833 67,428 66,834 67,979 68,534 69,095 69,660 70,233 70,805 71,366 71,972 72,562 73,760		col 108.7 69 109.6 70 110.6 72 111.6 73 112.6 75 113.6 76 114.6 77 115.7 780 116.7 82 118.8 83 119.5 84 122.0 85 122.0 88 122.5 94 122.5 94 122.5 99 131.1 00 132.2 02 133.5 5.726.3 5.726.3	693 2 667 2 6662 2 6662 2 6662 2 6662 2 6662 2 6662 2 6662 2 6662 2 6682 2 6855 2 748 2 850 2 974 2 980 2 992 2 992 2 992 2 938 2 526 2 973 2 913 2 914 2 2326 2 519 2	7,640 7,523 7,406 7,7288 7,170 6,931 6,811 6,690 6,459 6,841 6,569 6,447 6,324 6,201 6,201 6,201 6,201 6,201 5,953 5,828 5,702 5,576 5,499 5,521 5,576 5,499 5,521 5,519 3,506 4,4935		0,963 50,	145 145 145 145 145 145 145 145 145 145	219.420	10,721 11,222 11,223 12,234 12,744 13,265 13,784 14,845 15,275 16,466 17,010 17,575 18,937 18,937 19,265 19,265 19,265 19,265 21,600 22,199 22,797	0 17.072 17.072 17.072	2/1 2/044 28 2044 30 2047 31 2044 33 2049 33 2055 36 2055 36 2055 37 2054 38 2055 39 2055 39 2055 40 2057 41 2056 42 2056 43 2066 44 2066 46 2066 49 2066 50 2067	- -			0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		317,982 317,982	Closed Cl		21 2041 28 2044 29 2044 30 2043 31 2044 32 2054 33 2055 36 2055 37 2055 38 2056 40 2055 41 2064 42 2065 43 2066 44 2066 44 2066 48 2066 49 2066 50 2067	15,315 16,028 16,028 16,748 17,475 18,208 18,947 19,693 20,445 21,204 22,743 22,503 22,503 22,503 22,673 29,766 30,26,710 27,525 28,347 30,857 31,708	24,389 24	5,105 5,543 5,583 5,825 6,069 6,584 6,684 6,684 6,684 6,684 7,068 7,708 7,732 7,7841 7,784 7,784 7,784 8,003 8,677 8,834 8,003 9,175 9,449 9,725 10,004 10,286	292 306 321 333 349 409 409 409 409 409 409 409 409 409 4	306 321 335 349 364 379 424 449 429 425 455 470 486 502 518 534 554 554 554 560 667	43,865 44,809 45,761 46,721 47,689 48,666 50,647 51,650 52,662 53,683 55,753 56,801 57,859 58,926 60,003 61,089 62,185 63,291 64,406 64,532 66,667 67,813	1,037,961 Cell 2 1,132,770 Cell 2 1,178,530 Cell 2 1,272,525 Cell 2 1,272,525 Cell 2 1,272,540 Cell 2 1,272,540 Cell 2 1,371,628 Cell 2 1,473,554 Cell 2 1,473,554 Cell 2 1,473,554 Cell 2 1,579,899 Cell 3 1,690,365 Cell 3 1,690,365 Cell 3 1,690,365 Cell 3 1,690,465 Cell 3 1,690,465 Cell 3 1,690,465 Cell 3 1,925,945 Cell 3 1,925,945 Cell 3 2,047,228 Cell 3 2,174,925 Cell 3 2,174,925 Cell 3 2,240,457 Cell 3 2,240,457 Cell 3 2,371,124 Cell 3 2,371,125 Cell 3 2,371,124 Cell 3 2,371,125 Ce	Cell 2 Cell 3 Cell 3 Ce	1,563,942

 CVRD growth rate beyond 2041 =
 1%

 CVRD disposal rate 2015-2016 =
 0.57
 tonnes per person per year (46% diversion)

 CVRD disposal rate 2017-2020 =
 0.55
 tonnes per person per year (46% diversion)

 CVRD disposal rate 2017-2067 =
 0.44
 tonnes per person per year (68% diversion)

 SRD disposal rate 2015-2016 =
 0.57
 tonnes per person per year (68% diversion)

 SRD disposal rate 2015-2016 =
 0.57
 tonnes per person per year (46% diversion)

 SRD disposal rate 2017-2020 =
 0.55
 tonnes per person per year (46% diversion)

 SRD disposal rate 2021-2067 =
 0.44
 tonnes per person per year (46% diversion)

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 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 = 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 O	perating Costs											
`	⁄ear	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	Capital -	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	
	2015													\$0		New Transfer station constructed 2012-2013			
	2015						\$16,000,000							\$16,000,000		New Transier station constructed 2012-2013		Construction of leachate management system and Cell 1	
0	2017						\$10,000,000	\$ 860.000	\$ 265,000	\$1,166,495		\$250.868	\$1,052,753	\$3,595,000				Closure Phase 2	Phase 2 SW mgn
1	2018							\$ 200,000		\$1,166,495		\$490,358	\$1,052,753	\$5,410,000				Closure Phase 2	Phase 2 Surface
2	2019							\$ -		\$1,166,495	\$390,000	\$191,695	\$1,052,753	\$2,801,000					Phase 2 Design a
3	2020	\$311,025			Ash / residuals	\$691,115		\$ 1,075,000		\$1,166,495	\$190,000	\$491,790	\$1,052,753	\$4,978,000	Permits		Permits and land		Phase 2 LFG and
4	2021	\$3,310,000	\$709,508	\$433,315	\$145,160	\$5,081,326		\$ 35,000		\$600,124	\$190,000	\$5,630,329		\$17,188,000	New transfer station		WTT facility begins operating		Phase 2 LFG and
5	2022 2023		\$709,508	\$438,167	\$146,786	\$5,118,312		\$ -		\$600,124	\$190,000	\$0	\$1,052,753	\$8,256,000					Phase 3 LFG and
7	2023		\$709,508 \$709,508	\$443,070 \$435,731	\$148,429 \$252,673	\$5,155,682 \$7,527,357		\$ 35,000		\$600,124 \$600,124	\$190,000 \$390,000	\$218,613 \$3,108,685	\$1,052,753 \$190,000	\$8,553,000 \$13,214,000					Phase 3 LFG and Phase 3 LFG and
8	2024		\$709,508	\$433,979	\$252,673	\$7,527,357		s -		\$600,124	\$190,000	\$3,100,003	\$190,000	\$9,904,000					Fliase 5 LFG and
9	2026		\$709,508	\$432,286	\$252,673	\$7,527,357		\$-		\$600,124	\$190,000		\$190,000	\$9,902,000					
10	2027		\$709,508	\$430,692	\$252,673	\$7,527,357		\$ 585,000		\$600,124	\$190,000		\$190,000	\$10,485,000					
11	2028		\$709,508	\$429,143	\$252,673	\$7,527,357		\$ -		\$600,124	\$190,000		\$190,000	\$9,899,000					
12	2029	\$200,000	\$709,508	\$427,634	\$252,673	\$7,527,357		\$ 385,000		\$600,124	\$390,000		\$190,000	\$10,682,000	New trailers every 8 years				
13	2030		\$709,508	\$426,197	\$252,673	\$7,527,357	\$8,850,000			\$600,124	\$190,000		\$190,000	\$18,921,000				Construction Cell 2	
14	2031		\$709,508	\$424,812	\$252,673	\$7,527,357		\$ -		\$725,124	\$190,000		\$190,000	\$10,019,000					
15	2032		\$709,508	\$423,486	\$252,673	\$7,527,357		\$ -	\$ 1,350,000	\$725,124	\$190,000		\$190,000	\$11,368,000				Closure Cell 1	
16	2033		\$709,508	\$422,207	\$252,673	\$7,527,357		\$ 235,000		\$725,124	\$190,000		\$190,000	\$10,252,000					
17	2034		\$709,508 \$709,508	\$421,059 \$419,950	\$252,673 \$252,673	\$7,527,357 \$7,527,357		\$ -		\$725,124 \$725,124	\$390,000		\$190,000 \$190,000	\$10,216,000 \$10,950,000					
10	2035 2036		\$709,508	\$418,860	\$252,673	\$7,527,357		\$ 935,000		\$725,124	\$190,000 \$190,000		\$190,000	\$10,014,000					
20	2030	\$200.000	\$709,508	\$417,843	\$252,673	\$7,527,357		\$ 550,000		\$725,124	\$190,000		\$190,000	\$10,763,000	New trailers every 8 years				
21	2038		\$709.508	\$416.885	\$252,673	\$7.527.357		\$ -		\$725,124	\$190,000		\$190.000	\$10,012,000					
22	2039		\$709,508	\$415,966	\$252,673	\$7,527,357		\$ 35,000		\$725,124	\$390,000		\$190,000	\$10,246,000					
23	2040		\$709,508	\$415,080	\$252,673	\$7,527,357		\$ 175,000		\$725,124	\$190,000		\$190,000	\$10,185,000					
24	2041	\$1,555,125	\$709,508	\$414,195	\$252,673	\$7,527,357		\$ 385,000		\$725,124	\$190,000		\$190,000	\$11,949,000	Major capital upgrade every 20 years				
25	2042		\$709,508	\$412,494	\$252,673	\$7,527,357		\$ -		\$725,124	\$190,000		\$190,000	\$10,007,000					
26	2043		\$709,508	\$410,786	\$252,673	\$7,527,357		\$ 200,000		\$725,124	\$190,000		\$190,000	\$10,205,000					
27	2044	0000.000	\$709,508	\$409,068	\$252,673	\$7,527,357		\$ -		\$725,124	\$390,000		\$190,000	\$10,204,000					
28 29	2045 2046	\$200,000	\$709,508 \$709,508	\$407,342 \$405,608	\$252,673 \$252,673	\$7,527,357 \$5,748,591		\$ 35,000		\$725,124 \$725,124	\$190,000 \$190,000		\$190,000 \$190,000	\$10,237,000 \$8,222,000	New trailers every 8 years		Amotization period over		
30	2040		\$709,508	\$403,808	\$252,673	\$5,748,591		\$ 585,000		\$725,124	\$190,000		\$190,000	\$8,805,000			Amouzation period over		
31	2048		\$709,508	\$402,113	\$252,673	\$5,748,591		\$ -		\$725,124	\$190,000		\$190,000	\$8,218,000					
32	2049		\$709.508	\$400,352	\$252,673	\$5,748,591		\$ -		\$725,124	\$390,000		\$190,000	\$8,416,000					
33	2050		\$709,508	\$398,583	\$252,673	\$5,748,591		\$ 1,075,000		\$725,124	\$190,000		\$190,000	\$9,289,000					
34	2051		\$709,508	\$396,804	\$252,673	\$5,748,591		\$ 35,000		\$725,124	\$190,000		\$190,000	\$8,248,000					
35	2052		\$709,508	\$395,017	\$252,673	\$5,748,591		\$ -		\$725,124	\$190,000		\$190,000	\$8,211,000					
36	2053	\$200,000	\$709,508	\$393,221	\$252,673	\$5,748,591		\$ 585,000		\$725,124	\$190,000		\$190,000	\$8,994,000	New trailers every 8 years				
37	2054		\$709,508	\$391,416	\$252,673	\$5,748,591	\$7,800,000			\$725,124	\$390,000		\$190,000	\$16,207,000				Construction Cell 3	
38	2055		\$709,508	\$389,602	\$252,673	\$5,748,591		\$ -		\$850,124	\$190,000		\$190,000	\$8,330,000					
39 40	2056		\$709,508	\$387,778	\$252,673	\$5,748,591		\$ -	\$ 2,850,000	\$850,124	\$190,000		\$190,000	\$11,179,000				Closure Cell 2	
40	2057		\$709,508	\$385,946	\$252,673	\$5,748,591		\$ 585,000		\$850,124	\$190,000		\$190,000	\$8,912,000					
41	2058 2059		\$709,508 \$709,508	\$384,104 \$382,254	\$252,673 \$252,673	\$5,748,591 \$5,748,591		\$ 35.000		\$850,124 \$850,124	\$190,000 \$390.000		\$190,000 \$190,000	\$8,325,000 \$8,558,000					
42	2059		\$709,508	\$380,394	\$252,673	\$5,748,591		\$ 175,000		\$850,124	\$190,000		\$190,000	\$8,496,000					
43	2000	\$1,755,125	\$709,508	\$378,525	\$252,673	\$5,748,591		\$ -		\$850,124	\$190,000		\$190,000	\$10,075,000	Major capital upgrade every 20 years				
45	2062	1,100,120	\$709,508	\$376,646	\$252,673	\$5,748,591	1	\$ -		\$850,124	\$190,000		\$190,000	\$8,318,000					
46	2063		\$709,508	\$374,758	\$252,673	\$5,748,591		\$ 235,000		\$850,124	\$190,000	1	\$190,000	\$8,551,000					
47	2064		\$709,508	\$372,860	\$252,673	\$5,748,591		\$-		\$850,124	\$390,000		\$190,000	\$8,514,000					
48	2065		\$709,508	\$370,954	\$252,673	\$5,748,591		\$ 1,285,000		\$850,124	\$190,000		\$190,000	\$9,597,000					
49	2066		\$709,508	\$369,037	\$252,673	\$5,748,591		\$ -		\$850,124	\$190,000		\$190,000	\$8,310,000					
50	2067		\$709,508	\$367,111	\$252,673	\$5,748,591		\$ 550,000		\$850,124	\$190,000		\$190,000	\$8,858,000					
⊢	- 4 - 1 -	A7 704 075	000 040 070	\$40.007.4C	011 553 003	6000 447 CC 1	840.050.000	011.015.000	60.005.0C2	000 404 000			845 700 600	0 404 040 CCC					
T	otals	\$7,731,275	\$33,346,853	\$19,087,194	\$11,557,987	\$308,117,294	\$16,650,000	\$11,045,000	\$6,965,000	\$39,121,800	\$11,310,000	\$10,382,338	\$15,729,269	\$491,048,000	1				

WTT Facility Tipping Fee (operating cost & revenue) = \$113 per tonne Capital cost annual payment = \$1,778,766 per year

30 years \$307,442,000 1,792,501 tonnes \$172 per tonne over 30 years

40 years \$403,446,000 2,448,090 tonnes \$165 per tonne over 40 years

50 years \$491,048,000 3,159,253 tonnes \$155 per tonne over 50 years

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CRWMC LF Notes
/ ragmt design & partial construction face water management construction sign and construction G and final cover design G and final cover construction
G and final cover design G and final cover construction

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

| |

 | |
 | | | Population an | nd Disposal Rates | s
 | | | | | | | | | | | CRWMC LF
 | ill Rate and C | apacity | | | | | | |
 | c | CVWMC LF Fi | I Rate and Ca | pacity | | |
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---|---|---|-----------------------------|
| Year | Projected
CVRD
Population

 | CVRD
Waste | Projected
SRD
Population
 | SRD Waste | Total Annual
Tonnage | Tonnage | Combined
Population | Tonnes to
Comox
Valley TS
 | Tonnes to
Campbell
River TS | Tonnes to
WTT Facility | day to WTT
facility | Fonnes MSW
to CRWMC
LF | CVWMC LF | Tonnes
Ash/Residual
s to CVWMC
LF | Y | | /olumetric
MSW
Disposal
Rate
m ³ | Daily
Cover Soil
m ³ | Operational
Soil
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 | Settlement | Net Fill
Volume
m ³ | Cumulative
Fill Volume
m ³ | Phase | Volumetric
Capacity (m³) | Year | M
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over Soil
m ³ | Operational
Soil
m ³ | Settlement | Net Fill
Volume
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CVRD growth rate beyond 2041 =
CVRD disposal rate 2015-2016=
CVRD disposal rate 2017-2020=
CVRD disposal rate 2021-2067=
SRD growth rate beyond 2041 =

 CVRD growth rate beyond 2041 =
 1%

 CVRD disposal rate 2015-2016 =
 0.57

 tonnes per person per year (46% diversion)

 CVRD disposal rate 2021-2020 =
 0.55

 tonnes per person per year (46% diversion)

 CVRD disposal rate 2021-2020 =
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 SRD disposal rate 2021-2067 =
 0.44

 SRD disposal rate 2021-2067 =
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 SRD disposal rate 2021-2067 =
 0.44

Days of operation = 351 days per year Bottom ash/residuals to landfill = 34% % 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 = 0.7 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

TBL-2018-03-05-CVRD WTE Assessment Long Term Cost Model Task 8 -5170674-Option 1(c) - Gold River

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

Year Valley TS Capital Camor Yalley Operating River TS Transport River TS Transport Transport WTT Facility from Gold River Capital 2015		Costs			1		1					
2016 S200,000 S200,000 S440,000 S460,000 2017 S311,025 S200,000 S0 S274,628 S5,081,326 2021 S3,10,00 S709,508 S819,784 S0 S274,628 S5,081,326 2022 S709,508 S838,241 S0 S220,010 S706,508 S838,241 S65 S0 S274,628 S5,081,326 2024 S709,508 S824,457 S851,040 S430,428 S478,030 S7,527,357 2026 S709,508 S811,422 S851,040 S433,033 S478,030 S7,527,357 2028 S200,000 S708,508 S800,114 S451,040 S441,312 S478,030 S7,527,357 2029 S200,000 S708,508 S800,318 S651,040 S444,813 S478,030 S7,527,357 2031 S709,508 S801,191 S346,000 S651,040 S444,813 S478,030 S7,527,357 2033 S709,508 S796,363 S98,77 S851,040 S444,8103 S478,235	F CVWMC LF CVWMC LF Capital - Capital - Minor Capital Closure	Capital -	I - Capital -	F CVWMC LF - Operating - n 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
2017 2018 2018 2019 2010 <th< td=""><td></td><td></td><td></td><td></td><td></td><td></td><td>\$0</td><td></td><td></td><td></td><td></td><td></td></th<>							\$0					
2018 S200,000 S410,025 S460,000 2021 \$3,310,005 \$709,508 \$819,784 \$0 \$277,703 \$\$118,312 2022 \$3,310,005 \$709,508 \$828,861 \$0 \$277,03 \$\$118,312 2023 \$709,508 \$828,351 \$651,040 \$430,428 \$478,030 \$7,527,357 2026 \$709,508 \$817,839 \$651,040 \$433,023 \$478,030 \$7,527,357 2026 \$709,508 \$814,822 \$6851,040 \$433,023 \$478,030 \$7,527,357 2026 \$709,508 \$814,822 \$200,000 \$766,523,57 \$7 2029 \$200,000 \$706,508 \$800,317 \$8651,040 \$443,312 \$478,030 \$7,527,357 2031 \$709,508 \$800,1191 \$346,000 \$651,040 \$446,975 \$478,030 \$7,527,357 2033 \$709,508 \$800,1191 \$346,000 \$651,040 \$446,975 \$478,030 \$7,527,357 2034 \$709,508 \$800,1191 <t< td=""><td></td><td>\$16,000,000</td><td></td><td></td><td></td><td></td><td>\$16,000,000</td><td></td><td>New Transfer station constructed 2012-2013</td><td></td><td>Construction of leachate management system and Cell 1</td><td></td></t<>		\$16,000,000					\$16,000,000		New Transfer station constructed 2012-2013		Construction of leachate management system and Cell 1	
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2023 \$709.508 \$838.241 \$0 \$0 \$280.811 \$5, 155.682 2024 \$709.508 \$824.357 \$651.040 \$432.795 \$478.030 \$7.527.357 2025 \$709.508 \$821.042 \$651.040 \$433.238 \$478.030 \$7.527.357 2026 \$709.508 \$814.822 \$8651.040 \$437.238 \$478.030 \$7.527.357 2029 \$200.000 \$709.508 \$809.037 \$8651.040 \$443.728 \$478.030 \$7.527.357 2029 \$200.000 \$709.508 \$800.318 \$8651.040 \$444.317 \$478.030 \$7.527.357 2031 \$709.508 \$803.688 \$8651.040 \$444.913 \$478.030 \$7.527.357 2033 \$709.508 \$708.750 \$861.040 \$445.133 \$478.030 \$7.527.357 2034 \$709.508 \$708.7449 \$8651.040 \$445.133 \$478.030 \$7.527.357 2033 \$709.508 \$789.58 \$709.508 \$787.27.357 \$27.357 \$27.357	\$ 35,000	\$,000	\$190,000	\$5,630,329	\$1,052,753	\$17,703,000	New transfer station		WTT facility begins operating		Phase 2 LFG and final cover construction
2024 \$709.508 \$824.357 \$8651.040 \$430.428 \$478.030 \$7.527.357 2025 \$709.508 \$821.042 \$8651.040 \$432.795 \$478.030 \$7.527.357 2026 \$709.508 \$814.822 \$8651.040 \$432.723 \$478.030 \$7.527.357 2028 \$200,000 \$709.508 \$814.822 \$8651.040 \$443.310 \$478.030 \$7.527.357 2029 \$200,000 \$709.508 \$803.638 \$8651.040 \$443.312 \$478.030 \$7.527.357 2030 \$709.508 \$803.638 \$8651.040 \$445.132 \$478.030 \$7.527.357 2033 \$709.508 \$878.77 \$8651.040 \$445.75 \$478.030 \$7.527.357 2034 \$709.508 \$739.47.499 \$8651.040 \$445.75 \$478.030 \$7.527.357 2036 \$709.508 \$739.42.48 \$200.000 \$651.040 \$445.071 \$478.030 \$7.527.357 2036 \$709.508 \$789.508 \$789.508 \$789.508 \$789.7357	\$ -	\$		\$190,000	\$0	\$1,052,753	\$8,777,000					
2025 \$709.508 \$821.042 \$661.040 \$432.795 \$478.030 \$7.527.357 2026 \$709.508 \$811.822 \$661.040 \$433.031 \$478.030 \$7.527.357 2027 \$709.508 \$811.822 \$505.040 \$433.31 \$478.030 \$7.527.357 2028 \$200.000 \$709.508 \$811.822 \$501.040 \$443.312 \$478.030 \$7.527.357 2030 \$709.508 \$801.181 \$5651.040 \$443.122 \$478.030 \$7.527.357 2033 \$709.508 \$801.191 \$346.000 \$661.040 \$445.163 \$478.030 \$7.527.357 2034 \$709.508 \$789.499 \$661.040 \$445.175 \$478.030 \$7.527.357 2035 \$709.508 \$789.508 \$789.499 \$661.040 \$445.175 \$478.030 \$7.527.357 2036 \$709.508 \$786.597 \$651.040 \$445.001 \$478.030 \$7.527.357 2037 \$200.000 \$709.508 \$787.27.357 \$478.030 \$7.527.357	\$ 35,000	\$		\$190,000	\$218,613	\$1,052,753	\$9,081,000					Phase 3 LFG and final cover design
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2030 S709.508 \$8063.318 \$8651.040 \$443.312 \$478.030 \$77.527.357 \$8.850 2031 \$709.508 \$800.808 \$651.040 \$444.183 \$478.030 \$7.527.357 \$8.850 2032 \$709.508 \$801.191 \$346.000 \$651.040 \$444.704 \$478.030 \$7.527.357 2033 \$709.508 \$789.770 \$661.040 \$445.754 \$478.030 \$7.527.357 2034 \$709.508 \$794.248 \$200.000 \$661.040 \$445.754 \$478.030 \$7.527.357 2036 \$709.508 \$789.742.38 \$200.000 \$661.040 \$455.226 \$478.030 \$7.527.357 2038 \$709.508 \$788.701 \$861.040 \$445.011 \$478.030 \$7.527.357 2039 \$709.508 \$788.527 \$861.040 \$445.132 \$478.030 \$7.527.357 2040 \$709.508 \$788.267 \$861.040 \$447.137 \$478.030 \$7.527.357 2041 \$709.508 \$783.311 \$861.040	\$ -	\$	-	\$190,000		\$190,000	\$11,797,000		New trailers every 8 years		Construction Cell 2	
\$709.508 \$803.688 \$865.040 \$445.183 \$478.030 \$7.527.357 2032 \$709.508 \$801.191 \$346.000 \$651.040 \$449.75 \$478.030 \$7.527.357 2033 \$709.508 \$708.701 \$651.040 \$449.764 \$478.030 \$7.527.357 2034 \$709.508 \$704.499 \$651.040 \$445.256 \$478.030 \$7.527.357 2035 \$709.508 \$790.514 \$500.000 \$651.040 \$445.261 \$478.030 \$7.527.357 2036 \$709.508 \$789.711 \$561.040 \$445.801 \$478.030 \$7.527.357 2039 \$709.508 \$788.701 \$561.040 \$445.801 \$478.030 \$7.527.357 2040 \$709.508 \$785.71 \$651.040 \$445.813 \$478.030 \$7.527.357 2041 \$1.555.125 \$709.508 \$777.162 \$651.040 \$446.138 \$478.030 \$7.527.357 2044 \$709.508 \$777.162 \$651.040 \$446.459 \$478.030 \$7.527.357 <td>\$ 385,000</td> <td>\$</td> <td></td> <td>\$390,000</td> <td></td> <td>\$190,000</td> <td>\$12,381,000</td> <td>New trailers every 8 years</td> <td></td> <td></td> <td></td> <td></td>	\$ 385,000	\$		\$390,000		\$190,000	\$12,381,000	New trailers every 8 years				
2032 \$709.508 \$801.191 \$346,000 \$861.040 \$448.075 \$478.030 \$7.527.357 2033 \$709.508 \$789.770 \$665.040 \$448.704 \$478.030 \$7.527.357 2034 \$709.508 \$789.770 \$665.040 \$448.704 \$478.030 \$7.527.357 2036 \$709.508 \$724.248 \$200.000 \$651.040 \$445.256 \$478.030 \$7.527.357 2037 \$200.000 \$709.508 \$789.738 \$865.040 \$445.226 \$478.030 \$7.527.357 2038 \$709.508 \$788.701 \$865.040 \$445.836 \$478.030 \$7.527.357 2039 \$709.508 \$785.287 \$865.040 \$445.031 \$478.030 \$7.527.357 2040 \$709.508 \$788.731 \$865.1040 \$445.334 \$478.030 \$7.527.357 2042 \$709.508 \$778.131 \$865.1040 \$447.133 \$478.030 \$7.527.357 2044 \$709.508 \$778.131 \$200.000 \$661.040 \$447.130	0 \$ 175,000	\$8,850,000 \$,000	\$190,000		\$190,000	\$20,621,000				Closure Cell 1	
2033 \$709,508 \$799,508 \$799,508 \$799,507 \$865,1040 \$448,704 \$478,030 \$7,527,357 2036 \$709,508 \$799,508 \$799,508 \$799,508 \$799,508 \$799,508 \$799,508 \$792,7357 2036 \$709,508 \$792,438 \$200,000 \$851,040 \$452,226 \$478,030 \$7,527,357 2037 \$200,000 \$709,508 \$792,438 \$200,000 \$455,1040 \$452,226 \$478,030 \$7,527,357 2038 \$709,508 \$787,603 \$7,527,357 \$478,030 \$7,527,357 2039 \$709,508 \$787,803 \$865,1040 \$445,834 \$478,030 \$7,527,357 2040 \$1,555,125 \$709,508 \$782,7357 \$865,1040 \$446,182 \$478,030 \$7,527,357 2041 \$1,555,125 \$709,508 \$777,162 \$865,1040 \$446,182 \$478,030 \$7,527,357 2043 \$709,508 \$776,7366 \$865,1040 \$447,33 \$478,030 \$7,527,357 2044	\$ -	\$	- - \$ 1.350.000	\$190,000 \$190,000		\$190,000	\$11,720,000					
2034 \$709.508 \$796.507 \$851.040 \$440.256 \$478.030 \$7.527.357 2035 \$709.508 \$704.499 \$865.040 \$445.754 \$478.030 \$7.527.357 2036 \$709.508 \$744.499 \$865.040 \$453.226 \$478.030 \$7.527.357 2037 \$200.000 \$709.508 \$789.508 \$788.711 \$865.040 \$445.801 \$478.030 \$7.527.357 2038 \$709.508 \$785.287 \$865.040 \$445.133 \$478.030 \$7.527.357 2040 \$709.508 \$785.287 \$865.1040 \$445.334 \$478.030 \$7.527.357 2041 \$709.508 \$783.611 \$865.1040 \$445.334 \$478.030 \$7.527.357 2042 \$709.508 \$773.913 \$200.000 \$661.040 \$447.130 \$47.527.357 2044 \$709.508 \$777.3913 \$200.000 \$661.040 \$447.130 \$478.030 \$7.527.357 2045 \$709.508 \$767.366 \$877.3913 \$200.000 \$661.040 <	\$ - \$ 1,350,000	\$		\$190,000 \$190.000		\$190,000 \$190.000	\$13,415,000 \$11,954,000		Transfer station - parking and roads (20 yr life) + capital upgrades			
2035 \$709.508 \$724.499 \$651.040 \$445.754 \$478.030 \$77.527.357 2036 \$709.508 \$724.243 \$200.000 \$651.040 \$445.226 \$478.030 \$7.527.357 2037 \$200.000 \$709.508 \$724.243 \$201.040 \$455.226 \$478.030 \$7.527.357 2038 \$709.508 \$786.763 \$661.040 \$445.137 \$478.030 \$7.527.357 2040 \$709.508 \$785.287 \$661.040 \$445.334 \$478.030 \$7.527.357 2041 \$1.555.125 \$709.508 \$783.611 \$661.040 \$445.351 \$478.030 \$7.527.357 2043 \$709.508 \$770.17162 \$661.040 \$446.138 \$478.030 \$7.527.357 2044 \$709.508 \$777.162 \$661.040 \$446.138 \$478.030 \$7.527.357 2045 \$200.000 \$709.508 \$77.742 \$661.040 \$446.138 \$478.030 \$7.527.357 2044 \$709.508 \$767.736 \$651.040 \$447.338 <t< td=""><td>\$ 235,000</td><td>¢ 2</td><td>,000</td><td>\$390,000</td><td></td><td>\$190,000</td><td>\$11,918,000</td><td></td><td></td><td></td><td></td><td></td></t<>	\$ 235,000	¢ 2	,000	\$390,000		\$190,000	\$11,918,000					
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2038 \$709.508 \$788.701 \$8651.040 \$445.8696 \$478.030 \$7.527.357 2039 \$709.508 \$768.6963 \$8651.040 \$4457.137 \$478.030 \$7.527.357 2040 \$709.508 \$768.6963 \$8651.040 \$4457.137 \$478.030 \$7.527.357 2041 \$1,555.125 \$709.508 \$780.361 \$8651.040 \$446.829 \$478.030 \$7.527.357 2042 \$709.508 \$770.317 \$200.000 \$651.040 \$446.128 \$478.030 \$7.527.357 2043 \$709.508 \$777.182 \$8651.040 \$446.128 \$478.030 \$7.527.357 2044 \$709.508 \$777.361 \$200.000 \$651.040 \$447.135 \$478.030 \$7.527.357 2045 \$200.000 \$709.508 \$767.366 \$8651.040 \$447.135 \$478.030 \$5.74.8591 2046 \$709.508 \$767.423 \$8651.040 \$4478.030 \$5.74.8591 2045 \$709.508 \$767.423 \$8651.040 \$448.022 \$478.030 <td>\$ -</td> <td>\$</td> <td>•</td> <td>\$190,000</td> <td></td> <td>\$190,000</td> <td>\$11,917,000</td> <td></td> <td>New trailers every 8 years</td> <td></td> <td></td> <td></td>	\$ -	\$	•	\$190,000		\$190,000	\$11,917,000		New trailers every 8 years			
2039 \$709,508 \$786,963 \$865,1040 \$447,137 \$478,030 \$7,527,357 2040 \$709,508 \$785,287 \$865,1040 \$445,834 \$478,030 \$7,527,357 2041 \$1,555,125 \$709,508 \$785,287 \$865,1040 \$458,834 \$478,030 \$7,527,357 2042 \$709,508 \$778,7162 \$865,1040 \$464,138 \$478,030 \$7,527,357 2044 \$709,508 \$777,162 \$865,1040 \$464,138 \$478,030 \$7,527,357 2044 \$200,000 \$709,508 \$777,162 \$865,1040 \$464,138 \$478,030 \$7,527,357 2045 \$200,000 \$709,508 \$767,366 \$865,1040 \$447,030 \$7,527,357 2046 \$709,508 \$767,7366 \$865,1040 \$447,030 \$7,527,357 2047 \$709,508 \$767,736 \$865,1040 \$447,030 \$7,527,357 2048 \$709,508 \$757,423 \$865,1040 \$447,337 \$478,030 \$5,748,591 2051 <	\$ 550,000	\$,000	\$190,000		\$190,000	\$12,466,000	New trailers every 8 years				
2040 \$709.508 \$785.287 \$855.1040 \$4478.030 \$7.527.357 2041 \$1,555.125 \$709.508 \$780.395 \$865.1040 \$449.293 \$478.030 \$7.527.357 2042 \$709.508 \$778.393 \$865.1040 \$449.29 \$478.030 \$7.527.357 2043 \$709.508 \$777.913 \$200.000 \$656.1040 \$446.129 \$478.030 \$7.527.357 2044 \$709.508 \$777.913 \$200.000 \$665.1040 \$446.129 \$478.030 \$7.527.357 2045 \$200,000 \$709.508 \$777.362 \$651.040 \$447.135 \$478.030 \$7.527.357 2046 \$709.508 \$776.366 \$8651.040 \$478.71.135 \$478.030 \$5.748.591 2047 \$709.508 \$767.46 \$8651.040 \$478.588 \$478.030 \$5.748.591 2048 \$709.508 \$767.42 \$8651.040 \$448.029 \$478.030 \$5.748.591 2050 \$709.508 \$767.12 \$241.000 \$651.040 \$448.029	\$ -	\$	-	\$190,000		\$190,000	\$11,716,000					
2041 \$1,55,125 \$709,508 \$783,611 \$851,040 \$4478,030 \$7,527,357 2042 \$709,508 \$770,048 \$803,045 \$8651,040 \$444,138 \$478,030 \$7,527,357 2043 \$709,508 \$777,162 \$651,040 \$444,138 \$478,030 \$7,527,357 2044 \$200,000 \$709,508 \$777,048 \$\$651,040 \$446,791 \$478,030 \$7,527,357 2045 \$200,000 \$709,508 \$770,648 \$\$651,040 \$446,791 \$478,030 \$7,527,357 2046 \$709,508 \$770,648 \$\$651,040 \$447,320 \$5,748,561 2047 \$709,508 \$764,066 \$\$651,040 \$477,3191 \$478,030 \$5,748,561 2048 \$709,508 \$767,423 \$\$651,040 \$472,337 \$478,030 \$5,748,561 2051 \$709,508 \$767,423 \$\$651,040 \$478,237 \$478,030 \$5,748,561 2053 \$20,000 \$709,508 \$743,331 \$\$241,000 \$661,040 \$478,730	\$ 35,000	\$		\$390,000		\$190,000	\$11,950,000					
2042 \$709.508 \$776.7357 \$476.030 \$7.527.357 2043 \$709.508 \$777.162 \$651.040 \$446.138 \$478.030 \$7.527.357 2044 \$709.508 \$777.162 \$651.040 \$446.4138 \$478.030 \$7.527.357 2044 \$709.508 \$777.913 \$200,000 \$651.040 \$446.4791 \$478.030 \$7.527.357 2045 \$200,000 \$709.508 \$767.366 \$865.1040 \$4478.030 \$7.527.357 2046 \$709.508 \$767.366 \$865.1040 \$4471.135 \$478.030 \$5.74.851 2047 \$709.508 \$767.366 \$865.1040 \$4473.237 \$478.030 \$5.74.851 2048 \$709.508 \$767.423 \$8651.040 \$478.030 \$5.74.851 2050 \$709.508 \$774.723 \$\$651.040 \$478.030 \$5.74.851 2051 \$709.508 \$747.323 \$2.615.000 \$651.040 \$447.837 \$478.030 \$5.74.851 2052 \$709.508 \$747.329 \$2.	\$ 175,000 \$ 385,000	\$		\$190,000 \$190,000		\$190,000 \$190,000	\$11,890,000 \$13,654,000	Maine combal un grade quere 20 unare				
2043 \$709.508 \$777,162 \$865,1040 \$446,138 \$478,030 \$7,527,357 2044 \$709.508 \$777,913 \$200,000 \$665,1040 \$446,459 \$478,030 \$7,527,357 2045 \$200,000 \$709,508 \$777,913 \$200,000 \$665,1040 \$447,135 \$478,030 \$7,527,357 2046 \$709,508 \$776,766 \$665,1040 \$471,135 \$478,030 \$5,748,591 2048 \$709,508 \$767,764 \$865,1040 \$477,1351 \$478,030 \$5,748,591 2049 \$709,508 \$767,423 \$865,1040 \$477,491 \$478,030 \$5,748,591 2051 \$709,508 \$757,17 \$241,000 \$651,040 \$4478,030 \$5,748,591 2052 \$709,508 \$757,11 \$241,000 \$651,040 \$4478,030 \$5,748,591 2053 \$200,000 \$709,508 \$747,329 \$2,615,000 \$661,040 \$447,874 \$478,030 \$5,748,591 2055 \$709,508 \$737,044 \$8651,040	\$ 365,000	3	,000	\$190,000 \$190.000		\$190,000	\$13,654,000	Major capital upgrade every 20 years				
2045 \$200,000 \$7709,508 \$777,366 \$8651,040 \$4478,030 \$7,527,357 2046 \$709,508 \$767,366 \$8651,040 \$471,135 \$478,030 \$5,748,591 2047 \$709,508 \$767,366 \$8651,040 \$471,135 \$478,030 \$5,748,591 2048 \$709,508 \$767,423 \$8651,040 \$477,831 \$478,030 \$5,748,591 2049 \$709,508 \$757,423 \$8651,040 \$478,237 \$478,030 \$5,748,591 2051 \$709,508 \$757,423 \$8651,040 \$4478,030 \$5,748,591 2052 \$709,508 \$757,11 \$241,000 \$861,040 \$4478,030 \$5,748,591 2053 \$200,000 \$709,508 \$747,391 \$2,615,000 \$861,040 \$480,022 \$478,030 \$5,748,591 2054 \$709,508 \$747,373 \$2,615,000 \$8651,040 \$4478,030 \$5,748,591 2055 \$709,508 \$737,044 \$8651,040 \$497,030 \$5,748,591 2056	\$ 200,000	ŝ	.000	\$190,000	-	\$190,000	\$11,912,000					
2046 \$709.508 \$767.366 \$651.040 \$471.135 \$478.030 \$57.48.591 2047 \$709.508 \$764.068 \$8551.040 \$474.391 \$478.030 \$57.48.591 2048 \$709.508 \$764.068 \$8551.040 \$477.391 \$478.030 \$57.48.591 2048 \$709.508 \$767.423 \$8551.040 \$477.8237 \$478.030 \$57.48.591 2050 \$709.508 \$777.423 \$8561.040 \$478.237 \$478.030 \$57.48.591 2051 \$709.508 \$774.075 \$241.000 \$651.040 \$487.803 \$57.48.591 2052 \$709.508 \$774.323 \$261.000 \$487.030 \$57.48.591 \$7.805 2053 \$200.000 \$709.508 \$747.329 \$2.615.000 \$497.674 \$478.030 \$57.48.591 \$7.800 2055 \$709.508 \$733.635 \$661.040 \$497.765 \$478.030 \$5.74.8.591 \$7.800 2056 \$709.508 \$733.635 \$661.040 \$497.705 \$478.030	\$ -	\$	-	\$390,000		\$190,000	\$12,111,000	***	New trailers every 8 years	*****		*******
2047 \$709.508 \$764.068 \$651.040 \$472.3491 \$478.030 \$57.48.591 2048 \$709.508 \$764.068 \$651.040 \$478.237 \$478.030 \$57.48.591 2049 \$709.508 \$777.423 \$651.040 \$478.237 \$478.030 \$57.48.591 2050 \$709.508 \$757.423 \$651.040 \$478.237 \$478.030 \$5.74.851 2051 \$709.508 \$757.123 \$651.040 \$478.237 \$478.030 \$5.74.851 2052 \$709.508 \$757.11 \$241.000 \$651.040 \$448.032 \$478.030 \$5.74.851 2053 \$200,000 \$709.508 \$747.391 \$2.615.000 \$657.040 \$449.031 \$478.030 \$5.74.851 2055 \$709.508 \$737.084 \$8651.040 \$497.754 \$478.030 \$5.74.851 2056 \$709.508 \$737.084 \$8651.040 \$497.755 \$478.030 \$5.74.851 2057 \$709.508 \$737.0184 \$8651.040 \$497.705 \$478.030 \$5	\$ 35,000	\$,000	\$190,000		\$190,000	\$11,945,000	New trailers every 8 years				
2048 \$709,508 \$776,742 \$8651,040 \$472,588 \$478,030 \$5,748,591 2059 \$709,508 \$777,423 \$8651,040 \$478,237 \$478,030 \$5,748,591 20501 \$709,508 \$757,7423 \$8651,040 \$478,237 \$478,030 \$5,748,591 2051 \$709,508 \$757,711 \$241,000 \$8651,040 \$488,032 \$478,030 \$5,748,591 2052 \$709,508 \$770,711 \$241,000 \$8651,040 \$488,402 \$478,030 \$5,748,591 2053 \$200,000 \$709,508 \$747,329 \$2,615,000 \$651,040 \$487,742 \$478,030 \$5,748,591 2054 \$709,508 \$737,084 \$8651,040 \$449,725 \$478,030 \$5,748,591 2056 \$709,508 \$733,635 \$851,040 \$449,725 \$478,030 \$5,748,591 2056 \$709,508 \$733,685 \$8651,040 \$497,030 \$5,748,591 2057 \$709,508 \$732,684 \$8651,040 \$478,030 \$5,748,591	\$ -	\$	-	\$190,000		\$190,000	\$9,931,000			Amotization period over		
2049 \$709.508 \$757.423 \$651.040 \$472.237 \$478.030 \$57.48.591 2050 \$709.508 \$754.075 \$651.040 \$440.629 \$478.030 \$57.48.591 2051 \$709.508 \$754.075 \$651.040 \$480.629 \$478.030 \$57.48.591 2052 \$709.508 \$757.129 \$24.1000 \$651.040 \$483.032 \$478.030 \$5.748.591 2053 \$200,000 \$709.508 \$747.329 \$2.615.000 \$651.040 \$485.447 \$478.030 \$5.748.591 2054 \$709.508 \$747.377 \$4478.030 \$5.748.591 \$7.800 2055 \$709.508 \$737.084 \$651.040 \$497.75 \$478.030 \$5.748.591 2056 \$709.508 \$737.084 \$651.040 \$497.75 \$478.030 \$5.748.591 2057 \$709.508 \$737.084 \$651.040 \$497.050 \$5.748.591 2058 \$709.508 \$730.168 \$651.040 \$500.194 \$478.030 \$5.748.591 2059 <td>\$ 585,000</td> <td>\$</td> <td>,000</td> <td>\$190,000 \$190.000</td> <td></td> <td>\$190,000</td> <td>\$10,515,000</td> <td></td> <td></td> <td></td> <td></td> <td></td>	\$ 585,000	\$,000	\$190,000 \$190.000		\$190,000	\$10,515,000					
2050 \$709.508 \$754.075 \$851.440 \$440.629 \$478.030 \$5,748.591 2051 \$709.508 \$757.011 \$241.000 \$651.140 \$448.022 \$478.030 \$5,748.591 2052 \$709.508 \$757.011 \$241.000 \$651.140 \$448.032 \$478.030 \$5,748.591 2053 \$200.000 \$709.508 \$747.329 \$2,615.000 \$651.040 \$448.787.4 \$478.030 \$5,748.591 2054 \$2709.508 \$747.329 \$2,615.000 \$651.040 \$449.774 \$478.030 \$5,748.591 2055 \$709.508 \$773.044 \$651.040 \$492.275 \$478.030 \$5,748.591 2056 \$709.508 \$733.635 \$8651.040 \$495.229 \$478.030 \$5,748.591 2057 \$709.508 \$732.684 \$651.040 \$492.295 \$478.030 \$5,748.591 2058 \$709.508 \$719.664 \$200.000 \$651.040 \$500.194 \$478.030 \$5,748.591 2059 \$709.508 \$719.664	s -	3	-	\$190,000		\$190,000 \$190,000	\$9,929,000 \$10,128,000					
2051 \$709,508 \$757,711 \$241,000 \$651,040 \$448,3022 \$478,030 \$5,748,591 2052 \$709,508 \$747,329 \$2,615,000 \$661,040 \$448,302 \$478,030 \$5,748,591 2053 \$200,000 \$709,508 \$747,329 \$2,615,000 \$661,040 \$447,874 \$478,030 \$5,748,591 2054 \$209,508 \$747,054 \$8561,040 \$449,765 \$478,030 \$5,748,591 2055 \$709,508 \$737,084 \$8651,040 \$492,765 \$478,030 \$5,748,591 2056 \$709,508 \$733,084 \$8651,040 \$492,765 \$478,030 \$5,748,591 2057 \$709,508 \$733,084 \$8651,040 \$492,765 \$478,030 \$5,748,591 2058 \$709,508 \$732,183 \$8651,040 \$492,705 \$478,030 \$5,748,591 2059 \$709,508 \$712,573 \$8651,040 \$502,685 \$478,030 \$5,748,591 2061 \$17,55,125 \$709,508 \$712,573 \$8651,040	\$ 1,075,000	Ş		\$190,000		\$190,000	\$11,002,000					
2053 \$200,000 \$709,508 \$743,931 \$851,040 \$487,874 \$478,030 \$5,748,591 2054 \$709,508 \$740,316 \$851,040 \$492,765 \$478,030 \$5,748,591 2055 \$709,508 \$737,004 \$861,040 \$492,765 \$478,030 \$5,748,591 2056 \$709,508 \$737,004 \$861,040 \$492,765 \$478,030 \$5,748,591 2056 \$709,508 \$733,035 \$861,040 \$492,765 \$478,030 \$5,748,591 2057 \$709,508 \$733,168 \$8651,040 \$497,705 \$478,030 \$5,748,591 2059 \$709,508 \$723,168 \$8651,040 \$497,705 \$478,030 \$5,748,591 2059 \$709,508 \$723,183 \$861,040 \$500,194 \$478,030 \$5,748,591 2060 \$709,508 \$712,173 \$861,040 \$502,295 \$478,030 \$5,748,591 2061 \$1,755,125 \$709,508 \$712,573 \$861,040 \$502,734 \$478,030 \$5,748,591 <td>\$ 35,000</td> <td>\$</td> <td></td> <td>\$190,000</td> <td></td> <td>\$190,000</td> <td>\$10,202,000</td> <td></td> <td>Transfer station permits etc</td> <td></td> <td></td> <td></td>	\$ 35,000	\$		\$190,000		\$190,000	\$10,202,000		Transfer station permits etc			
2054 \$749,508 \$740,516 \$651,040 \$449,0314 \$478,030 \$5,748,591 \$7,800 2055 \$709,508 \$737,064 \$651,040 \$492,765 \$478,030 \$5,748,591 \$7,800 2056 \$709,508 \$737,064 \$651,040 \$492,765 \$478,030 \$5,748,591 2057 \$709,508 \$737,064 \$651,040 \$492,705 \$478,030 \$5,748,591 2058 \$709,508 \$730,168 \$651,040 \$497,030 \$5,748,591 2058 \$709,508 \$723,183 \$651,040 \$500,194 \$476,030 \$5,748,591 2060 \$709,508 \$719,1664 \$200,000 \$661,040 \$500,194 \$478,030 \$5,748,591 2061 \$709,508 \$712,173 \$661,040 \$500,208 \$478,030 \$5,748,591 2062 \$709,508 \$712,573 \$661,040 \$507,734 \$478,030 \$5,748,591 2062 \$709,508 \$712,573 \$661,040 \$510,273 \$478,030 \$5,748,591	\$ -	\$	-	\$190,000		\$190,000	\$12,540,000		Transfer station - new facility + new trailer			
2055 \$709.508 \$737.084 \$851.040 \$492.765 \$478.030 \$5.748.591 2056 \$709.508 \$733.635 \$651.040 \$497.705 \$478.030 \$5.748.591 2057 \$709.508 \$733.635 \$651.040 \$497.705 \$478.030 \$5.748.591 2058 \$709.508 \$723.168 \$661.040 \$497.705 \$478.030 \$5.748.591 2058 \$709.508 \$723.183 \$661.040 \$500.194 \$478.030 \$5.748.591 2069 \$709.508 \$723.183 \$661.040 \$500.268 \$478.030 \$5.748.591 2060 \$709.508 \$719.664 \$200.000 \$661.040 \$500.2695 \$478.030 \$5.748.591 2061 \$1,755.125 \$709.508 \$711.672 \$661.040 \$510.273 \$478.030 \$5.748.591 2062 \$709.508 \$712.573 \$661.040 \$510.273 \$478.030 \$5.748.591 2063 \$709.508 \$716.51.273 \$651.040 \$51.284 \$478.030 \$5.748.591 <td>\$ 585,000</td> <td>\$</td> <td>,000</td> <td>\$190,000</td> <td></td> <td>\$190,000</td> <td>\$10,709,000</td> <td>New trailers every 8 years</td> <td></td> <td></td> <td></td> <td></td>	\$ 585,000	\$,000	\$190,000		\$190,000	\$10,709,000	New trailers every 8 years				
2056 \$709,508 \$733,635 \$8651,040 \$495,229 \$478,030 \$5,748,591 2057 \$709,508 \$733,635 \$651,040 \$497,055 \$478,030 \$5,748,591 2058 \$709,508 \$730,168 \$651,040 \$507,4705 \$478,030 \$5,748,591 2058 \$709,508 \$739,168 \$561,040 \$502,895 \$478,030 \$5,748,591 2059 \$709,508 \$719,164 \$200,000 \$501,040 \$502,208 \$478,030 \$5,748,591 2060 \$709,508 \$719,864 \$200,000 \$501,040 \$502,208 \$478,030 \$5,748,591 2061 \$709,508 \$712,1273 \$8651,040 \$507,273 \$478,030 \$5,748,591 2062 \$709,508 \$712,737 \$8651,040 \$517,273 \$478,030 \$5,748,591 2064 \$709,508 \$705,512 \$8651,040 \$517,858 \$478,030 \$5,748,591 2064 \$709,508 \$705,412 \$8651,040 \$515,388 \$478,030 \$5,748,591 <) \$ -	\$7,800,000 \$	-	\$390,000 \$190,000		\$190,000 \$190,000	\$17,923,000				Construction Cell 3	
2057 \$770,508 \$730,168 \$651,040 \$477,705 \$478,030 \$5,748,591 2058 \$709,508 \$726,684 \$651,040 \$500,194 \$478,030 \$5,748,591 2059 \$709,508 \$723,183 \$651,040 \$500,194 \$478,030 \$5,748,591 2060 \$709,508 \$712,183 \$651,040 \$502,695 \$478,030 \$5,748,591 2061 \$17,55,125 \$709,508 \$711,624 \$200,000 \$651,040 \$507,734 \$478,030 \$5,748,591 2061 \$1,755,125 \$709,508 \$711,273 \$8651,040 \$510,273 \$478,030 \$5,748,591 2063 \$709,508 \$712,573 \$8651,040 \$510,273 \$478,030 \$5,748,591 2064 \$709,508 \$705,412 \$8651,040 \$515,288 \$478,030 \$5,748,591 2064 \$709,508 \$705,412 \$8651,040 \$515,588 \$478,030 \$5,748,591 2066 \$709,508 \$701,804 \$\$651,040 \$515,588 \$478,030	\$ -	\$	- \$ 2,850,000	\$190,000 \$190,000		\$190,000	\$10,047,000 \$12,896,000				Closure Cell 2	
2058 \$709.508 \$722,684 \$651,040 \$500.194 \$478,030 \$5,748,591 2059 \$709,508 \$723,183 \$651,040 \$502,695 \$478,030 \$5,748,591 2060 \$709,508 \$723,183 \$651,040 \$502,695 \$478,030 \$5,748,591 2060 \$17,755,125 \$709,508 \$711,664 \$200,000 \$651,040 \$502,295 \$478,030 \$5,748,591 2061 \$17,95,058 \$712,173 \$8051,040 \$502,734 \$478,030 \$5,748,591 2062 \$709,508 \$712,1573 \$8051,040 \$510,273 \$478,030 \$5,748,591 2063 \$709,508 \$702,573 \$8051,040 \$512,73 \$478,030 \$5,748,591 2064 \$709,508 \$705,122 \$8651,040 \$515,388 \$478,030 \$5,748,591 2064 \$709,508 \$701,512 \$8651,040 \$515,388 \$478,030 \$5,748,591 2065 \$709,508 \$701,804 \$8651,040 \$517,858 \$478,030 \$5,748,591	\$ 585,000	3 e		\$190,000		\$190,000	\$12,896,000				Closure Cell 2	
2059 \$709,508 \$723,183 \$651,040 \$502,695 \$478,030 \$5,748,591 2060 \$709,508 \$719,664 \$200,000 \$651,040 \$505,208 \$478,030 \$5,748,591 2061 \$1,755,125 \$709,508 \$716,127 \$651,040 \$507,734 \$478,030 \$5,748,591 2062 \$709,508 \$716,127 \$651,040 \$507,734 \$478,030 \$5,748,591 2063 \$709,508 \$712,573 \$651,040 \$510,273 \$478,030 \$5,748,591 2063 \$709,508 \$704,500,011 \$661,040 \$512,824 \$478,030 \$5,748,591 2064 \$709,508 \$705,412 \$651,040 \$513,888 \$478,030 \$5,748,591 2064 \$709,508 \$509,112 \$651,040 \$513,888 \$478,030 \$5,748,591 2066 \$709,508 \$509,178 \$651,040 \$512,055 \$478,030 \$5,748,591 2066 \$709,508 \$698,178 \$651,040 \$52,555 \$478,030 \$5,748,591 <td>\$ 565,000</td> <td>\$ \$</td> <td>,000</td> <td>\$190,000</td> <td></td> <td>\$190,000</td> <td>\$10,030,000</td> <td></td> <td></td> <td></td> <td></td> <td></td>	\$ 565,000	\$ \$,000	\$190,000		\$190,000	\$10,030,000					
2060 \$709,508 \$719,664 \$200,000 \$8651,040 \$505,208 \$478,030 \$5,748,591 2061 \$1,755,125 \$709,508 \$718,127 \$8651,040 \$507,734 \$478,030 \$5,748,591 2062 \$709,508 \$712,573 \$8651,040 \$507,734 \$478,030 \$5,748,591 2063 \$709,508 \$712,573 \$8651,040 \$512,223 \$478,030 \$5,748,591 2064 \$709,508 \$705,122 \$8061,040 \$512,824 \$478,030 \$5,748,591 2064 \$709,508 \$705,122 \$8051,040 \$515,388 \$478,030 \$5,748,591 2064 \$709,508 \$705,122 \$8051,040 \$515,388 \$478,030 \$5,748,591 2065 \$709,508 \$701,804 \$8051,040 \$517,965 \$478,030 \$5,748,591 2066 \$709,508 \$808,178 \$8651,040 \$517,965 \$478,030 \$5,748,591 2066 \$709,508 \$808,178 \$8651,040 \$52,0555 \$478,030 \$5,748,591	\$ 35,000	ŝ	.000	\$390,000		\$190,000	\$10,278,000					
2062 \$709.508 \$712.573 \$8651.040 \$\$10.273 \$478.030 \$5,748.591 2063 \$709.508 \$709.001 \$661.040 \$512.824 \$478.030 \$5,748.591 2064 \$709.508 \$709.412 \$651.040 \$512.824 \$478.030 \$5,748.591 2064 \$709.508 \$705.412 \$651.040 \$515.388 \$478.030 \$5,748.591 2065 \$709.508 \$701.804 \$505.1040 \$517.985 \$478.030 \$5,748.591 2066 \$709.508 \$809.178 \$651.040 \$517.965 \$478.030 \$5,748.591 2066 \$709.508 \$698.178 \$6551.040 \$51.0403 \$5,748.591	\$ 175,000	S		\$190,000	1	\$190,000	\$10,417,000		New trailers every 8 years			
2063 \$709,508 \$709,001 \$651,040 \$512,824 \$478,030 \$5,748,591 2064 \$709,508 \$705,412 \$651,040 \$517,888 \$478,030 \$5,748,591 2065 \$709,508 \$701,804 \$651,040 \$517,965 \$478,030 \$5,748,591 2066 \$709,508 \$701,804 \$651,040 \$517,965 \$478,030 \$5,748,591 2066 \$709,508 \$698,178 \$651,040 \$520,555 \$478,030 \$5,748,591	\$ -	\$		\$190,000		\$190,000	\$11,796,000	Major capital upgrade every 20 years				
2064 \$709,508 \$705,412 \$651,040 \$515,388 \$478,030 \$5,748,591 2065 \$709,508 \$701,804 \$651,040 \$517,985 \$478,030 \$5,748,591 2066 \$709,508 \$698,178 \$\$651,040 \$512,055 \$478,030 \$5,748,591	\$ -	\$		\$190,000		\$190,000	\$10,040,000					
2065 \$709,508 \$701,804 \$651,040 \$517,965 \$478,030 \$5,748,591 2066 \$709,508 \$698,178 \$651,040 \$520,555 \$478,030 \$5,748,591	\$ 235,000	S	,000	\$190,000		\$190,000	\$10,274,000					
2066 \$709,508 \$698,178 \$651,040 \$520,555 \$478,030 \$5,748,591	\$ -	\$	- 000	\$390,000 \$190,000		\$190,000 \$190,000	\$10,238,000 \$11,322,000					
	\$ -	¢ 2	-	\$190,000	1	\$190,000	\$11,322,000 \$10,036,000					
2067 \$709,508 \$694,534 \$651,040 \$523,158 \$478,030 \$5,748,591	\$ 550,000	\$,000	\$190,000		\$190,000	\$10,585,000					
		1	·	1	1	1	1					

WTT Facility Tipping Fee (operating cost & revenue) = \$113 per tonne Capital cost annual payment = \$1,778,766 per year

30 years \$350,784,000 1,792,501 tonnes \$196 per tonne over 30 years

40 years \$466,790,000 2,448,090 tonnes \$191 per tonne over 40 years

50 years \$571,820,000 3,159,253 tonnes \$181 per tonne over 50 years

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

						Population a	nd Disposal Ra	ites											CRWMC LF	Fill Rate ar	nd Capacity								CVWMC LF	Fill Rate and C	apacity				
Year	Projected CVRD Population	CVRD Waste	Projected SRD Population	SRD Waste	Total Annual 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/Residual s to CVWMC LF	Year		/olumetric MSW Disposal Rate	Daily Cover Soil	Operational Soil	Settleme	ent Net Fill Volume			Volumetric Capacity (m³)	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)
	-	tonnes		tonnes	tonnes / yr	tonnes / da	у	tonnes	tonnes	tonnes	tonnes / day		tonnes				m ³	m ³	m ³	m ³	m ³	m ³				m ³	m ³	m ³	m ³	m ³	m ³	m ³	*		
2015	64,294 64,847	36,652 36,967	45,871 46,187	26,149 26,330	62,801 63,297		2 90,44 3 91,17					26,149 26,330	36,652 36,967			2015 2016	37,356 37,614	12,452 12,538	74 75		747 49,80		Dhase 2		201			17,453 17,603	1,047 1,056		69,813 70,413		Dhase 2	Dhase 2	
0 2017		36,967	46,187	25,521	61,527		5 91,17 59 91.11					25,521	36,907	0	0	2018	36,458	12,556			729 48,61		Phase 3 611 Phase 3		0 201			17,603	1,056			68 584	Phase 2 Cell 1	Phase 2 Phase 2	46,525
1 2018	66,372	36,435	46,809	25,696	62,131	17	0 92,06	68				25,696	36,435	0	1	2018	36,708	12,236	73	4	734 48,94	4 97,5	555 Phase 3		1 201	8 52,050) (17,350	1,041	1,041	69,400	137,984	Cell 1	Cell 1	
2 2019	67,139	36,856	47,116	25,864	62,720		2 93,00					25,864	36,856	0	2	2019	36,949 37,187	12,316		9	739 49,26		821 Phase 3		2 201			17,550	1,053 1,065	1,053				Cell 1	
3 2020	67,905 68,667	37,276 30,446	47,419 47,706	26,031 21,152	63,307 51,598					28,110	83	26,031 21,152	37,276 2,336	4 752	3	2020 2021	37,187	12,396 10,072			744 49,58 604 40,29		403 Phase 3 693 Phase 3		3 202 4 202		3.655	5 17,751	1,065	1,065 67	71,003 8,104	279,189 287,293		Cell 1 Cell 1	
5 2022	69,436	30,787	47,986	21,276	52,063	3 14	3 90,71			28,425	84	21,276	2,362 2,388	4,805	5	2022	30,395	10,132	60	3	608 40,52		219 Phase 3		5 202	2 3,374	3,696	3 1,125	67	67	8,195	295,487		Cell 1	
6 2023	8 70,213	31,131	48,267	21,401	52,532				Landfill closure	28,743	85	21,401	2,388	4,859	6	2023	30,573	10,191	61	1	611 40,76		982 Closed	288,480	6 202				68	68	8,286	303,774		Cell 1	
7 2024	70,986	31,474 31,816	48,539 48,806	21,521 21,640	52,995 53,456				21,521 21,640	48,930 49,355	145		4,065 4,101	8,271 8,343	7	2024 2025	0	0) 1	0		982 Closed 982 Closed		7 202- 8 202				116	116	14,106 14,229	317,880 332,108		Cell 1 Cell 1	
8 2025 9 2026	72,527	32,157	49,064	21,754	53,911		48 94,28		21,754	49,776	148		4,136	8,414	9	2026	0	0		5	0		982 Closed		9 202				118	118	14,350	346,458	Cell 1	Cell 1	
10 2027		32,496	49,307	21,862	54,357		00,10		21,862	50,188	149		4,170	8,484	10	2027	0	0		0	0		982 Closed		10 202				119		14,469	360,927		Cell 1	
11 2028	74,047 74,795	32,831 33,163	49,543 49,773	21,967 22,069	54,798				21,967	50,594	150		4,204 4,268	8,552 8,615	11	2028 2029	0	0		0	0		982 Closed 982 Closed		11 202 12 202				120		14,586 14,757	375,512		Cell 1 Cell 1	
12 2029 13 2030		33,163	49,773	22,069	55,231 55,655				22,069 22,166	50,963 50,963	151		4,268	8,615	12	2029	0	0		J N	0		982 Closed 982 Closed		12 202				122		14,757	390,269 405,833		Cell 1 Cell 1	
14 2031	76,255	33,810	50,203	22,259	56,069				22,259	50,963	151		5,106	8,615	14	2031	0	0		Ď	0		982 Closed		14 203				146	146	16,353	422,186		Cell 1	
15 2032	76,971	34,128	50,405	22,349	56,476		5 99,32		22,349	50,963	151		5,513	8,615	15	2032	0	0		0	0		982 Closed		15 203	2 7,876			158	158	17,128	439,314		Cell 1	
16 2033 17 2034		34,442 34,746	50,600 50,775	22,435 22,513	56,878 57,259		100,11		22,435 22,513	50,963 50,963	151		5,915 6,296	8,615 8,615	16	2033 2034	0	0		0	0		982 Closed 982 Closed		16 203 17 203				169 180	169 180	17,893 18.619	457,207 475,826		Cell 1 Cell 1	
18 2035		35,045	50,944	22,513	57,632				22,588	50,963	151		6,669	8,615	18	2034	0	0		0	0		982 Closed		18 203				191	191	19,330	495,156		Cell 1	
19 2036	5 79,710	35,342	51,110	22,661	58,003	3 15	59 102,37	'1	22,661	50,963	151		7,040	8,615	19	2036	0	0		D.	0	0 317,9	982 Closed		19 203	6 10,058	6,627	3,353	201	201	20,037	515,193	Cell 1	Cell 1	
20 2037	80,366	35,633	51,265	22,730	58,363				22,730	50,963	151		7,400	8,615	20	2037	0	0		0	0		982 Closed		20 203				211		20,722	535,915		Cell 1	517,470
21 2038 22 2039	8 81,010 81,643	35,918 36,199	51,411 51,551	22,795 22,857	58,713 59,056		51 103,80 52 104,50		22,795 22,857	50,963 50,963	151		7,750 8,093	8,615 8,615	21	2038 2039	0	0		ן ר	0		982 Closed 982 Closed		21 203 22 203				221 231	221 231	21,389 22,042	557,304 579,346		Cell 2 Cell 2	
23 2040		36,477	51,686	22,917	59,394				22,917	50,963	151		8,431	8,615	23	2040	0	0		Ď	0		982 Closed		23 204				241		22,685	602,031		Cell 2	
24 2041		36,751	51,821	22,977	59,728		100,00		22,977	50,963	151		8,765	8,615	24	2041	0	0		C	0		982 Closed		24 204				250	250	23,321	625,353		Cell 2	
25 2042 26 2043	83,717	37,119 37,490	52,080 52,341	23,091 23,207	60,210 60,697	16	6 106,80		23,091 23,207	50,963 50,963	151		9,247 9,734	8,615 8,615	25 26	2042 2043	0	0		0	0	0 317,9	982 Closed 982 Closed		25 204 26 204	2 13,210 3 13,905			264 278	264 278	24,240 25.167	649,593 674,760		Cell 2 Cell 2	
26 2043 27 2044	85,400	37,490	52,602	23,207	61,188				23,207	50,963	151		9,734	8,615	20	2043	0	0		5	0		982 Closed 982 Closed		26 204				278	276		700,862		Cell 2 Cell 2	
28 2045	86,254	38,243	52,865	23,440	61,683		69 109,69		23,440	50,963	151		10,720	8,615	28	2045	0	0		0	0	0 317,9	982 Closed		28 204				306	306	27,046	727,908	Cell 2	Cell 2	
29 2046		38,626	53,130	23,557	62,183		110,67		23,557	50,963	151		11,220	8,615	29	2046	0	0		0	0		982 Closed		29 204				321	321	27,997	755,905		Cell 2	
30 2047 31 2048		39,012 39,402	53,395 53,662	23,675 23,793	62,687 63,195				23,675 23,793	50,963 50,963	151		11,724 12,232	8,615 8,615	30	2047 2048	0	0		ן ר	0		982 Closed 982 Closed		30 204 31 204				335 349	335 349		784,863		Cell 2 Cell 2	
32 2049	89,756	39,796	53,930	23,912	63,708		75 113,66		23,912	50,963	151		12,745	8,615	32	2049	0	0		Ď	0	0 317,9	982 Closed		32 204	9 18,20	6,627	6,069	364	364	30,903	845,692		Cell 2	
33 2050	90,653	40,194	54,200	24,031	64,226		6 114,68		24,031	50,963	151		13,263	8,615	33 34	2050	0	0		D	0		982 Closed		33 205				379		31,889	877,581		Cell 2	
34 2051 35 2052	91,560 92,476	40,596 41,002	54,471 54,743	24,152 24,272	64,748 65,274		7 115,71 9 116,74		24,152 24,272	50,963 50,963	151		13,785 14,311	8,615 8,615	34	2051 2052	0	0) N	0		982 Closed 982 Closed		34 205 35 205				394 409	394 409	32,883 33.887	910,464 944,350		Cell 2 Cell 2	
36 2053	93,400	41,412	55,017	24,394	65,806	6 18	30 117,79	94	24,394	50,963	151		14,843	8,615	36	2053	0	0		Ď	0	0 317,9	982 Closed		36 205	3 21,204	6,627	7,068	424		34,899	979,249	Cell 2	Cell 2	
37 2054		41,826	55,292	24,516	66,342				24,516	50,963	151		15,379	8,615	37	2054	0	0		C	0		982 Closed		37 205				439	439	35,920	1,015,169		Cell 2	
38 2055	95,278	42,245	55,569	24,638	66,883				24,638	50,963	151		15,920	8,615	38	2055	0	0		0	0		982 Closed		38 205				455	455	36,950	1,052,119		Cell 2	
39 2056 40 2057		42,667 43,094	55,847 56,126	24,761 24,885	67,428 67,979				24,761 24,885	50,963 50,963	151		16,465 17,016	8,615 8,615	39 40	2056 2057	0	0		2	0		982 Closed 982 Closed		39 205 40 205				470	470 486		1,090,108		Cell 2 Cell 2	
41 2058		43,034	56,406	24,000	68,534		38 123,17		25,010	50,963	151		17,571	8,615	40	2058	0	0		5	0		982 Closed		40 205				502	502		1,129,140		Cell 2	
42 2059	99,146	43,960	56,688	25,135	69,095	5 18	124,28	31	25,135	50,963	151		18,132	8,615	42	2059	0	0		D	0	0 317,9	982 Closed		42 205	9 25,902	6,627	8,634	518	518	41,163	1,210,405	Cell 2	Cell 2	
43 2060 44 2061	100,138 101,139	44,399 44,843	56,972 57,257	25,260 25,387	69,660 70,230		1 125,39 1 126,52		25,260 25,387	50,963 50,963	151		18,697 19,267	8,615 8,615	43	2060 2061	0	0		2	0	0 317,9	982 Closed 982 Closed		43 206 44 206	0 26,710 1 27,524		7 8,903 7 9,175	534 550	534 550	42,240 43.326	1,252,645		Cell 2 Cell 2	
44 2061		44,843 45,292	57,257	25,387 25,514	70,230				25,387	50,963	151		19,267	8,615	44	2061	0	0		0	0		982 Closed 982 Closed		44 206				567	550	43,326	1,295,971		Cell 2 Cell 2	
46 2063	103,172	45,745	57,831	25,641	71,386	6 19	128,81	13	25,641	50,963	151		20,423	8,615	46	2063	0	0		0	0	0 317,9	982 Closed		46 206	3 29,176	6,627	9,725	584	584	45,528	1,385,920	Cell 2	Cell 2	
47 2064		46,202	58,120	25,769	71,972				25,769	50,963	151		21,009	8,615	47	2064	0	0		0	0		982 Closed		47 206				600	600	46,643	1,432,563		Cell 2	
48 2065 49 2066		46,664 47,131	58,411 58,703	25,898 26,028	72,562 73,159				25,898 26,028	50,963 50,963	151		21,599 22,196	8,615 8,615	48 49	2065 2066	0	0) 1	0		982 Closed 982 Closed		48 206 49 206				617 634	617 634	47,769 48,904	1,480,332 1,529,236		Cell 2 Cell 2	
50 2067		47,131	58,996	26,028	73,760				26,158	50,963	151		22,190	8,615	50	2000	0	0		5	0		982 Closed		50 206	7 32,56			651	651	50,050			Cell 2	
Totals	4,465,392	2,024,427	2,772,844	1,260,924	3,285,351	U	5,726,31	5	J 1,041,504	2,321,678		219,420	744,253	392,452																					

CVRD growth rate beyond 2041 =	1%	
CVRD disposal rate 2015-2016=	0.57	tonnes
CVRD disposal rate 2017-2020=	0.55	tonnes
CVRD disposal rate 2021-2067=	0.44	tonnes
SRD growth rate beyond 2041 =	0.50%	
SRD disposal rate 2015-2016=	0.57	tonnes
SRD disposal rate 2017-2020=	0.55	tonnes

nes per person per year (46% diversion) nes per person per year (48% diversion) nes per person per year (58% diversion)
 SRD disposal rate 2015-2016=
 0.57

 SRD disposal rate 2017-2020=
 0.55

 tonnes per person per year (46% diversion)

 SRD disposal rate 2021-2067=
 0.44

 Davs of operation =

Days of operation = 337 days per year Bottom ash/residuals to landfill = 17% % 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 = 1.3 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

TBL-2018-03-05-CVRD WTE Assessment Long Term Cost Model Task 8 -5170574:Option 2(a) - Comox Valley

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

					Capital and O	erating Costs											
Year	Campbell River TS Capital	Campbell River TS Operating	Campbell River TS Transport	EWS Facility Tipping Fees	CVWMC LF CVWM Capital - Capi Expansion Minor C	al - Capita	al- Oj	perating -	CVWMC LF Operating - Post-Closure	CRWMC LF Capital	CRWMC LF Operating	Total System	Campbell River TS Notes Co	mox Valley TS Notes	EWS Facility Notes	CVWMC LF Notes	CRWMC LF Notes
2015												03					
2015	-				\$16,000,000							\$16,000,000	New Transfer station constructed 2012-2013			Construction of leachate management system and Cell 1	
2017						0.000 \$ 265	.000 \$*	61.166.495		\$250.868	\$1.052.753	\$3.595.000				Closure Phase 2	Phase 2 SW mgmt design & partial construct
2018					\$ 20	0,000 \$ 2,500	,000 \$	51,166,495		\$490,358	\$1,052,753	\$5,410,000				Closure Phase 2	Phase 2 Surface water management constru
2019					\$	-	\$	51,166,495	\$390,000	\$191,695	\$1,052,753	\$2,801,000					Phase 2 Design and construction
2020	\$200,000			\$1,149,079		6,000		\$1,166,495	\$190,000	\$491,790	\$1,052,753	\$5,325,000	New trailers every 8 years		Permits and land		Phase 2 LFG and final cover design
2021				\$5,968,151	\$ 3	5,000		\$600,124	\$190,000	\$5,630,329	\$1,052,753	\$13,476,000			EWS facility begins operating		Phase 2 LFG and final cover construction
2022				\$5,994,627	\$	-		\$600,124	\$190,000	\$218,613	\$1,052,753	\$8,056,000					Phase 3 LFG and final cover design
2023				\$6,021,378	\$ 3	5,000		\$600,124	\$190,000	\$3,108,685	\$1,052,753	\$11,008,000					Phase 3 LFG and final cover construction
2024		\$651,040 \$651.040	\$318,516	\$7,719,113 \$7,754,884	5	-		\$600,124 \$600,124	\$390,000		\$190,000	\$9,869,000					
2025 2026		\$651,040 \$651,040	\$320,269 \$321,962	\$7,754,884 \$7,790,242	3 e	-		\$600,124 \$600,124	\$190,000 \$190,000		\$190,000 \$190,000	\$9,706,000 \$9,743,000			1		
2026	1	\$651,040	\$321,962 \$323,556	\$7,790,242	\$ \$.000		\$600,124	\$190,000		\$190,000	\$10,365,000					
2027	\$200,000	\$651,040	\$325,105	\$7,859,064	ອ ວເ	,000		\$600,124	\$190,000		\$190,000	\$10,015,000	New trailers every 8 years				
2020	\$200,000	\$651.040	\$326,614	\$7,890.091	\$ 35	.000		\$600,124	\$390.000		\$190,000	\$10,433,000					
2030		\$651.040	\$328,051	\$7.890.091		000		\$600.124	\$190.000		\$190,000	\$10,024,000					
2031		\$651,040	\$329,436	\$7,890,091	Ś	-		\$600,124	\$190,000		\$190,000	\$9,851,000					
2032	\$346,000	\$651,040	\$330,761	\$7,890,091	S	-	\$	\$600,124	\$190,000		\$190,000	\$10,198,000	Transfer station - parking and roads (20 yr life) + capital upgrades				
2033		\$651,040	\$332,041	\$7,890,091	\$ 23	000	5	\$600,124	\$190,000		\$190,000	\$10,088,000	,, ,, ,, ,, ,, ,, ,, ,, ,, ,, ,, ,, ,, ,, ,, ,,				
2034		\$651,040	\$333,189	\$7,890,091	\$	-		\$600,124	\$390,000		\$190,000	\$10,054,000					
2035		\$651,040	\$334,298	\$7,890,091	\$ 93	6,000	\$	\$600,124	\$190,000		\$190,000	\$10,791,000					
2036	\$200,000	\$651,040	\$335,388	\$7,890,091	\$	-		\$600,124	\$190,000		\$190,000	\$10,057,000	New trailers every 8 years				
2037		\$651,040	\$336,405	\$7,890,091	\$8,850,000 \$ 55	,000		\$725,124	\$190,000		\$190,000	\$19,383,000				Construction Cell 2	
2038		\$651,040	\$337,363	\$7,890,091	\$	-		\$725,124	\$190,000		\$190,000	\$9,984,000					
2039		\$651,040	\$338,281	\$7,890,091		6,000 \$ 1,350		\$725,124	\$390,000		\$190,000	\$11,570,000				Closure Cell 1	
2040		\$651,040	\$339,167	\$7,890,091		,000		\$725,124	\$190,000		\$190,000	\$10,160,000					
2041 2042		\$651,040 \$651.040	\$340,053 \$341,753	\$7,890,091	\$ 38	i,000		\$725,124	\$190,000		\$190,000	\$10,371,000					
2042		\$651,040 \$651,040	\$341,753 \$343,462	\$7,890,091 \$7,890,091	\$.000		\$725,124 \$725,124	\$190,000 \$190,000		\$190,000 \$190,000	\$9,988,000 \$10,190,000					
2043	\$200.000	\$651.040	\$345,180	\$7,890,091	\$ 20	,000		\$725,124	\$390,000		\$190,000	\$10,391,000	New trailers every 8 years		1		
2045	\$200,000	\$651.040	\$346,905	\$7,890,091	S 3	6,000		\$725,124	\$190,000		\$190,000	\$10,028,000					
2046		\$651,040	\$348,640	\$4,286,037	Ś	-		\$725,124	\$190,000		\$190,000	\$6,391,000			Amotization period over		
2047		\$651,040	\$350,383	\$4,286,037	\$ 58	000	\$	\$725,124	\$190,000		\$190,000	\$6,978,000					
2048		\$651,040	\$352,135	\$4,286,037	\$	-		\$725,124	\$190,000		\$190,000	\$6,394,000					
2049		\$651,040	\$353,896	\$4,286,037	\$	-		\$725,124	\$390,000		\$190,000	\$6,596,000					
2050		\$651,040	\$355,665	\$4,286,037		,000		\$725,124	\$190,000		\$190,000	\$7,473,000					
2051	\$241,000	\$651,040	\$357,444	\$4,286,037	\$ 3	5,000		\$725,124	\$190,000		\$190,000	\$6,676,000	Transfer station permits etc	and nameli name TC			
2052 2053	\$2,615,000	\$651,040 \$651.040	\$359,231 \$361,027	\$4,286,037 \$4,286,037	\$	-		\$725,124 \$725,124	\$190,000 \$190,000		\$190,000 \$190,000	\$9,016,000 \$6,988,000	Transfer station - new facility + new trailer: Locate, site Construct p	and permit perm TS			
2053		\$651,040	\$361,027 \$362,832	\$4,286,037	φ 20	-		\$725,124 \$725,124	\$390,000		\$190,000	\$6,988,000		export begins @ \$100/tonne	1		
2054	1	\$651,040	\$364,646	\$4,286,037	\$	-		\$725,124	\$190,000		\$190,000	\$6,407,000	Off Island e	vhour nedius (6 à Loouguille			
2055		\$651.040	\$366,469	\$4,286,037	ŝ	-		\$725,124	\$190,000		\$190,000	\$6,409,000					
2050		\$651.040	\$368,302	\$4,286,037	\$ 55	.000		\$725,124	\$190,000		\$190,000	\$6,996,000					
2058		\$651,040	\$370,143	\$4,286,037	\$ 50	-		\$725,124	\$190,000		\$190,000	\$6,412,000					
2059		\$651,040	\$371,994	\$4,286,037	\$ 3	6,000		\$725,124	\$390,000		\$190,000	\$6,649,000					
2060	\$200,000	\$651,040	\$373,854	\$4,286,037		,000		\$725,124	\$190,000		\$190,000	\$6,791,000	New trailers every 8 years				
2061		\$651,040	\$375,723	\$4,286,037	\$	-	\$	\$725,124	\$190,000		\$190,000	\$6,418,000		s every 8 years	1		
2062		\$651,040	\$377,602	\$4,286,037	\$	-		\$725,124	\$190,000		\$190,000	\$6,420,000			1		
2063		\$651,040	\$379,490	\$4,286,037	\$ 23	6,000		\$725,124	\$190,000		\$190,000	\$6,657,000					
2064		\$651,040	\$381,387	\$4,286,037	\$	-		\$725,124	\$390,000		\$190,000	\$6,624,000					
2065		\$651,040	\$383,294	\$4,286,037	\$ 1,28			\$725,124	\$190,000		\$190,000	\$7,710,000					
2066		\$651,040	\$385,211	\$4,286,037	\$	-		\$725,124	\$190,000		\$190,000	\$6,427,000			1		
2067		\$651,040	\$387,137	\$4,286,037	\$ 55	1,000	\$	\$725,124	\$190,000		\$190,000	\$6,979,000					
				1													

EWS Facility Tipping Fee (operating cost & revenue) = \$84 per tonne Capital cost annual payment = \$3,604,054 per year

30 years \$296,299,000 1,792,501 tonnes \$165 per tonne over 30 years

40 years \$365,859,000 2,448,090 tonnes \$149 per tonne over 40 years

50 years \$432,946,000 3,159,253 tonnes \$137 per tonne over 50 years

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

Image: brain			Р	opulation and	I Disposal Rates	s											CRWMC LF	Fill Rate and Capad	city							CVWMC	LF Fill Rate an	d Capacity				
No Las Sub Las Sub Las Sub Las Sub	Year CVRD Waste SRD	SRD waste				Comox	Campbell		day to EWS to	CRWMC	MSW 2	Ash/Residual	Y		MSW Disposal Rate		Soil	Settlement Volu	me Fill	l Volume Phase		Year	MSV Dispo Rate	etric Ash / V Residuals Sal Disposal Rate	Daily Cover Soil	Soil		Volume	Fill Volume	Phase / Cell	Phase / Cell	
1 1	tonnes	tonnes	tonnes / yr	tonnes / day		tonnes	tonnes	tonnes	tonnes / day		tonnes				m ³	m ³	m ³	m ³ m ³	3	m ³			m ³	m ³	m ³	m ³	m ³	m ³	m ³			
39 2056 96,230 42,667 55,847 24,761 67,428 185 120,962 26,078 317,982 [Oldead 59,847 24,761 67,428 185 120,962 26,078 37,989 10,0108 [Cell 2 Cell 2 <	Year CVRD Population Waste Tomes SRD Populatio 2015 64.294 36.652 45.8 2016 64.847 36.967 46.1 0 2017 65.592 36.007 46.4 1 2018 66.27 34.43 48.6 2 2019 67.139 38.856 47.1 3 2020 67.905 37.276 47.4 4 2021 68.667 30.446 47.7 5 2022 69.436 30.787 47.9 6 2023 70.213 31.131 48.8 9 2026 77.257 32.496 49.3 11 2020 74.974 33.483 49.5 12 2020 74.755 33.489 49.5 12 2020 74.975 33.489 49.5 12 2020 74.976 33.489 49.5 12 2023 76.971 34.128 50.0 <	SKU Watte 0 Tonnes 871 26,149 187 26,330 490 25,521 197 26,330 490 25,521 199 25,696 116 25,696 1170 21,152 896 21,276 399 21,521 806 21,764 900 22,499 900 22,499 900 22,496 900 22,493 910 22,661 110 22,661 122,258 110 122,655 122,857 141 22,977 050 23,912 122,977 23,323 130 23,675 686 22,917 131 23,207 132 23,675 682 23,733 341 23,207 395 23,675 682 23,792 <	Tonnage tonnes / yr 62,801 63,297 61,527 62,131 62,720 63,397 61,539 52,063 52,955 53,456 53,911 54,769 55,251 55,655 56,6687 57,652 58,003 59,076 59,972 60,210 60,210 61,683 61,188 62,183 62,183 64,769 63,195 64,784 64,784 66,873 66,874 66,724 66,747 66,748 66,749 66,883 66,883 66,883 66,883 67,742 66,883 66,883 66,883	Tonnage tonnes / day tonnes / day tonnes / day tonnes / day trip trip trip trip trip trip trip trip	Population Population 90,443 90,443 91,173 91,113 92,068 93,003 94,9819 94,9819 94,9819 94,281 94,28 94,281 94,28	Comox Valley TS tonnes ionnes ionnes	Campbell River TS	28,110 28,110 28,425 28,425 28,743 49,375 50,964 50,964 50,963 50	day to EWS facility tonnes / day tonnes / day 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	CRWMC LF C 26,149 26,330 25,521 25,864 26,031 21,152 21,276	MSW LF * tonnes * 36.652 36.967 36.967 * 37.276 * 2.362 2.862 2.365 - 2.362 2.862 2.365 - 3.111 - 4.101 - 4.105 - 4.101 - 4.105 - 5.105 5.915 5.915 5.915 6.699 - 7.400 7.400 7.400 7.404 7.401 - 9.734 1.225 10.225 1.1.220 11.220 1.7.24 12.232 1.7.25 13.785 14.311 14.843 15.379 15.920 16.465	sto/Residual s to CVWMC LF 0 0	22 22 22 22 33 33 33 33 33 33 33 33 33 3	2015 2016 2017 2018 2019 2019 2019 2019 2019 2019 2020 2021 2022 2023 2024 2025 2026 2027 2028 2029 2031 2033 2033 2036 2037 2038 2039 2039 2034 2035 2036 2037 2038 2040 2041 2040 2041 2044 2044 2044 2044 2044 2045 2046 2046 2050 2050 2050 2050 2050	MSW Disposal Rate 37,356 37,614 36,458 36,708 36,549 37,187 30,217 30,395	Cover Soil m ³ 12,452 12,538 12,153 12,236 12,316 12,396 10,072 10,132	Soil m ³ 747 752 729 734 739 744 604 608	Settlement Volu m³ m³ 747 49 752 50 729 48 734 49 734 49 604 40 608 40	me Fill 3 3,808 3,152 3,611 3,944 3,944 3,944 3,944 3,944 3,944 3,944 3,944 3,944 3,944 3,944 3,945 3,9588 3,9588 3,9	Volume m³ Phase Phase 3 48,611 Phase 3 97,555 Phase 3 146,621 Phase 3 126,603 Phase 3 126,603 Phase 3 236,693 Phase 3 237,219 Phase 3 317,982 Closed 317,982 Closed	Capacity (m*)	200 201 201 201 3 200 3 200 4 200 5 200 6 200 7 200 8 200 8 200 8 200 8 200 1 1 200 1 2 200 1 2 200 1 2 200 1 2 200 1 3 200 1 3 200 1 3 200 1 4 200 1 3 200 1 3 200 1 3 200 1 4 200 1 3 200 1 4 200 1 3 200 1 4 200 1 3 200 1 3 200 1 4 200 1 3 200 1 2 200 1 3 200 1 2 200 1 3 200 1 2 200 2 3 2 00 2 2 200 3 3 200 3	MSV Dispose 5 5.5 6 5.5 7 5.5 8 5.5 9 5.5 10 5.5 12 2.2 13 3.2 14 5.5 15 5.5 16 3.2 17 1.2 18 0.0 19 1.1 10 1.1 12 2.1 13 3.4 14 1.1 15 1.1 16 1.1 17 1.1 18 1.1 19 1.1 11 1.1 12 1.1 13 1.1 14 1.1 15 1.1 16 1.1 17 1.1 18 1.1 19 1.1 11 1.1	V Ash / Residuals Disposal Rate Residuals Rate National Rate 2,360	Cover Soil	Soil 1.047 1.056 1.022 1.041 1.055 67 68 111 122 123 141 152 161 117 118 122 123 144 158 166 172 121 221 222 134 166 180 191 201 211 211 211 211 211 211 211 211 211 211 211 211 211 211 211 211 212 2300 300 301 302	m³ 1.047 1.056 1.056 1.055 1.056 1.057 1.058 1.058 1.051 1.117 1.117 1.119 1.119 2.111 2.211 2.211 2.211 2.211 2.211 2.212 2.212 2.212 2.212 2.212 2.212 2.212 2.212	Volume m ³ 69,813 70,413 68,584 69,400 70,202 71,003 8,104 8,194 8,286 14,205 14,466 14,225 14,466 14,465 14,465 14,57 15,555 20,037 22,042 22,645 22,645 22,042 22,645 22,042 22,645 22,042 22,645 22,045 22,042 22,645 22,045 23,055 23,055 23,055 23,055 23,055 23,055 23,055 23,055 23,055 23,055 24,055 25,0	Fill Volume m³ (63,564 (37,964 (37,964 (37,964 (37,964 (37,964 (37,964 (37,973 (33,774 (33,2108 (33,774 (33,774 (33,774 (33,774) (33,774) (33,774) (33,774) (33,774) (33,774) (33,774) (33,774) (33,774) (33,774) (33,774) (33,774) (33,774) (33,774) (33,774) (33,774) (33,774) (33,774) (33,775) (33,775) (34,975) (35,975) (35,975) (37,756) (37,757) (37,758) (37,758) (37,758) (37,758) (37,758) (37,758)	Phase 2 Cell 1 Cell 2 C	Phase 2 Phase 2 Cell 1 Cell 2 Cell 2	Capacity (m ^a)

 CVRD growth rate beyond 2041 =
 1%

 CVRD disposal rate 2015-2016
 0.57

 tonnes per person per year (46% diversion)

 CVRD disposal rate 2017-2020
 0.55

 tonnes per person per year (46% diversion)

 CVRD disposal rate 2017-2027
 0.4

 Drawth rate beyond 2041 =
 0.50%

 SRD disposal rate 2017-2057
 0.44

 SRD disposal rate 2017-2020 =
 0.55

 SRD disposal rate 2017-2020 =
 0.55

 SRD disposal rate 2017-2020 =
 0.55

 Disposal rate 2017-2020 =
 0.55

 Days of operation =
 0.55

 Days of operation =
 0.57

 Bottom ashresiduals to landfill =
 17% % 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 = 1.3 tonnes per m³ In-situ MSW waste density = 0.7 tonnes per m³ Operational soit = 2% of waste volume per year Waste to cover ratio = 3:1 Settlement = 2% of waste volume per year

TBL-2018-03-05-CVRD WTE Assessment Long Term Cost Model Task 8 -5170574 Option 2(b) - Campbell River

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

						с	apital and Op	erating Costs											
Yea	ar	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)		1				\$16,000,000		New Transfer station constructed 2012-2013		Construction of leachate management system and Cell 1	
0	2017								\$ 265,000				\$1,052,753	\$3,595,000				Closure Phase 2	Phase 2 SW mgmt design & partial construction
1	2018							\$ 200,000	\$ 2,500,000			\$490,358	\$1,052,753	\$5,410,000				Closure Phase 2	Phase 2 Surface water management construction
2	2019 2020	\$311,025			Ash / residuals	\$957,915		\$ 1.075.000		\$1,166,495 \$1,166,495	\$390,000 \$190,000	\$191,695 \$491,790	\$1,052,753 \$1.052,753	\$2,801,000 \$5,245,000	Permits	New trailers every 8 years	Permits and land		Phase 2 Design and construction Phase 2 LFG and final cover design
4	2020	\$3,310,000	\$709.508	\$416,031	\$70,325	\$5,968,151		\$ 35,000		\$600,124	\$190,000	\$5,630,329	\$1,052,753	\$17,982,000	New transfer station	ivew trailers every o years	EWS facility begins operating		Phase 2 LFG and final cover construction
5	2022		\$709,508	\$420,691	\$71,113	\$5,994,627		\$ -		\$600,124	\$190,000		\$1,052,753	\$9,257,000			, , , , ,		Phase 3 LFG and final cover design
6	2023		\$709,508	\$425,398	\$71,909	\$6,021,378		\$ 35,000		\$600,124	\$190,000	\$3,108,685	\$1,052,753	\$12,215,000					Phase 3 LFG and final cover construction
7	2024		\$709,508	\$405,647	\$122,411	\$7,719,113		\$ -		\$600,124	\$390,000		\$190,000	\$10,137,000					
8	2025 2026		\$709,508 \$709,508	\$410,190 \$414,720	\$123,475 \$124,527	\$7,754,884 \$7,790,242		s -		\$600,124 \$600,124	\$190,000 \$190,000		\$190,000 \$190,000	\$9,978,000 \$10,019,000					
10	2020		\$709,508	\$419,220	\$125,558	\$7,824,877	1	\$ 585,000		\$600,124	\$190,000		\$190,000	\$10,644,000					
11	2028		\$709,508	\$423,688	\$126,575	\$7,859,064		\$ -		\$600,124	\$190,000		\$190,000	\$10,099,000		New trailers every 8 years			
12	2029	\$200,000	\$709,508	\$427,638	\$127,497	\$7,890,091		\$ 385,000		\$600,124	\$390,000		\$190,000	\$10,920,000	New trailers every 8 years				
13	2030		\$709,508	\$426,201	\$127,497	\$7,890,091		\$ 175,000		\$600,124	\$190,000		\$190,000	\$10,308,000					
14	2031		\$709,508 \$709,508	\$424,817 \$423,491	\$127,497 \$127,497	\$7,890,091 \$7.890.091		\$ -		\$600,124 \$600,124	\$190,000 \$190.000		\$190,000 \$190,000	\$10,132,000 \$10,131,000					
15 16	2032 2033		\$709,508	\$423,491 \$422,212	\$127,497 \$127,497	\$7,890,091		\$ - \$ 235,000		\$600,124	\$190,000		\$190,000	\$10,131,000		Transfer station - parking and roads (20 yr life) + capital upgra	ades		
17	2033		\$709,508	\$421,063	\$127,497	\$7,890,091		\$ 233,000		\$600,124	\$390,000		\$190,000	\$10,328,000					
18	2035		\$709,508	\$419,954	\$127,497	\$7,890,091		\$ 935,000		\$600,124	\$190,000		\$190,000	\$11,062,000					
19	2036		\$709,508	\$418,865	\$127,497	\$7,890,091		s -		\$600,124	\$190,000		\$190,000	\$10,126,000		New trailers every 8 years			
20	2037	\$200,000	\$709,508	\$417,848	\$127,497	\$7,890,091	\$8,850,000	\$ 550,000		\$725,124	\$190,000		\$190,000	\$19,850,000	New trailers every 8 years			Construction Cell 2	
21 22	2038 2039		\$709,508 \$709,508	\$416,890 \$415,971	\$127,497 \$127,497	\$7,890,091 \$7,890,091		\$ - \$ 35.000	\$ 1.350.000	\$725,124 \$725,124	\$190,000 \$390,000		\$190,000 \$190,000	\$10,249,000 \$11.833.000				Closure Cell 1	
22	2039		\$709,508	\$415,085	\$127,497	\$7,890,091		\$ 175,000	\$ 1,350,000	\$725,124 \$725,124	\$190,000		\$190,000	\$10,422,000	-			Closure Cell 1	
24	2041	\$1,555,125	\$709,508	\$414,199	\$127,497	\$7,890,091		\$ 385,000		\$725,124	\$190,000		\$190,000	\$12,187,000	Major capital upgrade every 20 years				
25	2042		\$709,508	\$412,499	\$127,497	\$7,890,091		\$ -		\$725,124	\$190,000		\$190,000	\$10,245,000					
26	2043		\$709,508	\$410,790	\$127,497	\$7,890,091		\$ 200,000		\$725,124	\$190,000		\$190,000	\$10,443,000					
27	2044	\$000 000	\$709,508	\$409,073	\$127,497	\$7,890,091		\$ -		\$725,124	\$390,000		\$190,000	\$10,441,000	N	New trailers every 8 years			
28 29	2045 2046	\$200,000	\$709,508 \$709,508	\$407,347 \$405,612	\$127,497 \$127,497	\$7,890,091 \$4,286,037		\$ 35,000		\$725,124 \$725,124	\$190,000 \$190,000		\$190,000 \$190,000	\$10,475,000 \$6,634,000	New trailers every 8 years		Amotization period over		
30	2040		\$709,508	\$403,869	\$127,497	\$4,286,037		\$ 585.000	1	\$725,124	\$190,000		\$190,000	\$7,217,000			Anouzation period over		
31	2048		\$709,508	\$402,117	\$127,497	\$4,286,037		\$ -		\$725,124	\$190,000		\$190,000	\$6,630,000					
32	2049		\$709,508	\$400,357	\$127,497	\$4,286,037		\$ -		\$725,124	\$390,000		\$190,000	\$6,829,000					
33 34	2050 2051		\$709,508 \$709,508	\$398,587 \$396,809	\$127,497 \$127,497	\$4,286,037 \$4,286,037		\$ 1,075,000 \$ 35,000		\$725,124 \$725,124	\$190,000 \$190.000		\$190,000 \$190,000	\$7,702,000 \$6,660,000		Transfer station permits etc			
34	2051		\$709,508	\$395,022	\$127,497 \$127,497	\$4,286,037		\$ 35,000		\$725,124	\$190,000		\$190,000	\$6,623,000		Transfer station - new facility + new trailer:			
36	2053	\$200,000	\$709,508	\$393,226	\$127,497	\$4,286,037		\$ 585,000		\$725,124	\$190,000		\$190,000	\$7,406,000	New trailers every 8 years	,			
37	2054		\$709,508	\$391,420	\$127,497	\$4,286,037		\$ -		\$725,124	\$390,000		\$190,000	\$6,820,000					
38	2055		\$709,508	\$389,606	\$127,497	\$4,286,037		\$ -		\$725,124	\$190,000		\$190,000	\$6,618,000					
39	2056		\$709,508	\$387,783	\$127,497	\$4,286,037		s -		\$725,124	\$190,000		\$190,000	\$6,616,000					
40 41	2057 2058		\$709,508 \$709,508	\$385,951 \$384,109	\$127,497 \$127,497	\$4,286,037 \$4,286,037		\$ 585,000		\$725,124 \$725,124	\$190,000 \$190,000		\$190,000 \$190,000	\$7,199,000 \$6,612,000					
41 42	2058		\$709,508	\$384,109 \$382,258	\$127,497 \$127,497	\$4,286,037 \$4,286,037		\$ 35.000		\$725,124 \$725,124	\$190,000		\$190,000 \$190,000	\$6,612,000					
42	2055		\$709,508	\$380,398	\$127,497	\$4,286,037		\$ 175,000		\$725,124	\$190,000		\$190,000	\$6,784,000		New trailers every 8 years			
44	2061	\$1,755,125	\$709,508	\$378,529	\$127,497	\$4,286,037		s -		\$725,124	\$190,000		\$190,000	\$8,362,000	Major capital upgrade every 20 years				
45	2062		\$709,508	\$376,651	\$127,497	\$4,286,037		s -		\$725,124	\$190,000		\$190,000	\$6,605,000					
46 47	2063		\$709,508	\$374,763 \$372,865	\$127,497	\$4,286,037		\$ 235,000		\$725,124	\$190,000		\$190,000	\$6,838,000					
47	2064 2065		\$709,508 \$709,508	\$372,865	\$127,497 \$127,497	\$4,286,037 \$4,286,037		\$ 1,285,000		\$725,124 \$725,124	\$390,000 \$190,000		\$190,000 \$190,000	\$6,801,000 \$7,884,000					
40	2065		\$709,508	\$369,042	\$127,497	\$4,286,037		\$ 1,203,000		\$725,124	\$190,000		\$190,000	\$6,597,000					
50	2067		\$709,508	\$367,116	\$127,497	\$4,286,037		\$ 550,000		\$725,124	\$190,000		\$190,000	\$7,145,000					
										-									
Tota	als	\$7,731,275	\$33,346,853	\$18,946,576	\$5,808,295	\$286,314,610	\$8,850,000	\$11,045,000	\$4,115,000	\$36,746,800	\$11,310,000	\$10,382,338	\$15,729,269	\$450,325,000					

29,269 \$450,325,000

EWS Facility Tipping Fee (operating cost & revenue) = \$84 per tonne Capital cost annual payment = \$3,604,054 per year

30 years \$310,749,000 1,792,501 tonnes \$173 per tonne over 30 years

40 years \$379,852,000 2,448,090 tonnes \$155 per tonne over 40 years

50 years \$450,325,000 3,159,253 tonnes \$143 per tonne over 50 years

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

						P	opulation and I	Disposal Rates											CRWMC LF F	ill Rate and O	Capacity						
Ye	ar	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/Residual s to CVWMC LF	Year	Volumetric MSW Disposal Rate	Daily Cover Soil	Operational Soil	Settlement	Net Fill Volume	Cumulative Fill Volume		Volumetric Capacity (m³)	Year	Volumetric MSW Disposal Rate	Volumetric Ash / Residuals Disposal Rate
			tonnes		tonnes	tonnes / yr	tonnes / day		tonnes	tonnes	tonnes	tonnes / day		tonnes			m ³	m ³	m ³	m³	m ³	m ³				m ³	m ³
	2015	64,294	36,652	45,871	26,149	62,801	172	90,443					26,149	36,652	2	2015	37,356	12,452	747	747	7 49,808				2015	52,360	5
	2016	64,847	36,967	46,187	26,330	63,297							26,330	36,967		2016	37,614	12,538	752	752			Phase 3		2016	52,810	
0	2017 2018	65,592 66,372	36,007 36,435	46,490 46,809		61,527 62,131		91,113 92,068					25,521 25,696	36,007 36,435		 0 2017	36,458 36,708	12,153 12,236	729 734	729	9 48,611 4 48,944	48,611 F 97,555 P			0 2017	51,438 52,050	
2	2019	67,139	36,856	47,116	25,864	62,720	172	93,003					25,864	36,856		 2 2019	36,949	12,316	734 739	739	9 49,265	146,821 F			2 2019	52,651	1
3	2020 2021	67,905 68,667	37,276	47,419 47,706	26,031 21,152	63,307 51,598					00.440		26,031 21,152	37,276		3 2020 4 2021	37,187	12,396 10,072	744 604	744 604					3 2020 4 2021	53,252 3,337	
4	2021	69,436	30,446 30,787	47,706	21,152	51,598					28,110 28,425	5 83	21,152			4 2021 5 2022	30,217 30,395	10,072		604		236,693 P 277,219 P			5 2022	3,337	7 3,65
6	2023	70,213	31,131	48,267	21,401	52,532	144	91,614	28,743	Landfill closur	28,743	8 85	21,401	2,362 2,388		 6 2023	30,573	10,191	608 611	611	40,763	317,982 C	Closed	288,480	6 2023	3,412	2 3,73
7	2024	70,986	31,474	48,539	21,521	52,995			27,409		48,930			4,065		7 2024	0	0	0	0	0 0	317,982 0			7 2024	5,808	8 6,36 8 6,41
8	2025 2026	71,758 72,527	31,816 32,157	48,806 49,064		53,456 53,911			27,716 28,022		49,355	5 146 5 148		4,101	8,343 8,414	 8 2025 9 2026	0	0	0			317,982 C			8 2025 9 2026	5,858 5,908	8 6,41 8 6,47
10	2027	73,290	32,496	49,307	21,862		149	95,152				3 149)	4,170		10 2027	0	0	0	C	0 0	317,982 C			10 2027	5,957	7 6,52
11	2028	74,047	32,831	49,543	21,967	54,798					50,594			4,204		 11 2028	0	0	0		0 0	317,982 C			11 2028	6,005	
12	2029 2030	74,795 75,531	33,163 33,489	49,773 49,992	22,069	55,231 55,655			28,894 28,797					4,268		 12 2029 13 2030	0	0	0	0		0 317,982 C 317,982 C			12 2029 13 2030	6,098 6,703	
13	2030	76,255	33,409	50,203			154	98,514						5,106		14 2031	0	0	0	0	0 0	317,982 0			14 2031	7,295	5 6,62
15	2032	76,971	34,128	50,405	22,349	56,476		99,320						5,513		15 2032	0	0	0	C	0 0	317,982 C			15 2032	7,876	6,62
16	2033 2034	77,681 78,366	34,442 34,746	50,600 50,775	22,435	56,878 57,259								5,915 6,296		 16 2033 17 2034	0	0	0	0	0 0	317,982 C			16 2033 17 2034	8,449 8,994	6,62
17	2034	78,366	34,746	50,775	22,513	57,259			28,450					6,290		17 2034 18 2035	0	0	0	(317,982 0			17 2034	8,994 9,528	
19	2036	79,710	35,342	51,110	22,661	58,003	159		28,302	22,661	50,963	3 151		7,040	8,615	19 2036	0	Ő	0	C	0 0	317,982 C	Closed		19 2036	10,058	8 6,62
20	2037	80,366	35,633	51,265										7,400		20 2037	0	0	0	C	0 0	317,982 C			20 2037	10,571	6,62
21 22	2038 2039	81,010 81,643	35,918 36,199	51,411 51,551	22,795 22,857	58,713 59,056		103,805 104,500			50,963 50,963			7,750	8,615 8,615	21 2038 22 2039	0	0	0			317,982 C 317,982 C	Closed		21 2038 22 2039	11,072 11,561	
23	2033	82,270	36,477	51,686	22,917	59,394			28,046		50,963			8,431	8,615	23 2040	0	0	0	0	0 0	317,982 C			23 2040	12,044	1 6.62
24	2041	82,888	36,751	51,821	22,977	59,728	164	105,865		22,977	50,963	3 151		8,765		24 2041	0	0	0	C	0 0	317,982 C			24 2041	12,521	4 6,62 1 6,62 0 6,62
25 26	2042 2043	83,717 84,554	37,119 37,490	52,080 52,341	23,091 23,207	60,210 60,697			27,872 27,756		50,963 50,963			9,247 9,734		25 2042 26 2043	0	0	0	0		317,982 C 317,982 C			25 2042 26 2043	13,210 13,905	0 6,62 5 6,62
20	2043	85,400	37,490	52,602	23,207	61,188								9,734		20 2043	0	0	0			317,982 0			20 2043	14,607	7 6,62
28	2045	86,254	38,243	52,865	23,440	61,683	169	109,693	27,523	23,440	50,963	3 151		10,720	8,615	28 2045	0	0	0	C	0 0	317,982 C	Closed		28 2045	15,314	4 6.62
29 30	2046 2047	87,116 87,987	38,626 39,012	53,130 53,395		62,183 62,687								11,220 11,724		29 2046	0	0	0		0 0	317,982 C			29 2046	16,028 16,748	
30	2047	87,987 88,867	39,012	53,395										11,724		30 2047 31 2048	0	0	0			317,982 C 317,982 C			30 2047 31 2048	16,748	
32	2049	89,756	39,796	53,930	23,912	63,708				23,912				12,745		32 2049	0	0	0		0 0	317,982 C			32 2049	18,207	7 6,62
33	2050	90,653	40,194	54,200	24,031	64,226		114,685	26,932	24,031	50,963	3 151		13,263	8,615	33 2050	0	0	0	C	0 0	317,982 C			33 2050	18,947	7 6,62
34 35	2051 2052	91,560 92,476	40,596 41,002	54,471 54,743	24,152 24,272	64,748 65,274				24,152 24,272				13,785 14,311	8,615 8,615	34 2051 35 2052	0	0	0	0		317,982 C 317,982 C			34 2051 35 2052	19,692 20,445	6,62
36	2052	93,400	41,412	55,017	24,272									14,311		36 2053	0	0	0			317,982 0			36 2052	20,443	4 6.62
37	2054	94,334	41,826	55,292	24,516	66,342	182	118,850	26,447	24,516	50,963	3 151		15,379	8,615	37 2054	0	0	0	C	0 0	317,982 C	Closed		37 2054	21,970	0 6,62
38	2055	95,278	42,245	55,569		66,883								15,920		38 2055	0	0	0	0	0 0	317,982 C			38 2055	22,743	3 6,62
39 40	2056 2057	96,230 97,193	42,667 43,094	55,847 56,126	24,761 24,885	67,428 67,979		120,992 122,078		24,761 24,885				16,465 17.016		 39 2056 40 2057	0	0	0	(317,982 C			39 2056 40 2057	23,522 24,308	2 6,62 8 6,62
40	2058	98,165	43,525	56,406		68.534								17,571	8.615	 41 2058	0	0	0		0 0	317,982			41 2058	25,102	
42	2059	99,146	43,960	56,688	25,135			124,281	25,828	25,135	50,963	3 151		18,132		42 2059	0	0	0	C	0 0	317,982 C			42 2059	25,902	2 6,62
43 44	2060 2061	100,138	44,399	56,972 57,257		69,660 70,230								18,697	8,615	43 2060 44 2061	0	0	0	0	0 0	317,982 C 317,982 C			43 2060	26,710 27,524	6,62
44	2061	101,139 102,151	44,843 45,292	57,257	25,387 25,514	70,230		126,526 127,664			50,963 50,963			19,267 19,842		44 2061 45 2062	0	0	0			317,982 0			44 2061 45 2062	27,524 28,346	
46	2063	103,172	45,745	57,831	25,641	71,386	196	128,813	25,322	25,641	50,963	3 151		20,423	8,615	46 2063	Ő	Ő	0	Č	o č	317,982 C	Closed		46 2063	29,176	6,62 ن
47	2064	104,204	46,202	58,120										21,009		47 2064	0	0	0		0 0	317,982 0			47 2064	30,012	2 6,62
48	2065 2066	105,246 106,298	46,664 47,131	58,411 58,703	25,898 26,028	72,562 73,159			25,065 24,935					21,599 22,196		48 2065 49 2066	0	0	0			317,982 C 317,982 C			48 2065 49 2066	30,856 31,708	6 6,62 8 6,62
49 50	2000	100,290	47,602	58,996	26,158		200	133,519	24,933					22,797		50 2067	0	0	0	0		317,982 C			50 2067	32,567	8 6,62 7 6,62
_																											
Tot	tals	4,465,392	2,024,427	2,772,844	1,260,924	3,285,351	1	5,726,315	1,280,174	1,041,504	2,321,678	3	219,420	744,253	392,452												

 CVRD growth rate beyond 2041 =
 1%

 CVRD disposal rate 2015-2016 =
 0.57
 tonnes per person per year (46% diversion)

 CVRD disposal rate 2017-2020 =
 0.55
 tonnes per person per year (46% diversion)

 CVRD disposal rate 2017-2020 =
 0.55
 tonnes per person per year (46% diversion)

 SRD growth rate beyond 2041 =
 0.50%
 tonnes per person per year (46% diversion)

 SRD disposal rate 2017-2020 =
 0.55
 tonnes per person per year (46% diversion)

 SRD disposal rate 2017-2020 =
 0.55
 tonnes per person per year (46% diversion)

 SRD disposal rate 2017-2020 =
 0.55
 tonnes per person per year (46% diversion)

 Days of operation =
 337 days per year
 337 days per year

 Bottom ashresiduals to landfill =
 17% % of input

In-situ MSW waste density = 0.7 tonnes per m³ Operetional 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

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		CVWMC LF Fil	I Rate and Cap	acity				
olumetric 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	m³	m ³			
	17,453	1,047	1,047	69,813				
	17,603	1,056	1,056	70,413		Phase 2	Phase 2	46,525
0	17,146	1,029	1,029	68,584	68,584	Cell 1	Phase 2	,
0	17,350	1,041	1,041	69,400	137,984	Cell 1	Cell 1	
0	17,550	1,053	1,053 1.065	70,202	208,186	Cell 1 Cell 1	Cell 1 Cell 1	
3,655	17,751	1,065 67	1,065	71,003 8,104	279,189 287,293		Cell 1	
3,655	1,112	67	67	8,104	287,293	Cell 1 Cell 1	Cell 1	
3,090	1,125	68	68	8,286	303,774	Cell 1	Cell 1	
6,362	1,936	116	116	14,106	317,880		Cell 1	
6,418	1,953	110	110	14,100	332,108		Cell 1	
6,472	1,955	117	117	14,225	346,458		Cell 1	
6,526	1,986	119	119	14,469	360,927	Cell 1	Cell 1	
6,579	2.002	110	120	14,586	375,512		Cell 1	
6,627	2,002	120	120	14,757	390,269		Cell 1	
6,627	2,033	134	134	15,563		Cell 1	Cell 1	
6,627	2,432	146	146	16,353	422,186		Cell 1	
6,627	2,625	158	158	17,128	439.314	Cell 1	Cell 1	
6,627	2,816	169	169	17,893	457,207	Cell 1	Cell 1	
6,627	2,998	180	180	18,619	475,826		Cell 1	
6.627	3,176	191	191	19,330	495,156		Cell 1	
6,627	3,353	201	201	20,037	515,193		Cell 1	
6,627	3,524	211	211	20,722	535,915		Cell 1	
6,627	3.691	221	221	21,389	557,304		Cell 2	517,470
6,627	3,854	231	231	22,042	579,346	Cell 2	Cell 2	
6,627	4.015	241	241	22,685	602,031		Cell 2	
6,627	4,174	250	250	23,321	625,353		Cell 2	
6,627	4,403	264	264	24,240	649,593		Cell 2	
6,627	4,635	278	278	25,167	674,760	Cell 2	Cell 2	
6,627	4,869	292	292	26,102	700,862	Cell 2	Cell 2	
6,627	5,105	306	306	27,046	727,908	Cell 2	Cell 2	
6,627	5,343	321	321	27,997	755,905	Cell 2	Cell 2	
6,627	5,583	335	335	28,957	784,863	Cell 2	Cell 2	
6,627	5,825	349	349	29,926	814,789	Cell 2	Cell 2	
6,627	6,069	364	364	30,903	845,692	Cell 2	Cell 2	
6,627	6,316	379	379	31,889	877,581	Cell 2	Cell 2	
6,627	6,564	394	394	32,883	910,464	Cell 2	Cell 2	
6,627	6,815	409	409	33,887	944,350		Cell 2	
6,627	7,068	424	424	34,899	979,249		Cell 2	
6,627	7,323	439	439	35,920		Cell 2	Cell 2	
6,627	7,581	455	455	36,950	1,052,119		Cell 2	
6,627	7,841	470	470	37,989		Cell 2	Cell 2	
6,627	8,103	486	486	39,038		Cell 2	Cell 2	
6,627	8,367	502	502	40,096	1,169,242	Cell 2	Cell 2	
6,627	8,634	518	518	41,163		Cell 2	Cell 2	
6,627	8,903	534	534	42,240	1,252,645		Cell 2	
6,627	9,175	550	550	43,326	1,295,971	Cell 2	Cell 2	
6,627	9,449	567	567	44,422	1,340,392		Cell 2	
6,627	9,725	584	584	45,528	1,385,920		Cell 2	
6,627	10,004	600	600	46,643			Cell 2	
6,627	10,285	617	617	47,769	1,480,332	Cell 2	Cell 2	
6,627	10,569	634	634	48,904		Cell 2	Cell 2	
6,627	10,856	651	651	50,050	1,579,285	Cell 3	Cell 2	
							1	

CVWMC LF Fi	II Rate and Ca	pacity

1.3	tonnes
0.7	400000

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

							Capit	al and Operating	g 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	Capital -	CVWMC LF Capital - Minor Capital	Capital - Op	perating -	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									\$10,000,000	\$ 860,000	\$ 265,000 \$1.	166 495		\$250.868	\$1,052,753	\$3,595,000				Closure Phase 2	Phase 2 SW mgmt design & partial construction
1 2018												.166.495		\$490.358	\$1.052.753	\$5,410,000				Closure Phase 2	Phase 2 Surface water management construction
2 2019										\$ -		,166,495	\$390,000	\$191,695	\$1,052,753	\$2,801,000					Phase 2 Design and construction
3 2020	\$311,025			\$200,000				\$726,800		\$ 1,075,000		,166,495	\$190,000		\$1,052,753	\$4,903,000	Construct TS	New trailers every 8 years	Permits and land		Phase 2 LFG and final cover design
4 2021	\$3,310,000	\$709,508	\$787,086			\$0	\$133,048	\$5,968,151		\$ 35,000	\$6	600,124	\$190,000	\$5,630,329	\$1,052,753	\$15,106,000	New trailers every 8 years	1	EWS facility begins operating		Phase 2 LFG and final cover construction
5 2022		\$709,508	\$795,901			\$0	\$134,538	\$5,994,627		\$ -	\$6	600,124	\$190,000	\$218,613	\$1,052,753	\$9,696,000	, ,				Phase 3 LFG and final cover design
6 2023		\$709,508	\$804,807			\$0	\$136,043	\$6,021,378		\$ 35,000	\$6	600,124	\$190,000	\$3,108,685	\$1,052,753	\$12,658,000					Phase 3 LFG and final cover construction
7 2024		\$709,508	\$767,441		\$651,040	\$430,428	\$231,589	\$7,719,113		\$ -	\$6	600,124	\$390,000		\$190,000	\$11,689,000					
8 2025		\$709,508	\$776,036		\$651,040	\$432,795	\$233,602	\$7,754,884		\$ -		600,124	\$190,000		\$190,000	\$11,538,000					
9 2026		\$709,508	\$784,604		\$651,040	\$435,083	\$235,592	\$7,790,242		\$ -		600,124	\$190,000		\$190,000	\$11,586,000					
10 2027		\$709,508	\$793,119		\$651,040	\$437,238	\$237,541	\$7,824,877		\$ 585,000		600,124	\$190,000		\$190,000	\$12,218,000					
11 2028		\$709,508	\$801,571	\$200,000	\$651,040	\$439,331	\$239,465	\$7,859,064		\$ -		600,124	\$190,000		\$190,000	\$11,880,000		New trailers every 8 years			
12 2029	\$200,000	\$709,508	\$809,046		\$651,040	\$441,370	\$241,211	\$7,890,091		\$ 385,000		600,124	\$390,000		\$190,000	\$12,307,000	New trailers every 8 years				
13 2030		\$709,508	\$806,327		\$651,040	\$443,312	\$241,211	\$7,890,091		\$ 175,000		600,124	\$190,000		\$190,000	\$11,897,000					
14 2031		\$709,508	\$803,707		\$651,040	\$445,183	\$241,211	\$7,890,091		\$ -		600,124	\$190,000		\$190,000	\$11,721,000					
15 2032		\$709,508	\$801,199	\$346,000	\$651,040	\$446,975	\$241,211	\$7,890,091		\$ -		600,124	\$190,000		\$190,000	\$12,066,000					
16 2033		\$709,508	\$798,779		\$651,040	\$448,704	\$241,211	\$7,890,091		\$ 235,000		600,124	\$190,000		\$190,000	\$11,954,000					
17 2034		\$709,508	\$796,606		\$651,040	\$450,256	\$241,211	\$7,890,091		\$ -		600,124	\$390,000		\$190,000	\$11,919,000					
18 2035		\$709,508	\$794,508		\$651,040	\$451,754	\$241,211	\$7,890,091		\$ 935,000		600,124	\$190,000		\$190,000	\$12,653,000					
19 2036		\$709,508	\$792,447	\$200,000	\$651,040	\$453,226	\$241,211	\$7,890,091		\$ -		600,124	\$190,000		\$190,000	\$11,918,000		New trailers every 8 years			
20 2037	\$200,000	\$709,508	\$790,523		\$651,040	\$454,601	\$241,211	\$7,890,091	\$8,850,000	\$ 550,000		725,124	\$190,000		\$190,000	\$21,242,000	New trailers every 8 years			Construction Cell 2	
21 2038		\$709,508	\$788,710		\$651,040	\$455,896	\$241,211	\$7,890,091		\$ -		725,124	\$190,000		\$190,000	\$11,842,000					
22 2039		\$709,508	\$786,972		\$651,040	\$457,137	\$241,211	\$7,890,091				725,124	\$390,000		\$190,000	\$13,426,000				Closure Cell 1	
23 2040		\$709,508	\$785,296		\$651,040	\$458,334	\$241,211	\$7,890,091		\$ 175,000		725,124	\$190,000		\$190,000	\$12,016,000	Major capital upgrade every 20 years				
24 2041	\$1,555,125	\$709,508	\$783,620		\$651,040	\$459,531	\$241,211 \$241,211	\$7,890,091		\$ 385,000		725,124	\$190,000		\$190,000	\$12,225,000					
25 2042		\$709,508	\$780,403 \$777,171		\$651,040	\$461,829 \$464,138	\$241,211 \$241,211	\$7,890,091 \$7,890.091		\$ -		725,124	\$190,000		\$190,000	\$11,839,000					
26 2043 27 2044		\$709,508 \$709,508	\$773.922	\$200.000	\$651,040 \$651.040	\$466,459	\$241,211 \$241,211	\$7,890,091 \$7.890.091		\$ 200,000 \$		725,124	\$190,000 \$390,000		\$190,000	\$12,038,000 \$12,237,000		New trailers every 8 years			
27 2044 28 2045	\$200,000	\$709,508	\$770,656	\$200,000	\$651,040	\$468,791	\$241,211	\$7,890,091		\$ 35,000		725,124	\$190,000		\$190,000	\$12,237,000	Number 11	new trailers every o years			
28 2045 29 2046	\$200,000	\$709,508	\$767,375		\$651,040	\$400,791 \$471,135	\$241,211	\$4,286,037		\$ 35,000		725,124	\$190,000		\$190,000	\$8,231,000	New trailers every 8 years		Amotization period over		
30 2046		\$709,508	\$764,077		\$651,040	\$471,135	\$241,211	\$4,286,037		\$ 585,000		725,124	\$190,000		\$190,000	\$8,231,000			Amouzation period over		
31 2048		\$709,508	\$760,763		\$651,040	\$475,858	\$241,211	\$4,286,037		\$ 383,000		725,124	\$190,000		\$190,000	\$8,230,000					
32 2048		\$709,508	\$757,432		\$651,040	\$478,237	\$241,211	\$4,286,037		ф -		725,124	\$390,000		\$190,000	\$8,429,000					
33 2050		\$709,508	\$754.084		\$651,040	\$480,629	\$241,211	\$4,286,037		\$ 1.075.000		725,124	\$190,000		\$190,000	\$9,303,000					
34 2051		\$709,508	\$750,720	\$241.000	\$651.040	\$483,032	\$241,211	\$4,286,037		\$ 35,000		725,124	\$190,000		\$190,000	\$8,503,000					
35 2052		\$709,508	\$747.338	\$2,615,000	\$651.040	\$485,447	\$241,211	\$4,286,037		\$ 33,000		725,124	\$190,000		\$190,000	\$10.841.000		New trailers every 8 years			
36 2053	\$200,000	\$709,508	\$743,940	+_,010,000	\$651,040	\$487,874	\$241,211	\$4,286,037		\$ 585,000		725,124	\$190,000		\$190,000	\$8,810,000	New trailers every 8 years				
37 2054	\$200,000	\$709,508	\$740.525		\$651.040	\$490,314	\$241,211	\$4.286.037		\$ -		725,124	\$390,000		\$190,000	\$8,424,000					
38 2055		\$709,508	\$737,093		\$651,040	\$492,765	\$241,211	\$4,286,037		\$ -		725,124	\$190,000		\$190,000	\$8,223,000					
39 2056		\$709,508	\$733,643		\$651,040	\$495,229	\$241,211	\$4,286,037		\$ -		725,124	\$190,000		\$190,000	\$8,222,000					
40 2057		\$709,508	\$730,177		\$651,040	\$497,705	\$241,211	\$4,286,037		\$ 585,000		725,124	\$190,000		\$190,000	\$8,806,000					
41 2058		\$709,508	\$726,693		\$651,040	\$500,194	\$241,211	\$4,286,037		\$ -		725,124	\$190,000		\$190,000	\$8,220,000					
42 2059		\$709,508	\$723,192		\$651,040	\$502,695	\$241,211	\$4,286,037		\$ 35,000		725,124	\$390.000		\$190,000	\$8,454,000					
43 2060		\$709,508	\$719,673	\$200,000	\$651,040	\$505,208	\$241,211	\$4,286,037		\$ 175,000		725,124	\$190,000		\$190,000	\$8,593,000	Major capital upgrade every 20 years	New trailers every 8 years			
44 2061	\$1,755,125	\$709,508	\$716,136		\$651,040	\$507,734	\$241,211	\$4,286,037		\$ -		725,124	\$190,000		\$190,000	\$8,217,000	New trailers every 8 years				
45 2062		\$709,508	\$712,582		\$651,040	\$510,273	\$241,211	\$4,286,037		\$-	\$7	725,124	\$190,000		\$190,000	\$8,216,000					
46 2063		\$709,508	\$709,010		\$651,040	\$512,824	\$241,211	\$4,286,037		\$ 235,000		725,124	\$190,000		\$190,000	\$8,450,000					
47 2064		\$709,508	\$705,420		\$651,040	\$515,388	\$241,211	\$4,286,037		\$ -		725,124	\$390,000		\$190,000	\$8,414,000					
48 2065		\$709,508	\$701,813		\$651,040	\$517,965	\$241,211	\$4,286,037		\$ 1,285,000		725,124	\$190,000		\$190,000	\$9,498,000					
49 2066		\$709,508	\$698,187		\$651,040	\$520,555	\$241,211	\$4,286,037		\$ -		725,124	\$190,000		\$190,000	\$8,212,000					
50 2067		\$709,508	\$694,543		\$651,040	\$523,158	\$241,211	\$4,286,037		\$ 550,000	\$7	725,124	\$190,000		\$190,000	\$8,761,000					
Totals	\$7,731,275	\$33,346,853	\$35,844,873	\$4,202,000	\$28,645,760	\$20,830,081	\$10,988,666	\$286,083,494	\$8,850,000	\$11,045,000	\$4,115,000 \$36	6,746,800	\$11,310,000	\$10,382,338	\$15,729,269	\$518,123,000					
	•										-						•				

EWS Facility Tipping Fee (operating cost & revenue) = \$84 per tonne Capital cost annual payment = \$3,604,054 per year

\$212.31 \$154.82

30 years \$345,297,000 1,792,501 tonnes \$193 per tonne over 30 years

40 years \$433,088,000 2,448,090 tonnes \$177 per tonne over 40 years

50 years \$518,123,000 3,159,253 tonnes \$164 per tonne over 50 years

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

						Population a	nd Disposal Rat	es										CRWMC LF	Fill Rate a	and Capacity								CVWMC LF	Fill Rate and C	apacity				
Year	Projected CVRD Population	CVRD Waste	Projecteo SRD Populatio	SRD Waste	Total Annua Tonnage		Combined	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/Residual s to CVWMC LF	Year	Volumetric MSW Disposal Rate	Daily Cover Soil	Operational	Settlem	Net Fill			Volumetric Capacity (m ³)	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	Volumetri Capacity (r
		tonnes		tonnes	tonnes / yr	tonnes / da	у	tonnes	tonnes	tonnes	tonnes / day		tonnes			m ³	m ³	m ³	m ³	m ³	m ³				m ³	m ³	m ³	m ³	m³	m³	m ³			
2015	5 64.294	36,652	45.8	371 26.14	62,80	1 17	2 90.443	3				26,149	36.652		20	15 37.356	6 12.452	74	7	747 49.80	8			201	15 52.360		17.453	1.047	1.047	69.813				l
2016	64,847	36,967	46,1	87 26,33	63,29	7 17	3 91,177	7				26,330	36,967		20	16 37,614	12,538	75	2	752 50,15	2	Phase 3		201	16 52,810		17,603	1,056	1,056	70,413			Phase 2	46.525
0 2017 1 2018		36,007 36,435	46,4				69 91,113 70 92.068					25,521 25,696	36,007 36,435		0 20				9	729 48,61 734 48,94		,611 Phase 3 .555 Phase 3		0 201			17,146 17,350	1,029	1,029	68,584 69,400			Phase 2 Cell 1	40,020
2010			40,0				2 93,003					25,896	36,435		2 20				+	739 49,26		,821 Phase 3		2 201			17,350	1,041					Cell 1	
3 2020	67,905	37,276	47,4	19 26,03	63,30	7 17	3 93,936	6				26,031	37,276	0	3 20	20 37,18	7 12,396	74	1	744 49,58	2 196,	,403 Phase 3		3 202	20 53,252		17,751	1,065	1,065	71,003	279,189	Cell 1	Cell 1	
4 2021		30,446	47,7							29,195	83	21,152	1,251		4 20				1	604 40,29		,693 Phase 3		4 202			596	36	36	5,570			Cell 1	
5 2022 6 2023		30,787 31,131	47,9 48.2						Landfill closur	29,522 29,852		21,276 21,401	1,265 1,279	3,222 3,259	5 20 6 20	22 30,39 23 30,57			5	608 40,52 611 40,76		,219 Phase 3 ,982 Closed	288.480	5 202 6 202				36	36	5,632	290,391 296.087		Cell 1 Cell 1	i
7 2024		31,474	48,5						21,521	50,817	145	21,101	2,178		7 20		0 0		D	0		,982 Closed	200,100	7 202				62	62	9,695	305,782		Cell 1	
8 2025	5 71,758		48,8				6 93,398		21,640	50,963			2,493		8 20	25	0 0)	0		,982 Closed		8 202	25 3,562			71	71	10,312	316,094		Cell 1	
9 2026 0 2027		32,157 32,496	49,0 49,3				01,201		21,754 21,862				2,948 3.394		9 20 10 20				1	0		,982 Closed ,982 Closed		9 202 10 202				84	84	11,179 12.029	327,273 339.301		Cell 1 Cell 1	
1 2028			49,5						21,002				3,835		11 20				5	0		,982 Closed		11 202				110	110	12,025	352,169		Cell 1	
2 2029	74,795	33,163	49,7	73 22,06	55,23	1 15	51 96,864	1	22,069	50,963	146		4,268	5,563	12 20	29	0 0		D	0	0 317,	,982 Closed		12 202	6,098			122	122	13,693	365,862	Cell 1	Cell 1	
3 2030		33,489	49,9						22,166				4,692		13 20		0 0		2	0		,982 Closed		13 203				134 146	134	14,500	380,362		Cell 1	
4 2031 5 2032	1 76,255 2 76,971	33,810 34,128	50,2 50,4				00,011		22,259 22,349				5,106 5,513		14 20 15 20				1	0		,982 Closed ,982 Closed		14 203 15 203				146	140	15,289 16,065	395,651 411,716		Cell 1 Cell 1	1
6 2033		34,442	50,4		5 56,878				22,345				5,915	5,563	16 20	33			5	0		,982 Closed		16 203	33 8,449			169	169	16,829	428,544		Cell 1	
7 2034		34,746	50,7		57,259				22,513				6,296		17 20		0 C)	0		,982 Closed		17 203				180	180	17,555	446,100		Cell 1	
8 2035 9 2036			50,9 51,1				58 101,627 59 102,371		22,588		146		6,669 7.040		18 20		0 0)	0		,982 Closed		18 203 19 203				191 201	101	18,266			Cell 1	
9 2030 0 2037		35,342 35,633	51,1						22,661 22,730	50,963 50,963	146		7,040		19 20 20 20				5	0		,982 Closed ,982 Closed		20 203				201 211	201	18,973 19.658	483,339 502,997		Cell 1 Cell 1	i
1 2038	81,010	35,918	51,4	11 22,79	5 58,713	3 16			22,795				7,750	5,563	21 20	38	0 0		5	0	0 317,	,982 Closed		21 203	38 11,072	5,563	3,691	221		20,325	523,323	Cell 2 0	Cell 1	517,470
2 2039		36,199	51,5						22,857	50,963			8,093		22 20		0 0)	0		,982 Closed		22 203				231	231		544,301		Cell 2	517,470
3 2040 4 2041		36,477 36,751	51,6 51,8						22,917 22,977	50,963 50,963			8,431 8,765		23 20 24 20) 	0		,982 Closed .982 Closed		23 204 24 204				241 250		21,622 22,258			Cell 2 Cell 2	
5 2042		37,119	52,0						23,091				9,247		25 20					0		,982 Closed		25 204				250			611,357		Cell 2	
6 2043	84,554	37,490	52,3	341 23,20	60,69	7 16			23,207	50,963			9,734	5,563	26 20	13 (0 0		D	0	0 317,	,982 Closed		26 204	13,905	5,563		278		24,103	635,460	Cell 2	Cell 2	
7 2044		37,865	52,6						23,323		146		10,225				0 0		0	0		,982 Closed		27 204				292			660,499		Cell 2	
8 2045 9 2046		38,243 38,626	52,8 53.1				69 109,693 70 110,673		23,440 23,557	50,963 50,963			10,720 11,220		28 20 29 20				1	0		,982 Closed ,982 Closed		28 204 29 204				306 321	306 321	25,982 26,934	686,481 713,414		Cell 2 Cell 2	1
0 2047			53,3				2 111,662		23,675				11,724		30 20				Ď	0		,982 Closed		30 204				335	335				Cell 2	
1 2048		39,402	53,6				3 112,660		23,793				12,232	5,563	31 20		0 0	()	0		,982 Closed		31 204				349 364	349	28,862			Cell 2	
2 2049 3 2050		39,796 40,194	53,9 54,2				75 113,668 76 114,685		23,912 24,031	50,963 50,963			12,745 13,263		32 20 33 20				2	0		,982 Closed ,982 Closed		32 204 33 205		5,563		364 379		29,839 30,825	800,009 830.835		Cell 2 Cell 2	
4 2050	1 91,560	40,194	54,2	24,03	64,220		7 115,712		24,031				13,203	5,563	34 20	51				0		,982 Closed		34 205	51 19,692			379	394	31,820			Cell 2	
5 2052	92,476	41,002	54,7	43 24,27	65,274		9 116,748	3	24,272	50,963	146		14,311	5,563	35 20	52	0 0)	0	0 317,	,982 Closed		35 205	52 20,445	5,563	6,815	409		32,823	895,477	Cell 2 0	Cell 2	
6 2053 7 2054	3 93,400	41,412 41,826	55,0 55,2	24,39 292 24,51	65,800 66,342				24,394				14,843 15,379		36 20 37 20	53	0 0)	0	0 317,	,982 Closed ,982 Closed		36 205 37 205	53 21,204			424 439					Cell 2	
7 2054 8 2055		41,826	55,5						24,516 24,638				15,379		37 20					0		,982 Closed ,982 Closed		37 205				439	439	34,856 35,886	964,168 1,000,054		Cell 2 Cell 2	i
9 2056		42,667	55.8				110,010		24,000				16,465		39 20				ó	0		,982 Closed		39 205				435			1,036,980		Cell 2	
0 2057	7 97,193	43,094	56,1	26 24,88	67,979	9 18	36 122,078	3	24,885	50,963	146		17,016		40 20	57 (0 0)	0		,982 Closed		40 205	57 24,308	5,563		486		37,974	1,074,954	Cell 2	Cell 2	
1 2058		43,525	56,4				38 123,174		25,010				17,571		41 20		0 0		2	0		,982 Closed		41 205				502 518	502	39,032	1,113,986		Cell 2	ļ
2 2059 3 2060		43,960 44,399	56,6 56,9						25,135 25,260				18,132 18,697	5,563 5,563	42 20 43 20				ן ר	0		,982 Closed ,982 Closed		42 205 43 206		5,563 5,563		518		40,099 41,176	1,154,085 1,195,261		Cell 2 Cell 2	
4 2061	1 101,139	44,399	57,2	257 25,38	70,230	0 19			25,387				19,267	5,563	44 20	61 0			5	ő	0 317,	,982 Closed	I	44 206	51 27,524	5,563	9,175	550	550		1,237,523		Cell 2	
5 2062		45,292	57,5	543 25,51	70,805	5 19	127,664		25,514				19,842		45 20		0 0	()	0		,982 Closed		45 206		5,563		567	567	43,358	1,280,881		Cell 2	
6 2063 7 2064		45,745 46,202	57,8 58.1				96 128,813 97 129,973		25,641 25,769				20,423 21,009		46 20 47 20				2	0		,982 Closed ,982 Closed		46 206 47 206		5,563 5,563		584 600	584 600	44,464 45,579	1,325,345		Cell 2 Cell 2	l
7 2064 8 2065		46,202	58,1						25,769		140		21,009		47 20				ś	0		,982 Closed ,982 Closed		47 200				600	617	45,579 46,705	1,370,925		Cell 2	
9 2066	6 106,298	47,131	58,7	03 26,02	3 73,159	9 20	132,326	3	26,028		146		22,196	5,563	49 20	66	0 0		D	ō	0 317,	,982 Closed		49 206	31,708	5,563	10,569	634	634	47,840	1,465,470	Cell 2 0	Cell 2	1
0 2067	7 107,361	47,602	58,9	996 26,15	3 73,760	0 20	133,519	9	26,158	50,963	146		22,797	5,563	50 20	67 (0 0		0	0	0 317,	,982 Closed		50 206	32,567	5,563	10,856	651	651	48,986	1,514,455	Cell 2	Cell 2	ļ
Totals				1,260,92		_	5.726.315		1.041.504			219,420	735,137	254,421		1	1	1	1		1				1	1	1					1		

 CVRD growth rate beyond 2041 =
 1%

 CVRD disposal rate 2015-2016=
 0.57
 tonnes per person per year (46% diversion)

 CVRD disposal rate 2017-2020=
 0.55
 tonnes per person per year (48% diversion)

 CVRD disposal rate 2017-2020=
 0.55
 tonnes per person per year (48% diversion)

 CVRD disposal rate 2017-2020=
 0.55
 tonnes per person per year (58% diversion)

 SRD disposal rate 2015-2016=
 0.57
 tonnes per person per year (46% diversion)

 SRD disposal rate 2017-2020=
 0.55
 tonnes per person per year (46% diversion)

 SRD disposal rate 2017-2020=
 0.44
 tonnes per person per year (46% diversion)

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										
Ye	ar	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	
	2015 2016					\$16,000,000							\$0 \$16,000,000	New Transfer station constructed 2012-2013			Construction of leachate management system and Cell 1	
0	2016					\$16,000,000	\$ 860,000	\$ 265,000	\$1 166 495		\$250.868	\$1.052.753	\$3,595,000	New Transier station constructed 2012-2013			Closure Phase 2	Pha
1	2017						\$ 200,000				\$490,358	\$1,052,753	\$5,410,000				Closure Phase 2	Phas
2	2019						\$ -	+ _,,	\$1,166,495	\$390,000	\$191,695	\$1,052,753	\$2,801,000					Phas
3	2020	\$200,000			\$1,805,696		\$ 1,075,000		\$1,166,495	\$190,000	\$491,790	\$1,052,753	\$5,982,000	New trailers every 8 years		Permits and land		Phas
4	2021				\$3,250,037		\$ 35,000		\$600,124	\$190,000	\$5,630,329	\$1,052,753	\$10,758,000			Sustane facility begins operating		Phas
5	2022				\$3,267,280		\$ - \$ 35,000		\$600,124	\$190,000	\$0 \$218.613	\$1,052,753	\$5,110,000 \$5,381,000					
5	2023 2024		\$651,040	\$318,516	\$3,284,702 \$4,390,399		\$ 35,000 \$ -		\$600,124 \$600,124	\$190,000 \$390,000	\$218,613	\$1,052,753 \$190,000	\$9,649,000					Phas Phas
8	2024		\$651.040	\$320,269	\$4,398,073		\$ - \$ -		\$600,124	\$190,000	\$3,100,003	\$190,000	\$6,350,000					Filds
9	2026		\$651,040	\$321,962	\$4,398,073		\$-		\$600,124	\$190,000		\$190,000	\$6,351,000					
10	2027		\$651,040	\$323,556	\$4,398,073		\$ 585,000		\$600,124	\$190,000		\$190,000	\$6,938,000					
11	2028	\$200,000	\$651,040	\$325,105	\$4,398,073		\$-		\$600,124	\$190,000		\$190,000	\$6,554,000	New trailers every 8 years				
12	2029		\$651,040	\$326,614	\$4,398,073		\$ 385,000		\$600,124	\$390,000		\$190,000	\$6,941,000					
13	2030		\$651,040	\$328,051	\$4,398,073		\$ 175,000		\$600,124	\$190,000		\$190,000	\$6,532,000					
14	2031	6 040,000	\$651,040	\$329,436	\$4,398,073		\$ -		\$600,124	\$190,000		\$190,000	\$6,359,000					
15 16	2032 2033	\$346,000	\$651,040 \$651,040	\$330,761 \$332,041	\$4,398,073		\$ - \$ 235,000		\$600,124 \$600,124	\$190,000 \$190,000		\$190,000 \$190,000	\$6,706,000	Transfer station - parking and roads (20 yr life) + capital upgrades				
10	2033		\$651,040	\$332,041 \$333,189	\$4,398,073 \$4,398,073		\$ 235,000		\$600,124	\$390,000		\$190,000	\$6,596,000 \$6,562,000					
18	2035		\$651,040	\$334,298	\$4,398,073		\$ 935,000		\$600,124	\$190,000		\$190,000	\$7,299,000					
19	2036	\$200,000	\$651,040	\$335,388	\$4,398,073		\$ -		\$600,124	\$190,000		\$190,000	\$6,565,000	New trailers every 8 years				
20	2037		\$651,040	\$336,405	\$4,398,073		\$ 550,000		\$600,124	\$190,000		\$190,000	\$6,916,000					
21	2038		\$651,040	\$337,363	\$4,398,073	\$8,850,000	\$ -		\$600,124	\$190,000		\$190,000	\$15,217,000				Construction Cell 2	
22	2039		\$651,040	\$338,281	\$4,398,073		\$ 35,000		\$725,124	\$390,000		\$190,000	\$6,728,000					
23	2040		\$651,040	\$339,167	\$4,398,073			\$ 1,350,000	\$725,124	\$190,000		\$190,000	\$8,018,000				Closure Cell 1	
24	2041		\$651,040	\$340,053	\$4,398,073		\$ 385,000		\$725,124	\$190,000		\$190,000	\$6,879,000					
25	2042 2043		\$651,040 \$651,040	\$341,753 \$343,462	\$4,398,073 \$4,398,073		\$ - \$ 200,000		\$725,124 \$725,124	\$190,000 \$190,000		\$190,000 \$190,000	\$6,496,000 \$6,698,000					
26 27	2043	\$200,000	\$651,040	\$345,180	\$4,398,073		\$ 200,000		\$725,124	\$390,000		\$190,000	\$6,899,000	New trailers every 8 years				
28	2045	\$200,000	\$651,040	\$346,905	\$4,398,073		\$ 35,000		\$725,124	\$190,000		\$190,000	\$6,536,000			Amotization period over		
29	2046		\$651,040	\$348,640	\$2,687,721		\$ -		\$725,124	\$190,000		\$190,000	\$4,793,000					
30	2047		\$651,040	\$350,383	\$2,687,721		\$ 585,000		\$725,124	\$190,000		\$190,000	\$5,379,000					
31	2048		\$651,040	\$352,135	\$2,687,721		\$ -		\$725,124	\$190,000		\$190,000	\$4,796,000					
32	2049		\$651,040	\$353,896	\$2,687,721		\$ -		\$725,124	\$390,000		\$190,000	\$4,998,000					
33 34	2050 2051	\$241.000	\$651,040 \$651,040	\$355,665 \$357,444	\$2,687,721 \$2,687,721		\$ 1,075,000 \$ 35,000		\$725,124 \$725,124	\$190,000 \$190,000		\$190,000 \$190,000	\$5,875,000 \$5,077,000	Transfer station permits etc				
35	2052	\$2,615,000	\$651,040	\$359,231	\$2,687,721		\$ 33,000		\$725,124	\$190,000		\$190,000	\$7,418,000	Transfer station - new facility + new trailers	Locate, site and permit perm TS			
36	2053	\$2,010,000	\$651.040	\$361,027	\$2.687.721		\$ 585,000		\$725,124	\$190,000		\$190.000	\$5.390.000		Construct perm TS			
37	2054		\$651,040	\$362,832	\$2,687,721		\$ -		\$725,124	\$390,000		\$190,000	\$5,007,000		Off island export begins @ \$100/tonne			
38	2055		\$651,040	\$364,646	\$2,687,721		\$-		\$725,124	\$190,000		\$190,000	\$4,809,000					
39	2056		\$651,040	\$366,469	\$2,687,721		\$-		\$725,124	\$190,000		\$190,000	\$4,810,000					
40	2057		\$651,040	\$368,302	\$2,687,721		\$ 585,000		\$725,124	\$190,000		\$190,000	\$5,397,000					
41	2058		\$651,040	\$370,143	\$2,687,721		\$ -		\$725,124	\$190,000		\$190,000	\$4,814,000					
42	2059	£200.000	\$651,040 \$651,040	\$371,994	\$2,687,721		\$ 35,000		\$725,124	\$390,000		\$190,000	\$5,051,000					
43 44	2060 2061	\$200,000	\$651,040 \$651.040	\$373,854 \$375,723	\$2,687,721 \$2,687,721		\$ 175,000		\$725,124 \$725,124	\$190,000 \$190,000		\$190,000 \$190,000	\$5,193,000 \$4,820,000	New trailers every 8 years	New trailers every 8 years			
44	2061		\$651,040	\$377,602	\$2,687,721		÷ -		\$725,124	\$190,000		\$190,000	\$4,821,000		INCAN GENEIS EVELY O YEARS			
46	2063		\$651,040	\$379,490	\$2,687,721		\$ 235,000		\$725,124	\$190,000		\$190,000	\$5,058,000					
47	2064		\$651,040	\$381,387	\$2,687,721		\$ -		\$725,124	\$390,000		\$190,000	\$5,025,000					
48	2065		\$651,040	\$383,294	\$2,687,721		\$ 1,285,000		\$725,124	\$190,000		\$190,000	\$6,112,000					
49	2066		\$651,040	\$385,211	\$2,687,721		\$ -		\$725,124	\$190,000		\$190,000	\$4,829,000					
50	2067		\$651,040	\$387,137	\$2,687,721		\$ 550,000		\$725,124	\$190,000		\$190,000	\$5,381,000					

Sustane Facility Tipping Fee (operating cost & revenue) = \$53 per tonne Capital cost annual payment = \$1,710,352 per year 30 years \$208,998,000 1,792,501 tonnes \$117 per tonne over 30 years

40 years \$262,575,000 2,448,090 tonnes \$107 per tonne over 40 years

50 years \$313,679,000 3,159,253 tonnes \$99 per tonne over 50 years

CRWMC LF Notes
hase 2 SW mgmt design & partial construction
hase 2 Surface water management construction hase 2 Design and construction hase 2 LFG and final cover design hase 2 LFG and final cover construction
hase 3 LFG and final cover design hase 3 LFG and final cover construction

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

						Population a	nd Disposal Rates	5										CRWMC LF	Fill Rate and	Capacity								CVWMC LF Fi	II Rate and Ca	oacity			
Year	Projected CVRD Population	CVRD Waste	Projected SRD Population	SRD Waste	Total Annual		Combined Population	Tonnes to Comox Valley TS	Tonnes to Campbell River TS	Tonnes to Sustane Facility		Tonnes MSW to CRWMC LF	Tonnes to MSW CVWMC LF	Tonnes Ash/Residual s to CVWMC LF	Year	Volumetr MSW Disposa Rate	Daily	Operational	Settlement	Net Fill Volume	Cumulative Fill Volume		Volumetric Capacity (m³)	Year	Volumetric MSW Disposal Rate	Volumetric Ash / Residuals Disposal	Daily Cover Soil	Operational	Settlement	Net Fill Volume	Cumulative Fill Volume Cel		Volumetric Capacity (m ³)
		tonnes		tonnes	tonnes / vr	tonnes / day	,	tonnes	tonnes	tonnes	tonnes / day		tonnes			m ³	m ³	m ³	m ³	m ³	m ³				m ³	Rate m ³	m ³	m ³	m ³	m ³	m ³		
2015 2016			45,871 46,187				2 90,443 3 91,177					26,149 26,330	36,652 36,967		20			747 752	74	49,808		Phase 3		2015	5 52,360 6 52,810		17,453			69,813 70,413	Phase	2 Phase 2	10 505
0 2017			46,490				9 91,113					25,521	36,007	0	0 20			729	72	48,611		1 Phase 3		0 2017			17,146				68,584 Cell 1	Phase 2	46,525
1 2018 2 2019							0 92,068 2 93,003					25,696 25,864	36,435 36,856	0	1 20 2 20			734	73	48,944 49,265		5 Phase 3 1 Phase 3		1 2018			17,350			69,400 70,202	137,984 Cell 1 208,186 Cell 1	Cell 1 Cell 1	
3 2020	67,90	5 37,276	47,419	26,031	63,307	17	3 93,936					26,031	37,276	0	3 20	20 37,1	87 12,396	744	74	49,582	196,40	3 Phase 3		3 2020	0 53,252	C	17,751		1,065		279,189 Cell 1	Cell 1	
4 2021 5 2022	68,66 69,43		47,706				1 89,819 3 90,712	29,195 29,522		29,195 29,522	83	21,152 21,276	1,251 1,265	3,187 3,222	4 20 5 20			604	604	40,290 40,526		3 Phase 3 9 Phase 3		4 202 5 2022			596	36	36	5,570	284,759 Cell 1 290,391 Cell 1	Cell 1 Cell 1	
6 2022			47,980						2 Landfill closur			21,276	1,205	3,222	6 20			611	61	40,526		2 Closed	288,480	6 2023				30	30	5,695	296,087 Cell 1	Cell 1	
7 2024								29,296		50,817	145		2,178	5,547	7 20		0 0	() (0		2 Closed		7 2024					62	9,695	305,782 Cell 1	Cell 1	
8 2025 9 2026	71,75		48,806				6 93,398 8 94,281	29,323		50,963 50,963			2,493 2,948	5,563 5,563	8 20		0 0	0		0		2 Closed 2 Closed		8 2025					71	10,312	316,094 Cell 1 327,273 Cell 1	Cell 1 Cell 1	
10 2027								29,203		50,963			3,394	5,563	10 20		0 0	(0		2 Closed		10 2020					97	12,029	339,301 Cell 1	Cell 1	_
11 2028								28,996		50,963	146		3,835	5,563	11 20		0 0	()	0		2 Closed		11 2028						12,867	352,169 Cell 1	Cell 1	
12 2029 13 2030							1 96,864 2 97,697	28,894		50,963 50,963	146		4,268 4,692	5,563 5,563	12 20 13 20 14 20		0 0	(0 0		2 Closed 2 Closed		12 2029 13 2030						13,693 14,500	365,862 Cell 1 380,362 Cell 1	Cell 1 Cell 1	
14 2031	76,25							28,704		50,963			5,106	5,563	14 20		0 0	(0		2 Closed		14 203						15,289	395,651 Cell 1	Cell 1	
15 2032	76,97							28,614		50,963			5,513	5,563	15 20	32	0 0	()	0		2 Closed		15 2032	2 7,876					16,065	411,716 Cell 1	Cell 1	
16 2033 17 2034						15	100,110	28,528		50,963 50,963			5,915 6,296	5,563 5,563	16 20 17 20		0 0	(2 Closed 2 Closed		16 2033 17 2034				100	169	16,829 17,555	428,544 Cell 1 446 100 Cell 1	Cell 1 Cell 1	
18 2035	79,03	9 35,045	50,944	1 22,588				28,375		50,963			6,669	5,563	18 20	35	0 0	(0	317,98	2 Closed		18 2035	5 9,528	5,563	3,176	191	100	18,266	464,366 Cell 1	Cell 1	
19 2036			51,110				9 102,371	28,302		50,963			7,040	5,563	19 20		0 0	(0		2 Closed		19 2036					201 211	18,973	483,339 Cell 1	Cell 1	
20 2037 21 2038							100,000	28,233		50,963 50,963	146		7,400 7,750	5,563 5,563	20 20 21 20 22 20 23 20 24 20		0 0	(2 Closed 2 Closed		20 203						19,658 20,325	502,997 Cell 1 523,323 Cell 2	Cell 1 Cell 1	
22 2039	81,64	3 36,199	51,551	1 22,857	59,056	16	2 104,500	28,100		50,963			8,093	5,563	22 20		0 0	(0	317,98	2 Closed		22 2039	9 11,561	5,563	3,854	231	231	20,978	544,301 Cell 2		517,470
23 2040			51,686				100,107	28,046		50,963			8,431	5,563	23 20		0 0	()	0		2 Closed		23 2040							565,923 Cell 2	Cell 2	
24 2041 25 2042	82,88 83,71						4 105,865 5 106,808	27,986		50,963 50,963			8,765 9,247	5,563 5,563	24 20 25 20		0 0	(2 Closed 2 Closed		24 204 25 2042					250 264	22,258 23,176	588,180 Cell 2 611.357 Cell 2		
26 2043	84,55	4 37,490	52,341	1 23,207	60,697	16	6 107,761	27,756	6	50,963	146		9,734	5,563	26 20	13	0 0	Ċ)	0	317,98	2 Closed		26 2043	3 13,905	5,563	4,635	278	278	24,103	635,460 Cell 2	Cell 2	
27 2044 28 2045			52,602 52,865					27,640		50,963 50,963	146		10,225 10,720	5,563 5,563	27 20 28 20		0 0	(0		2 Closed 2 Closed		27 2044 28 2045						25,039 25,982	660,499 Cell 2 686,481 Cell 2	Cell 2 Cell 2	
28 2045 29 2046			52,865		62,183			27,523		50,963	146		10,720	5,563	28 20 29 20		0 0	(2 Closed		28 204						25,982	713,414 Cell 2		
30 2047	87,98	7 39,012	53,395	5 23,675	62,687		2 111,662	27,288	3	50,963	146		11,724	5,563	30 20		0 0	() (0	317,98	2 Closed		30 2047	7 16,748	5,563	5,583	335	335	27,894	741,308 Cell 2	Cell 2	
31 2048							0 112,000	27,170		50,963			12,232	5,563	31 20		0 0	(0		2 Closed		31 2048							770,170 Cell 2		
32 2049 33 2050							5 113,668 6 114,685	27,051 26,932		50,963 50,963			12,745 13,263	5,563 5,563	32 20 33 20		0 0	(2 Closed 2 Closed		32 2049 33 2050						29,839 30,825	800,009 Cell 2 830,835 Cell 2		
34 2051	91,56	0 40,596	54,471	1 24,152	64,748	17	7 115,712	26,811	1	50,963			13,785	5,563	34 20	51	0 0	(0	317,98	2 Closed		34 205	1 19,692	5,563	6,564	394	394	31,820	862,654 Cell 2	Cell 2	
35 2052 36 2053			54,743 55.017				9 116,748 0 117,794	26,691 26,569	1	50,963 50,963	146		14,311 14,843	5,563 5,563	35 20 36 20		0 0	(0		2 Closed 2 Closed		35 2052 36 2053						32,823 33.835	895,477 Cell 2 929,312 Cell 2	Cell 2 Cell 2	
37 2053							2 118,850	26,365		50,963			14,643	5,563	35 20 36 20 37 20		0 0	(0		2 Closed		37 2054						33,855	964,168 Cell 2		
38 2055	95,27	8 42,245	55,569	24,638	66,883	18	3 119,916	26,325		50,963			15,920	5,563	38 20	55	0 0	(0	317,98	2 Closed		38 2055	5 22,743	5,563	7,581	455	455	35,886	1,000,054 Cell 2	Cell 2	
39 2056							0 120,002	26,202		50,963	146		16,465	5,563	39 20		0 0	(0		2 Closed		39 2056							1,036,980 Cell 2	Cell 2	
40 2057 41 2058	97,19 98.16						6 122,078 8 123,174	26,078		50,963 50,963			17,016	5,563 5,563	40 20		0 0	(2 Closed 2 Closed		40 2057						37,974 39,032	1,074,954 Cell 2 1,113,986 Cell 2	Cell 2 Cell 2	
42 2059	99,14	6 43,960	56,688	3 25,135	69,095	18	9 124,281	25,828	3	50,963	146		18,132	5,563	42 20	59	0 0	(0	317,98	2 Closed		42 2059	9 25,902	5,563	8,634	518	518	40,099	1,154,085 Cell 2	Cell 2	
43 2060							1 125,398	25,703		50,963	146		18,697	5,563	43 20		0 0	(0		2 Closed		43 2060						41,176	1,195,261 Cell 2	Cell 2	
44 2061 45 2062	101,13		57,257 57,543				2 126,526 4 127,664	25,576		50,963 50,963	146		19,267 19,842	5,563 5,563	44 20 45 20		0 0	(0		2 Closed 2 Closed		44 206 45 2062					550 567	42,262 43,358	1,237,523 Cell 2 1,280,881 Cell 2	Cell 2 Cell 2	
46 2063	103,17	2 45,745	57,831	1 25,641	71,386	19	6 128,813	25,322	2	50,963	146		20,423	5,563		53	0 0	(i i	0	317,98	2 Closed		46 2063	3 29,176	5,563	9,725	584	584	44,464	1,325,345 Cell 2	Cell 2	
47 2064 48 2065							7 129,973 9 131,144	25,194 25,065		50,963 50,963			21,009 21,599	5,563 5,563	46 20 47 20 48 20		0 0	(0		2 Closed 2 Closed		47 2064					600 617	45,579 46,705	1,370,925 Cell 2 1,417,629 Cell 2	Cell 2 Cell 2	
48 2065			58,703				0 132,326	25,065		50,963			21,599	5,563	48 20		0 0	(0		2 Closed		49 2066	6 31,708	5,563	10,569		634		1,465,470 Cell 2	Cell 2	
50 2067	107,36		58,996				2 133,519	24,805	5	50,963	146		22,797	5,563	50 20	67	0 0	() (0		2 Closed		50 2067	7 32,567	5,563	10,856		651	48,986	1,514,455 Cell 2	Cell 2	
Totals	4 465 20	2 2.024.427	2 772 844	1.260.924	3 285 351		5,726,315	1.289.291	0	2.330.795		219.420	735.137	254,421	F				I	1					1	1	I	I					1

 CVRD growth rate beyond 2041 =
 1%

 CVRD disposal rate 2015-2016
 0.57
 tonnes per person per year (46% diversion)

 CVRD disposal rate 2017-2020
 0.55
 tonnes per person per year (46% diversion)

 CVRD disposal rate 2017-2020
 0.55
 tonnes per person per year (68% diversion)

 SRD disposal rate 2015-2016
 0.57
 tonnes per person per year (46% diversion)

 SRD disposal rate 2015-2016
 0.57
 tonnes per person per year (46% diversion)

 SRD disposal rate 2017-2020
 0.55
 tonnes per person per year (46% diversion)

 SRD disposal rate 2021-2057
 0.44
 tonnes per person per year (46% diversion)

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 soll = 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 raito = 3:1 Settlement = 2% of waste volume per year

TBL-2018-03-05-CVRD WTE Assessment Long Term Cost Model Task 8 -5170574 Option 3(b) - Campbell River

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

							Capital and Op	perating Costs											
Ye	ar	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	
T	2015													\$0					
	2015						\$16,000,000							\$16,000,000		New Transfer station constructed 2012-2013		Construction of leachate management system and Cel	11
	2017							\$ 860,000	\$ 265,000	\$1,166,495		\$250,868	\$1,052,753	\$3,595,000				Closure Phase 2	Phase 2 SW m
	2018							\$ 200,000	\$ 2,500,000	\$1,166,495		\$490,358	\$1,052,753	\$5,410,000				Closure Phase 2	Phase 2 Surfa
	2019 2020	\$311,025			Ash / residuals	\$1,327,789		\$ - \$ 1,075,000		\$1,166,495 \$1,166,495	\$390,000 \$190,000	\$191,695 \$491,790	\$1,052,753 \$1,052,753	\$2,801,000 \$5,615,000	Permits		Permits and land		Phase 2 Desig Phase 2 LFG a
	2020	\$3,310,000	\$709,508	\$432.080	\$47,000	\$3,250,037		\$ 35,000		\$600,124	\$190,000	\$5,630,329		\$15,257,000	New transfer station		Sustane facility begins operating		Phase 2 LFG a
	2022		\$709,508	\$436,919	\$48,000	\$3,267,280		\$ -		\$600,124	\$190,000	\$0	\$1,052,753	\$6,305,000					
3	2023		\$709,508	\$441,808	\$48,000	\$3,284,702		\$ 35,000		\$600,124	\$190,000	\$218,613	\$1,052,753	\$6,581,000					Phase 3 LFG a
	2024		\$709,508	\$433,582	\$82,000	\$4,390,399		\$ -		\$600,124	\$390,000	\$3,108,685	\$190,000	\$9,904,000					Phase 3 LFG a
3	2025 2026		\$709,508	\$433,984	\$82,000	\$4,398,073		\$ -		\$600,124	\$190,000		\$190,000	\$6,604,000					
	2026		\$709,508 \$709,508	\$432,291 \$430,696	\$82,000 \$82,000	\$4,398,073 \$4,398,073		\$ - \$ 585,000		\$600,124 \$600,124	\$190,000 \$190,000		\$190,000 \$190,000	\$6,602,000 \$7,185,000					
	2027		\$709,508	\$429,148	\$82,000	\$4,398,073		\$ 363,000		\$600,124	\$190,000		\$190,000	\$6,599,000					
	2029	\$200,000	\$709,508	\$427,638	\$82,000	\$4,398,073		\$ 385,000		\$600,124	\$390,000		\$190,000	\$7,382,000	New trailers every 8 years				
	2030	+=++,+++	\$709,508	\$426,201	\$82,000	\$4,398,073		\$ 175,000		\$600,124	\$190,000		\$190,000	\$6,771,000	now wanter every e years				
14 :	2031		\$709,508	\$424,817	\$82,000	\$4,398,073		\$ -		\$600,124	\$190,000		\$190,000	\$6,595,000					
	2032		\$709,508	\$423,491	\$82,000	\$4,398,073		\$ -		\$600,124	\$190,000		\$190,000	\$6,593,000					
	2033		\$709,508	\$422,212	\$82,000	\$4,398,073		\$ 235,000		\$600,124	\$190,000		\$190,000	\$6,827,000					
	2034 2035		\$709,508	\$421,063	\$82,000	\$4,398,073		\$ -		\$600,124	\$390,000		\$190,000	\$6,791,000					
	2035		\$709,508 \$709,508	\$419,954 \$418,865	\$82,000 \$82,000	\$4,398,073 \$4,398,073		\$ 935,000 \$ -		\$600,124 \$600,124	\$190,000 \$190,000		\$190,000 \$190,000	\$7,525,000 \$6,589,000					
	2030	\$200,000	\$709,508	\$417,848	\$82,000	\$4,398,073		\$ 550,000		\$600,124	\$190,000		\$190,000	\$7,338,000	New trailers every 8 years				
	2038	φ200,000	\$709,508	\$416.890	\$82,000	\$4,398,073	\$8,850,000	\$ -		\$600,124	\$190,000		\$190,000	\$15,437,000				Construction Cell 2	
	2039		\$709,508	\$415,971	\$82,000	\$4,398,073	\$0,000,000	\$ 35,000		\$725,124	\$390,000		\$190,000	\$6,946,000					
23 3	2040		\$709,508	\$415,085	\$82,000	\$4,398,073		\$ 175,000	\$ 1,350,000	\$725,124	\$190,000		\$190,000	\$8,235,000				Closure Cell 1	
	2041	\$1,555,125	\$709,508	\$414,199	\$82,000	\$4,398,073		\$ 385,000		\$725,124	\$190,000		\$190,000	\$8,649,000	Major capital upgrade every 20 years				
	2042		\$709,508	\$412,499	\$82,000	\$4,398,073		\$ -		\$725,124	\$190,000		\$190,000	\$6,707,000					
	2043 2044		\$709,508 \$709,508	\$410,790 \$409,073	\$82,000 \$82,000	\$4,398,073 \$4,398,073		\$ 200,000		\$725,124 \$725,124	\$190,000 \$390,000		\$190,000 \$190,000	\$6,905,000 \$6,904,000					
	2044	\$200,000	\$709,508	\$409,073	\$82,000	\$2,687,721		\$ - \$ 35,000		\$725,124 \$725,124	\$190,000		\$190,000	\$5,227,000	New trailers every 8 years		Amortization period over		
	2046	φ200,000	\$709,508	\$405,612	\$82,000	\$2,687,721		\$ 55,000		\$725,124	\$190,000		\$190,000	\$4,990,000	New trailers every o years		Amorazation period over		
	2047		\$709,508	\$403,869	\$82,000	\$2,687,721		\$ 585,000		\$725,124	\$190,000		\$190,000	\$5,573,000					
31	2048		\$709,508	\$402,117	\$82,000	\$2,687,721		\$ -		\$725,124	\$190,000		\$190,000	\$4,986,000					
	2049		\$709,508	\$400,357	\$82,000	\$2,687,721		\$-		\$725,124	\$390,000		\$190,000	\$5,185,000					
	2050		\$709,508	\$398,587	\$82,000	\$2,687,721		\$ 1,075,000		\$725,124	\$190,000		\$190,000	\$6,058,000					
	2051		\$709,508	\$396,809	\$82,000	\$2,687,721		\$ 35,000		\$725,124	\$190,000		\$190,000	\$5,016,000					
	2052 2053	\$200.000	\$709,508 \$709,508	\$395,022	\$82,000 \$82,000	\$2,687,721		\$ - \$ 585,000		\$725,124	\$190,000		\$190,000	\$4,979,000	New trailers every 8 years				
	2053	\$200,000	\$709,508	\$393,226 \$391,420	\$82,000	\$2,687,721 \$2,687,721		\$ 585,000		\$725,124 \$725,124	\$190,000 \$390,000		\$190,000 \$190,000	\$5,763,000 \$5,176,000	inew trailers every o years				
	2055		\$709,508	\$389,606	\$82,000	\$2,687,721		\$ -		\$725,124	\$190,000		\$190,000	\$4,974,000					
	2056		\$709,508	\$387,783	\$82,000	\$2,687,721		\$ -		\$725,124	\$190,000		\$190,000	\$4,972,000					
	2057		\$709,508	\$385,951	\$82,000	\$2,687,721		\$ 585,000		\$725,124	\$190,000		\$190,000	\$5,555,000	-				
41	2058		\$709,508	\$384,109	\$82,000	\$2,687,721		\$ -		\$725,124	\$190,000		\$190,000	\$4,968,000					
	2059		\$709,508	\$382,258	\$82,000	\$2,687,721		\$ 35,000		\$725,124	\$390,000		\$190,000	\$5,202,000					
	2060		\$709,508	\$380,398	\$82,000	\$2,687,721		\$ 175,000		\$725,124	\$190,000		\$190,000	\$5,140,000					
	2061	\$1,755,125	\$709,508	\$378,529	\$82,000	\$2,687,721		\$ -		\$725,124	\$190,000		\$190,000	\$6,718,000	Major capital upgrade every 20 years				
	2062 2063		\$709,508 \$709.508	\$376,651 \$374,763	\$82,000 \$82,000	\$2,687,721 \$2,687,721		\$ - \$ 235,000		\$725,124 \$725,124	\$190,000 \$190.000		\$190,000 \$190.000	\$4,961,000 \$5,194,000					
	2063		\$709,508	\$372,865	\$82,000	\$2,687,721		\$ 235,000		\$725,124	\$390,000		\$190,000	\$5,194,000					
	2065		\$709,508	\$370,958	\$82,000	\$2,687,721		\$ 1,285,000		\$725,124	\$190,000		\$190,000	\$6,240,000					
49	2066		\$709,508	\$369,042	\$82,000	\$2,687,721		\$ -		\$725,124	\$190,000		\$190,000	\$4,953,000					
50	2067		\$709,508	\$367,116	\$82,000	\$2,687,721		\$ 550,000		\$725,124	\$190,000		\$190,000	\$5,501,000					
														L					
Tot	als	\$7,731,275	\$33,346,853	\$19,081,500	\$3,751,000	\$165,299,261	\$8,850,000	\$11,045,000	\$4,115,000	\$36,496,800	\$11,310,000	\$10,382,338	\$15,729,269	\$327,140,000					

Sustane Facility Tipping Fee (operating cost & revenue) = \$53 per tonne Capital cost annual payment = \$1,710,352 per year

30 years \$220,442,000 1,792,501 tonnes \$123 per tonne over 30 years

40 years \$273,106,000 2,448,090 \$112 per tonne over 40 years

50 years \$327,140,000 3,159,253 \$104 per tonne over 50 years

variable

TBL-2018-03-05-CVRD WTE Assessment Long Term Cost Model Task 8 -5170574:Option 3(b) - Campbell River

CRWMC LF Notes	
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and final cover design	1
and final cover construction	
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Ye	ar	Organics Facility (CR) and TS (CV) Capital	Organics faciity operating	Organics TS Operating (CV)	Organics transfer
	0045				
	2015 2016				
0	2010				
1	2018	\$5,410,000			
2	2019	\$3,150,000			
3	2020				
4	2021		\$781,000	\$230,000	\$ 134,106
5	2022		\$781,000	\$230,000	\$ 135,608
6	2023		\$781,000	\$230,000	\$ 137,126
7	2024		\$781,000	\$230,000	\$ 138,635 \$ 140,143
9	2025 2026		\$781,000 \$781,000	\$230,000 \$230,000	\$ 140,143 \$ 141,645
10	2020		\$781,000	\$230,000	\$ 143,135
11	2028		\$781,000	\$230,000	\$ 144,614
12	2029		\$781,000	\$230,000	\$ 146.074
13	2030		\$781,000	\$230,000	\$ 147,512
14	2031		\$781,000	\$230,000	\$ 148,926
15	2032		\$781,000	\$230,000	\$ 150,324
16	2033		\$781,000	\$230,000	\$ 151,711
17	2034		\$781,000	\$230,000	\$ 153,049
18	2035		\$781,000	\$230,000	\$ 154,363
19	2036		\$781,000	\$230,000	\$ 155,673
20 21	2037 2038		\$781,000 \$781,000	\$230,000 \$230,000	\$ 156,955 \$ 158,212
21	2030		\$781,000	\$230,000	\$ 159,449
23	2033		\$781,000	\$230,000	\$ 160,673
24	2041		\$781,000	\$230,000	\$ 161,880
25	2042		\$781,000	\$230,000	\$ 163,499
26	2043		\$781,000	\$230,000	\$ 165,134
27	2044		\$781,000	\$230,000	\$ 166,785
28	2045		\$781,000	\$230,000	\$ 168,453
29	2046	2140000	\$781,000	\$230,000	\$ 170,138
30	2047		\$781,000	\$230,000	\$ 171,839
31	2048 2049		\$781,000	\$230,000	\$ 173,557 \$ 175,293
32 33	2049		\$781,000 \$781,000	\$230,000 \$230,000	\$ 175,293 \$ 177,046
34	2050		\$781,000	\$230,000	\$ 178,816
35	2052		\$781,000	\$230,000	\$ 180,604
36	2053		\$781,000	\$230,000	\$ 182,411
37	2054		\$781,000	\$230,000	\$ 184,235
38	2055		\$781,000	\$230,000	\$ 186,077
39	2056		\$781,000	\$230,000	\$ 187,938
40	2057		\$781,000	\$230,000	\$ 189,817
41	2058		\$781,000	\$230,000	\$ 191,715
42 43	2059		\$781,000	\$230,000	\$ 193,632 \$ 195,569
43	2060 2061		\$781,000 \$781,000	\$230,000 \$230,000	\$ 195,569 \$ 197,524
44	2061		\$781,000	\$230,000	\$ 197,524
46	2062		\$781,000	\$230,000	\$ 201,495
47	2064		\$781,000	\$230,000	\$ 203,510
48	2065		\$781,000	\$230,000	\$ 205,545
49	2066		\$781,000	\$230,000	\$ 207,600
50	2067		\$781,000	\$230,000	\$ 209,676
Tot	als	\$10,700,000	\$36,707,000	\$10,810,000	\$7,947,222

Transfer stations and remote landfills capital - development & closure	Transfer stations and remote landfills operating	Host community agreements	Diversion Programs Capital	Diversion Programs Capital - Equipment	Diversion Programs Operating	Support Services and Staff Disposal - Operating	lllegal Dumping Operating	One Time Expenses Operating	Capital Costs	
										-
	\$1,279,881	\$356.225		\$90,000	\$3.945.914	\$500.480	\$197,531		\$1,465.868	s
\$140,000	\$1,279,881	\$356,225	\$455,000	\$325,000	\$3,945,914	\$500,480	\$197,531	\$1,150,000	\$9,520,358	S
\$0	\$1,279,881	\$356,225		\$0	\$3,945,914	\$500,480	\$197,531		\$3,341,695	5
\$0	\$1,279,881	\$356,225		\$205,000	\$3,945,914	\$500,480	\$197,531		\$2,082,815	\$
\$0	\$1,279,881	\$356,225		\$35,000	\$3,945,914	\$500,480	\$197,531		\$9,010,329	\$
\$0	\$1,279,881	\$356,225		\$375,000	\$3,945,914	\$500,480	\$197,531		\$375,000	\$
\$310,000	\$1,279,881	\$356,225	\$455,000	\$270,000	\$3,945,914	\$500,480	\$197,531		\$1,288,613	\$
\$1,995,000	\$1,279,881	\$356,225		\$35,000	\$3,945,914	\$500,480	\$197,531		\$5,138,685	\$
\$1,505,000	\$1,279,881	\$356,225		\$225,000	\$3,945,914	\$500,480	\$197,531		\$1,730,000	\$
\$414,600	\$1,279,881	\$356,225		\$30,000	\$3,945,914	\$500,480	\$197,531		\$444,600	\$
\$1,210,700	\$1,279,881	\$356,225		\$410,000	\$3,945,914	\$500,480	\$197,531		\$2,205,700	\$
	\$1,279,881	\$356,225	\$455,000	\$240,000	\$3,945,914	\$500,480	\$197,531		\$695,000	\$
	\$1,279,881	\$356,225		\$30,000	\$3,945,914	\$500,480	\$197,531		\$615,000	\$
	\$1,279,881	\$356,225		\$210,000	\$3,945,914	\$500,480	\$197,531		\$385,000	\$
	\$1,279,881	\$356,225		\$0	\$3,945,914	\$500,480	\$197,531		\$0	\$
	\$1,279,881	\$356,225		\$455,000	\$3,945,914	\$500,480	\$197,531		\$455,000	\$
	\$1,279,881	\$356,225	\$455,000	\$275,000	\$3,945,914	\$500,480	\$197,531		\$965,000	\$
	\$1,279,881	\$356,225		\$0	\$3,945,914	\$500,480	\$197,531		\$0	\$
	\$1,279,881	\$356,225		\$205,000	\$3,945,914	\$500,480	\$197,531		\$1,140,000	\$
	\$1,279,881	\$356,225		\$35,000	\$3,945,914	\$500,480	\$197,531		\$35,000	\$
	\$1,279,881	\$356,225		\$375,000	\$3,945,914	\$500,480	\$197,531		\$1,125,000	\$
	\$1,279,881	\$356,225	\$455,000	\$270,000	\$3,945,914	\$500,480	\$197,531		\$9,575,000	\$
	\$1,279,881	\$356,225		\$85,000	\$3,945,914	\$500,480	\$197,531		\$120,000	\$
	\$1,279,881	\$356,225		\$175,000	\$3,945,914	\$500,480	\$197,531		\$1,700,000	ş
	\$1,279,881	\$356,225		\$30,000	\$3,945,914	\$500,480	\$197,531		\$1,970,125	\$
	\$1,279,881	\$356,225		\$410,000	\$3,945,914	\$500,480	\$197,531		\$410,000	\$
	\$1,279,881	\$356,225	\$455,000	\$240,000	\$3,945,914	\$500,480	\$197,531		\$895,000	\$
	\$1,279,881	\$356,225		\$30,000	\$3,945,914	\$500,480	\$197,531		\$30,000	\$
	\$1,279,881	\$356,225		\$210,000	\$3,945,914	\$500,480	\$197,531		\$445,000	\$
	\$1,279,881	\$356,225		\$50,000	\$3,945,914	\$500,480	\$197,531		\$2,190,000	\$
	\$1,279,881	\$356,225		\$405,000	\$3,945,914	\$500,480	\$197,531		\$990,000	\$
	\$1,279,881	\$356,225	\$455,000	\$275,000	\$3,945,914	\$500,480	\$197,531		\$730,000	\$
\$340,000	\$1,279,881	\$356,225		\$0	\$3,945,914	\$500,480	\$197,531		\$340,000	\$
	\$1,279,881	\$356,225		\$205,000	\$3,945,914	\$500,480	\$197,531		\$1,280,000	\$
	\$1,279,881	\$356,225		\$35,000	\$3,945,914	\$500,480	\$197,531		\$70,000	\$
	\$1,279,881	\$356,225		\$375,000	\$3,945,914	\$500,480	\$197,531		\$375,000	\$
	\$1,279,881	\$356,225	\$455,000	\$320,000	\$3,945,914	\$500,480	\$197,531		\$1,560,000	\$
	\$1,279,881	\$356,225		\$35,000	\$3,945,914	\$500,480	\$197,531		\$35,000	\$
	\$1,279,881	\$356,225		\$175,000	\$3,945,914	\$500,480	\$197,531		\$175,000	\$
	\$1,279,881	\$356,225		\$30,000	\$3,945,914	\$500,480	\$197,531		\$30,000	\$
	\$1,279,881	\$356,225		\$410,000	\$3,945,914	\$500,480	\$197,531		\$995,000	\$
	\$1,279,881	\$356,225	\$455,000	\$240.000	\$3.945.914	\$500.480	\$197,531		\$695.000	\$
	\$1,279,881	\$356,225	,	\$30,000	\$3,945,914	\$500,480	\$197,531		\$65,000	\$
	\$1,279,881	\$356,225		\$260,000	\$3,945,914	\$500,480	\$197,531		\$435,000	\$
	\$1,279,881	\$356,225		\$0	\$3,945,914	\$500,480	\$197,531		\$1,755,125	\$
	\$1,279,881	\$356,225		\$405,000	\$3,945,914	\$500,480	\$197,531		\$405,000	\$
	\$1,279,881	\$356,225	\$455,000	\$275,000	\$3,945,914	\$500,480	\$197,531		\$965,000	\$
	\$1,279,881	\$356,225		\$0	\$3,945,914	\$500,480	\$197,531		\$0	\$
	\$1,279,881	\$356,225		\$205,000	\$3,945,914	\$500,480	\$197,531		\$1,490,000	\$
	\$1,279,881	\$356,225		\$35,000	\$3,945,914	\$500,480	\$197,531		\$35,000	\$
	\$1,279,881	\$356,225		\$425,000	\$3,945,914	\$500,480	\$197,531		\$975,000	\$
\$5,915,300	\$65,273,955	\$18,167,482	\$4,550,000	\$9,465,000	\$201,241,631	\$25,524,460	\$10,074,083	\$1,150,000	\$72,753,913	\$6

Capital Costs	Operating Costs	Total System Cost	
\$1,465,868	\$8,499,280	\$9,965,148	
\$9,520,358	\$9,649,280	\$19,169,638	1
\$3,341,695	\$8,889,280	\$12,230,975	1
\$2,082,815	\$10,017,068	\$12,099,883	1
\$9,010,329	\$13,706,639	\$22,716,968	i
\$375,000	\$13,731,223	\$14,106,223	1
\$1,288,613	\$13,755,052	\$15,043,665	i
\$5,138,685	\$14,225,280	\$19,363,965	1
\$1,730,000	\$14,034,863	\$15,764,863	1
\$444,600	\$14,034,672	\$14,479,272	1
\$2,205,700	\$14,034,568	\$16,240,268	16,121,572
\$695,000	\$14,034,497	\$14,729,497	1
\$615,000	\$14,234,449	\$14,849,449	1
\$385,000	\$14,034,449	\$14,419,449	1
\$0	\$14,034,479	\$14,034,479	
\$455,000	\$14,034,552	\$14,489,552	1
\$965,000	\$14,034,659	\$14,999,659	1
\$0	\$14,234,848	\$14,234,848	1
\$1,140,000	\$14,035,053	\$15,175,053	1
\$35,000	\$14,035,275	\$14,070,275	1
\$1,125,000	\$14,035,539	\$15,160,539]
\$9,575,000	\$14,035,838	\$23,610,838	
\$120,000	\$14,361,156	\$14,481,156	
\$1,700,000	\$14,161,494	\$15,861,494	ļ
\$1,970,125	\$14,161,816	\$16,131,941	
\$410,000	\$14,161,734	\$14,571,734	
\$895,000	\$14,161,660	\$15,056,660	
\$30,000	\$14,361,594	\$14,391,594	
\$445,000	\$12,451,184	\$12,896,184	
\$2,190,000	\$12,451,134	\$14,641,134	A 470 407 404
\$990,000	\$12,451,092	\$13,441,092	\$472,427,494
\$730,000	\$12,451,059	\$13,181,059	ł
\$340,000	\$12,651,034	\$12,991,034	
\$1,280,000	\$12,451,017	\$13,731,017	
\$70,000	\$12,451,009	\$12,521,009	ł
\$375,000	\$12,451,010	\$12,826,010	1
\$1,560,000	\$12,451,020	\$14,011,020	}
\$35,000	\$12,651,039	\$12,686,039	1
\$175,000	\$12,451,067	\$12,626,067	1
\$30,000	\$12,451,105	\$12,481,105	¢600.000.007
\$995,000	\$12,451,152	\$13,446,152	\$602,928,007
\$695,000	\$12,451,209	\$13,146,209	1
\$65,000 \$435,000	\$12,651,275	\$12,716,275 \$12,886,351	}
	\$12,451,351 \$12,451,438	\$12,886,351 \$14,206,563	1
\$1,755,125 \$405,000	\$12,451,438 \$12,451,534	\$12,856,534	1
\$965,000	\$12,451,641	\$13,416,641	1
\$965,000	\$12,651,759	\$12,651,759	1
\$1,490,000	\$12,451,887	\$13,941,887	i
\$35,000	\$12,452,026	\$12,487,026	1
\$975,000	\$12,452,176	\$13,427,176	\$734,664,429
			1
\$72,753,913	\$661,910,516	\$734,664,429	Ĩ

\$14,693,288.58

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

							Population	ion and [Disposal Rate	es													CRW	MC LF Fil	I Rate and	Capacity									CVWMC L	F Fill Rate an	d Capacity				
Year	Projected CVRD Population	CVRD Waste	Projected SRD Populatior	SRD V		otal Annua Tonnage		ane	Combined Population	Tonnes to Comox Valley TS	Ca	mpbell	onnes to Sustane Facility	Tonnes p day to Sustane facility	to C	RWMC	Tonnes to MSW WWMC LF	Tonnes Ash/Residua s to CVWMC LF	Year		Volumetric MSW Disposal Rate	Daily Cover Sc	ioil S	ioil	Settlement	Volum	e Fill Vo	olume	Phase	Volumetric Capacity (m³)	Year	Volumetric MSW Disposal Rate	Volumetric Ash / Residuals Disposal Rate	Daily Cover Soi		Settleme	Volume	Fill Volume		Phase / Cell	Volume Capacity
		tonnes		tonr	ies t	tonnes / yr	tonnes	/ day		tonnes	t	onnes	tonnes	tonnes / d	ay		tonnes				m ³	m ³	1	m ³	m ³	m ³	m	13				m ³	m ³	m ³	m ³	m ³	m ³	m ³			
2015 2016	64,294 64,847	36,967	45,8	37 2	6,149 6,330	62,80 63,29	7	172 173	90,443 91,177	7						26,149 26,330	36,652 36,967			2015 2016 2017	37,356	4 12,5	538	747 752	741		52		nase 3		2015	52,360 52,810)	17,45 17,60 0 17.14	3 1,05	6 1,0	47 69,81 56 70,41	3		Phase 2	46,52
0 2017 1 2018 2 2019	65,592 66,372 67,139	36,007 36,435 36,856	46,49 46,80 47,1)9 2	5,521 5,696 5,864	61,52 62,13 62,720	1	170	91,113 92,068 93,003	3						25,521 25,696 25,864	36,007 36,435 36,856	(1	2017 2018 2019	36,458 36,708 36,949	8 12,2	236	729 734 739	729 734 739	48,9	144	48,611 Pr 97,555 Pr 46,821 Pr	nase 3		0 2017 1 2018 2 2019	51,438 52,050 52,65)	0 17,14 0 17,35 0 17,55	0 1,04	1 1,0	41 69,40	0 137,98	984 Cell 1	Phase 2 Cell 1 Cell 1	
3 2020 4 2021	67,905 68,667		47,4 47,7	19 2	6,031	63,30 51,598	7	173 141	93,936	5	95		29,195	5	83	26,031 21,152	37,276	3,187	3	2020 2021	37,187	7 12,3	396	744 604	744	49,5	82 1	96,403 Pt 36,693 Pt	nase 3		3 2020	53,252	2	0 17,75 7 59			65 71,00 36 5,57	3 279,18	189 Cell 1	Cell 1 Cell 1	
5 2022 6 2023	69,436 70,213	31,131	47,98 48,26	67 2	1,276 1,401	52,063 52,532	2	143 144	90,712 91,614	1 29,8	52 Land	fill closure	29,522 29,852	2	84 85	21,276 21,401	1,265 1,279	3,222 3,259	5	2022 2023	30,395 30,573			608 611	608 61	8 40,5 1 40,7	63 3	77,219 Ph 17,982 Cl	osed	288,480	5 2022 6 2023	1,80 1,82	3 3,25		2 3 9 3	6 7	36 5,63 37 5,69	5 296,08	087 Cell 1	Cell 1 Cell 1	
7 2024 8 2025 9 2026	70,986 71,758 72,527	31,474 31,816 32,157	48,53 48,80 49.00	06 2	1,521 1,640 1,754	52,995 53,456	ô	145 146	92,507 93,398 94,281	3 29,3	23	21,521 21,640 21,754	50,817 50,963 50,963		145 146 146		2,178 2,493 2,948	5,547 5,563 5,563	7	2024 2025 2026	(0	0	0	(0	0 3	17,982 CI 17,982 CI 17,982 CI	osed		7 2024 8 2025 9 2026	3,11 3,56 4,21	2 5,56	3 1,18	7	2	62 9,69 71 10,31	2 316,09	094 Cell 1	Cell 1 Cell 1 Cell 1	
9 2020 10 2027 11 2028	73,290		49,00 49,30 49,54	07 2	1,754	53,91 54,35 54,798	7	140	94,201 95,152 96,014	2 29,1	01	21,754 21,862 21,967	50,963 50,963 50,963		146		2,946 3,394 3,835	5,563	9 10 11	2028 2027 2028		0	0	0	(5 5 1	0 3	17,982 CI 17,982 CI 17,982 CI	osed		10 2027 11 2028	4,21	5,56	3 1,61	6 9	4 7 0 1	97 12,02 10 12,86	9 339,30	301 Cell 1	Cell 1 Cell 1	
12 2029 13 2030	74,795 75,531	33,163	49,7	3 2	2,069	55,23 55,655	1	151 152	96,864 97,697	28,8	94	22,069 22,166	50,963 50,963		146 146		4,268 4,692	5,563 5,563	12 13	2029 2030	(0	0	0	(0	0 3	17,982 CI 17,982 CI	osed osed		12 2029 13 2030	6,098 6,703	3 5,56 3 5,56	3 2,03 3 2,23	3 12		22 13,69 34 14,50	3 365,86	362 Cell 1	Cell 1 Cell 1	
14 2031 15 2032	76,255 76,971	33,810 34,128	50,20 50,40	05 2	2,259 2,349	56,069 56,476	6	154 155 156	98,514 99,320	28,6	14	22,259 22,349	50,963 50,963		146 146		5,106 5,513	5,563 5,563	14 15	2031 2032	(0	0	0	(0	0 3	17,982 CI 17,982 CI	osed		14 2031 15 2032	7,29	5,56	3 2,62	5 15	8 1	46 15,28 58 16,06	5 411,71	716 Cell 1	Cell 1 Cell 1	
16 2033 17 2034 18 2035	77,681 78,366 79,039	34,442 34,746 35.045	50,60 50,71 50,94	75 2	2,435 2,513 2,588	56,878 57,259 57,632	9	156 157 158	100,116 100,879 101.627	28,4	50	22,435 22,513 22,588	50,963 50,963 50,963		146 146 146		5,915 6,296 6,669	5,563 5,563 5,563	16 17 18	2033 2034 2035	(0	0	0	()))	0 3	17,982 CI 17,982 CI 17,982 CI	osed		16 2033 17 2034 18 2035	8,449 8,994 9,521	1 5,56	3 2,99	8 18	0 1	69 16,829 80 17,559 91 18,260	5 446,10	100 Cell 1	Cell 1 Cell 1 Cell 1	
19 2036 20 2037	79,710 80,366	35,342	51,1 51,2	10 2	2,661	58,003 58,363	3	159 160	102,371	28,3	02	22,661 22,730	50,963 50,963		146 146		7,040	5,563	19 20	2035 2036 2037	(0	0	0	(0	0 3	17,982 CI 17,982 CI 17,982 CI	osed		19 2036	10,05	5,56	3 3,35	3 20	1 2	01 18,97 11 19,65	3 483,33	339 Cell 1	Cell 1 Cell 1	
21 2038 22 2039	81,010 81,643	35,918 36,199	51,4 51,5	51 2	2,795 2,857	58,713 59,056	6	161 162	103,805 104,500	28,1	06	22,795 22,857	50,963 50,963		146 146		7,750 8,093	5,563 5,563	21 22	2038 2039	(0	0	0	(D D	0 3	17,982 CI 17,982 CI	osed		21 2038 22 2039	11,072 11,56	5,56	3 3,85	4 23	1 2	21 20,32 31 20,97	8 544,30	301 Cell 2	Cell 1 Cell 2	517,4
23 2040 24 2041 25 2042	82,270 82,888 83,717	36,477 36,751 37,119	51,68 51,82 52,08	21 2	2,917 2,977 3,091	59,394 59,728 60,210	В	163 164	105,187 105,865 106,808	5 27,9	86	22,917 22,977 23,091	50,963 50,963 50,963		146 146 146		8,431 8,765 9,247	5,563 5,563 5,563	23	2040 2041 2042		0	0	0	(0 3	17,982 CI 17,982 CI 17,982 CI	osed		23 2040 24 2041 25 2042	12,04 12,52 13,210	5,56	3 4,17	4 25	0 2	41 21,62 50 22,25 64 23,17	8 588,18	180 Cell 2	Cell 2 Cell 2 Cell 2	
26 2043 27 2044	84,554 85,400	37,490	52,34 52,60	1 2	3,207	60,691	7	166 168	107,761	27,7	'56	23,207	50,963 50,963		146 146		9,734	5,563	26	2042 2043 2044	(0	0	0	(0	0 3	17,982 CI 17,982 CI	osed		26 2042 27 2044	13,90	5 5,56	3 4,63	5 21	8 2	78 24,10 92 25,03	3 635,46	160 Cell 2	Cell 2 Cell 2 Cell 2	
28 2045 29 2046	86,254 87,116	38,626	52,80 53,13	35 2 30 2	3,440 3,557	61,683 62,183	3	169 170	109,693 110,673	3 27,5 3 27,4	23 06	23,440 23,557	50,963 50,963	1 ·	146 146		10,720 11,220	5,563 5,563	28 29	2045 2046	(0	0	0	(0 0	0 3	17,982 CI 17,982 CI	osed osed		28 2045 29 2046	15,31 16,02	4 5,56 3 5,56	3 5,34	5 30 3 32	6 3 1 3	06 25,98 21 26,93	2 686,48 4 713,41	481 Cell 2 414 Cell 2	Cell 2 Cell 2	
0 2047 31 2048	87,987 88,867			32 2	3,675 3,793	62,68 63,19	5	172 173	111,662	27,1	70	23,675 23,793	50,963 50,963		146 146		11,724 12,232	5,563 5,563	30 31	2047 2048	(0	0	0	(0	0 3	17,982 CI 17,982 CI	osed		30 2047 31 2048	16,74	1 5,56	3 5,82	5 34	9 3	35 27,89 49 28,86	2 770,17	170 Cell 2	Cell 2 Cell 2	
32 2049 33 2050 34 2051	89,756 90,653 91,560	39,796 40,194 40,596	53,93 54,20 54,4	00 2	3,912 4,031 4,152	63,708 64,226 64,748	6	175 176 177	113,668 114,685 115,712	5 26,9	32	23,912 24,031 24,152	50,963 50,963 50,963		146 146		12,745 13,263 13,785	5,563 5,563 5,563	32 33	2049 2050 2051	(0	0	0	(0	0 3	17,982 CI 17,982 CI 17,982 CI	osed		32 2049 33 2050 34 2051	18,20 18,94 19,69	5,56	3 6,31	6 31	9 3	64 29,83 79 30,82 94 31,82	5 830,83	335 Cell 2	Cell 2 Cell 2 Cell 2	
35 2052 36 2053	92,476 93,400	41,002	54,74 55,0	13 2	4,272	65,274 65,800	4	179 180	116,748	3 26,6	91	24,272 24,394	50,963 50,963		146 146		14,311 14,843	5,563 5,563	35	2052 2053	(0	0	0	(0	0 3	17,982 CI 17,982 CI	osed		35 2052 36 2053	20,44	5 5,56	3 6,81	5 40	9 4	09 32,82 24 33,83	3 895,47	177 Cell 2	Cell 2 Cell 2	
7 2054 8 2055	94,334 95,278		55,29 55,56	69 2	4,516 4,638	66,342 66,883	3	182 183	118,850 119,916	26,3	25	24,516 24,638	50,963 50,963		146 146		15,379 15,920	5,563 5,563	37 38	2054 2055	(0	0	0	(0	0 3	17,982 CI 17,982 CI	osed		37 2054 38 2055	21,970 22,743	5,56	3 7,58	1 45	5 4	39 34,85 55 35,88	6 1,000,05	054 Cell 2	Cell 2 Cell 2	
39 2056 40 2057	96,230 97,193	42,667 43,094	55,84 56,12	26 2	4,761	67,428	9	185 186	120,992	3 26,0	78	24,761 24,885	50,963 50,963		146 146		16,465 17,016 17,571	5,563 5,563 5,563	39 40	2056 2057	(0	0	0	(0 3	17,982 CI 17,982 CI 17,982 CI	osed		39 2056 40 2057 41 2058	23,522	5,56	3 8,10	3 48	6 4	70 36,920 86 37,97 02 39.03	4 1,074,95	954 Cell 2	Cell 2 Cell 2	
1 2058 2 2059 3 2060	98,165 99,146 100,138	43,525 43,960 44,399	56,40 56,68 56,9	38 2	5,010 5,135 5,260	68,534 69,095 69,660	5	188	123,174 124,281 125,398	25,8	28	25,010 25,135 25,260	50,963 50,963 50,963		146 146		17,571 18,132 18,697	5,563 5,563 5,563	41 42 43	2058 2059 2060	(0	0	0	(2	0 3	17,982 CI 17,982 CI 17,982 CI	osed		41 2058 42 2059 43 2060	25,102 25,902 26,710	2 5,56	3 8,63	4 5	8 5	02 39,03 18 40,09 34 41,17	9 1,154,08	085 Cell 2	Cell 2 Cell 2 Cell 2	
4 2061 5 2062	100,138 101,139 102,151	44,399 44,843 45,292	57,25 57,54	57 2	5,387 5,514	70,230	0	192 194	126,526	6 25,5	76	25,387 25,514	50,963 50,963		146 146		19,267 19,842	5,563 5,563	43 44 45	2000 2061 2062	(0	0	0	(D D	0 3	17,982 CI 17,982 CI	osed		43 2000 44 2061 45 2062	27,524	1 5,56	3 9,17	5 55	0 5	50 42,262 67 43,354	2 1,237,52	523 Cell 2	Cell 2 Cell 2 Cell 2	1
46 2063 47 2064	103,172 104,204	45,745 46,202	57,83 58,12	20 2	5,641	71,386	2	196 197	128,813 129,973	3 25,1	94	25,641 25,769	50,963 50,963		146 146		20,423 21,009	5,563 5,563	46 47	2063 2064	(0	0	0	(2	0 3	17,982 CI 17,982 CI	osed		46 2063 47 2064	29,176	2 5,56	3 10,00	4 60	0 6	84 44,464 00 45,579	9 1,370,92	25 Cell 2	Cell 2 Cell 2	
48 2065 49 2066 50 2067	105,246 106,298 107,361	46,664 47,131 47,602	58,4 58,70 58,99	03 2	5,898 6,028 6,158	72,562 73,159 73,760	9	199 200 202	131,144 132,326 133,519	3 24,9	35	25,898 26,028 26,158	50,963 50,963 50,963		146 146 146		21,599 22,196 22,797	5,563 5,563 5,563	48 49 50	2065 2066 2067	(0	0	0	(0	0 3	17,982 CI 17,982 CI 17,982 CI	osed		48 2065 49 2066 50 2067	30,856 31,708 32,56	5,56	3 10,56	9 63	4 6	17 46,70 34 47,84 51 48,98	0 1,465,47	170 Cell 2	Cell 2 Cell 2 Cell 2	
	4,465,392							202	5.726.315							219.420	735.137		50	2007			0	0			5 S	17,302 CI	oacu		30 2007	32,30	3,50	0,00	6		40,90	1,514,45		00112	

 CVRD growth rate beyond 2041 =
 1%

 CVRD disposal rate 2015-2016 =
 0.57
 tonnes per person per year (46% diversion)

 CVRD disposal rate 2017-2020 =
 0.55
 tonnes per person per year (48% diversion)

 CVRD disposal rate 2017-2020 =
 0.55
 tonnes per person per year (48% diversion)

 CVRD disposal rate 2017-2020 =
 0.50%
 tonnes per person per year (58% diversion)

 SRD disposal rate 2017-2020 =
 0.57
 tonnes per person per year (46% diversion)

 SRD disposal rate 2017-2020 =
 0.57
 tonnes per person per year (46% diversion)

 SRD disposal rate 2017-2020 =
 0.44
 tonnes per person per year (46% diversion)

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

1 2018 -								Capita	al and Operating	Costs					-							
No. No. <th></th> <th>Valley TS</th> <th>Valley TS</th> <th></th> <th>River TS</th> <th>River TS</th> <th>River TS</th> <th>Transport from Gold</th> <th>Facility</th> <th>Capital -</th> <th>Capital -</th> <th>Capital -</th> <th>Operating -</th> <th>Operating -</th> <th></th> <th></th> <th>Total System</th> <th>Comox Valley TS Notes</th> <th>Campbell River TS Notes</th> <th>Sustane Facility Notes</th> <th>CVWMC LF Notes</th> <th>CRWMC LF Notes</th>		Valley TS	Valley TS		River TS	River TS	River TS	Transport from Gold	Facility	Capital -	Capital -	Capital -	Operating -	Operating -			Total System	Comox Valley TS Notes	Campbell River TS Notes	Sustane Facility Notes	CVWMC LF Notes	CRWMC LF Notes
0 0 -	2015																\$0		New Transfer station constructed 2012-2013			
No. No. <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>\$16,000,000</td> <td></td>										\$16,000,000												
0 0																						Phase 2 SW mgmt design & partial construction
1 0 1000 0											\$ 200,000	\$ 2,500,000									Closure Phase 2	Phase 2 Surface water management construction
4 5 5000 70000 800.00 70000 800.00 800.00 <th< td=""><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>\$ -</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>Phase 2 Design and construction</td></th<>											\$ -											Phase 2 Design and construction
5 50 7000				00.18.110	\$200,000														New trailers every 8 years			Phase 2 LFG and final cover design
6 7		\$3,310,000																New trailers every 8 years		Sustane facility begins operating		Phase 2 LFG and final cover construction
1 1																						
1 1 1 0							A 100 100				\$ 35,000											Phase 3 LFG and final cover design
N N											\$ -				\$3,108,685							Phase 3 LFG and final cover construction
0 10 10 10 10 10 10 10 100 10000 10000											3 - C											
11 12 20 90.00 <td></td> <td>φ - 6 595 000</td> <td></td>											φ - 6 595 000											
9 0.0 800.00 900.00 900.00 900.00					\$200.000														Now trailors over 8 years			
10 10<		\$200.000			\$200,000													Neu trailere even Queere	New trailers every o years			
1 1		\$200,000																New trailers every o years				
1 1											\$ 175,000											
10 10<					\$346,000						\$ - \$ -											
11 12<					\$340,000						\$ -											
10 10<								\$155,762			\$ 235,000											
10 200 201,00 910,00 910,00 910,00											\$ -											
9 70 800.00 879.50 879.50 879.50 <					\$200.000														Now trailors even 9 years			
1 1 0		\$200.000			\$200,000													New trailers every 8 years	New trailers every o year:			
2 2		\$200,000								\$9 950 000								New trailers every o year.			Construction Cell 2	
2 2 0 970,568 970,578								\$155,762		\$0,000,000											Construction Cell 2	
21 214 515,512 5770,508 <td></td> <td>\$ 1 350 000</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>Major capital upgrade every 20 years</td> <td></td> <td></td> <td>Closure Cell 1</td> <td></td>												\$ 1 350 000						Major capital upgrade every 20 years			Closure Cell 1	
2 2 2 2 2 2 5 5 5 0 5 0 5 0 5 0 5 0 5 0 5 0 5 0 5 0 5 0 0 5 0 0 5 0 0 5 0 0 5 0 0 5 0 0 5 0		\$1 555 125										φ 1,000,000						major capital apgrade every 20 year				
28 30 9706,508 9777,771 505,000 545,100 5706,508 9777,771 505,000 545,100 5100,000 58,4000 56,4000 56,4000 Feature every 8 years Amotation period over 20 5706,508 5770,568 5770,568 5706,508 5706,508 5706,508 5706,508 5706,708 5650,000 572,512 5500,000 5180,000 58,440,00 New traiters every 8 years Amotation period over 30 204 5706,508 5707,708 5650,00 5156,702 52,87721 5<0,00		φ1,000,120									\$											
21 204 9709,503 9779,522 92000 9569,640 9570,520 9570,500 9570,560 9570,560 9570,560 9570,560 9570,560 9570,560 9570,570 9561,40 9467,772 \$5.00 777,522 \$5.000 777,522 \$5.000 9570,570 9561,40 9471,752 \$5.000 777,522 \$5.000 9770,520 <th< td=""><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>\$ 200,000</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></th<>											\$ 200,000											
2 2 5 500,00 5770,508 5770,568 5770,576 5861,00 58,340,00 58,340,00 Merallers every 8 years Amotzation period over 30 2047 5705,508 5776,757 5851,040 5477,572 5863,000 572,574 590,000 573,000					\$200.000						\$ -								New trailers every 8 years			
20 8 707.900 877.375 8 847.04 915.000 576.076 576.076 576.076 585.104 947.38 815.762 22.887.721 \$5.85.00 \$725.124 \$190.000 \$519.000 \$574.000 585.400 578.076 585.100 \$575.72 \$2.887.721 \$5.85.00 \$725.124 \$190.000 \$519.000 \$5.740.00 56.740.00 \$5.94		\$200.000			+						\$ 35,000							New trailers every 8 years		Amotization period over		
30 20/7 8 709,008 5704,073 5764,000 5761,000 5725,124 5190,000 5712,0000 5712,00											\$ -								I	,		
31 2 2 94 970,008 \$7	2047										\$ 585,000											
32 249 870,508 \$77,422 \$851,00 \$472,37 \$155,762 \$2,687,721 \$107,000 \$725,124 \$190,000 \$67,400 \$67,400 \$67,100 \$100,000 \$67,400 \$190,000 \$67,400 \$190,000 \$67,400 \$190,000 \$67,400	2048																					
33 2050 570,508 577,07 524,000 561,000 572,512 519,000 572,512 519,000 572,5100 561,000 572,512 519,000 572,5100 561,000 572,512 519,000 572,5100 572,000 572,000 570,508 577,334,00 585,702 52,877,72 5 2,877,72 5 2,877,72 5 55,000 572,512 519,000 519,000 572,500 572,000	2049										\$ -											
34 370 500 5700,500 5740,700 560,100 540,000 5725,724 5190,000 586,819,000 566,819,000 Feet allows Feet all											\$ 1,075,000											
55 2052 \$709.508 \$747.338 \$2,615.000 \$651,400 \$446,447 \$155,762 \$2,887.721 \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$					\$241.000																	
36 2003 \$2003 \$700,508 \$743,204 \$487,304 \$455,762 \$26,687,721 \$580,00 \$725,124 \$300,000 \$57,320,000 New trailers every 8 year 37 2054 \$700,508 \$740,525 \$651,040 \$492,765 \$155,762 \$2,687,721 \$ \$725,124 \$300,000 \$57,300,000 \$6,730,000 New trailers every 8 year 38 2055 \$700,508 \$730,933 \$651,040 \$492,765 \$155,762 \$2,687,721 \$ \$725,124 \$190,000 \$5,630,000 \$ New trailers every 8 year 41 2056 \$700,508 \$730,473 \$651,040 \$492,725 \$155,762 \$2,687,721 \$ \$725,124 \$190,000 \$190,000 \$6,530,000 \$190,000 \$190,000 \$5,630,000 \$150,000 \$190,000 \$5,630,000 </td <td></td> <td>\$ -</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>New trailers every 8 years</td> <td></td> <td></td> <td></td>											\$ -								New trailers every 8 years			
37 2054 \$709,508 \$740,525 \$651,040 \$490,312 \$155,762 \$26,687,721 \$ \$725,124 \$390,000 \$56,740,00		\$200,000			1						\$ 585,000							New trailers every 8 years				
38 2055 5709,508 \$737,093 \$651,040 \$492,765 \$155,762 \$2,687,721 \$725,124 \$190,000 \$6,539,000 \$6,538,000 \$6,538,000 \$736,763 \$736,763 \$736,763 \$756,762 \$2,687,721 \$ 565,000 \$725,124 \$190,000 \$190,000 \$6,538,000 \$736,763 \$706,508 \$736,773 \$651,040 \$492,765 \$155,762 \$2,687,721 \$ 565,000 \$725,124 \$190,000							\$490,314				\$ -											
39 2056 5705,08 5733,67 5735,67 556,100 5455,720 52,687,721 5 856,000 5725,124 5190,000 556,380,000 66,380,000 66,380,000 66,380,000 6701,070 68,580,000 6701,070 68,580,000 6701,070 68,580,000 6701,070 68,580,000 6701,070 68,580,000 6701,070 68,580,000 6701,070 68,580,000 6701,070 68,580,000 6701,070 68,580,000 68,570,000 68,570,000 68,570,000 68,570,000 68,570,000 68,570,000 68,570,000 68,570,000 68,570,000 68,570,000 68,570,000 68,570,000 68,570,000 68,570,000 68,570,000<	2055					\$651,040					\$ -			\$190,000								
40 207 5709,508 \$730,570 \$709,508 \$726,174 \$407,050 \$155,762 \$2,687,721 \$565,000 \$725,124 \$190,000 \$7,122,000 \$653,600 \$653,600 \$653,600 \$709,508 \$726,124 \$190,000 \$5,720,000 \$65,380,000 \$563,600 \$5709,508 \$712,120 \$651,040 \$502,687,721 \$35,000 \$725,124 \$190,000 \$5,770,000 \$65,380,000 \$190,000 \$5,770,000 \$507,000 \$507,308 \$716,5762 \$2,687,721 \$155,762 \$2,687,721 \$155,762 \$2,687,721 \$155,762 \$2,687,721 \$155,762 \$2,687,721 \$155,762 \$2,687,721 \$155,762 \$2,687,721 \$155,762 \$2,687,721 \$155,762 \$2,687,721 \$155,762 \$2,687,721 \$155,762 \$2,687,721 \$155,762 \$2,687,721 \$155,762 \$2,687,721 \$190,000 \$190,000 \$5,920,000 \$190,000 \$190,000 \$190,000 \$190,000 \$190,000 \$190,000 \$190,000 \$190,000 \$190,000 \$190,000 \$190,000 \$190,000 \$190,000 \$190,000 \$190,000 \$190,000 \$190,000 \$190,000 \$190,000<											\$ -											
41 2058 \$709,508 \$726,603 \$709,508 \$726,603 \$509,000 \$190,000 \$6,380,000 \$190,000 \$6,370,000 \$6,772,102 \$100,000 \$190,000 \$6,370,000 \$6,772,102 \$100,000 \$190,000 \$6,770,000 \$190,000 \$6,770,000 \$190,000 \$6,770,000 \$190,000 \$190,000 \$6,770,000 \$190,000 \$10,273,000 <td>2057</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>\$ 585,000</td> <td></td>	2057										\$ 585,000											
42 2059 \$709,508 \$723,192 \$651,040 \$502,628 \$155,762 \$2,687,721 \$35,000 \$725,124 \$190,000 \$5,990,000 \$401 capital upgrade every 20 years New trailers every 8 years 4 2061 \$779,508 \$716,136 \$651,040 \$507,734 \$155,762 \$2,687,721 \$175,000 \$190,000 \$5,990,000 \$190,000 \$5,990,000 \$190,000 \$2,900,000 \$190,000 \$2,900,000 \$190,000 \$2,900,000 \$190,000 \$2,900,000 \$190,000 \$2,900,000 \$190,000 \$2,900,000 \$190,000 \$2,900,000 \$190,000 \$2,900,000 \$190,000 \$2,900,000 \$190,000 \$2,900,000 \$190,000 \$2,900,000 \$190,000 \$2,900,000 \$190,000 \$2,900,000 \$2,900,000 \$190,000 \$2,900,000 \$190,000 \$2,900,000											\$ -											
43 2060 \$709,508 \$716,173 \$200,000 \$651,040 \$555,762 \$2,687,721 \$175,000 \$725,124 \$190,000 \$590,900 Major capital upgrade every 20 years New trailers every 8 years 44 2061 \$17,551,25 \$709,508 \$716,136 \$650,734 \$155,762 \$2,687,721 \$<-											\$ 35,000											
44 2061 \$1,755,125 \$709,508 \$716,136 \$651,040 \$507,734 \$155,762 \$2,687,721 \$ \$725,124 \$190,000 \$8,288,000 New trailers every 8 years 45 2062 \$709,508 \$712,582 \$651,040 \$512,721 \$ \$725,124 \$190,000 \$8,532,000 46 2063 \$709,508 \$51,940 \$51,962 \$2,687,721 \$ \$725,124 \$390,000 \$8,730,000 \$6,730,000 \$6,730,000 \$6,780,000 \$781,000 \$781,000 \$781,000 \$781,000 \$781,000 \$781,000 \$781,000 \$781,000 \$78,80,000 \$78,80,000 \$78,80,000 \$78,80,000 \$78,80,000 \$78,80,000 \$78,80,000 \$78,80,000 </td <td></td> <td></td> <td></td> <td></td> <td>\$200.000</td> <td></td> <td></td> <td>\$155,762</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>Major capital upgrade every 20 years</td> <td>s New trailers every 8 years</td> <td></td> <td></td> <td></td>					\$200.000			\$155,762										Major capital upgrade every 20 years	s New trailers every 8 years			
45 2062 \$709,508 \$712,522 \$\$651,040 \$\$15,762 \$2,687,721 \$\$- \$\$725,124 \$\$190,000 \$\$6,532,000 46 2063 \$709,508 \$709,508 \$\$709,508 \$\$709,508 \$\$15,782 \$\$2,687,721 \$\$<-		\$1.755.125									\$ -											
46 2063 \$709,508 \$709,500 \$265,1040 \$512,824 \$155,762 \$2,687,721 \$25,000 \$190,000 \$6,760,000 47 2064 \$709,508 \$704,813 \$55,1640 \$515,762 \$2,687,721 \$- \$725,124 \$390,000 \$6,730,000 48 2065 \$709,508 \$701,813 \$6651,040 \$515,762 \$2,687,721 \$- \$725,124 \$190,000 \$6,730,000 49 2066 \$709,508 \$651,040 \$515,762 \$2,687,721 \$- \$725,124 \$190,000 \$7,814,000 49 2066 \$709,508 \$651,040 \$515,762 \$2,687,721 \$- \$725,124 \$190,000 \$190,000 \$7,814,000											\$ -											
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48 2065 \$709,508 \$701,813 \$651,040 \$517,965 \$155,762 \$2,687,721 \$1,285,000 \$725,124 \$190,000 \$7,814,000 49 2066 \$709,508 \$698,187 \$651,040 \$525,752 \$2,687,721 \$- \$725,124 \$190,000 \$7,814,000 \$6,528,000											\$ -											
49 2066 \$ \$709,508 \$698,187 \$ \$651,040 \$520,555 \$ 155,762 \$ 2,687,721 \$ \$ - \$725,124 \$ 190,000 \$ \$190,000 \$ \$6,528,000	2065										\$ 1,285,000											
	2066		\$709,508			\$651,040	\$520,555		\$2,687,721		\$ -			\$190,000		\$190,000	\$6,528,000					
											\$ 550,000											
Totals \$7,731,275 \$33,346,853 \$36,100,134 \$4,202,000 \$28,645,760 \$20,830,081 \$7,123,800 \$16,431,825 \$8,850,000 \$11,045,000 \$4,115,000 \$36,496,800 \$11,310,000 \$10,382,338 \$15,729,269 \$402,342,000	fotals ?	\$7,731,275	\$33,346,853	\$36,100,134	\$4,202,000	\$28,645,760	\$20,830,081	\$7,123,800	\$166,431,825	\$8,850,000	\$11,045,000	\$4,115,000	\$36,496,800	\$11,310,000	\$10,382,338	\$15,729,269	\$402,342,000					

Sustane Facility Tipping Fee (operating cost & revenue) = \$53 per tonne Capital cost annual payment = \$1,710,352 per year \$15,729,269 \$402,342,000

30 years \$261,241,000 1,792,501 tonnes \$146 per tonne over 30 years

40 years \$332,392,000 2,448,090 tonnes \$136 per tonne over 40 years

50 years \$402,342,000 3,159,253 tonnes \$127 per tonne over 50 years

Y	ear
	1
	2015
	2016
0	2017 2018
2	2010
3	2020
4	2021
5	2022
6	2023 2024
8	2024
9	2026
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11	2028
12	2029
13	2030 2031
14	2031
16	2033
17	2034
18	2035
19	2036
20	2037 2038
21	2038
23	2040
24	2041
25	2042
26 27	2043 2044
27	2044
29	2045
30	2047
31	2048
32	2049
33	2050
34	2051 2052
36	2053
37	2054
38	2055
39	2056
40	2057
41 42	2058 2059
42	2059
44	2000
45	2062
46	2063
47	2064
48 49	2065
49 50	2066 2067

Drganics Facility (CR) and TS (CV) Capital	Organics faciity operating	Organics TS Operating (CV)	Organics transfer	Transfer stations and remote landfills capital - development & closure	Transfer stations and remote landfills operating	Host community agreements	Diversion Programs Capital	Diversion Programs Capital - Equipment	Diversion Programs Operating	Support Services and Staff Disposal - Operating	lllegal Dumping Operating	One Time Expenses Operating	Capital Costs	Operating Costs	Total System Cost	
					\$1.279.881	\$356.225		\$90.000	\$3.945.914	\$500.480	\$197.531		\$1.465.868	\$8,499,280	\$9.965.148	
\$5,410,000				\$140,000	\$1,279,881	\$356,225	\$455,000	\$325,000	\$3,945,914	\$500,480	\$197,531	\$1,150,000	\$9,520,358	\$9,649,280	\$19,169,638	
\$3,150,000				\$0	\$1,279,881	\$356,225	9433,000	\$325,000	\$3,945,914	\$500,480	\$197,531	\$1,130,000	\$3,341,695	\$8,889,280	\$12,230,975	
\$3,130,000				\$0	\$1,279,881	\$356,225		\$205,000	\$3,945,914	\$500,480	\$197,531		\$2,282,815	\$9,439,280	\$12,230,975	
	\$781.000	\$230.000	\$ 134.106	\$0 \$0	\$1,279,881	\$356,225		\$35,000	\$3,945,914	\$500,480	\$197,531		\$9,010,329	\$14,134,238	\$23,144,567	
	\$781,000		\$ 135.608	\$0	\$1,279,881	\$356,225		\$375,000	\$3,945,914	\$500,480	\$197.531		\$375,000	\$14,163,136	\$14,538,136	
	\$781,000		\$ 137,126	\$310,000	\$1,279,881	\$356,225	\$455,000	\$270,000	\$3,945,914	\$500,480	\$197,531		\$1,288,613	\$14,192,335	\$15,480,948	
	\$781.000		\$ 138.635	\$1,995,000	\$1,279,881	\$356,225		\$35.000	\$3,945,914	\$500,480	\$197.531		\$5,138,685	\$15,766,774	\$20,905,459	
	\$781,000	\$230,000	\$ 140,143	\$1,505,000	\$1,279,881	\$356,225		\$225,000	\$3,945,914	\$500,480	\$197,531		\$1,730,000	\$15,579,528	\$17,309,528	
	\$781,000	\$230,000	\$ 141,645	\$414,600	\$1,279,881	\$356,225		\$30,000	\$3,945,914	\$500,480	\$197,531		\$444,600	\$15,580,114	\$16,024,714	
	\$781,000	\$230,000	\$ 143,135	\$1,210,700	\$1,279,881	\$356,225		\$410,000	\$3,945,914	\$500,480	\$197,531		\$2,205,700	\$15,580,743	\$17,786,443	16,83
	\$781,000	\$230,000	\$ 144,614		\$1,279,881	\$356,225	\$455,000	\$240,000	\$3,945,914	\$500,480	\$197,531		\$895,000	\$15,581,384	\$16,476,384	
	\$781,000	\$230,000	\$ 146,074		\$1,279,881	\$356,225		\$30,000	\$3,945,914	\$500,480	\$197,531		\$615,000	\$15,782,029	\$16,397,029	
	\$781,000		\$ 147,512		\$1,279,881	\$356,225		\$210,000	\$3,945,914	\$500,480	\$197,531		\$385,000	\$15,582,690	\$15,967,690	
	\$781,000	\$230,000	\$ 148,926		\$1,279,881	\$356,225		\$0	\$3,945,914	\$500,480	\$197,531		\$0	\$15,583,355	\$15,583,355	
	\$781,000		\$ 150,324		\$1,279,881	\$356,225		\$455,000	\$3,945,914	\$500,480	\$197,531		\$801,000	\$15,584,037	\$16,385,037	
	\$781,000		\$ 151,711		\$1,279,881	\$356,225	\$455,000	\$275,000	\$3,945,914	\$500,480	\$197,531		\$965,000	\$15,584,732	\$16,549,732	
	\$781,000		\$ 153,049		\$1,279,881	\$356,225		\$0	\$3,945,914	\$500,480	\$197,531		\$0	\$15,785,449	\$15,785,449	
	\$781,000		\$ 154,363		\$1,279,881	\$356,225		\$205,000	\$3,945,914	\$500,480	\$197,531		\$1,140,000	\$15,586,164	\$16,726,164	
	\$781,000		\$ 155,673		\$1,279,881	\$356,225		\$35,000	\$3,945,914	\$500,480	\$197,531		\$235,000	\$15,586,886	\$15,821,886	
	\$781,000		\$ 156,955		\$1,279,881	\$356,225		\$375,000	\$3,945,914	\$500,480	\$197,531		\$1,125,000	\$15,587,617	\$16,712,617	
	\$781,000		\$ 158,212		\$1,279,881	\$356,225	\$455,000	\$270,000	\$3,945,914	\$500,480	\$197,531		\$9,575,000	\$15,588,357	\$25,163,357	
	\$781,000		\$ 159,449		\$1,279,881	\$356,225		\$85,000	\$3,945,914	\$500,480	\$197,531		\$120,000	\$15,914,096	\$16,034,096	
	\$781,000		\$ 160,673		\$1,279,881	\$356,225		\$175,000	\$3,945,914	\$500,480	\$197,531		\$1,700,000	\$15,714,842	\$17,414,842	
	\$781,000		\$ 161,880		\$1,279,881	\$356,225		\$30,000	\$3,945,914	\$500,480	\$197,531		\$1,970,125	\$15,715,570	\$17,685,695	
	\$781,000		\$ 163,499		\$1,279,881	\$356,225		\$410,000	\$3,945,914	\$500,480	\$197,531		\$410,000	\$15,716,270	\$16,126,270	
	\$781,000		\$ 165,134		\$1,279,881	\$356,225	\$455,000	\$240,000	\$3,945,914	\$500,480	\$197,531		\$895,000	\$15,716,981	\$16,611,981	
	\$781,000		\$ 166,785		\$1,279,881	\$356,225		\$30,000	\$3,945,914	\$500,480	\$197,531		\$230,000	\$15,917,704	\$16,147,704	
2140000	\$781,000 \$781,000		\$ 168,453 \$ 170,138		\$1,279,881	\$356,225 \$356,225		\$210,000 \$50,000	\$3,945,914 \$3,945,914	\$500,480 \$500,480	\$197,531 \$197,531		\$445,000 \$2,190,000	\$15,718,439 \$14.008.834	\$16,163,439	
2140000	\$781,000		\$ 170,138 \$ 171,839		\$1,279,881 \$1,279,881	\$356,225		\$405,000		\$500,480					\$16,198,834	\$513,22
							\$455.000		\$3,945,914		\$197,531		\$990,000	\$14,009,593	\$14,999,593	\$513,22
	\$781,000				\$1,279,881	\$356,225	\$455,000	\$275,000	\$3,945,914	\$500,480	\$197,531		\$730,000	\$14,010,365	\$14,740,365	
	\$781,000		\$ 175,293	\$340,000	\$1,279,881	\$356,225		\$0	\$3,945,914	\$500,480	\$197,531		\$340,000	\$14,211,149	\$14,551,149	
	\$781,000		\$ 177,046 \$ 178,816		\$1,279,881 \$1,279,881	\$356,225		\$205,000	\$3,945,914	\$500,480	\$197,531		\$1,280,000	\$14,011,945 \$14,012,754	\$15,291,945	
	\$781,000 \$781,000		\$ 178,816 \$ 180.604			\$356,225 \$356,225		\$35,000 \$375.000	\$3,945,914 \$3,945,914	\$500,480 \$500,480	\$197,531 \$197,531		\$311,000 \$2,990,000		\$14,323,754 \$17.003.576	
	\$781,000		\$ 180,604 \$ 182,411		\$1,279,881 \$1,279,881	\$356,225	\$455.000	\$320,000	\$3,945,914	\$500,480	\$197,531 \$197,531		\$2,990,000 \$1,560,000	\$14,013,576 \$14,014,411	\$17,003,576 \$15,574,411	
	\$781,000		\$ 184,235		\$1,279,881	\$356,225	\$455,000	\$35,000	\$3,945,914	\$500,480	\$197,531		\$35,000	\$14,014,411	\$15,574,411 \$14,250,260	
	\$781,000 \$781,000		\$ 186,077 \$ 187,938		\$1,279,881 \$1,279,881	\$356,225 \$356,225		\$175,000 \$30,000	\$3,945,914 \$3,945,914	\$500,480 \$500,480	\$197,531 \$197,531		\$175,000	\$14,016,121	\$14,191,121 \$14,046,997	
													\$30,000	\$14,016,997		eeco 04
	\$781,000				\$1,279,881	\$356,225	\$455.000	\$410,000	\$3,945,914	\$500,480	\$197,531		\$995,000	\$14,017,886	\$15,012,886	\$662,21
	\$781,000				\$1,279,881	\$356,225 \$356,225	\$455,000	\$240,000	\$3,945,914	\$500,480	\$197,531		\$695,000	\$14,018,788	\$14,713,788	
	\$781,000		\$ 193,632		\$1,279,881			\$30,000	\$3,945,914	\$500,480	\$197,531		\$65,000	\$14,219,705	\$14,284,705	
	\$781,000		\$ 195,569 \$ 197,524		\$1,279,881	\$356,225		\$260,000	\$3,945,914	\$500,480	\$197,531		\$635,000	\$14,020,636	\$14,655,636	
	\$781,000 \$781,000		T		\$1,279,881	\$356,225		\$0 \$405.000	\$3,945,914 \$3,945,914	\$500,480 \$500,480	\$197,531		\$1,755,125	\$14,021,581	\$15,776,706	
					\$1,279,881	\$356,225	\$455.000				\$197,531		\$405,000	\$14,022,541	\$14,427,541	
	\$781,000 \$781,000	\$230,000 \$230,000	\$ 201,495 \$ 203,510		\$1,279,881 \$1,279,881	\$356,225 \$356,225	\$455,000	\$275,000 \$0	\$3,945,914 \$3,945,914	\$500,480 \$500,480	\$197,531 \$197,531		\$965,000 \$0	\$14,023,516 \$14,224,505	\$14,988,516 \$14,224,505	
	\$781,000		\$ 203,510 \$ 205,545		\$1,279,881 \$1,279,881	\$356,225		\$0	\$3,945,914	\$500,480	\$197,531 \$197,531		\$0	\$14,224,505 \$14,025,509	\$14,224,505 \$15,515,509	
	\$781,000		\$ 205,545 \$ 207,600		\$1,279,881	\$356,225		\$35,000	\$3,945,914	\$500,480	\$197,531		\$35,000	\$14,025,509	\$15,515,509 \$14,061,529	
	\$781,000		\$ 209,676		\$1,279,881	\$356,225		\$425,000	\$3,945,914	\$500,480	\$197,531		\$975,000	\$14,020,529 \$14,027,564	\$15,002,564	\$809,86
\$10,700,000	\$36,707,000	\$10,810,000	\$7,947,222	\$5,915,300	\$65,273,955	\$18,167,482	\$4,550,000	\$9,465,000	\$201,241,631	\$25,524,460	\$10,074,083	\$1,150,000	\$76,955,913	\$732,910,354	\$809,866,267	

\$16,197,325.35

APPENDIX C: Vendor Response Memo – Increasing Capacity





Report on Follow-up Consultation with Technology Vendors

1.0 BACKGROUND

As part of a Waste to Energy Update Report for Comox Strathcona Waste Management (CSWM), SLR Consulting (SLR) was requested to assist Morrison Hershfield (MH) in some follow-up consultation with selected Technology Vendors, following an RfI process. The purpose of the consultation was to clarify the responses from two of the three Vendors selected by MH, from the evaluation of RfI responses, to represent a potentially suitable technology choice for future waste management in the two Regional Districts.

The two firms selected for further engagement were:

- Sustane Technologies Inc. (Sustane); and
- Waste Treatment Technologies Netherlands B.V. (WTT).

An initial set of questions, common to both Vendors, was developed by MH, to improve understanding of the firms' abilities to respond to higher annual plant throughputs than had been proposed in the original RfI and to provide more details of the cost implications of such increased waste volumes.

SLR were also asked to review the RfI submissions from the two Vendors and to develop any additional questions which might assist in better understanding the nature and suitability of the proposed technologies.

This report summarizes the findings of these two sets of questions. It should be read in conjunction with the documentation submitted by the two Vendors, which is included as Appendices 1 and 2, for Sustane and WTT respectively.

2.0 SUSTANE TECHNOLOGIES INC

Sustane acknowledge that their particular technology mix has not yet been fully tested on a commercial basis. They strongly assert however that the evidence from the operation of the Madrid plant, combined with the additional proprietary processes included in the mix, allow them to make a number of projections regarding the anticipated performance of their process. No operational performance evidence has been provided, however. In our view these performance assertions can only be indicative until full mass and energy balances have been made available.

2.1 Assessment by NS Dept. of Environment

Evidence has been provided to substantiate the assertions in Sustane's previous submissions that the technology mix has been subject to consideration by the Nova Scotia Dept. of Environment (DoE). While Sustane now stress that this was not a formal assessment process, it has enabled the DoE to state that Sustane's biomass fuel pellets segregated from mixed MSW "would be considered a recovered product derived from the waste stream and eligible for inclusion in the (Province's) diversion credits program". This is a slightly different statement than was given in Sustane's original Rfl response, which suggested that the biomass pellets had been "certified as recovered biomass, by the DoE".



2.2 Thermal De-bonding Process

Sustane have confirmed that the preliminary "*thermal de-bonding process*" referred to in their submission is some form of autoclave. In SLR's experience this means that Sustane will need significant odour control and steam recovery post/during operation. Subject to exact operating conditions this is likely to require significant water removal treatment, either as a vapour when opening the vessel post-operation and/or during the operating process.

The autoclave is said to operate at a temperature above 130°C. At this temperature the autoclaving process must be at ~2.7 Bar. There is energy used in achieving this pressure and in the time and temperature elements of such a scheme. Such energy is in addition to a similar amount of energy required by a non-autoclaving separation scheme; therefore we cannot see how such a scheme could operate at lower energy consumption than comparable schemes, as stated in the Sustane submission. It is possible that they are somehow discounting the re-used energy from diesel generated from plastics, but if so this should not be double-counted in other energy balance assertions.

2.3 Moisture Content Post-autoclaving

The material entering the trommel screening process is said to have a moisture content of only 30%. This is an extremely low figure for biomass output from an autoclave and needs some further clarification as to how the process can achieve this. Further, Sustane give different figures for the moisture content reduction achieved by the belt dryer, in their answers to Questions 3 (15%) and 4 (10%).

2.4 **Process Residues**

Process residues are stated to be around 10% by weight and to comprise rubber, wood pieces & some fabrics, which will go to landfill, plus glass & grit which should be clean enough for beneficial use, although no chemical analyses were provided by Sustane. We are skeptical about this until chemical analysis evidence is available and indeed Sustane acknowledge that they intend to landfill this stream until it is proven safe to divert.

2.5 Impacts of Increased Feedstock Delivery

An increase of feedstock inputs from 29Ktpa to 70Ktpa can be accommodated by Sustane and would involve an increase in Capex from around \$25 to \$27.5M, as set out in their original RfI submission. In their responses to our new questions, the firm also indicated that they would expect to make an annual allowance of \$150,000 for unspecified capital works related to future improvements and upgrades of the plant. At 75Ktpa this allowance would be equivalent to adding a further \$2 per tonne to the Opex costs.

Sustane indicate that increasing throughput should not impact on equipment downtime or operating availability. Opex would decrease incrementally from \$75.42/t at around £47Ktpa throughput, to \$54.45/t at 70Ktpa, before allowing for the capital works allowance referred to above.

2.6 Progress Monitoring

Subject to the timing by which CSWM propose to reach a conclusion on the selection of a preferred technology, we would recommend that they monitor the progress of developments at Sustane's Chester, NS plant and take up the invitation to visit the site once actual performance data have been corroborated by the advisory team.



3.0 WASTE TREATMENT TECHNOLOGIES NETHERLANDS B.V.

Unlike Sustane, WTT is an established company with a track record of numerous operational installations. They recently responded to an RfI process which SLR is managing on behalf of an Ontario Municipality and this has provided reference material which is consistent with the data provided to CSWM.

3.1 Compost Quality

In response to our question regarding how the use of a compost product from the process will align with current BC regulations, WTT have simply quoted an extract from the OMRR. Compost, even as Class B, is required to be "...only derived from organic matter..." It is our understanding that such compost can only be derived from source-segregated organic matter (which would be in line with EU and UK regulation).

We therefore suggest that the material may not be suited to land application except under special circumstances which may be defined elsewhere in BC legislation. It is recommended that clarification is sought from BC MoE as to the precise nature of the applications that composted MSW can be utilised for.

3.2 RDF/SRF Specification

In responding to our enquiry regarding potential materials which could be extracted in an optimized recycling system, WTT's response seems to imply that any rejects can go into RDF generation. However, they are also advocating an SRF specification for use in cement kilns, which requires a tight specification which might be in conflict with this concept. It is likely that the potentially conflicting responses simply reflect the very early conceptualization stage of a new facility to serve the CSWM area.

3.3 Plastics Contamination

WTT indicate that segregated plastics from their process will have a purity of "*over 80%*". This is a surprisingly low figure for a modern plant using infrared sensors and may reflect a misunderstanding of the question. It may be because they are rejecting plastics from organic streams to improve the organics quality as far as possible, resulting in a very low purity plastic. The inclusion of the HDPE and PET segregation options would be beneficial to improving the purity of plastics collected.

3.4 Impacts of Increased Feedstock Delivery

An increase of feedstock inputs from 29Ktpa to 70Ktpa could be accommodated by WTT, by running a 3 shift system for the mechanical separation stage of the process. This would give a modest margin of spare capacity with no significant increase in Capex and only a pro-rata increase in Opex, relating to labour, power and consumables. The alternative approach, using higher capacity processing equipment would result in a higher Capex, but could allow a lower unit Opex, from the lower labour costs of a 2 shift system as well as from extended life of plant operating below capacity.

WTT only provided limited numerical data to indicate how Capex would change with increased feedstock deliveries, as follows:

- Mechanical separation None if change to 3 shift system;
- Anaerobic digestion Additional \$1.4 1.6M Capex;
- Composting Additional £0.8 1.0M Capex.



WTT did not provide any information on additional Opex costs of increased throughput. They state that "*labour costs per tonne would go up as soon as new shift needs to be started*", but in our view this is unlikely. While overall labour costs of the operation will go up, the labour costs per tonne should stay the same, assuming management costs are measured separately.

3.5 Impacts of Including HDPE & PET Extraction

In their original RfI response WTT indicated an option to include extra equipment allowing the segregation of HDPE and PET plastics. The firm indicates that this would involve the overall Capex increasing by \$1.5M. It is not made clear whether this figure applies to the lower or higher proposed plant throughput, but given the context of the response, we believe that it is based on a 70Ktpa plant.

WTT estimate that addition of the HDPE & PET separation will increase Opex by only \$3 – 4/t processed.

4.0 CONCLUSION

Overall we do not think either Vendor is saying anything unexpected. However in many instances they are making comment about what <u>might</u> be possible in a proposed system, rather than what they would expect to be achieved from a facility, with the given technology mix and market circumstances.

If the project is to proceed through a formal RfP process or ITT, specifications for performance and for outputs will need to be very tightly managed in the supporting documents and in the final contract, to ensure that there are appropriate safeguards with respect to performance liability and performance achievement. This may seem obvious but it will need some careful consideration to ensure that business models and technical assumptions can be realised and followed, along with realistic targets and attainable performance criteria.

Appendix 1

Clarification responses from Sustane

- 1. We note the following statements in your RfI submissions:
 - a) "The biomass pellets are not considered a refuse derived fuel (RDF) as they contain virtually zero plastics and have been certified by Dept. of Environment, Nova Scotia as recovered biomass, with all the attributes of forest based biomass". (Page 2 of RfI response, July 14th 2017).
 - b) "From a technical and environmental viewpoint burning conventional RDF in a paper mill biomass boiler is a non-starter. In contrast, Sustane's clean, dry biomass is already enthusiastically greeted by the local mills. Note that it is endorsed by Nova Scotia department of Environment and we have a long term off-take from Emera Energy in Nova Scotia". (Letter to Morrison Hershfield, Aug 8th 2017).

Please explain the basis upon which the technology has been formally assessed by the Nova Scotia Dept. of Environment and provide any relevant supporting documentary evidence. This relates specifically to the nature of the original feedstock and the extent of any trials used to generate a representative sample for testing. Also what analysis has been made with regard to heavy metals and other contaminants excluding plastics?

Answer:

I do not believe that we suggested that the Nova Scotia (NS) Department of Environment "formally assessed" the technology at a detailed level. What they did do is review the general process flows and product specifications, specifically the contaminants characterization, and made a determination that the process was classified as recycling. This means that under the NS rules, the products are designated as non-waste, when consumed. A copy of this letter, signed by the NS Minister of Environment is attached.

Regarding trials, Sustane's co-founder operated a facility in Spain utilizing his original (patented) thermal de-bonding and separation system with over 5 years of successful operation. In 2014, Sustane was founded to take this base to the next level by adding proprietary biomass cleaning stages and then subsequently by separating and selectively pyrolyzing the plastics stream to synthetic diesel. We performed extensive trials of this cleaning process at a scale of 200 metric tonnes per day stream rate until it was perfected. We achieved sustained plastics levels of less than 0.2% in the biomass. Glass and silica is under 1% and heavy metals were within NS composting levels.

For the biomass offtake on Vancouver Island, I have many years of personal work experience in many of the pulp and paper mills on the coast (from my pulp and paper career). These mills have strong interest in an offtake already, based on our product specification and we are working on formalizing expressions of interest from the mills in the near future. The synthetic diesel is suited to direct combustion or marine use (among many other applications) and we are currently developing this offtake as well. For interest sake, in Nova Scotia we have already secured offtake for 1.0 million litres and 1.5 million litres respectively with industrial fuel oil customers. In addition, we have commitments to burn volumes in commercial, municipal and provincial buildings.

2. Section 7. on P10 of your RfI submission refers to the original Madrid plant from which the Sustane technology has been developed. We appreciate that there is no commercial relationship between Sustane and the current operator of this plant. However, in the absence of data from a current operational Sustane facility, we would be interested in any further information you can

provide regarding the operating performance of the Madrid plant. This could include the following:

- Feedstock origin and description/specification;
- Overall mass & energy balance for the facility, including:
 - Biomass feedstock generated, as % of waste input by weight;
 - Actual calorific value of the biomass pellets;
 - Actual calorific value of the synthetic diesel product;
 - Char residues generated through the pyrolysis process, as a % of waste input;
 - Indicative chemical analysis for any typical residues generated;
 - Typical residue to final disposal, as % of waste input by weight;
- Any information on actual air emissions from the operations.

Answer:

Feedstock origin was Madrid mixed MSW. Note that the material was designated as post recycling, but we noted high levels of food and also high levels of yard waste, some C&D waste and significant sand (street sweepings).

As noted above, the Madrid facility is only similar in the first three stages (shredding, autoclaving and trommel separation). The Sustane process adds several additional stages to fully separate components, clean the biomass plus plastics separation, preparation, pyrolysis and distillation. We have tested all components at full scale however the Chester facility is the first full implementation of the overall concept. It will be operational in the Summer of 2018. That said, we can share our general understanding of the Madrid process details as follows:

- Biomass feedstock generated, as % of waste input by weight; Biomass generated was approx. 55% of MSW by weight. Note that in Madrid, this biomass was then further processed in an anaerobic digester which is not the path Sustane has followed.
- Actual calorific value of the biomass pellets; No pellets were produced in Madrid. Biomass product was going to A.D. Testing for our pellets produced in trials in Spain indicate a range from 15 mj/kg to 16 mj/kg (at 10% moisture). Note that ash levels in Spanish MSW are much higher than we will see in Canada so we project 17 mj/kg in Canada.
- Actual calorific value of the synthetic diesel product; Again, no diesel was produced in Spain. We have licensed a system that is operating in the US and it delivers a product of 46 mj/kg.
- Char residues generated through the pyrolysis process, as a % of waste input; 1% to 2% of plastic input to the pyrolysis system so assuming 20% plastics in MSW and 70% of plastics as suitable it will be a maximum of 0.14% to 0.28% of the MSW input, assuming optimal utilization of plastics.
- Indicative chemical analysis for any typical residues generated; Residues are sand, glass and light inorganics plus odd materials such as rubber, wood pieces and some fabrics. We have chemical analysis on the glass, grit stream which indicates is does not need to be landfilled and we expect to find a beneficial use. We will landfill this stream however until it is tested and proven safe to divert.

- Jan 2018
- Typical residue to final disposal, as % of waste input by weight; Based on our tests and process modelling from Nova Scotia MSW characterizations, we project residue between 8% and 12% of input MSW by weight.
 - Any information on actual air emissions from the operations. For the Madrid plant there were no designated air emissions points. Note that the cooking process is fully closed with no vapour venting. For the Chester plant we have detailed projections based on testing of individual processes. This data is part of our operating/environmental permit application. In summary, there is no liquid

effluent and air emissions are limited to a low level of VOC from the biomass dryer plus typical combustion by-products from the combustion of a portion of the synthetic diesel (approx. 25%) which is used to fuel the boiler and biomass dryer and approximately 10% of the vaporized plastic in non-condensable form that is used to heat the pyrolysis reactors.

3. Para (b) on P3 of your submission includes a simple process flow sketch which provides a helpful overview. A number of other Technology Vendors have provided a more detailed process flow diagram which incorporates the anticipated tonnages of materials at each step in their process. We recognize that Sustane does not yet have a full-scale reference facility from which to obtain operating data, however it would be helpful to have a diagram which enables us to understand how the tonnage data in the table on P5, is derived.

Answer:

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Unfortunately, many of our internal process flows are highly proprietary with several process technologies and configurations and are the basis of Sustane's unique value proposition. At this time, we are not prepared to share this information, even under an NDA.

Pages 2 and 3 of the RfI response references your "proprietary de-bonding, separation and cleaning processes...", "...thermo-mechanical de-bonding..." and "...patented continuous thermal de-bonding unit" among the descriptions of process operations. Can you provide clear information about how this plant will achieve the stated high levels of separation, cleaning and efficiency, including:

- a. Process operations employed to pulp and 'slurrify' the feedstock;
- b. Temperatures employed for the thermo-mechanical de-bonding;
- c. Types of separation schemes used i.e. screening methods i.e. ballistic separation, trommel, vibratory screens etc;
- d. De-watering and drying processes to achieve clean dried outputs and/or water content of any outputs from the process.

Answer:

- a. Process operations employed to pulp and 'slurrify' the feedstock; This is achieved using a series of proprietary thermal de-bonding, conditioning chambers. Shredded MSW is subjected to a temperature above 130C for an extended period while exerting a unique mechanical action that has the effect of causing plastics to soften and shrink while not sticking to the biogenic material (fibres).
- b. Temperatures employed for the thermo-mechanical de-bonding; *See above*
- c. Types of separation schemes used i.e. screening methods i.e. ballistic separation, trommel, vibratory screens etc;

For metals we use magnets and eddy current separators. For initial separation of biomass stream we use a proprietary trommel. For separation of the residual plastics and inorganics from the biomass stream, we use a proprietary mechanical technology developed in house.

- d. De-watering and drying processes to achieve clean dried outputs and/or water content of any outputs from the process. Biomass separated from the first trommel enters a low temperature belt dryer at approximately 30% moisture and exits at 15% moisture. The dryer is a fabric belt design that uses air at 110C to perform the drying. Fuel for the dryer is from a portion of the synthetic diesel produced.
- 4. Do the operating costs set out on P10 of your submission fully incorporate all costs associated with the drying of the output material from the thermal de-bonding stage and the management of related process waters?

Answer:

Yes, it is all inclusive of drying biomass to 10% moisture. Note that at higher production volumes, the operating costs will be reduced (see below)

5. We note in para (c) on P5 of your RfI submission that your technology should have the capacity to accommodate increasing tonnages as projected in the table below. Please confirm this is correct, subject to provision of the necessary additional equipment.

Year	Projected tonnage
2021	29,000
2026	52,000
2031	54,000
2036	56,000
2041	57,000
2046	60,000
2051	62,000
2056	65,000
2061	68,000
2066	70,000

Answer:

Yes, the proposed design and equipment configuration can accommodate up to 75,000 tonnes per year of MSW capacity.

6. How would these increased throughputs affect planned downtime? (We note in para (f) on P6 of your RfI submission, that you anticipate an operating availability of 90%). Please advise anticipated operating performance and any changes resulting from increased throughputs.

Answer:

Increasing capacity will not affect the expected downtime or operating availability as all equipment is correctly sized for 75,000 tonnes per year and can readily process the proposed volumes.

7. How would the increased throughput affect operating and maintenance cost? (Provide additional \$/tonne or % change).

Answer:

Assuming operation at 75,000 tonnes per year, operating costs (which includes maintenance costs) will be reduced as per the following table;

Annual Capacity (MSW Tonnes)	46,557	50,000	60,000	70,000
VARIABLE	<u>\$/t MSW</u>	<u>\$/t MSW</u>	<u>\$/t MSW</u>	<u>\$/t MSW</u>
Pellet transport	5.57	5.57	5.57	5.57
Diesel transport	1.09	1.11	1.07	1.13
Royalties for technology	11.56	11.59	11.54	11.61
Energy (steam)	0.94	0.94	0.94	0.94
Energy (electricity)	11.37	10.58	8.82	7.56
Water treatment	0.11	0.10	0.08	0.07
Residue disposal	3.32	0.00	0.00	0.00
FIXED				
Water supply	0.21	0.20	0.17	0.14
Waste water management	0.21	0.20	0.17	0.14
Maintenance (spares and materials)	8.00	7.45	6.21	5.32
Equipment lease	3.76	3.50	2.92	2.50
Operating consumables	0.54	0.50	0.42	0.36
Hourly labour	15.45	14.39	11.99	10.28
Salaries	7.80	7.27	6.06	5.19
Other fixed	5.48	5.10	4.25	3.64
TOTAL	75.42	68.50	60.20	54.45

8. How would the increased throughput affect the capital cost of the facility? (Consider the facility and overall waste management system costs are projected over 50 years. Include anticipated potential minor and major upgrades, along with proposed scheduling thereof).

Answer:

As noted in our submission on page 9, 5 (b), assuming an increase in capacity to 75,000 tonnes per year (from the original design basis), the additional capital cost is estimated to be 2.5 million for a total of \$27.5 million. We would allow for \$150,000 per year for "maintenance of business" capital improvements and upgrades.

9. Processes need to be optimized for recycling, within reasonable expectations of market conditions (but without going overboard). Please advise which additional materials could be extracted, at what cost, and what the ultimate residual going to landfill would be as a percentage of input (by weight).

Answer:

Sustane's process will recover approximately 90% of the MSW destined for landfill. We are performing additional analysis on the residual product (glass/grit stream) that comprises the remaining 10% to better understand its composition and potential future value. In addition to this research, our team is currently working with companies in the construction industry to explore possible uses for these mixtures that currently are not included in the 90% diversion.





PO Box 442, Halifax, Nova Scotia, Canada B3J 2P8 • www.novascotia.ca/nse

DEC 2 2 2015

Our File number:

Mr. Peter Vinall Sustane Technologies Inc. 3770 Kempt Road, Suite 110 Halifax NS B3K 4X8

Dear Mr. Vinall:

Thank you for your email of December 7, 2015, regarding Sustane Technologies Inc. and your system for producing fuel pellets from components of the mixed municipal solid waste stream.

Nova Scotia Environment considers that the proposed technology for separating and recovering biomass from mixed municipal solid waste is distinct from incineration and is a beneficial use of wastes that would otherwise be landfilled. This is consistent with the commonly accepted waste hierarchy, where recovery is a preferred option to landfilling.

The resulting biomass fuel pellets along with other recyclable materials would be considered a recovered product derived from the waste stream and eligible for inclusion in the diversion credits program. Please note that payment of the credit is to the municipality that generated the waste materials and not to the processor.

Utilization of pellets by Nova Scotia Power in their Brooklyn facility will require an amendment to their industrial approval. Amendments can be considered by way of a formal application, which will be given every consideration. Nova Scotia Power can contact Johnathan MacDonald, District Manager at 902-527-5945 in our Bridgewater office to discuss the regulatory implications.

The mixed municipal solid waste required by the Sustane Technologies Inc. facility can be sourced from any municipality. However, Nova Scotia Environment does not possess the ability to direct a municipality to supply Sustane Technologies with waste resources. To discuss the regulatory implications of a proposed facility for the manufacture of fuel pellets, you should also contact our Bridgewater office.

In closing, thank you for your efforts to divert waste in NS. Through your efforts and the efforts of all Nova Scotians we will continue to lead the way in diverting waste from disposal.

Sincerely,

Randy Delorey, MLA Minister of Environment

c: J. MacDonald, District Manager, Bridgewater

Appendix 2

Clarification responses from WTT

Follow-up Questions for Selected Technology Vendors

1. On P19 of your RfI submission you indicate that your process can generate a compost from MSW feedstock that will be suitable for land application. We note your comment that regulatory aspects would be elaborated in a subsequent project stage. However, it would be helpful for us to understand how this proposed use will align with the current regulatory regime in British Columbia, regarding application of wastes to land.

Answer:

Compost will be produced as defined in the BC Organic Material Recycling Regulation (OMRR) – section 1 - definitions:

"compost" means a product which is

- (a) a stabilized earthy matter having the properties and structure of humus,
- (b) beneficial to plant growth when used as a soil amendment,
- (c) produced by composting, and
- (d) only derived from organic matter

It would be an Class B Compost – Division 6 of the OMRR:

'Process and quality criteria

14 (1) Compost that meets the requirements of all of the following is Class B compost:

- (a) Schedule 1, Pathogen Reduction Processes;
- (b) Schedule 2, Vector Attraction Reduction;
- (c) Schedule 3, Pathogen Reduction Limits;
- (d) Column 3 of Schedule 4, Quality Criteria;
- (e) Schedule 5, Sampling and Analyses Protocols and Frequency;
- (f) Schedule 6, Record-keeping.
- (2) Class B compost must be derived only from organic matter.

Land application

15 (1) Class B compost must only be applied to land in accordance with

(a) a land application plan for Class B compost,

(b) the methodology specified in Schedule 8, and

- (c) the soil substance concentrations specified in Schedule 10.1, or the site-
- specific numeric soil standards approved by a director.
- (2) The land application plan must, before land application, be made available to the registered owner of the land.

(3) Class B compost must not be land applied in a watershed used as a permitted water supply under the Drinking Water Protection Regulation, B.C. Reg. 200/2003.'

2. On P18 of your RfI submission you have set out your understanding of the specification requirements of the BC cement manufacturers. Can you provide evidence of RDF production from one of your reference facilities which is able to consistently meet this specification?

Answer:

Veolia Southwark is producing an Refuse Derived Fuel (RDF) which is a pre-Solid Refuse Fuel (SRF) for cement kiln fuel. The material of Veolia Southwark is complying as the RDF fraction of proposed mechanical separation process will comply with SUBCOAL[®] Production General Acceptance Guideline as provide in Appendix 1.

The RFD will be upgraded to a cement kiln grade quality fuel or SRF. Analyses of a SRF for cement kilns produced from RDF is provide in Appendix 2.

3. The Regional District has asked us to consider the implications of increasing volumes of feedstock being delivered to the facility over the next 50 years. Would the WTT technology have the capacity to accommodate increasing tonnages as projected in the table below?

Year	Projected tonnage
2021	29,000
2026	52,000
2031	54,000
2036	56,000
2041	57,000
2046	60,000
2051	62,000
2056	65,000
2061	68,000
2066	70,000

Answer:

Our RFI response was based on the process-flow mass balance as presented is Appendix B of our RFI submission. The presented capacity was 46,557 tpy.

Mechanical Treatment/Separation:

Equipment capacity: 10 – 15 tph/2 shifts resulting in a capacity of app. 50,000 tpy

- ➢ up to 25,000 tpy only 1 shift is needed
- > above 50,000 tpy 3 shifts are needed

Life cycle analyses are indicating, that the main mechanical equipment, such as shredders and screens, should be replaced every 7-9 year. It could be considered to replace by a higher capacity equipment e.g. approximately 25 tpy, so that only 2 shifts remain necessary.

Anaerobic Digestion

10 AD reactors + 1 logistic AD reactor/28 days average cycle duration

- > 25,000 tpy: 10 AD reactors + 1 logistic AD reactor are needed if 28 days cycle duration
- > 70,000 tpy: 14 AD reactors + 1 logistic AD reactor are needed if 28 days cycle duration

The Anaerobic Digestion system is a modular system. For optimal operation/logistic conditions is calculated with one AD reactor for app. 5,000 tpy. An AD reactor can be designed smaller or bigger. The cycle duration or residence time will probably vary between 21 and 28 days: 28 days in the winter and 21 days during peak seasons Spring and Fall.

Composting

16 composting tunnels/14 days average cycle duration

- > 25,000 tpy: 8 composting tunnels are needed for 14 days residence time
- > 70,000 tpy: 22 composting tunnels are needed for 14 days residence time

The composting tunnels are a modular system. For optimal operation/logistic conditions is calculated with the same size anaerobic and composting tunnels. A composting tunnel can be designed smaller or bigger. In a final design the composting tunnels will probably be bigger e.g. at least 5,000 tpy per tunnel.

4. How would these increased throughputs affect planned downtime? (MH have currently assumed that most maintenance can be achieved in 3 days and that there is one plant shutdown for about 14-15 consecutive days per year). Please advise anticipated operating performance and any changes resulting from increased throughputs.

Answer:

Mechanical Separation: The operations will be based on preventive maintenance (replacement before completely worn and unexpected stops may be expected). Daily cleaning and maintenance is included in the 2-shift operation. Periodic maintenance shutdowns will be carefully planned, prepared and executed within 3 days. All maintenance will be included in the maintenance management program and manuals.

Anaerobic Digestion/Composting: These 24/7 operations. Maintenance of reactors and/or tunnels will be planned when the supply of feedstock is minimal, which is during winter. It's our and others experience, that no other measures, such as diversion or storage of feedstock, are not necessary.

5. How would these increased throughputs affect operating and maintenance cost? (Provide additional \$/tonne or % change).

Answer:

Cost of maintenance and labour per tonne will be rather constant, because of modular approach and capacity increase by extension of the number of shifts. The labour costs per tonne will go up as soon as new shift needs to be started. 6. How would these increased throughputs affect the capital cost of the facility? (Consider the facility and overall waste management system costs are projected over 50 years. Include anticipated potential minor and major upgrades, along with proposed scheduling thereof).

Answer:

Mechanical Separation: CAPEX will not be much affected if the production will be increased by extension of the number of shifts. If for a lifecycle replacement will be chosen for higher capacity equipment, it will probably be done because of a lower overall cost; a slightly higher invest in combination with a bigger operational/personal cost reduction

Anaerobic Digestion/Composting:

- Anaerobic Digestion Reactor: 1,400,000 1,600,000 \$
- Composting Tunnel: 800,000 1,000,000 \$
- 7. Processes need to be optimized for recycling, within reasonable expectations of market conditions (but without going overboard). Please advise which additional materials can be extracted, at what cost, and what the ultimate residual going to landfill will be as a percentage of input (by weight).

Answer:

Additional extraction of additional recyclables e.g.. cardboard, paper and plastics, will not result in higher waste diversion rates. These Material would otherwise be part of the RDF fraction.

8. How much would the inclusion of HDPE separation, PET separation and a drum dryer add to the capital cost?

Answer:

٠	HDPE-separation	app. 750,000\$
٠	PET-Separation	app. 750,000 \$
٠	Drum Dryer (inc.l Cyclone, Dust filter and stack):	app. 2,400.0000 \$

- 9. How would the inclusion of HDPE and PET extraction affect:
 - The overall diversion rate and quantity of generated product?
 - The operation cost (\$/tonne processed)?
 - The maintenance costs (\$/tonne processed)?

Answer:

The decision of the implementation of HDPE and/or PET extraction would be based of financial analyses; what would be the cost to extract the recyclables versus the revenues of the recyclables.

- Overall diversion rate would remain the same: HDPE and PET would otherwise be part of the RDF fraction.
- The operation cost : < 2 \$/tonne processed
- The maintenance costs: 1 2 \$/tonne processed (depending on the volumes

10. At the staffing and equipment levels upon which your suggested operating costs are based, what would be the typical levels of contamination that you would expect to see in the individual stockpiles of recycled materials?

Answer:

The contamination levels would be at a level as required by the processing industry. Plastics will have a purity of over 80% and will not contain metals and/or mineral grid. Other recyclables, such as metals and plastic, will contain much less contaminants. The quality of the recyclables will result in such revenues that will legitimate the extractions costs.

11. We appreciate that the project parameters are not yet developed sufficiently to present accurate costs. It would however be very useful if you could provide an indication of typical figures for the main categories of operating costs, for a facility accepting MSW at the proposed initial input rate at CSRD (\$/tonne processed)?

Answer:

The estimates for the overall capital and operating costs are presented in the table on page 24 of our RFI submission:

Costs	Option 1	Option 2	Option 3*
Capital Cost (\$)	10,000,000	15,000,000	26,000,000
Operating Costs (\$/t)	40 - 60	70 - 110	80 - 120

*: Without options HDPE separation, PET separation and drum dryer

Appendix 1: SUBCOAL® Production General Acceptance Guideline



SUBCOAL PRODUCTION GENERAL ACCEPTANCE GUIDELINE

MAY 2017













GENERAL ACCEPTANCE SPECIFICATIONS GUIDELINE

Acceptance criteria guideline for non-recyclable paper-plastic waste fractions coming from various waste sources. This format acts as a guideline for the input feed into the Subcoal process, every individual case can choose to accept materials outside of the guideline if this fits in the input mix. Guideline is based on standard production but can differ depending on technology which is used.

Preferred European waste codes (eural):

- 19.12.10 (preferred)
- 19.12.12
- **19.12.04**
- 03.03.07 (only for waste from paper mills)

Minimum acceptance criteria:

 Preferred dry substance 	> 75%
 Max moisture 	50%
 Typical value of ash (815°C) 	< 15% on dry base
 Max ash content 	20%
 Preferred value of chlorine 	< 0,7% on dry base
 Max value of chlorine 	< 1,2% on dry base
 Value of sulphur 	< 0,1% on dry base
 Particle size 	< 500 mm x 500 mm
 Calorific value 	> 20 MJ on dry base
 Sum heavy metals 	< 800 mg/kg
Preferred values for:	
 Biomass-% 	> 50%
 Copper (Cu) 	< 50 mg/kg on dry base
 Nickel (Ni) 	< 10 mg/kg on dry base
 Aluminium (A) 	< 10.000 mg/kg on dry base

General acceptance criteria:

Excluded from the waste acceptance are harmful to the technical equipment, the environment and the workers, such as in particular:

- Non-combustible materials and waste, such as Soil, gravel, stones, sand, slag, slag, glass and mineral wool
- Organic waste
- Mono batches of e.g. plastic granules, fine dusts
- Batteries, rechargeable batteries, refrigerators, televisions, computer screens, lightemitting fluorescent tubes
- Flammable and highly flammable substances, explosives, fireworks, ammunition
- Toxic substances
- acids, alkalis, corrosive substances
- Radioactive substances
- Hospital waste, carcasses





- Cytostatics
- Solid metal objects, e.g. the endanger the plant
- Metal and aluminum foils, metal dust or metal chips, in particular of light metals such as aluminum, magnesium, beryllium
- Outgassing, reactive substances
- Condensed gases
- All types of liquids

If upon inspection the input materials include the above mentioned items, the material can be rejected and send back to its original location.

Delivered materials should not include:

- Large particles (> 500 mm x 100 mm)
- String, tape, rope, or any form of binding material > 100 mm
- Heavy particles such as ferro, non-ferro, minerals, etc.
- Rubber and foam-like materials
- Textiles and clothing
- Large pieces of hard plastics (> 100mm)
- PVC

The above can be a reason for rejection!

Preferred input material includes:

- High content of light folios and plastics
- High CV
- Low chlorine
- Low paper content
- Very low ash content
- < 100 mm particle size</p>
- Low aluminium content (cans, folio)
- Freshly produced material (no old stocks)





Bale preferences:

- Wrapping
- Ties
- Size
- Weight

Reference photos:

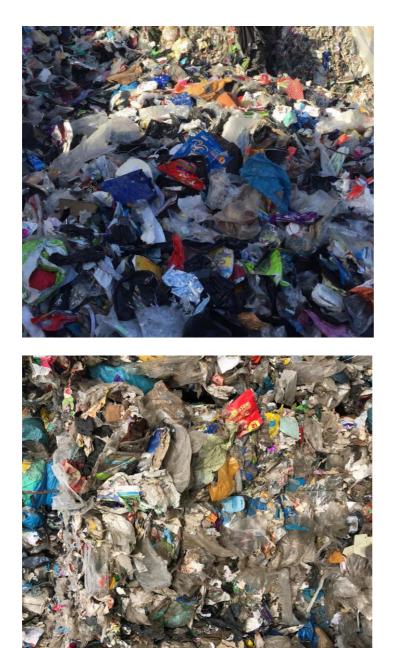
Preferred; > 6 layers of film Plastic or twinces (WxLxH) < 1,30m x 1,50m x 1,50m Max 1,200 kg per bale













Appendix 1: SRF analyses

GBA LABORGRUPPE - WISSEN WAS DRIN IST...





GBA GESELLSCHAFT FÜR BIOANALYTIK MBH Wiedehopfstraße 30 • 45892 Gelsenkirchen

Qlyte Operations B.V.

Kranssteenweg 2

9936 TH Farmsum

Test Report No.: 2014P202043 / 1

Order/Sample-No.	14200276 / 002
Date of Arrival	17.01.2014
Taking of samples	durch den Auftraggeber
Material	Abfall
Sample Name	Datum: 10-1-2014: Mengmonster 8mm pellets - duwbak RWE

Start / End of analyses 17.01.2014 - 12.03.2014

Parameter	Result	Unit	Methods
Appearance	Pellets		
Colour	mehrfarbig		
Sample amount	0,92	kg	
Sample preparation	Reißmühle		analogous DIN ISO 11464ª
Dry weight	94,1	W%	DIN ISO 11465ª
Chlorine, total	0,84	W% DW	DIN EN 15408 / DIN EN ISO 10304-1ª
Copper (Cu)	38	mg/kg DW	DIN EN ISO 16171ª 5
Nickel (Ni)	9,3	mg/kg DW	DIN EN ISO 16171 ^a 5
Aluminum	23000	mg/kg DW	DIN EN ISO 22036 ^a 5
Aluminum, metallic	19000	mg/kg DW	CEN/TS 15412 5
Higher heating value (dry)	24500	kJ/kg	DIN 51900ª 22
Lower heating value (dry)	22800	kJ/kg	DIN 51900ª 22
Lower heating value (as received)	21300	kJ/kg	DIN 51900ª 22
Lower heating value (water and ash free)	25900	kJ/kg	DIN 51900 ^a 22
Ashes (815°C)	12,1	W% DW	DIN 51719ª
Bromine, total	0,0020	W% DW	DIN EN 15408 / DIN EN ISO 10304-1ª
Fluorine, total	0,0040	W% DW	DIN EN 15408 / DIN EN ISO 10304-1ª
Sulfur, total	0,087	W% DW	DIN EN 15408 / DIN EN ISO 10304-1ª

The test results do only reflect the stated testing parameters. Without written consent of GBA parts of the test report are not allowed to be duplicated.

				Page 1 of 3	for Test Rep	oort No.: 2014P202043 / 1
Standort: Telefon: Fax: E-Mail: Homepage	Gelsenkirchen +49 209 97 61 9-0 +49 209 97 61 9-785 gelsenkirchen@gba-laborgruppe.de : www.gba-laborgruppe.de	HypoVereinsbank IBAN: DE 45 2003 0000 0050 4043 92 BIC: HYVEDEMM300 Commerzbank Hamburg IBAN: DE 67 2004 0000 0449 6444 00 BIC: COBADEHHXXX	Sitz der Gesellschaft: Hamburg Handelsregister:	Geschäftsführer: Manfred Giesecke Ralf Murzen Dr. Roland Bernerth Carsten Schaffors Dr. Herwig Döllefeld		(DAKKS Deutsche Akkreditierungsstelle D-PL-14170-01-00



Parameter	Result	Unit	Methods
Biomass	65,1	W% DW	CEN/TS 15440 ^a
TC	52,3	W% DW	DIN EN 13137ª
TIC	0,5	W% DW	DIN EN 13137ª
TOC	51,8	W% DW	DIN EN 13137ª
TOC biomass residue	73,4	W%	DIN EN 13137ª
TOC biogen	26,2	W% DW	CEN/TS 15440ª
TOC fossil	25,6	W% DW	CEN/TS 15440ª
Nitrogen	0,21	W% DW	elemental analysis (GE-MA M-7-1) ^a
Hydrogen	6,4	W% DW	elemental analysis (GE-MA M-7-1) ^a
Oxygen	24,3	W%	elemental analysis (GE-MA M-7-1)
Antimony (Sb)	11	mg/kg DW	DIN EN ISO 16171° 5
Arsenic (As)	<1,0	mg/kg DW	DIN EN ISO 16171ª 5
Lead (Pb)	26	mg/kg DW	DIN EN ISO 16171ª 5
Cadmium (Cd)	0,53	mg/kg DW	DIN EN ISO 16171 ^a 5
Chromium, total (Cr)	17	mg/kg DW	DIN EN ISO 16171 ^a 5
Cobalt (Co)	2,0	mg/kg DW	DIN EN ISO 16171ª 5
Manganese (Mn)	45	mg/kg DW	DIN EN ISO 16171ª 5
Manganese (Min)	0,19	mg/kg DW	DIN EN ISO 16171ª 5
Selenium (Se)	<0,20	mg/kg DW	DIN EN ISO 16171ª 5
Tellurium	0,088	mg/kg DW	DIN EN ISO 16171ª 5
Thallium	<0,30	mg/kg DW	DIN EN ISO 16171° 5
Vanadium (V)	3,3	mg/kg DW	DIN EN ISO 16171ª 5
Zinc (Zn)	209	mg/kg DW	
Tin	12	mg/kg DW	DIN EN ISO 16171° 5
Barium (Ba)	203	mg/kg DW	
Calcium (Ca)	27190	mg/kg DW	DIN EN ISO 16171ª 5
Iron, total	2630	mg/kg DW	DIN EN ISO 16171 ^a 5
Potassium	306	mg/kg DW	
Magnesium (Mg)	1150	mg/kg DW	DIN EN ISO 16171 ^a 5
Molybdenum (Mo)	3,2	mg/kg DW	DIN EN ISO 16171 ^a 5
Sodium	900	mg/kg DW	DIN EN ISO 16171 ^a 5
Phosphorus (P)	180	mg/kg DW	/ DIN EN ISO 22036 ^a 5
Silicon (Si)	2000	mg/kg DW	

With a marked methods are accredited methods. Detection limits may vary depending on the matrix of the sample.

Testing laboratory: 22GBA Herten 5GBA Pinneberg

other units:

Higher heating value (dry)10500 Btu/poundLower heating value (dry)9800 Btu/poundLower heating value (as received)9200 Btu/poundLower heating value (water and ash free)11100 Btu/pound



Gelsenkirchen, 08.07.2014

(

Dr. Büschler Laborleiter APPENDIX D: Long-Term Cost Model – Increasing Capacity



Table D1: Long Term Cost Model for Option 1(a) - WTT facility located in Comox Valley - Increasing Capacity

Population and Disposal Rates													CRWMC LF Fill Rate and Capacity								CVWMC LF Fill Rate and Capacity													
Year	Proje CVF Popul	RD Wa	/aste	Projected SRD Population	SRD Waste	Total Annual Tonnage	Daily Tonnage	Combined Population	Tonnes to Comox Valley TS	Tonnes to Campbell River TS	WTT Eacility	Tonnes per day to WTT facility	Tonnes MSW to CRWMC LF	Tonnes to MSW CVWMC LF	Tonnes Ash/Residual s to CVWMC LF	Year	Volumetric MSW Disposal Rate	Daily Cover Soil	Operational Soil	Settlement	t Net Fill Volume	Cumulative Fill Volume	Phase	Volumetric Capacity (m³)	Year	Volumetric MSW Disposal Rate	Volumetric Asl / Residuals Disposal Rate	Dally	Operational Soil	Settlement	Net Fill Volume		nase / Phase Cell Cell	
		tor	nnes		tonnes	tonnes / yr	tonnes / day	1	tonnes	tonnes	tonnes	tonnes / day		tonnes			m ³	m ³	m ³	m ³	m ³	m ³				m ³	m ³	m ³	m ³	m ³	m ³	m ³		
201	15	64 294	36.652	45 871	26 149	62 801	17:	2 90.443					26 149	20.05		2014	37.356	12 452	747	74	49.80	0			2015	50 260		17 453	1 047	1 047	69.813			
201			36,967	45,871	26,149	63,297	173		, ,				26,149	36,652 36,967	7	2015	37,556	12,452	752	2 75	52 50,15		Phase 3		2016	5 52,360 5 52,810		17,453			70,413	Pha	ise 2 Phase 2	
0 201			36,007 36,435	46,490 46,809	25,521 25,696	61,527 62,131	169 170		5				25,521	36,00 36,43	0	0 2017	36,458	12,153 12,236		72			Phase 3 Phase 3		0 2017	7 51,438 52,050		0 17,146	1,029	1,029	68,584 69,400	68,584 Cel 137,984 Cel		
2 201			36,856	40,009	25,864	62,131			5				25,890	36,856		2 2019	36,708	12,230		73					2 2019	52,050		0 17,550	1,041		70,202	208,186 Cel		
3 202			37,276	47,419	26,031	63,307	173						26,031	37,276		3 2020	37,187	12,396			10,00				3 2020	53,252		0 17,751	1,065	1,065	71,003	279,189 Cel		
4 202 5 202			30,446 30,787	47,706	21,152 21,276	51,598 52,063	14				29,27		21,152 21,276	1,16	3 9,808 1 9,918	4 2021 5 2022	30,217 30,395	10,072 10,132	604 608	60					4 2021 5 2022	1 1,668	,	2 556	33	33	16,236 16,418	295,425 Cel 311,843 Cel		
6 202	23	70,213	31,131	48,267	21,401	52,532	144	4 91,614		Landfill closu	ure 29,93	7 85	21,401	1,194	10,029	6 2023	30,573	10,191		61		3 317,982	Closed	288,480	6 2023	3 1,706	14,32		34	34	16,602	328,444 Cel	1 Cell 1	
7 202			31,474	48,539	21,521	52,995	145			21,52				2,03		7 2024		0	0)	0	0 317,982			7 2024				58	58	28,261	356,705 Cel		
8 202 9 202			31,816 32,157	48,806 49,064	21,640 21,754	53,456 53,911	140		5	21,64				2,05		8 2025 9 2026	0	0)	0	0 317,982 0 317,982			9 202	5 2,929 6 2,953			59	59	28,506 28,749	385,211 Cel 413,960 Cel		
10 202	27	73,290	32,496	49,307	21,862	54,357	149			21,86				2,08		10 2027	0	0	0)	0	0 317,982			10 2027				60	60	28,987	442,947 Cel		
11 202 12 202			32,831 33,163	49,543 49,773	21,967 22,069	54,798 55,231	150 15 ⁻			21,96				2,10		11 2028 12 2029		0	()	0	0 317,982 0 317,982			11 2028				60	60	29,222 29,453	472,169 Cel 501,622 Cel		
13 202			33,489	49,773	22,069	55,655	15		•	22,00				2,110		13 2030		0)	0	0 317,982			12 2029				61	61	29,455	531,302 Cel		F47 470
14 203	31	76,255	33,810	50,203	22,259	56,069			ŀ	22,25	9 53,91	9 154		2,15	18,063	14 2031	0	0	0)	0	0 317,982	Closed		14 2031	1 3,072	25,80	4 1,024	61	61	29,900	561,202 Cel	2 Cell 2	517,470
15 203 16 203			34,128 34,442	50,405 50.600	22,349 22,435	56,476 56,878	15)	22,34				2,16		15 2032 16 2033		0	0)	0	0 317,982 0 317,982			15 2032				62	62	30,118 30,331	591,320 Cel 621.651 Cel		
17 203		78,366	34,746	50,775	22,433	57,259	15)	22,43				2.19	18.446	17 2034	0	0)	0	0 317,982			17 2034	4 3,137			63	63	30,531	652,185 Cel		
18 203	35	79,039	35,045	50,944	22,588	57,632		B 101,627	·	22,58	8 55,422	2 158		2,210		18 2035		0	0)	0	0 317,982	Closed		18 2035		26,52	3 1,053		63	30,733	682,919 Cel	2 Cell 2	
19 203 20 203			35,342 35,633	51,110 51,265	22,661 22,730	58,003 58,363	159			22,66				2,224		19 2036 20 2037	0	0	0)	0	0 317,982 0 317,982			19 2036					64	30,931 31,124	713,850 Cel 744,974 Cel		
21 203			35,918	51,411	22,795	58,713	16		, ,	22,79				2,25		21 2038	0	0	()	0	0 317,982			21 2038				64	64	31,311	776,285 Cel		
22 203			36,199	51,551	22,857	59,056	162)	22,85				2,26		22 2039		0	C)	0	0 317,982			22 2039				65	65	31,493	807,778 Cel		
23 204 24 204			36,477 36,751	51,686 51,821	22,917 22,977	59,394 59,728	163 164			22,91 22,97				2,27		23 2040 24 2041	0	0			0	0 317,982 0 317,982			23 2040	-,			65	65	31,673 31,851	839,450 Cel 871,301 Cel		
25 204	42	83,717	37,119	52,080	23,091	60,210	16	5 106,808	5	23,09	1 57,90	1 165		2,309	9 19,397	25 2042	0	0)	0	0 317,982	Closed		25 2042	2 3,299		0 1,100	66	66	32,108	903,410 Cel	2 Cell 2	
26 204			37,490	52,341	23,207	60,697	160			23,20				2,32		26 2043 27 2044		0	0)	0	0 317,982			26 2043				67	67	32,368	935,777 Cel		
27 204 28 204			37,865 38,243	52,602 52,865	23,323 23,440	61,188 61.683	16		6	23,32 23,44				2,34				0	((0	0 317,982 0 317,982			27 2042				67	68	32,630 32,894	968,407 Cel 1.001.301 Cel		
29 204	46	87,116	38,626	53,130	23,557	62,183	170	0 110,673	8	23,55	7 59,79	7 170		2,38	20,032	29 2046		ő	Ċ	Ď	0	0 317,982	Closed		29 2046	3,408	28,61	7 1,136	68	68	33,161	1,034,462 Cel	2 Cell 2	
30 204			39,012	53,395	23,675	62,687	172		2	23,67				2,40			0	0	0)	0	0 317,982			30 204				69	69	33,429	1,067,891 Cel		
31 204 32 204			39,402 39,796	53,662 53,930	23,793 23,912	63,195 63,708	17:			23,79 23,91				2,42		31 2048 32 2049		0			0	0 317,982 0 317,982			31 2048				69	69 70	33,701 33,973	1,101,592 Cel 1,135,565 Cel		
33 205	50		40,194	54,200	24,031	64,226	176	6 114,685		24,03				2,464		33 2050	0	0	0)	0	0 317,982	Closed		33 2050	,			70	70	34,250	1,169,815 Cel		
34 205			40,596	54,471	24,152	64,748	17		2	24,15				2,484		34 2051	0	0	()	0	0 317,982			34 205				71	71	34,529	1,204,344 Cel		
35 205 36 205			41,002 41,412	54,743 55.017	24,272 24,394	65,274 65,806	179			24,27 24,39				2,50 2,52		35 2052 36 2053		0			0	0 317,982 0 317,982			35 2052 36 2053				72	72	34,809 35.092	1,239,153 Cel 1,274,245 Cel		
37 205	54	94,334	41,826	55,292	24,516	66,342	183	2 118,850)	24,51	6 63,79	7 182		2,54	5 21,372	37 2054	0	0	c c)	0	0 317,982	Closed		37 2054	4 3,636	30,53	1,212	73	73	35,379	1,309,624 Cel	2 Cell 2	
38 205			42,245	55,569	24,638	66,883	183		6	24,63				2,56		38 2055		0	0)	0	0 317,982			38 2055				73	73	35,667	1,345,291 Cel		
39 205 40 205			42,667 43,094	55,847 56,126	24,761 24.885	67,428 67,979				24,76 24,88				2,58		39 2056 40 2057	0	0			0	0 317,982 0 317,982			39 2056 40 2057				74	74	35,958 36,252	1,381,249 Cel 1,417,501 Cel		
41 205			43,525	56,406	25,010	68,534				25,01				2,62		41 2058	0	0	0)	0	0 317,982			41 2058					75	36,547	1,454,048 Cel		
42 205			43,960	56,688	25,135	69,095	189			25,13				2,65		42 2059		0	0)	0	0 317,982			42 2059				76	76	36,847	1,490,895 Cel		
43 206 44 206			44,399 44,843	56,972 57,257	25,260 25,387	69,660 70,230	19 ⁻ 192			25,26 25,38				2,67		43 2060 44 2061	0	0	()	0	0 317,982 0 317,982			43 2060				76	76	37,148 37,452	1,528,043 Cel 1,565,495 Cel		
45 200			45,292	57,543	25,514	70,230	194			25,50				2,03		45 2062	0	0	()	0	0 317,982			44 200	-,				78	37,758	1,603,253 Cel		1,563,942
46 206	63 1	103,172	45,745	57,831	25,641	71,386	196	6 128,813		25,64	1 68,64			2,73	3 22,997	46 2063	0	0	()	0	0 317,982	Closed		46 2063	3 3,911	32,85	3 1,304		78	38,068	1,641,321 Cel	3 Cell 3	
47 206 48 206			46,202 46,664	58,120 58,411	25,769 25,898	71,972 72,562	19			25,76 25,89		197		2,76		47 2064 48 2065	0	0	((0	0 317,982 0 317,982			47 2064	4 3,944 5 3,976	00,12		79	79 80	38,381 38,696	1,679,702 Cel 1,718,398 Cel		
49 206	66 10	106,298	47,131	58,703	26,028	73,159	200	0 132,326		26,02	8 70,353	3 200		2,80	3 23,568	49 2066		0	()	0	0 317,982	Closed		49 2066	6 4,008	33,66	9 1,336	80	80	39,013	1,757,411 Cel	3 Cell 3	
50 206	67 1	107,361	47,602	58,996	26,158	73,760	202	2 133,519		26,15	8 70,93	1 202		2,82	23,762	50 2067	0	0	0)	0	0 317,982	Closed		50 2067	7 4,042	33,94	6 1,347	81	81	39,334	1,796,745 Cel	3 Cell 3	
Totals	4.4	465,392 2,03	124 427	2,772,844	1,260,924	3,285,351		5,726,315		1,041,50	4 2,736,589	9		329,342	916,757		1		I	1	1	1	1			1	L	1	L	L				1

CVRD growth rate beyond 2041 =	1%	
CVRD disposal rate 2015-2016=	0.57	tonnes per person per year (46% diversion
CVRD disposal rate 2017-2020=	0.55	tonnes per person per year (48% diversion
CVRD disposal rate 2021-2067=	0.44	tonnes per person per year (58% diversion
SRD growth rate beyond 2041 =	0.50%	
SRD disposal rate 2015-2016=	0.57	tonnes per person per year (46% diversior
SRD disposal rate 2017-2020=	0.55	tonnes per person per year (48% diversion
SRD disposal rate 2021-2067=	0.44	tonnes per person per year (58% diversion

Days of operation = 351 days per year Bottom ash/residuals to landfill = 34% % of input

 In-situ MSW waste density =
 0.7
 tonnes per m³
 In-situ MSW waste density =
 0.7
 tonnes per m³

 Operational soll =
 2%
 of waste volume per year
 In-situ MSW waste density =
 0.7
 tonnes per m³

 Waste to cover ratio =
 3.1
 Operational soll =
 2%
 of waste volume per year

 Settlement =
 2%
 of waste volume per year
 Waste to cover ratio =
 3.1

 Settlement =
 2%
 of waste volume per year
 Waste to cover ratio =
 3.1

	0.7
=	07

Table D1: Long Term Cost Model for Option 1(a) - WTT facility located in Comox Valley - Increasing Capacity

	Capital and Operating Costs																
Year	r	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	Capital -	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 2016					\$16.000.000							\$0 \$16.000.000	New Transfer station constructed 2012-2013		Construction of leachate management system and Cell 1	
	2017					\$10,000,000	\$ 860,000	\$ 265,000	\$1,141,495		\$250,868	\$1,052,753	\$3,570,000			Closure Phase 2	Phase 2 SW mgmt design & partial construe
	2018						\$ 200,000	\$ 2,500,000	\$1,141,495		\$490,358	\$1,052,753	\$5,385,000			Closure Phase 2	Phase 2 Surface water management constr
	2019						\$-		\$1,141,495	\$390,000	\$191,695	\$1,052,753	\$2,776,000				Phase 2 Design and construction
	2020	\$200,000			\$906,279		\$ 1,075,000		\$1,141,495	\$190,000	\$491,790	\$1,052,753	\$5,057,000	New trailers every 8 years	Permits and land		Phase 2 LFG and final cover design
	2021				\$5,245,520		\$ 35,000		\$575,124	\$190,000	\$5,630,329	\$1,052,753	\$12,729,000		WTT facility begins operating		Phase 2 LFG and final cover construction
5	2022 2023				\$5,282,505 \$5,319,875		\$ -		\$575,124 \$575,124	\$190,000 \$190,000	\$0 \$218.613	\$1,052,753 \$1,052,753	\$7,100,000 \$7,391,000				Phase 3 LFG and final cover design
	2023		\$651.040	\$318,516	\$7.691.586		\$ 35,000		\$575,124	\$390,000	\$3,108,685	\$1,052,755	\$12,925,000				Phase 3 LFG and final cover construction
	2024		\$651,040	\$320,269	\$7,741,557		\$ -		\$575,124	\$190,000	\$3,100,000	\$190,000	\$9,668,000				These of Er of and imar cover construction
	2026		\$651,040	\$321,962	\$7,790,963		\$ -		\$575,124	\$190,000		\$190,000	\$9,719,000				
	2027		\$651,040	\$323,556	\$7,839,354		\$ 585,000		\$575,124	\$190,000		\$190,000	\$10,354,000				
1	2028	\$200,000	\$651,040	\$325,105	\$7,887,069		\$ -		\$575,124	\$190,000		\$190,000	\$10,018,000	New trailers every 8 years			
	2029		\$651,040	\$326,614	\$7,934,106		\$ 385,000		\$575,124	\$390,000		\$190,000	\$10,452,000				
3	2030		\$651,040	\$328,051	\$7,980,016	\$8,850,000	\$-		\$575,124	\$190,000		\$190,000	\$18,764,000			Construction Cell 2	
	2031		\$651,040	\$329,436	\$8,025,023		\$ -		\$650,124	\$190,000		\$190,000	\$10,036,000				
5 6	2032	\$346,000	\$651,040	\$330,761	\$8,069,128			\$ 1,350,000		\$190,000		\$190,000	\$11,777,000	Transfer station - parking and roads (20 yr life) + capital upgrades		Closure Cell 1	
	2033 2034		\$651,040 \$651,040	\$332,041	\$8,112,669		\$ 235,000		\$650,124	\$190,000		\$190,000	\$10,361,000				
	2034		\$651,040	\$333,189 \$334,298	\$8,154,066 \$8,194,562		\$ -		\$650,124 \$650,124	\$390,000		\$190,000 \$190,000	\$10,368,000				
	2035	\$200,000	\$651,040	\$335,388	\$8,234,831		\$ 35,000		\$650,124	\$190,000 \$190,000		\$190,000	\$10,245,000 \$10,451,000	New trailers every 8 years			
	2037	\$200,000	\$651,040	\$336,405	\$8,273,747		\$ 550,000		\$650,124	\$190,000		\$190,000	\$10,841,000				
1	2038		\$651,040	\$337,363	\$8,311,761		\$ -		\$650,124	\$190,000		\$190,000	\$10,330,000				
2 3	2039		\$651,040	\$338,281	\$8,348,985		\$ 35,000		\$650,124	\$390,000		\$190,000	\$10,603,000				
3	2040		\$651,040	\$339,167	\$8,385,645		\$ -		\$650,124	\$190,000		\$190,000	\$10,406,000				
	2041		\$651,040	\$340,053	\$8,421,854		\$ 385,000		\$650,124	\$190,000		\$190,000	\$10,828,000				
5	2042		\$651,040	\$341,753	\$8,474,193		\$-		\$650,124	\$190,000		\$190,000	\$10,497,000				
	2043		\$651,040	\$343,462	\$8,526,983		\$ 200,000		\$650,124	\$190,000		\$190,000	\$10,752,000				
	2044 2045	\$200,000	\$651,040	\$345,180	\$8,580,225		\$ -		\$650,124	\$390,000		\$190,000	\$11,007,000	New trailers every 8 years			
	2045		\$651,040 \$651.040	\$346,905 \$348,640	\$8,633,918 \$6,745,102		\$ 35,000		\$650,124 \$650,124	\$190,000 \$190,000		\$190,000 \$190,000	\$10,697,000 \$8,775,000		Amotization period over		
0	2040		\$651,040	\$350,383	\$6,799,810		\$ 585,000		\$650,124	\$190,000		\$190,000	\$9,416,000		Amouzation period over		
	2048		\$651.040	\$352,135	\$6.854.969		\$ -		\$650,124	\$190,000		\$190,000	\$8,888,000		5 5 5 5		
	2049		\$651,040	\$353,896	\$6,910,692		\$ -		\$650,124	\$390,000		\$190,000	\$9,146,000				
	2050		\$651,040	\$355,665	\$6,966,754		\$ -		\$650,124	\$190,000		\$190,000	\$9,004,000				
4	2051	\$241,000	\$651,040	\$357,444	\$7,023,379		\$ 35,000		\$650,124	\$190,000		\$190,000	\$9,338,000	Transfer station permits etc			
5	2052	\$2,615,000	\$651,040	\$359,231	\$7,080,569		\$-		\$650,124	\$190,000		\$190,000	\$11,736,000	Transfer station - new facility + new trailer:			
3	2053		\$651,040	\$361,027	\$7,138,210		\$ 585,000		\$650,124	\$190,000		\$190,000	\$9,765,000				
	2054		\$651,040	\$362,832	\$7,196,302		<u> </u>		\$650,124	\$390,000		\$190,000	\$9,440,000				
	2055		\$651,040	\$364,646	\$7,254,958		ş -		\$650,124	\$190,000		\$190,000	\$9,301,000				
	2056		\$651,040	\$366,469	\$7,314,178		\$ -		\$650,124	\$190,000		\$190,000	\$9,362,000				
	2057		\$651,040	\$368,302	\$7,373,849		\$ 585,000		\$650,124	\$190,000		\$190,000	\$10,008,000				
	2058		\$651,040	\$370,143	\$7,434,197		\$ -		\$650,124	\$190,000		\$190,000	\$9,486,000				
	2059	6 000 000	\$651,040	\$371,994	\$7,494,883		\$ 35,000		\$650,124	\$390,000		\$190,000	\$9,783,000				
3 4	2060 2061	\$200,000	\$651,040 \$651,040	\$373,854 \$375,723	\$7,556,246 \$7,618,061	\$7,800,000	ə - S -		\$650,124 \$650,124	\$190,000 \$190,000		\$190,000 \$190,000	\$9,811,000 \$17,475,000	New trailers every 8 years		Construction Cell 3	
	2062		\$651,040	\$377,602	\$7,680,552	\$1,000,000	\$ -		\$725,124	\$190,000		\$190,000	\$9,814,000				
	2062		\$651.040	\$379,490	\$7,743,494		\$ 235,000	\$ 2,850,000	\$725,124	\$190,000		\$190,000	\$12,964,000			Closure Cell 2	
	2064		\$651,040	\$381,387	\$7,807,001		\$ -		\$725,124	\$390,000		\$190,000	\$10,145,000				
3	2065		\$651,040	\$383,294	\$7,871,071		\$ 385,000		\$725,124	\$190,000		\$190,000	\$10,396,000				
	2066		\$651,040	\$385,211	\$7,935,818		\$-		\$725,124	\$190,000		\$190,000	\$10,077,000				
0	2067		\$651,040	\$387,137	\$8,001,017		\$ 550,000		\$725,124	\$190,000		\$190,000	\$10,694,000				
				\$15,414,260	\$358,167,529	1							\$509,931,000				

30 years \$303,298,000 1,792,501 tonnes \$169 per tonne over 30 years

40 years \$399,286,000 2,448,090 tonnes \$163 per tonne over 40 years

50 years \$509,931,000 3,159,253 tonnes \$161 per tonne over 50 years



Table D2: Long Term Cost Model for Option 1(b) - WTT facility located in Campbell River - Increasing Capacity

Year F	Projected CVRD Population	CVRD Waste	Projected																						Volumetric						
2015			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 MSW to CRWMC LF	Tonnes to MSW CVWMC LF	Tonnes Ash/Residual s to CVWMC LF	Year	Volumetric MSW Disposal Rate	Daily Cover Soil	Operational Soil	Settlement	Net Fill Volume	Cumulative Fill Volume Pha	se Volumetric Capacity (m ³)	Year	Volumetric MSW Disposal Rate	Ash / Residuals Disposal Rate	Daily Cover Soil	Operational Soil	Settlement			hase / Volumetric Cell Capacity (m ³)
2015		tonnes		tonnes	tonnes / yr	tonnes / day		tonnes	tonnes	tonnes	tonnes / day		tonnes			m ³	m ³	m ³	m ³	m ³	m ³			m ³	m ³	m ³	m ³	m ³	m ³	m ³	
	64.294	36.652	45.871	26 149	62,801	17	90.443	2				26,149	36.652		2015	37.356	12.452	747	747	49.808			2	015 52.36	0	17.453	1 047	1.047	69.813		
2016	64,847	36,967	46,187	26,330	63,297	172	91,177	7				26,330	36,967		2016	37,614	12,538	752	752	50,152	Phase	3	2	016 52,81	0	17,603	1,056	1,056	70,413		ase 2
0 2017 1 2018	65,592 66,372	36,007 36,435	46,490 46,809	25,521 25,696	61,527 62,131	169 170						25,521 25.696	36,007 36,435	0	0 2017 1 2018	36,458 36,708	12,153 12,236	729 734	729		48,611 Phase 97,555 Phase		0 2	017 51,43 018 52,05		0 17,146 0 17,350	1,029 1.041	1,029 1.041	68,584 69,400		ase 2
2 2018	67,139	36,856	40,009	25,864	62,131	172		3				25,864	36,435	0	2 2018	36,949	12,230	739	739		146,821 Phase			018 52,05		17,550	1,041		70,202	208,186 Cell 1 Ce	
3 2020	67,905 68.667	37,276	47,419 47,706	26,031	63,307	173				29.278		26,031	37,276	0	3 2020 4 2021	37,187 30,217	12,396 10.072	744 604	744		196,403 Phase 236,693 Phase			020 53,25		0 17,751 2 556	1,065	1,065	71,003 16,236		1
4 2021 5 2022	69,436	30,446 30,787	47,706	21,152 21,276	51,598 52,063	143	90,712			29,278	83	21,152	1,168 1,181	9,808 9,918	5 2022	30,217 30,395	10,072	604	604	40,290	236,693 Phase 277,219 Phase			021 1,66 022 1,68			33 34	33	16,236	295,425 Cell 1 Ce 311.843 Cell 1 Ce	1 1
6 2023	70,213	31,131	48,267	21,401	52,532	144	91,614	4 29,937	Landfill closu	29,937	85	21,401	1,194	10,029	6 2023	30,573		611	611	40,763	317,982 Closed	288,480	6 2	023 1,70	6 14,327	7 569	34	34 34	16,602	328,444 Cell 1 Ce	II 1
7 2024 8 2025	70,986 71,758	31,474 31,816	48,539 48,806	21,521 21,640	52,995 53 456	145 146			3	50,963 51,406	145		2,033 2,050	17,072 17,221	7 2024 8 2025	0	0	0	(0	317,982 Closed 317,982 Closed			024 2,90 025 2,92			58 59	58 59	28,261 28,507		1 1
9 2026	72,527	32,157	49,064	21,754	53,911	148	94,281	1 30,089)	51,844	148		2,068	17,368	9 2026	0	0	0	(0	317,982 Closed	1	9 2	026 2,95	4 24,811	1 985	59	59	28,750	413,962 Cell 1 Ce	# 1
10 2027	73,290	32,496	49,307	21,862	54,357	149				52,273	149		2,085	17,511	10 2027	0	0	0	(0	317,982 Closed			027 2,97			60	60	28,987		ll 1
11 2028 12 2029	74,047 74,795	32,831 33,163	49,543 49,773	21,967 22,069	54,798 55,231	150				52,696 53,113	150		2,102 2,118	17,653 17,793	11 2028 12 2029	0	0	0	(0	317,982 Closed 317,982 Closed			028 3,00 029 3,02			61	61	29,222 29,453		1 1
13 2030	75,531	33,489	49,992	22,166	55,655	152	97,697	7 31,354	ł	53,520	152		2,135	17,929	13 2030	0	0	0	(0	317,982 Closed	t	13 2	030 3,05	0 25,613	3 1,017	61	61	29,679	531,304 Cell 2 Ce	1 517 470
14 2031 15 2032	76,255 76,971	33,810 34,128	50,203 50,405	22,259 22,349	56,069 56,476)	53,919 54,310	154		2,151 2,166	18,063 18,194	14 2031 15 2032	0	0	0	(0	317,982 Closed 317,982 Closed			031 3,07 032 3,09			61	61	29,900 30,117		11 2 011,470
16 2032	77,681	34,120	50,600	22,349	56,878				1	54,696	155		2,100	18,323	15 2032 16 2033	0	0	0	(0	317,982 Closed			032 3,09			62	62	30,331	621,653 Cell 2 Ce	
17 2034	78,366	34,746	50,775	22,513	57,259	157				55,063	157		2,196	18,446	17 2034	0	0	0	(0 0	317,982 Closed			034 3,13			63	63	30,535		11 2
18 2035 19 2036	79,039 79,710	35,045 35,342	50,944 51,110	22,588 22,661	57,632 58,003				ļ ,	55,422 55,779	158		2,211 2,225	18,566 18,686	18 2035 19 2036	0	0	0	(0	317,982 Closed 317,982 Closed		18 2	035 3,15 036 3,17			63	63	30,734 30,932		2 2
20 2037	80,366	35,633	51,265	22,001	58,363				ł	56,124	160		2,223	18,802	20 2037	0	0	0	(0	317,982 Closed	1		037 3,19			64	64	31,123		11 2
21 2038	81,010	35,918	51,411	22,795	58,713	161			3	56,461	161		2,252	18,915	21 2038	0	0	0	(0	317,982 Closed			038 3,21			64	64	31,310		11 2
22 2039 23 2040	81,643 82,270	36,199 36,477	51,551 51,686	22,857 22,917	59,056 59,394	162 163				56,791 57,116	162		2,265 2,278	19,025 19,134	22 2039 23 2040	0	0	0	(317,982 Closed 317,982 Closed			039 3,23 040 3,25			65	65	31,493 31,673		2 2
24 2041	82,888	36,751	51,821	22,977	59,728	164	105,865			57,437	164		2,291	19,241	24 2041	0	0	0	(0	317,982 Closed	d l		041 3,27	3 27,488	3 1,091	65	65	31,851	871,305 Cell 2 Ce	11 2
25 2042 26 2043	83,717 84,554	37,119 37,490	52,080 52,341	23,091	60,210 60,697	165				57,901 58,369	165		2,309 2,328	19,397 19,554	25 2042 26 2043	0	0	0	(0	317,982 Closed 317,982 Closed			042 3,29 043 3,32			66	66	32,109 32,368		2 2
26 2043	84,554	37,490	52,341	23,207 23,323	61,188					58,369	168		2,328	19,554	26 2043	0	0	0	(0	317,982 Closed			043 3,32			67	67	32,368		12
28 2045	86,254	38,243	52,865	23,440	61,683		109,693	3 35,877	,	59,317	169		2,366	19,871	28 2045	0	0	0	(0	317,982 Closed	đ	28 2	045 3,38			68	68	32,894	1,001,305 Cell 2 Ce	11 2
29 2046 30 2047	87,116 87,987	38,626 39,012	53,130 53,395	23,557 23,675	62,183 62,687	170 172			2	59,797 60,282	170		2,385 2,404	20,032 20,195	29 2046 30 2047	0	0	0	(0	317,982 Closed 317,982 Closed	1	29 2 30 2	046 3,40 047 3,43			68	68 69	33,160 33,429		2 2
31 2048	88,867	39,402	53,662	23,793	63,195	173				60,771	172		2,404	20,358	21 2038 22 2039 23 2040 24 2041 25 2042 26 2043 27 2044 28 2045 29 2046 30 2047 31 2048	0	0	0	(0	317,982 Closed			048 3,46			69	69	33,700		11 2
32 2049	89,756	39,796	53,930	23,912	63,708	175	5 113,668	3 37,353		61,265	175		2,444	20,524	32 2049	0	0	0	(0	317,982 Closed	t l	32 2	049 3,49			70	70	33,974	1,135,569 Cell 2 Ce	11 2
33 2050 34 2051	90,653 91,560	40,194 40,596	54,200 54,471	24,031 24,152	64,226 64,748	176				61,762 62,264	176		2,463 2,483	20,690 20,859	33 2050 34 2051	0	0	0	(0	317,982 Closed 317,982 Closed			050 3,51 051 3,54			70	70	34,250 34,528		2 2
35 2052	92,476	41,002	54,743	24,272	65,274	179	116,748	38,498		62,771	179		2,504	21,028	35 2052	0	0	0	(0	317,982 Closed	d	35 2	052 3,57	7 30,040	1,192	71	71	34,809		#1 2 #1 2
36 2053 37 2054	93,400 94,334	41,412 41.826	55,017	24,394 24,516	65,806 66,342					63,282 63,797	180		2,524 2,545	21,199 21,372	32 2049 33 2050 34 2051 35 2052 36 2053 37 2054	0	0	0	(0	317,982 Closed			053 3,60 054 3.63			72	72	35,093		12
37 2054	94,334 95,278	41,826	55,292 55,569	24,516	66,883	182				64,317	182		2,545	21,372	37 2054 38 2055	0	0	0	(0	317,982 Closed 317,982 Closed			054 3,63 055 3,66			73	73 73	35,378 35,667	1,309,628 Cell 2 Ce 1,345,295 Cell 2 Ce	#12 #12
39 2056	96,230	42,667	55,847	24,761	67,428	185	5 120,992			64,842	185		2,586	21,722	39 2056 40 2057	0	0	0	(0	317,982 Closed			056 3,69	5 31,032		74	74	35,958		11 2
40 2057	97,193	43,094	56,126	24,885	67,979		,			65,371	186		2,607	21,899		0	0	0	(0	317,982 Closed			057 3,72			74	74	36,251		11 2
41 2058 42 2059	98,165 99,146	43,525 43,960	56,406 56,688	25,010 25,135	68,534 69.095					65,906 66,444	188		2,629 2,650	22,078 22,259	41 2058 42 2059	0	0	0	(0	317,982 Closed 317,982 Closed			058 3,75 059 3,78			75	75	36,548 36,846	1,454,051 Cell 2 Ce 1,490,898 Cell 2 Ce	
43 2060	100,138	44,399	56,972	25,260	69,660	191	1 125,398	3 41,728		66,988	109		2,672	22,441	43 2060	0	0	0	(0	317,982 Closed	đ	43 2	060 3,81	7 32,059	9 1,272	76	76	37,148	1,528,046 Cell 2 Ce	11 2 11 2
44 2061	101,139	44,843	57,257	25,387	70,230	192	2 126,526			67,536	192		2,694	22,625	44 2061	0	0	0	(0	317,982 Closed			061 3,84		1 1,283	77	77	37,452	1,565,498 Cell 3 Ce	
45 2062 46 2063	102,151 103,172	45,292 45,745	57,543 57,831	25,514 25,641	70,805 71,386				7	68,090 68,648	194 196		2,716	22,810 22,997	45 2062 46 2063	0	0	0	(0	317,982 Closed 317,982 Closed	3	45 2	062 3,88 063 3,91			78 78	78 78	37,759 38.068	1,603,256 Cell 3 Ce 1,641,325 Cell 3 Ce	II 3
47 2064	104,204	46,202	58,120	25,769	71,972	197	129,973	3 43,442	2	69,211	197		2,761	23,186	47 2064	0	0	0	Ċ	0 O	317,982 Closed	t	47 2	064 3,94	4 33,122	2 1,315	79	79	38,381	1,679,705 Cell 3 Ce	11 3
48 2065 49 2066	105,246 106,298	46,664	58,411 58,703	25,898 26,028	72,562 73,159					69,779 70,353	199		2,783 2,806	23,376 23,568	48 2065 49 2066	0	0	0	(0	317,982 Closed 317,982 Closed			065 3,97 066 4,00			80	80	38,696 39,014		3 3
49 2066 50 2067	106,298	47,131 47,602	58,703	26,028	73,159	200				70,353	200		2,806	23,568	49 2066 50 2067	0	0	0	(0	317,982 Closed			067 4,00			80	80	39,014		ll 3
Totals			2,772,844				5,726,315			2,736,587		219,420	329,344	916,757												<i></i>					

 CVRD growth rate beyond 2041 =
 1%

 CVRD disposal rate 2015-2016 =
 0.57

 tonnes per person per year (46% diversion)

 CVRD disposal rate 2017-2020 =
 0.55

 tonnes per person per year (46% diversion)

 CVRD disposal rate 2017-2026 =
 0.54

 SRD growth rate beyond 2041 =
 0.50%

 SRD disposal rate 2015-2016 =
 0.57

 tonnes per person per year (46% diversion)

 SRD disposal rate 2017-2020 =
 0.55

 tonnes per person per year (46% diversion)

 SRD disposal rate 2021-2067 =
 0.44

 tonnes per person per year (46% diversion)

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 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 = 0.7 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 D2: Long Term Cost Model for Option 1(b) - WTT facility located in Campbell River - Increasing Capacity

							Capital and Op	perating Costs											
Ye	ar	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	C
-	0045																		
	2015 2016				1		\$16.000.000							\$0 \$16,000,000		New Transfer station constructed 2012-2013		Construction of leachate management system and Cell 1	
	2010						\$10,000,000	\$ 860,000	\$ 265,000	\$1,141,495		\$250,868	\$1,052,753	\$3,570,000				Closure Phase 2	Phase 2 SW mgmt d
	2018							\$ 200,000	\$ 2,500,000	\$1,141,495	1	\$490,358	\$1,052,753	\$5,385,000				Closure Phase 2	Phase 2 Surface wat
2	2019							\$ -		\$1,141,495	\$390,000	\$191,695	\$1,052,753	\$2,776,000					Phase 2 Design and
	2020	\$311,025			Ash / residuals	\$715,115		\$ 1,075,000		\$1,141,495	\$190,000	\$491,790	\$1,052,753	\$4,977,000	Permits		Permits and land		Phase 2 LFG and fin
	2021	\$3,310,000	\$709,508	\$433,315	\$145,160	\$5,245,520		\$ 35,000		\$575,124	\$190,000	\$5,630,329	\$1,052,753	\$17,327,000	New transfer station		WTT facility begins operating		Phase 2 LFG and fin
5	2022		\$709,508	\$438,167	\$146,786	\$5,282,505		\$ -		\$575,124	\$190,000	\$0	\$1,052,753	\$8,395,000					
	2023		\$709,508	\$443,070	\$148,429	\$5,319,875		\$ 35,000		\$575,124	\$190,000	\$218,613	\$1,052,753	\$8,692,000					Phase 3 LFG and fin Phase 3 LFG and fin
	2024		\$709,508	\$435,731	\$252,673	\$7,691,551		\$ -		\$575,124	\$390,000	\$3,108,685	\$190,000	\$13,353,000					Phase 3 LFG and tin
	2025 2026		\$709,508 \$709,508	\$440,536 \$445,323	\$254,869 \$257,040	\$7,741,522 \$7,790,916		\$ - \$ -		\$575,124 \$575,124	\$190,000 \$190,000		\$190,000 \$190,000	\$10,102,000 \$10,158,000					
	2020		\$709,508	\$450,077	\$259,167	\$7,839,300		\$ 585,000		\$575,124	\$190,000		\$190,000	\$10,798,000					
	2028		\$709,508	\$454,795	\$261,266	\$7,887,058		\$ 505,000		\$575,124	\$190,000		\$190,000	\$10,268,000					
	2029	\$200,000	\$709,508	\$459,457	\$263,334	\$7,934,096		\$ 385,000		\$575,124	\$390,000		\$190,000	\$11,107,000	New trailers every 8 years				
	2030		\$709,508	\$464,046	\$265,353	\$7,980,027	\$8,850,000	\$ -		\$575,124	\$190,000		\$190,000	\$19,224,000				Construction Cell 2	
	2031		\$709,508	\$468,562	\$267,329	\$8,024,996		\$ -		\$650,124	\$190,000		\$190,000	\$10,501,000					
15	2032		\$709,508	\$473,029	\$269,270	\$8,069,147		\$ -	\$ 1,350,000	\$650,124	\$190,000		\$190,000	\$11,901,000				Closure Cell 1	
	2033		\$709,508	\$477,461	\$271,183	\$8,112,673		\$ 235,000		\$650,124	\$190,000		\$190,000	\$10,836,000					
	2034		\$709,508	\$481,739	\$273,001	\$8,154,035		\$ -		\$650,124	\$390,000		\$190,000	\$10,848,000					
	2035		\$709,508	\$485,943	\$274,781	\$8,194,532		\$ 35,000		\$650,124	\$190,000		\$190,000	\$10,730,000					
	2036		\$709,508	\$490,136	\$276,550	\$8,234,787		\$-		\$650,124	\$190,000		\$190,000	\$10,741,000					
	2037	\$200,000	\$709,508	\$494,237	\$278,265	\$8,273,793		\$ 550,000		\$650,124	\$190,000		\$190,000	\$11,536,000	New trailers every 8 years				
	2038		\$709,508	\$498,264	\$279,935	\$8,311,788		\$ -		\$650,124	\$190,000		\$190,000	\$10,830,000					
	2039		\$709,508	\$502,223	\$281,569	\$8,348,966		\$ 35,000		\$650,124	\$390,000		\$190,000	\$11,107,000					
	2040	A4 555 405	\$709,508	\$506,146	\$283,180	\$8,385,614		\$ -		\$650,124	\$190,000		\$190,000	\$10,915,000	M-1				
	2041 2042	\$1,555,125	\$709,508 \$709,508	\$510,011 \$515,177	\$284,772 \$287,072	\$8,421,830 \$8,474,157		\$ 385,000		\$650,124 \$650,124	\$190,000 \$190,000		\$190,000 \$190,000	\$12,896,000 \$11,016,000	Major capital upgrade every 20 years				
	2042		\$709,508	\$520,394	\$289,392	\$8,526,945		\$ 200,000		\$650,124	\$190,000		\$190,000	\$11,276,000					
	2043		\$709,508	\$525,664	\$291,733	\$8,580,198		\$ 200,000		\$650,124	\$390,000		\$190,000	\$11,337,000					
	2045	\$200,000	\$709,508	\$530,987	\$294,094	\$8,633,921		\$ 35,000		\$650,124	\$190,000		\$190,000	\$11,434,000	New trailers every 8 years				
	2045	\$200,000	\$709,508	\$536,363	\$296,476	\$6,745,158		\$ -		\$650,124	\$190,000		\$190,000	\$9,318,000	New daliers every o years		Amotization period over		
30	2047		\$709,508	\$541,794	\$298,879	\$6,799,833		\$ 585,000		\$650,124	\$190,000		\$190,000	\$9,965,000			/ modelation poned ever		
31	2048		\$709,508	\$547,279	\$301,304	\$6,854,991		\$ -		\$650,124	\$190,000		\$190,000	\$9,443,000					
	2049		\$709,508	\$552,819	\$303,749	\$6,910,636		\$ -		\$650,124	\$390,000		\$190,000	\$9,707,000					
33	2050		\$709,508	\$558,415	\$306,217	\$6,966,774		\$ -		\$650,124	\$190,000		\$190,000	\$9,571,000					
34	2051		\$709,508	\$564,067	\$308,706	\$7,023,408		\$ 35,000		\$650,124	\$190,000		\$190,000	\$9,671,000					
	2052		\$709,508	\$569,777	\$311,217	\$7,080,543		\$-		\$650,124	\$190,000		\$190,000	\$9,701,000					
	2053	\$200,000	\$709,508	\$575,543	\$313,751	\$7,138,184		\$ 585,000		\$650,124	\$190,000		\$190,000	\$10,552,000	New trailers every 8 years				
	2054		\$709,508	\$581,368	\$316,307	\$7,196,335		\$ -		\$650,124	\$390,000		\$190,000	\$10,034,000					
	2055		\$709,508	\$587,251	\$318,886	\$7,255,002		\$ -		\$650,124	\$190,000		\$190,000	\$9,901,000					
	2056		\$709,508	\$593,194	\$321,487	\$7,314,189		\$ -		\$650,124	\$190,000		\$190,000	\$9,969,000					
	2057		\$709,508	\$599,196	\$324,112	\$7,373,901		\$ 585,000		\$650,124	\$190,000		\$190,000	\$10,622,000					
	2058		\$709,508	\$605,258	\$326,760	\$7,434,143		\$ -		\$650,124	\$190,000		\$190,000	\$10,106,000					
	2059 2060		\$709,508 \$709,508	\$611,382 \$617,567	\$329,431 \$332,126	\$7,494,920		\$ 35,000		\$650,124 \$650,124	\$390,000 \$190.000		\$190,000 \$190.000	\$10,410,000					
	2060	\$1,755,125	\$709,508	\$623,815	\$332,126	\$7,556,237 \$7,618,099	\$7,800,000	\$ - \$ -		\$650,124 \$650,124	\$190,000		\$190,000	\$10,246,000 \$19,872,000	Major capital upgrade every 20 years			Construction Cell 3	
	2061	ψ1,733,125	\$709,508	\$630,125	\$337,588	\$7,680,511	φ1,000,000	\$ -		\$725,124	\$190,000		\$190,000	\$10,463,000	major capital upgraue every 20 years				
46	2062		\$709,508	\$636,498	\$340,356	\$7,743,478		\$ 235,000	\$ 2,850,000	\$725,124	\$190,000	1	\$190,000	\$13,620,000				Closure Cell 2	
	2064		\$709,508	\$642,936	\$343,148	\$7,807,006		\$ -	- 2,000,000	\$725,124	\$390,000		\$190,000	\$10,808,000					
48	2065		\$709,508	\$649,439	\$345,966	\$7,871,100		\$ 385,000		\$725,124	\$190,000	1	\$190,000	\$11,066,000					
49	2066		\$709,508	\$656,007	\$348,808	\$7,935,764		\$ -		\$725,124	\$190,000		\$190,000	\$10,755,000					
50	2067		\$709,508	\$662,641	\$351,675	\$8,001,005		\$ 550,000		\$725,124	\$190,000		\$190,000	\$11,380,000					
Tot	tals	\$7.731.275	\$33,346,853	\$25,087,222	\$13,567,996	\$357,976,084	\$16,650,000	\$7,645,000	\$6,965,000	\$34,821,800	\$11,310,000	\$10,382,338	\$15,729,269	\$541,216,000					

30 years \$323,319,000 1,792,501 tonnes \$180 per tonne over 30 years

40 years \$422,490,000 2,448,090 tonnes \$173 per tonne over 40 years

50 years \$541,216,000 3,159,253 tonnes \$171 per tonne over 50 years

CRWMC LF Notes
imt design & partial construction
and construction and construction and final cover design and final cover construction
id final cover design id final cover construction

Table D3: Long Term Cost Model for Option 1(c) - WTT facility located in Gold River - Increasing Capacity

 | Population ar | nd Disposal Rate | s | |
 | | |
 | | | | | | CRWMC LF F
 | II Rate and C | apacity | | | | |
 | | | CVWMC LF Fi | II Rate and Ca | pacity | | | |
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--|---|---|--|--|---|--|
| Year | Projected
CVRD
Population | CVRD
Waste | Projected
SRD
Population | SRD Waste | Total Annual
Tonnage
tonnes / yr
 | Tonnage | Combined
Population | Tonnes to
Comox
Valley TS | River 13 | Tonnes to
WTT Facility
tonnes
 | day to WTT
facility | onnes MSW
to CRWMC
LF | CVWMC LF
 | Tonnes
Ash/Residual
s to CVWMC
LF | Year | D | | Daily
over Soil
m ³ | Operational
Soil
m ³
 | Settlement
m ³ | Net Fill
Volume
m ³ | Cumulative
Fill Volume
m ³ | Phase | Volumetric
Capacity (m³) | Year | Volumetric
MSW
Disposal
Rate
m ³
 | Volumetric
Ash /
Residuals
Disposal
Rate
m ³ | Daily
Cover Soil
m ³ | Operational
Soil
m ³ | Settlement | Net Fill
Volume
m ³ | | ase / Phase
ell Cell | |
| 2015 2016 2017 2018 2017 2019 32020 422019 32021 52022 62033 72024 82020 102027 112028 122029 132030 142031 152022 203317 204 20313 2032 132030 142031 2032 2033 204 | 65.592
66.372
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| Totals | 4,465,392 | 2,024,427 | 2,772,844 | 1,260,924 | 3,285,351
 | | 5,726,315 | 1,695,083 | 1,041,504 | 2,736,587
 | | 219,420 | 329,344
 | 916,757 | | | | |
 | | | | | | In-situ | ash / residuals v
 | vaste densitu = | 0.7 | tonnes per m ³ | | | | | |

CVRD growth rate beyond 2041
CVRD disposal rate 2015-2016
CV/DD dispessel rate 2017 2020

•		4,400,002	2,024,421	2,112,044	1,200,324	0,200,001		
	CVRD	growth rate bey	ond 2041 =	1%				
	CVR	D disposal rate	2015-2016=	0.57	tonnes per per	son per year (+	46% diversion)	
	CVR	D disposal rate	2017-2020=	0.55	tonnes per per	son per year (48% diversion)	
	CVR	D disposal rate :	2021-2067=	0.44	tonnes per per	son per year (58% diversion)	
	SRD	growth rate bey	ond 2041 =	0.50%				
	SR	D disposal rate	2015-2016=	0.57	tonnes per per	son per year (+	46% diversion)	
	SR	D disposal rate .	2017-2020=	0.55	tonnes per per	son per year (48% diversion)	
	SR	D disposal rate	2021-2067=	0.44	tonnes per per	son per year (58% diversion)	
		Davs of	operation =	351	days per year			
	Botto	om ash/residuals			% of input			

0.57	tonnes per person per year (46% diversio
0.55	tonnes per person per year (48% diversio
0 44	tonnes per person per vear (58% diversio

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

Table D3: Long Term Cost Model for Option 1(c) - WTT facility located in Gold River - Increasing Capacity

							Capita	al and Operating	Costs							-		,		
'ear	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	Capital - 0	WMC LF CVWMC apital - Operatin Closure Expansi	g - Operating -	CRWMC LI Capital	F 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	
2017											265,000 \$1,141,4		\$250,868		\$3,570,000				Closure Phase 2	Phase 2 SW mgmt design & partial constru
2018										\$ 200,000 \$	2,500,000 \$1,141,4		\$490,358		\$5,385,000				Closure Phase 2	Phase 2 Surface water management const
2019	0011.005			\$200.000				\$484,000		\$ -	\$1,141,4		\$191,695 \$491,790		\$2,776,000	D		Describe and lead		Phase 2 Design and construction
2020 2021	\$311,025 \$3,310,000	\$709,508	\$819,784	\$200,000		02	\$274,628	\$5,245,520		\$ 1,075,000 \$ 35,000	\$1,141,4 \$575,12		\$491,790		\$4,946,000 \$17,843,000	Permits New transfer station	New trailers every 8 years	Permits and land WTT facility begins operating		Phase 2 LFG and final cover design Phase 2 LFG and final cover construction
2022	\$0,010,000	\$709,508	\$828,965			\$0	\$277,703	\$5,282,505		\$ 55,000	\$575.12		\$0	\$1.052.753	\$8.917.000			With lacinty begins operating		
2023		\$709,508	\$838,241			\$0	\$280,811	\$5,319,875		\$ 35,000	\$575,12		\$218,613		\$9,220,000					Phase 3 LFG and final cover design
2024		\$709,508	\$824,357		\$651,040	\$430,428	\$478,030	\$7,691,551		\$ -	\$575,12		\$3,108,685		\$15,049,000					Phase 3 LFG and final cover construction
2025		\$709,508	\$833,446		\$651,040	\$432,795	\$482,185	\$7,741,522		\$-	\$575,12			\$190,000	\$11,806,000					
2026		\$709,508	\$842,504		\$651,040	\$435,083	\$486,293	\$7,790,916		\$ -	\$575,12			\$190,000	\$11,870,000					
2027		\$709,508	\$851,497		\$651,040	\$437,238	\$490,316	\$7,839,300		\$ 585,000	\$575,12			\$190,000	\$12,519,000					
2028	\$200.000	\$709,508 \$709,508	\$860,422 \$869,243	\$200,000	\$651,040 \$651.040	\$439,331 \$441.370	\$494,288 \$498,199	\$7,887,058 \$7,934,096		\$ - \$ 385.000	\$575,12 \$575,12			\$190,000 \$190,000	\$12,197,000	No. to line on the line of the	New trailers every 8 years		Construction Cell 2	
2029 2030	\$200,000	\$709,508	\$877,925		\$651,040	\$441,370 \$443,312	\$502,018	\$7,980,027	\$8,850,000	\$ 365,000	\$575,12			\$190,000	\$12,844,000 \$20,969,000	New trailers every 8 years			Closure Cell 1	
2030		\$709,508	\$886,468		\$651.040	\$445,183	\$505,758	\$8,024,996	\$0,030,000	s -	\$650.12			\$190,000	\$12,253,000				Closure Cell 1	
2032		\$709,508	\$894,920	\$346,000	\$651,040	\$446.975	\$509,429	\$8,069,147		\$ - \$	1,350,000 \$650,12			\$190,000	\$14,007,000		Transfer station - parking and roads (20 yr life) + capital upgrades			
2033		\$709,508	\$903,304		\$651,040	\$448,704	\$513,049	\$8,112,673		\$ 235,000	\$650,12			\$190,000	\$12,603,000		······································			
2034		\$709,508	\$911,398		\$651,040	\$450,256	\$516,488	\$8,154,035		\$ -	\$650,12	4 \$390,000		\$190,000	\$12,623,000	***			*****	
2035		\$709,508	\$919,352		\$651,040	\$451,754	\$519,856	\$8,194,532		\$ 35,000	\$650,12			\$190,000	\$12,511,000					
2036		\$709,508	\$927,284	\$200,000	\$651,040	\$453,226	\$523,203	\$8,234,787		\$ -	\$650,12			\$190,000	\$12,729,000		New trailers every 8 years			
2037	\$200,000	\$709,508	\$935,042		\$651,040	\$454,601	\$526,447	\$8,273,793		\$ 550,000	\$650,12			\$190,000	\$13,331,000	New trailers every 8 years				
2038 2039		\$709,508 \$709,508	\$942,661 \$950,151		\$651,040 \$651,040	\$455,896 \$457,137	\$529,606 \$532,698	\$8,311,788 \$8,348,966		\$ -	\$650,12 \$650,12			\$190,000 \$190,000	\$12,631,000 \$12,915,000					
2039		\$709,508	\$957,573		\$651,040	\$458,334	\$535,746	\$8,385,614		\$ 33,000	\$650,12			\$190,000	\$12,728,000					
2041	\$1,555,125		\$964,886		\$651,040	\$459,531	\$538,757	\$8,421,830		\$ 385,000	\$650,12			\$190,000	\$14,716,000	Major capital upgrade every 20 years				
2042		\$709,508	\$974,659		\$651,040	\$461,829	\$543,108	\$8,474,157		\$ -	\$650,12			\$190,000	\$12,844,000	, , , , , , , , , , , , , , , , , , , ,				
2043		\$709,508	\$984,529		\$651,040	\$464,138	\$547,498	\$8,526,945		\$ 200,000	\$650,12			\$190,000	\$13,114,000					
2044		\$709,508	\$994,499	\$200,000	\$651,040	\$466,459	\$551,926	\$8,580,198		\$ -	\$650,12			\$190,000	\$13,384,000		New trailers every 8 years			
2045 2046	\$200,000	\$709,508 \$709,508	\$1,004,569 \$1,014,741		\$651,040 \$651.040	\$468,791 \$471,135	\$556,394 \$560,901	\$8,633,921 \$6,745,158		\$ 35,000	\$650,12			\$190,000	\$13,289,000 \$11,183,000	New trailers every 8 years		A		
2046		\$709,508	\$1,014,741 \$1,025,015		\$651,040	\$471,135 \$473,491	\$565,447	\$6,799,833		\$ - \$ 585,000	\$650,12 \$650,12			\$190,000 \$190,000	\$11,839,000			Amotization period over		
2048		\$709,508	\$1,035,392		\$651,040	\$475,858	\$570,034	\$6,854,991		\$ 565,000	\$650,12			\$190,000	\$11,327,000					
2049		\$709,508	\$1,045,874		\$651,040	\$478,237	\$574,661	\$6,910,636		\$ -	\$650,12			\$190,000	\$11,600,000					
2050		\$709,508	\$1,056,461		\$651,040	\$480,629	\$579,329	\$6,966,774		\$-	\$650,12			\$190,000	\$11,474,000					
2051		\$709,508	\$1,067,155	\$241,000	\$651,040	\$483,032	\$584,039	\$7,023,408		\$ 35,000	\$650,12			\$190,000	\$11,824,000		Transfer station permits etc			
2052		\$709,508	\$1,077,956	\$2,615,000	\$651,040	\$485,447	\$588,790	\$7,080,543		\$ -	\$650,12			\$190,000	\$14,238,000		Transfer station - new facility + new trailer:			
2053 2054	\$200,000	\$709,508 \$709,508	\$1,088,866 \$1,099,885		\$651,040 \$651.040	\$487,874 \$490,314	\$593,583 \$598,419	\$7,138,184 \$7,196,335		\$ 585,000	\$650,12 \$650,12			\$190,000 \$190,000	\$12,484,000 \$11,976,000	New trailers every 8 years				
2055		\$709,508	\$1,111,016		\$651,040	\$492,765	\$603,297	\$7,255,002		\$ - \$ -	\$650,12			\$190,000	\$11,853,000					
2056		\$709,508	\$1,122,258		\$651,040	\$495,229	\$608,219	\$7,314,189		φ - ¢ _	\$650,12			\$190,000	\$11,931,000					
2057		\$709,508	\$1,133,614		\$651.040	\$497,705	\$613,184	\$7,373,901		\$ 585.000	\$650,12			\$190,000	\$12,594,000					
2058		\$709.508	\$1,145,084		\$651.040	\$500,194	\$618,194	\$7,434,143		\$ -	\$650.12			\$190,000	\$12,088,000					
2059		\$709,508	\$1,156,669		\$651,040	\$502,695	\$623,248	\$7,494,920		\$ 35,000	\$650,12			\$190,000	\$12,403,000					
2060		\$709,508	\$1,168,370	\$200,000	\$651,040	\$505,208	\$628,347	\$7,556,237		\$ -	\$650,12			\$190,000	\$12,449,000		New trailers every 8 years		Construction Cell 3	
2061	\$1,755,125		\$1,180,190		\$651,040	\$507,734	\$633,491	\$7,618,099	\$7,800,000	\$ -	\$650,12			\$190,000	\$21,885,000	Major capital upgrade every 20 years				
2062		\$709,508	\$1,192,128		\$651,040	\$510,273	\$638,681	\$7,680,511		\$ -	\$725,12			\$190,000	\$12,487,000				Closure Cell 2	
2063 2064		\$709,508 \$709,508	\$1,204,186 \$1,216,366		\$651,040 \$651.040	\$512,824 \$515,388	\$643,917 \$649,200	\$7,743,478 \$7,807.006		\$ 235,000 \$	2,850,000 \$725,12 \$725,12			\$190,000 \$190.000	\$15,655,000 \$12,854,000					
2064		\$709,508	\$1,216,366		\$651,040	\$515,388	\$654,529	\$7,807,006		\$ 385,000	\$725,12			\$190,000	\$12,854,000 \$13,123,000					
2066		\$709,508	\$1,241,094		\$651.040	\$520,555	\$659,907	\$7,935,764		\$ -	\$725.12			\$190,000	\$12.823.000					
2067		\$709,508	\$1,253,644		\$651,040	\$523,158	\$665,332	\$8,001,005		\$ 550,000	\$725,12			\$190,000	\$13,459,000					
		1																		

30 years \$368,611,000 1,792,501 tonnes \$206 per tonne over 30 years

40 years \$489,912,000 2,448,090 tonnes \$200 per tonne over 40 years

50 years \$629,138,000 3,159,253 tonnes \$199 per tonne over 50 years

Table D4: Long Term Cost Model for Option 3(a) - Sustane facility located in Comox Valley - Increasing Capacity

						Population	and Disposal Rat	tes											CRWMC LF F	ill Rate and	Capacity								CVWMC LF	Fill Rate and C	apacity				
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/Residual s to CVWMC LF	Year	N Dis		Daily over Soil	Operational Soil	Settlement	Net Fill Volume	Cumulative Fill Volume	Phase	Volumetric Capacity (m³)	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)
		tonnes		tonnes	tonnes / yr	tonnes / da	ау	tonnes	tonnes	tonnes	tonnes / day		tonnes				m ³	m ³	m ³	m ³	m ³	m ³				m ³	m ³	m ³	m ³	m ³	m ³	m ³	-		
2015 2016	64,294 64,847	36,652 36,967	45,871 46,187	26,149 26,330		1	72 90,44 73 91,17	7				26,149 26,330	36,652 36,967			2015 2016	37,356 37,614	12,452 12,538	747 752	74 75			Phase 3		2015 2016	52,810		17,453 17,603	1,047 1,056					Phase 2	46.525
0 2017 1 2018	65,592 66,372	36,007 36,435	46,490 46,809	25,521 25,696		1	69 91,113 70 92,068					25,521 25,696	36,007 36,435	0	1	2017 2018	36,458 36,708	12,153 12,236	729 734	72			Phase 3 Phase 3		0 2017		(0 17,146 0 17,350	1,029 1,041	1,041	69,400	137,984	Cell 1	Phase 2 Cell 1	
2 2019 3 2020	67,139 67,905	36,856 37,276	47,116 47,419	25,864 26,031	62,720 63,307		72 93,00 73 93,93					25,864 26,031	36,856 37,276	0		2019 2020	36,949 37,187	12,316 12,396	739	73			Phase 3 Phase 3		2 2019 3 2020		(0 17,550 0 17,751	1,053 1,065	1,053 1,065	70,202 71,003			Cell 1 Cell 1	
4 2021	68,667	30,446	47,706	21,152	51,598	1	41 89,819	9		29,195	83	21,152	1,251	3,187	4	2021	30,217	10,072	604	60	4 40,290	236,693	Phase 3		4 2021	1,787	3,187	7 596	36	36	5,570	284,759	Cell 1	Cell 1	
5 2022 6 2023	69,436 70,213	30,787 31,131	47,986 48,267	21,276 21,401	52,063 52,532		43 90,712 44 91.614		Landfill closure	29,522 29,852	84	21,276 21,401	1,265 1,279	3,222 3,259		2022 2023	30,395 30,573	10,132 10,191	608 611	60 61			Phase 3 Closed	288.480	5 2022 6 2023		3,222		36	36 37	5,632	290,391 296,087		Cell 1 Cell 1	
7 2024	70,986	31,474	48,539	21,521	52,995	1	45 92,50	7	21,521	50,817	145	21,101	2,178	5,547	7	2024	00,010	0	0	0.	0 0	317,982	Closed	200,100	7 2024	3,111	5,547	7 1,037	62	62	9,695	305,782	Cell 1	Cell 1	
8 2025 9 2026	71,758 72,527	31,816 32,157	48,806 49,064	21,640 21,754	53,456 53,911		46 93,394 48 94,28		21,640 21,754	51,259 51,696	146 148		2,197 2,216	5,595 5,643	8	2025 2026	0	0	0		0 0	317,982 317,982			8 2025 9 2026				63 63	63 63	9,780 9.863	315,562 325,425		Cell 1 Cell 1	
10 2027	73,290	32,496	49,307	21,862	54,357		49 95,15	2	21,862	52,124	149		2,234	5,690	10	2027	0	0	0		0 0	317,982	Closed		10 2027	3,191	5,690	1,064	64	64	9,945	335,370	Cell 1	Cell 1	
11 2028 12 2029	74,047 74,795	32,831 33,163	49,543 49,773	21,967 22,069			50 96,014 51 96,864		21,967 22,069	52,546 52,962	150 151		2,252 2,270	5,736 5,781		2028 2029	0	0	0		0 0	317,982 317,982			11 2028 12 2029		5,736		64	64 65	10,025 10,104	345,395 355,499		Cell 1 Cell 1	
13 2030	75,531	33,489	49,992	22,166	55,655	1	52 97,69		22,166	53,368	152		2,287	5,825 5,869	13	2030	0	0	0		0 0	317,982	Closed		13 2030	3,267	5,825		65	65	10,182	365,681		Cell 1	
14 2031 15 2032	76,255 76,971	33,810 34,128	50,203 50,405	22,259 22,349	56,069 56,476		54 98,514 55 99,320		22,259 22,349	53,765 54,155	154		2,304 2,321	5,869		2031 2032	0	0	0		0 0	317,982 317,982			14 2031 15 2032		5,869 5,911		66	66 66	10,258 10,332	375,939 386,271		Cell 1 Cell 1	
16 2033	77,681	34,442 34,746	50,600 50,775	22,435			56 100,116 57 100.879		22,435	54,540	156		2,337	5,953 5,993	16	2033 2034	0	0	0	1	0 0	317,982	Closed		16 2033 17 2034	3,339			67	67	10,406 10,475	396,677 407,152		Cell 1	
17 2034 18 2035	78,366 79,039	34,746	50,775	22,513 22,588	57,259 57,632		58 101,62		22,513 22,588	54,906 55,264	157		2,353 2,368	5,993 6,032		2034	0	0	0		0 0	317,982 317,982			18 2035				68	68	10,475	407,152 417,696		Cell 1 Cell 1	
19 2036 20 2037	79,710 80,366	35,342 35,633	51,110 51,265	22,661 22,730	58,003 58,363		59 102,37 60 103,096		22,661 22,730	55,620 55,965	159		2,384 2,398	6,071 6,109	19	2036 2037	0	0	0		0 0	317,982 317,982			19 2036 20 2037				68	68	10,612 10,677	428,308 438,985		Cell 1 Cell 1	
21 2038	81,010	35,918	51,411	22,795			61 103,80	5	22,795	56,300	161		2,413	6,146	21	2038	0	0	0		0 0	317,982	Closed		21 2038	3,447			69	69	10,742	430,903		Cell 1	
22 2039 23 2040	81,643 82,270	36,199 36,477	51,551 51,686	22,857 22,917	59,056 59,394		62 104,500 63 105,18		22,857 22,917	56,629 56,953	162 163		2,427 2,441	6,181 6,217		2039 2040	0	0	0		0 0	317,982 317,982			22 2039 23 2040		6,18 6,217		69 70	69 70	10,804 10.866	460,531 471,397		Cell 1 Cell 1	
24 2041	82,888	36,751	51,821	22,977	59,728	1	64 105,865	5	22,977	57,273	165		2,455	6,252	24	2041	0	0	0		0 0	317,982	Closed		24 2041	3,507	6,252	2 1,169	70	70	10,927	482,324	Cell 1	Cell 1	
25 2042 26 2043	83,717 84,554	37,119 37,490	52,080 52,341	23,091 23,207	60,210 60,697		65 106,808 66 107,76		23,091 23,207	57,736 58,202	165		2,474 2,494	6,302 6,353		2042 2043	0	0	0		0 0	317,982 317,982			25 2042 26 2043				71	71	11,015	493,339 504,444		Cell 1 Cell 1	
27 2044	85,400	37,865	52,602	23,323	61,188	1	68 108,723	3	23,323	58,673	168		2,515	6,405	27	2044	0	0	0		0 0	317,982	Closed		27 2044	3,592	6,405	5 1,197	72	72	11,194	515,638	Cell 1	Cell 1	
28 2045 29 2046	86,254 87,116	38,243 38,626	52,865 53,130	23,440 23,557	61,683 62,183		69 109,693 70 110,673		23,440 23,557	59,148 59,627	169		2,535 2,555	6,456 6,509		2045 2046	0	0	0		0 0	317,982 317,982			28 2045 29 2046		6,456		72	72	11,285 11,376	526,923 538,299		Cell 1 Cell 2	517,470
30 2047	87,987	39,012	53,395	23,675	62,687	1	72 111,662	2	23,675	60,110	172		2,576	6,561	30	2047	0	0	Ő		0 0	317,982	Closed		30 2047	3,680	6,56	1 1,227	74	74	11,468	549,767	Cell 2	Cell 2	
31 2048 32 2049	88,867 89,756	39,402 39,796	53,662 53,930	23,793 23,912	63,195 63,708		73 112,660 75 113,660		23,793 23,912	60,598 61,090	173		2,597 2,618	6,615 6,668		2048 2049	0	0	0		0 0	317,982 317,982			31 2048 32 2049				74	74	11,561 11.655	561,329 572,984		Cell 2 Cell 2	
33 2050	90,653	40,194	54,200	24,031	64,226	1	76 114,68	5	24,031	61,586	176		2,639	6,723	33	2050	0	0	0		0 0	317,982	Closed		33 2050	3,771	6,723	3 1,257	75	75	11,750	584,734	Cell 2	Cell 2	
34 2051 35 2052	91,560 92,476	40,596 41,002	54,471 54,743	24,152 24,272			77 115,712 79 116,74		24,152 24,272	62,087 62,592	177 179		2,661 2,683	6,777 6,832		2051 2052	0	0	0		0 0	317,982 317,982			34 2051 35 2052		6,777		76	76	11,846 11,942	596,580 608,522		Cell 2 Cell 2	
36 2053	93,400	41,412	55,017	24,394	65,806		80 117,79		24,394	63,101	180		2,704	6,888	36	2053	0	0	0		0 0	317,982			36 2053	3,863			77	77	12,039	620,561		Cell 2	
37 2054 38 2055	94,334 95,278	41,826 42,245	55,292 55,569	24,516 24,638			82 118,850 83 119,916		24,516 24,638	63,616 64,134	182		2,726 2,749	6,944 7,001		2054 2055	0	0	0		0 0	317,982 317,982	Closed Closed		37 2054 38 2055				78	78	12,137 12,236	632,698 644,934		Cell 2 Cell 2	
39 2056	96,230	42,667	55,847	24,761	67,428	1	85 120,992	2	24,761	64,657	185		2,771	7,058	39	2056	0	0	0		0 0	317,982	Closed		39 2056	3,959	7,058	3 1,320	79	79	12,336	657,270	Cell 2	Cell 2	
40 2057 41 2058	97,193 98,165	43,094 43,525	56,126 56,406	24,885 25,010	67,979 68,534		86 122,078 88 123,174		24,885 25,010	65,185 65,718	186		2,794 2,816	7,115 7,174		2057 2058	0	0	0		0 0	317,982 317,982			40 2057 41 2058		7,115		80	80	12,437 12,538	669,706 682,245		Cell 2 Cell 2	
42 2059	99,146	43,960	56,688	25,135	69,095	1	89 124,28	1	25,135	66,255	189		2,840	7,232	42	2059	0	0	0		0 0	317,982	Closed		42 2059	4,056	7,232	2 1,352	81	81	12,641	694,885	Cell 2	Cell 2	
43 2060 44 2061	100,138 101,139	44,399 44,843	56,972 57,257	25,260 25,387	69,660 70,230		91 125,398 92 126,526		25,260 25,387	66,797 67,344	191		2,863 2,886	7,291 7,351		2060 2061	0	0	0		0 0	317,982 317,982			43 2060 44 2061				82	82	12,744 12,848	707,630 720,478		Cell 2 Cell 2	
45 2062	102,151	45,292	57,543	25,514	70,805	1	94 127,664	4	25,514	67,896	192		2,910	7,411	45	2062	0	0	0		0 0	317,982	Closed		45 2062	4,157	7,411	1 1,386	83	83	12,954	733,432	Cell 2	Cell 2	
46 2063 47 2064	103,172 104,204	45,745 46,202	57,831 58,120	25,641 25,769	71,386 71,972		96 128,813 97 129,973		25,641 25,769	68,452 69.014	196		2,934 2,958	7,472		2063 2064	0	0	0		0 0	317,982 317,982	Closed		46 2063 47 2064		7,472		84	84	13,060 13,167	746,492 759.659		Cell 2 Cell 2	
48 2065	105,246	46,664	58,411	25,898	72,562	1	99 131,144	4	25,898	69,580	197		2,982	7,533 7,595	48	2065	0	0	0		0 0	317,982	Closed		48 2065	4,260	7,595	5 1,420	85	85	13,275	772,934	Cell 2	Cell 2	
49 2066 50 2067	106,298 107,361	47,131 47,602	58,703 58,996	26,028 26,158			00 132,320		26,028 26,158	70,152 70,729	200		3,007 3,031	7,658 7,721		2066 2067	0	0	0		0 0	317,982 317,982			49 2066 50 2067		7,658		86	86	13,384 13,494	786,318 799,813		Cell 2 Cell 2	
											202					2001			0			517,302	Citadu		30 2007	-,330	1,12	1,443	07	07	10,734	133,013		55II Z	
Totals	4,465,392	2,024,427	2,772,844	1,260,924	3,285,351		5,726,31	5 (1,041,504	2,728,790		219,420	337,141	297,865																					

 CVRD growth rate beyond 2041 =
 1%

 CVRD disposal rate 2015-2016 =
 0.57
 tonnes per person per year (46% diversion)

 CVRD disposal rate 2017-2020 =
 0.55
 tonnes per person per year (46% diversion)

 CVRD disposal rate 2017-2020 =
 0.55
 tonnes per person per year (46% diversion)

 SRD growth rate beyond 2041 =
 0.50%
 tonnes per person per year (46% diversion)

 SRD disposal rate 2015-2016 =
 0.57
 tonnes per person per year (46% diversion)

 SRD disposal rate 2017-2020 =
 0.55
 tonnes per person per year (46% diversion)

 SRD disposal rate 2021-2067 =
 0.44
 tonnes per person per year (46% diversion)

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 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 D4: Long Term Cost Model for Option 3(a) - Sustane facility located in Comox Valley - Increasing Capacity

						Capital	and Operating C	Costs										
Y	'ear	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	
	1																	
	2015 2016					\$16.000.000							\$0 \$16,000,000	New Transfer station constructed 2012-2013			Construction of loophote monogenerate waters and Call 1	
0	2016					\$16,000,000	\$ 860,000	\$ 265,000	\$1,116,495		\$250,868	\$1,052,753	\$3,545,000	New transfer station constructed 2012-2013			Construction of leachate management system and Cell 1 Closure Phase 2	Pha
1	2017							\$ 2,500,000	\$1,116,495		\$490.358	\$1,052,753	\$5,360,000				Closure Phase 2 Closure Phase 2	Pha
2	2019						\$ -	\$ 2,000,000	\$1,116,495	\$390,000	\$191,695	\$1,052,753	\$2,751,000					Ph
3	2020	\$200,000			\$1,830,696		\$ 1,075,000		\$1,116,495	\$190,000	\$491,790	\$1,052,753	\$5,957,000	New trailers every 8 years		Permits and land		Ph
4	2021	******			\$3,571,072		\$ 35,000		\$423,924	\$190,000	\$5,630,329	\$1,052,753	\$10,903,000			Sustane facility begins operating		Ph
5	2022				\$3,588,315		\$ -		\$423,924	\$190,000	\$0	\$1,052,753	\$5,255,000					
6	2023				\$3,605,737		\$ 35,000		\$423,924	\$190,000	\$218,613	\$1,052,753	\$5,526,000					Pha
7	2024		\$651,040	\$318,516	\$4,711,435		\$ -		\$423,924	\$390,000	\$3,108,685	\$190,000	\$9,794,000					Pha
8	2025		\$651,040	\$320,269	\$4,734,732		<u>\$</u> -		\$423,924	\$190,000		\$190,000	\$6,510,000					
10	2026 2027		\$651,040 \$651,040	\$321,962 \$323,556	\$4,757,760 \$4,780,317		\$ - \$ 585,000		\$423,924	\$190,000 \$190,000		\$190,000 \$190,000	\$6,535,000 \$7,144,000					
10	2027	\$200,000	\$651,040	\$323,556 \$325,105	\$4,780,317 \$4,802,582		\$ 585,000		\$423,924 \$423,924	\$190,000 \$190,000		\$190,000 \$190,000	\$7,144,000 \$6,783,000					
12	2028	\$200,000	\$651,040	\$326,614	\$4,802,582		\$ 385,000		\$423,924 \$423,924	\$390,000		\$190,000	\$7,191,000	New trailers every 8 years				
13	2029		\$651.040	\$328,051	\$4,845,925		\$ 303,000		\$423,924	\$190,000		\$190,000	\$6,629,000					
14	2031		\$651,040	\$329,436	\$4,866,890		\$ -		\$423,924	\$190,000		\$190,000	\$6,651,000					
15	2032	\$346,000	\$651,040	\$330,761	\$4,887,474		\$ -		\$423,924	\$190,000		\$190,000	\$7,019,000	Transfer station - parking and roads (20 yr life) + capital upgrades				
16	2033		\$651,040	\$332,041	\$4,907,766		\$ 235,000		\$423,924	\$190,000		\$190,000	\$6,930,000	Tanolor dation parking and roade (20 Jr ind) - dapital apgraded				
17	2034		\$651,040	\$333,189	\$4,927,049		\$ -		\$423,924	\$390,000		\$190,000	\$6,915,000					
18	2035		\$651,040	\$334,298	\$4,945,929		\$ 35,000		\$423,924	\$190,000		\$190,000	\$6,770,000					
19	2036	\$200,000	\$651,040	\$335,388	\$4,964,697		\$ -		\$423,924	\$190,000		\$190,000	\$6,955,000	New trailers every 8 years				
20	2037		\$651,040	\$336,405	\$4,982,881		\$ 550,000		\$423,924	\$190,000		\$190,000	\$7,324,000					
21	2038		\$651,040	\$337,363	\$5,000,595		\$-		\$423,924	\$190,000		\$190,000	\$6,793,000					
22	2039		\$651,040	\$338,281	\$5,017,928		\$ 35,000		\$423,924	\$390,000		\$190,000	\$7,046,000					
23 24	2040 2041		\$651,040	\$339,167	\$5,035,014		\$ -		\$423,924	\$190,000		\$190,000	\$6,829,000					
24	2041		\$651,040 \$651,040	\$340,053 \$341,753	\$5,051,898 \$5,076,293		\$ 385,000		\$423,924 \$423,924	\$190,000 \$190,000		\$190,000 \$190,000	\$7,232,000 \$6,873,000					
26	2042		\$651,040	\$343,462	\$5,100,903		\$ 200,000		\$423,924	\$190,000		\$190,000	\$7,099,000					
27	2043	\$200,000	\$651,040	\$345,180	\$5,125,730		\$ -		\$423,924	\$390,000		\$190,000	\$7,326,000	New trailers every 8 years				
28	2045		\$651,040	\$346,905	\$5,150,776	\$8,850,000	\$ 35,000		\$423,924	\$190,000		\$190,000	\$15,838,000			Amotization period over	Construction Cell 2	
29	2046		\$651,040	\$348,640	\$3,294,656		\$ -		\$523,924	\$190,000		\$190,000	\$5,198,000					
30	2047		\$651,040	\$350,383	\$2,317,301		\$ 585,000	\$ 1,350,000	\$523,924	\$190,000		\$190,000	\$6,158,000				Closure Cell 1	
31	2048		\$651,040	\$352,135	\$2,334,882		\$ -		\$523,924	\$190,000		\$190,000	\$4,242,000					
32	2049		\$651,040	\$353,896	\$2,352,618		\$ -		\$523,924	\$390,000		\$190,000	\$4,461,000					
33	2050	0044.000	\$651,040	\$355,665	\$2,370,510		\$ -		\$523,924	\$190,000		\$190,000	\$4,281,000	To a fear the fear of the second s				
34 35	2051 2052	\$241,000	\$651,040	\$357,444	\$2,388,561		\$ 35,000		\$523,924	\$190,000		\$190,000	\$4,577,000	Transfer station permits etc	Locate, site and parmit parm TS			
35	2052	\$2,615,000	\$651,040 \$651,040	\$359,231 \$361,027	\$2,406,772 \$2,425,143		\$ -		\$523,924 \$523,924	\$190,000 \$190,000		\$190,000 \$190,000	\$6,936,000 \$4,926,000	Transfer station - new facility + new trailer:	Locate, site and permit perm TS Construct perm TS			
37	2053		\$651,040	\$362,832	\$2,425,143		\$ 363,000		\$523,924	\$390,000		\$190,000	\$4,561,000		Off island export begins @ \$100/tonne			
38	2055		\$651,040	\$364.646	\$2,462,377		\$ -		\$523,924	\$190,000		\$190,000	\$4,382,000					
39	2056		\$651.040	\$366,469	\$2,481,241		\$ -		\$523,924	\$190,000		\$190,000	\$4,403,000					
40	2057		\$651,040	\$368,302	\$2,500,273		\$ 585,000		\$523,924	\$190,000		\$190,000	\$5,009,000					
41	2058		\$651,040	\$370,143	\$2,519,474	1	\$ -		\$523,924	\$190,000		\$190,000	\$4,445,000					
42	2059		\$651,040	\$371,994	\$2,538,845	1	\$ 35,000		\$523,924	\$390,000		\$190,000	\$4,701,000					
43	2060	\$200,000	\$651,040	\$373,854	\$2,558,389		\$ -		\$523,924	\$190,000		\$190,000	\$4,687,000	New trailers every 8 years				
44	2061		\$651,040	\$375,723	\$2,578,106		\$ -		\$523,924	\$190,000		\$190,000	\$4,509,000	······	New trailers every 8 years			
45	2062		\$651,040	\$377,602	\$2,597,999		\$ -		\$523,924	\$190,000		\$190,000	\$4,531,000					
46	2063		\$651,040	\$379,490	\$2,618,068		\$ 235,000		\$523,924	\$190,000		\$190,000	\$4,788,000					
47	2064		\$651,040	\$381,387	\$2,638,316		\$ -		\$523,924	\$390,000		\$190,000	\$4,775,000					
48	2065		\$651,040	\$383,294	\$2,658,745		\$ 385,000		\$523,924	\$190,000		\$190,000	\$4,982,000					
49	2066		\$651,040	\$385,211	\$2,222,518		\$ -		\$523,924	\$190,000		\$190,000	\$4,163,000					
50	2067		\$651,040	\$387,137	\$2,239,557		\$ 550,000		\$523,924	\$190,000		\$190,000	\$4,732,000					
- T-	otals	\$4 202 000	\$28.645.760	\$15.414.260	\$176.042.022	\$9.950.000	\$7,645,000	\$4 115 000	\$26 500 422	\$11,310,000	\$10 202 220	\$15 720 260	\$308,930,000					
1 10	Julis	\$4,∠02,000	\$20,045,760	a13,414,260	\$170,042,933	000,0co,o¢	\$1,045,000	ə4,115,000	azo,590,423	\$11,310,000	⇒10,362,338	\$10,129,209	aauo,930,000					

30 years \$214,839,000 1,792,501 tonnes \$120 per tonne over 30 years

40 years \$262,617,000 2,448,090 tonnes \$107 per tonne over 40 years

50 years \$308,930,000 3,159,253 tonnes \$98 per tonne over 50 years

CRWMC LF Notes
nase 2 SW mgmt design & partial construction
nase 2 Surface water management construction nase 2 Design and construction
nase 2 LFG and final cover design
nase 2 LFG and final cover construction
nase 3 LFG and final cover design
nase 3 LFG and final cover construction

Table D5: Long Term Cost Model for Option 3(b) - Sustane facility located in Campbell River - Increasing Capacity

						Population a	nd Disposal Rate	S											CRWMC LF	ill Rate and C	apacity								CVWMC LF F	ill Rate and Ca	pacity				
Year	CVRD Population	CVRD Waste	Projected SRD Population	SRD Waste	Total Annual Tonnage tonnes / yr	Daily Tonnage tonnes / day	Combined Population	Tonnes to Comox Valley TS tonnes	Campbell	Tonnes to Sustane Facility tonnes		Tonnes MSW to CRWMC LF	MSW A	Tonnes Ash/Residual s to CVWMC LF	Ye		Volumetric MSW Disposal Rate m ³	Daily Cover Soil m ³	Operational Soil m ³	Settlement	Net Fill Volume m ³	Cumulative Fill Volume m ³		Volumetric Capacity (m³)	Year	Volumetric MSW Disposal Rate m ³	Volumetric Ash / Residuals Disposal Rate m ³	Daily Cover Soil m ³	Operational Soil m ³	Settlement	Net Fill Volume m ³	Cumulative Fill Volume m ³	Phase / Cell	Phase / Cell	Volumetric Capacity (m ³)
2015 2016 2017 2018 2019 2019 2019 2019 2019 2019 32020 42021 52022 62023 72024 82025 92026 102027 112028 122020 132030 142031 152032 162033 1772034 182035 192036 192036 202037 212039 233200 242041 252042 262043 272044 322047 332040 2047 332050 342050 342050 342050 342050 432050 432050 432050 432050 432050	64,294 64,847 65,592 66,372 67,905 77,905 77,905 77,986 77,986 72,527 73,290 74,047 75,551 76,975 76,971 76,255 76,971 77,681 86,856 87,971 80,366 81,010 81,643 82,270 83,866 81,010 81,643 82,270 83,866 81,010 81,643 82,270 83,866 81,010 81,643 82,270 83,866 83,717 84,555 84,554 85,400 86,524 87,716 88,867 83,756 89,653 91,560 92,276 93,400 94,334 95,278 99,146 99,576 99,147 99,147 99,146 99,278 99,146 97,278 97,147 97	36,652 36,967 36,007 36,435 36,435 37,276 30,446 30,787 31,131 31,474 31,474 31,474 31,474 31,474 31,474 33,163 33,489 34,442 35,643 35,544 35,545 36,199 37,865 37,776 40,199 37,865 39,012 39,786 40,199 39,786 41,102 39,786 41,102 41	45,871 46,187 46,490 47,116 47,419 47,706 48,287 48,529 49,064 49,064 49,073 49,073 49,932 50,005 50,040 50,040 50,040 50,040 50,040 51,265 51,867 51,867 51,867 52,867 55,897 55,569 55	28, 140 26, 330 25, 521 26, 562 27, 584 27, 584 21, 152 21, 152 21, 1640 21, 152 21, 1640 21, 152 21, 1640 22, 1660 22, 1660 22, 1660 22, 1660 22, 1660 22, 1660 22, 253 22, 253 22, 253 22, 253 22, 253 22, 253 22, 253 22, 253 22, 253 22, 253 23, 253 23, 253 23, 253 23, 253 23, 253 23, 253 24, 253 24, 253 24, 253 24, 253 24, 253 24, 253 24, 253 24, 253 25, 2540 24, 253 25, 2560 25, 2560 25	 62,801 63,297 61,527 62,131 62,720 63,307 64,783 64,357 65,6476 66,878 65,6476 66,878 66,874 67,979 77,2502 77,2562 77,2562 	177 177 177 177 177 177 177 177 174 144 14	2 90,443 3 91,177 9 91,113 0 92,068 2 93,003 9 3,936 1 89,819 3 90,712 4 91,614 5 92,507 6 93,398 8 94,281 9 95,152 0 96,014 1 96,864 2 97,697 4 98,320 6 100,116 7 100,879 9 101,627 9 102,371 103,805 5 106,808 6 107,761 2 106,865 5 106,808 6 107,761 8 108,723 2 111,662 3 112,660 5 113,668 6 114,685 5 116,788 6 114,685 5 116,788 8 114,685 5 122,072 6 122,072 8 122,572 9 116,748 9 112,650 6 122,078 9 123,078 9 123,078 124,078	29, 199 29, 522 29, 852 29, 944 30, 263 31, 500 33, 1200 33, 1200 34, 1200 36, 1200 37, 1505 37, 1505	5 2 2 2 3 3 4 5 5 5 5 5 5 5 5 5 5 5 5 5	29,19 29,52	5 83 2 84 2 85 9 146 6 148 4 149 9 150 2 151 3 152 5 154 5 155 5 155 5 155 5 155 5 155 5 155 6 160 0 161 1 665 1 665 1 665 1 665 1 666 1 668 1 669 1 777 1 779 1 779 1 779 1 779 1 779 1 779 1 789 1 885 1 885 1 886 1 889 1 997 1 997 1 992 2 000 2 022	26,149 26,330 25,521 25,086 20,586 20,586 21,152 21,401	36 652 36,967 36,435 36,866 1,251 1,265 1,270 2,178 2,274 2,252 2,270 2,287 2,304 2,252 2,270 2,327 2,368 2,384 2,384 2,384 2,384 2,384 2,384 2,384 2,384 2,384 2,384 2,384 2,384 2,384 2,384 2,384 2,384 2,385 2,577 2,618 2,719 2,719 2,719 2,719 2,719 2,719 2,719 2,886 2,886 2,880 2,9344 2,934 2,934 2,934 2,934 2,934 2,934 2	0 0 0 0 0 3,187 3,222 3,259 5,547 5,595 5,643 5,595 5,643 5,595 5,869 5,811 5,953 5,953 6,071 6,146 6,181 6,177 6,352 6,353 6,405 6,405 6,668 6,672 6,573 6,671 6,515 6,668 6,672 6,581 6,777 6,832 6,672 6,353 6,773 6,585 6,456 6,675 6,672 6,575 6,688 6,777 6,832 6,672 7,7658 7,115 7,174 7,535 7,655 7,7595 7,7595 7,7595 7,721 297,665	0 1 2 3 4 5 6 7 7 8 9 9 10 11 12 13 14 15 16 17 18 19 20 21 17 18 19 20 21 17 22 23 24 25 26 27 28 29 30 31 32 25 26 27 28 29 30 31 4 4 4 4 4 4 4 4 4 5 5 26 27 27 28 29 30 30 31 4 4 4 4 4 4 4 5 26 27 27 28 29 20 20 21 22 23 24 25 26 26 27 27 28 29 30 30 31 32 25 26 26 27 27 28 29 30 31 32 23 33 34 4 35 35 26 26 27 27 28 29 30 31 32 33 34 4 35 35 36 6 37 37 28 29 30 31 32 33 34 4 35 35 36 6 37 37 4 4 35 5 5 5 5 5 5 5 5 5 5 5 5 5	2040 2041 2042 2043 2044 2045 2046 2047 2048 2050 2050 2055 2055 2055 2055 2055 205	37,35 37,61 36,45 36,70 36,94 37,18 30,21 30,39 30,57	4 12,538 8 12,153 8 12,236 9 12,316 7 12,396 7 10,072 5 10,132	747 752 729 734 604 608 611 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	747 752 729 734 604 608 601 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	49,808 50,152 48,611 48,944 49,265 40,290 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	97.55 97.55 146.82 196.40 236.699 277.21 317.962 317.9	Phase 3 Phase 2 Closed 2 2 2 12 2	288,480	2016 2017 2018 2017 2018 2017 2018 2017 2018 2021 52022 62023 72024 82025 92026 92026 12030 14 2031 15 2032 16 2033 17 2034 18 2035 18 2036 2037 21 2038 22 2039 22 2039 22 2034 2042 2043 22 2044 2045 2042 2043 2044 2055 32 32 32	52,360 52,810 54,438 52,055 52,252 1,787 1,807 1,807 1,807 3,111 3,113 3,165 3,191 3,243 3,342 3,345 3,342 3,345 3,342 3,345 3,342 3,345 3,342 3,345 3,342 3,345 3,342 3,345 3,342 3,345 3,342 3,345 3,342 3,3453,345 3,345 3,345 3,3453,345 3,345 3,3453,345 3,345 3,3453,345 3,345 3,3453,345 3,345 3,3453,345 3,345 3,3453,345 3,3453,345 3,3453,345 3,3453,345 3	0 0 0 0 0 0 0 0 0 0 0 0 0 0	609 1.037 1.046 1.055 1.064 1.055 1.064 1.072 1.081 1.072 1.081 1.072 1.081 1.072 1.081 1.072 1.081 1.072 1.081 1.072 1.081 1.072 1.081 1.072 1.081 1.072 1.081 1.072 1.081 1.072 1.081 1.072 1.081 1.072 1.081 1.072 1.081 1.072 1.081 1.072 1.081 1.072 1.081 1.072 1.081 1.121 1.121 1.122 1.122 1.1227 1.227 1.227 1.227 1.227 1.228 1.300 1.4000 1.4000 1.4000 1.4000 1.4000 1.4000 1.4000 1.4000 1.	1 10565 1 10262 1 1044 1 1044 1 1056 1 1044 1 1066 1 1077 1 1777 1 777 1 7777 1 777 1 777	6 1,056 9 1,029 1 1,041 3 1,053	70,413 68,544 69,400 68,544 69,400 70,202 71,003 5,570 5,685 9,865 9,865 9,865 10,025 10,025 10,025 10,025 10,025 10,025 10,025 10,0406 10,475 10,544 10,866 10,927 10,027 11,045 11,104 11,114	68, 584 68, 584 137, 984 137, 984 137, 984 137, 984 137, 984 137, 984 137, 984 137, 984 137, 985 137, 933 135, 495 137, 533 136, 495 137, 535 137, 535	4 Cell 1 4 4 Cell 1 6 4 Cell 1 6 6 Oal 1 1 9 Cell 1 1 9 Cell 1 1 9 Cell 1 1 1 Cell 1 1 1 Cell 1 1 2 Cell 1 1 2 Cell 1 1 5 Cell 1 1 6 Cell 1 1 7 Cell 1 1 1 Cell 1 1 1 Cell 1 1 1 Cell 1 1 1 Cell 1 1 2 Cell 1 1 2 Cell 1 1 2 Cell 1 1 3 Cell 2 1 4 Cell 1 1 4 Cell 2 1 4 Cell 2 1 <td< td=""><td>Phase 2 Phase 2 Cell 1 Cell 2 Cell 2</td><td>46,525</td></td<>	Phase 2 Phase 2 Cell 1 Cell 2 Cell 2	46,525

 CVRD growth rate beyond 2041 =
 1%

 CVRD disposal rate 2015-2016 =
 0.57
 tonnes per person per year (46% diversion)

 CVRD disposal rate 2017-2020 =
 0.55
 tonnes per person per year (46% diversion)

 CVRD disposal rate 2017-2020 =
 0.55
 tonnes per person per year (46% diversion)

 SRD growth rate beyond 2041 =
 0.50%
 tonnes per person per year (46% diversion)

 SRD disposal rate 2015-2016 =
 0.57
 tonnes per person per year (46% diversion)

 SRD disposal rate 2017-2020 =
 0.55
 tonnes per person per year (46% diversion)

 SRD disposal rate 2021-2027 =
 0.44
 tonnes per person per year (58% diversion)

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

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Table D5: Long Term Cost Model for Option 3(b) - Sustane facility located in Campbell River - Increasing Capacity

		-				Capital and Op	perating Costs						r					
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	,
2015													\$0					
2015						\$16,000,000							\$16,000,000		New Transfer station constructed 2012-2013		Construction of leachate management system and Cell 1	
0 2017								\$ 265,000	\$1,116,495		\$250,868	\$1,052,753	\$3,545,000				Closure Phase 2	Phase 2 SW mgmt
1 2018							\$ 200,000	\$ 2,500,000			\$490,358	\$1,052,753	\$5,360,000				Closure Phase 2	Phase 2 Surface w
2 2019 3 2020	\$311.025			Ash / residuals	\$1,352,789		\$ - \$ 1,075,000		\$1,116,495 \$1,116,495	\$390,000 \$190,000	\$191,695 \$491,790	\$1,052,753 \$1,052,753	\$2,751,000 \$5,590,000	Permits		Permits and land		Phase 2 Design an Phase 2 LFG and f
4 2021	\$3.310.000	\$709,508	\$432,080	\$47,000	\$3,571,072		\$ 35,000		\$423,924	\$190,000	\$5,630,329	\$1,052,753	\$15,402,000	New transfer station		Sustane facility begins operating		Phase 2 LFG and f
5 2022		\$709,508	\$436,919	\$48,000	\$3,588,315		\$ -		\$423,924	\$190,000	\$0	\$1,052,753	\$6,449,000			, , , , , , , , , , , , , , , , , , , ,		
6 2023		\$709,508	\$441,808	\$48,000	\$3,605,737		\$ 35,000		\$423,924	\$190,000	\$218,613	\$1,052,753	\$6,725,000					Phase 3 LFG and f
7 2024		\$709,508	\$433,582	\$82,000	\$4,711,435		\$ -		\$423,924	\$390,000	\$3,108,685	\$190,000	\$10,049,000					Phase 3 LFG and f
8 2025 9 2026		\$709,508 \$709,508	\$438,368 \$443,137	\$83,000 \$84,000	\$4,734,732 \$4,757,760		\$ - \$ -		\$423,924 \$423,924	\$190,000 \$190,000		\$190,000 \$190,000	\$6,770,000 \$6,798,000					
10 2027		\$709,508	\$447.873	\$84,000	\$4,780,317		\$ 585,000		\$423,924	\$190,000		\$190,000	\$7,411,000					
11 2028		\$709,508	\$452,573	\$85,000	\$4,802,582		\$ -		\$423,924	\$190,000		\$190,000	\$6,854,000					
12 2029	\$200,000	\$709,508	\$457,217	\$86,000	\$4,824,511		\$ 385,000		\$423,924	\$390,000		\$190,000	\$7,666,000	New trailers every 8 years				
13 2030		\$709,508	\$461,790	\$86,000	\$4,845,925		\$ -		\$423,924	\$190,000		\$190,000	\$6,907,000					
14 2031		\$709,508	\$466,288	\$87,000	\$4,866,890		\$ -		\$423,924	\$190,000		\$190,000	\$6,934,000					
15 2032 16 2033		\$709,508 \$709,508	\$470,739 \$475,154	\$87,000 \$88.000	\$4,887,474 \$4,907,766		\$ 235,000		\$423,924 \$423,924	\$190,000 \$190,000		\$190,000 \$190,000	\$6,959,000 \$7,219,000					
17 2034		\$709,508	\$479,417	\$89,000	\$4,907,766		\$ 235,000		\$423,924	\$390,000		\$190,000	\$7,209,000					
18 2035		\$709,508	\$483.607	\$89.000	\$4,945,929		\$ 35,000		\$423,924	\$190,000		\$190.000	\$7.067.000					
19 2036		\$709,508	\$487,784	\$90,000	\$4,964,697		\$-		\$423,924	\$190,000		\$190,000	\$7,056,000					
20 2037	\$200,000	\$709,508	\$491,870	\$90,000	\$4,982,881		\$ 550,000		\$423,924	\$190,000		\$190,000	\$7,828,000	New trailers every 8 years				
21 2038		\$709,508	\$495,883	\$91,000	\$5,000,595		\$ -		\$423,924	\$190,000		\$190,000	\$7,101,000					
22 2039 23 2040		\$709,508 \$709,508	\$499,828 \$503,737	\$91,000 \$92,000	\$5,017,928 \$5,035,014		\$ 35,000		\$423,924 \$423,924	\$390,000 \$190,000		\$190,000 \$190,000	\$7,357,000 \$7,144,000					
23 2040	\$1,555,125		\$507,590	\$92,000	\$5,051,898		\$ 385,000		\$423,924 \$423,924	\$190,000		\$190,000	\$9,106,000	Major capital upgrade every 20 years				
25 2042	φ1,000,120	\$709,508	\$512,735	\$93,000	\$5,076,293		\$ -		\$423,924	\$190,000		\$190,000	\$7,195,000	Major capital upgrade every 20 years				
26 2043		\$709,508	\$517,933	\$94,000	\$5,100,903		\$ 200,000		\$423,924	\$190,000		\$190,000	\$7,426,000					
27 2044		\$709,508	\$523,183	\$95,000	\$5,125,730		\$-		\$423,924	\$390,000		\$190,000	\$7,457,000					
28 2045 29 2046	\$200,000	\$709,508	\$528,486	\$96,000	\$5,150,776	\$8,850,000	\$ 35,000		\$423,924	\$190,000		\$190,000	\$16,374,000	New trailers every 8 years		Amortization period over	Construction Cell 2	
29 2046		\$709,508 \$709,508	\$533,842 \$539,252	\$96,000 \$97,000	\$3,294,656 \$2,317,301		\$ -	\$ 1,350,000	\$523,924 \$523,924	\$190,000 \$190,000		\$190,000 \$190,000	\$5,538,000 \$6,502,000				Closure Cell 1	
31 2048		\$709,508	\$539,252	\$97,000	\$2,334,882		\$ 585,000	\$ 1,350,000	\$523,924 \$523,924	\$190,000		\$190,000	\$4,591,000					
32 2049		\$709,508	\$550,236	\$99,000	\$2,352,618		\$ -		\$523,924	\$390,000		\$190,000	\$4,815,000					
33 2050		\$709,508	\$555,811	\$99,000	\$2,370,510		\$ -		\$523,924	\$190,000		\$190,000	\$4,639,000					
34 2051		\$709,508	\$561,442	\$100,000	\$2,388,561		\$ 35,000		\$523,924	\$190,000		\$190,000	\$4,698,000					
35 2052		\$709,508	\$567,130	\$101,000	\$2,406,772		\$-		\$523,924	\$190,000		\$190,000	\$4,688,000					
36 2053	\$200,000	\$709,508	\$572,875	\$102,000	\$2,425,143		\$ 585,000		\$523,924	\$190,000		\$190,000	\$5,498,000	New trailers every 8 years				
37 2054 38 2055		\$709,508 \$709,508	\$578,678 \$584,539	\$103,000 \$104,000	\$2,443,678 \$2,462,377		\$ - \$ -		\$523,924 \$523,924	\$390,000 \$190,000		\$190,000 \$190,000	\$4,939,000 \$4,764,000					
39 2056		\$709,508	\$590,460	\$104,000	\$2,481,241		\$ - \$ -		\$523,924	\$190,000		\$190,000	\$4,789,000					
40 2057		\$709,508	\$596,439	\$105,000	\$2,500,273		\$ 585,000		\$523,924	\$190,000		\$190,000	\$5,400,000					
41 2058		\$709,508	\$602,480	\$106,000	\$2,519,474		\$ -		\$523,924	\$190,000		\$190,000	\$4,841,000					
42 2059		\$709,508	\$608,580	\$107,000	\$2,538,845		\$ 35,000		\$523,924	\$390,000		\$190,000	\$5,103,000					
43 2060		\$709,508	\$614,743	\$108,000	\$2,558,389		\$ -		\$523,924	\$190,000		\$190,000	\$4,895,000					
44 2061	\$1,755,125	\$709,508	\$620,967	\$109,000	\$2,578,106		\$ -		\$523,924	\$190,000	1	\$190,000	\$6,677,000	Major capital upgrade every 20 years				
45 2062 46 2063		\$709,508 \$709,508	\$627,254 \$633,604	\$110,000 \$111,000	\$2,597,999 \$2,618,068		\$ - \$ 235,000		\$523,924 \$523,924	\$190,000 \$190,000		\$190,000 \$190,000	\$4,949,000 \$5,211,000					
40 2003		\$709,508	\$640,018	\$111,000	\$2,638,316		\$ -		\$523,924 \$523,924	\$190,000		\$190,000	\$5,203,000					
48 2065	1	\$709,508	\$646,496	\$112,000	\$2,658,745		\$ 385,000		\$523,924	\$190,000	1	\$190,000	\$5,416,000					
49 2066		\$709,508	\$653,040	\$113,000	\$2,222,518		\$-		\$523,924	\$190,000		\$190,000	\$4,602,000					
50 2067		\$709,508	\$659,650	\$114,000	\$2,239,557		\$ 550,000		\$523,924	\$190,000		\$190,000	\$5,177,000					
1	1	1				1					1		1	1				

30 years \$229,749,000 1,792,501 tonnes \$128 per tonne over 30 years

40 years \$278,570,000 2,448,090 \$114 per tonne over 40 years

50 years \$330,644,000 3,159,253 \$105 per tonne over 50 years

CRWMC LF Notes
ment design 9 portial construction
mgmt design & partial construction ace water management construction
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and final cover design
and final cover construction

Table D6: Long Term Cost Model for Option 3(c) - Sustane facility located in Gold River - Increasing Capacity

	Population and Disposal Rates											CRWMC LF	Fill Rate and (Capacity								CVWMC LF	Fill Rate and O	apacity											
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/Residual s to CVWMC LF	Yea		/olumetric MSW Disposal Rate	Daily Cover Soil	Operational Soil	Settlement	Net Fill Volume	Cumulative Fill Volume Pha	ase Volumetric Capacity (m³)	Yea		Volumetric MSW	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)
		tonnes		tonnes	tonnes / yr	tonnes / day		tonnes	tonnes	tonnes	tonnes / day		tonnes				m ³	m ³	m ³	m ³	m ³	m ³				m ³	m ³	m ³	m ³	m ³	m ³	m ³	-		
201 201	5 64,29 6 64,84		45,871 46,187	26,149 26,330	62,801 63,297		90,443 91,177					26,149 26,330	36,652 36,967			2015 2016	37,356 37,614	12,452 12,538	747 752	747	7 49,808 2 50,152	Phas	e 3		2015 2016	52,360 52,810		17,453 17,603	1,047 1,056	1,047 1,056	69,813 70,413		Phase 2	Phase 2	40.505
0 201			46,490	25,521	61,527		91,113					25,521	36,007	0	0	2017	36,458	12,153	729	729		48,611 Phas		0	2017	51,438	0	17,146	1,029	1,029			Cell 1	Phase 2	46,525
1 201 2 201			46,809 47,116	25,696 25,864	62,131 62,720		92,068 93,003					25,696 25,864	36,435 36,856	0	1	2018 2019	36,708 36,949	12,236 12,316	734 739	734		97,555 Phas 146,821 Phas		1	2018 2019	52,050 52,651	0	17,350 17,550	1,041 1,053	1,041 1,053	69,400 70,202			Cell 1 Cell 1	
3 202	0 67,90	5 37,276	47,419	26,031	63,307	173	93,936					26,031	37,276	0	3	2020	37,187	12,396	739 744	744	4 49,582	196,403 Phas	e 3	3	2020	53,252	0	17,751	1,065	1,065	71,003	279,189	Cell 1	Cell 1	ł
4 202 5 202			47,706 47,986	21,152 21,276	51,598 52,063		89,819 90,712			29,195 29,522	83	21,152 21,276	1,251 1,265	3,187	4	2021 2022	30,217 30,395	10,072 10,132	604 608	604 608	,	236,693 Phas 277,219 Phas		4	2021 2022	1,787 1,807	3,187	596 602	36	36	5,570	284,759 290,391		Cell 1 Cell 1	
6 202	3 70,21		48,267	21,401	52,532		91,614		Landfill closur		85	21,401	1,279	3,259	6	2023	30,573	10,191	611	611	1 40,763	317,982 Close		6	2023	1,828	3,259		37	37	5,695	296,087		Cell 1	1
7 202	4 70,98 5 71,75			21,521	52,995 53,456		92,507 93,398			50,817	145 146		2,178 2,197	5,547 5,595	7	2024	0	0	0	(0 0	317,982 Close		7	2024	3,111	5,547 5,595			62	9,695	305,782		Cell 1 Cell 1	1
8 202 9 202	6 72,52		48,806	21,640 21,754	53,456		93,398	29,619 29,942		51,259 51,696	148		2,197	5,595	8	2025 2026	0	0	0	(0 0	317,982 Close 317,982 Close		8	2025 2026	3,138 3,165	5,595			63	9,780	315,562 325,425		Cell 1 Cell 1	P
10 202	7 73,29	32,496	49,307	21,862			95,152				149		2,234	5,690	10	2027	0	0	0	(0 0	317,982 Close		10	2027	3,191	5,690			64	9,945	335,370		Cell 1	
11 202			49,543 49,773	21,967	54,798 55,231		96,014 96,864				150		2,252 2,270	5,736 5,781	11	2028 2029	0	0	0	(0 0	317,982 Close 317,982 Close		11	2028	3,217 3,243	5,736 5,781		64	64	10,025 10,104	345,395 355,499		Cell 1 Cell 1	
12 202 13 203	0 75,53	1 33,489	49,773	22,069 22,166	55,655	151	90,804			53,368	151		2,287	5,761	12	2030	0	0	0	(0 0	317,982 Close		13	2029 2030	3,267	5,761		65	65	10,104	365,681		Cell 1	P
14 203			50,203	22,259	56,069		98,514				154		2,304	5,869	14	2031	0	0	0	(0 0	317,982 Close		14	2031	3,292	5,869			66	10,258	375,939		Cell 1	
15 203 16 203				22,349 22,435			99,320 100,116				155		2,321 2,337	5,911 5,953	15	2032 2033	0	0	0	(0 0	317,982 Close 317,982 Close		15	2032 2033	3,316 3,339	5,911 5,953			66 67	10,332 10,406	386,271 396,677		Cell 1 Cell 1	
17 203	4 78,36	34,746	50,775	22,513	57,259	157	100,879	32,393	22,513	54,906	150		2,353	5,993	17	2034	0	0	0	(0 0	317,982 Close		17	2034	3,362	5,993	1,121		67	10,475	407,152	Cell 1	Cell 1	
18 203			50,944	22,588			101,627				158		2,368	6,032	18	2035	0	0	0	(0 0	317,982 Close		18	2035	3,384	6,032			68	10,544	417,696		Cell 1	
19 203 20 203			51,110 51,265	22,661 22,730	58,003 58,363		102,371 103,096	32,958 33,234			159		2,384 2,398	6,071 6,109	19	2036 2037	0	0	0	(0 0	317,982 Close 317,982 Close		19	2036 2037	3,405 3,426	6,071 6,109			68 69	10,612 10,677	428,308 438,985		Cell 1 Cell 1	
21 203	8 81,01	35,918	51,411	22,795	58,713	161	103,805				161		2,413	6,146	21	2038	0	0	0	(0 0	317,982 Close		21	2038	3,447	6,146			69	10,742	449,727		Cell 1	P
22 203 23 204			51,551 51,686	22,857	59,056 59,394		104,500 105,187				162 163		2,427 2,441	6,181 6,217	22	2039 2040	0	0	0	(0 0	317,982 Close 317,982 Close		22	2039 2040	3,467 3,487	6,181 6,217			69	10,804 10,866	460,531 471,397		Cell 1 Cell 1	,
23 204 24 204			51,686	22,917 22,977	59,394	100	105,187	34,036		56,953			2,441	6,217	23	2040	0	0	0	(0 0	317,982 Close		23	2040	3,487	6,217			70	10,866	471,397 482,324		Cell 1 Cell 1	
25 204	2 83,71	7 37,119	52,080	23,091	60,210	165	106,808	34,644	23,091	57,736	164 165		2,474	6,302	25	2042	Ő	Ő	0	(0 0	317,982 Close	ed	25	2042	3,535	6,302	1,178	71	71	11,015	493,339	Cell 1	Cell 1	
26 204 27 204			52,341 52,602	23,207 23,323	60,697 61,188		107,761 108,723		23,207 23,323		166		2,494 2,515	6,353 6,405	26	2043 2044	0	0	0	(0 0	317,982 Close 317,982 Close		26	2043 2044	3,563 3,592	6,353 6,405			71	11,104	504,444 515,638		Cell 1 Cell 1	
28 204			52,865	23,323			108,723				160		2,515	6,405	27	2044	0	0	0	(0 0	317,982 Close		28	2044	3,592	6,405			72	11,194	515,636		Cell 1	
29 204	6 87,11	38,626	53,130	23,557			110,673				170		2,555	6,509	29	2046	0	0	0	(0 0	317,982 Close	ed	29	2046	3,651	6,509	1,217	73	73	11,376	538,299	Cell 2	Cell 2	517,470
30 204 31 204			53,395 53,662	23,675 23,793			111,662 112,660				172		2,576 2,597	6,561 6,615	30	2047 2048	0	0	0	(0 0	317,982 Close 317,982 Close		30	2047 2048	3,680 3,710	6,561 6,615			74	11,468 11,561	549,767 561,329		Cell 2 Cell 2	
32 204			53,930	23,793	63,708		112,000				175		2,557	6.668	32	2040	0	0	0	(0 0	317,982 Close		32	2040	3,740	6.668			74	11,501	572,984		Cell 2	
33 205	0 90,65	3 40,194	54,200	24,031	64,226		114,685	37,555	24,031	61,586	176		2,639	6,723	33	2050	0	0	0	(0 0	317,982 Close	ed	33	2050	3,771	6,723			75	11,750	584,734	Cell 2	Cell 2	
34 205 35 205			54,471 54,743	24,152 24,272	64,748 65.274		115,712 116,748				177		2,661 2,683	6,777 6.832	34	2051 2052	0	0	0	(0 0	317,982 Close 317,982 Close		34	2051 2052	3,801 3,832	6,777 6.832			76	11,846 11,942	596,580 608,522		Cell 2 Cell 2	
36 205				24,272			117,794				180		2,003	6,888	36	2052	0	0	0	(0 0	317,982 Close		36	2053	3,863	6,888			77	12,039	620,561		Cell 2	
37 205			55,292	24,516			118,850				182		2,726	6,944	37	2054	0	0	0	(0 0	317,982 Close		37	2054	3,895	6,944			78	12,137	632,698		Cell 2	
38 205 39 205			55,569 55.847	24,638 24,761	66,883 67,428		119,916 120,992				183		2,749 2,771	7,001	38	2055 2056	0	0	0	(0 0	317,982 Close 317,982 Close		38	2055 2056	3,927 3,959	7,001			79	12,236 12,336	644,934 657,270		Cell 2 Cell 2	
40 205			56,126	24,701			120,992				185		2,794	7,030	40	2057	0	0	0	(0 0	317,982 Close		40	2057	3,991	7,030			80	12,330	669,706		Cell 2	
41 205			56,406	25,010	68,534		123,174	40,708		65,718	188		2,816	7,174	41	2058	0	0	0	(0 0	317,982 Close		41	2058	4,024	7,174			80	12,538	682,245		Cell 2	
42 205 43 206			56,688	25,135			124,281	41,120			189		2,840	7,232	42	2059	0	0	0	(0 0	317,982 Close		42	2059	4,056	7,232			81	12,641 12,744	694,885		Cell 2	1
43 206 44 206	0 100,13		56,972 57,257	25,260 25,387	69,660 70,230		125,398 126,526				191		2,863 2,886	7,291 7,351	43	2060 2061	0	0	0	(0 0	317,982 Close 317,982 Close		43	2060 2061	4,090 4,123	7,291 7,351			82	12,744	707,630 720,478		Cell 2 Cell 2	
45 206	2 102,15	1 45,292	57,543	25,514	70,805	194	127,664	42,382	25,514	67,896	194		2,910	7,411	45	2062	0	0	0	(0 0	317,982 Close	ed	45	2062	4,157	7,411	1,386	83	83	12,954	733,432	Cell 2	Cell 2	
46 206 47 206			57,831 58,120	25,641 25,769	71,386 71,972		128,813 129,973	42,811 43,244	25,641 25,769	68,452 69,014	196 197		2,934 2,958	7,472	46	2063 2064	0	0	0	(0 0	317,982 Close 317,982 Close		46	2063 2064	4,191 4,225	7,472 7,533			84	13,060 13,167	746,492 759,659		Cell 2	
47 206				25,769			129,973				197		2,958	7,533	47	2064	0	0	0		0 0	317,982 Close		47	2064	4,225	7,533			85	13,167	759,659		Cell 2 Cell 2	
49 206	6 106,29	8 47,131	58,703	26,028	73,159	200	132,326	44,124	26,028	70,152	200		3,007	7,658	49	2066	0	0	0	(0 0	317,982 Close	ed	49	2066	4,295	7,658	1,432	86	86	13,384	786,318	Cell 2	Cell 2	
50 206	7 107,36	1 47,602	58,996	26,158	73,760	202	133,519	44,571	26,158	70,729	202		3,031	7,721		2067	0	0	0	(U 0	317,982 Close	d	50	2067	4,330	7,721	1,443	87	87	13,494	799,813	Cell 2	Cell 2	
Totals	4,465,392	2 2,024,427	2,772,844	1,260,924	3,285,351		5,726,315	1,687,286	1,041,504	2,728,790		219,420	337,141	297,865	L	I				1	1 1		I					1	1			1	1	1 1	

 CVRD growth rate beyond 2041 =
 1%

 CVRD disposal rate 2015-2016 =
 0.57

 tonnes per person per year (46% diversion)

 CVRD disposal rate 2017-2020 =
 0.55

 VRD disposal rate 2017-2067 =
 0.44

 tonnes per person per year (68% diversion)

 SRD disposal rate 2015-2016 =
 0.57

 SRD disposal rate 2015-2016 =
 0.57

 SRD disposal rate 2017-2020 =
 0.55

 SRD disposal rate 2017-2020 =
 0.55

 SRD disposal rate 2021-2067 =
 0.44

 tonnes per person per year (46% diversion)

 SRD disposal rate 2021-2067 =
 0.44

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

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Table D6: Long Term Cost Model for Option 3(c) - Sustane facility located in Gold River - Increasing Capacity

							Capit	al and Operating	g Costs	Capital and Operating Costs													
ar	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					
016									\$16,000,000							\$16,000,000				Construction of leachate management system and Cell 1			
017										\$ 860,000		\$1,116,495		\$250,868	\$1,052,753	\$3,545,000				Closure Phase 2	Phase 2 SW mgmt design & partial construct		
2018										\$ 200,000	\$ 2,500,000	\$1,116,495		\$490,358	\$1,052,753	\$5,360,000				Closure Phase 2	Phase 2 Surface water management constru		
019	\$311.025			\$200.000				\$775.000		\$ - \$ 1.075.000		\$1,116,495 \$1,116,495	\$390,000 \$190.000	\$191,695 \$491,790	\$1,052,753 \$1.052,753	\$2,751,000 \$5.212.000	Construct TS	New trailars even 0 veen	Permits and land		Phase 2 Design and construction Phase 2 LFG and final cover design		
020	\$3.310.000	\$709.508	\$817,449	\$200,000			\$89.230	\$3.571.072		\$ 35,000		\$423,924	\$190,000	\$491,790		\$15,829,000	New trailers every 8 years	New trailers every 8 years	Sustane facility begins operating		Phase 2 LFG and final cover construction		
022	\$5,510,000	\$709,508	\$826.603				\$90,229	\$3.588.315		\$ 55,000		\$423,924	\$190,000	\$0,000,020	\$1.052.753	\$6,881,000	New daliers every o years		oustance lacinty begins operating				
023		\$709,508	\$835,853				\$91,239	\$3,605,737		\$ 35,000		\$423,924	\$190,000	\$218,613	\$1,052,753	\$7,163,000					Phase 3 LFG and final cover design		
2024		\$709,508	\$820,291		\$651,040	\$430,428	\$155,318	\$4,711,435		\$ -		\$423,924	\$390,000	\$3,108,685	\$190,000	\$11,591,000					Phase 3 LFG and final cover construction		
025		\$709,508	\$829,345		\$651,040	\$432,795	\$156,668	\$4,734,732		\$-		\$423,924	\$190,000		\$190,000	\$8,318,000							
2026		\$709,508	\$838,368		\$651,040	\$435,083	\$158,002	\$4,757,760		\$ -		\$423,924	\$190,000		\$190,000	\$8,354,000							
2027		\$709,508	\$847,327	* 000 000	\$651,040	\$437,238	\$159,310	\$4,780,317		\$ 585,000		\$423,924	\$190,000		\$190,000	\$8,974,000		N					
028	\$200.000	\$709,508 \$709,508	\$856,219 \$865,006	\$200,000	\$651,040 \$651,040	\$439,331 \$441.370	\$160,600 \$161,871	\$4,802,582 \$4,824,511		\$ - \$ 385,000		\$423,924 \$423,924	\$190,000 \$390.000		\$190,000 \$190,000	\$8,623,000 \$9,242,000	N	New trailers every 8 years					
029 030	\$200,000	\$709,508	\$873.656		\$651,040	\$443.312	\$163,112	\$4,845,925		\$ 365,000		\$423,924	\$190,000		\$190,000	\$9,242,000	New trailers every 8 years						
030		\$709,508	\$882,167		\$651.040	\$445,183	\$164,327	\$4,866,890		\$ - \$ -		\$423,924	\$190,000		\$190,000	\$8,523,000							
032		\$709,508	\$890,588	\$346,000	\$651,040	\$446,975	\$165,520	\$4,887,474		\$-		\$423,924	\$190,000		\$190,000	\$8,901,000							
033		\$709.508	\$898.941		\$651.040	\$448,704	\$166.696	\$4,907,766		\$ 235,000		\$423,924	\$190.000		\$190.000	\$8,822,000							
034		\$709,508	\$907,006		\$651,040	\$450,256	\$167,813	\$4,927,049		\$ -		\$423,924	\$390,000		\$190,000	\$8,817,000					******		
)35		\$709,508	\$914,931		\$651,040	\$451,754	\$168,907	\$4,945,929		\$ 35,000		\$423,924	\$190,000		\$190,000	\$8,681,000							
036		\$709,508	\$922,835	\$200,000	\$651,040	\$453,226	\$169,995	\$4,964,697		\$-		\$423,924	\$190,000		\$190,000	\$8,875,000		New trailers every 8 years					
037	\$200,000	\$709,508	\$930,565		\$651,040	\$454,601	\$171,049	\$4,982,881		\$ 550,000		\$423,924	\$190,000		\$190,000	\$9,454,000	New trailers every 8 years						
038 039		\$709,508 \$709,508	\$938,157 \$945.621		\$651,040 \$651,040	\$455,896 \$457,137	\$172,076 \$173,080	\$5,000,595 \$5,017,928		\$ - \$ 35.000		\$423,924 \$423,924	\$190,000 \$390,000		\$190,000 \$190,000	\$8,731,000 \$8,993,000							
039		\$709,508	\$953,016		\$651,040	\$458,334	\$173,080	\$5,035,014		\$ 35,000		\$423,924 \$423,924	\$390,000		\$190,000	\$8,785,000	Major capital upgrade every 20 years						
040	\$1,555,125		\$960,304		\$651,040	\$459,531	\$175,049	\$5,051,898		\$ 385,000		\$423,924	\$190,000		\$190,000	\$10,751,000	major capital upgrade every 20 year.						
042	\$1,000,120	\$709.508	\$970.040		\$651.040	\$461.829	\$176,462	\$5.076.293		\$ -		\$423,924	\$190,000		\$190,000	\$8,849,000							
2043		\$709,508	\$979,873		\$651,040	\$464,138	\$177,889	\$5,100,903		\$ 200,000		\$423,924	\$190,000		\$190,000	\$9,087,000							
044		\$709,508	\$989,805	\$200,000	\$651,040	\$466,459	\$179,328	\$5,125,730		\$-		\$423,924	\$390,000		\$190,000	\$9,326,000		New trailers every 8 years					
045	\$200,000	\$709,508	\$999,837		\$651,040	\$468,791	\$180,779	\$5,150,776	\$8,850,000	\$ 35,000		\$423,924	\$190,000		\$190,000	\$18,050,000	New trailers every 8 years		Amotization period over	Construction Cell 2			
046 047		\$709,508	\$1,009,971		\$651,040	\$471,135	\$182,243	\$3,294,656		\$ -		\$523,924	\$190,000		\$190,000	\$7,222,000				Closure Cell 1			
047		\$709,508	\$1,020,206 \$1,030,544		\$651,040 \$651,040	\$473,491 \$475,858	\$183,721 \$185,211	\$2,317,301 \$2,334,882		\$ 585,000	\$ 1,350,000	\$523,924 \$523,924	\$190,000		\$190,000	\$8,194,000							
)40)49		\$709,508 \$709,508	\$1,030,544 \$1,040,987		\$651,040	\$475,858 \$478,237	\$185,211 \$186,714	\$2,334,882 \$2,352,618		s - s -		\$523,924 \$523,924	\$190,000 \$390,000		\$190,000 \$190,000	\$6,291,000 \$6,523,000							
049 050		\$709,508	\$1,040,987		\$651,040	\$480.629	\$188,231	\$2,352,618		s - \$ -		\$523,924	\$190,000		\$190,000	\$6,355,000							
051		\$709,508	\$1,062,188	\$241,000	\$651.040	\$483,032	\$189,761	\$2,388,561		\$ 35,000		\$523,924	\$190,000		\$190,000	\$6,664,000							
052		\$709,508	\$1,072,948	\$2,615,000	\$651,040	\$485,447	\$191,305	\$2,406,772		\$ -		\$523,924	\$190,000		\$190,000	\$9,036,000		New trailers every 8 years					
053	\$200,000	\$709,508	\$1,083,818		\$651,040	\$487,874	\$192,862	\$2,425,143		\$ 585,000		\$523,924	\$190,000		\$190,000	\$7,239,000	New trailers every 8 years						
)54		\$709,508	\$1,094,796		\$651,040	\$490,314	\$194,433	\$2,443,678		\$-		\$523,924	\$390,000		\$190,000	\$6,688,000							
)55		\$709,508	\$1,105,885		\$651,040	\$492,765	\$196,018	\$2,462,377		\$-		\$523,924	\$190,000		\$190,000	\$6,522,000							
056		\$709,508	\$1,117,086		\$651,040	\$495,229	\$197,618	\$2,481,241		\$-		\$523,924	\$190,000		\$190,000	\$6,556,000							
057		\$709,508	\$1,128,399		\$651,040	\$497,705	\$199,231	\$2,500,273		\$ 585,000		\$523,924	\$190,000		\$190,000	\$7,175,000							
58		\$709,508	\$1,139,826		\$651,040	\$500,194	\$200,859	\$2,519,474		\$ -		\$523,924	\$190,000		\$190,000	\$6,625,000							
059		\$709,508	\$1,151,368	\$200.000	\$651,040 \$651,040	\$502,695 \$505,208	\$202,501 \$204,157	\$2,538,845 \$2,558,389		\$ 35,000		\$523,924 \$523,924	\$390,000 \$190.000		\$190,000 \$190.000	\$6,895,000	M	No. 4 all and a second second					
060 061	\$1,755,125	\$709,508 \$709,508	\$1,163,027 \$1,174,802	\$200,000	\$651,040	\$505,208	\$204,157 \$205,829	\$2,558,389 \$2,578,106		s - s -		\$523,924	\$190,000		\$190,000	\$6,895,000 \$8,486,000	Major capital upgrade every 20 years New trailers every 8 years	New trailers every 8 years					
062	\$1,700,120	\$709,508	\$1,186,696		\$651.040	\$510,273	\$203,829	\$2,597,999		\$ -		\$523,924	\$190,000		\$190,000	\$6,767,000	non adulta every o years						
063		\$709,508	\$1,198,710		\$651,040	\$512,824	\$209,216	\$2,618,068		\$ 235,000		\$523,924	\$190,000		\$190,000	\$7,038,000							
064		\$709,508	\$1,210,845		\$651,040	\$515,388	\$210,933	\$2,638,316	1	\$ -		\$523,924	\$390,000		\$190,000	\$7,040,000							
065		\$709,508	\$1,223,101		\$651,040	\$517,965	\$212,664	\$2,658,745		\$ 385,000		\$523,924	\$190,000		\$190,000	\$7,262,000							
066		\$709,508	\$1,235,481		\$651,040	\$520,555	\$214,412	\$2,222,518		\$ -		\$523,924	\$190,000		\$190,000	\$6,457,000							
2067		\$709,508	\$1,247,986		\$651,040	\$523,158	\$216,174	\$2,239,557		\$ 550,000		\$523,924	\$190,000		\$190,000	\$7,041,000							
		1	\$47,244,009					1	1		\$4,115,000			1		1	1						

30 years \$270,394,000 1,792,501 tonnes \$151 per tonne over 30 years

40 years \$339,443,000 2,448,090 tonnes \$139 per tonne over 40 years

50 years \$409,949,000 3,159,253 tonnes \$130 per tonne over 50 years

C LF Notes	CRWMC LF Notes
agement system and Cell 1	Phase 2 SW mgmt design & partial construction Phase 2 Surface water management construction Phase 2 Design and construction Phase 2 LFG and final ocver design Phase 2 LFG and final ocver construction
	Phase 3 LFG and final cover design Phase 3 LFG and final cover construction

APPENDIX E: Long-Term Cost Model – Full System Cost



Table E: Long-Term Model - Full System Cost (excl. capital and operating costs associated with WTE facility, CVWMC Landfill and CRWMC Landfill as well as transfer and hauling of waste and residuals).

Y	ear	Organics Facility (CR) and TS (CV) Capital	Organics Facility Operating	Organics TS Operating (CV)	Organics Transfer	Remote Transfer Stations and Landfills Capital - Development & Closure	Remote Transfer Stations and Landfills Operating	Host Community Agreements	Diversion Programs Capital	Diversion Programs Capital - Equipment	Diversion Programs Operating	Support Services and Staff Disposal Operating	Illegal Dumping Operating	One Time Expenses Operating
	2015													
	2016													ł
0	2017 2018	\$5,410,000				\$140,000	\$1,279,881 \$1,279,881	\$356,225 \$356,225	\$455.000	\$90,000 \$325,000	\$3,945,914 \$3,945,914	\$500,480 \$500,480	\$197,531 \$197,531	\$1.150.000
2	2018	\$3,150,000				\$140,000	\$1,279,881	\$356,225	\$455,000	\$325,000	\$3,945,914	\$500,480	\$197,531	\$1,150,000
3	2019	\$3,130,000				\$0	\$1,279,881	\$356,225		\$205,000	\$3,945,914	\$500,480	\$197,531	1
4	2020		\$781.000	\$230.000	\$ 134,106	\$0	\$1,279,881	\$356,225		\$35.000	\$3,945,914	\$500,480	\$197,531	1
5	2022		\$781,000	\$230,000	\$ 135,608	\$0	\$1,279,881	\$356,225		\$375,000	\$3,945,914	\$500,480	\$197,531	1
6	2023		\$781,000	\$230,000	\$ 137.126	\$310.000	\$1,279,881	\$356,225	\$455,000	\$270,000	\$3,945,914	\$500,480	\$197,531	1
7	2024		\$781,000	\$230,000	\$ 138,635	\$1,995,000	\$1,279,881	\$356,225		\$35,000	\$3,945,914	\$500,480	\$197,531	
8	2025		\$781,000	\$230,000	\$ 140,143	\$1,505,000	\$1,279,881	\$356,225		\$225,000	\$3,945,914	\$500,480	\$197,531	1
9	2026		\$781,000	\$230,000	\$ 141,645	\$414,600	\$1,279,881	\$356,225		\$30,000	\$3,945,914	\$500,480	\$197,531	1
10	2027		\$781,000	\$230,000	\$ 143,135	\$1,210,700	\$1,279,881	\$356,225		\$410,000	\$3,945,914	\$500,480	\$197,531	1
11	2028		\$781,000	\$230,000	\$ 144,614		\$1,279,881	\$356,225	\$455,000	\$240,000	\$3,945,914	\$500,480	\$197,531	
12	2029		\$781,000	\$230,000	\$ 146,074		\$1,279,881	\$356,225		\$30,000	\$3,945,914	\$500,480	\$197,531	ļ
13	2030		\$781,000	\$230,000	\$ 147,512		\$1,279,881	\$356,225		\$210,000	\$3,945,914	\$500,480	\$197,531	L
14	2031		\$781,000	\$230,000	\$ 148,926		\$1,279,881	\$356,225		\$0	\$3,945,914	\$500,480	\$197,531	
15	2032		\$781,000	\$230,000	\$ 150,324		\$1,279,881	\$356,225		\$455,000	\$3,945,914	\$500,480	\$197,531	
16	2033		\$781,000	\$230,000	\$ 151,711		\$1,279,881	\$356,225	\$455,000	\$275,000	\$3,945,914	\$500,480	\$197,531	
17	2034		\$781,000	\$230,000	\$ 153,049		\$1,279,881	\$356,225		\$0	\$3,945,914	\$500,480	\$197,531	1
18 19	2035 2036		\$781,000 \$781,000	\$230,000 \$230,000	\$ 154,363 \$ 155,673		\$1,279,881 \$1,279,881	\$356,225 \$356,225		\$205,000 \$35,000	\$3,945,914 \$3,945,914	\$500,480 \$500,480	\$197,531 \$197,531	
20	2030		\$781,000	\$230,000	\$ 155,673		\$1,279,881	\$356,225		\$375,000	\$3,945,914	\$500,480	\$197,531	[
20	2037		\$781,000	\$230,000	\$ 158,212		\$1,279,881	\$356,225	\$455,000	\$270,000	\$3,945,914	\$500,480	\$197,531	
22	2030		\$781,000	\$230,000	\$ 159,449		\$1,279,881	\$356,225	Q400,000	\$85,000	\$3,945,914	\$500,480	\$197,531	1
23	2033		\$781,000	\$230,000	\$ 160,673		\$1,279,881	\$356,225		\$175,000	\$3,945,914	\$500,480	\$197,531	1
24	2041		\$781,000	\$230,000	\$ 161,880		\$1,279,881	\$356,225		\$30,000	\$3,945,914	\$500,480	\$197,531	1
25	2042		\$781,000	\$230,000	\$ 163,499		\$1,279,881	\$356,225		\$410,000	\$3,945,914	\$500,480	\$197,531	1
26	2043		\$781,000	\$230,000	\$ 165,134		\$1,279,881	\$356,225	\$455,000	\$240,000	\$3,945,914	\$500,480	\$197,531	
27	2044		\$781,000	\$230,000	\$ 166,785		\$1,279,881	\$356,225		\$30,000	\$3,945,914	\$500,480	\$197,531	1
28	2045		\$781,000	\$230,000	\$ 168,453		\$1,279,881	\$356,225		\$210,000	\$3,945,914	\$500,480	\$197,531	
29	2046	\$2,140,000	\$781,000	\$230,000	\$ 170,138		\$1,279,881	\$356,225		\$50,000	\$3,945,914	\$500,480	\$197,531	1
30	2047		\$781,000	\$230,000	\$ 171,839		\$1,279,881	\$356,225		\$405,000	\$3,945,914	\$500,480	\$197,531	1
31	2048		\$781,000	\$230,000	\$ 173,557		\$1,279,881	\$356,225	\$455,000	\$275,000	\$3,945,914	\$500,480	\$197,531	1
32	2049		\$781,000	\$230,000	\$ 175,293	\$340,000	\$1,279,881	\$356,225		\$0	\$3,945,914	\$500,480	\$197,531	L
33	2050		\$781,000	\$230,000	\$ 177,046		\$1,279,881	\$356,225		\$205,000	\$3,945,914	\$500,480	\$197,531	ļ
34	2051		\$781,000	\$230,000	\$ 178,816		\$1,279,881	\$356,225		\$35,000	\$3,945,914	\$500,480	\$197,531	
35	2052		\$781,000	\$230,000	\$ 180,604	*****	\$1,279,881	\$356,225	0.455.000	\$375,000	\$3,945,914	\$500,480	\$197,531	
36	2053		\$781,000	\$230,000	\$ 182,411		\$1,279,881	\$356,225	\$455,000	\$320,000	\$3,945,914	\$500,480	\$197,531	
37 38	2054 2055		\$781,000 \$781,000	\$230,000 \$230,000	\$ 184,235 \$ 186,077		\$1,279,881	\$356,225		\$35,000 \$175,000	\$3,945,914 \$3,945,914	\$500,480 \$500,480	\$197,531 \$197,531	
38	2055			\$230,000 \$230,000	\$ 186,077		\$1,279,881	\$356,225 \$356,225			\$3,945,914 \$3,945,914			
39 40	2056		\$781,000 \$781,000	\$230,000	\$ 187,938		\$1,279,881 \$1,279,881	\$356,225		\$30,000 \$410,000	\$3,945,914	\$500,480 \$500,480	\$197,531 \$197,531	1
40	2058		\$781,000	\$230,000	\$ 191,715		\$1,279,881	\$356,225	\$455,000	\$240.000	\$3,945,914	\$500,480	\$197,531	1
42	2059		\$781,000	\$230,000	\$ 193,632		\$1,279,881	\$356,225	9700,000	\$30,000	\$3,945,914	\$500,480	\$197,531	
43	2060		\$781,000	\$230,000	\$ 195,569		\$1,279,881	\$356,225		\$260,000	\$3,945,914	\$500,480	\$197,531	1
44	2061		\$781,000	\$230,000	\$ 197,524		\$1,279,881	\$356,225		\$0	\$3,945,914	\$500,480	\$197,531	
45	2062		\$781,000	\$230.000	\$ 199,500		\$1,279,881	\$356,225		\$405.000	\$3.945.914	\$500,480	\$197,531	
46	2063		\$781,000	\$230,000	\$ 201,495		\$1,279,881	\$356,225	\$455,000	\$275,000	\$3,945,914	\$500,480	\$197,531	
47	2064		\$781,000	\$230,000	\$ 203,510		\$1,279,881	\$356,225		\$0	\$3,945,914	\$500,480	\$197,531	
48	2065		\$781,000	\$230,000	\$ 205,545		\$1,279,881	\$356,225		\$205,000	\$3,945,914	\$500,480	\$197,531	
49	2066		\$781,000	\$230,000	\$ 207,600		\$1,279,881	\$356,225		\$35,000	\$3,945,914	\$500,480	\$197,531	
50	2067		\$781,000	\$230,000	\$ 209,676		\$1,279,881	\$356,225		\$425,000	\$3,945,914	\$500,480	\$197,531	
							1							

APPENDIX F: GHG Emissions Assessment

Table C1: Option 0 - Status Quo Table C2: Option 1(a) - WTT located in Comox Valley Table C3: Option 1(b) - WTT located in Campbell River Table C4: Option 1(c) - WTT located in Gold River Table C5: Option 2(a) -EWS located in Comox Valley Table C6: Option 2(b) - EWS located in Campbell River Table C7: Option 2(c) - EWS located in Gold River Table C8: Option 3(a) - Sustane located in Comox Valley Table C9: Option 3(b) - Sustane located in Campbell River Table C10: Option 3(c) - Sustane located in Gold River



		Methane Capture	ed, Destroyed, Ox	idized and Emit	ted - CVWMC				
		Methane Volume	Methane Collected	Methane Destroyed	Methane not Collected & Destroyed	Methane Oxidized	Total Methane Emitted	Tonnes Methane Emitted	Tonnes Methane Destroyed
Y	ear	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
		m³/year	m³/year	m³/year	m³/year	m³/year	m³/year	tonnes CH ₄	tonnes CH₄
0	2017								
1	2018	603,415	452,561	448,036	155,379	15,085	140,294	94	299
2	2019	1,151,150	863,363	854,729	296,421	28,779	267,642	179	570
3	2020	1,648,886	1,236,665	1,224,298	424,588	41,222	383,366	256	817
4	2021	2,101,822	1,576,367	1,560,603	541,219	52,546	488,674	326	1,041
5	2022	2,393,106	1,794,830	1,776,881	616,225	59,828	556,397	371	1,185
6	2023	2,659,762	1,994,822	1,974,873	684,889	66,494	618,395	412	1,317
7	2024	2,904,415	2,178,311	2,156,528	747,887	72,610	675,277	450	1,438
8	2025	3,489,991	2,617,493	2,591,318	898,673	87,250	811,423	541	1,728
9	2026	4,022,289	3,016,717	2,986,550	1,035,739	100,557	935,182	624	1,992
10	2027	4,506,772	3,380,079	3,346,278	1,160,494	112,669	1,047,824	699	2,232
11	2028	4,948,262	3,711,197	3,674,085	1,274,178	123,707	1,150,471	767	2,451
12	2029	5,351,143	4,013,357	3,973,224	1,377,919	133,779	1,244,141	830	2,650
13	2030	5,719,325	4,289,493	4,246,599	1,472,726	142,983	1,329,743	887	2,832
14	2031	6,056,250	4,542,188	4,496,766	1,559,484	151,406	1,408,078	939	2,999
15 16	2032 2033	6,365,027	4,773,770 4,986,345	4,726,032 4,936,482	1,638,994 1,711,979	159,126 166,212	1,479,869 1,545,767	987 1,031	3,152 3,293
10	2033	6,648,461 6,909,095	4,986,345	5,130,003	1,779,092	172.727	1,606,365	1,031	3,422
17	2034	7,148,970	5,361,727	5,308,110	1,840,860	172,727	1,662,136	1,109	3,422
10	2035	7,370,115	5,527,586	5,472,310	1,840,800	184,253	1,713,552	1,143	3,650
20	2030	7,574,443	5,680,832	5,624,024	1,950,419	189,361	1,761,058	1,145	3,751
20	2037	7,763,513	5,822,635	5,764,408	1,999,105	194,088	1,805,017	1,173	3,845
22	2030	7,938,759	5,954,069	5,894,528	2,044,230	198,469	1,845,761	1,231	3,932
23	2000	8,101,493	6,076,120	6,015,359	2,086,135	202,537	1,883,597	1,256	4,012
24	2040	8,252,938	6,189,704	6,127,807	2,125,132	206,323	1,918,808	1,280	4,087
25	2042	8,394,203	6,295,653	6,232,696	2,161,507	209,855	1,951,652	1,302	4,157
26	2043	8,528,837	6,396,628	6,332,662	2,196,176	213,221	1,982,955	1,323	4,224
27	2044	8,657,602	6,493,202	6,428,270	2,229,333	216,440	2,012,893	1.343	4,288
28	2045	8,781,182	6,585,886	6,520,028	2,261,154	219,530	2,041,625	1,362	4,349
29	2046	8,900,188	6,675,141	6,608,390	2,291,799	222,505	2,069,294	1,380	4,408
30	2047	9,015,171	6,761,379	6,693,765	2,321,407	225,379	2,096,027	1,398	4,465
31	2048	9,126,624	6,844,968	6,776,518	2,350,106	228,166	2,121,940	1,415	4,520
32	2049	9,234,989	6,926,242	6,856,979	2,378,010	230,875	2,147,135	1,432	4,574
33	2050	9,340,662	7,005,497	6,935,442	2,405,221	233,517	2,171,704	1,449	4,626
34	2051	9,444,001	7,083,001	7,012,171	2,431,830	236,100	2,195,730	1,465	4,677
35	2052	9,545,325	7,158,994	7,087,404	2,457,921	238,633	2,219,288	1,480	4,727
36	2053	9,644,921	7,233,691	7,161,354	2,483,567	241,123	2,242,444	1,496	4,777
37	2054	9,743,048	7,307,286	7,234,213	2,508,835	243,576	2,265,259	1,511	4,825
38	2055	9,839,938	7,379,953	7,306,154	2,533,784	245,998	2,287,786	1,526	4,873
39	2056	9,935,798	7,451,849	7,377,330	2,558,468	248,395	2,310,073	1,541	4,921
40	2057	10,030,818	7,523,113	7,447,882	2,582,936	250,770	2,332,165	1,556	4,968

CO ₂ e Methane Emitted	CO ₂ from Methane	CO ₂ from Oxidized	Total GHG Emissions from
Linited	Destruction	Methane	LFG
21 x Tonnes Emmitted	1 Tonne for Every Tonne Destroyed	1 Tonne for Every Tonne Oxidized	Sum of GHG Emissions
tonnes CO ₂ e	tonnes CO ₂	tonnes CO ₂	tonnes CO ₂ e
1 005	000	10	4.005
1,965	299	10	1,965
3,749	570	19	3,749
5,370	817	27	5,370
6,845	1,041	35	6,845
7,793	1,185	40	7,793
8,662	1,317	44	8,662
9,459	1,438	48	9,459
11,366	1,728	58	11,366
13,099	1,992	67	13,099
14,677	2,232	75	14,677
16,115	2,451	83	16,115
17,427	2,650	89	17,427
18,626	2,832	95	18,626
19,723	2,999	101	19,723
20,729	3,152	106	20,729
21,652	3,293	111	21,652
22,500	3,422	115	22,500
23,282	3,541	119	23,282
24,002	3,650	123	24,002
24,667	3,751	126	24,667
25,283	3,845	129	25,283
25,854	3,932	132	25,854
26,384	4,012	135	26,384
26,877	4,087	138	26,877
27,337	4,157	140	27,337
27,775	4,224	142	27,775
28,195	4,288	144	28,195
28,597	4,349	146	28,597
28,985	4,408	148	28,985
29,359	4,465	150	29,359
29,722	4,520	152	29,722
30,075	4,574	154	30,075
30,419	4,626	156	30,419
30,756	4,677	157	30,756
31,086	4,727	159	31,086
31,410	4,777	161	31,410
31,729	4,825	162	31,729
32.045	4.873	164	32.045
32,357	4,921	166	32,357
32,667	4,968	167	32,667

Elect	ricity Generation	and Offsets - CV	WMC 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 ₂ e per GWh
ft³/min	kW	GWh / year	tonnes CO ₂ e
0	0	0	0
30	61	0	0
58	116	0	0
83	166	0	0
106	212	0	0
121	241	0	0
134	268	0	0
146	293	0	0
176	352	0	0
203	405	0	0
227	454	0	0
249	499	0	0
270	539	0	0
288	576	0	0
305	610	0	0
321	641	0	0
335	670	0	0
348	696	0	0
360	721	0	0
371	743	0	0
382	763	0	0
391	782	0	0
400	800	0	0
408	817	0	0
416	832	0	0
423	846	0	0
430	860	0	0
436	873	0	0
443	885	0	0
449	897	0	0
454	909	0	0
460	920	0	0
465	931	0	0
471	941	0	0
476	952	0	0
481	962	0	0
486	972	0	0
491	982	0	0
496	992	0	0
501	1,001	0	0
505	1,011	0	0

Table F1: GHG assessment of Option 0 - Status Quo

		Transfer St	Transfer Station Hauling and Operations			Net Transfer		
CVWMC LF Emissions LFG - Electricity Offset + Operations		Fuel Consumption	Waste Hauling 0.00269 Tonnes CO ₂ e / L	Transfer Station Operations 0.0044 Tonnes CO ₂ e / Tonne Waste		Station Emissions		
		2.4 L/tonne				Hauling + Operations	Year	
tonnes CO ₂ e		L	tonnes CO ₂ e	tonnes CO ₂ e		tonnes CO ₂ e		
	180	0	0	0			0	20
	2,147	0	0	0		0	1	20
	3,933	0	0	0		0	2	20
	5,556	0	0	0		0	3	20
	6,997	0	0	0		0	4	20
	7,947	0	0	0		0	5	20
	8,818	0	0	0		0	6	20
	9,724	51,651	139	95		234	7	20
	11,633	51,935	140	95		235	8	20
	13,369	52,210	140	96		236	9	20
	14,949	52,469	141	96		237	10	20
	16,389	52,720	142	97		238	11 12	20
	17,703	52,964	142 143	97 98		240 241		20
	18,904 20,003	53,197 53,422	143	98		241	13 14	20
	20,003	53,637	144	98		242	14 15	20
	21,936	53,844	144	98		243	15	20
	21,930	54,031	145	99		244 244	10	20
	23,570	54,031	145	99		244 245	17	20
	24,292	54,387	146	100		245	19	20
	24,292	54,552	140	100		240	20	20
	25,576	54,707	147	100		247	20	20
	26,149	54,856	147	100		247	22	20
	26,681	55,000	148	101		240	23	20
	27,175	55,144	148	101		249	23	20
	27,638	55,419	149	101		251	25	20
	28,079	55,697	150	102		252	26	20
	28,501	55,975	150	102		252	20	20
	28,905	56,255	151	103		254	28	20
	29,296	56,536	152	100		256	29	20
	29,672	56,819	153	104		257	30	20
	30,038	57,103	154	105		258	31	20
	30,393	57,388	154	105		260	32	20
	30,740	57,675	155	106		261	33	20
	31,079	57,964	156	106		262	34	20
	31,412	58,254	157	107		264	35	20
	31,739	58,545	157	107		265	36	20
	32,061	58,838	158	108		266	37	20
	32,379	59,132	159	108		267	38	204
	32,694	59,427	160	109		269	39	20
	33,007	59,725	161	109		270	40	20

Total CVWMC LF GHGs - 40 years 890,020 tonnes CO2e

Total TS GHGs - 40 years 8,530 tonnes CO₂e

Table F2: GHG assessment of Option 1(a) - WTT located in Comox Valley

			RDF GHG						
		RDF Combustion GHG							
Y	ear	CO ₂	CH₄ as CO₂e	N ₂ O as CO ₂ e	Total GHG CO ₂ e				
		tonnes CO ₂	tonnes CO₂e	tonnes CO ₂ e	tonnes CO₂e				
0	2017	0	0	0	0				
1	2018	0	0	0	0				
2	2019	0	0	0	0				
3	2020	0	0	0	0				
4	2021	2,502	0	125	2,627				
5	2022	2,530	0	126	2,656				
6	2023	2,558	0	128	2,686				
7	2024	4,354	0	218	4,572				
8	2025	4,354	0	218	4,572				
9	2026	4,354	0	218	4,572				
10	2027	4,354	0	218	4,572				
11	2028	4,354	0	218	4,572				
12	2029	4,354	0	218	4,572				
13	2030	4,354	0	218	4,572				
14	2031	4,354	0	218	4,572				
15	2032	4,354	0	218	4,572				
16	2033	4,354	0	218	4,572				
17	2034	4,354	0	218	4,572				
18	2035	4,354	0	218	4,572				
19	2036	4,354	0	218	4,572				
20	2037	4,354	0	218	4,572				
21	2038	4,354	0	218	4,572				
22	2039	4,354	0	218	4,572				
23	2040	4,354	0	218	4,572				
24	2041	4,354	0	218	4,572				
25	2042	4,354	0	218	4,572				
26	2043	4,354	0	218	4,572				
27	2044	4,354	0	218	4,572				
28	2045	4,354	0	218	4,572				
29	2046	4,354	0	218	4,572				
30	2047	4,354	0	218	4,572				
31	2048	4,354	0	218	4,572				
32	2049	4,354	0	218	4,572				
33	2050	4,354	0	218	4,572				
34	2051	4,354	0	218	4,572				
35	2052	4,354	0	218	4,572				
36	2053	4,354	0	218	4,572				
37	2054	4,354	0	218	4,572				
38	2055	4,354	0	218	4,572				
39	2056	4,354	0	218	4,572				
40	2057	4,354	0	218	4,572				

Electricity Generation and Offsets - WTT					
Metal - ferrous	Metal - Non- Ferrous	Cardboard	Bio-gas to electricity	BC Electricity Offset BC Hydro Offset of 22 Tonnes CO ₂ e per GWh	
3% of Throughput CO ₂ e Offset	1.8% of throughput CO2e Offset	7% of Throughout CO₂e Offset	200 kWh/tonne organics		
tonnes	tonnes	tonnes	GWh	tonnes	
0	0	0	0	0	
0	0	0	0	0	
0	0	0	0	0	
0	0	0	0	0	
1,739	5,275	12,604	2	45	
1,759	5,334	12,745	2	46	
1,778	5,394	12,888	2	46	
3,027	9,183	21,940	4	78	
3,027	9,183	21,940	4	78	
3,027	9,183	21,940	4	78	
3,027	9,183	21,940	4	78	
3,027	9,183	21,940	4	78	
3,027	9,183	21,940	4	78	
3,027	9,183	21,940	4	78	
3,027	9,183	21,940	4	78	
3,027	9,183	21,940	4	78	
3,027	9,183	21,940	4	78	
3,027	9,183	21,940	4	78	
3,027	9,183	21,940	4	78	
3,027	9,183	21,940	4	78	
3,027	9,183	21,940	4	78	
3,027	9,183	21,940	4	78	
3,027	9,183	21,940	4	78	
3,027	9,183	21,940	4	78	
3,027	9,183	21,940	4	78	
3,027	9,183	21,940	4	78	
3,027	9,183	21,940	4	78	
3,027	9,183	21,940	4	78	
3,027	9,183	21,940	4	78	
3,027	9,183	21,940	4	78	
3,027	9,183	21,940	4	78	
3,027	9,183	21,940	4	78	
3,027	9,183	21,940	4	78	
3,027	9,183	21,940	4	78	
3,027	9,183	21,940	4	78	
3,027	9,183	21,940	4	78	
3,027	9,183	21,940	4	78	
3,027	9,183	21,940	4	78	
3,027	9,183	21,940	4	78	
3,027	9,183	21,940	4	78	
3,027	9,183	21,940	4	78	

	Methane Capture	ed, Destroyed, Ox	idized and Emit	ted - CVWMC				
Net WTT Emissions	Methane Volume	Methane Collected	Methane Destroyed	Methane not Collected & Destroyed	Methane Oxidized	Total Methane Emitted	Tonnes Methane Emitted	Tonnes Methane Destroyed
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	m³/year	m³/year	m³/year	m³/year	m³/year	m³/year	tonnes CH ₄	tonnes CH ₄
0								
0	603,415	452,561	448,036	155,379	15,085	140,294	94	299
0	1,151,150	863,363	854,729	296,421	28,779	267,642	179	570
0	1,648,886	1,236,665	1,224,298	424,588	41,222	383,366	256	817
-17,037	2,101,822	1,576,367	1,560,603	541,219	52,546	488,674	326	1,041
-17,228	1,902,454	1,426,841	1,412,572	489,882	47,561	442,321	295	942
-17,421	1,724,073	1,293,055	1,280,124	443,949	43,102	400,847	267	854
-29,656	1,564,494	1,173,370	1,161,637	402,857	39,112	363,745	243	775
-29,656	1,435,587	1,076,690	1,065,923	369,664	35,890	333,774	223	711
-29,656	1,327,827	995,870	985,912	341,915	33,196	308,720	206	658
-29,656	1,238,923	929,193	919,901	319,023	30,973	288,050	192	614
-29,656	1,166,756	875,067	866,316	300,440	29,169	271,271	181	578
-29,656	1,109,483	832,113	823,791	285,692	27,737	257,955	172	549
-29,656	1,065,444	799,083	791,092	274,352	26,636	247,716	165	528
-29,656	1,033,088	774,816	767,068	266,020	25,827	240,193	160	512
-29,656	1,011,050	758,287	750,705	260,345	25,276	235,069	157	501
-29,656	998,128	748,596	741,110	257,018	24,953	232,065	155	494
-29,656	993,277	744,958	737,508	255,769	24,832	230,937	154	492
-29,656	995,322	746,491	739,026	256,295	24,883	231,412	154	493
-29,656	1,003,410	752,557	745,032	258,378	25.085	233,293	156	497
-29,656	1,016,874	762,656	755,029	261,845	25,422	236,423	158	504
-29,656	1,034,962	776,222	768,460	266,503	25,874	240,629	160	513
-29,656	1,057,036	792,777	784,849	272,187	26,426	245,761	164	523
-29,656	1,082,555	811,916	803,797	278,758	27,064	251,694	168	536
29,656	1,111,077	833,307	824,974	286,102	27,777	258,325	172	550
29,656	1,142,223	856.667	848,100	294,122	28,556	265,567	177	566
9,656	1,178,209	883,657	874,820	303,389	29,455	273,934	183	584
29,656	1,218,601	913,951	904,812	313,790	30,465	283,325	189	604
29,656	1,263,014	947,260	937,788	325,226	31,575	293,651	196	626
29,656	1,311,100	983,325	973,492	337,608	32,777	304,831	203	649
29,656	1,362,550	1,021,913	1,011,693	350,857	34.064	316,793	203	675
29,656	1,417,088	1,062,816	1,052,188	364,900	35,427	329,473	220	702
-29,656	1,474,466	1,105,849	1,094,791	379.675	36.862	342,813	229	730
-29,656	1,534,464	1,150,848	1,139,340	395,125	38,362	356,763	238	760
-29,656	1,596,885	1,197,664	1,185,687	411,198	39,922	371,276	248	791
-29,656	1,661,554	1,246,165	1,233,704	411,198	41,539	386,311	248	823
-29,656	1,728,313	1,296,235	1,283,273	445,041	43,208	401,833	268	856
29,656	1,797,024	1,347,768	1,334,290	445,041	43,208	401,808	200	890
							279	
29,656	1,867,561	1,400,671	1,386,664	480,897	46,689	434,208		925
-29,656	1,939,814	1,454,860	1,440,312	499,502	48,495	451,007	301	961
-29,656	2,013,685	1,510,264	1,495,161	518,524	50,342	468,182	312	997

Total Technology GHGs - 40 years -1,059,981 tonnes CO₂e

RDF per tonne waste throughput:

WTE Emissions Factors

ssions Factors	
CO ₂ =	0.32 tonnes / tonne MSW

27%

CH₄ =	0.0000031	tonnes CO2e / tonne MSW
0114	0.000000	

 $N_2O =$ 0.016 tones CO2e / 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 F2: GHG assessment of Option 1(a) - WTT located in Comox Valley

LFG	GHG Emissions	Summary - CVW	MC	Ele	ctricity Generation	and Offsets - C	/WMC LF	Landfil	I Operations - CV	WMC LF		Transfer St	ation Hauling an	d Operations
CO₂e Methane Emitted	CO ₂ from Methane Destruction	CO ₂ from Oxidized Methane	Total GHG Emissions from LFG	Total Gas Collected	Potential Powe	Energy Generation	BC Electricity Offset	Buildings - Fuel and Electricity	Landfill Equipment	GHGs from Landfill Operations	CVWMC LF Emissions	Fuel Consumption	Waste Hauling	Transfer Station Operations
21 x Tonnes Emmitted	1 Tonne for Every Tonne Destroyed	1 Tonne for Every Tonne Oxidized	Sum of GHG Emissions	From LandGEM	200 kW per 100 ft ³ /min	Based on Operation 91% of the Year	BC Hydro Offset of 22 Tonnes CO ₂ e per GWh	0.001 Tonnes CO₂e per Tonne Waste	0.004 Tonnes CO₂e per Tonne Waste	Buildings and Equipment	LFG - Electricity Offset + Operations	2.4 L/tonne	0.00269 Tonnes CO₂e / L	0.0044 Tonnes CO ₂ e / Tonne Waste
tonnes CO ₂ e	tonnes CO ₂	tonnes CO ₂	tonnes CO ₂ e	ft³/min	kW	GWh / year	tonnes CO ₂ e	tonnes CO ₂ e	tonnes CO ₂ e	tonnes CO ₂ e	tonnes CO ₂ e	L	tonnes CO ₂ e	tonnes CO ₂ e
				0	0	0	0	36	144	180	180	0	0	0
1,965	299	10	1,965	30	61	0	0	36	146	182	2,147	0	0	0
3,749	570	19	3,749	58	116	0	0	37	147	184	3,933	0	0	0
5,370	817	27	5,370	83	166	0	0	37	149	186	5,556	0	0	0
6,845	1,041	35	6,845	106	212	0	0	1	5	6	6,851	0	0	0
6,196	942	32	6,196	96	192	0	0	1	5	6	6,201	0	0	0
5,615	854	29	5,615	87	174	0	0	1	5	6	5,621	0	0	0
5,095	775	26	5,095	79	158	0	0	2	8	10	5,105	51,651	139	95
4,675	711	24	4,675	72	145	0	0	2	10	12	4,688	51,935	140	95
4,324	658	22	4,324	67	134	0	0	3	12	15	4,339	52,210	140	96
4,035	614	21	4,035	62	125	0	0	3	14	17	4,052	52,469	141	96
3,800	578	19	3,800	59	118	0	0	4	15	19	3,819	52,720	142	97
3,613	549	19	3,613	56	112	0	0	4	17	21	3,635	52,964	142	97
3,470	528	18	3,470	54	107	0	0	5	19	23	3,493	53,197	143	98
3,364	512	17	3,364	52	104	0	0	5	20	26	3,390	53,422	144	98
3,293	501	17	3,293	51	102	0	0	6	22	28	3,320	53,637	144	98
3,251	494	17	3,251	50	101	0	0	6	24	30	3,280	53,844	145	99
3,235	492	17	3,235	50	100	0	0	6	25	31	3,266	54,031	145	99
3,241	493	17	3,241	50	100	0	0	7	27	33	3,275	54,211	146	99
3,268	497 504	17	3,268	51	101	0	0	7	28	35 37	3,303	54,387	146 147	100
3,312		17 17	3,312	51	102	0	-	-	30	37	3,349	54,552	147	100
3,370 3,442	513 523		3,370 3,442	<u>52</u> 53	<u> </u>	0	0	8	31 32	39 40	3,409 3,483	54,707 54,856	147	100 101
	523	18			-		0	8		40			148	
3,525 3.618	536	18 19	3,525 3.618	<u>55</u> 56	109 112	0	0	9	34 35	42	3,568 3,662	55,000 55,144	148	101
3,720	566	19	3,720	58	112	0	0	9	35	44 46	3,766	55,419	140	101
3,837	584	20	3,837	59	115	0	0	10	39	40	3,886	55,697	149	102
3,969	604	20	3,969	61	123	0	0	10	41	49 51	4,020	55,975	150	102
4.113	626	20	4.113	64	123	0	0	10	41	54	4,020	56,255	151	103
4,113	649	22	4,113	66	132	0	0	11	45	56	4,326	56,536	152	103
4,437	675	23	4,437	69	132	0	0	12	43	59	4,320	56,819	153	104
4.615	702	23	4,615	71	143	0	0	12	49	61	4.676	57,103	153	104
4,802	730	25	4,802	74	149	0	0	13	51	64	4,866	57,388	154	105
4,997	760	26	4,997	77	155	0	0	13	53	66	5,063	57,675	155	100
5,200	791	27	5,200	80	161	0	0	14	55	69	5,269	57,964	156	100
5.411	823	28	5,411	84	167	0	0	14	57	72	5,483	58.254	157	100
5,628	856	29	5,628	87	174	0	0	15	59	74	5,703	58,545	157	107
5,852	890	30	5,852	91	181	0	0	15	62	77	5,929	58,838	158	108
6.082	925	31	6.082	94	188	0	0	16	64	80	6,162	59,132	159	108
6,317	961	32	6,317	98	196	0	0	16	66	82	6,400	59,427	160	109
6.558	997	34	6.558	101	203	0	0	17	68	85	6.643	59,725	161	109
0,558	997	34	0,000	101	203	U	U	17	80	85	0,043	59,725	101	<u> </u>

Total CVWMC LF GHGs - 40 years 177,777 tonnes CO2e

Total TS GHGs - 40 years 8,530 tonnes CO2e

TBL-2018-02-01-CVRD WTE Options GHG Analysis-er-5171574:Option 1(a) WTT CV

Net Transfer Station Emissions Hauling + Operations tonnes CO ₂ e	Ye	əar
	0	2011
0	1	2012
0	2	2013
0	3	2014
0	4	2015
0	5	2016
0	6	2017
234	7	2018
235	8	2019
236	9	2020
237	10	2021
238	11	2022
240	12	2023
241	13	2024
242	14	2025
243	15	2026
244	16	2027
244	17	2028
245	18	2029
246	19	2030
247	20	2031
247	21	2032
248	22	2033
249	23	2034
249	24	2035
251	25	2036
252	26	2037
253	27	2038
254	28	2039
256	29	2040
257	30	2041
258	31	2042
260	32	2043
261	33	2044
262	34	2045
264	35	2046
265	36	2047
266	37	2048
267	38	2049
269	39	2050
270	40	2051

Table F3: GHG assessment of Option 1(b) - WTT located in Campbell River

			RDF GHG						
		RDF Combustion GHG							
Y	ear	CO ₂	CH₄ as CO₂e	N ₂ O as CO ₂ e	Total GHG CO₂e				
		tonnes CO ₂	tonnes CO ₂ e	tonnes CO ₂ e	tonnes CO₂e				
0	2017	0	0	0	0				
1	2018	0	0	0	0				
2	2019	0	0	0	0				
3	2020	0	0	0	0				
4	2021	2,502	0	125	2,627				
5	2022	2,530	0	126	2,656				
6	2023	2,558	0	128	2,686				
7	2024	4,354	0	218	4,572				
8	2025	4,354	0	218	4,572				
9	2026	4,354	0	218	4,572				
10	2027	4,354	0	218	4,572				
11	2028	4,354	0	218	4,572				
12	2029	4,354	0	218	4,572				
13	2030	4,354	0	218	4,572				
14	2031	4,354	0	218	4,572				
15	2032	4,354	0	218	4,572				
16	2033	4,354	0	218	4,572				
17	2034	4,354	0	218	4,572				
18	2035	4,354	0	218	4,572				
19	2036	4,354	0	218	4,572				
20	2037	4,354	0	218	4,572				
21	2038	4,354	0	218	4,572				
22	2039	4,354	0	218	4,572				
23	2040	4,354	0	218	4,572				
24	2041	4,354	0	218	4,572				
25	2042	4,354	0	218	4,572				
26	2043	4,354	0	218	4,572				
27	2044	4,354	0	218	4,572				
28	2045	4,354	0	218	4,572				
29	2046	4,354	0	218	4,572				
30	2047	4,354	0	218	4,572				
31	2048	4,354	0	218	4,572				
32	2049	4,354	0	218	4,572				
33	2050	4,354	0	218	4,572				
34	2051	4,354	0	218	4,572				
35	2052	4,354	0	218	4,572				
36	2053	4,354	0	218	4,572				
37	2054	4,354	0	218	4,572				
38	2055	4,354	0	218	4,572				
39	2056	4,354	0	218	4,572				
40	2057	4,354	0	218	4,572				

Electricity Generation and Offsets - WTT						
Metal - ferrous	Metal - Non- Ferrous	Cardboard	Bio-gas to electricity	BC Electricity Offset BC Hydro Offset of 22 Tonnes CO ₂ e per GWh		
3% of Throughput CO ₂ e Offset	1.8% of throughput CO2e Offset	7% of Throughout CO₂e Offset	200 kWh/tonne organics			
tonnes	tonnes	tonnes	GWh	tonnes		
0	0	0	0	0		
0	0	0	0	0		
0	0	0	0	0		
0	0	0	0	0		
1,739	5,275	12,604	2	45		
1,759	5,334	12,745	2	46		
1,778	5,394	12,888	2	46		
3,027	9,182	21,939	4	78		
3,027	9,182	21,939	4	78		
3,027	9,182	21,939	4	78		
3,027	9,182	21,939	4	78		
3,027	9,182	21,939	4	78		
3,027	9,182	21,939	4	78		
3,027	9,182	21,939	4	78		
3,027	9,182	21,939	4	78		
3,027	9,182	21,939	4	78		
3,027	9,182	21,939	4	78		
3,027	9,182	21,939	4	78		
3,027	9,182	21,939	4	78		
3,027	9,182	21,939	4	78		
3,027	9,182	21,939	4	78		
3,027	9,182	21,939	4	78		
3,027	9,182	21,939	4	78		
3,027	9,182	21,939	4	78		
3,027	9,182	21,939	4	78		
3,027	9,182	21,939	4	78		
3,027	9,182	21,939	4	78		
3,027	9,182	21,939	4	78		
3,027	9,182	21,939	4	78		
3,027	9,182	21,939	4	78		
3,027	9,182	21,939	4	78		
3,027	9,182	21,939	4	78		
3,027	9,182	21,939	4	78		
3,027	9,182	21,939	4	78		
3,027	9,182	21,939	4	78		
3,027	9,182	21,939	4	78		
3,027	9,182	21,939	4	78		
3,027	9,182	21,939	4	78		
	9,182	21,939	4	78		
3,027	., .		4	78		
3,027 3,027	9,182 9,182	21,939 21,939	4	78		

	Methane Cap	tured, Destroyed, Ox	didized and Emit	tted - CVWMC				
Net WTT Emissions	Methane Volume	Methane Collected	Methane Destroyed	Methane not Collected & Destroyed	Methane Oxidized	Total Methane Emitted	Tonnes Methane Emitted	Tonnes Methane Destroyed
Combustion - Electricity Offset	From LandG	em 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	m³/year	m³/year	m³/year	m³/year	m³/year	m³/year	tonnes CH ₄	tonnes CH ₄
0								
0	603,415	452,561	448,036	155,379	15,085	140,294	94	299
0	1,151,150	863,363	854,729	296,421	28,779	267,642	179	570
0	1,648,886	1,236,665	1,224,298	424,588	41,222	383,366	256	817
-17,037	2,101,822	1,576,367	1,560,603	541,219	52,546	488,674	326	1,041
-17,228	1,902,454	1,426,841	1,412,572	489,882	47,561	442,321	295	942
-17,421	1,724,073	1,293,055	1,280,124	443,949	43,102	400,847	267	854
-29,656	1,564,494	1,173,370	1,161,637	402,857	39,112	363,745	243	775
-29,656	1,435,587	1,076,690	1,065,923	369,664	35,890	333,774	223	711
-29,656	1,327,827	995,870	985,912	341,915	33,196	308,720	206	658
-29,656	1,238,923	929,193	919,901	319,023	30,973	288,050	192	614
-29,656	1,166,756	875,067	866,316	300,440	29,169	271,271	181	578
-29,656	1,109,483	832,113	823,791	285,692	27,737	257,955	172	549
-29,656	1,065,444	799,083	791,092	274,352	26,636	247,716	165	528
-29,656	1,033,088		767,068	266,020	25,827	240,193	160	512
-29,656	1,011,050		750,705	260,345	25,276	235,069	157	501
-29,656	998,128	748,596	741,110	257,018	24,953	232,065	155	494
-29,656	993,277	744,958	737,508	255,769	24,832	230,937	154	492
-29,656	995,322	746,491	739,026	256,295	24,883	231,412	154	493
-29,656	1,003,410		745,032	258,378	25,085	233,293	156	497
-29,656	1,016,874		755,029	261,845	25,422	236,423	158	504
-29,656	1,034,962		768,460	266,503	25,874	240,629	160	513
-29,656	1,057,036		784,849	272,187	26,426	245,761	164	523
-29,656	1,082,555		803,797	278,758	27,064	251,694	168	536
-29,656	1,111,077		824,974	286,102	27,777	258,325	172	550
-29,656	1,142,223		848,100	294,122	28,556	265,567	177	566
-29,656	1,178,209		874,820	303,389	29,455	273,934	183	584
-29,656	1,218,601	913,951	904,812	313,790	30,465	283,325	189	604
-29,656	1,263,014		937,788	325,226	31,575	293,651	196	626
-29,656	1,311,100		973,492	337,608	32,777	304,831	203	649
-29,656	1,362,550		1,011,693	350,857	34,064	316,793	211	675
-29,656	1,417,088		1,052,188	364,900	35,427	329,473	220	702
-29,656	1,474,466		1,094,791	379,675	36,862	342,813	229	730
-29,656	1,534,464		1,139,340	395,125	38,362	356,763	238	760
-29,656	1,596,885		1,185,687	411,198	39,922	371,276	248	791
-29,656	1,661,554		1,233,704	427,850	41,539	386,311	258	823
-29,656	1,728,313		1,283,273	445,041	43,208	401,833	268	856
-29,656	1,797,024		1,334,290	462,734	44,926	417,808	279	890
-29,656	1,867,561	1,400,671	1,386,664	480,897	46,689	434,208	290	925
-29,656	1,939,814		1,440,312	499,502	48,495	451,007	301	961
-29,656	2,013,685	1,510,264	1,495,161	518,524	50,342	468,182	312	997

Total Technology GHGs - 40 years -1,059,974 tonnes CO₂e

RDF per tonne waste throughput:

WTE Emissions Factors

CO ₂ =	0.32 tonnes / tonne MSW
CH ₄ =	0.0000031 tonnes CO2e / tonne MS

27%

0.0000031 tonnes CO_2e / tonne MSW 0.016 tones CO2e / tonne MSW

 $N_2O =$

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%

Electrical Conversion Efficiency =

Table F3: GHG assessment of Option 1(b) - WTT located in Campbell River

LFG	GHG Emissions	Summary - CVW	MC	E	lectricity Generation	and Offsets - CV	WMC LF	Landfil	Operations - CV	WMC LF		Transfer St	ation Hauling an	d Operations
CO₂e Methane Emitted	CO ₂ from Methane Destruction	CO ₂ from Oxidized Methane	Total GHG Emissions from LFG	Total Ga Collecte		Energy Generation	BC Electricity Offset	Buildings - Fuel and Electricity	Landfill Equipment	GHGs from Landfill Operations	CVWMC LF Emissions	Fuel Consumption	Waste Hauling	Transfer Station Operations
21 x Tonnes Emmitted	1 Tonne for Every Tonne Destroyed	1 Tonne for Every Tonne Oxidized	Sum of GHG Emissions	From LandGE	200 kW per M 100 ft ³ /min	Based on Operation 91% of the Year	BC Hydro Offset of 22 Tonnes CO ₂ e per GWh	0.001 Tonnes CO₂e per Tonne Waste	0.004 Tonnes CO₂e per Tonne Waste	Buildings and Equipment	LFG - Electricity Offset + Operations	2.4 L/tonne	0.00269 Tonnes CO₂e / L	0.0044 Tonnes CO ₂ e / Tonne Waste
tonnes CO ₂ e	tonnes CO ₂	tonnes CO ₂	tonnes CO ₂ e	ft ³ /min	kW	GWh / year	tonnes CO ₂ e	tonnes CO ₂ e	tonnes CO ₂ e	tonnes CO ₂ e	tonnes CO₂e	L	tonnes CO ₂ e	tonnes CO ₂ e
				0	0	0	0	36	144	180	180	0	0	0
1,965	299	10	1,965	30	61	0	0	36	146	182	2,147	0	0	0
3,749	570	19	3,749	58	116	0	0	37	147	184	3,933	0	0	0
5,370	817	27	5,370	83	166	0	0	37	149	186	5,556	0	0	0
6,845	1,041	35	6,845	106	212	0	0	1	5	6	6,851	93,807	252	129
6,196 5.615	942 854	32 29	6,196 5.615	96 87	<u> </u>	0	0	1	5	6	6,201 5,621	94,857 95,919	255 258	130 132
5.095	775	29	5,015	79	174	0	0	2	8	10	5,021	111,633	300	132
4,675	711	20	4,675	72	138	0	0	2	10	10	4,688	111,349	300	129
4,324	658	22	4,324	67	134	0	0	3	10	15	4,339	111,074	299	129
4,035	614	21	4,035	62	125	0	0	3	14	17	4,052	110,816	298	128
3,800	578	19	3,800	59	118	0	0	4	15	19	3,819	110,565	297	128
3,613	549	19	3,613	56	112	0	0	4	17	21	3,635	110,320	297	127
3,470	528	18	3,470	54	107	0	0	5	19	23	3,493	110,087	296	127
3,364	512	17	3,364	52	104	0	0	5	20	26	3,390	109,862	296	126
3,293	501	17	3,293	51	102	0	0	6	22	28	3,320	109,647	295	126
3,251	494	17	3,251	50	101	0	0	6	24	30	3,280	109,440	294	126
3,235	492 493	17 17	3,235	50	100	0	0	6	25 27	31 33	3,266	109,254	294 293	125
3,241 3,268	493	17	3,241 3,268	50	100	0	0	7	27	33	3,275 3,303	109,074 108.897	293	125 125
3,312	504	17	3,200	<u>51</u> 51	101	0	0	7	30	35	3,303	108,897	293	125
3.370	513	17	3,370	52	102	0	0	8	31	39	3,409	108,577	292	124
3,442	523	18	3,442	53	107	0	0	8	32	40	3,483	108,428	292	124
3.525	536	18	3.525	55	109	0	0	8	34	42	3,568	108,284	291	123
3,618	550	19	3,618	56	112	0	0	9	35	44	3,662	108,141	291	123
3,720	566	19	3,720	58	115	0	0	9	37	46	3,766	107,865	290	123
3,837	584	20	3,837	59	119	0	0	10	39	49	3,886	107,588	289	122
3,969	604	20	3,969	61	123	0	0	10	41	51	4,020	107,309	289	122
4,113	626	21	4,113	64	127	0	0	11	43	54	4,167	107,030	288	121
4,270	649	22	4,270	66	132	0	0	11	45	56	4,326	106,748	287	121
4,437 4.615	675 702	23 24	4,437 4.615	<u>69</u> 71	<u> </u>	0	0	<u> </u>	47 49	59 61	4,496 4,676	106,466 106,181	286 286	120 120
4,615	702	24	4,615	71	143	0	0	12	49 51	64	4,866	106,181	286	120
4,802	760	25	4,802	74	149	0	0	13	53	66	5,063	105,609	285	119
5,200	700	20	5,200	80	161	0	0	14	55	69	5,269	105,321	283	118
5,411	823	28	5,411	84	167	0	0	14	57	72	5,483	105,031	283	117
5,628	856	29	5,628	87	174	0	0	15	59	74	5,703	104,740	282	117
5,852	890	30	5,852	91	181	0	0	15	62	77	5,929	104,447	281	116
6,082	925	31	6,082	94	188	0	0	16	64	80	6,162	104,153	280	116
6,317	961	32	6,317	98	196	0	0	16	66	82	6,400	103,857	279	115
6,558	997	34	6,558	101	203	0	0	17	68	85	6,643	103,560	279	115

Total CVWMC LF GHGs - 40 years 177,777 tonnes CO2e

Total TS GHGs - 40 years 15,185 tonnes CO₂e

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Net Transfer Station Emissions Hauling + Operations tonnes CO ₂ e	Year				
	0	2011			
0	1	2012			
0	2	2013			
0	3	2014			
381	4	2015			
385	5	2016			
390	6	2017			
430	7	2018			
429	8	2019			
427	9	2020			
426	10	2021			
425	11	2022			
424	12	2023			
423	13	2024			
422	14	2025			
421	15	2026			
420	16	2027			
419	17	2028			
418	18	2029			
417	19	2030			
417	20	2031			
416	21	2032			
415	22	2033			
415	23	2034			
414	24	2035			
413	25	2036			
412	26	2037			
410	27	2038			
409	28	2039			
408	29	2040			
406	30	2041			
405	31	2042			
404 403	32 33	2043 2044			
403	33	2044 2045			
401	34	2045			
399	35	2046			
399	36	2047			
	37	2048			
396 395	38	2049 2050			
395	40	2050			

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RDF GHG RDF Combustion GHG Year Total GHG CO₂e CO2 CH₄ as CO₂e N₂O as CO₂e tonnes CO₂ tonnes CO₂e tonnes CO₂e tonnes CO₂e 2017 2018 0 0 0 0 0 0 2,627 0 125 126 128 218 2,656 2,686 4,572 218 4,572 218 4,572 4,572 218 218 218 4,572 4,572 218 218 4,572 4,572 4,572 4,572 4,572 218 218 4,572 4,572 218 218 218 218 218 4,572 4,572 218 4,572 218 218 218 4,572 4,572 4,572 4,572 4,572 218 218 218 218 4,572 4,572 4,572 4,572 4,572 218 218 4,572 4,572 218 218 218 4,572 4,572 4,572 4,572 218 218 4,572 4,572 218 218 218 218 218 218 4,572

Electricity Generation and Offsets - WTT							
Metal - ferrous	Metal - Non- Ferrous	Cardboard		BC Electricity Offset			
3% of Throughput CO₂e Offset	1.8% of throughput CO2e Offset	7% of Throughout CO₂e Offset	200 kWh/tonne organics	BC Hydro Offset of 22 Tonnes CO ₂ e per GWh			
tonnes	tonnes	tonnes	GWh	tonnes			
0	0	0	0	0			
0	0	0	0	0			
0	0	0	0	0			
0	0	0	0	0			
1,739	5,275	12,604	2	45			
1,759	5,334	12,745	2	46			
1,778	5,394	12,888	2	46			
3,027	9,182	21,939	4	78			
3,027	9,182	21,939	4	78			
3,027	9,182	21,939	4	78			
3,027	9,182	21,939	4	78			
3,027	9,182	21,939	4	78			
3,027	9,182	21,939	4	78			
3,027	9,182	21,939	4	78			
3,027	9,182	21,939	4	78			
3,027	9,182	21,939	4	78			
3,027	9,182	21,939	4	78			
3,027	9,182	21,939	4	78			
3,027	9,182	21,939	4	78			
3,027	9,182	21,939	4	78			
3,027	9,182	21,939	4	78			
3,027	9,182	21,939	4	78			
3,027	9,182	21,939	4	78			
3.027	9,182	21,939	4	78			
3,027	9,182	21,939	4	78			
3,027	9,182	21,939	4	78			
3,027	9,182	21,939	4	78			
3,027	9,182	21,939	4	78			
3,027	9,182	21,939	4	78			
3,027	9,182	21,939	4	78			
3,027	9,182	21,939	4	78			
3,027	9,182	21,939	4	78			
3,027	9,182	21,939	4	78			
3,027	9,182	21,939	4	78			
3,027	9,182	21,939	4	78			
3,027	9,182	21,939	4	78			
3,027	9,182	21,939	4	78			
3,027	9,182	21,939	4	78			
3,027	9,182	21,939	4	78			
3,027	9,182	21,939	4	78			
3,027	9,182	21,939	4	78			

	Mothana Contur	ed, Destroyed, Ox	idized and Emit					
Net WTT missions	Methane Volume	Methane Collected	Methane Destroyed	Methane not Collected & Destroyed	Methane Oxidized	Total Methane Emitted	Tonnes Methane Emitted	Tonnes Methane Destroyed
mbustion - lectricity 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	m³/year	m³/year	m³/year	m³/year	m³/year	m³/year	tonnes CH ₄	tonnes CH₄
0								
0	603,415	452,561	448,036	155,379	15,085	140,294	94	299
0	1,151,150	863,363	854,729	296,421	28,779	267,642	179	570
0	1,648,886	1,236,665	1,224,298	424,588	41,222	383,366	256	817
-17,037	2,101,822	1,576,367	1,560,603	541,219	52,546	488,674	326	1,041
-17,228	1,902,454	1,426,841	1,412,572	489,882	47,561	442,321	295	942
-17,421	1,724,073	1,293,055	1,280,124	443,949	43,102	400,847	267	854
-29,656	1,564,494	1,173,370	1,161,637	402,857	39,112	363,745	243	775
-29,656	1,435,587	1,076,690	1,065,923	369,664	35,890	333,774	223	711
-29,656	1,327,827	995,870	985,912	341,915	33,196	308,720	206	658
-29,656	1,238,923	929,193	919,901	319,023	30,973	288,050	192	614
-29,656	1,166,756	875,067	866,316	300,440	29,169	271,271	181	578
-29,656	1,109,483	832,113	823,791	285,692	27,737	257,955	172	549
-29,656	1,065,444	799,083	791,092	274,352	26,636	247,716	165	528
-29,656	1,033,088	774,816	767,068	266,020	25,827	240,193	160	512
-29,656	1,011,050	758,287	750,705	260,345	25,276	235,069	157	501
-29,656	998,128	748,596	741,110	257,018	24,953	232,065	155	494
-29,656	993,277	744,958	737,508	255,769	24,832	230,937	154	492
-29,656	995,322	746,491	739,026	256,295	24,883	231,412	154	493
-29,656	1,003,410	752,557	745,032	258,378	25,085	233,293	156	497
-29,656	1,016,874	762,656	755,029	261,845	25,422	236,423	158	504
-29,656	1,034,962	776,222	768,460	266,503	25,874	240,629	160	513
-29.656	1.057.036	792,777	784,849	272,187	26,426	245,761	164	523
-29,656	1,082,555	811,916	803,797	278,758	27,064	251,694	168	536
-29,656	1,111,077	833,307	824,974	286,102	27,777	258,325	172	550
-29,656	1,142,223	856.667	848,100	294.122	28,556	265,567	177	566
-29,656	1,178,209	883,657	874,820	303,389	29,455	273,934	183	584
-29,656	1,218,601	913,951	904,812	313,790	30,465	283,325	189	604
-29,656	1,263,014	947,260	937,788	325,226	31,575	293.651	196	626
-29,656	1,311,100	983,325	973,492	337,608	32,777	304,831	203	649
-29,656	1,362,550	1,021,913	1,011,693	350,857	34,064	316,793	211	675
-29,656	1.417.088	1,062,816	1,052,188	364,900	35,427	329.473	220	702
-29,656	1,474,466	1,105,849	1,094,791	379,675	36,862	342,813	229	730
-29,656	1,534,464	1,150,848	1,139,340	395,125	38,362	356,763	238	760
-29,656	1,596,885	1,197,664	1,185,687	411,198	39,922	371.276	248	791
-29,656	1,661,554	1,246,165	1,233,704	427,850	41,539	386,311	258	823
-29,656	1,728,313	1,296,235	1.283.273	445.041	43,208	401.833	268	856
-29,656	1,797,024	1,347,768	1,334,290	462,734	44,926	401,808	279	890
-29,656	1,867,561	1,400,671	1,386,664	480,897	46,689	434,208	290	925
-29,656	1,939,814	1,454,860	1,440,312	499.502	48,495	454,208	301	925
-29,656	2,013,685	1,510,264	1,495,161	518,524	50,342	468,182	312	997

Total Technology GHGs - 40 years -1,059,974 tonnes CO2e

RDF per tonne waste throughput:

WTE Emissions Factors

27%

4,572 4,572

CH₄ = 0.0000031 tonnes CO2e / tonne MSW

 $N_2O =$ 0.016 tones CO2e / 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 F4: GHG assessment of Option 1(c) - WTT located in Gold River

Table F4: GHG assessment of Option 1(c) - WTT located in Gold River

LFG	GHG Emissions	Summary - CVW	/MC	E	ectricity Generation	and Offsets - CV	/WMC LF	Landfil	Operations - CV	WMC LF		Transfer St	ation Hauling and	d Operations
CO ₂ e Methane Emitted	CO ₂ from Methane Destruction	CO ₂ from Oxidized Methane	Total GHG Emissions from LFG	Total Gas Collected		Energy Generation	BC Electricity Offset	Buildings - Fuel and Electricity	Landfill Equipment	GHGs from Landfill Operations	CVWMC LF Emissions	Fuel Consumption	Waste Hauling	Transfer Station Operations
21 x Tonnes Emmitted	1 Tonne for Every Tonne Destroyed	1 Tonne for Every Tonne Oxidized	Sum of GHG Emissions	From LandGEN	200 kW per 100 ft ³ /min	Based on Operation 91% of the Year	BC Hydro Offset of 22 Tonnes CO ₂ e per GWh	0.001 Tonnes CO₂e per Tonne Waste	0.004 Tonnes CO₂e per Tonne Waste	Buildings and Equipment	LFG - Electricity Offset + Operations	2.4 L/tonne	0.00269 Tonnes CO₂e / L	0.0044 Tonnes CO ₂ e / Tonne Waste
tonnes CO ₂ e	tonnes CO ₂	tonnes CO ₂	tonnes CO ₂ e	ft³/min	kW	GWh / year	tonnes CO ₂ e	tonnes CO ₂ e	tonnes CO ₂ e	tonnes CO ₂ e	tonnes CO ₂ e	L	tonnes CO ₂ e	tonnes CO ₂ e
				0	0	0	0	36	144	180	180	0	0	0
1,965	299	10	1,965	30	61	0	0	36	146	182	2,147	0	0	0
3,749	570	19	3,749	58	116	0	0	37	147	184	3,933	0	0	0
5,370	817	27	5,370	83	166	0	0	37	149	186	5,556	0	0	0
6,845	1,041	35	6,845	106	212	0	0	1	5	6	6,851	250,151	673	129
6,196	942	32	6,196	96	192	0	0	1	5	6	6,201	252,953	680	130
5,615	854	29	5,615	87	174	0	0	1	5	6	5,621	255,783	688	132
5,095	775	26	5,095	79	158	0	0	2	8	10	5,105	383,774	1,032	224
4,675	711	24	4,675	72	145	0	0	2	10	12	4,688	383,490	1,032	224
4,324	658	22	4,324	67	134	0	0	3	12	15	4,339	383,215	1,031	224
4,035	614	21	4,035	62	125	0	0	3	14	17	4,052	382,957	1,030	224
3,800	578	19	3,800	59	118	0	0	4	15	19	3,819	382,706	1,029	224
3,613	549	19	3,613	56	112	0	0	4	17	21	3,635	382,461	1,029	224
3,470	528	18	3,470	54	107	0	0	5	19	23	3,493	382,228	1,028	224
3,364	512	17	3,364	52	104	0	0	5	20	26	3,390	382,003	1,028	224
3,293	501	17	3,293	51	102	0	0	6	22	28	3,320	381,788	1,027	224
3,251	494	17	3,251	50	101	0	0	6	24	30	3,280	381,581	1,026	224
3,235	492	17	3,235	50	100	0	0	6	25	31	3,266	381,395	1,026	224
3,241	493	17	3,241	50	100	0	0	7	27	33	3,275	381,215	1,025	224
3,268	497 504	17 17	3,268	<u>51</u> 51	101	0	0	7	28	35 37	3,303 3,349	381,038	1,025 1,025	224 224
3,312			3,312			-	-		30			380,873		
3,370 3,442	513 523	17 18	3,370 3,442	<u>52</u> 53	104	0	0	8	31 32	39 40	3,409 3,483	<u>380,718</u> 380,569	1,024	224 224
	523	18	3,442	55	107	0	0	8	32	40		380,569		224
3,525 3,618	550	10	3,525	55	112	0	0	9	35	42	3,568 3,662	380,281	1,023 1,023	224
3,720	566	19	3,720	58	112	0	0	9	35	44 46	3,766	380,006	1,023	224
3,720	584	20	3,837	59	115	0	0	10	39	40	3,886	379,729	1,022	224
3,969	604	20	3,969	61	123	0	0	10	41	51	4,020	379,450	1,021	224
4.113	626	20	4,113	64	123	0	0	11	41	54	4,167	379,450	1,021	224
4,113	649	22	4,113	66	132	0	0	11	45	56	4,326	378,889	1,020	224
4,437	675	23	4,437	69	132	0	0	12	47	59	4,496	378,606	1,019	224
4,615	702	23	4,615	71	143	0	0	12	49	61	4,676	378,322	1,018	224
4,802	730	25	4,802	74	149	0	0	13	51	64	4,866	378,037	1,017	224
4,997	760	26	4,997	77	155	0	0	13	53	66	5,063	377,750	1,016	224
5,200	791	27	5,200	80	161	0	0	14	55	69	5,269	377.461	1,015	224
5.411	823	28	5,411	84	167	0	0	14	57	72	5,483	377,172	1,015	224
5,628	856	29	5,628	87	174	0	0	15	59	74	5,703	376,880	1,010	224
5,852	890	30	5,852	91	181	0	0	15	62	77	5,929	376,588	1,014	224
6,082	925	31	6,082	94	188	0	0	16	64	80	6,162	376,293	1,012	224
6,317	961	32	6,317	98	196	0	0	16	66	82	6,400	375,998	1,012	224
6.558	997	34	6.558	101	203	0	0	17	68	85	6,643	375.701	1,011	224
0,000	331	34	0,000	101	203	U	U	17	00	00	0,045	575,701	1,011	224

Total CVWMC LF GHGs - 40 years 177,777 tonnes CO2e

Total TS GHGs - 40 years 44,808 tonnes CO2e

Net Transfer Station Emissions Hauling + Operations tonnes CO ₂ e	Year				
	0	2011			
0	1	2012			
0	2	2013			
0	3	2014			
802	4	2015			
811	5	2016			
820	6	2017			
1,257	7	2018			
1,256	8	2019			
1,255	9	2020			
1,254	10	2021			
1,254	11	2022			
1,253	12	2023			
1,252	13	2024			
1,252	14	2025			
1,251	15	2026			
1,251	16	2027			
1,250	17	2028			
1,250	18	2029			
1,249	19	2030			
1,249	20	2031			
1,248	21	2032			
1,248	22	2033			
1,248	23	2034			
1,247	24	2035			
1,246	25	2036			
1,246	26	2037			
1,245	27	2038			
1,244	28	2039			
1,243	29	2040			
1,243	30	2041			
1,242	31	2042			
1,241	32	2043			
1,240	33	2044			
1,240	34 35	2045			
1,239		2046			
1,238 1,237	36 37	2047 2048			
		2048			
1,236 1,236	38	2049 2050			
1.230	39	2000			

Table F5: GHG assessment of Option 2(a) -EWS located in Comox Valley

			EWS GHG						
	WTE Combustion GHG								
Y	ear	CO2	CH₄ as CO₂e	N ₂ O as CO ₂ e	Total GHG CO₂e				
		tonnes CO ₂	tonnes CO ₂ e	tonnes CO ₂ e	tonnes CO ₂ e				
0	2017	0	0	0	0				
1	2018	0	0	0	0				
2	2019	0	0	0	0				
3	2020	0	0	0	0				
4	2021	8,995	0	450	9,445				
5	2022	9,096	0	455	9,551				
6	2023	9,198	0	460	9,658				
7	2024	15,658	0	783	16,441				
8	2025	15,794	0	790	16,584				
9	2026	15,928	0	796	16,725				
10	2027	16,060	0	803	16,863				
11	2028	16,190	0	810	17,000				
12	2029	16,308	0	815	17,124				
13	2030	16,308	0	815	17,124				
14	2031	16,308	0	815	17,124				
15	2032	16,308	0	815	17,124				
16	2033	16,308	0	815	17,124				
17	2034	16,308	0	815	17,124				
18	2035	16,308	0	815	17,124				
19	2036	16,308	0	815	17,124				
20	2037	16,308	0	815	17,124				
21	2038	16.308	0	815	17,124				
22	2039	16,308	0	815	17,124				
23	2040	16,308	0	815	17,124				
24	2041	16,308	0	815	17,124				
25	2042	16,308	0	815	17,124				
26	2043	16,308	0	815	17,124				
27	2044	16,308	0	815	17,124				
28	2045	16,308	0	815	17,124				
29	2046	16,308	0	815	17,124				
30	2047	16,308	0	815	17,124				
31	2048	16,308	0	815	17,124				
32	2049	16,308	0	815	17,124				
33	2050	16,308	0	815	17,124				
34	2051	16,308	0	815	17,124				
35	2052	16,308	0	815	17,124				
36	2053	16,308	0	815	17,124				
37	2054	16,308	0	815	17,124				
38	2055	16,308	0	815	17,124				
39	2056	16,308	0	815	17,124				
40	2057	16,308	0	815	17,124				

Elec	1			
Metal - ferrous	LHV of Waste	Potential Power	BC Electricity Offset	Net EWS Emission
3% of Throughput CO ₂ e Offset	10.5 GJ/tonne	at 16% Net Coversion Efficiency	BC Hydro Offset of 22 Tonnes CO ₂ e per GWh	Combustio Electricity Offset
tonnes	GWh	GWh	tonnes	tonnes
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
1,459	82	13	289	7,616
1,475	83	13	292	7,701
1,492	84	13	295	7,787
2,539	143	23	502	13,256
2,562	144	23	507	13,371
2,583	145	23	511	13,485
2,605	146	23	515	13,597
2,626	148	24	519	13,707
2,645	149	24	523	13,807
2,645	149	24	523	13,807
2,645	149	24	523	13.807
2,645	149	24	523	13,807
2,645	149	24	523	13,807
2,645	149	24	523	13,807
2,645	149	24	523	13,807
2,645	149	24	523	13,807
2,645	149	24	523	13,807
2,645	149	24	523	13,807
2,645	149	24	523	13,807
2,645	149	24	523	13,807
2,645	149	24	523	13,807
2,645	149	24	523	13,807
2,645	149	24	523	13,807
2.645	149	24	523	13,807
2,645	149	24	523	13,807
2,645	149	24	523	13,807
2,645	149	24	523	13,807
2,645	149	24	523	13,807
2,645	149	24	523	13,807
2,645	149	24	523	13,807
2,645	149	24	523	13,807
2,645	149	24	523	13,807
2,645	149	24	523	13,807
2,645	149	24	523	13,807
2,645	149	24	523	13.807
2,645	149	24	523	13,807
2,645	149	24	523	13,807

	Methane Capture	ed, Destroyed, Ox	idized and Emit	ted - CVWMC				
Net EWS Emissions	Methane Volume	Methane Collected	Methane Destroyed	Methane not Collected & Destroyed	Methane Oxidized	Total Methane Emitted	Tonnes Methane Emitted	Tonnes Methane Destroyed
ombustion - 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	m³/year	m³/year	m³/year	m³/year	m ³ /year	m³/year	tonnes CH ₄	tonnes CH ₄
0								
0	603,415	452,561	448,036	155,379	15,085	140,294	94	299
0	1,151,150	863,363	854,729	296,421	28,779	267,642	179	570
0	1,648,886	1,236,665	1,224,298	424,588	41,222	383,366	256	817
7,616	2,101,822	1,576,367	1,560,603	541,219	52,546	488,674	326	1,041
7,701	1,922,024	1,441,518	1,427,103	494,921	48,051	446,871	298	952
7,787	1,761,394	1,321,045	1,307,835	453,559	44,035	409,524	273	872
13,256	1,617,938	1,213,454	1,201,319	416,619	40,448	376,171	251	801
13,371	1,517,534	1,138,150	1,126,769	390,765	37,938	352,827	235	752
13,485	1,428,180	1,071,135	1,060,424	367,756	35,705	332,052	221	707
13,597	1,348,720	1,011,540	1,001,424	347,295	33,718	313,577	209	668
13,707	1,278,110	958,582	948,996	329,113	31,953	297,160	198	633
13,807	1,215,421	911,566	902,450	312,971	30,386	282,585	188	602
13,807	1,160,346	870,260	861,557	298,789	29,009	269,781	180	575
13,807	1,118,105	838,579	830,193	287,912	27,953	259,959	173	554
13,807	1,087,211	815,408	807,254	279,957	27,180	252,776	169	538
13,807	1,066,356	799,767	791,769	274,587	26,659	247,928	165	528
13,807	1,054,398	790,798	782,890	271,507	26,360	245,148	164	522
13,807	1,050,076	787,557	779,681	270,394	26,252	244,143	163	520
13,807	1,052,460	789,345	781,452	271.008	26,312	244,697	163	521
13,807	1,060,815	795,611	787,655	273,160	26,520	246,640	165	525
13,807	1,074,326	805,745	797,687	276,639	26,858	249,781	167	532
13,807	1,092,300	819,225	811,033	281,267	27,307	253,960	169	541
13,807	1,114,145	835,609	827,253	286,892	27,854	259,039	173	552
13,807	1,139,376	854,532	845,987	293,389	28,484	264,905	177	564
13,807	1,167,575	875,681	866,924	300,650	29,189	271,461	181	578
13,807	1,200,920	900,690	891,683	309,237	30,023	279,214	186	595
13,807	1,238,947	929,210	919,918	319,029	30,974	288,055	192	614
13,807	1,281,240	960,930	951,321	329,919	32,031	297,888	199	635
13,807	1,327,427	995,571	985,615	341,813	33,186	308,627	206	657
13,807	1,377,177	1,032,883	1,022,554	354,623	34,429	320,194	214	682
13,807	1,430,191	1,072,643	1,061,917	368,274	35,755	332,519	222	708
13,807	1,486,204	1,114,653	1,103,507	382,698	37,155	345,542	230	736
13,807	1,544,980	1,158,735	1,147,147	397,832	38,624	359,208	240	765
13,807	1,606,305	1,204,729	1,192,682	413,624	40,158	373,466	249	796
13,807	1,669,993	1,252,495	1,239,970	430,023	41,750	388,273	259	827
13,807	1,735,873	1,301,905	1,288,886	446,987	43,397	403,591	269	860
13,807	1,803,796	1,352,847	1,339,319	464,477	45,095	419,383	280	893
13,807	1,873,628	1,405,221	1,391,169	482,459	46,841	435,618	291	928
13,807	1,945,249	1,458,937	1,444,347	500,902	48,631	452,270	302	963
13,807	2,018,554	1,513,915	1,498,776	519,778	50,464	469,314	313	1,000

Total Technology GHGs - 40 years 490,920 tonnes CO2e

WTE Emissions Factors

CO ₂ =	0.32 tonnes / tonne MSW

CH ₄ =	0.0000031	tonnes CO2e /	tonne MSW
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 $N_2O =$ 0.016 tones CO2e / 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.

1 HV MSW =

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

tonne

TBL-2018-02-01-CVRD WTE Options GHG Analysis-er-5171574:Option 2(a) EWS CV

Table F5: GHG assessment of Option 2(a) -EWS located in Comox Valley

CO ₂ e Methane Emitted Methane Destruction Oxidi Methane Destruction 21 x Tonnes Emmitted 1 Tonne for Every Tonne Destroyed 1 Tonne Every Tonne Destroyed 1 Tonne Every Tonne Destroyed 1,965 299 100 3,749 570 19 5,370 817 27 6,845 1,041 37 6,259 952 32 5,736 872 29 5,269 801 27 4,942 752 25 4,651 707 24 4,392 668 22 4,162 633 21 3,958 602 200 3,641 554 19 3,434 522 18 3,4430 520 18 3,455 525 18 3,456 525 19 3,711 564 19 3,711 595 20 4,035 614 21 3,420	ummary - CVW	nissions Summary - CVW	ИС	Elec	tricity Generation	and Offsets - CV	WMC LF	Landfill	Operations - CVV	VMC LF		Transfer St	ation Hauling and	d Operations
21 x Tonnes Emmitted Every Tonne Destroyed Every T Oxidi tonnes CO ₂ e tonnes CO ₂ tonnes 1,965 299 100 3,749 570 19 5,370 817 27 6,845 1,041 35 6,259 952 32 5,736 872 22 5,269 801 27 4,942 752 25 4,651 707 24 4,392 668 22 4,162 633 21 3,958 602 200 3,641 554 19 3,434 522 18 3,434 522 18 3,420 520 16 3,421 532 18 3,423 552 18 3,434 522 18 3,455 525 18 3,628 552 19 3,711 564 1	CO ₂ from Oxidized Methane	hane Oxidized	Total GHG Emissions from LFG	Total Gas Collected	Potential Power	Energy Generation	BC Electricity Offset	Buildings - Fuel and Electricity	Landfill Equipment	GHGs from Landfill Operations	CVWMC LF Emissions	Fuel Consumption	Waste Hauling	Transfer Station Operations
$\begin{array}{ c c c c c c c c c c c c c c c c c c c$	1 Tonne for Every Tonne Oxidized	Tonne Every Tonne	Sum of GHG Emissions	From LandGEM	200 kW per 100 ft ³ /min	Based on Operation 91% of the Year	BC Hydro Offset of 22 Tonnes CO ₂ e per GWh	0.001 Tonnes CO₂e per Tonne Waste	0.004 Tonnes CO ₂ e per Tonne Waste	Buildings and Equipment	LFG - Electricity Offset + Operations	2.4 L/tonne	0.00269 Tonnes CO ₂ e / L	0.0044 Tonnes CO ₂ e / Tonne Waste
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	tonnes CO ₂	es CO ₂ tonnes CO ₂	tonnes CO ₂ e	ft³/min	kW	GWh / year	tonnes CO ₂ e	tonnes CO ₂ e	tonnes CO ₂ e	tonnes CO ₂ e	tonnes CO ₂ e	L	tonnes CO ₂ e	tonnes CO ₂ e
$\begin{array}{c c c c c c c c c c c c c c c c c c c $				0	0	0	0	36	144	180	180	0	0	0
5,370 817 27 $6,845$ $1,041$ 35 $6,259$ 952 32 $5,736$ 872 22 $5,269$ 801 27 $4,942$ 752 25 $4,651$ 707 24 $4,392$ 668 222 $4,162$ 633 21 $3,958$ 602 20 $3,779$ 575 19 $3,641$ 554 19 $3,473$ 528 18 $3,473$ 528 18 $3,434$ 522 16 $3,420$ 520 18 $3,427$ 521 18 $3,455$ 525 18 $3,426$ 552 12 $3,427$ 521 18 $3,426$ 552 12 $3,427$ 525 18 $3,426$ 552 12	10		1,965	30	61	0	0	36	146	182	2,147	0	0	0
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	19		3,749	58	116	0	0	37	147	184	3,933	0	0	0
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	27		5,370	83	166	0	0	37	149	186	5,556	0	0	0
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	35		6,845	106	212	0	0	2	9	12	6,857	0	0	0
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	32		6,259	97	194	0	0	2	9	12	6,271	0	0	0
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	29		5,736	89	178	0	0	2	10	12	5,748	0	0	0
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	27		5,269	82	163	0	0	4	16	20	5,289	51,651	139	95
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	25		4,942	76	153	0	0	4	16	21	4,963	51,935	140	95
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	24		4,651	72	144	0	0	4	17	21	4,672	52,210	140	96
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	22		4,392	68	136	0	0	4	17	21	4,413	52,469	141	96
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	21		4,162	64	129	0	0	4	17	21	4,183	52,720	142	97
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	20		3,958	61	122	0	0	4	17	21	3,980	52,964	142	97
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	19		3,779	58	117	0	0	5	19	23	3,802	53,197	143	98
$\begin{array}{c c c c c c c c c c c c c c c c c c c $			3,641	56	113	0	0	5	20	26	3,667	53,422	144	98
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$			3,541	55	110	0	0	6	22	28	3,568	53,637	144	98
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$			3,473	54	107	0	0	6	24	30	3,502	53,844	145	99
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$			3,434	53	106	0	0	6	25	31	3,465	54,031	145	99
3,455 525 18 3,499 532 18 3,557 541 18 3,628 552 19 3,711 564 19 3,802 578 19 3,911 595 20 4,035 614 21 4,173 635 21 4,485 682 23 4,658 708 24 4,840 736 25 5,031 765 26 5,231 796 27 5,439 827 28			3,420	53	106	0	0	7	27	33	3,453	54,211	146	99
3,499 532 18 3,557 541 18 3,628 552 19 3,711 564 19 3,802 578 19 3,911 595 20 4,035 614 21 4,173 635 21 4,485 682 23 4,658 708 24 4,840 736 25 5,031 765 26 5,233 796 27 5,439 827 28			3,427 3,455	53 53	106	0	0	7	28	35 37	3,463	54,387 54,552	146 147	100
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$					107	0	-	-	30	37	3,492		147	100
3,628 552 19 3,711 564 19 3,802 578 19 3,911 595 20 4,035 614 21 4,173 635 21 4,323 657 22 4,485 682 23 4,658 708 24 4,840 736 25 5,031 765 26 5,231 796 27 5,439 827 28			3,499 3,557	<u>54</u> 55	108 110	0	0	8	31 32	<u> </u>	3,537 3,598	54,707 54,856	147	100 101
3,711 564 19 3,802 578 19 3,911 595 20 4,035 614 21 4,173 635 21 4,323 657 22 4,485 682 23 4,658 708 24 4,840 736 25 5,031 765 26 5,231 796 27 5,439 827 28						-	0	8		40			148	
3,802 578 19 3,911 595 20 4,035 614 21 4,173 635 21 4,323 657 22 4,485 682 23 4,658 708 24 4,840 736 25 5,031 765 26 5,231 796 27 5,439 827 28			3,628 3.711	<u>56</u> 57	112 115	0	0	9	34 35	42	3,671 3,754	55,000 55,144	148	101 101
3,911 595 20 4,035 614 21 4,173 635 21 4,323 657 22 4,485 682 23 4,658 708 24 4,840 736 25 5,031 765 26 5,231 796 27 5,439 827 28			3,802	59	115	0	0	9	35	44 46	3,849	55,419	148	101
4,035 614 21 4,173 635 21 4,323 657 22 4,485 682 23 4,658 708 24 4,840 736 25 5,031 765 26 5,231 796 27 5,439 827 28	20		3,911	61	121	0	0	10	37	40	3,960	55,697	149	102
4,173 635 21 4,323 657 22 4,485 682 23 4,658 708 24 4,658 708 24 5,031 765 26 5,231 796 27 5,439 827 28			4,035	62	121	0	0	10	41	51	4,086	55,975	150	102
4,323 657 22 4,485 682 23 4,658 708 24 4,840 736 25 5,031 765 26 5,231 796 27 5,439 827 28	21		4,033	65	129	0	0	10	41	54	4,000	56,255	151	103
4,485 682 23 4,658 708 24 4,840 736 25 5,031 765 26 5,231 796 27 5,439 827 28	21		4,323	67	129	0	0	11	45	56	4,379	56,536	152	103
4,658 708 24 4,840 736 25 5,031 765 26 5,231 796 27 5,439 827 28	23		4,485	69	139	0	0	12	43	59	4,544	56,819	152	104
4,840 736 25 5,031 765 26 5,231 796 27 5,439 827 28	23		4,658	72	144	0	0	12	49	61	4,719	57,103	153	104
5,031 765 26 5,231 796 27 5,439 827 28	25		4,840	75	150	0	0	13	51	64	4,904	57,388	154	105
5,231 796 27 5,439 827 28	26		5,031	78	156	0	0	13	53	66	5,098	57,675	155	106
5,439 827 28	27		5,231	81	162	0	0	14	55	69	5,300	57,964	156	106
	28		5,439	84	168	0	0	14	57	72	5,510	58,254	157	100
	29		5,653	87	175	0	0	15	59	74	5,727	58,545	157	107
	30		5,874	91	182	0	0	15	62	77	5,951	58,838	158	108
	31		6.102	94	189	0	0	16	64	80	6,181	59,132	159	108
	32		6,335	98	196	0	0	16	66	82	6,417	59,427	160	109
	34		6.574	102	203	0	0	17	68	85	6.659	59,725	161	109

Total CVWMC LF GHGs - 40 years 182,673 tonnes CO2e

Total TS GHGs - 40 years 8,530 tonnes CO2e

TBL-2018-02-01-CVRD WTE Options GHG Analysis-er-5171574:Option 2(a) EWS CV

Net Transfer Station Emissions Hauling + Operations tonnes CO ₂ e	Ye	əar
	0	2011
0	1	2012
0	2	2013
0	3	2014
0	4	2015
0	5	2016
0	6	2017
234	7	2018
235	8	2019
236	9	2020
237	10	2021
238	11	2022
240	12	2023
241	13	2024
242	14	2025
243	15	2026
244	16	2027
244	17	2028
245	18	2029
246	19	2030
247	20	2031
247	21	2032
248	22	2033
249	23	2034
249	24	2035
251	25	2036
252	26	2037
253	27	2038
254	28	2039
256	29	2040
257	30	2041
258	31	2042
260	32	2043
261	33	2044
262	34	2045
264	35	2046
265	36	2047
266	37	2048
267	38	2049
269	39	2050
270	40	2051

Table F6: GHG assessment of Option 2(b) - EWS located in Campbell River

			EWS GHG				
	WTE Combustion GHG						
Y	ear	CO ₂	CH₄ as CO₂e	N ₂ O as CO ₂ e	Total GHG CO₂e		
		tonnes CO ₂	tonnes CO ₂ e	tonnes CO₂e	tonnes CO ₂ e		
0	2017	0	0	0	0		
1	2018	0	0	0	0		
2	2019	0	0	0	0		
3	2020	0	0	0	0		
4	2021	8,995	0	450	9,445		
5	2022	9,096	0	455	9,551		
6	2023	9,198	0	460	9,658		
7	2024	15,658	0	783	16,441		
8	2025	15,794	0	790	16,584		
9	2026	15,928	0	796	16,725		
10	2027	16,060	0	803	16,863		
11	2028	16,190	0	810	17,000		
12	2029	16,308	0	815	17,124		
13	2030	16,308	0	815	17,124		
14	2031	16,308	0	815	17,124		
15	2032	16,308	0	815	17,124		
16 17	2033 2034	16,308	0	815 815	17,124 17,124		
17	2034	16,308 16,308	0	815	17,124		
18	2035	16,308	0	815	17,124		
20	2030	16,308	0	815	17,124		
20	2037	16,308	0	815	17,124		
22	2030	16,308	0	815	17,124		
23	2033	16,308	0	815	17,124		
24	2040	16,308	0 0	815	17,124		
25	2041	16,308	0	815	17,124		
26	2042	16,308	0 0	815	17,124		
27	2044	16,308	0	815	17,124		
28	2045	16,308	Ő	815	17,124		
29	2046	16,308	0	815	17,124		
30	2047	16,308	0	815	17,124		
31	2048	16,308	0	815	17,124		
32	2049	16,308	0	815	17,124		
33	2050	16,308	0	815	17,124		
34	2051	16,308	0	815	17,124		
35	2052	16,308	0	815	17,124		
36	2053	16,308	0	815	17,124		
37	2054	16,308	0	815	17,124		
38	2055	16,308	0	815	17,124		
39	2056	16,308	0	815	17,124		
40	2057	16,308	0	815	17,124		

Ele				
Metal - ferrous	LHV of Waste	Potential Power	BC Electricity Offset	Net EWS Emission
3% of Throughput CO ₂ e Offset	10.5 GJ/tonne	at 16% Net Coversion Efficiency	BC Hydro Offset of 22 Tonnes CO ₂ e per GWh	Combustic Electricit Offset
tonnes	GWh	GWh	tonnes	tonnes
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
1,459	82	13	289	7,616
1,475	83	13	292	7,701
1,492	84	13	295	7,787
2,539	143	23	502	13,256
2,562	144	23	507	13,371
2,583	145	23	511	13,485
2,605	146	23	515	13,597
2,626	148	24	519	13,707
2,645	149	24	523	13,807
2,645	149	24	523	13,807
2,645	149	24	523	13,807
2,645	149	24	523	13,807
2,645	149	24	523	13,807
2,645	149	24	523	13,807
2,645	149	24	523	13,807
2,645	149	24	523	13,807
2,645	149	24	523	13,807
2,645	149	24	523	13,807
2,645	149	24	523	13,807
2,645	149	24	523	13,807
2,645	149	24	523	13,807
2,645	149	24	523	13,807
2,645	149	24	523	13,807
2,645	149	24	523	13,807
2,645	149	24	523	13,807
2,645	149	24	523	13,807
2,645	149	24	523	13,807
2,645	149	24	523	13,807
2,645	149	24	523	13,807
2,645	149	24	523	13,807
2,645	149	24	523	13,807
2,645	149	24	523	13,807
2,645	149	24	523	13,807
2,645	149	24	523	
	149			13,807
2,645		24	523	13,807
2,645	149		523	13,807
2,645	149	24	523	13,807

	Methane Captur	ed, Destroyed, Ox	idized and Emit	ted - CVWMC				
WS lions	Methane Volume	Methane Collected	Methane Destroyed	Methane not Collected & Destroyed	Methane Oxidized	Total Methane Emitted	Tonnes Methane Emitted	Tonnes Methane Destroyed
tion - city et	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
nes	m ³ /year	m³/year	m³/year	m³/year	m³/year	m³/year	tonnes CH ₄	tonnes CH ₄
)								
)	603,415	452,561	448,036	155,379	15,085	140,294	94	299
)	1,151,150	863,363	854,729	296,421	28,779	267,642	179	570
	1,648,886	1,236,665	1,224,298	424,588	41,222	383,366	256	817
6	2,101,822	1,576,367	1,560,603	541,219	52,546	488,674	326	1,041
1	1,922,024	1,441,518	1,427,103	494,921	48,051	446,871	298	952
7	1,761,394	1,321,045	1,307,835	453,559	44,035	409,524	273	872
56	1,617,938	1,213,454	1,201,319	416,619	40,448	376,171	251	801
71	1,517,534	1,138,150	1,126,769	390,765	37,938	352,827	235	752
35	1,428,180	1,071,135	1,060,424	367,756	35,705	332,052	221	707
7	1,348,720	1,011,540	1,001,424	347,295	33,718	313,577	209	668
7	1,278,110	958,582	948,996	329,113	31,953	297,160	198	633
)7	1,215,421	911,566	902,450	312,971	30,386	282,585	188	602
)7	1,160,346	870,260	861,557	298,789	29,009	269,781	180	575
07	1,118,105	838,579	830,193	287,912	27,953	259,959	173	554
7	1,087,211	815,408	807,254	279,957	27,180	252,776	169	538
)7	1,066,356	799,767	791,769	274,587	26,659	247,928	165	528
07	1,054,398	790,798	782,890	271,507	26,360	245,148	164	522
07	1,050,076	787,557	779,681	270,394	26,252	244,143	163	520
)7	1,052,460	789,345	781,452	271,008	26,312	244,697	163	521
)7	1,060,815	795,611	787,655	273,160	26,520	246,640	165	525
07	1,074,326	805,745	797,687	276,639	26,858	249,781	167	532
)7	1,092,300	819,225	811,033	281,267	27,307	253,960	169	541
)7	1,114,145	835,609	827,253	286,892	27,854	259,039	173	552
7	1,139,376	854,532	845,987	293,389	28,484	264,905	177	564
7	1,167,575	875,681	866,924	300,650	29,189	271,461	181	578
7 7	1,200,920	900,690	891,683	309,237	30,023	279,214	186	595
	1,238,947	929,210	919,918	319,029	30,974	288,055	192	614
	1,281,240	960,930	951,321	329,919	32,031	297,888	199	635
	1,327,427	995,571	985,615	341,813	33,186	308,627	206	657
	1,377,177	1,032,883	1,022,554	354,623	34,429	320,194	214	682
	1,430,191	1,072,643	1,061,917	368,274	35,755	332,519	222	708
	1,486,204	1,114,653	1,103,507	382,698	37,155	345,542	230	736
	1,544,980	1,158,735	1,147,147	397,832	38,624	359,208	240	765
	1,606,305	1,204,729	1,192,682	413,624	40,158	373,466	249	796
	1,669,993	1,252,495	1,239,970	430,023	41,750	388,273	259	827
	1,735,873	1,301,905	1,288,886	446,987	43,397	403,591	269	860
_	1,803,796	1,352,847	1,339,319	464,477	45,095	419,383	280	893
	1,873,628	1,405,221	1,391,169	482,459	46,841	435,618	291	928
	1,945,249	1,458,937	1,444,347	500,902	48,631	452,270	302	963
)7	2,018,554	1,513,915	1,498,776	519,778	50,464	469,314	313	1,000

Total Technology GHGs - 40 years 490,920 tonnes CO2e

WTE Emissions Factors

CO ₂ =	0.32 tonnes / tonne MSW
-	

CH₄ =	0.0000031	tonnes CO2e / tonne MSW
0114	0.000000	

 $N_2O =$ 0.016 tones CO2e / 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%

Electrical Conversion Efficiency =

onne

Table F6: GHG assessment of Option 2(b) - EWS located in Campbell River

LFG	GHG Emissions	Summary - CVW	/MC	E	ectricity Generation	and Offsets - CV	WMC LF	Landfill	Operations - CV	WMC LF		Transfer St	ation Hauling and	d Operations
CO ₂ e Methane Emitted	CO ₂ from Methane Destruction	CO ₂ from Oxidized Methane	Total GHG Emissions from LFG	Total Ga Collected	Potential Power	Energy Generation	BC Electricity Offset	Buildings - Fuel and Electricity	Landfill Equipment	GHGs from Landfill Operations	CVWMC LF Emissions	Fuel Consumption	Waste Hauling	Transfer Station Operations
21 x Tonnes Emmitted	1 Tonne for Every Tonne Destroyed	1 Tonne for Every Tonne Oxidized	Sum of GHG Emissions	From LandGE	200 kW per 1 100 ft ³ /min	Based on Operation 91% of the Year	BC Hydro Offset of 22 Tonnes CO ₂ e per GWh	0.001 Tonnes CO₂e per Tonne Waste	0.004 Tonnes CO ₂ e per Tonne Waste	Buildings and Equipment	LFG - Electricity Offset + Operations	2.4 L/tonne	0.00269 Tonnes CO₂e / L	0.0044 Tonnes CO ₂ e / Tonne Waste
tonnes CO ₂ e	tonnes CO ₂	tonnes CO ₂	tonnes CO ₂ e	ft³/min	kW	GWh / year	tonnes CO ₂ e	tonnes CO ₂ e	tonnes CO ₂ e	tonnes CO ₂ e	tonnes CO ₂ e	L	tonnes CO ₂ e	tonnes CO ₂ e
				0	0	0	0	36	144	180	180	0	0	0
1,965	299	10	1,965	30	61	0	0	36	146	182	2,147	0	0	0
3,749	570	19	3,749	58	116	0	0	37	147	184	3,933	0	0	0
5,370	817	27	5,370	83	166	0	0	37	149	186	5,556	0	0	0
6,845	1,041	35	6,845	106	212	0	0	2	9	12	6,857	78,869	212	124
6,259	952	32	6,259	97	194	0	0	2	9	12	6,271	79,752	215	125
5,736	872	29 27	5,736	89	178	0	0	2 4	10 16	12	5,748	80,644	217	126
5,269 4,942	801 752	27	5,269 4,942	82 76	<u> </u>	0	0	4	16	20 21	5,289 4,963	85,631 86,540	230 233	121 122
4,942	707	25	4,942	70	153	0	0	4	17	21	4,963	87,445	235	122
4,392	668	24	4,392	68	136	0	0	4	17	21	4,672	88,342	235	125
4,162	633	21	4,162	64	129	0	0	4	17	21	4,183	89,232	240	125
3,958	602	20	3,958	61	120	0	0	4	17	21	3,980	90,022	242	120
3,779	575	19	3,779	58	117	0	0	5	19	23	3,802	89,789	242	127
3,641	554	19	3,641	56	113	0	0	5	20	26	3,667	89,564	241	126
3,541	538	18	3,541	55	110	0	0	6	22	28	3,568	89,350	240	126
3,473	528	18	3,473	54	107	0	0	6	24	30	3,502	89,142	240	126
3,434	522	18	3,434	53	106	0	0	6	25	31	3,465	88,956	239	125
3,420	520	18	3,420	53	106	0	0	7	27	33	3,453	88,776	239	125
3,427	521	18	3,427	53	106	0	0	7	28	35	3,463	88,599	238	125
3,455	525	18	3,455	53	107	0	0	7	30	37	3,492	88,434	238	124
3,499	532	18	3,499	54	108	0	0	8	31	39	3,537	88,279	237	124
3,557	541	18	3,557	55	110	0	0	8	32	40	3,598	88,130	237	124
3,628 3,711	552 564	19 19	3,628 3,711	56 57	<u>112</u> 115	0	0	8	34 35	42	3,671 3,754	87,986 87,843	237 236	123 123
3,711	578	19	3,711	57	115	0	0	9	35	44 46	3,754	87,567	236	123
3,802	595	20	3,802	61	121	0	0	10	39	40	3,960	87,290	235	123
4,035	614	20	4,035	62	125	0	0	10	41	51	4,086	87,011	233	122
4,173	635	21	4,000	65	129	0	0	11	43	54	4,226	86,732	233	121
4,323	657	22	4,323	67	134	0	0	11	45	56	4,379	86,450	233	121
4,485	682	23	4,485	69	139	0	0	12	47	59	4,544	86,168	232	120
4,658	708	24	4,658	72	144	0	0	12	49	61	4,719	85,883	231	120
4,840	736	25	4,840	75	150	0	0	13	51	64	4,904	85,598	230	119
5,031	765	26	5,031	78	156	0	0	13	53	66	5,098	85,311	229	118
5,231	796	27	5,231	81	162	0	0	14	55	69	5,300	85,023	229	118
5,439	827	28	5,439	84	168	0	0	14	57	72	5,510	84,733	228	117
5,653	860	29	5,653	87	175	0	0	15	59	74	5,727	84,442	227	117
5,874	893	30 31	5,874	91	182	0	0	15	62 64	77	5,951	84,149	226	116 116
6,102 6,335	928 963	31	6,102 6,335	94 98	189 196	0	0	<u> </u>	64 66	80 82	6,181 6,417	83,855 83,559	226 225	116
6,535	1.000	32	6,535	102	203	0	0	16	68	85	6,659	83,262	225	115
0,074	1,000	54	0,074	102	203	U	U	17	00	05	0,035	03,202	224	115

Total CVWMC LF GHGs - 40 years 182,673 tonnes CO2e

Total TS GHGs - 40 years 13,119 tonnes CO₂e

TBL-2018-02-01-CVRD WTE Options GHG Analysis-er-5171574:Option 2(b) EWS CR

Net Transfer Station Emissions Hauling + Operations tonnes CO ₂ e	Ye	par
	0	2011
0	1	2012
0	2	2013
0	3	2014
336	4	2015
340	5	2016
343	6	2017
351	7	2018
355	8	2019
359	9	2020
362	10	2021
366	11	2022
369	12	2023
368	13	2024
367	14	2025
366	15	2026
365	16	2027
364	17	2028
364	18	2029
363	19	2030
362	20	2031
361	21	2032
361	22	2033
360	23	2034
359	24	2035
358	25	2036
357	26	2037
356	27	2038
354	28	2039
353	29	2040
352	30	2041
351	31	2042
349	32	2043
348	33	2044
347	34	2045
345	35	2046
344	36	2047
343	37	2048
341	38	2049
340	39	2050
339	40	2051

EWS GHG WTE Combustion GHG Year Total GHG CO₂e CO2 CH₄ as CO₂e N₂O as CO₂e tonnes CO₂ tonnes CO₂e tonnes CO₂e tonnes CO₂e 2017 2018 0 2 2019 3 2020 4 2021 0 8,995 450 9,445 5 2022 6 2023 7 2024 9,096 9,198 15,658 455 460 783 9,551 9,658 16,441 7 2024 8 2025 9 2026 10 2027 11 2028 12 2029 15,794 790 16,584 15,928 796 16,725 16,060 803 810 815 16,863 17,000 17,124 16,190 16,308 12 2020 13 2030 14 2031 17,124 17,124 17,124 17,124 17,124 16,308 815 14 2031 15 2032 16 2033 17 2034 18 2035 19 2036 20 2037 21 2038 22 2039 23 2040 24 2041 25 2042 26 2043 27 2044 28 2045 29 2046 30 2047 31 2048 32 2049 33 2050 34 2051 36 2052 16.308 815 16,308 16,308 815 815 17,124 17,124 17,124 17,124 17,124 815 815 16,308 16,308 16,308 16,308 815 815 16,308 815 17,124 17,124 17,124 17,124 17,124 16,308 815 16,308 16,308 815 815 815 815 16,308 17,124 17,124 16,308 16,308 16,308 815 815 17,124 17,124 16,308 16,308 17,124 17,124 17,124 815 815 16,308 16,308 17,124 815 815 16,308 815 17,124 815 815 16,308 17,124 17,124 16,308 33 2032 36 2053 37 2054 38 2055 39 2056 40 2057 16,308 16,308 17,124 17,124 815 815

Ele	ctricity Generation	on and Offsets - E	ws	
Metal - ferrous	LHV of Waste	Potential Power	BC Electricity Offset	Net EWS Emissions
3% of Throughput CO₂e Offset	10.5 GJ/tonne	at 16% Net Coversion Efficiency	BC Hydro Offset of 22 Tonnes CO ₂ e per GWh	Combustion Electricity Offset
tonnes	GWh	GWh	tonnes	tonnes
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
1,459	82	13	289	7,616
1,475	83	13	292	7,701
1,492	84	13	295	7,787
2,539	143	23	502	13,256
2,562	144	23	507	13,371
2,583	145	23	511	13,485
2,605	146	23	515	13,597
2,626	148	24	519	13,707
2,645	149	24	523	13,807
2,645	149	24	523	13,807
2,645	149	24	523	13,807
2,645	149	24	523	13,807
2,645	149	24	523	13,807
2,645	149	24	523	13,807
2,645	149	24	523	13,807
2,645	149	24	523	13,807
2,645	149	24	523	13,807
2,645	149	24	523	13,807
2,645	149	24	523	13,807
2,645	149	24	523	13,807
2,645	149	24	523	13,807
2,645	149	24	523	13,807
2,645	149	24	523	13,807
2,645	149	24	523	13,807
2,645	149	24	523	13,807
2,645	149	24	523	13,807
2,645	149	24	523	13,807
2,645	149	24	523	13,807
2,645	149	24	523	13,807
2,645	149	24	523	13,807
2,645	149	24	523	13,807
2,645	149	24	523	13,807
2,645	149	24	523	13,807
2,645	149	24	523	13,807
2,645	149	24	523	13,807
2,645	149	24	523	13,807
2,645	149	24	523	13,807

	Methane Capture	ed, Destroyed, Ox	idized and Emit	ted - 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 ²
	m³/year	m ³ /year	m³/year	m³/year	m³/year	m³/year	tonnes CH ₄	tonnes CH
	603,415	452,561	448,036	155,379	15,085	140,294	94	299
	1,151,150	863,363	854,729	296,421	28,779	267,642	179	570
	1,648,886	1,236,665	1,224,298	424,588	41,222	383,366	256	817
	2,101,822	1,576,367	1,560,603	541,219	52,546	488,674	326	1,041
	1,922,024	1,441,518	1,427,103	494,921	48,051	446,871	298	952
	1,761,394	1,321,045	1,307,835	453,559	44,035	409,524	273	872
	1,617,938	1,213,454	1,201,319	416,619	40,448	376,171	251	801
	1,517,534	1,138,150	1,126,769	390,765	37,938	352,827	235	752
	1,428,180	1,071,135	1,060,424	367,756	35,705	332,052	221	707
	1,348,720	1,011,540	1,001,424	347,295	33,718	313,577	209	668
	1,278,110	958,582	948,996	329,113	31,953	297,160	198	633
	1,215,421	911,566	902,450	312,971	30,386	282,585	188	602
	1,160,346	870,260	861,557	298,789	29,009	269,781	180	575
	1,118,105	838,579	830,193	287,912	27,953	259,959	173	554
	1,087,211	815,408	807,254	279,957	27,180	252,776	169	538
	1,066,356	799,767	791,769	274,587	26,659	247,928	165	528
	1,054,398	790,798	782,890	271,507	26,360	245,148	164	522
	1,050,076	787,557	779,681	270,394	26,252	244,143	163	520
	1,052,460	789,345	781,452	271,008	26,312	244,697	163	521
	1,060,815	795,611	787,655	273,160	26,520	246,640	165	525
	1,074,326	805,745	797,687	276,639	26,858	249,781	167	532
	1,092,300	819,225	811,033	281,267	27,307	253,960	169	541
	1,114,145	835,609	827,253	286,892	27,854	259,039	173	552
	1,139,376	854,532	845,987	293,389	28,484	264,905	177	564
	1,167,575	875,681	866,924	300,650	29,189	271,461	181	578
	1,200,920	900,690	891,683	309,237	30,023	279,214	186	595
	1,238,947	929,210	919,918	319,029	30,974	288,055	192	614
	1,281,240	960,930	951,321	329,919	32,031	297,888	199	635
	1,327,427	995,571	985,615	341,813	33,186	308,627	206	657
	1,377,177	1,032,883	1,022,554	354,623	34,429	320,194	214	682
	1,430,191	1,072,643	1,061,917	368,274	35,755	332,519	222	708
	1,486,204	1,114,653	1,103,507	382,698	37,155	345,542	230	736
	1,544,980	1,158,735	1,147,147	397,832	38,624	359,208	240	765
	1,606,305	1,204,729	1,192,682	413,624	40,158	373,466	249	796
	1,669,993	1,252,495	1,239,970	430,023	41,750	388,273	259	827
	1,735,873	1,301,905	1,288,886	446,987	43,397	403,591	269	860
	1,803,796	1,352,847	1,339,319	464,477	45,095	419,383	280	893
	1,873,628	1,405,221	1,391,169	482,459	46,841	435,618	291	928
	1,945,249	1,458,937	1,444,347	500,902	48,631	452,270	302	963
	2,018,554	1,513,915	1,498,776	519,778	50,464	469,314	313	1,000

Total Technology GHGs - 40 years 490,920 tonnes CO2e

WTE Emissions Factors

16,308

16,308 16,308

$CO_2 =$	0.32 tonnes / tonne MSW

17,124

17,124 17,124 17,124

CH4 = 0.0000031 tonnes CO2e / tonne MSW

0.016 tones CO2e / tonne MSW

 $N_2O =$

815 815 815

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%

Electrical Conversion Efficiency =

Table F7: GHG assessment of Option 2(c) - EWS located in Gold River

Table F7: GHG assessment of Option 2(c) - EWS located in Gold River

LFG GHG Emissions Summary - CVWMC			E	lectricity Generation	and Offsets - CV	WMC LF	Landfil	Landfill Operations - CVWMC LF			Transfer Station Hauling and Operations			
CO₂e Methane Emitted	CO ₂ from Methane Destruction	CO ₂ from Oxidized Methane	Total GHG Emissions from LFG	Total Ga Collecte	Dotontial Dowor	Energy Generation	BC Electricity Offset	Buildings - Fuel and Electricity	Landfill Equipment	GHGs from Landfill Operations	CVWMC LF Emissions	Fuel Consumption	Waste Hauling	Transfer Station Operations
21 x Tonnes Emmitted	1 Tonne for Every Tonne Destroyed	1 Tonne for Every Tonne Oxidized	Sum of GHG Emissions	From LandGE	200 kW per M 100 ft ³ /min	Based on Operation 91% of the Year	BC Hydro Offset of 22 Tonnes CO ₂ e per GWh	0.001 Tonnes CO₂e per Tonne Waste	0.004 Tonnes CO ₂ e per Tonne Waste	Buildings and Equipment	LFG - Electricity Offset + Operations	2.4 L/tonne	0.00269 Tonnes CO ₂ e / L	0.0044 Tonnes CO ₂ e / Tonne Waste
tonnes CO ₂ e	tonnes CO ₂	tonnes CO ₂	tonnes CO ₂ e	ft³/min	kW	GWh / year	tonnes CO ₂ e	tonnes CO₂e	tonnes CO ₂ e	tonnes CO ₂ e	tonnes CO ₂ e	L	tonnes CO₂e	tonnes CO ₂ e
				0	0	0	0	36	144	180	180	0	0	0
1,965	299	10	1,965	30	61	0	0	36	146	182	2,147	0	0	0
3,749	570	19	3,749	58	116	0	0	37	147	184	3,933	0	0	0
5,370	817	27	5,370	83	166	0	0	37	149	186	5,556	0	0	0
6,845	1,041	35	6,845	106	212	0	0	2	9	12	6,857	210,316	566	124
6,259	952	32	6,259	97	194	0	0	2	9	12	6,271	212,672	572	125
5,736	872	29	5,736	89	178	0	0	2	10	12	5,748	215,052	578	126
5,269 4,942	801 752	27 25	5,269 4,942	<u>82</u> 76	163 153	0	0	4	16 16	20 21	5,289 4,963	314,435 317,333	846 854	215 217
4,942	707	25	4,942	70	153	0	0	4	17	21	4,903	317,333	861	217
4,392	668	24	4,392	68	136	0	0	4	17	21	4,072	323,027	869	219
4,162	633	21	4,162	64	129	0	0	4	17	21	4,183	325,817	876	223
3.958	602	20	3,958	61	122	0	0	4	17	21	3,980	328,333	883	224
3,779	575	19	3,779	58	117	0	0	5	19	23	3,802	328,100	883	224
3,641	554	19	3,641	56	113	0	0	5	20	26	3,667	327,875	882	224
3,541	538	18	3,541	55	110	0	0	6	22	28	3,568	327,660	881	224
3,473	528	18	3,473	54	107	0	0	6	24	30	3,502	327,453	881	224
3,434	522	18	3,434	53	106	0	0	6	25	31	3,465	327,267	880	224
3,420	520	18	3,420	53	106	0	0	7	27	33	3,453	327,087	880	224
3,427	521 525	18	3,427	53	106	0	0	7	28	35	3,463	326,910	879	224 224
3,455 3,499	525	18 18	3,455 3,499	53 54	107	0	0	8	30 31	37 39	3,492 3,537	326,745 326,590	879 879	224
3,499	532	18	3,499	55	108	0	0	<u> </u>	32	40	3,598	326,590	878	224
3.628	552	19	3.628	56	110	0	0	8	34	40	3,671	326,297	878	224
3,711	564	19	3,711	57	115	0	0	9	35	44	3,754	326,153	877	224
3,802	578	19	3,802	59	118	0	0	9	37	46	3,849	325,878	877	224
3,911	595	20	3,911	61	121	0	0	10	39	49	3,960	325,601	876	224
4,035	614	21	4,035	62	125	0	0	10	41	51	4,086	325,322	875	224
4,173	635	21	4,173	65	129	0	0	11	43	54	4,226	325,042	874	224
4,323	657	22	4,323	67	134	0	0	11	45	56	4,379	324,761	874	224
4,485	682	23	4,485	69	139	0	0	12	47	59	4,544	324,478	873	224
4,658	708	24	4,658	72	144	0	0	12	49	61	4,719	324,194	872	224
4,840 5,031	736 765	25 26	4,840 5,031	75 78	<u>150</u> 156	0	0	13 13	51 53	64 66	4,904 5,098	323,909 323,622	871 871	224 224
5,031	765	26	5,031	81	156	0	0	13	53	69	5,098	323,622	871	224
5,231	827	27	5,231	84	162	0	0	14	55	72	5,510	323,044	869	224
5,653	860	20	5,653	87	175	0	0	14	59	74	5,727	322,752	868	224
5.874	893	30	5.874	91	182	0	0	15	62	77	5,951	322,460	867	224
6,102	928	31	6,102	94	189	0	0	16	64	80	6,181	322,165	867	224
6,335	963	32	6,335	98	196	0	0	16	66	82	6,417	321,870	866	224
6,574	1,000	34	6,574	102	203	0	0	17	68	85	6,659	321,573	865	224

Total CVWMC LF GHGs - 40 years 182,673 tonnes CO2e

Total TS GHGs - 40 years 39,370 tonnes CO2e

Net Transfer Station Emissions Hauling + Operations tonnes CO ₂ e	Y	əar
	0	2011
0	1	2012
0	2	2013
0	3	2014
689	4	2015
697	5	2016
705	6	2017
1,061	7	2018
1,071	8	2019
1,080	9	2020
1,090	10	2021
1,099	11	2022
1,107	12	2023
1,107	13	2024
1,106	14	2025
1,106	15	2026
1,105	16	2027
1,105	17	2028
1,104	18	2029
1,104	19	2030
1,103	20	2031
1,103	21	2032
1,102	22	2033
1,102	23	2034
1,102	24	2035
1,101	25	2036
1,100	26	2037
1,099	27	2038
1,099	28	2039
1,098	29	2040
1,097	30	2041
1,096	31	2042
1,096	32	2043
1,095	33	2044
1,094	34	2045
1,093	35	2046
1,092	36	2047
1,092	37	2048
1,091	38	2049
1,090	39 40	2050 2051

Table F8: GHG assessment of Option 3(a) - Sustane located in Comox Valley

	Bio-diesel GHG			Electricity G	eneration and Off	sets - Sustane		Methane Capture	ed, Destroyed, Ox	idized and Emit	ted - CVWMC		
		Bio-diesel Co	ombustion GHG	Metal - ferrous	Metal - Non- Ferrous	Plastics	Net Sustane Emissions	Methane Volume	Methane Collected	Methane Destroyed	Methane not Collected & Destroyed	Methane Oxidized	Total Methane Emitted
Ye	Year 0.12 tonnes CO ₂ e per tonne throughput Total GHG CO ₂ e		3% of Throughput CO₂e Offset	1.8% of throughput CO2e Offset	7% of Throughout CO₂e Offset	Combustion - Electricity Offset	From LandGem	75% Collection Efficiency	99% of Collected Methane	Total - Destroyed	10% of Methane not Collected	Total - Destroyed - Oxidized	
		tonnes CO ₂	tonnes CO ₂ e	tonnes	tonnes	tonnes	tonnes	m³/year	m³/year	m³/year	m³/year	m³/year	m³/year
0	2017	0	0	0	0	0	0						
1	2018	0	0	0	0	0	0	603,415	452,561	448,036	155,379	15,085	140,294
2	2019	0	0	0	0	0	0	1,151,150	863,363	854,729	296,421	28,779	267,642
3	2020	0	0	0	0	0	0	1,648,886	1,236,665	1,224,298	424,588	41,222	383,366
4	2021	3,503	3,503	1,734	5,260	1.941	-5,433	2,101,822	1,576,367	1,560,603	541,219	52,546	488,674
5	2022	3,543	3,543	1,754	5,319	1,963	-5,493	1,903,852	1,427,889	1,413,610	490,242	47,596	442,646
6	2023	3,582	3,582	1,773	5,379	1,985	-5,555	1,726,738	1,295,054	1,282,103	444,635	43,168	401,467
7	2024	6.098	6.098	3,019	9,156	3,379	-9,456	1.568.311	1,176,234	1,164,471	403,840	39,208	364.632
8	2025	6,116	6,116	3,027	9,183	3,389	-9,483	1,441,445	1,081,084	1,070,273	371,172	36,036	335,136
9	2026	6,116	6,116	3,027	9,183	3,389	-9,483	1,333,075	999,806	989,808	343,267	33,327	309,940
10	2027	6,116	6,116	3,027	9,183	3,389	-9,483	1,243,625	932,719	923,391	320,233	31,091	289,143
11	2028	6,116	6,116	3.027	9,183	3,389	-9.483	1,170,967	878.225	869,443	301,524	29.274	272.250
12	2029	6,116	6,116	3,027	9,183	3,389	-9,483	1,113,256	834,942	826,593	286,664	27,831	258,832
13	2030	6,116	6,116	3,027	9,183	3,389	-9,483	1,068,824	801,618	793,602	275,222	26,721	248,502
14	2031	6,116	6,116	3,027	9,183	3,389	-9,483	1,036,116	777,087	769,316	266,800	25,903	240,897
15	2032	6,116	6,116	3,027	9,183	3,389	-9,483	1,013,762	760,322	752,719	261,044	25,344	235,700
16	2032	6,116	6,116	3,027	9,183	3,389	-9,483	1,000,558	750,419	742,915	257,644	25.014	232,630
10	2033	6,116	6,116	3,027	9,183	3,389	-9,483	995,454	746,591	739,125	256,329	24,886	231,443
18	2034	6,116	6,116	3,027	9,183	3,389	-9,483	997,272	740,391	740,474	256,798	24,000	231,866
19	2035	6,116	6,116	3,027	9,183	3,389	-9,483	1,005,157	753,867	746,329	258,828	25,129	233,699
20	2030	6,116	6,116	3,027	9,183	3,389	-9,483	1,018,439	763,829	756,191	262,248	25,461	236,787
20	2037	6,116	6,116	3,027	9,183	3,389	-9,483	1,036,364	777,273	769,500	266,864	25,909	240,955
21	2038	6,116	6,116	3,027	9,183	3,389	-9,483	1,058,292	793,719	785,782	272,510	25,909	240,955
22	2039	6,116	6,116		9,183							20,457	
23	2040	6,116	6,116	3,027 3,027	9,183	3,389 3,389	-9,483 -9,483	1,083,680	812,760 834,063	804,632 825,723	279,048 286,362	27,092	251,956 258,560
								1,112,085					
25	2042	6,116	6,116	3,027	9,183	3,389	-9,483	1,143,126	857,344	848,771	294,355	28,578	265,777
26 27	2043	6,116	6,116	3,027	9,183	3,389	-9,483	1,179,018	884,263	875,421	303,597	29,475	274,122
	2044	6,116	6,116	3,027	9,183	3,389	-9,483	1,219,326	914,495	905,350	313,976	30,483	283,493
28	2045	6,116	6,116	3,027	9,183	3,389	-9,483	1,263,663	947,747	938,270	325,393	31,592	293,802
29	2046	6,116	6,116	3,027	9,183	3,389	-9,483	1,311,681	983,761	973,923	337,758	32,792	304,966
30	2047	6,116	6,116	3,027	9,183	3,389	-9,483	1,363,071	1,022,303	1,012,080	350,991	34,077	316,914
31	2048	6,116	6,116	3,027	9,183	3,389	-9,483	1,417,554	1,063,166	1,052,534	365,020	35,439	329,581
32	2049	6,116	6,116	3,027	9,183	3,389	-9,483	1,474,884	1,106,163	1,095,101	379,783	36,872	342,911
33	2050	6,116	6,116	3,027	9,183	3,389	-9,483	1,534,839	1,151,129	1,139,618	395,221	38,371	356,850
34	2051	6,116	6,116	3,027	9,183	3,389	-9,483	1,597,221	1,197,916	1,185,936	411,284	39,931	371,354
35	2052	6,116	6,116	3,027	9,183	3,389	-9,483	1,661,855	1,246,391	1,233,927	427,928	41,546	386,381
36	2053	6,116	6,116	3,027	9,183	3,389	-9,483	1,728,583	1,296,437	1,283,473	445,110	43,215	401,895
37	2054	6,116	6,116	3,027	9,183	3,389	-9,483	1,797,265	1,347,949	1,334,469	462,796	44,932	417,864
38	2055	6,116	6,116	3,027	9,183	3,389	-9,483	1,867,777	1,400,833	1,386,824	480,953	46,694	434,258
39	2056	6,116	6,116	3,027	9,183	3,389	-9,483	1,940,008	1,455,006	1,440,456	499,552	48,500	451,052
40	2057	6,116	6,116	3,027	9,183	3,389	-9,483	2,013,858	1,510,394	1,495,290	518,568	50,346	468,222

Total Technology GHGs - 40 years -338,882 tonnes CO2e

Tonnes

Methane

Destroyed

0.000667

Tonnes/m³

tonnes CH₄

299

570 817

1,041

943 855 777

714

660 616

580 551

529 513

502 496

493 494

498 504

566 584

604 626

650 675

702 730

760

791 823

856 890

925 961 997

Tonnes

Methane

Emitted

0.000667

Tonnes/m³

tonnes CH₄

94

179 256

326

295 268 243

224

166 161

157 155

154 155

156 158

177 183

189 196

203 211

220 229

238

248 258

268 279

290 301 312

Table F8: GHG assessment of Option 3(a) - Sustane located in Comox Valley

LFG	LFG GHG Emissions Summary - CVWMC			EI	ectricity Generation	n and Offsets - C\	/WMC LF	Landfill Operations - CVWMC LF				Transfer Station Hauling and Operations			
CO₂e Methane Emitted	CO ₂ from Methane Destruction	CO ₂ from Oxidized Methane	Total GHG Emissions from LFG	Total Gas Collected	Potential Power	Energy Generation	BC Electricity Offset	Buildings - Fuel and Electricity	Landfill Equipment	GHGs from Landfill Operations	CVWMC LF Emissions	Fuel Consumption	Waste Hauling	Transfer Station Operations	
21 x Tonnes Emmitted	1 Tonne for Every Tonne Destroyed	1 Tonne for Every Tonne Oxidized	Sum of GHG Emissions	From LandGEM	200 kW per 100 ft ³ /min	Based on Operation 91% of the Year	BC Hydro Offset of 22 Tonnes CO ₂ e per GWh	0.001 Tonnes CO₂e per Tonne Waste	0.004 Tonnes CO₂e per Tonne Waste	Buildings and Equipment	LFG - Electricity Offset + Operations	2.4 L/tonne	0.00269 Tonnes CO₂e / L	0.0044 Tonnes CO ₂ e / Tonne Waste	
tonnes CO ₂ e	tonnes CO ₂	tonnes CO ₂	tonnes CO ₂ e	ft³/min	kW	GWh / year	tonnes CO₂e	tonnes CO ₂ e	tonnes CO ₂ e	tonnes CO ₂ e	tonnes CO ₂ e	L	tonnes CO ₂ e	tonnes CO ₂ e	
				0	0	0	0	36	144	180	180	0	0	0	
1,965	299	10	1,965	30	61	0	0	36	146	182	2,147	0	0	0	
3,749	570	19	3,749	58	116	0	0	37	147	184	3,933	0	0	0	
5,370	817	27	5,370	83	166	0	0	37	149	186	5,556	0	0	0	
6,845	1,041	35	6,845	106	212	0	0	1	5	6	6,851	0	0	0	
6,200	943	32	6,200	96	192	0	0	1	5	6	6,206	0	0	0	
5,623 5,107	855 777	29 26	5,623 5,107	87 79	174 158	0	0	2	5	6 11	<u>5,630</u> 5,118	0 51,651	0 139	0 95	
4.694	714	20	4,694	73	145	0	0	2	10	11	4,707	51,935	139	95	
4,094	660	24	4,094	67	134	0	0	3	10	12	4,356	52.210	140	96	
4.050	616	21	4,050	63	125	0	0	3	14	17	4,067	52,469	140	96	
3.813	580	20	3,813	59	118	0	0	4	15	19	3,833	52,720	142	97	
3,625	551	19	3,625	56	112	0	0	4	17	21	3,647	52,964	142	97	
3,481	529	18	3,481	54	108	0	0	5	19	23	3,504	53,197	143	98	
3,374	513	17	3,374	52	104	0	0	5	20	26	3,400	53,422	144	98	
3,301	502	17	3,301	51	102	0	0	6	22	28	3,329	53,637	144	98	
3,258	496	17	3,258	50	101	0	0	6	24	30	3,288	53,844	145	99	
3,242	493	17	3,242	50	100	0	0	6	25	31	3,273	54,031	145	99	
3,248	494	17	3,248	50	101	0	0	7	27	33	3,281	54,211	146	99	
3,273 3.317	498 504	17 17	3,273 3,317	<u>51</u> 51	101	0	0	7	28 30	35 37	3,309 3,354	54,387 54,552	146 147	100 100	
3,317	504	17	3,317	51	103	0	0	8	30	37	3,354	54,552	147	100	
3,375	513	18	3,446	53	104	0	0	8	32	40	3,414	54,856	147	100	
3,529	537	18	3,529	55	109	0	0	8	34	40	3,571	55,000	148	101	
3,622	551	19	3,622	56	112	0	0	9	35	44	3,665	55,144	148	101	
3,723	566	19	3,723	58	115	0	0	9	37	46	3,769	55,419	149	102	
3,840	584	20	3,840	59	119	0	0	10	39	49	3,888	55,697	150	102	
3,971	604	20	3,971	61	123	0	0	10	41	51	4,022	55,975	151	103	
4,115	626	21	4,115	64	127	0	0	11	43	54	4,169	56,255	151	103	
4,272	650	22	4,272	66	132	0	0	11	45	56	4,328	56,536	152	104	
4,439	675	23	4,439	69	137	0	0	12	47	59	4,498	56,819	153	104	
4,616 4,803	702 730	24 25	4,616 4,803	71 74	143 149	0	0	<u>12</u> 13	49 51	61 64	<u>4,678</u> 4,867	57,103 57,388	154 154	105 105	
4,803	730	25	4,803	74	149	0	0	13	51	66	4,867	57,388	154	105	
4,998	780	20	4,998	80	161	0	0	13	55	69	5,065	57,964	155	106	
5,202	823	28	5,202	84	167	0	0	14	57	72	5,484	58,254	150	100	
5.629	856	29	5,629	87	174	0	0	15	59	74	5,704	58,545	157	107	
5,853	890	30	5,853	91	181	0	0	15	62	77	5,930	58,838	158	108	
6,083	925	31	6,083	94	188	0	0	16	64	80	6,162	59,132	159	108	
6,318	961	32	6,318	98	196	0	0	16	66	82	6,400	59,427	160	109	
6,558	997	34	6,558	101	203	0	0	17	68	85	6,643	59,725	161	109	

Total CVWMC LF GHGs - 40 years 177,983 tonnes CO2e

Total TS GHGs - 40 years 8,530 tonnes CO2e

TBL-2018-02-01-CVRD WTE Options GHG Analysis-er-5171574:Option 3(a) Sustane CV

Net Transfer Station Emissions Hauling + Operations tonnes CO ₂ e	Ye	əar
	0	2011
0	1	2012
0	2	2013
0	3	2014
0	4	2015
0	5	2016
0	6	2017
234	7	2018
235	8	2019
236	9	2020
237	10	2021
238	11	2022
240	12	2023
241	13	2024
242	14	2025
243	15	2026
244	16	2027
244	17	2028
245	18	2029
246	19	2030
247	20	2031
247	21	2032
248	22	2033
249	23	2034
249	24	2035
251	25	2036
252	26	2037
253	27	2038
254	28	2039
256	29	2040
257	30	2041
258	31	2042
260	32	2043
261	33	2044
262	34	2045
264	35	2046
265	36	2047
266	37	2048
267	38	2049
269	39	2050
270	40	2051

Table F9: GHG assessment of Option 3(b) - Sustane located in Campbell River

	l	Bio-diesel GHG		Electricity
		Bio-diesel Co	ombustion GHG	Metal - ferro
Ye	ar	0.12 tonnes CO₂e per tonne throughput	Total GHG CO ₂ e	3% of Throughpu CO₂e Offse
		tonnes CO ₂	tonnes CO₂e	tonnes
0	2017	0	0	0
1	2018	0	0	0
2	2019	0	0	0
3	2020	0	0	0
4	2021	3,513	3,513	1,739
5	2022	3,553	3,553	1,759
6	2023	3,592	3,592	1,778
7	2024	6,116	6,116	3,027
8	2025	6,116	6,116	3,027
9	2026	6,116	6,116	3,027
10	2027	6,116	6,116	3,027
11	2028	6,116	6,116	3,027
12	2029	6,116	6,116	3,027
13	2030	6,116	6,116	3,027
14	2031	6,116	6,116	3,027
15	2032	6,116	6,116	3,027
16	2033	6,116	6,116	3,027
17	2034	6,116	6,116	3,027
18	2035	6,116	6,116	3,027
19	2036	6,116	6,116	3,027
20	2037	6,116	6,116	3,027
21	2038	6,116	6,116	3,027
22	2039	6,116	6,116	3,027
23	2040	6,116	6,116	3,027
24	2041	6,116	6,116	3,027
25	2042	6,116	6,116	3,027
26	2043	6,116	6,116	3,027
27	2044	6,116	6,116	3,027
28	2045	6,116	6,116	3,027
29	2046	6,116	6,116	3,027
30	2047	6,116	6,116	3,027
31 32	2048 2049	6,116 6,116	6,116 6,116	<u>3,027</u> 3,027
33	2049	6,116		3,027
			6,116	
34 35	2051 2052	6,116 6,116	6,116 6,116	<u>3,027</u> 3,027
36	2052	6,116	6,116	
36	2053	6,116	6,116	<u>3,027</u> 3,027
38	2054	6,116	6,116	3,027
39	2055	6,116	6,116	3,027
40	2050	6,116	6,116	3,027

Electricity Generation and Offsets - Sustane							
etal - ferrous	Metal - Non- Ferrous	Plastics					
3% of Throughput CO ₂ e Offset	1.8% of throughput CO2e Offset	7% of Throughout CO₂e Offset					
tonnes	tonnes	tonnes					
0	0	0					
0	0	0					
0	0	0					
0	0	0					
1,739	5,275	1,947					
1,759	5,334	1,969					
1,778	5,394	1,991					
3,027	9,182	3,389					
3,027	9,182	3,389					
3,027	9,182	3,389					
3,027	9,182	3,389					
3,027	9,182	3,389					
3,027	9,182	3,389					
3,027	9,182	3,389					
3,027	9,182	3,389					
3,027	9,182	3,389					
3,027	9,182	3,389					
3,027	9,182	3,389					
3,027	9,182	3,389					
3,027	9,182	3,389					
3,027	9,182	3,389					
3,027	9,182	3,389					
3,027	9,182	3,389					
3,027	9,182	3,389					
3,027	9,182	3,389					
3,027	9,182	3,389					
3,027	9,182	3,389					
3,027	9,182	3,389					
3,027	9,182	3,389					
3,027	9,182	3,389					
3,027	9,182	3,389					
3,027	9,182	3,389					
3,027	9,182	3,389					
3,027	9,182	3,389					
3,027	9,182	3,389					
3,027	9,182	3,389					
3,027	9,182	3,389					
3,027	9,182	3,389					
3,027	9,182	3,389					
3,027	9,182	3,389					
3,027	9,182	3,389					

Methane Volume	Methane Collected	Methane Destroyed	Methane not Collected & Destroyed	Methane Oxidized	Total Methane Emitted	Tonnes Methane Emitted	Tonne Metha Destroy	
From LandGem	75% Collection Efficiency	99% of Collected Methane	Total - Destroyed	10% of Methane not Collected	Total - Destroyed - Oxidized	0.000667 Tonnes/m ³	0.00066 Tonnes/	
m³/year	m³/year	m³/year	m³/year	m³/year	m³/year	tonnes CH₄	tonnes	
603,415	452.561	448.036	155,379	15.085	140,294	94	299	
1,151,150	863,363	854,729	296,421	28,779	267,642	179	570	
1.648.886	1,236,665	1.224.298	424,588	41.222	383,366	256	817	
2,101,822	1,576,367	1,560,603	541,219	52,546	488,674	326	1.041	
1,903,852	1,427,889	1,413,610	490,242	47,596	442,646	295	943	
						295	855	
1,726,738	1,295,054	1,282,103	444,635	43,168 39,208	401,467		777	
1,568,311	1,176,234	1,164,471	403,840		364,632	243	714	
1,441,445	1,081,084	1,070,273	371,172	36,036	335,136	224		
1,333,075	999,806	989,808	343,267	33,327	309,940	207	660	
1,243,625	932,719	923,391	320,233	31,091	289,143	193	616	
1,170,967	878,225	869,443	301,524	29,274	272,250	182	580	
1,113,256	834,942	826,593	286,664	27,831	258,832	173	551	
1,068,824	801,618	793,602	275,222	26,721	248,502	166	529	
1,036,116	777,087	769,316	266,800	25,903	240,897	161	513	
1,013,762	760,322	752,719	261,044	25,344	235,700	157	502	
1,000,558	750,419	742,915	257,644	25,014	232,630	155	496	
995,454	746,591	739,125	256,329	24,886	231,443	154	493	
997,272	747,954	740,474	256,798	24,932	231,866	155	494	
1,005,157	753,867	746,329	258,828	25,129	233,699	156	498	
1,018,439	763,829	756,191	262,248	25,461	236,787	158	504	
1,036,364	777,273	769,500	266,864	25,909	240,955	161	513	
1,058,292	793,719	785,782	272,510	26,457	246,053	164	524	
1,083,680	812,760	804,632	279,048	27,092	251,956	168	537	
1,112,085	834,063	825,723	286,362	27,802	258,560	172	551	
1,143,126	857,344	848,771	294,355	28,578	265,777	177	566	
1,179,018	884,263	875,421	303,597	29,475	274,122	183	584	
1,219,326	914,495	905,350	313,976	30,483	283,493	189	604	
1,263,663	947,747	938,270	325,393	31,592	293,802	196	626	
1,311,681	983,761	973,923	337,758	32,792	304,966	203	650	
1,363,071	1,022,303	1,012,080	350,991	34,077	316,914	211	675	
1,417,554	1,063,166	1,052,534	365,020	35,439	329,581	220	702	
1,474,884	1,106,163	1,095,101	379,783	36,872	342,911	229	730	
1,534,839	1,151,129	1,139,618	395,221	38,371	356,850	238	760	
1,597,221	1,197,916	1,185,936	411,284	39,931	371,354	248	791	
1,661,855	1,246,391	1,233,927	427,928	41,546	386,381	258	823	
1,728,583	1,296,437	1,283,473	445,110	43,215	401,895	268	856	
1,797,265	1,347,949	1,334,469	462,796	44,932	417,864	279	890	
1,867,777	1,400,833	1,386,824	480,953	46,694	434,258	290	925	
1,940,008	1,455,006	1,440,456	499,552	48,500	451,052	301	961	
2,013,858	1,510,394	1,495,290	518,568	50,346	468,222	312	997	

Total Technology GHGs - 40 years -338,954 tonnes CO₂e

Net Sustane Emissions

Combustion -

Electricity Offset

tonnes

0

0 -5,448 -5,509 -5,571 -9,483 -9,483

-9,483 -9,483 -9,483 -9,483 -9,483

-9,483 -9,483 -9,483 -9,483 -9,483

-9,483 -9,483 -9,483 -9,483 -9,483 -9,483 -9,483 -9,483 -9,483 -9,483 -9,483

-9,483 -9,483

-9,483 -9,483 -9,483 -9,483 -9,483 -9,483 -9,483

-9,483 -9,483 -9,483 -9,483 -9,483 -9,483

-9,483 -9,483 -9,483

Table F9: GHG assessment of Option 3(b) - Sustane located in Campbell River

LFG	GHG Emissions	Summary - CVW	MC	Ele	ctricity Generatior	eration and Offsets - CVWMC LF Landfill Operations - CVWMC LF			WMC LF		Transfer Station Hauling and Operations				
CO ₂ e Methane Emitted	CO ₂ from Methane Destruction	CO ₂ from Oxidized Methane	Total GHG Emissions from LFG	Total Gas Collected	Potential Powe	Energy Generation	BC Electricity Offset	Buildings - Fuel and Electricity	Landfill Equipment	GHGs from Landfill Operations	CVWMC LF Emissions	Fuel Consumption	Waste Hauling	Transfer Station Operations	
21 x Tonnes Emmitted	1 Tonne for Every Tonne Destroyed	1 Tonne for Every Tonne Oxidized	Sum of GHG Emissions	From LandGEM	200 kW per 100 ft ³ /min	Based on Operation 91% of the Year	BC Hydro Offset of 22 Tonnes CO ₂ e per GWh	0.001 Tonnes CO₂e per Tonne Waste	0.004 Tonnes CO₂e per Tonne Waste	Buildings and Equipment	LFG - Electricity Offset + Operations	2.4 L/tonne	0.00269 Tonnes CO₂e / L	0.0044 Tonnes CO ₂ e / Tonne Waste	
tonnes CO ₂ e	tonnes CO ₂	tonnes CO ₂	tonnes CO ₂ e	ft ³ /min	kW	GWh / year	tonnes CO ₂ e	tonnes CO ₂ e	tonnes CO ₂ e	tonnes CO ₂ e	tonnes CO ₂ e	L	tonnes CO₂e	tonnes CO ₂ e	
				0	0	0	0	36	144	180	180	0	0	0	
1,965	299	10	1,965	30	61	0	0	36	146	182	2,147	0	0	0	
3,749	570	19	3,749	58	116	0	0	37	147	184	3,933	0	0	0	
5,370	817	27	5,370	83	166	0	0	37	149	186	5,556	0	0	0	
6,845	1,041	35	6,845	106	212	0	0	1	5	6	6,851	77,937	210	129	
6,200	943	32	6,200	96	192	0	0	1	5	6	6,206	78,810	212	130	
5,623	855	29	5,623	87	174	0	0	1	5	6	5,629	79,692	214	132	
5,107	777	26	5,107	79	158	0	0	2	8	10	5,118	84,010	226	130	
4,694 4,341	714 660	24 22	4,694 4,341	73	145	0	0	2	10 12	12	4,707	83,726	225 224	129 129	
4,341	616	22	4,341 4,050	<u>67</u> 63	134 125	0	0	3	12	15 17	4,356 4,067	83,451 83,193	224	129	
3.813	580	20	3,813	59	125	0	0	4	14	17	3,833	82.942	224	128	
3.625	551	19	3,615	56	118	0	0	4	15	21	3,647	82,942	223	120	
3,481	529	18	3,481	54	108	0	0	5	19	23	3,504	82,464	222	127	
3.374	513	17	3,374	52	100	0	0	5	20	26	3,400	82,239	221	126	
3.301	502	17	3,301	51	102	0	0	6	22	28	3,329	82,024	221	126	
3,258	496	17	3,258	50	101	0	0	6	24	30	3,288	81,817	220	126	
3,242	493	17	3,242	50	100	0	0	6	25	31	3,273	81,631	220	125	
3,248	494	17	3,248	50	101	0	0	7	27	33	3,281	81,451	219	125	
3,273	498	17	3,273	51	101	0	0	7	28	35	3,309	81,274	219	125	
3,317	504	17	3,317	51	103	0	0	7	30	37	3,354	81,109	218	124	
3,375	513	17	3,375	52	104	0	0	8	31	39	3,414	80,954	218	124	
3,446	524	18	3,446	53	107	0	0	8	32	40	3,487	80,805	217	124	
3,529	537 551	18 19	3,529 3.622	55	109	0	0	8	34 35	42 44	<u>3,571</u> 3.665	80,661	217 217	123 123	
3,622 3,723	566	19	3,622	<u> </u>	<u> </u>	0	0	9	35 37	44 46	3,005	80,518 80,242	217	123	
3,723	584	20	3,723	59	115	0	0	10	39	40	3,888	79,965	215	123	
3,971	604	20	3,971	61	123	0	0	10	41	51	4,022	79,686	213	122	
4,115	626	20	4,115	64	123	0	0	11	43	54	4,169	79,406	214	121	
4,272	650	22	4,272	66	132	0	0	11	45	56	4,328	79,125	213	121	
4,439	675	23	4,439	69	137	0	0	12	47	59	4,498	78,843	212	120	
4,616	702	24	4,616	71	143	0	0	12	49	61	4,678	78,558	211	120	
4,803	730	25	4,803	74	149	0	0	13	51	64	4,867	78,273	211	119	
4,998	760	26	4,998	77	155	0	0	13	53	66	5,065	77,986	210	118	
5,202	791	27	5,202	80	161	0	0	14	55	69	5,270	77,698	209	118	
5,412	823	28	5,412	84	167	0	0	14	57	72	5,484	77,408	208	117	
5,629	856	29	5,629	87	174	0	0	15	59	74	5,704	77,117	207	117	
5,853	890	30	5,853	91	181	0	0	15	62	77	5,930	76,824	207	116	
6,083 6,318	925 961	31 32	6,083	94	188 196	0	0	16	64 66	80 82	6,162 6,400	76,530 76,234	206 205	116 115	
6,318	961	32	6,318 6,558	101	203	0	0	16 17	68	82	6,400	76,234	205	115	
0,000	991	34	0,000	101	203	U	U	17	00	CO	0,043	10,937	204	115	

Total CVWMC LF GHGs - 40 years 177,981 tonnes CO2e

Total TS GHGs - 40 years 12,529 tonnes CO2e

TBL-2018-02-01-CVRD WTE Options GHG Analysis-er-5171574:Option 3(b) Sustane CR

Net Transfer Station Emissions Hauling + Operations tonnes CO ₂ e	Year					
	0	2011				
0	1	2012				
0	2	2013				
0	3	2014				
338	4	2015				
342	5	2016				
346	6	2017				
356	7	2018				
354	8	2019				
353	9	2020				
352	10	2021				
351	11	2022				
350	12	2023				
349	13	2024				
348	14	2025				
347	15	2026				
346	16	2027				
345	17	2028				
344	18	2029				
343	19	2030				
342	20	2031				
342	21	2032				
341	22	2033				
340	23	2034				
340	24	2035				
338	25	2036				
337	26	2037				
336	27	2038				
335	28	2039				
333	29	2040				
332	30	2041				
331	31	2042				
330	32	2043				
328	33	2044				
327	34	2045				
326	35	2046				
324	36	2047				
323	37	2048				
322	38	2049				
320	39	2050				
319	40	2051				

Table F10: GHG assessment of Option 3(c) - Sustane located in Gold River

		Bio-diesel GHG				
		Bio-diesel Co	Combustion GHG			
Ye	əar	0.12 tonnes CO₂e per tonne throughput	Total GHG CO₂e			
		tonnes CO ₂	tonnes CO ₂ e			
0	2017	0	0			
1	2018	0	0			
2	2019	0	0			
3	2020	0	0			
4	2021	3,513	3,513			
5	2022	3,553	3,553			
6	2023	3,592	3,592			
7	2024	6,116	6,116			
8	2025	6,116	6,116			
9	2026	6,116	6,116			
10	2027	6,116	6,116			
11	2028	6,116	6,116			
12	2029	6,116	6,116			
13	2030	6,116	6,116			
14	2031	6,116	6,116			
15	2032	6,116	6,116			
16 17	2033	6,116 6,116	6,116 6,116			
17	2034 2035	6,116	6,116			
19	2035	6,116	6,116			
20	2030	6,116	6,116			
20	2037	6,116	6,116			
22	2030	6,116	6,116			
23	2033	6,116	6,116			
24	2040	6,116	6,116			
25	2041	6,116	6,116			
26	2042	6,116	6,116			
27	2044	6,116	6,116			
28	2045	6,116	6,116			
29	2046	6,116	6,116			
30	2047	6,116	6,116			
31	2048	6,116	6,116			
32	2049	6,116	6,116			
33	2050	6,116	6,116			
34	2051	6,116	6,116			
35	2052	6,116	6,116			
36	2053	6,116	6,116			
37	2054	6,116	6,116			
38	2055	6,116	6,116			
39	2056	6,116	6,116			
40	2057	6,116	6,116			

Electricity Generation and Offsets - Sustane						
Metal - ferrous	Metal - Non- Ferrous	Plastics				
3% of Throughput CO ₂ e Offset	1.8% of throughput CO2e Offset	7% of Throughout CO₂e Offset				
tonnes	tonnes	tonnes				
0	0	0				
0	0	0				
0	0	0				
0	0	0				
1,739	5,275	1,947				
1,759	5,334	1,969				
1,778	5,394	1,991				
3,027	9,182	3,389				
3,027	9,182	3,389				
3,027	9,182	3,389				
3,027	9,182	3,389				
3,027	9,182	3,389				
3,027	9,182	3,389				
3,027	9,182	3,389				
3,027	9,182	3,389				
3,027	9,182	3,389				
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3,027	9,182	3,389				
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3,027	9,182	3,389				
3,027	9,182	3,389				
3,027	9,182	3,389				
3,027	9,182	3,389				
3,027	9,182	3,389				
3,027	9,182	3,389				
3,027	9,182	3,389				
3,027	9,182	3,389				
3,027	9,182	3,389				

Net Sustane Emissions	Methane	-						
	Volume	Methane Collected	Methane Destroyed	Methane not Collected & Destroyed	Methane Oxidized	Total Methane Emitted	Tonnes Methane Emitted	Tonnes Methane Destroyed
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	m³/year	m³/year	m³/year	m³/year	m³/year	m³/year	tonnes CH ₄	tonnes CH ₄
0								
0	603,415	452,561	448,036	155,379	15,085	140,294	94	299
0	1,151,150	863,363	854,729	296,421	28,779	267,642	179	570
0	1,648,886	1,236,665	1,224,298	424,588	41,222	383,366	256	817
-5,448	2,101,822	1,576,367	1,560,603	541,219	52,546	488,674	326	1,041
-5,509	1,903,852	1,427,889	1,413,610	490,242	47,596	442,646	295	943
-5,571	1,726,738	1,295,054	1,282,103	444,635	43,168	401,467	268	855
-9,483	1,568,311	1,176,234	1,164,471	403,840	39,208	364,632	243	777
-9,483	1,441,445	1,081,084	1,070,273	371,172	36,036	335,136	224	714
-9,483	1,333,075	999,806	989,808	343,267	33,327	309,940	207	660
-9,483	1,243,625	932,719	923,391	320,233	31,091	289,143	193	616
-9,483	1,170,967	878,225	869,443	301,524	29,274	272,250	182	580
-9,483	1,113,256	834,942	826,593	286,664	27,831	258,832	173	551
-9,483	1,068,824	801,618	793,602	275,222	26,721	248,502	166	529
-9,483	1,036,116	777,087	769,316	266,800	25,903	240,897	161	513
-9,483	1,013,762	760,322	752,719	261,044	25,344	235,700	157	502
-9,483	1,000,558	750,419	742,915	257,644	25,014	232,630	155	496
-9,483	995,454	746,591	739,125	256,329	24,886	231,443	154	493
-9,483	997,272	747,954	740,474	256,798	24,932	231,866	155	494
-9,483	1,005,157	753,867	746,329	258,828	25,129	233,699	156	498
-9,483	1,018,439	763,829	756,191	262,248	25,461	236,787	158	504
-9,483	1,036,364	777,273	769,500	266,864	25,909	240,955	161	513
-9,483	1,058,292	793,719	785,782	272,510	26,457	246,053	164	524
-9,483	1,083,680	812,760	804,632	279,048	27,092	251,956	168	537
-9,483	1,112,085	834,063 857,344	825,723 848,771	286,362	27,802 28,578	258,560 265,777	172 177	551
-9,483	1,143,126			294,355				566
-9,483	1,179,018	884,263 914,495	875,421 905,350	303,597	29,475 30,483	274,122	183 189	584 604
-9,483 -9,483	1,219,326 1,263,663	914,495	938,270	313,976 325,393	30,483	283,493 293,802	189	626
-9,483	1,263,663	947,747 983,761	973,923	325,393	31,592	293,802 304,966	203	
-9,483	1,311,681	1,022,303	1,012,080	337,758	32,792	304,966	203	650 675
-9,483	1,363,071	1,022,303	1.052.534	365.020	35,439	329,581	211	702
-9,483	1,417,554	1,106,163	1,095,101	379,783	36,872	342,911	220	702
-9,483	1,474,884	1,151,129	1,139,618	395,221	38,371	356,850	229	760
-9,483	1,597,221	1,197,916	1,185,936	411.284	39,931	371,354	238	791
-9,483	1,661,855	1,246,391	1,233,927	411,284	41,546	386,381	248	823
-9,483	1,728,583	1,296,437	1,283,473	445,110	43,215	401,895	268	856
-9,483	1,797,265	1,347,949	1,334,469	462,796	44,932	401,895	208	890
-9,483	1,797,203	1,400,833	1,386,824	480,953	46,694	434,258	279	925
-9,483	1,940,008	1,400,833	1,440,456	499,552	46,694 48,500	434,256	301	925
-9,483	2,013,858	1,510,394	1,495,290	518,568	50.346	468.222	312	997

Total Technology GHGs - 40 years -338,954 tonnes CO₂e

Table F10: GHG assessment of Option 3(c) - Sustane located in Gold River

LFG	GHG Emissions	Summary - CVW	/MC	EI	Electricity Generation and Offsets - CVWMC LF Landfill Operations - CVWMC LF		WMC LF		Transfer St	Transfer Station Hauling and Operations				
CO ₂ e Methane Emitted	CO ₂ from Methane Destruction	CO ₂ from Oxidized Methane	Total GHG Emissions from LFG	Total Gas Collected		Energy Generation	BC Electricity Offset	Buildings - Fuel and Electricity	Landfill Equipment	GHGs from Landfill Operations	CVWMC LF Emissions	Fuel Consumption	Waste Hauling	Transfer Station Operations
21 x Tonnes Emmitted	1 Tonne for Every Tonne Destroyed	1 Tonne for Every Tonne Oxidized	Sum of GHG Emissions	From LandGEN	200 kW per 100 ft ³ /min	Based on Operation 91% of the Year	BC Hydro Offset of 22 Tonnes CO ₂ e per GWh	0.001 Tonnes CO₂e per Tonne Waste	0.004 Tonnes CO₂e per Tonne Waste	Buildings and Equipment	LFG - Electricity Offset + Operations	2.4 L/tonne	0.00269 Tonnes CO₂e / L	0.0044 Tonnes CO ₂ e / Tonne Waste
tonnes CO ₂ e	tonnes CO ₂	tonnes CO ₂	tonnes CO ₂ e	ft³/min	kW	GWh / year	tonnes CO ₂ e	tonnes CO ₂ e	tonnes CO ₂ e	tonnes CO₂e	tonnes CO ₂ e	L	tonnes CO₂e	tonnes CO ₂ e
				0	0	0	0	36	144	180	180	0	0	0
1,965	299	10	1,965	30	61	0	0	36	146	182	2,147	0	0	0
3,749	570	19	3,749	58	116	0	0	37	147	184	3,933	0	0	0
5,370	817	27	5,370	83	166	0	0	37	149	186	5,556	0	0	0
6,845	1,041	35	6,845	106	212	0	0	1	5	6	6,851	207,833	559	129
6,200	943	32	6,200	96	192	0	0	1	5	6	6,206	210,160	565	130
5,623	855	29	5,623	87	174	0	0	1	5	6	5,629	212,512	572	132
5,107	777	26	5,107	79	158	0	0	2	8	10	<u>5,118</u> 4,707	310,112	834 833	224
4,694	714 660	24 22	4,694 4,341	73 67	145 134	0	0	2	10 12	12 15	4,707	309,828 309,554	833	224 224
4,341	616	22	4,341	63	134	0	0	3	12	15	4,067	309,295	832	224
3,813	580	21	3,813	59	125	0	0	4	14	19	3,833	309,044	831	224
3.625	551	19	3,625	56	112	0	0	4	17	21	3,647	308,799	831	224
3,481	529	18	3,481	54	108	0	0	5	19	23	3,504	308,566	830	224
3.374	513	17	3.374	52	100	0	0	5	20	26	3.400	308.342	829	224
3.301	502	17	3.301	51	102	0	0	6	22	28	3,329	308,127	829	224
3,258	496	17	3,258	50	101	0	0	6	24	30	3,288	307,919	828	224
3,242	493	17	3,242	50	100	0	0	6	25	31	3,273	307,733	828	224
3,248	494	17	3,248	50	101	0	0	7	27	33	3,281	307,553	827	224
3,273	498	17	3,273	51	101	0	0	7	28	35	3,309	307,377	827	224
3,317	504	17	3,317	51	103	0	0	7	30	37	3,354	307,212	826	224
3,375	513	17	3,375	52	104	0	0	8	31	39	3,414	307,056	826	224
3,446	524	18	3,446	53	107	0	0	8	32	40	3,487	306,907	826	224
3,529	537	18	3,529	55	109	0	0	8	34	42	3,571	306,764	825	224
3,622 3,723	551 566	19 19	3,622 3,723	<u> </u>	<u> </u>	0	0	9	35 37	44 46	3,665 3,769	306,620 306,344	825 824	224 224
3,723	584	20	3,723	58	115	0	0	10	39	40	3,888	306,344	823	224
3,971	604	20	3,971	61	123	0	0	10	41	51	4,022	305,789	823	224
4,115	626	20	4,115	64	123	0	0	10	41	54	4,169	305,509	822	224
4,272	650	22	4,272	66	132	0	0	11	45	56	4,328	305,228	821	224
4,439	675	23	4,439	69	137	0	0	12	47	59	4,498	304,945	820	224
4,616	702	24	4,616	71	143	0	0	12	49	61	4,678	304,661	820	224
4,803	730	25	4,803	74	149	0	0	13	51	64	4,867	304,375	819	224
4,998	760	26	4,998	77	155	0	0	13	53	66	5,065	304,088	818	224
5,202	791	27	5,202	80	161	0	0	14	55	69	5,270	303,800	817	224
5,412	823	28	5,412	84	167	0	0	14	57	72	5,484	303,510	816	224
5,629	856	29	5,629	87	174	0	0	15	59	74	5,704	303,219	816	224
5,853	890	30	5,853	91	181	0	0	15	62	77	5,930	302,926	815	224
6,083	925	31	6,083	94	188	0	0	16	64	80	6,162	302,632	814	224
6,318	961	32	6,318	98	196	0	0	16	66	82	6,400	302,336	813	224
6,558	997	34	6,558	101	203	0	0	17	68	85	6,643	302,039	812	224

Total CVWMC LF GHGs - 40 years 177,981 tonnes CO2e

Total TS GHGs - 40 years 37,725 tonnes CO2e

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Station Emissions Hauling + Operations tonnes CO ₂ e	Year					
	0	2011				
0	1	2012				
0	2	2013				
0	3	2014				
688	4	2015				
696	5	2016				
703	6	2017				
1,058	7	2018				
1,058	8	2019				
1,057	9	2020				
1,056	10	2021				
1,056	11	2022				
1,055	12	2023				
1,054	13	2024				
1,054	14	2025				
1,053	15	2026				
1,053	16	2027				
1,052	17	2028				
1,052	18	2029				
1,051	19	2030				
1,051	20	2031				
1,050	21	2032				
1,050	22	2033				
1,049	23	2034				
1,049	24	2035				
1,048	25	2036				
1,048	26	2037				
1,047	27	2038				
1,046	28	2039				
1,045	29	2040				
1,045	30	2041				
1,044	31	2042				
1,043	32	2043				
1,042	33	2044				
1,041	34	2045				
1,041	35	2046				
1,040	36	2047				
1,039	37	2048				
1,038	38	2049				
1,038 1,037	39 40	2050 2051				