FINAL REPORT
Feasibility Assessment of Food Waste Collection and Processing

Presented to:

Clarke Kruiswyk
Regional District of Central Okanagan
1450 KLO Road
Kelowna, BC, Canada V1W 3Z4

Report No. 220151600
November 30, 2022

EXECUTIVE SUMMARY

Residents in the Regional District of Central Okanagan (RDCO) and the member municipalities currently do not source segregate food waste through a separate curbside collection like many other places do across BC. The food waste is instead collected mixed with the residual waste destined for landfilling at Glenmore Landfill where landfill gas (LFG) is captured and processed into renewable natural gas (RNG) by FortisBC.

The RDCO undertook a Life Cycle Assessment (LCA), which was published in 2012 to determine the most sustainable way to manage organic waste within the region. The study found that the introduction of a food waste collection program and the establishment of an in-region organics processing facility was unlikely to provide benefits over the region's 2010 status quo waste management practices. The RDCO decided to continue sending food waste to the landfill where LFG is captured for energy recovery but made a commitment in RDCO's Solid Waste Management Plan (SWMP), which was approved in 2020, to re-evaluate organic waste diversion opportunities in the future.

There are now more organics processing facilities available within or near the RDCO and a growing number of residents have been enquiring about organics management options. These factors and the RDCOs' commitment to reducing greenhouse gas (GHG) emissions have prompted the RDCO to revisit the feasibility of food waste collection and processing. Is current practice still the most cost effective and environmentally sustainable option for the region?

Morrison Hershfield (MH) was engaged to undertake a feasibility assessment of food waste collection and processing in the RDCO. The study was conducted in two phases:

Phase 1 involved the review of the current situation for organics management in the RDCO, and collection/processing options.

Phase 2 involved a comparison of selected feasible options against current practice using criteria such as environmental (GHG emissions), financial (system costs), social (impacts on local community and user convenience).

Food Waste Collection Options Assessed

MH reviewed collection and processing options for food waste from the residential sector. Multi-family dwellings are currently not serviced by the RDCO's curbside collection program. Apartments, condominiums and stratified properties are serviced by private collectors on a subscription-basis, similar to the industrial, commercial, or institutional (ICI) sector. Since there are already private collectors/haulers in the region servicing the ICI sector, including MF residents, MH recommended limiting the feasibility study to food waste from currently serviced residents only. Rather than competing with the private service providers, the RDCO can instead influence the ICI sector to divert organics by implementing organics waste bans or differential tipping fees in the future.

MH developed three scenarios as feasible food waste collection options that were considered in the feasibility assessment as shown in the table below.

Table ES1: Three Potential Scenarios to Consider in the Feasibility Assessment

	Status Quo – Automated Yard Waste Collection	1: Manual Food Waste & Automated Yard Waste Collection	2: Automated Food & Yard Waste (Commingled) Collection	3: Kitchen Composting – No Food Waste Collection
Collection Container(s)	Yard waste cart	Kitchen catcher 55 L bin RDCO branded Yard waste in current carts	Kitchen catcher Existing yard waste cart	Kitchen appliance
Collection Method	Automated *Contracted*	Manual *The service is assumed to be contracted out*	Automated *The service is assumed to be contracted out*	*Primarily backyard application was assumed (no transportation required)*
Collection Frequency	Yard waste bi-weekly *(no service in winter)*	Food waste weekly Yard waste bi-weekly *(no service in winter)*	Weekly	Not applicable
Wildlife Resistance	None required	Not available for manual bins	Potential for retrofitted locks	Not applicable
Transfer Station Requirement	None required	Yes	Yes	No
Processing Technology	Yard waste to Glenmore Compost Facility	Food waste to third-party processing facility Yard waste to Glenmore Compost Facility	Commingled waste to third-party processing facility	In-kitchen (onsite)
Impact on Other Curbside Services	No impact. Remains as weekly Garbage	Bi-weekly Garbage	Bi-weekly Garbage	Bi-weekly Garbage

In the second phase of the study, MH developed waste flows for these three scenarios to the year 2047 (a 25-year period) to understand the waste streams and related quantities generated in the RDCO. A range of performance indicators were assessed in four evaluation categories: financial, environmental, social and policy-related areas, either qualitatively (subjectively) or quantitatively. Together with the RDCO, and with input from Solid Waste Technical Advisory Committee, MH determined a weighting for each indicator based on their relative level of importance.

Results and Discussion

The table below shows the weighted scoring for the status quo and the three diversion scenarios. The assessment showed that the status quo offers the lowest cost option when there are no changes to the existing services. However, once all the other financial, environmental, and social indicators are taken into account, Scenario 2 with a commingled collection of food and yard waste, is the highest ranked option, followed by the status quo, and with the manual food waste collection is third. To provide individual kitchen composting appliances to all households scored the worst of all four scenarios in the weighted results.

Table ES2: Overall Assessment Results - Weighted

Focus Area	Indicator (Weighting%)	Status Quo	Scenario 1	Scenario 2	Scenario 3
Financial	Life-Cycle Costs (25%)	1.25	0.92	0.87	0.80
	Financial Confidence (5%)	0.20	0.10	0.15	0.05
Environmental	GHG Impact (25%)	0.71	0.90	1.06	1.25
	Soil Quality Impacts (5%)	0.10	0.25	0.20	0.15
	Air and Water Quality Impacts (5%)	0.15	0.10	0.15	0.20
Social	Local Employment (5%)	0.10	0.25	0.20	0.05
	Odour, Noise, and Transportation Impacts (5%)	0.15	0.05	0.10	0.25
	Convenience to Residents (15%)	0.75	0.45	0.60	0.30
Policy & Adaptability	Contribution to RDCO Waste Policy (4%)	0.08	0.16	0.20	0.12
	Adaptability to Meet Future Needs (3%)	0.09	0.12	0.12	0.15
	Risk (3%)	0.06	0.12	0.12	0.06
	Total	**3.64**	**3.42**	**3.77**	**3.38**
	Rank	**2**	**3**	**1**	**4**

The life cycle costs and GHG impacts were assessed quantitatively, and these two indicators had the highest weighting.

Life-Cycle Costs

The life cycle costs for each scenario were analyzed over a 25-year period. The net present value was calculated for each scenario to give a simple method for comparison. The status quo scenario provides the lowest cost as there are no additional services being provided. The average annual additional cost per household resulting from Scenarios 1, 2 and 3 are $53, $63, and $83. These costs to the RDCO from each scenario are expressed on a per-household basis. The third scenario with the use of a kitchen composting appliance would result in an additional cost of $15 in annual electricity costs from appliance use, which would be paid by residents.

The status quo scenario provides the lowest cost at $9.3 million per year over the 25 years which does not result in any additional cost to households compared to current costs. Scenario 1 (a weekly manual food waste collection) is estimated to cost $3.3 million per year (35%) more than the status quo cost over the 25-year period.

Scenario 2 (weekly commingled food and yard waste collection) is estimated to cost $4.0 million per year (43%) more than the status quo. Scenarios 1 and 2 include capital costs for the transfer station, land purchase and operating costs. Organics hauling costs and tipping fees are higher in Scenario 2 than in Scenario 1 as larger quantities of commingled food and yard waste are sent to a third-party processor and yard waste is no longer composted for free at the Glenmore Landfill.

Scenario 3 (no collection due to use of kitchen composting appliances) is estimated to cost $5.3 million per year (57%) more than the status quo. This scenario is costly due to a large initial investment for providing serviced households with one unit each. The annual maintenance costs to replace filters, etc. also adds to the high life-cycle costs.

A sensitivity analysis was completed for potential scenarios affecting the feasibility assessment outcome, including a change in yard waste tipping fee at the Glenmore Landfill, tipping fee changes for food, and commingled food and yard waste, land purchasing cost for a transfer station site, and the assumed cost of the kitchen composting appliance.

GHG Impacts

GHG emissions resulting from status quo and the three alternative scenarios were assessed and given a net GHG emission over the 25-year project evaluation period. Net emissions were calculated for each scenario. The emissions categories common through all scenarios include LFG emissions (landfill and flare), curbside collection emissions, and emissions associated with the composting process. Emissions reductions exist through the RNG production and carbon sequestration from the compost product.

The status quo results in the highest GHG emissions largely due to the impact of higher LFG production. The status quo had the highest RNG production. Scenario 3 shows the lowest GHG emissions as food waste is diverted from landfill with less waste collection and transfer emissions using the kitchen composting appliance. Scenarios 1 and 2 have less GHG impacts than the status quo with emission reductions from their compost carbon sequestration potential. These scenarios had GHG emissions from additional collection, transfer station operations and waste hauling when compared to the status quo.

Study Comparisons

Why are these results different than the 2012 LCA study? The 2012 LCA study considered all organic materials, including wood waste, paper, and cardboard and biosolids, as well as food and yard waste. However, the key difference in the approach between the studies lies in the assumption of ownership of the food waste processing facility. In the 2012 LCA it was assumed that a new organics processing facility would be established in the region to process the segregated food waste. The report does not state the assumed facility location. Since this option is compared to an already established engineered landfill, any option involving new composting infrastructure is likely to be more expensive. The LCA study notes that capital and operating costs for the baseline scenario are low, as the additional capital investment required is marginal in comparison to other scenarios. If the RDCO sends segregated food waste to an already established private sector facility, which is assumed by for this feasibility study, the costs and other impacts associated with the construction of a new facility are not applicable.

The diversion of organic municipal waste materials (i.e., food and yard waste) has been a growing focus throughout Canada. Organics diversion is often driven by the goals of reducing GHG emissions, preserving landfill capacity and producing a beneficial end product such as compost that can improve soil health when applied to land. The Ministry of Environment and Climate Change Strategy has set a target to have 75% of BC’s population covered by organic waste disposal restrictions.

With food waste being source separated and diverted from Glenmore Landfill, LFG production and related GHG emissions from the landfill would be reduced as there will be less decaying organic material landfilled. This will affect the LFG available for RNG production in the FortisBC processing plant. However, much of the organic waste will still continue to generate LFG. Food waste that is not successfully source segregated (captured) through the residential food waste curbside collection will continue to generate LFG, together with non-diverted organic waste from the ICI sector and MF buildings. There is also other residual waste which is classified as moderately decomposable that will also generate LFG. These will still provide a source for RNG production, and the City of Kelowna will still need to maintain existing landfill gas collection infrastructure.

Recommended Steps

With these results, it is recommended that the RDCO reconsider the collection of residential food waste as part of the current yard waste collection program. The report identifies some important steps in pursuing food waste diversion in the RDCO in the near future. Considerations are outlined below.

Resident Engagement: The RDCO's SWMP includes a commitment to ensure that the organics diversion option should be socially acceptable. Therefore, it is important for the RDCO to engage residents prior to implementing any overall system changes to receive confirmation that residents are wanting a curbside collection to also include food waste. For the engagement, the RDCO will need to convey the anticipated cost of the additional food waste collection service.

Contractor Engagement: The inclusion of food waste into the existing yard waste collection program will have some contractual implications. The RDCO is advised to reach out to the contractor to gauge their willingness to change the service, and to assess the cost/timing of expanding the current bi-weekly yard waste collection to a weekly collection for food and yard waste year-around and reducing garbage collection to bi-weekly.

Long term, the RDCO may also want to consider piloting suitable organics diversion solutions for the multi family and business sector. Depending on sector needs the use of commercial scale "kitchen composting" units or the smaller kitchen composting units can be considered as a pilot.

TABLE OF CONTENTS

Page

LIST OF FIGURES

LIST OF TABLES

APPENDICES

1. STUDY BACKGROUND AND SCOPE

Food waste from residents in the Regional District of Central Okanagan (RDCO) and the member municipalities is currently not source segregated and collected at the curb. It is mixed with the residual waste destined for landfilling at Glenmore Landfill. At the City of Kelowna-owned and operated landfill, landfill gas (LFG) is processed through the Fortis Biogas Plant for beneficial use as renewable natural gas (RNG) by FortisBC. FortisBC owns and operates the biogas upgrading plant. Yard waste collected at the curb or self-hauled to the Glenmore Landfill is composted.

In 2011 the RDCO commissioned SLR to undertake a Life Cycle Assessment (LCA) to determine the most sustainable way to manage organic waste within the region. According to the LCA study published in 2012, the organics management methods that were utilized by the RDCO in 2010 represented the highest scoring option when compared to other alternative treatment methods. The LCA focused on a number of environmental, social, financial and policy indicators which were assessed through qualitative or quantitative means. The 2012 study considered all organic materials, including wood waste, paper, and cardboard and biosolids, as well as food and yard waste.

Food Waste: Food scraps, like fruit and vegetable peels, meat, bones, fats, cooked food leftovers, etc.

Yard Waste: Organic waste materials of yard and garden origin.

Both food and yard wastes are organic waste of residential or ICI origin.

Based on the 2012 LCA study, the introduction of a segregated food waste collection program and the establishment of an organics processing facility in-region was unlikely to provide benefits over the RDCO's 2010 waste management practices (i.e., sending food waste to landfill where LFG is captured for energy recovery). However, in the RDCO's Solid Waste Management Plan (SWMP), which was approved by the Ministry of Environment and Climate Change Strategy (MOECSS) in February 2020, the RDCO committed to re-evaluating organic waste diversion opportunities in the future.

The diversion of organic municipal waste materials (i.e., food and yard waste) through composting and anaerobic digestion (AD) has been a growing focus throughout Canada. Organics diversion is often driven by the goals of reducing GHG emissions, preserving landfill capacity and producing a beneficial end product, such as compost, which can improve soil health when applied to land. In Canada, 91% of Canada's population lives in an area with some type of organics management program and 71% live in an area with curbside collection of food waste. Limited landfill space, challenges in developing new landfill capacity and, more recently, national, and more local goals to reduce greenhouse gas (GHG) emissions have all contributed to the adoption of policies and programs that have increased organic waste diversion[1]. The Province of BC has been pushing for organics diversion at many levels. MOECCS has set a target to have 75% of BC's population covered by organic waste disposal restrictions. The federal government has also set a target of reducing emissions from the use of fertilizers by 30 per cent below 2020 levels by 2030. The practice of replacing synthetic fertilizer with compost, or digestate has the potential to reduce emissions by 10-20%[2].

Since the LCA study was completed in 2012, there are now more available organics processing facilities within or near the RDCO. There have also been an increasing number of resident enquiries about organics management options. These enquiries and the RDCOs' commitment to reducing greenhouse gas (GHG emissions) have prompted the RDCO to revisit the feasibility of food waste collection and processing. Is current practice still the most cost effective and environmentally sustainable option for the Region?

This study was conducted in two phases, with each phase resulting in a technical memorandum (memo).

- PHASE 1: Review of Current Situation, Collection and Processing Options
- PHASE 2: Feasibility Study

Phase 1 involved the review of the current situation for organics management in the RDCO, and collection/processing options. Phase 2 involved a comparison of selected feasible options against current practice using criteria such as environmental (GHG emissions), financial (system costs), social (impacts on local community and user convenience). This Study Report summarizes the findings of both phases and provides a recommendation on whether a new food waste collection and diversion program is desirable and feasible. These findings will be discussed with the Solid Waste Technical Advisory Committee, which will make a recommendation to the RDCO Board.

2. CURRENT SITUATION

2.1 Current Food and Yard Waste Management Practices

2.1.1 Curbside Collection

A fully automated curbside collection service is provided to the majority of single family (SF) households for recycling, garbage and yard waste. Environmental 360 Solutions (E360S) is contracted to provide the three-stream curbside collection in the Central Okanagan region using automated compressed natural gas (CNG) trucks. The contract between the contractor and the RDCO and each member municipality expires on April 30, 2026. E360S is paid a per-household rate by the RDCO and

[1] The State of Practice of Organic Waste Management and Collection in Canada State of the Art report, Environmental Research and Education Foundation of Canada (EREF-Canada) (2021) accessible via URL: https://www.waste.ccacoalition.org/document/state-practice-organic-waste-management-and-collection-canada

[2] Government of Canada Discussion Document: Reducing emissions arising from the application of fertilizer in Canada's agriculture sector, August 16, 2022.

each member municipality (to cover collection and cart management). Table 1 shows the number of households (residential dwellings) serviced by the curbside collection as of February 2022.

According to the RDCO Solid Waste Management Regulation Bylaw No. 1253, a "Residential Dwelling Premise" means an individual dwelling unit with direct access to and from the outdoors, which could include single-family dwellings, two family dwellings, residential triplexes or fourplexes, manufactured homes, or individually serviced units of apartments or condominiums. For clarification, Residential Dwelling Premise does not include, for the purposes of this bylaw, stratified properties to which access to each individual unit is only available via common strata property.

Management of residential recyclables in BC is overseen by an Extended Producer Responsibility (EPR) program which was approved by the Province in 2013. Recycle BC is the stewardship organization for end-of-life packaging and printed paper (PPP) and the RDCO receives financial incentives to collect recycling on its behalf. The costs to collect residential recycling are covered through a financial incentive received from Recycle BC.

The current contract with Recycle BC is valid until December 2024. The RDCO is contracting E360S to undertake the recycling collection.

Table 1: Total Households Serviced by Curbside Collection (February 2022)

Area	No. of Households
City of Kelowna	40,924
District of Lake Country	5,318
District of Peachland	2,583
City of West Kelowna	11,677
RDCO Electoral Areas	1,748
Total	**62,250**

Garbage is collected weekly. Recycling and yard waste is collected bi-weekly (every-other-week). Yard waste is collected from March to December.

Each serviced household is provided one 240L cart for yard waste but has the option to upgrade to a 360L cart. Households also have the option to pay for up to two additional 360 L yard waste carts. In 2022 approximately 15% of households have upsized their yard waste carts and 2% of households have multiple yard waste carts.

Residents in the North Westside area do not receive curbside collection, but registered users may drop off garbage, yard waste, and recyclables at the local Trader’s Cove or North Westside Road transfer stations. A total of 1,239 households were serviced by the transfer stations at Trader’s Cove (248 households) and North Westside (991 households) as of June 2022.

Table 2 shows the current user fees set by the RDCO and each member municipality for the garbage, yard waste, and recycling curbside collection services.

Table 2: Curbside Collection User Fees (February 2022)

Area	Annual User Fees Per hh (Default Cart Sizes)
City of Kelowna	$164
District of Lake Country	$174
District of Peachland	$136
City of West Kelowna	$179
RDCO Electoral Areas	$167

2.1.2 Private Sector Collection

Multi-family (MF) dwellings that are not serviced by the RDCO's curbside collection program (e.g., apartments, condominiums and stratified properties (refer to the definition in the section above) are serviced by private collectors on a subscription-basis, like the industrial, commercial, or institutional (ICI) sectors. In this report, MF buildings are included when this report refers to the ICI sector. These private collectors often offer a range of services including waste, recycling as well as food and yard waste collection. ICI collection services for food and yard waste are provided by several companies. Valley Pro Recycling takes only small amounts of food waste (approximately 1 tonne per week) from ICI generators at a pick-up fee $23 for 65 gallons of food waste[3].

LC (Lake Country) Compost is a small local business offering residential and commercial food and yard waste collection. The collected organics are processed at Spa Hills composting facility in Salmon Arm. The facility is unable to process meat and dairy. Commercial customers pay a $50.00 one-time registration fee and a collection fee of $15.00 per bin (54 L) per pick up. Residential customers pay a $20 registration fee and weekly pick-up fees of $25 to $30[4].

Spa Hills collects and transports food and yard waste from some ICI customers in the region, to a composting facility located in Salmon Arm. Fees range depending on service levels.

The University of British Columbia and Okanagan College attract many students to Kelowna. Both the university and the college have their own on-site composting, but it is unknown to the RDCO how much food waste is still landfilled from these sources.

Overall, it is unclear to the RDCO how much organics are currently diverted by the ICI sector including MF buildings.

3 Personal communication with Cody Hunt, Valley Pro Recycling, April 14, 2022.

4 April 2022 rates as specified on the website accessible via URL on April 4, 2022: https://www.lccompost.com/

Wildlife Awareness

There were 695 black bear reports in the RDCO in 2021 to BC Conservation Officer Service, which was significantly higher than the annual average of 516 reports from 2016-2020. The West Kelowna and Westbank First Nation areas have the largest proportion of black bear reports with 50% of the overall reports in the Central Okanagan. The increase in black bear reports this year, particularly on the westside, is likely due to a combination of drought conditions that reduced natural food availability and nearby wildfires that resulted in bears needing to move to adjacent habitats. This theory is supported by the higher than usual amount of black bear reports made during August, September, and October when pressure for food resources is highest for bears[5].

To prevent waste related conflicts with wildlife, the RDCO actively promotes responsible waste management to all residents. A WildSafeBC Community Coordinator (WCC) performs outreach activities with the goal of preventing conflict with wildlife in the community. In 2021, The WCC worked with the RDCO Waste Reduction Office to develop bear-in-area signage for the communities of Kelowna and Lake Country, which did not previously have any signage, and supported the bear-resistant garbage bin pilot project, with the end goal of these bins being more widely available to residents. In 2021 the WCC tagged 245 bins and found that 72% of the residences whose bins were tagged during the initial survey were not found on the curb again during the second survey.

The RDCO has tested different certified bear resistant carts for usability by residents and the collector. Although gravity locks are preferred, the RDCO found it difficult to find a provider of 120L carts (only larger sizes). The RDCO has recently ordered 120L Schaefer carts retrofitted with carabiner locks at a per-unit cost of $165. The regional district will distribute 100 bear resistant garbage carts in Spring of 2022. The per-unit cost may be reduced if larger cart quantities are purchased.

WildSafeBC mapping shows a need across the region for bear resistant carts and the cart distribution approach will need to be determined following the pilot.

2.1.3 Yard Waste Drop-Off

Yard waste can also be dropped off at the Westside Residential Waste Disposal and Recycling Centre and at the Glenmore Landfill.

The Westside facility is intended for residential customers only. Yard waste is accepted at volume-based fees with average yard waste revenue of approximately $36 per tonne in 2021.

The Glenmore Landfill accepts yard waste at $40 per tonne, including grass clippings, leaves, hedge clippings, flowers, vegetable stalks, woody and herbaceous wastes and twigs less than five centimetres in circumference. Additional fees[6] are applied for the following:

[5] WildSafeBC Annual Report 2021 Central Okanagan, prepared by: Meg Bjordal, WCC, RDCO.

[6] April 2022 fees for Glenmore Landfill as listed on the City website: https://www.kelowna.ca/city-services/waste/glenmore-landfill/accepted-products-tipping-fees

- Prunings over five centimetres in circumference and less than 20 cm (8") in diameter, with or without leaves or needles attached, are charged at $10 per metric tonne
- Logs, limbs, and branches greater than 20 cm in diameter are accepted at $10 per metric tonne. Logs, limbs, and branches must be cut to a maximum length of 4 feet (no rocks or soil).
- Stumps cut at ground level, with rocks and soil removed from roots, are accepted at $90 per metric tonne.

2.1.4 Backyard Composting

The RDCO promotes backyard composting by subsidizing and distributing different types of composters and information on their use. The RDCO provides advice to residents on wildlife smart measures when selling backyard composting units to residents.

Since 2007, the RDCO has sold over 10,000 backyard composter-units. Over the last ten years an average of 400 units have been sold per year. In addition to backyard composters, the RDCO has sold Green Cone Food Digesters and Worm Bins at subsidized fees. Green Cone systems have been sold since 2015 with an average of approximately 30 units per year. The Worm Bins were only sold from 2015 to 2017.

It is unknown how many residents in the region currently undertake backyard composting. The RDCO believes that some households may have purchased several backyard composters and that residents may also be using other composting systems acquired elsewhere.

2.1.5 Current Organic Diversion

Table 3 provides an overview of organics tonnages diverted from landfilling in the region in 2021. Organics diversion through backyard composting is not included since no information is available about resident uptake and how much is composted.

Table 3: Organics Diversion witin the Region (2021)

Organics Diversion	Tonnes (2021)
Yard waste self-hauled to RDCO's three Transfer Stations	2,687
Yard Waste collected at curbside	15,659
Other Yard waste accepted at Glenmore Landfill	26,987
Total	**45,333**

All yard waste quantities are processed at the composting facility at Glenmore Landfill, which uses a windrow composting process to produce GlenGrow compost.

Figure 1 shows the trend of yard waste quantities collected at the curb and composted at Glenmore Landfill between 2015 and 2021. There was a 1.7% annual increase in curbside yard waste tonnage over this period.

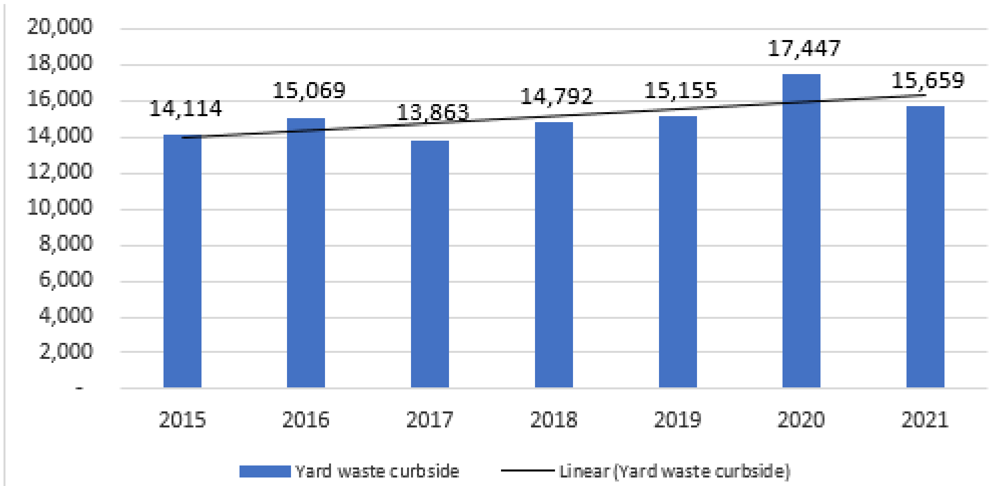

Figure 1: Curbside Yard Waste Quantities Accepted at Glenmore Landfill (2015 -2021)

2.1.6 Organics Management Policies

The RDCO is encouraging waste diversion at the source with differential (variable) tipping fees. For example, yard waste is accepted at Glenmore landfill at $40 per tonne while garbage disposal is $102 per tonne.

The curbside collection service is funded on a user-pay principle. Residents who generate more waste (garbage and yard waste) than the allocated default cart sizes pay more than residents who generate less waste. The residential “Tag-a-bag” program allows for up to two additional bags to be placed with a household’s waste cart for $2.50 per tag. Yard waste carts (refer to Section 2.1.1) can be upgraded from the default size (240L) carts to upgrade to 360L carts and households are able to pay for the use of additional 360 L yard waste carts.

2.2 Current Curbside Collection Costs

The cost of the automated curbside collection of recycling, garbage and yard waste for SF households was $5.5 million in 2021. Additional annual curbside collection costs include the purchase of new carts, which typically range from $350,000 to $470,000 depending on quantities required. Carts are generally ordered once a year to replace worn out carts and to provide new residents carts.

Standard tipping fees are applied to collected curbside garbage ($100 per tonne in 2021), amounting to a total of $3.2 million for the RDCO (assuming 32,082 tonnes of residential curbside garbage).

Although the standard yard waste tipping fee is $40 per tonne, the curbside collected yard waste is not currently charged tipping fees. There is no indication from the City of Kelowna there will be charges for curbside yard waste in the near future.

The City of Kelowna estimates a net yard waste processing cost of approximately $40 per tonne ($50 per tonne processing costs less sales revenue of approximately $10 per tonne). The total net cost to process the 45,333 tonnes of curbside yard waste in 2021, equates to approximately $1.8 million. These costs are covered by compost sales and standard yard waste tipping fees.

The City of Kelowna has a 10-year financial model for the Glenmore Landfill. Based on the model the City sets aside disposal tipping fee revenue based on the expected volumes of waste and expected capital and operating costs. The model ensures that there are always sufficient funds in reserve for the planned capital projects. The landfilling costs in 2021 were estimated to be approximately $100 per tonne of garbage received, which includes $65- $75 per tonne for the construction costs associated with the current landfill cell and the remainder for other site development works. The standard tipping fee for garbage was $100 per tonne in 2021 increasing to $102 per tonne in 2022.

The 2021 City budget included revenue from biogas sold to FortisBC of $367,605 (77,374 GJ of biogas). This revenue partially offsets the costs to install the required landfill gas collection system.

2.3 Current Waste Composition

Waste composition data can be used to estimate the quantity of food waste that could be diverted from landfill disposal. The RDCO undertook waste composition studies in the Fall 2020 and Spring 2021.

Although the Fall 2020 and Spring 2021 results were similar with respect to compostable food waste and soiled paper, it was determined that the waste compositions from Fall 2020 were not as representative of typical RDCO waste streams due to the COVID-19 restrictions affecting ICI waste. With the lock-down restrictions eased in the Spring of 2021, the 2021 waste composition results are assumed to be a better representation of the RDCO waste stream. The ICI waste composition data includes waste collected at MF and ICI locations.

For the analysis undertaken during this study, Morrison Hershfield (MH) altered the original waste composition categories to represent organic materials that would be accepted in a food waste curbside collection. The original “compostable organics” and “paper” categories were divided further. The compostable organics category has been separated into either food waste or yard waste categories, while food soiled paper was removed from the paper category and included under the food waste category, as soiled paper is typically more suitable to manage via composting than recycling.

The figures below illustrate the altered Spring 2021 waste composition percentages for residential curbside garbage collection and ICI waste streams. The compostable food waste and soiled paper represent the waste composition that would typically be captured through a food waste curbside collection program.

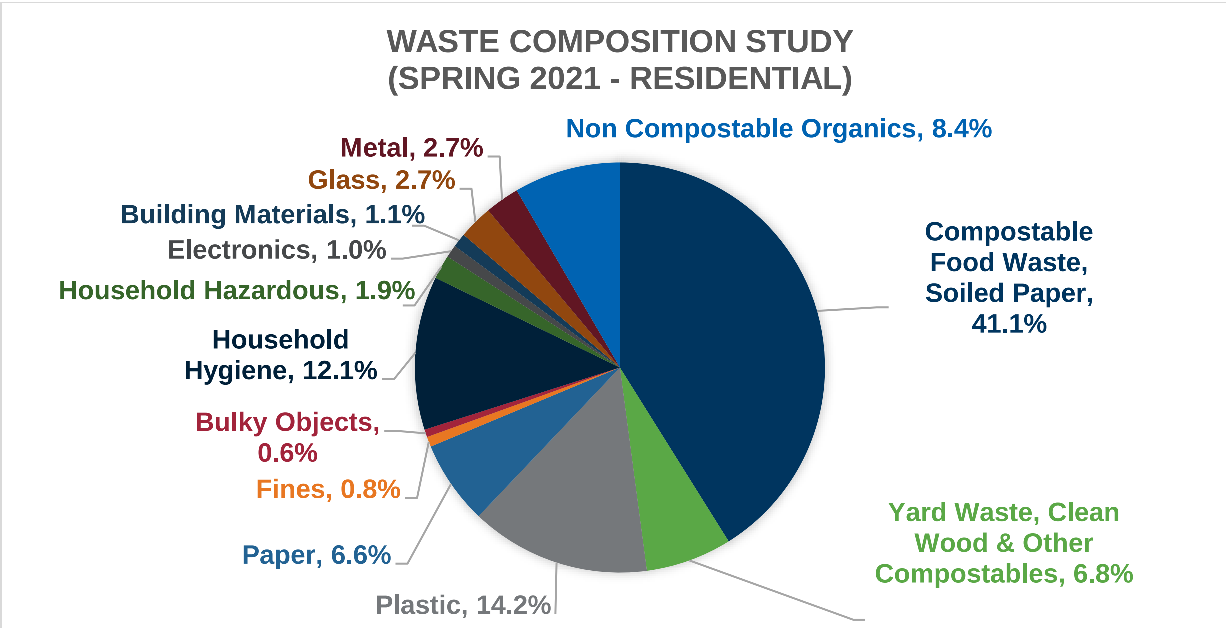

Figure 2: Spring 2021 Waste Composition of Garbage Collected at Curbside from Residents

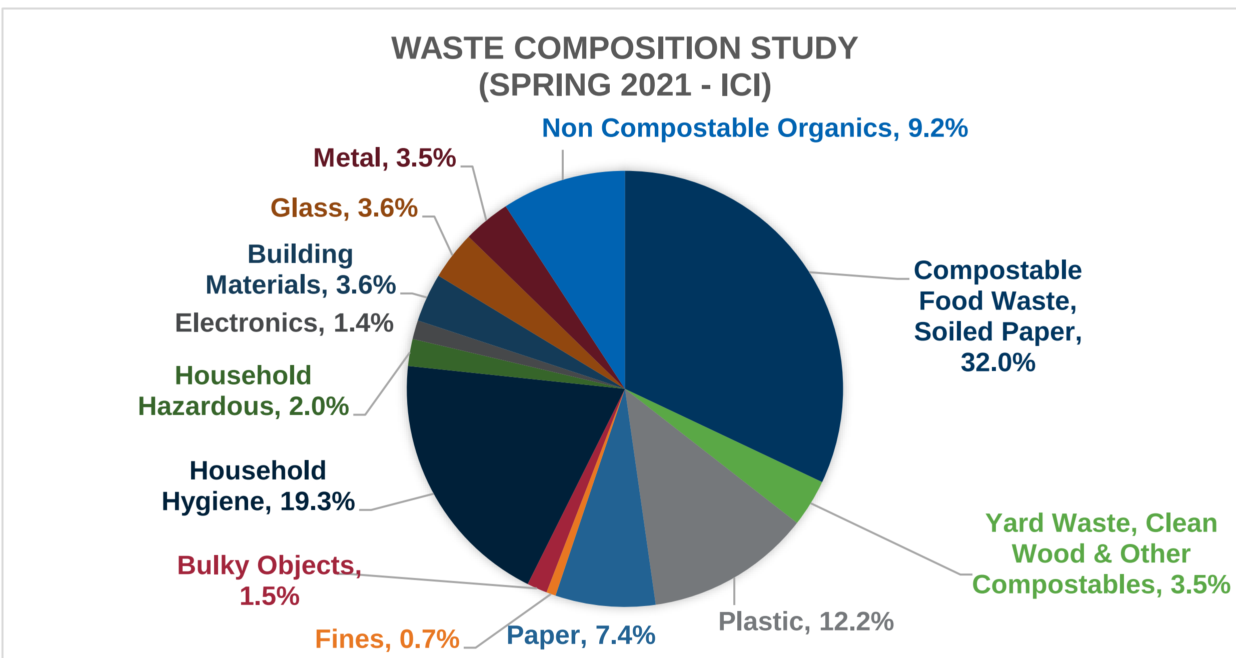

Figure 3: Spring 2021 Waste Composition of ICI Garbage

In the Spring of 2021, compostable food waste was the largest portion of the waste stream at 33% for residential and 25.1% for ICI. Food soiled paper classified as compostable accounted for 8.1% in residential waste and 6.9% in ICI waste. Combining the compostable food waste and food soiled paper, the total compostable food waste available within the curbside residential garbage cart and ICI/MF collection bins were 41.1% and 32.0%, respectively. This information informs MH's organics diversion estimates in Section 5.

2.4 Current Landfill Gas Management

Currently, the landfill gas (LFG) produced at the Glenmore Landfill is managed through the recovery system that collects LFG for utilization and flaring. An agreement with FortisBC allows the collected LFG to be processed into RNG that can be distributed through FortisBC piping infrastructure. The LFG recovery system flares the remainder of collected gas not processed at the FortisBC plant.

The Glenmore Landfill's LFG collection system is externally reviewed on an annual basis and the LFG collection efficiency is reported in the landfill's annual report. The LFG collection efficiency has fluctuated from year to year with a three-year average (2019-2021) calculated at 70.7%. Of the total LFG collected, 68% (three-year average) was then processed into RNG through the FortisBC Biogas Plant, while the remainder was destroyed through on-site flaring. See Table 4 below for the 2019-2021 LFG collection efficiency, RNG production and the portion of LFG flares.

Table 4: LFG collection efficiency at Glenmore Landfill (2019- 2021)

Year	LFG Collection Efficiency (%)	RNG Production (%)	Destroyed Through Flaring (%)
2019	3,826,176 m^3 (70%)	3,416,229 m^3 (89%)	408,947 m^3 (11%)
2020	3,260,697 m^3 (66%)	2,737,570 m^3 (84%)	523,127 m^3 (16%)
2021	3,851,545 m^3 (76%)	1,209,564 m^3 (31%)	2,641,981 m^3 (69%)
Average (%)	**70.7%**	**68%**	**32%**

2.5 RDCO Demographics

The RDCO has a population of 222,162 (2021 census[7]) and is comprised of seven separate areas as shown in the table below. The residents of Westbank First Nation and Central Okanagan West Electoral Area do not have curbside collection.

Table 5: 2021 Population of Each Area

Area	Population (2021 Census)	% of Population
City of Kelowna	144,576	66%
District of Lake Country	15,817	7%
District of Peachland	5,789	3%
City of West Kelowna	36,078	16%

[7] StatsCan 2021 Census

Area	Population (2021 Census)	% of Population
First Nations Reserves, including Westbank First Nation with the largest reserve areas (Tsinstikeptum IR9 and IR10)	10,900	5%
Central Okanagan West Electoral Area	2,897	1%
Central Okanagan East Electoral Area (formerly Joe Rich – Ellison)	3,316	2%

The RDCO has experienced long term population growth since the mid-80s. According to Census data, the region's population increased by 14% since 2016 to 222,162 in 2021[8]. MH applied these population projections to the actual 2021 population and projected that the region's population will continue to grow to 307,367 by 2047.The average population growth between 2021 and 2047 is estimated at 1.25% annually.

As reported in the 2021 by the Central Okanagan Economic Development Commission[9], 2021 census data showed that the region had 94,335 occupied private dwellings. Figure 4 illustrates the break-down of dwelling types. Approximately 50% of all occupied dwellings are single detached houses. The average household size is 2.3 persons per household[10].

[8] BC Stats – RDCO with projections for 2021 onwards.
[9] 2021 Census Dwelling highlights available via URL: https://www.investkelowna.com/application/files/1516/5176/3868/2021_Dwelling_Census_Highlights.pdf
[10]The Economic Development Commission, available via URL: https://data.investkelowna.com/

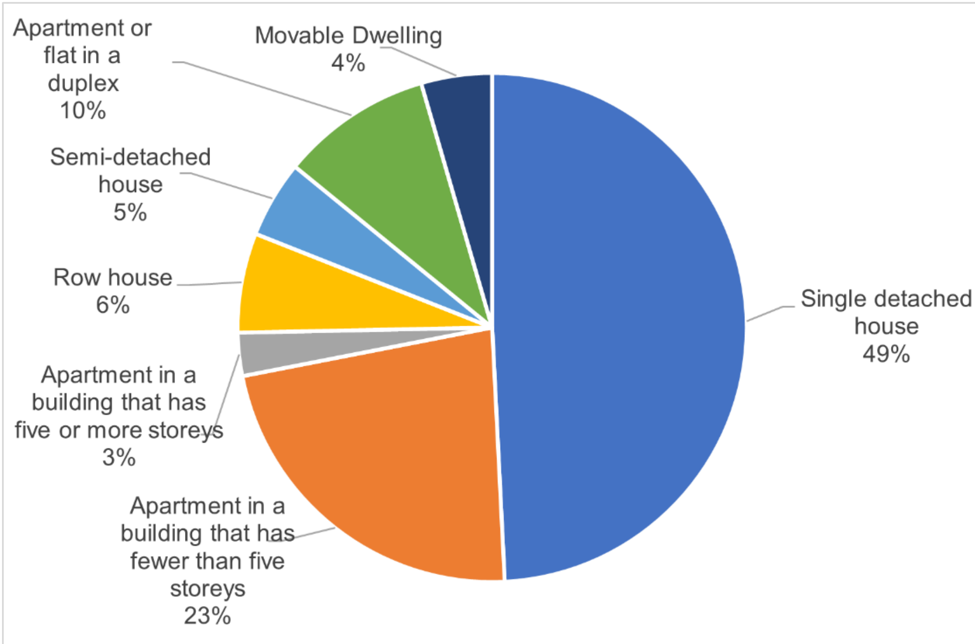

Figure 4: Break-Down of Occupied Private Dwellings into Dwelling Types

The RDCO has developed an inventory of MF buildings in the region. In 2020, there were 849 MF buildings providing 36,072 residential units with the majority located in the City of Kelowna (Figure 5). These MF buildings are not serviced by the RDCO curbside collection program.

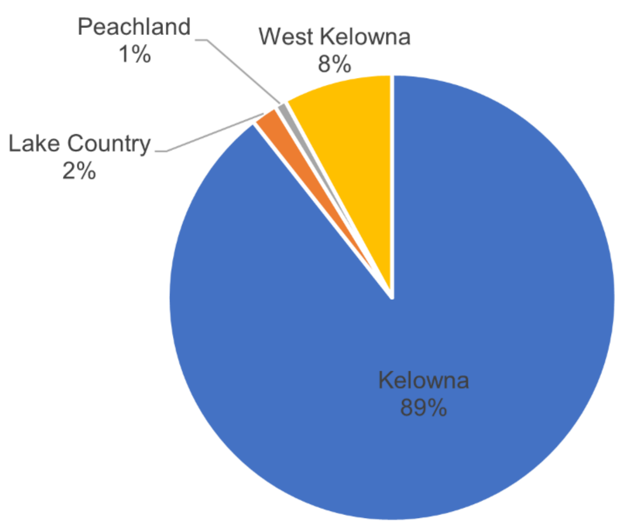

Figure 5: Break-Down in Locations of MF Buildings in the Region

Population growth projections of individual communities are provided in the Official Community Plans (OCPs). Unless stated, the information presented in Table 6 comes from the RDCO, who summarized OCP projections as part of analyzing impacts on regional septage flows in 2022[11].

Table 6: OCP Growth Projections

Area	OCP Population Growth
City of Kelowna	According to the City of Kelowna's Official Community Plan (OCP) 2040[12], the population is projected to grow 1.43% per annum through to 2040. The City's OCP noted a significant shift toward more compact housing forms such as MF units.
District of Lake Country	The medium population growth rate was assumed to be 2.4% per year.
District of Peachland	Historical growth rate of 1.03% and with moderate growth rate assumption of 2.3% per year.
City of West Kelowna	Reports an average growth rate of 1.34% per year.

3. PROCESSING OPTIONS

There is a range of technologies available for processing segregated organic waste at a central processing facility. Currently, all RDCO's yard waste quantities are processed at the composting facility at Glenmore Landfill, which uses a windrow composting process to produce compost. The City of Kelowna is planning to upgrade the facility to use aerated static composting process, but the facility will still be limited to processing yard waste only.

Appendix A provides summaries of common processing technologies with an emphasis on those that can process either food waste or commingled food and yard waste. In reviewing processing options for the RDCO, it is important to gain an understanding, at least at a high level, of the common available technology options.

The composting technologies included in Appendix A are presented under the two main categories; Passively Aerated & Turned Systems, and Actively Aerated Composting Systems. Each system offers differing methods but produce the same results at differing times for specific needs of the sites.

Composting is an aerobic biological process in which organic matter is consumed through microbial activity, in the presence of oxygen, to produce a humus material. Composting technologies can be very simple pile systems, generally only suitable for composting yard waste, or can be more complex systems that are capable of processing mixed organics, which may contain yard waste, food waste, and other household organic materials.

Anaerobic Digestion (AD) involves organics processing in the absence of oxygen to produce a usable biogas. Costs for AD facilities are typically higher than for composting facilities. However, the business

11 Information provided by Clarke Kruiswyk, RDCO, via email on May 31, 2022.
12 City of Kelowna's Official Community Plan 2040, available via URL: https://www.kelowna.ca/2040ocp

case and comparisons between the technologies depend on considerations such as local factors, the amount of waste received and the value of the end-products.

The Organic Matter Recycling Regulation (OMRR) governs the construction and operation of compost facilities and the production, distribution, storage, sale and use of biosolids and compost in BC. For more OMRR information and guidance, visit https://www2.gov.bc.ca/gov/content/environment/waste-management/food-and-organic-waste/regulations-guidelines

Other applicable regulations that fall under the Environmental Management Act and that apply to organics processing and compost production include:

- Code of Practice for Agricultural Environmental Management (AEM Code) (BC Reg. 8/2019)
- Code of Practice for Soil Amendments (BC Reg. 210/2007)

For more information on typical processing systems, including composting and AD and their end products, refer to Environment Canada's "Technical Document on Municipal Solid Waste Organics Processing" (2013)[13].

3.1 Comparison of Centralized Processing: Composting and AD

The table below provides a high-level comparison of the two main processing technologies for central large-scale processing: composting and AD processing. With standard composting, we have assumed an aerated static pile system that is enclosed to maintain odour control.

Table 7: Technology Comparison between ASP Composting and AD

Aspect	ASP Composting	AD
Flexibility to Handle Varying Feedstock	Typically, able to process a wide rangeof feedstock, provided sufficient pre-processing.	Dry AD can process yard and garden waste, Wet AD is less suitable. Inputs impact biogas yield.
Pre-Processing Requirements	Does not require source-separation of food waste (organics can be co- mingled) Mechanical pre-treatment and mixingto create homogeneous mixture	May require source-separation of food waste (depends on technologychoice) Mechanical pre-treatment to createuniform mixture.
Marketable End Products	Compost	Biogas Compost, but lower volumes than composting
Compost Quality	Can produce a high-quality compostfor local land application	Can produce a high-quality compost for local land application

[13] Reference available at: https://www.canada.ca/en/environment-climate-change/services/managing-reducing-waste/municipal-solid/environment/organics-processing-technical-document-summary.html

Aspect	ASP Composting	AD
Residuals	Overs are typically re-used in the composting process, but there are examples of overs being re-processed into biomass fuel when contamination (plastics) are removed Residue to landfill (e.g., contaminants from pre-processing)	Effluent Digestate Residue to landfill (e.g., contaminants from pre-processing)
Energy Recovery	Limited – potential recovery of low- grade heat from the composting piles	Potential for biogas to RNG production or electricity generation
GHG Benefits	Moderate as compared to AD	Significant due to biogas production
Odour Control	Technology dependent. High if all operations are fully contained with robust odour treatment. Also, likely more dependent on good operationsthan AD.	High level through containment of all processes (including feedstock reception), negative air pressure, chemical scrubbers and biofilter treatment
Costs	At lower tonnages costs are likely higher than status quo but lower than AD. At higher tonnages costs can be similar to AD.	Capital costs are higher than for composting, but operating costs could be similar since AD operating costs are partially offset by revenue from sales of end products (biogas). At lower tonnages, costs are relatively high. At higher tonnages could be comparable to composting costs.

The Capital Regional District (CRD) undertook a financial analysis of a potential new composting facility and a potential new AD facility, considering both a small (10,000 tpy) and a large throughput (24,000 tpy). These were compared to the current practice of utilizing a third-party processor on Vancouver Island. The analysis, which considered a 20-year duration, showed that a smaller sized composting facility would not be cost competitive compared to the current situation. The AD facility could be economically feasible if enough value was placed on the GHG benefits associated with an AD facility. In the end, the CRD opted to continue hauling food waste to an out-of-region facility. At higher tonnages the analysis favoured a new facility – the estimated costs of a new composting facility and an AD facility were similar, and lower than the status quo. It is not possible to make a direct comparison of these scenarios to the RDCO as there are many variables and local factors to consider. However, the example shows that regional facilities may only be justifiable when significant feedstock quantities can be secured.

For the purpose of this study, MH recommends that food waste or commingled food and yard waste should be assumed to be processed in an enclosed process such as ASP composting. This technology is relatively common throughout BC.

3.2 Technologies for On-site Processing

For this study, on-site processing refers to compostable organic waste being utilized locally, at the source, where the waste is produced, such as in a residential home. This section describes on-site processing methods involving enhanced backyard composting and counter-top kitchen composting.

3.2.1 Backyard Composting

Backyard composting is one of the most common methods of on-site processing of residential yard and garden waste, and certain food waste. Backyard composting is actively encouraged by many regional districts, including the RDCO, Columbia Shuswap, Kootenay Boundary and Central Kootenay. Many local governments support reducing volumes of organics at the source through backyard composting. Even after an organics curbside collection program is introduced, home composting is an important way to reduce organics needing to be collected, processed, and marketed. Home composting can still be actively supported through initiatives including providing subsidized compost units, encouraging residents who wish to further reduce their waste through compost coaching or educational materials.

There are many types of backyard composting technologies available, suitable for both rural and urban areas. As described in Section 2.1.4, the RDCO has sold backyard composters, Green Cone Food Digesters and Worm Bins at subsidized fees.

3.2.2 Kitchen Composting

Commercial

In-house, or kitchen, composting within the kitchen area used to be rare, mostly undertaken by major commercial restaurants where they are able to process large amounts of food waste in a day, often to achieve size reduction of waste and odour control. For example, Food Courts in Vancouver and Vancouver International Airport use the Oklin Composter, which is an in-house composter. The Oklin Composter is an enclosed compost system that uses microbes and heat to process organic waste. It has a short processing time (less than 24-hour conversion cycle) that produces an end product that can be mixed into municipal garden beds. A common size is 16' x 10.5' vessel costing over $100,000 per unit with operating costs of approximately 3% of the capital costs. The system needs to be located inside an insulated building[14].

Residential

A number of compact kitchen composters are becoming available for residential use. Examples include the FoodCycler and the LOMI systems, but other brands also exist. These devices are smaller compared to the backyard composters and are ideal for residential areas without access to a large backyard or with wildlife management issues.

[14] Personal communication with Jeff Wint, Recycling Alternative, May 30, 2019.

The FoodCycler is a portable device manufactured by Vitamix that can process small amounts of food. The weight and volume of food waste are reduced by approximately 90%, leaving users with sterile biomass that is easy to store and can be used in backyard gardening or even be collected at the curb. There are many communities across Canada that are working with FoodCycler to implement pilots where the appliance is used by residents. Over thirty municipalities in Canada are partnering with FoodCycler on pilot programs either to provide an appliance to every home or as an opt-in model. Currently all municipal programs are targeting single family residents and not MF residents. FoodCycler is looking at starting a MF pilot later in 2022. A FoodCycler appliance costs $500 in the retail stores, however the vendor has found pilot subsidies (including municipal funding) that have reduced the costs per unit to between $50 and $175 per participating household. The appliance requires replacement of carbon filters and additives when a high level of odour control is needed (e.g., when used in a kitchen). FoodCycler reports an annual maintenance cost of $50 per year per unit. Municipal programs can have appliance warranties of up to 12 years with maintenance plans included[15].

A pilot program undertaken by the City of Nelson in 2020 has shown promising results after providing 151 participants each with a “pre-treatment appliance” (a FoodCycler) for 3 months[16]. The City documented the use of the appliance and amount of food waste processed. Approximately 80% of the participants were City residents while about 20% lived outside city limits. The City estimated capture rates of 288 kg/household/year, based on the pilot results[17]. According to FoodCycler the typical per-household capture rates range between 200 to 400 kg of food waste per year, with an overall average of 276 kg/household/year. The capture rates are heavily influenced by how many people there are in a household, and seasonality since there are more food scraps in the summer months.

The City of Nelson pilot was deemed a success with majority of the residents favouring the ease of use and convenience of processing their food waste at the comfort of their home. The majority of participants used the compost for their own garden or donated the compost to another garden (e.g., nearby community/friend). After the trial, 83% of the participants responded via a survey that they would recommend the device to others. 53% responded that they would be willing to use the device if the cost is the same or less than the curbside collection cost.

In 2020, the City of Nelson decided to pursue a city-wide roll-out and will be starting the first phase of the rollouts later in 2022. The program will be implemented in phases to ensure smooth uptake in the community and will take 1-2 years to engage the whole community. The City of Nelson will be looking at piloting MF buildings in the roll-out and should have data to share in 2023.

[15] Personal communication with Alex Hayman, Director of Strategy, FoodCycler, April 29, 2022, and June 10, 2022.

[16] City of Nelson Pilot Program Presentation 2020 available via URL: https://www.nelson.ca/DocumentCenter/View/4286/FoodCycler-Pilot-Program-Presentation

[17] Personal communication with Emily Mask, Organic Waste Diversion Coordinator, City of Nelson, April 27, 2022.

The main reasons why the City chose this organics diversion option instead of a curbside collection include:

- The prevalence of wildlife (bears and rats)
- The cold climate, which can create challenges for a separate food waste collection service (freezing of food waste in collection containers)
- The distance to a food waste processing facility (approximately 100 km round-trip to a facility in Salmo, which is not yet established)
- Lack of suitable land for a City-owned composting facility

LOMI is another countertop kitchen composter that is available for residents, created by the start-up company Pela. The device is similar to the FoodCycler that is being trialled by the City of Nelson, but no local governments in North America have so far piloted the use of LOMI's. The device is available for private purchase from Pela company at USD$499[18] (approximately CAD $640). Maintenance of the LOMI device is USD$39 every quarter, which includes the necessary replacement carbon filters and additives for the LOMI device to work, costing approximately CAD $200/household/year. Pela is able to offer local governments lower unit-costs through 5-year agreements. Pela has completed an internal GHG impact assessment on the LOMI devices and shared some of the GHG assessment results on its website. Pela's GHG calculations show promising results for reducing the impact of producing the composter units.

The end product from the kitchen composters (e.g., FoodCycler and LOMI) is a sterile biomass. According to FoodCycler, the biomass is beneficial as a soil amendment as it provides soil nutrients once it is broken down further. FoodCycler has completed studies on the end product benefits and MH has asked for access to these[19].

The end products can be accepted in the yard waste collection in Ontario as the Ontario government has allowed the material to be accepted as feedstock. The BC Ministry has indicated that it will not be accepting the pre-treated end product (biomass) together with yard waste as feedback for composting[20].The end product is still regarded as food waste and would not be able to be processed at the yard waste compost facility at Glenmore Landfill.

The kitchen composters, such as FoodCycler or LOMI, may only be suitable for some residents. In rural areas where many residents already undertake backyard composting, the addition of kitchen composting would be unnecessary. The kitchen composting appliances are more suited to residents without backyard composting. The option may not be suitable for residents in small apartments with

[18] Interview with Pela representatives, Jeff Keen & Jeremy Lang, March 4, 2022.

[19] Personal communication with Alex Hayman, Director of Strategy, FoodCycler, June 10, 2022.

[20] Personal communication with Gloria Parker, Environmental Management Officer, Clean Technologies | Environmental Standards Branch, MOECSS, July 26, 2022.

limited kitchen space. The City of Kamloops is considering offering residents with bear issues the option to use a counter-top kitchen composter, such as the FoodCycler[21].

The RDCO may want to consider this as a food waste scenario that assumes one appliance to each of the curbside serviced households. However, the RDCO is most likely to first test this food waste diversion option through a small pilot. According to FoodCycler, a 12- week pilot involving 250 households typically costs approximately $30,000, which would allow data gathering from the targeted community[22]. Pela, which is the manufacturer of LOMI, another pre-treatment system, would also be interested in developing a pilot project for the RDCO.

3.3 Facilities Capable of Processing RDCO's Food Waste

This section identifies current facilities that are capable of processing food waste from the RDCO. The table below is limited to facilities within reasonable hauling distance from a central location in the region.

[21] Personal communication with Marcia Dick, Solid Waste Coordinator at City of Kamloops, March 23, 2022.

[22] Personal communication with Alex Hayman, Director of Strategy, FoodCycler, April 29, 2022.

Table 8: Food Waste Processing Facilities Near the RDCO (2021)

Facility	Facility Owner	Technology	Hauling Distance to Kelowna	Comments
Spa Hill Farms Inc.	Josh & De-Anna Mitchell	Enclosed Aerated Static Pile	Approximately 90 km one way to/from the facility located in Salmon Arm.	▪ Fully operational ▪ Provides ICI organics curbside pickup ▪ Accepts food waste ▪ Appears to have had little to no odour issues. The facility is located in a rural area ▪ Tipping fees are at $110 per tonne (as of April 2022) ▪ Has indicated that the facility has capacity to accept up to 50,000 tpy[23]. Current capacity has not been disclosed.
Brenda Renewables Ltd.	Glencore Canada	ASP composting and an anaerobic digester system	Approximately 40 km one way to/from the site located west of Peachland.	▪ Not operational. A phased construction is planned to start in 2022 with an ASP composting facility followed by an AD facility in 2024/25[24] ▪ Will accept variety of organics, potentially food waste ▪ Designed to produce a Class A compost product ▪ Potential area to consider in future

23 Personal communication with Josh Mitchell, Spa Hill Farms Inc., April 4, 2022.

24 Information from PowerPoint Presentation Brenda Renewables Project Site Tour, October 26-29, 2021, provided by Matt Malkin, Rolfe Philip and Mark TenBrink, Brenda Renewables, to the District of Peachland.

Facility	Facility Owner	Technology	Hauling Distance to Kelowna	Comments
Ingerbelle Compost Facility	Arrow	Aerated Static Pile	Approximately 150 km one way to/from the facility located by Princeton.	▪ Fully operational ▪ Facility started operations in 2003 as a mushroom composting facility. Once acquired by Arrow, the facility was converted to an ASP composting facility in 2018 ▪ The facility accepts food as well as yard waste ▪ Permitted to process 100,000 tpy ▪ Industry rates for tipping fees range between $35-$80 per tonne ▪ End product called Nutrigrow. All products not sold to retail markets is allocated to nearby Copper Mountain for reclamation
Net Zero Waste Eastgate	Net Zero Waste	Aerated Static Pile (Gore Cover System with Encapsulated Membrane	Approximately 230 km one way to/from the facility located near Manning Park	▪ Fully operational ▪ Started operations in May of 2021 ▪ Accepts food waste ▪ Currently undertaking upgrades and the new facility will be completed in spring of 2022 ▪ Currently handling 20,000 tpy, once upgraded, it will have a capacity of 60,000 tpy. Has confirmed capacity to accept RDCO organics ▪ Tipping fees are dependent on types of contract and contamination level of organics collected[25]. Fees for the RDCO are not likely to exceed $75 per tonne. ▪ The Class "A" end product is sold commercially as a soil amendment

[25] Personal communication with Mateo Ocejo, Net Zero Waste, April 27, 2022.

Facility	Facility Owner	Technology	Hauling Distance to Kelowna	Comments
Revelstoke Compost Facility	Columbia Shuswap Regional District (CSRD)	Aerated Static Pile	Approximately 110 km one way to/from the facility located in Salmon Arm by CSRD Landfill	▪ Fully operational by November, 2022 ▪ Accepts food waste ▪ The CSRD's current bylaws prevents the facility from accepting waste from other regional districts[26]

As shown in the table above, there are currently at least two food waste processing facilities within 230 km driving distance or less, and in the next year there should be another two facilities capable of accepting curbside collected food waste from the RDCO. All available facilities use ASP composting systems, except for one facility; Brenda Renewables, which will initially use an ASP composting process and establish an anaerobic digester system in the later construction phase.

[26] Personal communication with Ben van Nostrand, CSRD, November 27, 2022.

3.4 Comparison of Available Food Waste Processing Options

The table below compares the three primary processing options for either food waste or food and yard waste that should be considered by the RDCO.

Table 9: Comparison Between Main Processing Options

Onsite Processing (In-Kitchen)	Central Processing at Established Facility	Central Processing at RDCO-Owned Facility
ADVANTAGES		
▪ Minimizes local transport impacts ▪ High odour control ▪ Does not contribute to wildlife conflicts ▪ Positive user feedback from pilots (e.g., City of Nelson) ▪ Appears to have high diversion rates at the source ▪ Especially suitable in dwellings with access to backyard gardens or nearby gardens, where backyard composting is not already in place ▪ Does not require collection bins, trucks, central processing capacity	▪ Uses existing permitted facility that has already been sited ▪ Likely to receive competitive offers from nearby facility operators via an RFP/RFQ process ▪ Can commence food waste collection within short time frame	▪ Potential to access government/provincial funding to establish facility ▪ Have control of the processing facility and costs ▪ Might be closer than an existing facility (i.e., less transport and lower related hauling costs)
DISADVANTAGES		
▪ May not be suitable for all residents (e.g., lack of space in kitchen) ▪ High capital and operating costs ▪ Residents need to be responsible for ensuring appliance maintenance ▪ If residents chose to simply dispose of the compost into the mixed garbage, this would be a wasted opportunity ▪ Some level of organics collection may be needed to cater for households without ability to apply compost to local gardens	▪ The region would become dependent on third-party for food waste processing ▪ Potentially longer distance and higher collection/ transport costs as compared to a more local RDCO facility	▪ An organics processing facility is often difficult to site, even at a landfill ▪ Time and resource intensive to plan, permit, and establish new facility ▪ Significant increase in capital costs to fully enclose a composting operation

For the RDCO, the hauling and processing of either food waste or commingled food and yard waste to a private sector facility appears to be a more suitable option than the establishment of a new regional facility. Apart from the difficulty in finding a suitable location for an organics processing facility, member municipalities also need to commit feedstock volumes to ensure financial viability.

The other potential option is to focus on on-site (kitchen) composting, which may be suitable to the RDCO. The City of Nelson has had positive results from its pilot. Kitchen composting manages odours, diverts food waste from landfilling and benefits local gardens. The compost generated by a kitchen composter can potentially be accepted in the RDCO yard waste collection if a dwelling finds no local use for it. Kitchen composting may be especially suited to rural settings where curbside collection may be challenging, and compost is easy to apply to local land.

4. COLLECTION OPTIONS

4.1 Curbside Collection Programs in Neighbouring or Similar Jurisdictions

4.1.1 Residential Curbside Collection

This section provides an overview of residential organics curbside programs in neighbouring communities where either food waste (FW) and yard waste (YW) are collected separately or commingled or where only food waste is collected. The table below compares the curbside collection services provided by a number of local governments with yard waste collection in the RDCO and performance metrics related to each collection program. The RDCO demonstrates a relatively high capture rate considering that only yard waste is collected.

The examples included in the table are all programs that are well established. The table is followed by a couple of additional examples of neighbouring municipalities that are in the pilot phase of curbside collection roll-out.

Table 10: Curbside Organics Collection Programs in Neighbouring or Similar Jurisdictions

	City of Salmon Arm[27]	City of Grand Forks	City of Terrace	City of Nanaimo	District of Saanich	RDCO
Serviced households (hh)	6,706	1,830	4,730	29,000	33,127	62,250
Targeted Organics Materials and Capture Rate (kg/hh/yr)	FW: 142	FW: 74[28] YW (separately - no metrics available)	FW: 180[29] YW (separately - no metrics available)	Commingled FW & YW: 248	Commingled FW & YW: 306[30]	YW: 252
Organics Collection Service	Weekly manual FW collection using contractor	Weekly semi-automated FW collection & monthly manual YW collection (excl. winter) using contractor	Weekly automated FW collection & weekly manual YW collection (excl. winter)[31] (In-House Assumed)	Weekly automated commingled organics collection with in-house fleet	Bi-weekly semi-automated commingled organics collection with in-house fleet	Bi-weekly automated YW collection using contractor
Other Curbside Services	Garbage (Bi-weekly) Recycling (Bi-weekly) Yard waste (Bi-Annual)	Garbage (Weekly) Recycling (Bi-weekly)	Garbage (Bi-weekly) Recycling (Bi-weekly)	Garbage and Recycling (Weekly)	Garbage and Recycling (Bi-weekly) Recycling	Garbage (Weekly) Recycling (Bi-weekly)
User Fee (All Streams)*	$101	$227	$150	$216	$142 +$44 default organics cart	$136-179

*These are default user fees. They do not always reflect actual service costs.

[27] https://www.salmonarm.ca/DocumentCenter/View/2894/Curbside-Summary-Q1-2020-Website
[28] Capture rates in noted in Organics Management Strategy for the Regional District Kootenay Boundary, by Tetra Tech, June 2019.
[29] As per tonnages received at the RDKS compost facility.
[30] Personal communication with Jason Adams, Public Works Division, District of Saanich.
[31] As of May 2022, the City of Terrace is currently engaging the public to identify options to also include yard waste into the automated collection. Commingling of food and yard waste does not appear to be an option. Yard waste is windrow composted at the public works yard.

In May 2022 the City of Vernon launched its residential curbside collection service for food and yard waste. The City has purchased 15,000 organic waste bins (120 L and 240 L carts). The City received a CleanBC grant of $936,000 for the project that is expected to cost $1,100,000[32].

In 2019, the City of Kamloops undertook a pilot project in which a weekly organic waste collection was provided along five collection routes servicing approximately 2,500 households. Commingled food and yard waste were collected in 120 L carts. The pilot involved the testing of alternating bi-weekly garbage and recycling collection. On average each household set out 3.37 kg/week during December (equivalent to 175 kg/hh/yr). The City of Kamloops is confident to obtain higher capture rates when more education and outreach is provided as the pilots expands in 2022[33].

Common Food Waste Kitchen Collection Methods

It is common across BC to provide households participating in food waste collection with kitchen catchers. This provides a convenient collection option where kitchen and food waste can be collected before being transferred to the curbside collection container. Providing a kitchen catcher can support program uptake and participation by removing perceived barriers to food waste collection and storage.

Typically, including these with the curbside container procurement process only adds a small cost to the overall program start-up costs (2021 costs were $4-$6 per unit).

Figure 6: Kitchen Catcher Example

Manual Collection

In a manual collection system, the curbside collection containers are manually lifted and emptied into the truck hopper. Curbside collection containers for manual collection tend to be smaller and less expensive and are often available at local retail stores. Best practice for residential food waste collected manually will be a 45-55 litre curbside container. This size has enough capacity to hold a typical household's weekly food waste and is ideally sized for collection personnel. Manual containers (45-55 L) typically cost $30 - $40 per unit (as of May 2021)[34]. Based on experience, the containers typically last between 7 to 10 years[35].

Automated Commingled Collection

Many local governments provide organics collection programs for commingled organics, i.e., food and yard waste. Examples include the City of Nanaimo (weekly collection) and District of Saanich (bi-weekly). Collecting commingled food and yard waste is more common with

---

[32] Information from February 2022 from URL: https://www.castanet.net/news/Vernon/359893/Vernon-city-council-will-look-at-purchasing-15-000-organic-waste-bins

[33] Personal communication with Marcia Dick, Solid Waste Reduction Coordinator, City of Kamloops, April 28, 2022.

[34] Best Management Practices for Curbside Collection of Residential Organic Waste, MOECCS, 2021.

[35] Personal communication with Jeff Ainge, Jeff Ainge and Associates, June 9, 2022. Jeff 7 – 2016, co-author of the Best Management Practices for Curbside Collection of Residential Organic Waste for the MOECCS.

automated collection programs. This can reduce the "ick" factor associated with food waste collection (odour, insects), but also increases the amount of material collected. Automated collection programs that include yard waste typically use larger sized carts, which are already used by the RDCO.

Typical Capture Rates

Typical capture rates for existing programs throughout BC range from 120 to 140 kg of food waste per household per year[36]. Salmon Arm, Terrace and the pilot collection in Kamloops show even higher capture rates. A conservative estimate would be to assume that each household would have 120 kg/household/year to put out for collection. These capture rates appear modest compared to the rates from households using in-kitchen composting appliances such as the FoodCycler. As reported in Section 3.2.2. typical FoodCycler capture rates per-household range between 200 to 400 kg of food waste per year, with an overall average of 276 kg/household/year. This appears very high in comparison to the capture rates from a food waste curbside program.

The amount of yard waste collected in the RDCO is consistent with the MOECSS Best Management Practice Guide, which report yard waste collections of approximately 250 kg/household/year.

Wildlife Resistance

In 2015, the City of Port Coquitlam (Port Coquitlam) developed an in-house solution to make residential curbside carts bear-resistant and keep costs low. The locking mechanism (Figure 7) secures the cart lid, making it difficult for the bear to access the contents. These locks are now Wildsafe BC approved.

Figure 7: Port Coquitlam's Bear-Resistant Cart Design

With many other locking systems, the lock is riveted to the cart, necessitating a full lid replacement if a bear damages the cart and lock (costing about $75-$100 per cart). Instead, the Port Coquitlam lock uses two metal bands that clip under the rim on either side of the cart. The two parts clasp together across the cart lid to form a rigid barrier that keeps the lid tightly closed. Port Coquitlam has witnessed bears taking almost an hour of persistent effort to dislodge the lock. In the six years the municipality has used these locks, not a single lock has been damaged in a bear incident. Cart lids have been damaged, but their replacement cost is minimal ($20 in 2021). This in-house designed and manufactured lock costs $50 per unit. In addition to the cart locks, Port Coquitlam has developed an extensive

[36] MOECSS, 2020 B.C. Best Practices Methodology for Quantifying Greenhouse Gas Emissions for Public Sector Organizations, Local Governments and Community Emissions, April 2021.

education program to minimize bear conflicts[37]. The City provides wildlife-resistant locks for garbage and green carts for organics to households that do not have a garage or other secure shelter to store their carts.

Numerous manufacturers claim to have bearproof collection containers. However, only a few are certified as bear-resistant by the BC Conservation Foundation's WildSafeBC program. A complete list of certified bear-resistant products is posted on WildsafeBC's website at: https://wildsafebc.com/programs/bear-resistant-bin-testing.

There are currently no curbside containers that are certified as bear proof and compatible with a manual system (45-55 L containers).

4.2 Self-hauling of Food Waste to RDCO Depots

Drop-off depots for organics are relatively uncommon in BC. The City of Powell River provides a food and yard waste drop-off bin, which is located within a staffed recycling centre. Based on the tonnages collected and the population served[38], MH estimates that it diverts 5 kg of residential food waste per capita annually (10 kg/household/year). This is significantly less than the capture rates seen in typical food waste collection programs in BC.

The City of Vernon piloted centralized drop-off locations between April and November 2019. The municipality provided two bins within the City for the public to drop off residential compostable materials. City staff estimated that 105 tonnes of mixed organics (food scraps and yard waste) had been diverted from the landfill over the six-month timeframe. This equates to an estimated 5.25 kg/capita/year[39], which is very similar to the capture rates of Powell River.

If the RDCO simply accepted food waste at its depots a similar capture rate could be expected and, a likely annual maximum of 1,100 tonnes could be collected in this manner.

4.2.1 ICI Organics Collection

It is not common for local governments to provide curbside collection services to the ICI sector and there is not much data from ICI organics collections provided by local governments. In the context of the RDCO, MF buildings are serviced by private collectors and included in the ICI sector.

In 2022 (March 6 to April 12) the Coast Waste Management Associated (CWMA) undertook an organics management survey of local governments, who are CWMA members. A total of 29 organizations (local governments and regional districts) responded to the survey and provided responses in relation to curbside collection services. Survey results showed that about a third of

[37] Personal communication with Tom Madigan | City of Port Coquitlam, Section Manager – Solid Waste & Fleet, June 14, 2021, as part of the development of the MOECSS Best Management Practice Guide.

[38] Personal communication with Tai Uhlmann, Waste Reduction Educator, qathet Regional District, April 12, 2022.

[39] Carey McIver & Associates, Estimate in Memo Curbside Organics Collection, Transfer and Processing Options to the City of Vernon, December 2020.

the respondents provide a curbside collection to MF buildings, however the examples are mainly limited to municipalities in the Metro Vancouver region.

Although the Regional District of Nanaimo (RDN) does not provide curbside collection service to MF buildings, it has access to ICI organics collection data (including MF buildings) through its regulated hauler licensing requirements. The RDN's average ICI organics recovery rate is 30 kg/capita/year[40]. Using the same collection method, the RDCO could expect to recover 6,665 tonnes of food waste from this sector (using 2021 population), which equates to 71 kg/household/year (assuming RDCO's total number of households of 94,335 households in 2021).

5. WASTE PROJECTIONS WITH AND WITHOUT FOOD WASTE DIVERSION

Future waste quantities were projected to the year 2047 (a 25-year period) to better understand the potential waste streams generated in the RDCO. MH estimated the potential organics waste diversion using two different approaches; one using the RDCO's waste composition data and the tonnages of residual waste, and the other involving the typical capture rates experienced by other local governments in BC.

5.1 Waste Diversion Projections Based on RDCO's Waste Composition

MH projected how the waste streams would change over time if the RDCO continues with business-as-usual. The status quo scenario was based on the annual waste tonnages for 2021 and total number of households serviced. The per household rates were applied to population projections that are based on BC Stats (i.e., an average population increase of 1.25% per year and an average household size of 2.3 persons). These regional projections were assumed to be the most accurate forecast for this analysis. Waste projections are also tied to economic growth and activity, but for the purposes of this study, waste projections based on population growth estimates are deemed sufficient.

In 2021, 32,082 tonnes of residual waste were discarded in curbside residential garbage carts (equating to an average of 224 kg/capita/year or 515 kg/household/year based on 62,250 serviced households) and 45,128 tonnes of residual waste were discarded in ICI and MF collection bins (equating to an average of 203 kg/capita/year).

The recent RDCO waste composition report (Tetra Tech, 2021) was used to estimate the percentage of food and compostable waste within the residential and ICI waste streams. As stated in Section 2.3, it was assumed that the waste composition data from spring 2021 was most representative of typical conditions.

[40] Carey McIver and Associates, Estimate stated in the Sunshine Coast Regional District's Regional Organics Diversion Strategy, Jan 2018.

The table and figure below show the combined waste projection estimates for residential curbside and ICI collection divided into compostable food waste, residual waste, and yard waste categories that will require collection. The compostable food waste includes the food waste and food soiled paper products currently in the residential (41.1%) and ICI (32.0%) garbage, the yard waste includes the current residential curbside cart collected from March through December, and the residual waste includes the remainder of the landfilled waste in the residential garbage carts and ICI containers. The compostable food tonnages currently landfilled, are estimated to increase from the 27,627 tonnes in 2021 to approximately 38,222 tonnes in 2047, equivalent to 212 kg/household/year. Yard waste currently collected curbside will increase from the 15,659 tonnes in 2021 to 21,665 tonnes in 2047. This assumes that the current annual capture rate of 252 kg/household/year with curbside collection will remain unchanged and the increased yard waste tonnages only stem from a population increase.

Table 11: Total Waste Projections for Residential Curbside and ICI Collection

	Total Compostable Food Waste *(Tonnes)*	**Total Curbside Yard Waste** *(Tonnes)*	**Total Residual Waste** *(Tonnes)*	**Total Waste Collected** *(Tonnes)*
2021	27,627	15,659	49,583	92,853
2047	38,222	21,665	68,600	128,487

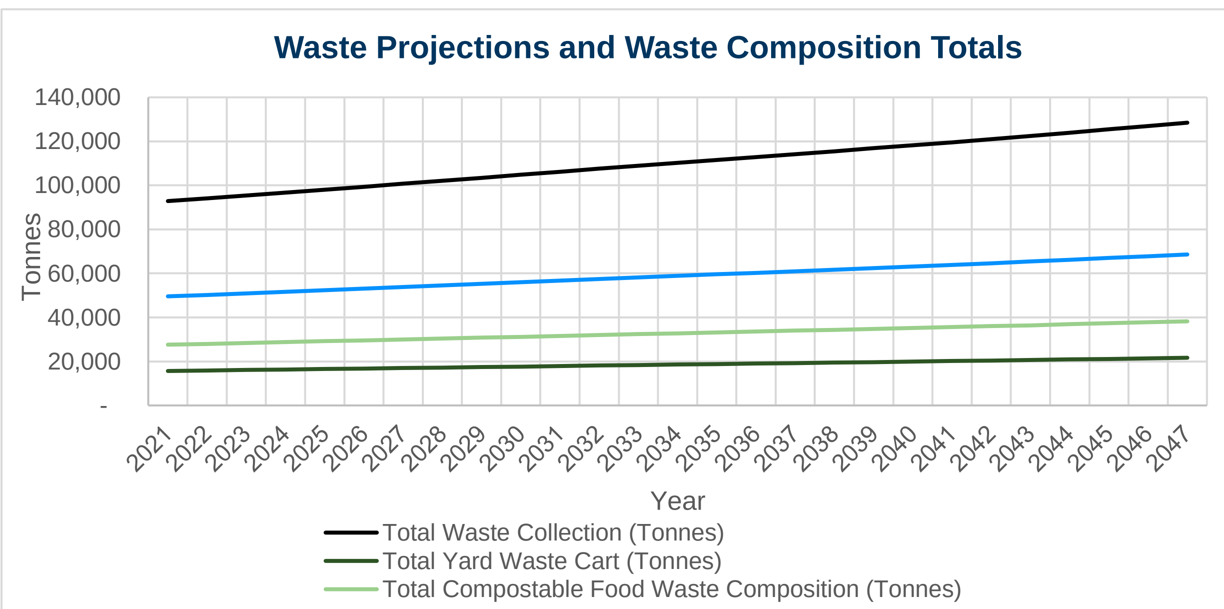

Figure 8: Total Waste Projections for Residential Curbside and ICI Collection

To estimate the realistic compostable food material requiring curbside collection, a capture rate is required to anticipate the percentage of the overall compostable material that will be diverted by RDCO residents and businesses. Environment Canada's Technical Document on MSW organics processing[41] states that typically there is a 50-75% recovery rate for food and yard waste. It was assumed that the residential curbside collection would be well established with a high recovery rate of 75% while the ICI would have a recovery rate on the lower end at 50%.

The table and figure below show the waste projections for the same waste streams accounting for realistic organics recovery rates. The residual waste component includes the 25% of compostable food material not diverted from landfill. The total compostable food material projected to be recovered by residents and ICI generators in 2021 is 17,110 tonnes (9,889 tonnes residential and 7,220 tonnes ICI) and increases to 22,980 tonnes (13,682 tonnes residential and 9,298 tonnes ICI) in 2047. For the year 2021, this equates to a residential curbside recovery rate of 159 kg food waste per serviced household (or 34% of current curbside residual waste material) and an ICI recovery rate of 77 kg food waste per household (assuming 94,335 households in the region) or 32 kg/capita/year.

Table 12: Waste Projections Accounting for Realistic Organics Recovery Rates

	Compostable Food in Residential Waste *(Tonnes)*	**Compostable Food in ICI Waste *(Tonnes)***	**Yard Waste *(Tonnes)***	**Residual Waste *(Tonnes)***	**Total Waste Collected *(Tonnes)***
2021	9,889	7,220	15,659	60,100	92,869
2047	13,682	9,990	21,665	83,150	128,487

[41] Environment Canada, 2013, available via URL: https://www.ec.gc.ca/gdd-mw/3E8CF6C7-F214-4BA2-A1A3-163978EE9D6E/13-047-ID-458-PDF_accessible_ANG_R2-reduced%20size.pdf

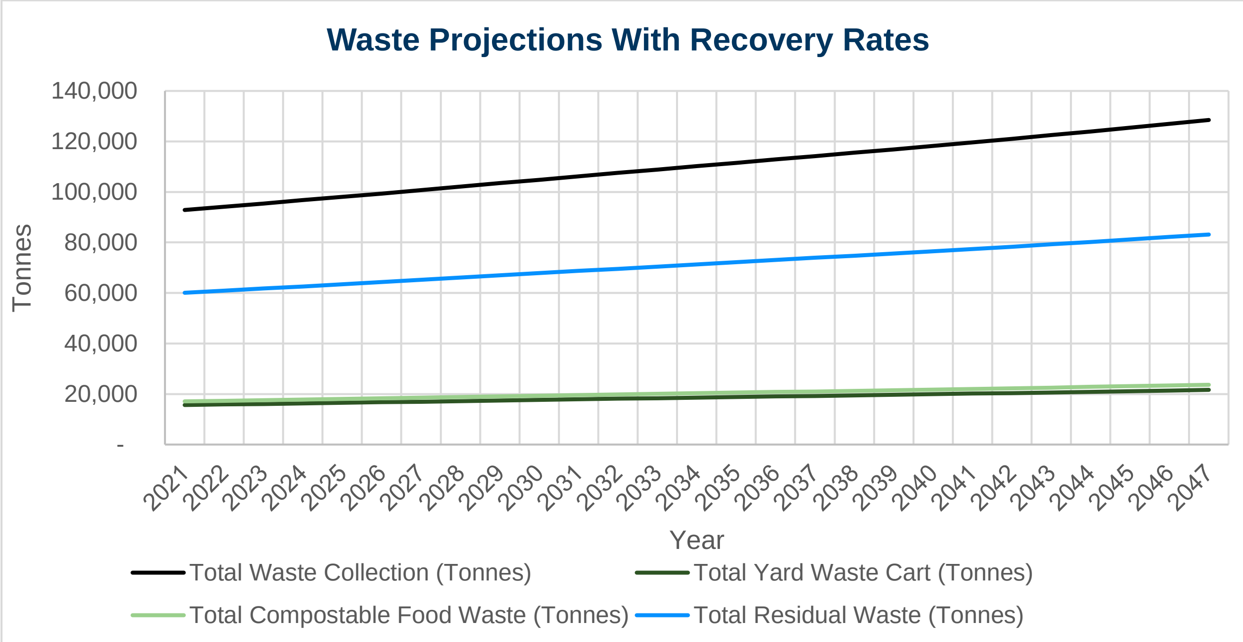

Figure 9: Waste Projections Accounting for Realistic Organics Recovery Rates

5.2 Estimated Organics Diversion from a RDCO Organics Curbside Collection Program

Although 2021 waste composition results can be combined with typical recovery rates to estimate the food waste diversion potential in the region, actual performance data from other jurisdictions may provide a more reliable estimate of the diversion potential of a curbside collection program. The table below compares the calculated diversion potential based on the two different approaches; the waste composition results and assumed recovery rates (%) described in Section 5.1, with the per-household capture rates from other jurisdictions and a total of 62,250 households to service. For ICI organics diversion, MH refers to the capture rates in relation to the total regional population (222,162 people or 94,335 households).

Table 13: Estimated Annual Organics Diversion Potential (Tonnes)

	Based on 2021 Waste Composition Results		Based on Capture Rates from Other Jurisdictions		
	Tonnes	Calculated kg/hh/year	Calculated Tonnes	Assumed kg/hh/year	Information Source for Assumption
Residential Food Waste Only	9,889	159	7,470	120	Best Management Practices for Curbside Collection of Residential Organic Waste published by MOECCS in 2021, refer to Section 4.1.

	Based on 2021 Waste Composition Results		Based on Capture Rates from Other Jurisdictions		
	Tonnes	Calculated kg/hh/year	Calculated Tonnes	Assumed kg/hh/year	Information Source for Assumption
Residential Food & Yard Waste Commingled	25,548	410	23,129	372	Assuming the FW capture as identified above, the RDCO's 2021 actual YW capture rate of 252 kg/household/year.
ICI (Including MF Buildings) Organics	7,220	77 (Assuming All Households)	6,665	71	Assuming same capture rate as RDN refer to Section 4.2.1.
Residential Food and Yard Waste and ICI Organics	32,768	347 (Assuming All Households)	29,794	316 (Assuming All Households)	A calculated rate based on residential FW capture rate, actual YW rate and RDN's ICI rate, calculated based on all region's households (not limited to only those serviced at the curb)

The identified organics diversion potential from a residential curbside collection for either food waste or commingled food and yard waste appear relatively similar using the two different approaches. For this study, it would be prudent to use food waste capture rates that are based on capture rates from well-established curbside programs and as recommended by the Best Management Practices for Curbside Collection of Residential Organic Waste published by MOECCS in 2021.

Although ICI waste composition can be extrapolated from the 2021 waste composition study, actual organics diversion data from the RDN's ICI sector, which includes MF buildings, can provide a more reliable estimate of diversion potential. It is also more conservative.

The tonnages presented in the table and figure below waste projections for divertible organics in 2021 and 2047. Section 7 provides a summary of the recommended organics diversion scenarios that were considered in the feasibility study (Phase 2 of the study).

Table 14: Waste Projections for Tonnes of Divertible Organics

	Residential food Waste	Residential Food & Yard Waste Commingled	ICI Organics	Residential and ICI Organics (Commingled)
2021	7,500	23,000	6,700	29,700
2047	10,380	32,050	9,270	41,320

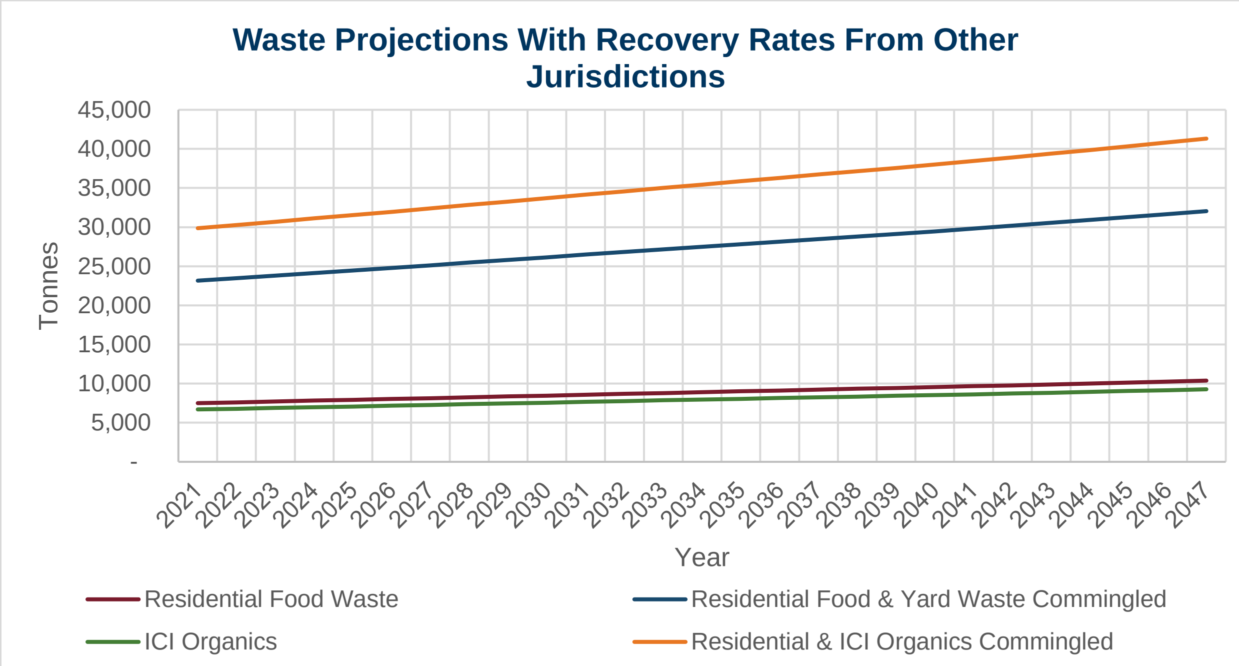

Figure 10: Waste Projections for Tonnes of Divertible Organics

6. REVIEW IMPACTS ON CURRENT INFRASTRUCTURE & SERVICES FROM A CURBSIDE FOOD WASTE PROGRAM

6.1 Current Curbside Collection

A fully automated residential curbside collection service is currently provided by a contractor (E360S) across the region. The service provides collection of recycling, garbage, and yard waste. The contract expires on April 30, 2026. Although the RDCO has not specifically asked the collection contractor about its abilities to collect food waste, E360S have indicated that they are willing to expand collection services if needed. The contractor may be willing to expand the current bi-weekly yard waste collection, which is only offered from March to December, to a weekly collection of food and yard waste either throughout the year, or from March to December with a bi-weekly collection during the winter months when the organics are less odorous.

The RDCO and its member municipalities are currently contracted to collect residential single-family curbside recycling for Recycle BC. The RDCO and its member municipalities recently requested that Recycle BC undertake direct curbside recycling services commencing April 30, 2026 to line up with the collection contract termination date with E360S. When the responsibility for recycling collection is transferred to Recycle BC, the garbage and yard waste collection contractor could have capacity to undertake food waste collection instead of recycling.

Alternatively, if the RDCO is interested in collecting food and yard waste separately using a manual collection with smaller collection containers, it may be suitable for the RDCO to engage this service through a separate contract. The current contractor may not have access to both cart and manual lift compatible trucks.

A manual collection system has Health & Safety implications for the collection crew. Depending on the number of homes on the collection routes and the number of runs completed in a day, the food waste tonnages lifted by one collection worker can be significant. Automated collection reduces workplace injuries and WorkSafe BC concerns associated with a manual collection.

Manual collection with an additional food waste container would lead to an increase in curbside containers for residents (and collectors) to manage; however, at least a container suitable for manual collection takes up less space than the current carts.

Regardless of food waste collection methods, the RDCO is able to reduce the current weekly garbage collection to bi-weekly (every-other-week). Adjusting collection frequency can be an effective tool for building participation for organics diversion, as well as allowing the acceptable garbage limit to be reduced. The MOECSS Best Management Practice guide identifies best practice as collecting food waste weekly, with garbage and recyclables collected every-other-week. This design has shown to maximize diversion and reduce disposal rates most effectively.

With respect to organics collection from the ICI sector, including the MF buildings, there are already private collectors/haulers in the region. Rather than competing with the private service providers, the RDCO should consider continuing to focus on servicing the residential sector. The RDCO can instead influence the ICI sector to divert organics by implementing organics waste bans or differential tipping fees.

6.2 RDCO Transfer Stations

The distance between the curbside collection area and the processing facility is a key consideration for determining if a transfer station is required. If the organics processing facility is located a significant distance from the collection area, it is often more economical to deliver the organic waste to a transfer station first where the material is consolidated then transported using larger vehicles to the processing facility. Transfer stations enable the collection vehicles to unload and return to their routes without the need to drive significant distances to a processing facility. Handling waste this way is cost-effective, produces fewer GHG emissions associated with collection and transfer, and causes less wear and tear on collection vehicles.

It is likely that the RDCO's organic waste from a curbside collection program will require a transfer station to economically haul to a private processing facility. A siting exercise would need to be undertaken to determine the best location for the transfer station.

The requirement for a new transfer facility will add capital costs to the food waste collection program implementation, as well as new on-going operating/maintenance costs and hauling costs. Any temporary organics storage facility will need to meet provincial Organic Matter Recycling Regulation (OMRR) requirements which relate to prevent water run off from a temporary organics storage facility.

The capital cost to build a new transfer facility depends on the amount and type of feedstock received, as well as the location. A cost estimate specific to the RDCO was developed as part of the feasibility assessment (Section 9). The cost estimate assumes a typical organics transfer station design with no biofilter. When selecting a location for a transfer station site, it is important to consider buffer distances to neighbouring residents. It would likely be challenging to select sites with close proximity to neighbours and obtain the necessary approvals. Existing waste management facilities are good locations for transfer stations as well as sites with surrounding land uses that are similar and compatible.

Odours at the transfer station can be managed through facility design (e.g., quick roll-up doors) and by following best management and operational practices. Odours are often generated when waste materials are stored for too long and therefore it is important to move materials out for processing as quickly as possible. As odours can be generated by incoming feedstock, special attention may be given to management of especially odorous feedstock, for example by moving it into transfer trailers as quickly as possible rather than storing it on the tipping floor for extended periods. Two larger organics transfer stations in BC are currently operating with no specific odour control infrastructure (e.g., a biofilter) and are successfully managing odours operationally.

6.3 Landfill

The diversion of compostable food and food soiled paper material from the Glenmore Landfill would lengthen the site’s lifespan as the annual landfill tonnages would decrease. As stated in Section 5.2, MH estimates that 7,500 tonnes of residential food waste could be diverted from the landfill in 2021. This tonnage accounted for 23% of the 2021 total waste collected and landfilled through RDCO curbside waste collection programs (excluding yard waste and recycling collection, which is already diverted from landfill) which will be available to save airspace and extend the Glenmore Landfill lifespan.

With the recovered food waste being diverted, LFG production and related GHG emissions from the landfill will be reduced as there will be less decaying organic material sent to the landfill. This will affect the LFG available for RNG production in the FortisBC processing plant. However, organic waste that is not recovered through the residential food waste curbside collection will continue to generate LFG and provide a source for RNG production (i.e., organic waste from the ICI sector and MF buildings). It is estimated that of the current organic materials going to landfill, 76% will continue to be landfilled. This includes the unrecovered food and yard waste, clean wood and other compostable waste identified in the Spring 2021 Waste Composition Study. There is also residual waste classified as moderately decomposable which will also generate LFG emissions.

7. RECOMMENDED COLLECTION & PROCESSING SCENARIOS FOR FEASIBILITY ASSESSMENT

This section identifies three specific collection and processing scenarios for food waste diversion that MH has identified. Waste flows for these three collection and processing scenarios were developed to allow the feasibility assessment of the three scenarios against the status quo shown in the flow diagram below.

For all scenarios MH assumed that the recycling collection will remain unchanged, and this collection cost has not been included in the analysis.

7.1 Status Quo

Figure 11 shows how food and yard waste is currently managed. This is the assumed status quo scenario.

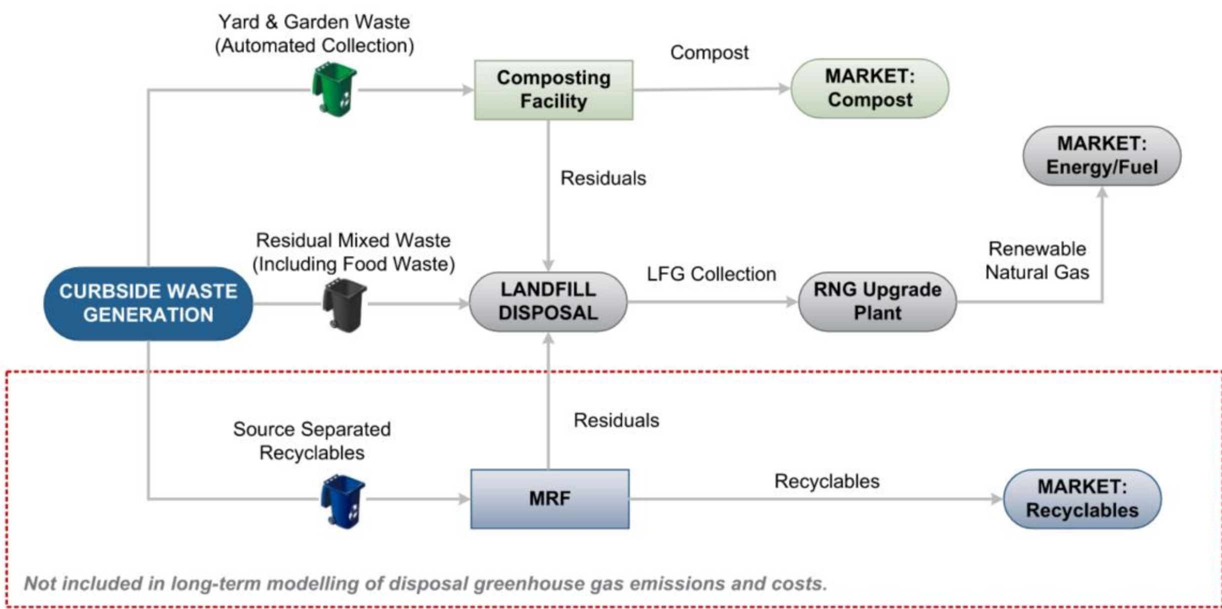

Figure 11: Flow Diagram Showing How Food and Yard Waste is Managed Currently (Status Quo)

All three alternative scenarios focus on residential food waste as we recommend that the RDCO and member municipalities simply support commercial and MF food waste collection systems through the establishment of organics restrictions/disposal bans once food waste diversion and processing capacity has been established for the residential sector.

Based on the feasibility of residential food waste diversion scenarios, MH will be able to outline suitable future options to address organics from MF buildings and the ICI sector.

7.2 Scenario 1 – Manual Food Waste & Automated Yard Waste Collection

Although uncommon, a combination of cart-based automated yard waste collection and manual food waste collection is possible. A separate collection of food waste would involve more curbside containers for residents and collectors to manage. This system may make sense for the RDCO if a separate collector is engaged with access to manual lift compatible trucks. A manual collection typically uses 45-55 L curbside containers that are available at local retail stores. These types of containers are not bear-resistant, however due to the small size, residents must always keep the food waste container in a bearproof location, except during the day of pick-up. This means keeping organic waste in a building such as garage or shed until the morning of collection.

By collecting food waste separately, the RDCO can continue sending yard waste to the Glenmore Landfill at a low tipping fee. Currently, the City of Kelowna is not applying a tipping fee on the RDCO's curbside yard waste and although the City has indicated that there are no current plans of charging tipping fees, MH recommends that the feasibility study should assume that a low tipping fee is implemented over time and the feasibility assessment identifies how overall costs are affected if yard waste tipping fees are applied as per the bylaw ($40 per tonne). The City is planning to upgrade the Glenmore compost facility to use an ASP technology in 2023. The facility will still be processing yard and garden waste but not food waste.

Segregated food waste can be sent to a private processing facility within hauling distance from the collection area. There are at least two food waste processing facilities within 230 km driving distance or less, and in the next year there should be another two facilities capable of accepting curbside collected food waste from the RDCO. Due to the large distance between the collection areas and a likely food waste processing facility, MH recommends that this scenario should assume that a transfer station is required. This scenario will need to consider the capital costs of a transfer facility, and on-going operating and maintenance (including hauling costs).

The flow diagram below shows Scenario 1.

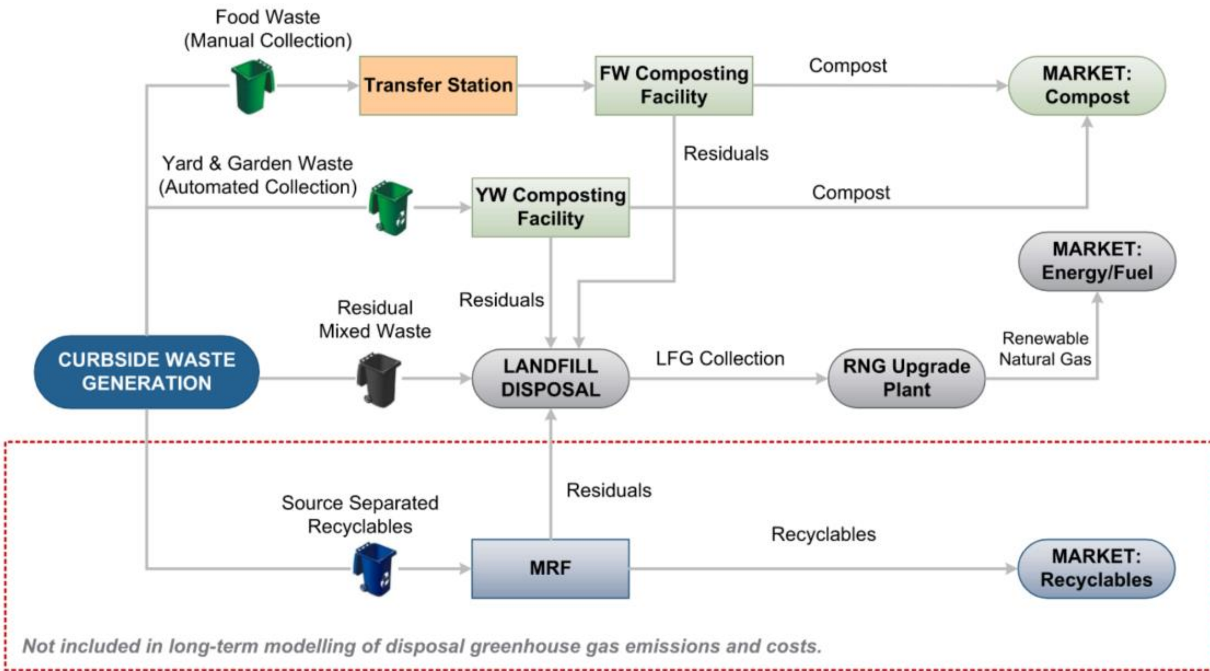

Figure 12: Flow Diagram Showing Scenario 1 - Manual Food Waste and Automated Yard Waste Collection

7.3 Scenario 2 – Automated Food & Yard Waste (Commingled) Collection

The RDCO could simply allow food waste to be accepted at the curb with the yard waste collection as an automated commingled collection. If food waste is commingled with yard waste, there may be a short period with less yard waste, such as in winter. Weekly organics collection would be suitable throughout the year, just with less material (food waste predominantly) in the curbside cart during winter. There is a potential to reduce collection frequency to bi-weekly during the winter period when the waste is less odorous. However, MH recommends that this scenario should involve weekly collection using existing carts.

Similar to the scenario described above (manual food waste collection), MH would assume that commingled food and yard waste is sent to a private processing facility within a reasonable hauling distance from the collection area. A transfer station would be assumed to manage the collected curbside organics.

The flow diagram below shows Scenario 2.

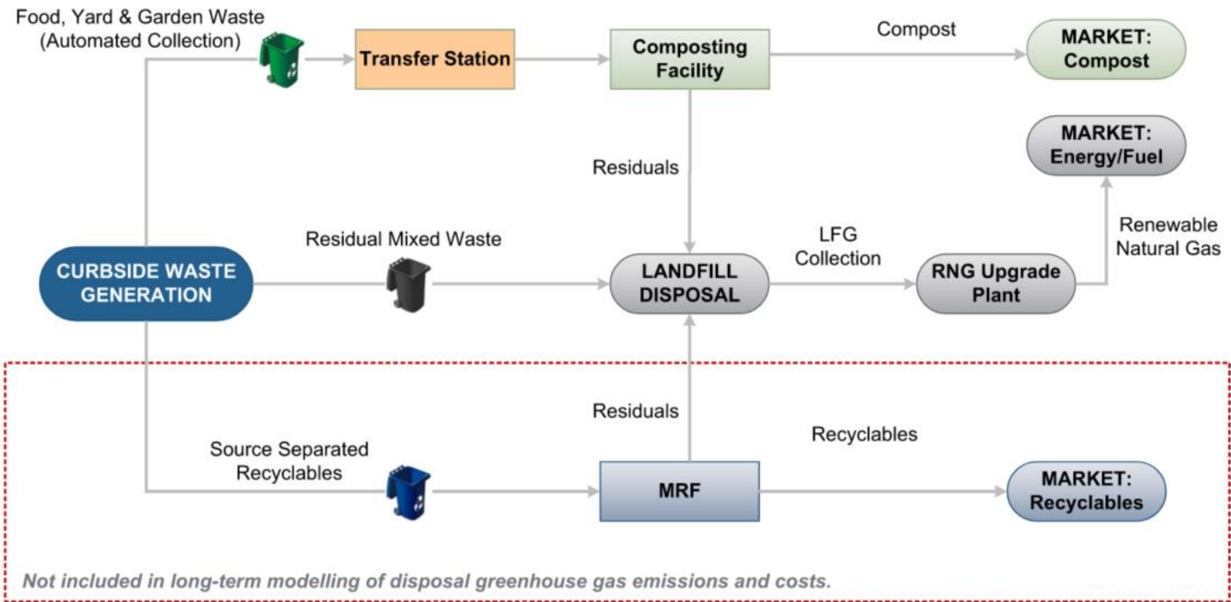

Figure 13: Flow Diagram Showing Scenario 2 - Automated Food and Yard Waste (Commingled) Collection

7.4 Scenario 3 – Kitchen Composting – No Food Waste Collection

The RDCO may want to follow City of Nelson's path and consider the use of pre-treatment appliances, which enables residents to process small amounts of food into an odourless biomass that can be used as a soil amendment in backyard gardening or even be collected at the curbside. The appliance is suitable in residential areas without access to a large backyard or with wildlife management issues.

It is assumed the soil amendment by-product from the appliance will be applied to backyard soils, with 20% of residents disposing the by-product in their garbage collection bin.

The flow diagram below shows Scenario 3.

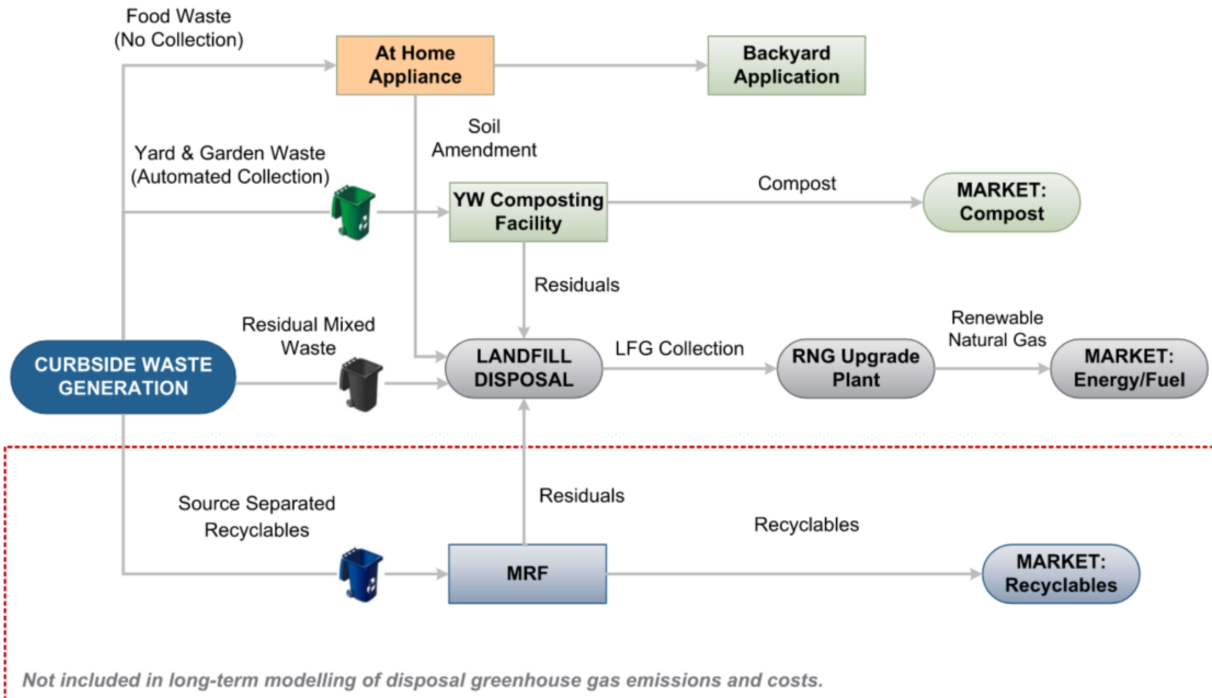

Figure 14: Flow Diagram Showing Scenario 3 - Kitchen Composting – No Food Waste Collection

7.5 Summary of Recommended Scenarios

The three recommended scenarios for food waste collection are presented in the table below.

Table 15: Three Scenarios to Consider in the Feasibility Assessment

	1: Manual Food Waste and Automated Yard Waste Collection	2: Automated Food &Yard Waste (Commingled) Collection	3: Kitchen Composting – No Food Waste Collection
Collection Container(s)	Kitchen catcher 55 L bin RDCO branded Yard waste in current carts	Kitchen catcher Existing yard waste cart	Kitchen appliance
Collection Method	Manual *The service is assumed to be contracted out and no capital expenditures are required to purchase collection trucks*	Automated *The service is assumed to be contracted out and no capital expenditures are required to purchase collection trucks*	*Primarily backyard application was assumed (no transportation required) with 20% of residents disposing the by-product in their garbage collection bin*
Collection Quantity	7,500 tpy in 2021 increasing to 10,380 tpy in 2047.	23,000 tpy increasing to 32,050 tpy in 2047.	7,500 tpy in 2021 increasing to 10,380 tpy in 2047 *(same food waste capture rate as Scenario 1 and 2)*
Collection Frequency	Food waste weekly	Weekly	Not applicable

	1: Manual Food Waste and Automated Yard Waste Collection	2: Automated Food &Yard Waste (Commingled) Collection	3: Kitchen Composting – No Food Waste Collection
	Yard waste bi-weekly *(no service in winter)*		
Wildlife Resistance	Not available for manual bins	Potential for retrofitted locks	Not applicable
Transfer Station Requirement	Yes	Yes	No
Processing Technology	Food waste to third-party processing facility Yard waste to Glenmore Compost Facility	Commingled waste to third-party processing facility	In-kitchen (onsite)
Impact on Other Curbside Services	Bi-weekly Garbage	Bi-weekly Garbage	Bi-weekly Garbage

8. EVALUATION CRITERIA

The following section describes the evaluation criteria that was used to evaluate the feasibility of each scenario.

The 2012 LCA included a range of financial, environmental and social criteria, which were assessed through qualitative or quantitative means. For the feasibility assessment, MH revisited the 2012 LCA evaluation and complemented or adjusted the findings. The methodology and assumptions made are described in Section 10.

The table below identifies which performance indicators were assessed for the four evaluation categories: financial, environmental, social and policy-related areas. Each indicator was ranked either qualitatively (subjectively) or quantitatively, depending on whether criteria are easily quantifiable.

Table 16: Evaluation Criteria

Indicator	Approach Description	Unit of Measurement
Financial		
Life-Cycle Costs to RDCO	The life-cycle costs included the net-present value of the 25-year capital and operating costs.	$CAD, which will inform the final valued scoring: 5 - Low life-cycle cost 1 - High life-cycle cost

Indicator	Approach Description	Unit of Measurement
Life-Cycle Costs to RDCO	High-level capital costs related to the collection and processing scenarios for organics compared to current costs (status quo). Capital costs were assumed to be minimal when using third-party contractors to collect and to process. Capital costs were limited to a transfer station, purchase of curbside collection carts/containers, or in-kitchen composting appliances. High-level operating costs for organics scenarios were based on RDCO's current collection costs and typical collection costs experienced by similar jurisdictions. The operating costs for collection included estimated service cost for collection, processing, and transfer station and impact on garbage tipping fees for residual stream.	MH determined a score for each of the scenarios on a scale of 1 to 5 based on the relative performance of each scenario (with decimal points to distinguish subtle differences in performance)
Financial Confidence	MH identified the financial confidence (i.e., risk) for the scenarios in comparison to the status quo. Considerations included confidence in cost estimates, reliance on out-of-region processing capacity, ability to secure feedstock, and potential for grant funding.	Subjective score: 1 to 5 5 - Low financial risk to RDCO 1 - High financial risk to RDCO
Environmental		
GHG Impact	GHG emissions included processing and collection over a 25-year timeframe. For the status quo, MH assessed net GHGs associated with current curbside collection using CNG trucks as well RNG generation based on the tonnages of curbside residual waste sent to Glenmore landfill. For the alternate scenarios, MH modelled the impact on RNG generation from removing organics from the landfill well as the GHG benefits associated with the land application of compost, such as carbon sequestration.	tCO_2e, which will inform the final valued scoring: 5 - Low GHG emissions 1 - High GHG emissions MH determined a score for each of the scenarios on a scale of 1 to 5 based on the relative performance of each scenario (with decimal points to distinguish subtle differences in performance)
Soil Quality Impacts	Soil quality impacts were based on a qualitative assessment of the options. MH considered the wider benefits in terms of replacing lost topsoil when applying organic matter as compost to the land rather than landfilling.	Subjective score: 1 to 5 5 - Low impact (i.e., benefit) to local/ regional soil 1 - High impact to soil
Air and Water Quality Impacts	Air and water quality impacts were based on the quantitative assessment conducted in the 2012 LCA. MH referred to current regulatory requirements for composting operators that can help to reduce environmental impacts from processing. Odour is addressed as a social impact.	Subjective score: 1 to 5 5 - Low impact to air and water 1 - High impact to air and water

Indicator	Approach Description	Unit of Measurement
Social		
Local Employment	MH focused on the jobs involved with curbside collection and the organics processing. An assessment of collection jobs was based on available information from published job impacts factors.	Subjective score: 1 to 5 5 - High job creation potential 1 - Low job creation potential
Odour, Noise and Transportation Impacts	MH evaluated these impacts based on a combination of quantitative assessment conducted in the 2012 LCA, and qualitatively. Considerations included the collection, transfer and processing activities (including landfilling in status quo) and MH's knowledge of management in relation to organics collection, processing, and transportation.	km travelled/subjective 5 - Low odour, noise and transportation impacts 1 - High odour, noise and transportation impacts
Convenience to Residents	This was evaluated qualitatively based on a number of factors including but not limited to education requirements (e.g., for implementing new services), number of bins, "ick" factor and overall convenience to residents.	Subjective score: 1 to 5 5 - High level of convenience 1 - Low level of convenience
Policy and Adaptability		
Contribution to RDCO Waste Policy	This was evaluated by focusing on how each scenario helps to meet SWMP targets for waste diversion and disposal rate per capita, as well alignment with the RDCO's Commitments to the B.C. Climate Action Charter[42].	Subjective score: 1 to 5 5 - Well aligned with RDCO policy 1 - Not well aligned with RDCO policy
Adaptability to Meet Future Needs	MH evaluated this indicator based on the qualitative assessment conducted in the 2012 LCA, which focused on ability to manage feedstock contamination and varying feedstock quantities. Considerations also included how the option is influenced by population growth and how adaptable each option is to changes in BC regulation relating to municipal solid waste.	Subjective score: 1 to 5 5 – High adaptability 1 – Low adaptability
Risk	This indicator was evaluated qualitatively by considering potential risks, e.g., commitments with Fortis BC for the sale of landfill gas.	Subjective score: 1 to 5 5 – Low risk to RDCO 1 – High risk to RDCO

[42] The RDCO is a signatory to the BC Government Climate Action Charter and report annually on the initiatives the organization is taking to help the community reduce GHG emissions. More information about the local government charter commitments via URL: https://www2.gov.bc.ca/assets/gov/british-columbians-our-governments/local-governments/planning-land-use/bc_climate_action_charter.pdf

8.1 Weighting for the Evaluation Criteria

MH applied weighting to each indicator set based on their relative level of importance to the RDCO. The table below provides a system for criteria weightings, which was proposed by MH and revised based on feedback from the Solid Waste Technical Advisory Committee (SWTAC) to ensure that the focus of the evaluation meets the RDCO's needs. The weighting has an emphasis on environmental and financial indicators ahead of indicators for social, and policy and adaptability. In addition to the weighting, MH was also asked to include a sensitivity analysis to determine how the result would be impacted with different weightings.

Table 17: Weighting for the Evaluation Criteria

Focus Area *(Weighting)*	**Indicator *(Individual Overall Weighting)***
Financial (30%)	Life-Cycle Costs (25%)
	Financial Confidence (5%)
Environmental (35%)	GHG Impact (25%)
	Soil Quality Impacts (5%)
	Air and Water Quality Impacts (5%)
Social (25%)	Local Employment (5%)
	Odour, Noise, and Transportation Impacts (5%)
	Convenience to Residents (15%)
Policy & Adaptability (10%)	Contribution to RDCO Waste Policy (4%)
	Adaptability to Meet Future Needs (3%)
	Risk (3%)

Sections 9 and 10 present the feasibility assessment results of the selected scenarios against the status quo with scores from the quantitative and qualitative assessment. The results in Section 10 assume that all indicators are equally important (i.e., no weighting factors applied) while Section 11 identifies the performance of each scenario based on criteria weightings that are set based on their relative level of importance.

9. FEASIBILITY ASSESSMENT

This section describes the feasibility assessment methodology and the key assumptions made. All three alternative scenarios focus on residential food waste as we recommend that the RDCO and member municipalities simply support commercial and MF food waste collection systems through the establishment of organics restrictions/disposal bans once food waste diversion and processing capacity has been established for the residential sector.

9.1 Assumptions Relevant to All Scenarios

The following assumptions are relevant to the status quo and all organics diversion scenarios. The assumptions were used to compare costs between different scenarios and may not represent actual costs.

I. Under scenarios 1, 2 and 3 when food waste is source separated, the weekly garbage collection service is assumed to be reduced to bi-weekly collection.

II. All collection vehicles were assumed to be powered with CNG. Emission factors for collection vehicles were assumed to be 2.133 kg CO_2e/m^3 of CNG[43].

III. As current collection carts for garbage are not wildlife resistant, we have not assumed that collection containers for garbage, food waste or commingled food and yard waste are wildlife resistant. Section 12.1 provides a discussion on potential wildlife considerations for a food waste collection.

IV. A cost for program education and public outreach was assumed to be $10 per household for the initial implementation year.

V. Costs and GHG emissions associated with the initial distribution of kitchen catchers, bins or kitchen composting appliances are not included in the assessment. GHG emissions related to the manufacturing of the carts, kitchen composter appliances, and construction of the transfer station are not included in the assessment.

VI. A disposal tipping fee at Glenmore Landfill of $102 per tonne is assumed when accounting for changes in tipping fees in the food waste diversion scenarios when less waste is being landfilled.

VII. All collection costs are tied to the 2022 household counts and increase with respect to the projected household increase.

VIII. Food waste is assumed to generate 160 m^3 of methane/tonne of waste in the landfill, aligning with the BC MOE Landfill Gas Generation Assessment Procedure Guidelines[44]. The BC Landfill Gas Generation Estimation Tool was used to estimate methane generation at the Glenmore Landfill. Tonnages for each waste category (relatively inert, moderately decomposable, and decomposable) are assumed to have the same

[43] As per MOECSS, 2020 B.C. Best Practices Methodology for Quantifying Greenhouse Gas Emissions for Public Sector Organizations, Local Governments and Community Emissions, April 2021.

[44] Landfill Gas Generation Assessment Procedure Guidelines, March 2009, Table 5.1.

percentages as calculated in the 2021 Landfill Gas Collection Efficiency Study for Glenmore Landfill [45]. The decomposable fraction was reduced to account for the food waste diversion scenarios. Emissions released within the 25-year investigation period are accounted for, but landfill gas will continue to be emitted from the landfill after the 25-year period.

IX. Methane is assumed to have a global warming potential of 25[46].

X. The Glenmore landfill LFG collection system has a capture efficiency of 70.7% (refer to Section 2.4). Fugitive emissions not captured by the collection system that are released to the atmosphere represent 29.3% of total LFG emissions. Of the collected LFG, 68% was assumed to be processed at the FortisBC upgrading facility and 32% was assumed to be flared.

XI. A total of 10% of the fugitive methane emissions are assumed to be oxidized by landfill cover material.

XII. Greenhouse gas credits from the production of RNG are assumed to be 0.04958 tonnes CO_2e/ GJ as stated by FortisBC[47].

XIII. GHG reductions from a potential displacement of fertilizer are excluded as there is uncertainty about the final use any compost products. Not all compost would be applied for agricultural use where it displaces fertilizer containing nitrogen and phosphorus.

9.2 Status Quo

Below are the assumptions applied to assess the feasibility of the status quo scenario.

I. No capital costs associated with the status quo.

II. The cost of the automated curbside collection for recycling, garbage and yard waste for the serviced households is assumed $5.5 million in 2021. The automated garbage collection is assumed to account for 52% of the total collection cost based on the number of collection carts tipped. A garbage collection cost of $47 per household/year in 2021 is assumed for the weekly garbage collection.

III. The automated yard waste collection is assumed to account for 22% of the total collection cost on the number of collection carts tipped. An annual yard waste collection cost of $20 per household/year in 2021 is assumed for bi-weekly collection (10 months of service as yard waste is collected from March to December).

IV. Yard waste tipping fees are set at $0/tonne as the Glenmore Landfill subsidizes the Glengrow composting program. Typical yard waste tipping fees at the Glenmore Landfill

[45] Jacobs. 2021 Landfill Gas Collection Efficiency Study – Glenmore Landfill Site Memorandum, March 2022.

[46] Environment and Climate Change Canada (ECCC). National Inventory Report 1990-2019: Greenhouse Gas Sources and Sinks in Canada - Part 1

[47] Fortis BC Report Update: Biomethane Greenhouse Gas Emissions Review, March, 2017.

are set at $40/tonne. The overall cost impact on the Status Quo as well as the other scenarios are outlined in Section 10.1.

V. An estimated $385,000 per year is assumed to cover the purchase of new collection carts to replace old carts for the waste and organic collection streams. These replacement costs are based on the RDCO's historic and budgeted cart replacement costs, assuming if two thirds of the annual replacement cost ($577,000) relate to organics and garbage carts. The replacement costs of recycling carts are excluded.

VI. Fugitive emissions from composting are assumed 0.187 tonnes CO_2e per tonne of yard waste[48].

VII. The compost product is assumed to have a carbon sequestration value of -0.265 tonnes CO_2e per compost[49], as the compost product decomposes slowly and acts as a carbon sink.

VIII. Finished compost is assumed to be 70% the original mass of the organic waste[50].

9.3 Scenario 1: Manual Food Waste and Automated Yard Waste Collection

Below are the assumptions applied to assess the feasibility of Scenario 1, which involves a manual food waste collection in addition to the current automated yard waste collection.

I. The food waste is assumed to be collected on a weekly basis year-round. Yard waste will be collected on a bi-weekly schedule with no service in the winter (i.e., unchanged from current service). Garbage will be collected on a bi-weekly schedule.

II. The collection service is assumed to be contracted out and no capital expenditures are required to purchase collection trucks. Contracted collection trucks are assumed to continue operating on compressed natural gas (CNG) with the assumptions that GHG emissions are tied to the number of carts tips regardless of waste tonnage. Manual food waste collection is assumed to cost an estimated $50 per serviced household/ year for a weekly food waste collection service. This cost is based on manual food waste collection costs experienced by local governments in BC.

III. Each serviced household is assumed to be provided a kitchen catcher and a 55 L bin for food waste collection. The kitchen catcher and the bin and curbside bin are estimated at $46 per household.

IV. The food waste collection is estimated to increase from 7,602 tonnes per year in 2022 to 10,380 tonnes per year in 2047.

---

48 U.S. Environmental Protection Agency Office of Resource Conservation and Recovery, Documentation for Greenhouse Gas Emission and Energy Factors Used in the Waste Reduction Model (WARM), Organic Materials Chapters, November 2020

49 U.S. Environmental Protection Agency Office of Resource Conservation and Recovery, Documentation for Greenhouse Gas Emission and Energy Factors Used in the Waste Reduction Model (WARM), Organic Materials Chapters, November 2020

50 Breitenbeck. G.A. Calculating the Reduction in Material Mass and Volume during Composting July 2013Compost Science & Utilization 12(4):365-371. Available via ResearchGate.

V. Capital Costs assumed for this scenario include the addition of a transfer station that accepts food waste only. The capital cost of the transfer station is estimated at $3.5 million for the transfer station infrastructure and a land purchase cost of $6 million for a 3-acre site. Transfer station costs included site preparation, a prefabricated metal building with concrete foundations, road preparation and surfacing, site drainage work and miscellaneous items such as signage, fencing, storage bins and contingency. A building footprint of 30 m by 30 m was assumed to manage up to 10,380 tonnes of food waste per year. Odour control costs exclude a dedicated biofilter as odour control can be dealt with through other facility design (e.g., quick roll-up doors) and operational management (e.g., frequent transfer).

VI. The food waste transfer station will be centrally located. For the purpose of the assessment, MH assumed the vicinity of the Glenmore landfill as a hypothetical site.

VII. Food waste will be processed at a third-party composting facility. The third-party processor is assumed to charge a tipping fee of $70 /tonne food waste. A discussion on the overall cost impact from higher tipping fees are outlined in Section 10.1.1.

VIII. Transfer station annual operating costs are estimated to be approximately 8% of the transfer station's capital cost. This factor is based on previous detailed operating cost estimates completed by MH.

IX. Transfer station operations are assumed to release 0.0044 tonnes CO_2 equivalent per tonne waste[51] and waste hauling emissions are assumed to be 0.023 tonnes CO_2 equivalent per tonne waste with a waste hauling distance of 300 km round trip[52].

X. Yard waste will continue to be collected via the current automated collection and be composted at the Glenmore Landfill.

Food waste will be hauled with a 53' walking floor style trailer or equivalent with a load capacity of approximately 15-20 tonnes. Costs to haul the food waste from the assumed transfer station location to a third-party compost processor is estimated at $65 per tonne. The third-party food waste composting facility is assumed to be located within a 150 km radius of the transfer station.

XI. An estimated $385,000 per year is assumed to cover the purchase of new automated collection carts to replace old carts (recycling collection carts are not included similar to the status quo scenario). In addition, the replacement cost of the $40 food waste collection bins is assumed after the typical service life of ten years. It is assumed that there will be no replacements of the kitchen catchers as they typically are only distributed at the program launch.

XII. Fugitive emissions from composting are assumed to be 0.132 tonnes CO_2e per tonne of food waste, and 0.187 tonnes CO_2e per tonne of yard waste[53].

---

[51] Eistad et. al. Waste Management & Research article: Collection, transfer and transport of waste: accounting of greenhouse gases and global warming contribution, 6 October 2009.

[52] Canadian Council of Ministers of the Environment, Biosolids Emissions Assessment Model (2011).

[53] U.S. Environmental Protection Agency Office of Resource Conservation and Recovery, Documentation for Greenhouse Gas Emission and Energy Factors Used in the Waste Reduction Model (WARM), Organic Materials Chapters, November 2020

XIII. The compost product is assumed to have a carbon sequestration value of -0.265 tonnes CO_2e per tonne compost[54], as the compost product decomposes slowly and acts as a carbon sink. Finished compost is assumed to be 70% the original mass of the organic waste[55].

9.4 Scenario 2: Automated Food and Yard Waste (Commingled) Collection

Below are the assumptions applied to assess the feasibility of Scenario 2, which involves the automated collection of commingled food and yard waste.

I. The food and yard waste will be collected weekly year-round. Garbage will be collected on a bi-weekly schedule.

II. The service is assumed to continue being contracted out and no capital expenditures are required to purchase collection trucks. Contracted collection trucks are assumed to continue operating on CNG with the assumptions that GHG emissions are tied to the number of carts tips regardless of waste tonnage.

III. The collection frequency is assumed to change from biweekly (10 months per year) collection of yard waste in status quo to weekly collection of food and yard waste. The weekly food and yard waste collection is assumed to cost $47 per household per year. The frequency of the garbage collection is reduced to bi-weekly collection and therefore this service cost is halved compared to the status quo.

IV. The existing yard waste carts will be used for the commingled food and yard waste collection. Kitchen catchers will be required for food waste collection at each household. Kitchen catcher bins are estimated at $6 for each household. Most households currently have yard waste carts and no additional costs of extra yard waste carts are assumed for properties that may not currently own carts.

V. An estimated $385,000 per year is assumed to cover the purchase of new automated collection carts to replace old carts (recycling collection carts not included similar to the status quo scenario. It is assumed that there will be no replacements of the kitchen catchers as they typically are only distributed at the program launch.

VI. The food and yard waste collection are estimated to increase from 23,400 tonnes per year in 2022 to 32,000 tonnes per year in 2047.

VII. Capital Costs assumed for this scenario includes the addition of a transfer station that accepts commingled food and yard waste. The capital cost of the transfer station is estimated at $5.4 million for the transfer station infrastructure and a land purchase cost of $6 million for a 3-acre site. Transfer station costs included site preparation, a

[54] U.S. Environmental Protection Agency Office of Resource Conservation and Recovery, Documentation for Greenhouse Gas Emission and Energy Factors Used in the Waste Reduction Model (WARM), Organic Materials Chapters, November 2020
[55] Calculating the Reduction in Material Mass and Volume during Composting, July 2013Compost Science & Utilization 12(4):365-371.

prefabricated metal building with concrete foundations, road preparation and surfacing, site drainage work and miscellaneous items such as signage, fencing, storage bins and contingency. A building footprint of 40 m by 40 m was assumed to manage up to 32,000 tonnes of commingled food and yard waste per year. Odour control costs exclude a dedicated biofilter as odour control can be dealt with through other facility design (e.g., quick roll-up doors) and operational management (e.g., frequent transfer).

VIII. The food and yard waste transfer station will be centrally located. For the purpose of the assessment, MH assumed the vicinity of the Glenmore Landfill as a hypothetical site.

IX. The commingled food and yard waste will be processed at a third-party composting facility. The third-party processor is assumed to charge a tipping fee of $70 /tonne commingled waste. A discussion on the overall cost impact from higher tipping fees are outlined in Section 10.1.1.

X. Transfer station annual operating costs are estimated to be approximately 8% of the transfer station's capital cost. This factor is based on previous detailed operating cost estimates completed by MH.

XI. Transfer station operations are assumed to release 0.0044 tonnes CO_2 equivalent per tonne waste[56] and waste hauling emissions are assumed to be 0.023 tonnes CO_2 equivalent per tonne waste with a waste hauling distance of 300 km round trip[57].

XII. Commingled food and yard waste will be hauled with a 53' walking floor style trailer or equivalent with a load capacity of approximately 15-20 tonnes. Costs to haul the food waste from the assumed transfer station location to a third-party compost processor is estimated at $65 per tonne. The third-party composting facility for commingled food and yard waste is assumed to be located within a 150 km radius of the transfer station.

XIII. Fugitive emissions from composting are assumed to be 0.154 tonnes CO_2e per tonne of commingled food and yard waste[58].

XIV. The compost product is assumed to have a carbon sequestration value of -0.265 tonnes CO_2e per tonne compost[59], as the compost product decomposes slowly and acts as a carbon sink. Finished compost is assumed to be 70% the original mass of the organic waste.

9.5 Scenario 3: Kitchen Composting - No Food Waste Collection

Below are the identified assumptions used to assess the feasibility of scenario 3, which involves the in-kitchen processing of food waste.

[56] Eistad et. al. Waste Management & Research article: Collection, transfer and transport of waste: accounting of greenhouse gases and global warming contribution, 6 October 2009.

[57] Canadian Council of Ministers of the Environment, Biosolids Emissions Assessment Model (2011).

[58] U.S. Environmental Protection Agency Office of Resource Conservation and Recovery, Documentation for Greenhouse Gas Emission and Energy Factors Used in the Waste Reduction Model (WARM), Organic Materials Chapters, November 2020

[59] U.S. Environmental Protection Agency Office of Resource Conservation and Recovery, Documentation for Greenhouse Gas Emission and Energy Factors Used in the Waste Reduction Model (WARM), Organic Materials Chapters, November 2020

I. Each household currently serviced by the curbside collection is assumed to be provided an in-kitchen kitchen composting appliance to process food waste. Since this processing solution has not been piloted in MF buildings and there is no capture data available for MF residents, MH recommends that this scenario only includes the households that are currently serviced by curbside collection.

II. Capital cost assumed for this scenario include the cost of the composting appliances. An appliance is assumed to cost $400 at wholesale cost (20% discount on the FoodCycler retail cost). MH assumed the procurement would be completed as a competitive process and therefore, the more low-cost option of FoodCycler was chosen to represent the cost. One appliance will be required for each household. No kitchen catcher bins are assumed to be required in this scenario.

III. The food waste quantities that require processing are estimated to increase from 7,602 tonnes per year in 2022 to 10,380 tonnes per year in 2047 (same as Scenario 1). This is a conservative estimate since data on residents' uptake and capture rates are not available for reference. If the average capture rate of 276 kg/household/year provided by FoodCycler (Section 3.2.2) is used across all serviced households (2021 households), it would mean that 17,181 tonnes of food waste would be diverted. This is an unrealistic capture rate in the RDCO where compostable food waste makes up 41% of residential garbage which would divert a maximum of 13,186 tonnes of food waste if 100% of the food waste is processed in the kitchen composter. For this scenario, MH assumed a capture rate for kitchen composting that is similar to that of the food waste capture rate used in Scenario 1 and 2. Until more data is available on residents' uptake and capture rates for kitchen composting, this conservative approach is recommended.

IV. It is assumed the soil amendment by-product from the appliance will be applied to backyard soils, with 20% of residents disposing the by-product in their garbage collection bin.

V. The yard waste collection will continue unchanged (bi-weekly collection schedule with no service in the winter). Garbage will be collected on a bi-weekly schedule.

VI. A kitchen composting appliance uses 0.8 kWh per cycle. One cycle treats approximately 1kg of food waste and it is assumed that the average household will run the appliance at 75% capacity. The electricity costs for use of in-home composting appliance were not included as life-cycle costs to the RDCO. However, annual electricity costs to homeowners were estimated and identified in the report in Section 10.1.

VII. To estimate the GHG emissions relating to electricity use, we used the BC electrical consumption intensity emission factor for grid electricity of 0.0197 kg CO_2e/kWh, as provided by Environment and Climate Change Canada[60].

VIII. Maintenance associated with the appliance is assumed at $50 per year. This cost is based on replacement carbon filters and additives to achieve a high level of odour control. MH

[60] ECCC. National Inventory Report 1990-2019: Greenhouse Gas Sources and Sinks in Canada - Part 3 (ECCC, 2021)

assumed the procurement would be completed as a competitive bid and therefore, the more economical option of FoodCycler was chosen to represent the cost.

IX. It is assumed that the appliance will require replacing every 10 years. For replacement of the initial year of appliances (program launch), 10% of the capital cost is applied as a replacement cost to each year throughout the 25-year period.

X. The end product (the sterile biomass) is assumed to reduce to 10% of the original volume[61] after the kitchen composting process and it is assumed 80% of household users will apply the product to their yard and 20% will throw it in their garbage waste collection bin. No significant impact on waste collection quantities is assumed due to the likely small quantities of biomass that is collected in this manner. The biomass requires further composting typically taking place in the backyard soils or composter.

XI. Compost product was assumed to have a carbon sequestration value of -0.265 tonnes CO_2e per tonne food waste[62], as the compost product decomposes slowly acting as a carbon sink. Carbon sequestration values were only applied to the reduced compost product volume composted in backyard soils.

10. UNWEIGHTED RESULTS

Table 18 below shows a summary of the assessment results for each of the evaluation indicators. Two of the indicators were assessed quantitatively (life cycle costs to the RDCO and GHG impact), while the others were assessed primarily qualitatively. Rationale for the qualitative/ subjective scoring is provided in Table 19.

Each scenario was scored between 1 and 5. For the quantitative indicators, MH determined a score for each of the scenarios on a scale of 1 to 5 based on the relative performance of each scenario (with decimal points to distinguish subtle differences in their performance). For the subjective scores, MH did not use decimal points.

To clarify, a score of 5 is the best score and a score of 1 is the worst. It would mean that the scenario option with a score of 5 has a low life-cycle cost, high financial confidence, low GHG impact, low impact to soil/ air/ water, high job creation potential, low transportation impacts, high level of convenience, is well aligned with RDCO policy, has a high adaptability and has a low overall risk.

In Table 18 below, each indicator is considered to have equal importance to the RDCO. In addition, MH was asked to identify if the feasibility results are different if different weighting (relative importance) is placed on each indicator. Section 11 shows how the results would be impacted with different weightings allocated to the evaluation criteria as described in Section 8.1.

[61] Based on information provided by FoodCycler, July 2022.

[62] U.S. Environmental Protection Agency Office of Resource Conservation and Recovery, Documentation for Greenhouse Gas Emission and Energy Factors Used in the Waste Reduction Model (WARM), Organic Materials Chapters, November 2020

Table 18: Overall Assessment Results - Unweighted

Focus Area	Indicator	Status Quo	Scenario 1	Scenario 2	Scenario 3
Financial	Life-Cycle Costs	5.0	3.7	3.5	3.2
	Financial Confidence	4	2	3	1
Environmental	GHG Impact	2.8	3.6	4.2	5.0
	Soil Quality Impacts	2	5	4	3
	Air and Water Quality Impacts	3	2	3	4
Social	Local Employment	2	5	4	1
	Odour, Noise, and Transportation Impacts	3	1	2	5
	Convenience to Residents	5	3	4	2
Policy & Adaptability	Contribution to RDCO Waste Policy	2	4	5	3
	Adaptability to Meet Future Needs	3	4	4	5
	Risk	2	4	4	2

10.1 Life Cycle Costs

The life cycle costs for each scenario were analysed over a 25-year period. An inflation factor of 2.0% was assumed for the life of the project (Statistics Canada 2017-2021 5-year average).

The net present value was calculated for each scenario to give a simple method for comparison. The status quo scenario provides the lowest cost as there are no additional services being provided. Figure 15 shows the average annual additional cost per household resulting from scenarios 1, 2 and 3. These reflect the per-household costs to the RDCO from each scenario. The third scenario identifies the additional cost of annual electricity costs from using the composting appliance. These costs are in addition to the RDCO costs and would be paid by residents.

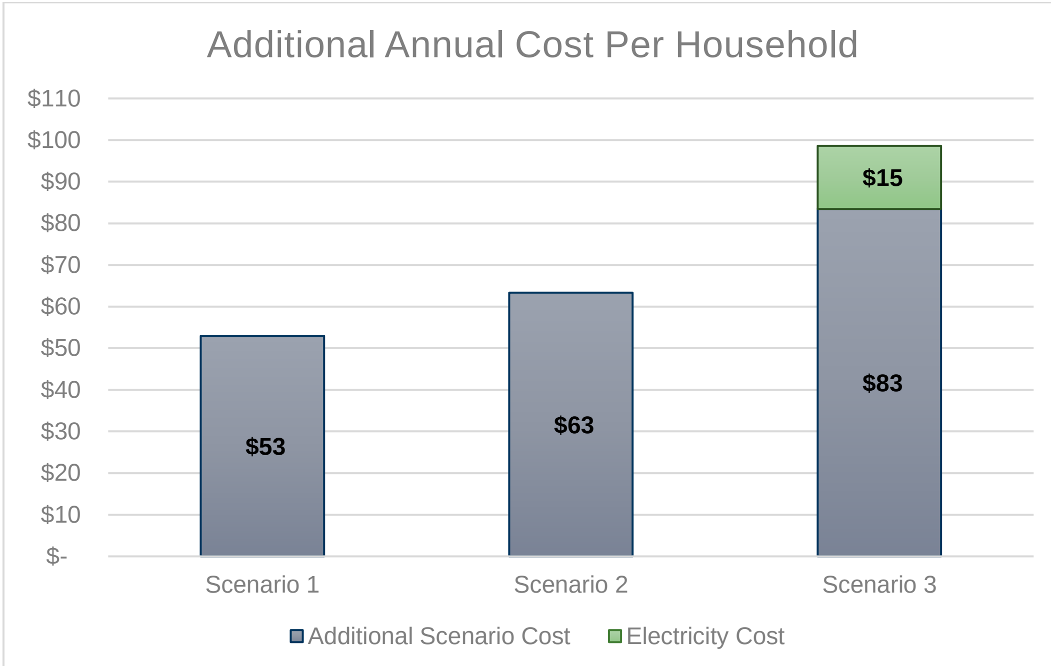

Figure 15: Additional Annual Cost per Household for the Three Food Waste Diversion Scenarios

The figure below shows the total estimated annual cost for the status quo and each food waste diversion scenario. The status quo provides the lowest cost at $9.3 million per year over the 25 years which does not result in any additional cost to households compared to current costs ($147 per household).

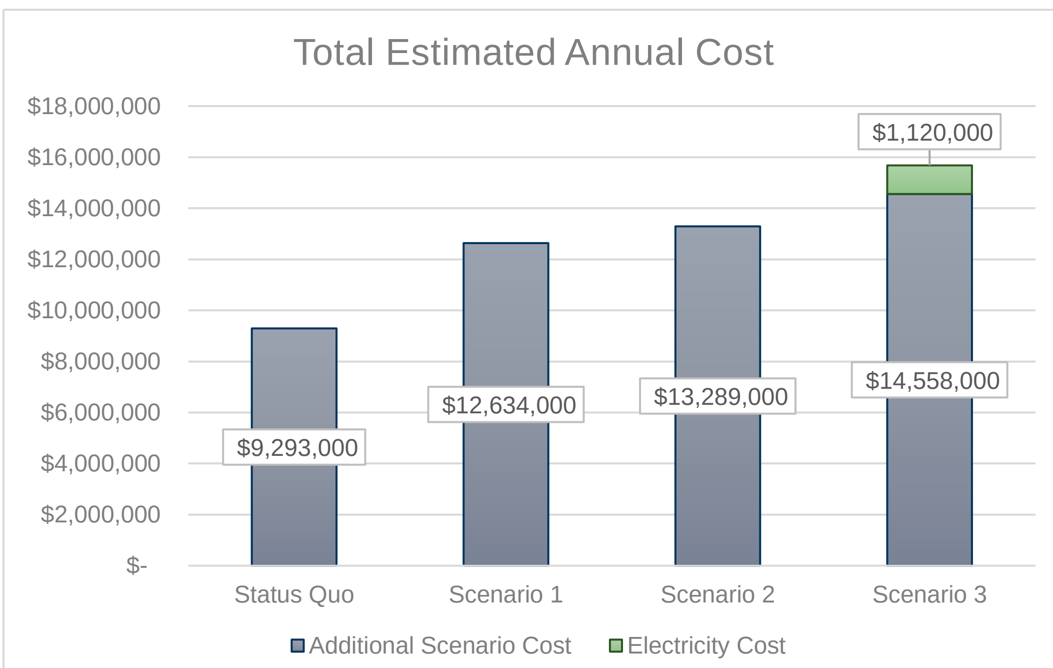

Figure 16: 25-Year Average Annual Cost for each Scenario

When food waste is segregated and garbage collection is reduced to bi-weekly, garbage collection costs and tipping fees for all three scenarios are reduced by an average of $3.4 million per year over the 25-year period.

The following costs should be noted for each scenario:

- **Scenario 1** (manual food waste collection) is estimated to cost $12.6 million per year over the 25-year period, or $3.3 million per year (35%) more than the status quo. This includes capital costs of $3.5 million for the transfer station and $6 million for land, and an additional $0.3 million for annual operating costs. The weekly manual food waste collection service is estimated to cost approximately $3 million annually and $2.8 million to provide household collection bins. Food waste hauling costs and tipping fees are estimated at around $1 million annually. The assessment included an additional $0.3 million for bin replacement costs.
- **Scenario 2** (commingled food and yard waste collection) is estimated to cost $13.3 million per year over the 25-year period, or $4.0 million per year (43%) more than the status quo. This includes capital costs of $5.4 million for the transfer station and $6 million for land, and an additional $0.4 million for annual operating costs. The weekly commingled food and yard waste collection is costing an additional $1.7 million. Organics hauling and tipping fees are estimated just over $3.1 million, more than in scenario 1 as yard waste is also sent to a third-party processor and is no longer composted for free at the Glenmore Landfill.
- **Scenario 3** (kitchen composting) is estimated to cost $14.5 million per year over the 25-year period, or $5.3 million per year (57%) more than the status quo. An initial investment cost of $25 million is estimated to provide all serviced households with one unit each. The annual maintenance costs to replace filters, etc. is estimated to cost approximately $3 million per year.

  In Scenario 3, each household using the kitchen composting appliance is likely to incur an additional $15/household (nearly $1 million for all residents combined) per year in electricity costs in addition to the life cycle costs to the RDCO shown in Figure 15.

Note that all costs indicated above represent a 25-year annual average. Scenarios 1, 2, and 3 will all require significant capital investment up-front that will be required to be funded through fees, reserves, grants, and/or borrowing.

The total estimated 25-year cost for the status quo and three scenarios is provided in the figure below.

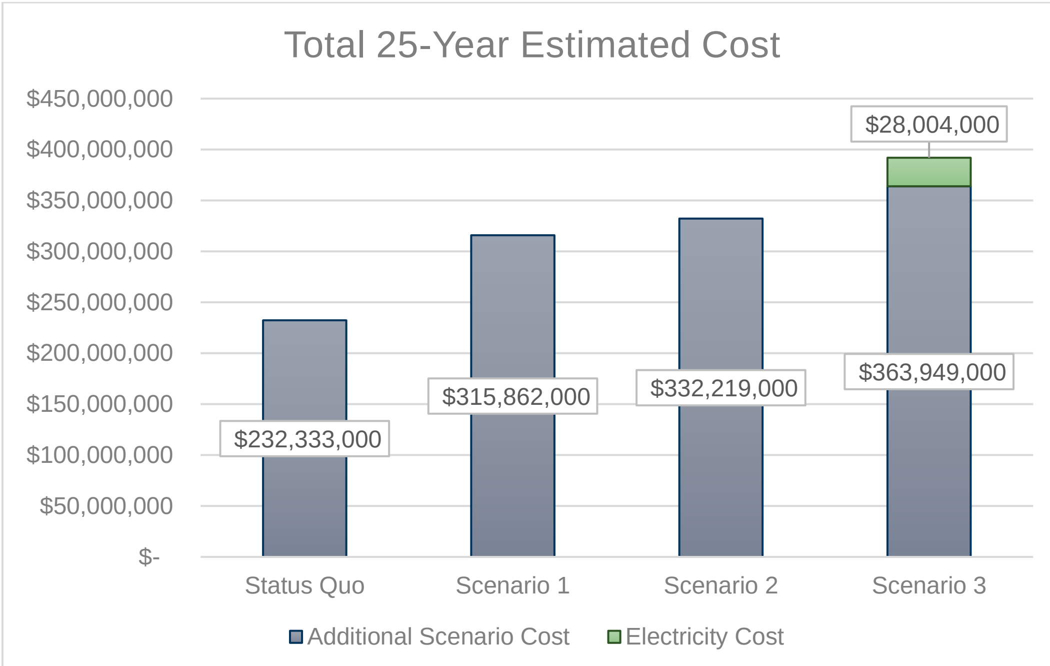

Figure 17: 25-Year Total Estimated Cost for each Scenario

10.1.1 Sensitivity Analysis of Life Cycle Costs

Yard Waste Tipping Fees at Glenmore Landfill

Although the curbside collected yard waste is currently not charged any tipping fees, the standard yard waste tipping fee is $40 per tonne. There is no indication from the City of Kelowna there will be charges for curbside yard waste in the near future, however a sensitivity analysis was completed to assess the impact on life cycle costs to all scenarios including the status quo if the standard yard waste tipping fee ($40 per tonne) was applied.

When applied, the status quo and Scenario's 1 and 3 increase by $740,000 annually. The status quo would experience a $12/household/year increase from the original $147 per household in this analysis. Yard waste in Scenario 2 (i.e., commingled food and yard waste) is already managed, lowering costs closer to that of the status quo (only $52/household/year more than status quo). This also lowers Scenario 2 below the cost of Scenario 1, making it the lowest cost scenario besides status quo. Figure 18 shows the comparison of the scenario annual costs.

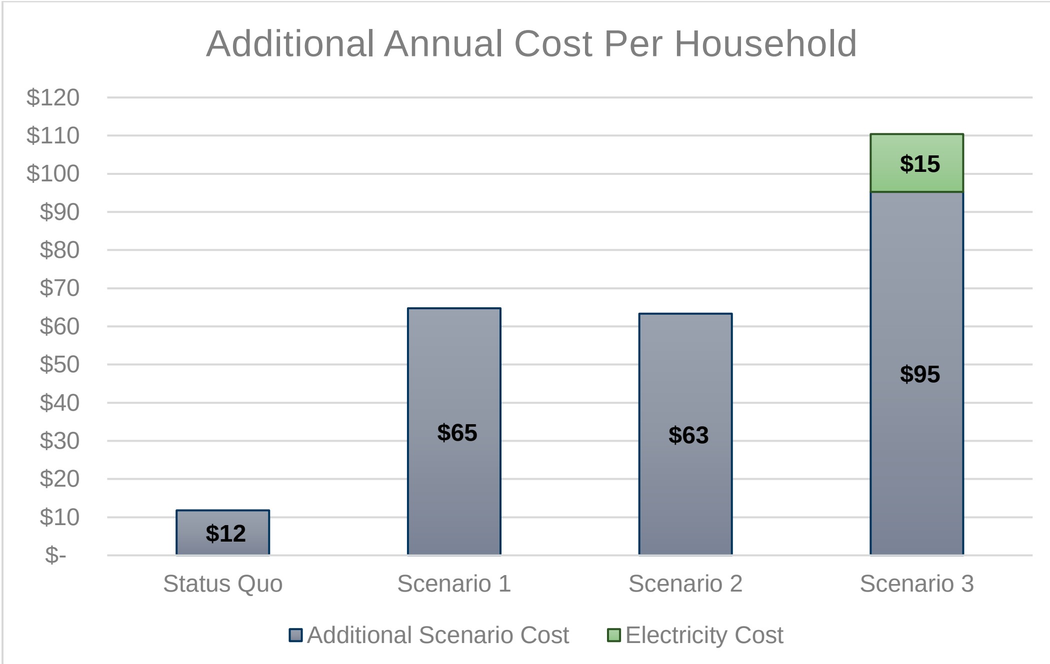

Figure 18: Additional Annual Cost per Household with a Yard Waste Tipping Fee of $40

Tipping Fees for Food Waste/Commingled Food and Yard Waste

The costing of Scenario 1 and 2 is highly influenced by the assumed tipping fees to process food waste and commingled food and yard waste at a third-party processor. A wide range of tipping fees were provided when MH approached processors with facilities in close proximity of the RDCO. Table 8 in Section 3.3 shows a wide range of the likely tipping fees from $35 to $110. With tipping fees that are lower than the MSW tipping fee at Glenmore Landfill ($102), there are potential savings from avoiding MSW tipping fees and instead paying tipping fees for segregated food waste; however, these savings are offset against higher hauling costs. This analysis will have a greater impact on Scenario 2 as significantly more tonnage is sent to the third-party processor. In the initial assessment (Figure 15), a tipping fee of $70 per tonne is assumed. Figure 19 shows the life-cycle costs per household if the tipping fee is as low as $35 per tonne. With a per-tonne tipping fee of $35, the cost of Scenario 1 is reduced by $300,000 and Scenario 2 reduced by nearly $1 million.

Figure 20 shows the results if tipping fees are at the higher end ($110 per tonne), which would be more costly than landfilling. This would increase Scenarios 1 and 2 by $300,000 and $1 million respectfully, making Scenario 1 outperform Scenario 2.

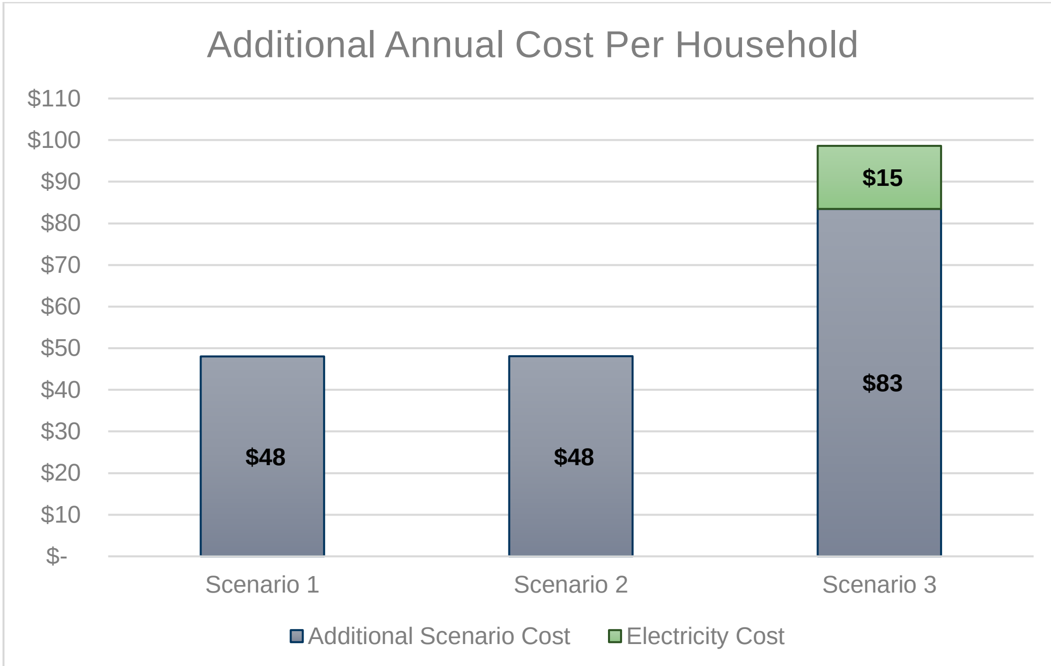

Figure 19: Additional Annual Cost per Household with a Food Waste/ Food and Yard Waste Tipping Fee of $35

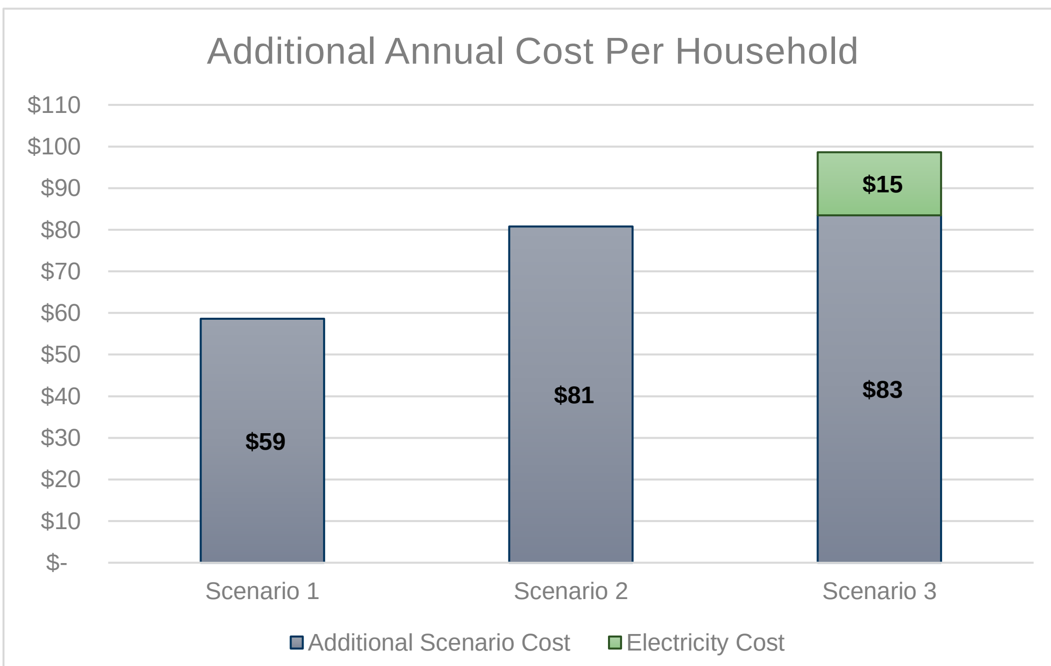

Figure 20: Additional Annual Cost per Household with a Food Waste/Food and Yard Waste Tipping Fee of $110

Land Purchasing Cost for Transfer Station

Land purchasing cost for the required organics transfer station in Scenario 1 and 2 was assumed to be $6 million for a 3-acre site. Although the building footprints are different in these two scenarios, the required land area is linked to the required road network, accounting for the turning radii of trucks servicing the site, and therefore the same land area is assumed in Scenarios 1 and 2.

If the transfer station was located on land owned by the RDCO or a member municipality and a land purchase was not required, annual costs for both scenarios would reduce by about $240,000.

Land purchase costs would need to be higher than $60 million to make the status quo rank better than Scenario 2.

Assumed Cost of Kitchen Composting Unit

The retail cost of a kitchen composting appliance is currently $500 - $640, however a wholesale discounted cost of $400 was assumed. The maintenance costs of the composting appliance also vary from $50 - $200 per year while a cost of $50 was chosen as stated in the assumptions.

For the life-cycle costs, the unit costs would need to be reduced to around $250 per appliance to make Scenario 3 financially competitive with other two scenarios. According to FoodCycler they have been able to secure pilot subsidies (including municipal funding) that have reduced the costs per unit to between $50 and $175 per participating household. It is unlikely that the RDCO can secure subsidies for a full roll-out to all households, but it may be possible to secure lower per-unit costs for such large quantities. As these costs are highly uncertain, the financial risk associated with Scenario 3 is considered high.

10.2 GHG Impacts

The feasibility assessment included a detailed analysis of the GHG emissions resulting from status quo and the three alternative scenarios.

The emissions categories common through all scenarios include the LFG emissions released from the landfill and flare, curbside collection emissions for the various waste streams, and emissions associated with the composting process. Emission reductions exist through the production of RNG and carbon sequestration from the compost product. Carbon sequestration is the process of capturing and storing atmospheric carbon dioxide.

Carbon sequestration also occurs in a landfill as not all components of organic waste decompose. The decomposition rate of organic materials varies due to material composition and the carbon storage potential is largely based on lignin content. Lignin does not easily degrade and allows for carbon storage as it is not transformed into carbon dioxide and methane. However, the carbon storage potential of food waste in a landfill is considered to be low as food waste contains a low lignin content[63]. As the carbon sequestration value of food waste in a landfill is relatively low (0.02 tCO_2e/short ton[64]) compared to composting (0.24 tCO_2e/short ton[65]), it is not included in the GHG analysis.

Figure 21 shows the emission categories and net GHG emissions of each scenario over the 25-year project evaluation period.

Scenarios 1 and 2 include additional emission categories for the transfer station operations and the waste hauling from the transfer station to the compost processor. Scenario 3 includes electricity and composting related emissions associated with the kitchen composting appliance.

The status quo results in the highest GHG emissions as it has the highest landfill related emissions at 55,000 tCO_2e. This scenario also has the highest RNG production, however there is also less organic material composted compared to the three food waste scenarios and less benefit from carbon sequestration offsets. With food waste diverted from landfill, the three scenarios have only 24,000 tCO_2e of landfill related emissions. Scenarios 1 and 2 show approximately 40,000 tCO_2e reduction for both scenarios based on their compost carbon sequestration potential. Compared to the status quo, the collection, transfer station operations and waste hauling result in approximately 33,000 tCO_2e for both Scenario 1 and 2, although these emissions are generated from different sources. Scenario 1 has higher GHG impacts from the new manual collection, and Scenario 2 has greater impact from transfer and waste hauling the commingled food and yard waste.

Scenario 3 has similar carbon sequestration offsets as the status quo, but it achieves the lowest GHG emissions as all other emission categories are lower including less LFG emissions as food waste is kept out of landfill. There are also less waste collection and transfer emissions as there is no additional collection service with the kitchen composting appliance.

63 U.S. Environmental Protection Agency Landfill Carbon Storage in WARM (2010)

64 SCS Engineers – Current MSW Industry Position and State-of-the-Practice on LFG Collection Efficiency, Methane Oxidation, and Carbon Sequestration in Landfills (2009)

65 U.S. Environmental Protection Agency Office of Resource Conservation and Recovery, Documentation for Greenhouse Gas Emission and Energy Factors Used in the Waste Reduction Model (WARM), Organic Materials Chapters, November 2020

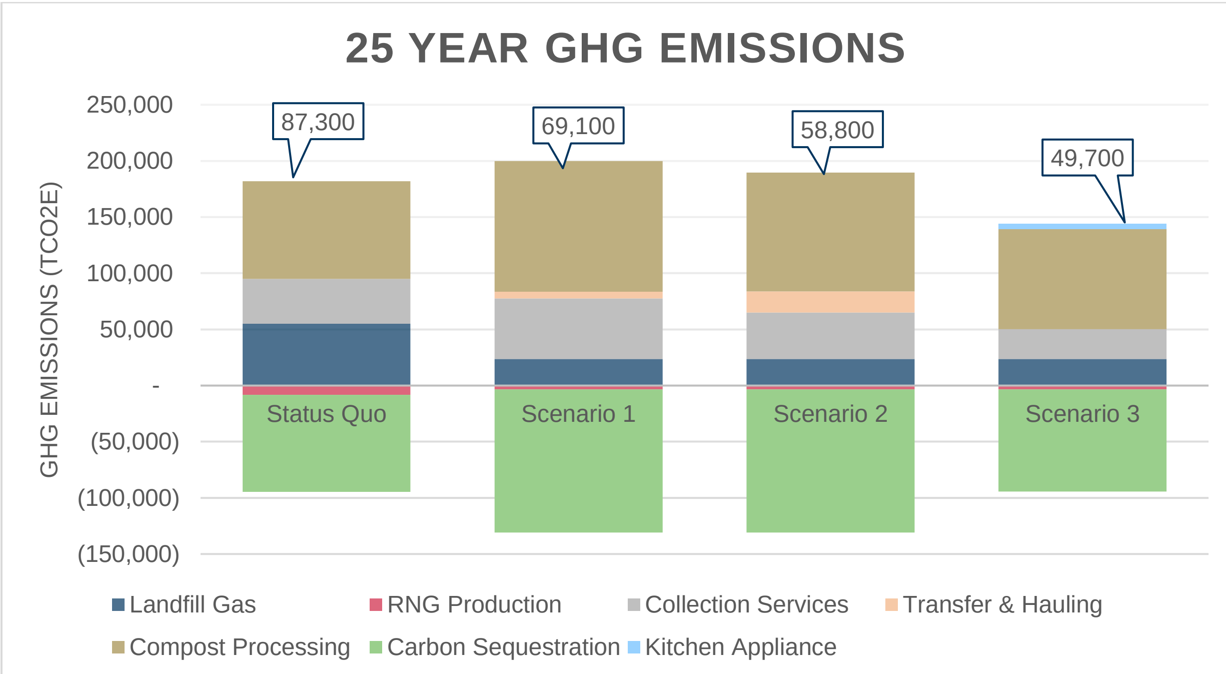

Figure 21:GHG Impacts for Status Quo and the Three Food Waste Diversion Scenarios

10.3 Scoring Rationale for Subjective Scores

Table 19 provides justifications for the subjective scoring of status quo in comparison to the three alternative organics diversion scenarios.

Table 19: Rationale for Subjective Scoring

Indicator	Status Quo	Scenario 1 – Manual Food Collection	Scenario 2 – Commingled Food and Yard Waste Collection	Scenario 3 – Kitchen Composting
Financial Confidence	Relatively low risk as the landfill is expected to reach capacity by 2107. However, the landfill life would be extended if organics are diverted from the landfill. Score 4	There will be a risk associated with relying on an out-of-region processing facility and the processing fee. Lower tonnages of feedstock may not give as competitive rates as Scenario 2 with commingled food and yard waste. Collection costs (e.g., costs of kitchen catchers and manual curbside containers) may be reduced if the RDCO can access grant funding. Score 2	There will be a risk associated with relying on an out-of-region processing facility and the processing fee. Higher tonnages of feedstock may give more competitive rates compared with Scenario 1 with food waste only. Collection costs (e.g., costs of kitchen catchers) may be reduced if the RDCO can access grant funding, however opportunities may be limited as curbside carts are already in place. Score 3	There is uncertainty about how much grant funding would be available for this option. So far, grant funding has been allocated for pilot projects. There is also uncertainty regarding the service life of each appliance as the technology is relatively new. Score 1
Soil Quality Impacts	Landfilling of food waste does not support the replacement of topsoil as organic matter cannot be beneficially used. Backyard composting is still encouraged and GlenGrow compost will continue being produced from yard waste and will have local benefits to soil. Score 2	Food waste is likely to be processed into a Class A compost, which can be beneficially applied to soils through markets near the compost facility. This may take place outside the region if the facility is located in a nearby region. GlenGrow compost will continue being produced from yard waste and will have local benefits to soil. When applied to land compost adds nutrients and organic material to the land, which helps with moisture retention, minimizes erosion, etc. Score 5	Commingled food and yard waste is likely to be processed into a Class A compost, which can be beneficially applied to soils through markets near the compost facility. This may take place outside the region if the facility is located in a nearby region. GlenGrow compost will not be produced from the curbside yard waste reducing the quantity of compost used locally. When applied to land compost adds nutrients and organic material to the land, which helps with moisture retention, minimizes erosion, etc. Score 4	The end product from the kitchen composters is a sterile biomass, which can be beneficial as a soil amendment once the biomass is broken down further in the soil. More testing is required to demonstrate that the products can effectively provide soil nutrients in the same way as a Class A compost product. If a household elects to place the biomass into garbage, there would be minimal benefits to soil (same as status quo). The biomass is not an accepted feedstock at the compost facility at Glenmore and would not be allowed to be placed into the yard waste collection. There are no benefits to soil if residents place the biomass into garbage. Score 3
Air and Water Quality Impacts	The status quo involves local landfilling at an already permitted disposal facility (Glenmore Landfill) with recirculating leachate. The LCA 2012 estimated the adverse impacts on air quality (photochemical oxidation, ozone depletion and air acidification) to be similar for the status quo compared to a food collection scenario. The LCA showed that the calculated emissions contributing to aquatic ecotoxicity to be lower for the status quo compared to scenarios when organics are sent to an enclosed composting facility. The LCA also showed similar air impacts. With the 2022 updates to OMRR 2022, a permitted compost facility is likely to have environmental controls that are equivalent to those at landfills. Air and water quality impacts are assumed to be similar. Score 3	With the 2022 updates to OMRR, a permitted compost facility is likely to have environmental controls that are equivalent to those of permitted landfills. Impacts are assumed to be similar. This scenario may perform slightly worse as more air impacts are likely from the trucks of the new food waste collection. Score 2	With the 2022 updates to OMRR, a permitted compost facility is likely to have environmental controls that are equivalent to those at permitted landfills. Impacts are assumed to be similar. Score 3	It is unclear what air impacts the kitchen composting unit has from the heating and pulverization process compared to traditional composting, but they are assumed to be minor. There would be no impacts relating to the transportation of food waste. Score 4
Local Employment	The management of MSW for landfill disposal is typically not labour intensive and generates the fewest jobs per tonne of waste (0.62 jobs per 1,000 tonnne collected and 0.11 jobs per 1,000 tonnes landfilled, converted to metric from the	The automated garbage collection frequency was assumed to reduce to bi-weekly, however a manual food waste collection is more labour intensive and a net positive impact is assumed (1.84 jobs are created per 1,000 tonnes of material collected for composting as per the	A small positive impact on collection staffing was assumed. The automated garbage collection frequency was assumed to reduce to bi-weekly at the same time as the collection of commingled food and yard waste increases to weekly and with a collection during the winter months. Additional	The appliance vendors (FoodCycler and LOMI) have Canadian offices and support centres, but the manufacturing of the kitchen units are undertaken in Asia. Score 1

Indicator	Status Quo	Scenario 1 – Manual Food Collection	Scenario 2 – Commingled Food and Yard Waste Collection	Scenario 3 – Kitchen Composting
	Tellus 2011 report[66]). Landfill equipment can handle large tonnages with few employees. Consistent with this, the 2012 LCA estimated that employment opportunities associated with landfilling are approximately half of those of the food waste collection scenario. Score 2	Tellus 2011 report). Additional employment is required at the transfer station and the increase in feedstock at the processing facility will require more staffing. Score 5	staff are required at the transfer station and at the processing facility where the feedstock is received. Although yard waste would no longer be sent to composting facility at Glenmore Landfill, which will be upgraded from window composting to an aerated static composting system, a positive impact on jobs can be expected overall from the processing. A processing facility was assumed to use a more labour intensive process than the process at Glenmore facility (an enclosed composting process is more labour intensive than an aerated system that is likely to be in place at Glenmore). These assumptions are consistent with those of the 2012 LCA study report. Score 4	
Odour, Noise, and Transportation Impacts	Landfill activities are generally odorous and noisy. The status quo involves local landfilling at an already permitted disposal facility (Glenmore Landfill). Odour and noise impacts are assumed relatively low from a permitted landfill and impacts from transportation are limited to MSW collection. Score 3	Although there would be lower MSW volumes managed at the Glenmore Landfill, there would be more noise generated resulting from the new food waste collection and the local transfer station facility. There will be a net increase in collection kilometers compared to status quo as garbage collection reduces to bi-weekly but food waste is collected weekly and require transfer to a processing facility.. Odour and noise impacts are assumed low from a permitted processing facility. Score 1	There will be a net increase in collection kilometers compared to status quo as garbage collection reduces to bi-weekly but yard waste is collected weekly and require transfer to a processing facility. There would also be more noise generated resulting from a new local transfer station facility. Odour and noise impacts are assumed low from a permitted processing facility. Score 2	There will be a net reduction in collection kilometers compared to status quo as garbage collection reduces to bi-weekly. This scenario has the lowest transportation impacts since no food waste is collected or transferred. Odour and noise impacts are assumed minimal with this scenario. Noise and odours would be limited to the proximity of the kitchen appliance, if not managed properly (maintained regularly with new filters). Score 5
Convenience to Residents	In the status quo it is difficult for residents who are wanting to divert food waste. They either have to backyard compost or seek a private company to collect their food waste. However, the status quo requires the fewest number of carts for residents to manage, has the less of the ick factor, and is simple for residents. Score 5	This scenario allows the use of a kitchen catcher and a small food waste container that should be easy to maneuver, thanks to its small size. The fact that residents need a new cart is slightly less convenient than using the existing yard waste cart. Source segregating organics does present the most ick factor. Score 3	No additional cart would be needed as residents use the existing yard waste cart. Residents will benefit from the year-round weekly collection which offer an increased level of service compared to current yard waste collection. Source segregating organics does present the most ick facto and residents will require to line the bin with newspaper and clean out their own carts on a regular basis to limit the ick factor. Score 4	From the City of Nelson pilot, 30% of residents reported issues with odour, noise or capacity. Approximately 50% had no complains of the appliance. 83% would recommend the use of the unit to others. It appears that the in-kitchen unit was perceived as convenient. However, the pilot was undertaken amongst residents who registered their interest to participate, and this may sway results. Participants were already eager to try the unit. The long-term maintenance lowers the convenience. The lack of access to a yard space for application of the end product makes this scenario less convenient. This scenario requires residents to have space for a large kitchen appliance and operate and maintain the appliance. Score 2
Contribution to RDCO Waste Policy	Does not support with the SWMP goals of actively engaging citizens in behaviours that reflect the	This scenario aligns well with the SWMP goals, guiding principles and it saves landfill space and	This scenario aligns well with the SWMP goals, guiding principles and it saves landfill space and	This scenario aligns well with the SWMP goals, guiding principles and it saves landfill space,

66 Tellus Institute and Sound Resource Management. 2011. More Jobs, Less Pollution: Growing the Recycling Economy in the US. Bluegreen Alliance.

Indicator	Status Quo	Scenario 1 – Manual Food Collection	Scenario 2 – Commingled Food and Yard Waste Collection	Scenario 3 – Kitchen Composting
	waste management hierarchy and making it easy for residents and businesses to make the right decisions. The status quo is also not aligned with some of the SWMP's adopted principles (originally recommended by the MOECSS). Yet, the SWMP justifies why the landfilling of food waste is currently in place. Score 2	diversifies the waste management system and makes it more adaptable over the long term. It can be seen as a slightly less convenient option compared to scenario 2 and it can rank lower against the goal to making it easy for residents and businesses to make the right decisions. Score 4	diversifies the waste management system and makes it more adaptable over the long term. It can be seen as a more convenient option compared to scenario 1 and it can rank higher against the goal to making it easy for residents and businesses to make the right decisions Score 5	manages waste locally, diversifies the waste management system and makes it more adaptable over the long term. It can be seen as a relatively convenient option that is equivalent or better than scenarios 1 and 2 since no organics needs to be placed at the curb; however, residents are required to operate the appliance. The final uptake is still unclear since all pilots have been small scale and more data is needed to confirm that the scenario is making it easy for participating residents to make the right decisions. If residents have no access to a yard, they will need to place the end product into garbage. Score 3
Adaptability to Meet Future Needs	Landfill capacity is not an issue and this scenario can cater for population growth, however the scenario may not be as adaptable as other scenarios to changes in BC regulation relating to MSW if organics diversion is further encouraged. Score 3	As this scenario involves using an external processor, the RDCO will have flexibility to manage varying feedstock quantities. The transfer station size may require upgrading as the population grows, but this is relatively inexpensive. Curbside collections routes can be adjusted to account for population growth in new areas. Score 4	As this scenario involves using an external processor, the RDCO will have flexibility to manage varying feedstock quantities. The transfer station size may require upgrading as the population grows, but this is relatively inexpensive. Curbside collections routes can be adjusted to account for population growth in new areas. Score 4	This scenario should be providing maximum adaptability to manage population growth. No curbside collection is needed and new dwellings can be asked to purchase the in-kitchen composting unit. Score 5
Risk	The risk involves having a waste management system that is misaligned with BC's solid waste and climate change targets and goals. Public perception is another risk and residents' expectations of having access to food waste diversion options. There is also risk of negative public perception since Provincial goal involves organics diversion and bans. Score 2	Risks with using private processor involve having to enter agreements with a processor in which certain feedstock volumes must be guaranteed. These risks can be managed through procurement and contract management. As the curbside service targets the residential sector, the ICI sector would still be able to continue to send organics to landfill and the commitments with Fortis BC for the sale of landfill gas are likely to still be met. Even with differential tipping fees that encourage ICI organics diversion, there will be some organics being landfilled. Score 4	Risks with using private processor may involve having to enter agreements with a processor in which certain feedstock volumes must be guaranteed. These risks can be managed through procurement and contract management. As the curbside service targets the residential sector, the ICI sector would still be able to continue to send organics to landfill and the commitments with Fortis BC for the sale of landfill gas are likely to still be met. Even with differential tipping fees that encourage ICI organics diversion, there will be some organics being landfilled. Score 4	Although there would be no risk involved with guaranteeing feedstock quantities with a private processor, the largest risk involves residents not using the costly in-kitchen appliance. The ICI sector would still be able to continue to send organics to landfill and the commitments with Fortis BC for the sale of landfill gas are likely to still be met. Score 2

11. WEIGHTED RESULTS

The table below shows how the results are impacted with different weightings allocated to the evaluation criteria as described in Section 8.1.

Scenario 2 (automated food and yard waste collection) is the highest ranked option in both unweighted and weighted results. The status quo ranks second with the application of relative weighting to each indicator. Scenario 1 (manual food collection) scores in third place before Scenario 3 (kitchen composting).

MH was also asked to include a sensitivity analysis to determine how the result would be impacted with different weightings. Instead of having 25% weighting on life-cycle costs, MH checked how high the weighting would need to be on this factor to make status quo rank the highest. If 40% weighting was placed on Life-Cycle Costs, only 15% on GHG emissions and all other indicators were weighted at 5% each, the status quo would outperform Scenario 2.

Table 20: Overall Assessment Results - Weighted

Focus Area	Indicator (Weighting%)	Status Quo	Scenario 1	Scenario 2	Scenario 3
Financial	Life-Cycle Costs (25%)	1.25	0.92	0.87	0.80
	Financial Confidence (5%)	0.20	0.10	0.15	0.05
Environmental	GHG Impact (25%)	0.71	0.90	1.06	1.25
	Soil Quality Impacts (5%)	0.10	0.25	0.20	0.15
	Air and Water Quality Impacts (5%)	0.15	0.10	0.15	0.20
Social	Local Employment (5%)	0.10	0.25	0.20	0.05
	Odour, Noise, and Transportation Impacts (5%)	0.15	0.05	0.10	0.25
	Convenience to Residents (15%)	0.75	0.45	0.60	0.30
Policy & Adaptability	Contribution to RDCO Waste Policy (4%)	0.08	0.16	0.20	0.12
	Adaptability to Meet Future Needs (3%)	0.09	0.12	0.12	0.15
	Risk (3%)	0.06	0.12	0.12	0.06
	Total	**3.64**	**3.42**	**3.77**	**3.38**
	Rank	**2**	**3**	**1**	**4**

12. DISCUSSION AND RECOMMENDATIONS

The feasibility assessment focused on food waste generated by residents who are currently serviced at the curb within the RDCO. The assessment showed that the status quo offers the lowest cost option with no changes to the existing services. However, once all the other financial, environmental, and social indicators are taken into account, it shows that the commingled collection of food and yard waste is the highest ranked option, followed by the status quo, and the manual food waste collection. To provide individual kitchen composting appliances to all households scored the worst of all four scenarios.

Comparison to 2012 LCA Findings

The overall findings in this study show a different result than the 2012 LCA, which showed that the introduction of a food waste collection program and the establishment of an in-region organics processing facility was unlikely to provide benefits over the status quo. There are some differences in scope between the studies. The 2012 LCA considered all organic materials, including wood waste, paper and cardboard, and biosolids, and the recent study focuses on diversion opportunities for residential food and yard waste only. For the 2012 LCA, the estimated total feedstock was double the estimated for this study. The 2012 LCA report does not identify how much the ICI sector contributes to the projected food waste tonnages. In the 2012 study, few details of the curbside food waste collection were provided, and the assumptions related to curbside collection are not clear (e.g., if food waste is commingled with yard waste).

A key difference in approaches used for the studies lies in the assumption of which agency or agencies would own the food waste processing facility. In the LCA study it was assumed that a new organics processing facility would be established in the region to process the segregated food waste. The report does not state the assumed facility location. Since this option is compared to an already established engineered landfill, any option involving new infrastructure compost facility infrastructure will be costly by comparison. The LCA study notes that capital and operating costs for the baseline scenario are low, as the additional capital investment required is marginal in comparison to other scenarios. If the RDCO sends segregated food waste to an already established private sector facility, which is assumed for this study, the costs and other impacts associated with the construction of a new facility, are not applicable.

GHG Impacts

With the food waste being source separated and diverted from Glenmore Landfill, LFG production and related GHG emissions from the landfill will be reduced as there will be less decaying organic material landfilled. This will affect the LFG available for RNG production in the FortisBC processing plant. However, much of the organic waste will still continue to generate LFG. Food waste that is not successfully source segregated (captured) through the residential food waste curbside collection will continue to generate LFG, together with non-diverted organic waste from the ICI sector and MF buildings. These would still provide a source for RNG production, and the City of Kelowna would still need to maintain existing landfill gas collection infrastructure. MH estimated that of the current organic materials going to landfill, 76% will continue to be landfilled. This includes the unrecovered food and yard waste, clean wood, and other compostable waste. Even if the RDCO established differential tipping fees that encourage ICI organics diversion, there will be some organics landfilled. There is also other residual waste which is classified as moderately decomposable that will also generate LFG. The City would need to undertake a more detailed analysis of the impacts on LFG generation to confirm whether the current commitments with FortisBC for the sale of RNG can be met.

Each scenario was compared to the status quo in relation to the additional cost of implementation and resulting reduction in GHG emissions. A $/t$CO_2$e for each scenario was analysed and presented in the figure below. Scenario 2 and Scenario 3 are equal as the most cost effective per tCO_2e reduced. Both scenarios were more expensive than Scenario 1 but created a greater tCO_2e reduction. Scenario 3 was the highest cost scenario but because it had the largest difference from the status quo GHG emissions, it was just as cost effective for reducing GHG emissions.

As a comparison, the Canadian carbon pricing is currently set at $50/t$CO_2$e and will be increasing by $15 annually, reaching $170/t$CO_2$e by the 2030[67].

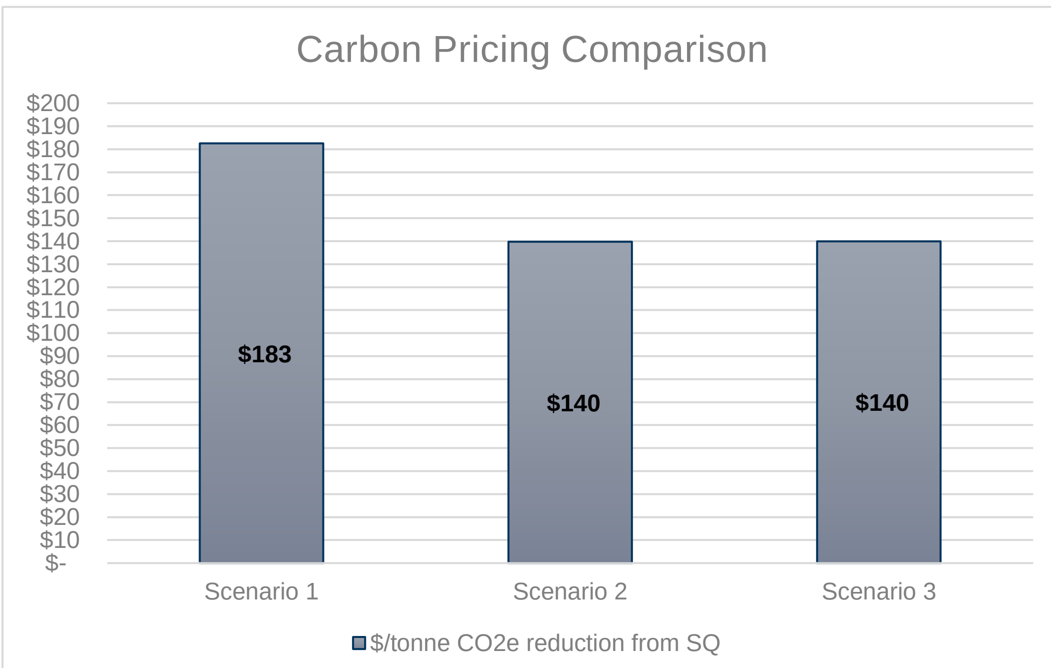

Figure 22: Comparing additional Cost above Status Quo to tCO_2e reduction from Status Quo

Although a $/t$CO_2$e is available, this metric should not be looked at alone as there are additional benefits to consider with these scenarios as described in the scoring table in Section 10.3.

[67] Government of Canada – The Federal Carbon Pollution Pricing Benchmark (2021)

12.1 Recommended Next Steps

Based on this feasibility assessment, there are advantages with collecting food waste using the existing automated collection compared to other scenarios. The existing collection trucks and curbside carts can be used, and the main change involves the increase to a year round weekly collection from the current bi-weekly for organics. Adjusting collection frequency can be an effective tool for building participation for organics diversion, as well as allowing the acceptable garbage limit to be reduced.

Resident Engagement

The SWMP states that the RDCO will investigate what additional organics diversion options are feasible in the region and identify options that are cost- effective, socially acceptable, etc. The current wording of the SWMP shows a commitment to ensure that the organics diversion option should be socially acceptable. Therefore, the RDCO is advised to engage residents prior to implementing any changes to receive confirmation that residents are wanting a curbside collection to also include food waste. Engagement can involve an online survey to confirm that such service change is favoured and socially acceptable. Understanding the community's willingness to pay more and their reactions to or preferences on the proposed service changes can be used to develop strategies to overcome reluctance in accepting the new service.

RDCO's SWMP Strategy Targeting Recycling

Strategy 7. Re-evaluate organic waste diversion opportunities while considering the need to maintain LFG collection and use at the landfill

Investigate what additional organics diversion options are feasible in RDCO (these must be cost- effective, socially acceptable, etc.) in the future, if there is sufficient organic waste generated in the region. Options to assess include:

- Opportunities for businesses and multi-family units; and
- An organics curbside collection and processing program, if sufficient quantities are available in the future.

Some strata properties are not serviced by the RDCO for yard waste collection and engage private contractors. The RDCO may want to seek input how to best cater for strata properties in terms of food and yard waste collection. The use of individual carts may not be suitable in tight/congested areas due to space requirements or truck maneuvering and alternate solutions may be more suitable. The RDCO will need to reach out to strata complexes to identify their preferences.

The RDCO can use resident feedback to design the curbside program to maximize convenience to residents and foster community buy-in when the program is implemented. For the engagement, the RDCO needs to have confidence in how much the additional food waste collection service will cost residents. This report should not be used to identify the final changes in user fees to receive the improved service.

Although the potential addition of food waste to the collected waste streams may feel like a minor service change to the RDCO, the implementation of a transition needs to be adequately planned and resources. Changing service levels can be a challenging and frustrating experience, especially if reasons for the change are not fully understood by residents. To build enthusiasm and understanding before changes are implemented, MH recommends that a meaningful consultation strategy is developed.

Contractual Changes

The inclusion of food waste into the existing yard waste collection will have some contractual implications. Although the RDCO has not specifically asked the collection contractor about its abilities to collect food waste, E360S has indicated that they are willing to expand collection services if needed. The RDCO is advised to reach out to the contractor to gauge their willingness and potential cost and timing of expanding the current bi-weekly yard waste collection to a weekly collection for food and yard waste year-around and reducing garbage collection to bi-weekly.

The RDCO and its member municipalities recently approved that request to Recycle BC to undertake direct curbside recycling services commencing April 30, 2026 to line up with the collection contract termination date with E360S. When the responsibility for recycling collection is transferred to Recycle BC, the garbage and yard waste collection contractor could have capacity to undertake food waste collection instead of recycling.

Communicating the Change

The development of a communication strategy is recommended to identify and describe the purpose, target audience, key messages (i.e., the reasons for the changes), engagement tools, and timing for communications. A useful tool for changes in collection service is the preparation of answers to anticipated frequently asked questions (FAQs). These can be provided with information packages, set up on posters at display booths, and made available on the relevant solid waste web pages of RDCO's and each member municipality.

MH recommends that the RDCO reviews the MOECSS guide on Best Management Practices for Curbside Collection of Residential Organic Waste[68], which identifies a range of key considerations for the expansion of existing collection programs. The guide has resources available to assist with communicating program information, including posters for communicating change.

The communication costs associated with changing the curbside collection fall into two categories: lead-up communications prior to program launch, and ongoing program communications after the program launch. For the RDCO, the estimated one-time public education and outreach costs are likely to range from $10 to $15 per household which have been included in the Life-Cycle Costs to the RDCO.

[68] Available via URL: https://www2.gov.bc.ca/assets/gov/environment/waste-management/organic-waste/org-infrastructure-program/best_management_practices_organic_waste_curbside_collection.pdf

Wildlife Considerations

Preventing wildlife interactions is a key consideration for many residents in the RDCO. It is essential to develop a curbside collection program that protects the environment and ensures wildlife, such as bears, cannot access waste materials.

If the RDCO expands the existing yard waste collection to include food waste, the RDCO may want to retrofit some of the existing carts with locks to make them bear-resistant. This may be best suited in problem areas.

The RDCO has recently ordered 120L Schaefer carts for garbage retrofitted with carabiner locks at a per-unit cost of $165. The per-unit cost may be reduced if larger cart quantities are purchased. A total of 100 bear resistant garbage carts were distributed during the spring of 2022. Depending on resident feedback from using these carts, the RDCO can determine the suitability of using similar carts for food and yard waste collection in specific problem areas.

Multi Family and Business Sector

It is more common for local governments across BC to provide curbside collection services only to the residential sector. Within the RDCO, there are private collectors/haulers to provide organics collection for the ICI sector (including MF buildings). Private haulers can tailor food waste collection systems to the specific customer needs and competition for business between private haulers also contributes to the development of cost-effective collection systems. Rather than competing with the private service providers, MH is recommending that the RDCO continues to focus on servicing the residential sector. The RDCO can instead influence the ICI sector to divert organics by implementing organics waste bans or differential tipping fees.

The kitchen composting units, which allows on-site composting, have not yet been tested on businesses and multi-family units. MH understands that FoodCycler has actively been looking for local government partners to pilot the use of their processing appliance in a multi-family setting. The vendor has several models available and the largest capacity units may be suited to used in a shared “recycling and waste” area of a building.

The RDCO may also want to consider the use of commercial scale “kitchen composting” units, such as the Oklin composter (mentioned in Section 3.2.2.) in MF buildings. More research is needed to confirm which of these systems are most suited to manage organics in MF buildings.

A pilot can determine if the technology is a good option to divert organics from landfill in MF buildings. The success of a pilot will depend on how well residents would be using the processing technology and how the resulting end products (i.e., the sterile biomass) can be beneficially used without being disposed into garbage with very little net benefit. The RDCO may want to follow City of Nelson’s wider roll-out in 2023 of the kitchen composting units before committing to a MF pilot using the same technology.

13. CLOSURE

The Regional District of Central Okanagan retained Morrison Hershfield to conduct the work described in this report, and this report has been prepared solely for this purpose.

This document, the information it contains, the information and basis on which it relies, and factors associated with implementation of suggestions contained in this report are subject to changes that are beyond the control of the author. The information provided by others is believed to be accurate and may not have been verified.

Morrison Hershfield does not accept responsibility for the use of this report for any purpose other than that stated above and does not accept responsibility to any third party for the use, in whole or in part, of the contents of this document. This report should be understood in its entirety, since sections taken out of context could lead to misinterpretation.

We trust the information presented in this report meets Client's requirements. If you have any questions or need addition details, please do not hesitate to contact one of the undersigned.

Morrison Hershfield Limited

Prepared by:

Veronica Bartlett, M.Sc.
Senior Solid Waste Planner
vbartlett@morrisonhershfield.com

Reviewed By:

Todd Baker, P.Eng.
Senior Environmental Engineer
Global Waste Practice Lead
tbaker@morrisonhershfield.com

APPENDIX A: Common Organics Processing Technologies

1 PASSIVELY AERATED AND TURNED SYSTEMS

1.1 Static Pile

The static pile method involves forming organic feedstocks into large, outdoor windrows or piles, which can decompose over a long period (up to 2-3 years with little or no mixing or turning). Static piles are normally built using front-end loaders, skid-steers, farm tractors or excavators. It is generally used at smaller facilities that process less than 1,000 tonnes per year (tpy).

Static pile composting has typically been used to process yard and garden waste, including leaves, brush and wood residuals. This method of composting is the simplest and least expensive option available. It is generally only appropriate when there is an abundance of space available.

In BC, static pile composting is not normally recommended outdoors in high rainfall climates because of the requirement to capture and treat the leachate. It is being used very successfully with animal disease outbreaks or animal mortality composting under very controlled conditions. It is not suitable for general food waste composting because of the potential for odour and leachate.

1.2 Bunker

Bunker composting can be considered as static piles built in small bunkers. This is a simple composting method well-suited to smaller feedstock quantities of yard and garden waste (less than 500 tpy).

The bunkers can be constructed from cast-in-place concrete, concrete lock-blocks, modular concrete barriers and even wood. Depending on the installation location and climate, bunkers can be located outdoors, covered by a simple roof structure, or contained within a building.

This technology is suited for garden and yard waste but not for food waste processing.

1.3 Windrow

Windrow composting involves the feedstocks being formed into long, low piles known as windrows. Windrows are typically 1.5m to 3.5 m high and 3m to 6m wide. The windows are regularly moved or turned to re-establish porosity, break up and blend the material.

Windrow composting has been the most common composting method used in North America because it has been considered to have lower infrastructure requirements. Windrow composting is appropriate for facilities that process as little as 500 tpy and as much as 50 000 tpy. The compost facility at the Glenmore Landfill uses an open windrow process.

Because windrow composting relies on oxygen introduction during turning, it typically requires a longer active composting time. It is not suitable for food waste composting because anaerobic compounds produced in anaerobic pockets inside the windrow are exposed and emitted to the air as odours when the windrow is turned. As turned windrows are typically small to accommodate turning equipment, there are more challenges with windrows freezing during the winter in colder climates.

Food waste can also be processed in this manner, but due to the lack of odour control, it is not generally recommended.

1.4 Turned Mass Bed

A turned mass bed is characterized by a much wider pile than a windrow. It typically requires a specialized piece of equipment to turn the material. While the suggested advantage is a smaller footprint, a turned mass bed system is not able to adequately benefit from the "chimney effect" where warm air rising from the compost draws cold air in from the sides.

A turned mass bed system is not suitable for food waste as the piles are very likely to become anaerobic, creating potential odour and reducing the efficiency of the process.

There are no examples of turned mass bed composting in BC.

1.5 Passively Aerated Windrow

In a passively aerated windrow the composting material is placed in long, low windrows, which are constructed over a network of 100-millimetre (mm)-diameter perforated pipes. It is designed to optimize the "chimney effect" during the composting process, where cold air is introduced through the pipes under the windrow to replace the warm air escaping from the top. The pipes are typically oriented perpendicular to the length of the windrow.

The presence of the pipes makes this system more difficult to construct and manage, as the loaders are likely to interfere with the pipes. A passively aerated windrow system is not suitable for food waste.

2 ACTIVELY AERATED COMPOSTING SYSTEMS

There are many types of compost systems using active/forced aeration. The following technologies are suitable for organic waste, such as food waste, yard, and garden waste.

2.1 Aerated Static Pile (ASP)

An actively aerated composting system can include either a windrow or a pile, where oxygen is provided to the composting material using a blower system and pipes either embedded in the floor, or on top of the floor. The aeration can be either positive (air blown into the bottom of the pile), or negative (air drawn down into the pile from the top). The aeration rate is often controlled with a timer or based on the temperature or oxygen status of the composting material.

Although negatively aerated piles allow better odour control, aeration is more costly as the system is fighting the desire for warm air to rise. Negative aeration also draws water and fine particles downward into the piping system and blowers, which may result in increased operational costs.

In ASP composting, feedstocks are mixed and piled to depths of between 1.5 and 3.5 m, depending upon the feedstock characteristics and site design. In more extensively engineered systems, pile heights of up to 8 m are possible. Pile size is often dependent on site-specific requirements and land availability.

Windrows or piles can be covered with a layer of finished compost “overs” (larger fraction of material after screening) for odour control and as an insulation layer. Windrows can also be covered with synthetic covers that divert rainwater from the windrows. Some of synthetic covers provide some odour control as well.

In BC, most of the food waste composting facilities use some variation of the ASP system, where the material is either in piles, or windrows; uncovered or covered with either compost or synthetic covers; aerated using either negative or positive aeration; and with no or some turning or mixing during the process.

A popular form of covered ASP composting uses membrane covers for food waste composting. This system was developed by GORE using their patented semi-permeable membrane (similar to that used for GORE-TEX jackets). The most notable part of the GORE (or equivalent) technology, which sets it apart from other composting technologies, is that it does not rely on a biofilter for odour control. The membrane cover effectively keeps moisture and odours in the compost piles, while allowing the covers to “breathe”. The GORE Cover system was developed in Germany and there are now over 250 installations worldwide, including several in Canada and BC. Smaller ASP systems are operating on Vancouver Island (e.g., Comox Valley Waste Management Centre, Coast Environmental in Chemainus), in Abbotsford, Pemberton, and outside Terrace).

The City of Kelowna is planning to upgrade the Glenmore compost facility to use ASP composting. The facility upgrade is planned for 2023. The facility will still be limited to processing yard and garden waste as well as white wood (clean wood). The facility will not be suited for food waste processing.

2.2 Enclosed Aerated Static Pile (Tunnel)

An enclosed aerated static pile consists of material placed in a bunker or tunnel that includes an aeration system and exhaust air control. Enclosed aerated static pile systems are typically more expensive but allow more material to be processed in a shorter time period. Tunnels are produced by several manufacturers and are generally made of concrete. These tunnels can be filled with either a loader or with a conveyor system.

Normally, some mixing or turning is required with tunnel systems (as with any other aerated system) to break preferential air pathways and redistribute moisture. The tunnel system design provides a high degree of odour control.

There are a number of successful enclosed ASP systems using tunnels in BC for food waste composting. They are suitable for very cold climates and have successfully been applied in all parts of Canada, especially on the Prairies and in Ontario. They are generally more expensive than covered ASP.

2.3 Static Container

A static container composting typically includes a container sized vessel fitted with an aeration system and air exhaust system, like an enclosed and aerated static pile system as described earlier. A static container is normally designed for smaller quantities of material and can be used as more "portable" systems. These static containers are normally filled with loaders and emptied using roll-off trucks or other mechanisms that can dump the material. As with enclosed ASP systems, some mixing is an important part of the composting process.

On Vancouver Island, the Fisher Road Recycling facility owned by DL Bins is one example of static containers.

2.4 Agitated Container

An agitated container is also an enclosed vessel or container as described above, except where some form of mixing can occur during the composting process. This mixing, as described above, is important to break preferential air pathways, as well as to redistribute moisture. Normally, agitated containers are used for smaller quantities of material.

There are a few successful agitated container systems operating in BC. The Resort Municipality of Whistler has an agitated container system for composting of biosolids and food waste.

2.5 Channel or Agitated Bed

A channel or agitated bed system typically utilizes both active aeration and mixing to produce a quality compost in a shorter period. These systems use specialized turning equipment to mix and move material through the composting process. A channel or agitated bed system is normally housed inside a building and is used for the first few weeks of composting.

Combined with a negatively ventilated building and good process and odour control, a channel or agitated bed composting system optimizes the use of space. The costs associated with channel or agitated bed composting are high but can produce a quality compost in a short period of time. Channel or agitated bed systems can be used for large amounts of composting material.

This technology is used for the City of Edmonton's large mixed waste composter; however, the facility has not accepted organics since 2019 due to building deterioration.

2.6 Rotating Drum

A rotating drum composter typically consists of an enclosed drum, where composting material is introduced into one end and the finished material is removed from the other end. Material is mixed and aerated either through rotation of the drum, or by turning of an auger system inside the drum.

A rotating drum is normally associated with smaller volumes of organic material, such as with institutions, in smaller communities, or with animal mortality composting. However, the system can be designed for larger processing capacities.

There are successful rotating drum systems operational in British Columbia. The Nanaimo composting facility used smaller rotating drums, before the facility was upgraded to using enclosed composting vessels.

3 ANAEROBIC DIGESTION

Anaerobic digestion (AD) is the biological conversion of organic materials in the absence of oxygen. The process is carried out by anaerobic micro-organisms that convert carbon-containing compounds to biogas, which is a gas consisting primarily of methane (CH_4) and carbon dioxide (CO_2), with trace amounts of other gases. For the process to take place efficiently, six key process parameters must be carefully controlled. These are pH, temperature, carbon to nitrogen ratio (C:N), organic loading ratio, retention time and reaction mixing.

Pre-treatment is required to separate the organic fraction from the inorganic fraction not suitable for treatment in the AD process. Pre-treatment helps to reduce unnecessary space taken up by inorganic materials in the digester, provides a uniform small particle size in the feedstock to promote efficient digestion, and protects plant equipment as well as the quality of the digestate. Mechanical pre-treatment is often achieved using trommels/screens, a hammer mill and by shredding/mixing of the feedstock.

Following pre-treatment, the organic fraction is loaded into the reactor where digestion takes place. In the first stage of digestion, organic material is broken down by microbes called acid formers, to produce fatty acids. In the second stage of the digestion process, another group of microbes called methane producers covert the fatty acids into biogas, along with traces of other gases. The material remaining is a partially stabilized organic material (digestate) that can be solid, semi-solid, or liquid, depending on the type of AD system. With proper authorizations from environmental regulators, liquid digestate can be applied to agricultural land. Alternatively, the digestate can be recirculated back into the AD system to minimize the use of potable water. Solid and semi-solid digestate is usually composted to achieve full stabilization, however other methods are also being used to create a pelletized product for use as a fertilizer. The insoluble solids in the digestate comprises non-digestible inert material, non-digestible organic materials and microbial biomass. This residue is sent to landfill.

AD system general categories are based on the solids content of the materials being digested, since this is the most important factor governing equipment design. AD technologies can be grouped by the number of digestion stages – single or two/multiple – and the total solids content – wet process (typically <15% total solids (TS)) or dry process (typically >20% TS).

Dry AD systems are more forgiving on the type of collection required, such as a curbside co-collection of mixed yard and food waste, and dry AD systems are much more flexible in managing feedstock contamination.

The Surrey Biofuel Facility, established in 2017, uses a Dry AD process with in-vessel composting of the digestate using tunnels. It is our understanding that this facility has the ability to use AD or composting processes, which allows for flexibility, but would reduce the amount of gas produced over a pure AD process.

Generally large-scale AD systems similar to the Surrey facility are cost prohibitive for smaller to medium size regions. MH is currently investigating smaller scale AD technologies however at this point are we are not currently aware of any technologies or vendors that have been proven small-scale in North America to successfully manage the organic fraction of municipal solid waste.