City of Thunder Bay:

Development of an Organics Diversion Program Implementation Plan

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Executive Summary

In April of 2018, the Ministry of Environment Conservation and Parks (MECP) introduced its Food and Organic Waste Framework (Framework). The Framework included a Food and Organic Waste Action Plan (Plan) and Food and Organic Waste Policy Statement (Statement). Amongst the many obligations found in the Policy Statement are two requirements of particular relevance to the City of Thunder Bay (City). The Policy Statement requires municipalities in Northern Ontario with a population greater than 50,000 and density greater than or equal to 300 persons per km^2 to provide curbside collection of food and organic waste to single-family dwellings in the urban settlement area by 2025. Moreover, the program must achieve a 50% waste reduction and resource recovery of food and organic waste by that date.

This report includes recommendations for the development and implementation of a food and organic waste diversion (Green Bin) program to ensure compliance with the requirements of the Province's Policy Statement. The proposed program would service the City's single-family and multi-family dwellings as well as qualifying businesses taking a phased-in approach to the program's implementation. The report also includes recommendations for the optimization of the City's collection services and policies to minimize the cost of implementing the new program and ensure effective participation. To ensure the policy statement's diversion target is met and the program costs are optimzed, the following recommendations, as detailed in Section 16 of this report, are proposed:

1) Expand current leaf and yard waste services in 2023.
2) Implement a curbside food and organic waste program for single-family dwellings in 2025.
3) Phase in Green Bin collection services for multi-family and local businesses over time.
4) Optimize garbage collection service to achieve diversion targets and reduce costs.
5) Hire necessary staff to support roll out of Green Bin services.
6) Implement automated cart-based collection of garbage and Green Bin materials.
7) Finalize program costs and design parameters as a next step.

The report also examines options for processing the collected organic waste while taking into consideration the implications of this new program on the City's landfilling operations and renewable energy partnership with Synergy North Inc. To ensure the City is consistent with the Policy Statement, future amendments to the City's official plan, waste collection and zoning by-laws may also be necessary. These recommendations are intended to support the City's climate change goals, reduce operational costs and ensure the province's food waste and organics diversion target will be met. The proposed changes are expected to increase the City's residential waste diversion level from 25% to 42% and reduce the City's climate change footprint by an estimated 5,380 tCO2e per year.

Implementation of these recommendations will not be without financial impact on the City. Roll out of the proposed program is expected to increase the cost per household for waste management services by an average of $33 per household or $1.5 million per year between the proposed seven year (2022-2028) planning and implementation timeframe. Implementation of automated cart collection is, however, expected to reduce that program cost increase by almost $827,000 per year or almost $18 per household after implementation in 2025.

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1. Background

Located on Lake Superior, the City of Thunder Bay (City) is the most populous municipality in Northwestern Ontario and the second most populous municipality (after Greater Sudbury) across Northern Ontario. In 2016, the national census reported the City population as being 107,909. By comparison, the metropolitan area of Thunder Bay, which includes the City, the municipalities of Oliver Paipoonge, Neebing and Shuniah, the townships of, Conmee, O'Connor, and Gillies, and the Fort William First Nation had a population of 121,621 in the same census year. In recent years, the City and surrounding area's population has seen modest but consistent growth. Based on Statistics Canada population estimates, the population of the metropolitan area and City is averaging just under 2% growth per year. The City has a culturally diverse population and significant Indigenous population and is home to Confederation College and Lakehead University.

The City provides a range of waste collection, diversion and disposal services to both residents and local businesses. Waste collection services are offered to approximately 37,018 single-family households, 9,133 multi-family units located in 439 buildings, approximately 956 small businesses, and a range of municipal facilities and public spaces. Manual garbage collection is provided by City staff using a fleet of City owned vehicles. Manual 'blue bag' recycling (recycling) and leaf and yard waste (yard waste) collection is provided by private contractors. Garbage is disposed of at the City owned and operated Solid Waste and Recycling Facility (SWRF). Recycling is shipped to a local private Material Recycling Facility (MRF) and yard waste is composted at the City's SWRF. The City also has three depots that receive recycling from local residents including two in the City and one at the SWRF. The SWRF also receives a variety of additional materials such as household hazardous waste for diversion.

Waste volumes have been declining in recent years. In 2018, the City generated 104,090 tonnes of waste. By comparison, only 82,699 tonnes was generated in 2021. Of that quantity, 47,641 tonnes was generated by the residential sector and the City's current waste diversion programs diverted 11,697 tonnes of material to achieve a diversion rate of 25%. In March of 2014, the City commissioned development of its Comprehensive Solid Waste Management Strategy. Key amongst the various recommendations was development of an enhanced leaf and yard waste program and implementation of a food waste diversion (i.e., "Green Bin") program. This latter recommendation was broadly supported by the public showing 67% of respondents favouring the implementation of a Green Bin program. In addition to the Comprehensive Solid Waste Management Strategy, the City's EarthCare Thunder Bay Sustainability Plan 2014-2020, Climate-Forward City: Thunder Bay Net-Zero Strategy, 2020, Program and Services Review, Phase 2 Final Report, 2020 and One City, Growing Together Corporate Strategic Plan 2019-2022 were relied upon to inform the development of this plan.

2. Ontario's Food and Organic Waste Framework

Ontario's Food and Organic Waste Framework (Framework) was developed as a key component of the Province's Strategy for a Waste Free Ontario. The Framework is structured in two parts including the Food and Organic Waste Framework Action Plan (Action Plan), and the Food and Organic Waste Policy Statement (Policy Statement). As implied by its title, the Action Plan lays out a series of 17 proposed initiatives intended to:

- Reduce food and organic waste
- Recover resources from food and organic waste

- Support resource recovery infrastructure
- Promote beneficial uses of recovered organic resources

The majority of the action items focus on immediate opportunities (i.e., to be implemented between 2018 and 2020) to work with federal and provincial partners to facilitate the goals of the framework. Longer term objectives of significance include commitments to:

- amend the 3Rs Regulations to include food and organic waste to increase recovery from the Industrial Commercial & Institutional (IC&I) sector;
- ban food and organic waste from disposal sites;
- support recovery from multi-unit residential buildings;
- promote on and off-farm end-use soil amendments from recovered organic resources; and
- support development of renewable natural gas including consideration for linkages to food and organic waste.

Arguably the most significant implications of the Action Plan to the City are the Province's plans to ban food and organic waste disposal at waste disposal sites (e.g., landfills, incineration facilities) and support the beneficial use of recovered organic resources. The Action Plan contemplated developing, consulting on, and implementing a disposal ban regulation under the Environmental Protection Act with a phased in implementation starting as early as 2021. Public comment was sought by the Province in the fall of 2020 on proposed amendments to the Policy Statement but given the current global pandemic it is unclear what the government's current timeline or plans are.

By comparison, the Policy Statement issued pursuant to Section 11 of the Resource Recovery and Circular Economy Act, 2016 (RRCEA), supports the provincial vision of a circular economy and is an important tool to help move the province towards its climate change goals. Section 2 of the Policy Statement sets out specific obligations and targets for the diversion of food and organic waste from various persons or entities including certain municipalities, industrial and commercial facilities, multi-unit residential buildings, educational institutions and hospitals. Of particular note, policy 4.3 requires:

> *Municipalities in Northern Ontario that, as of the effective date, do not provide curbside collection of source separated food and organic waste shall provide curbside collection of food and organic waste to single-family dwellings in an urban settlement area within a local municipality if:*
>
> *i. The population of the local municipality is greater than 50,000 and the population density of the local municipality is greater than or equal to 300 persons per km^2.*

Furthermore, Section 2.1 requires that Municipalities in Northern Ontario that are subject to policy 4.3 achieve a "50% waste reduction and resource recovery of food and organic waste generated by single-family dwellings in urban settlement areas by 2025".

Policy 4.10 requires that *"Multi-unit residential buildings shall provide collection of food and organic waste to their residents."* Additionally, Section 2.1 requires that such buildings achieve a "*50% waste reduction and resource recovery of food and organic waste generated at the building by 2025*." While the Policy Statement does not make collection from multi-family buildings a responsibility of municipalities, consideration is given to inclusion of service to this portion of the City later on in this report.

The Policy Statement also requires that municipalities and other planning authorities ensure that official plans are consistent with the Policy Statement with amendment of official plans occurring within the

next scheduled update. Municipal zoning by-laws must also be amended within three years after the related official plan amendment. By-laws made under other acts related to waste reduction and resource recovery, as well as relevant prescribed instruments, must also be made consistent with the proposed Policy Statement within two years of the proposed Policy Statement coming into effect.

In summary, the Policy Statement will create several obligations for the City. In addition to the requirement that it implement a curbside, food and organic waste diversion program for single-family households and achieve a diversion level of 50% by no later than 2025, the City will also need to consider how it intends to process collected food and organic waste and whether it wishes to extend food and organic waste collection service to its multi-family and business properties.

3. Current Program Overview

The City provides a range of waste collection, diversion and disposal services to both residents and local businesses. Curbside services include garbage, blue bag recycling and yard waste collection. Additional services are offered at the City's Solid Waste and Recycling Facility.

3.1 Waste Disposal Operations

3.1.1 Garbage Collection

Single-family households are currently eligible for curbside collection of garbage, recycling and seasonal yard waste. Garbage is collected on a weekly basis (i.e., Tuesday to Friday) subject to a two-item limit with an allowable additional tagged (i.e., for a fee) item for overflow. An additional item is allowed free of charge after specific statutory holidays including New Years Day, Victoria Day and Labour Day. As noted, collection services are provided using a City owned and operated fleet of collection vehicles.

Multi-family buildings also receive weekly garbage collection services from the City, subject to a limit of 3.75 m^3 (or 66 items) of waste per site. Property owners with additional collection needs may arrange for a second pick up from the City on a 'fee for service' basis and/or arrange for private collection services. Properties are added to the program on an 'as requested' basis and the City requires that garbage be stored in locked sheds on site.

The City provides garbage collection services to almost 40 municipal properties and approximately 956 local businesses. Municipal properties include various city buildings, works yards, community centres, arenas, pools and parks. Services to IC&I properties include weekly collection of no more than 66 items of waste and a 'fee for service' agreement for a second weekly pickup. Larger businesses, local universities, colleges, schools, hospital, nursing homes and City Hall arrange for private collection services due to the volumes involved. It should be noted that the City currently has two Business Improvement Areas (BIAs) including the Waterfront District BIA and the Fort William District BIA many of whom receive waste collection services from the City.

3.1.2 Thunder Bay Solid Waste and Recycling Facility

The City's primary waste management asset is the Thunder Bay Solid Waste and Recycling Facility (SWRF) located at 5405 Mapleward Blvd. The SWRF is operated by City staff and governed under

provincial Environmental Compliance Approval (ECA) No. A590106 which currently approves the use and operation of a 439 hectare waste disposal site. The site includes a 76.83 hectare landfilling area for the disposal of domestic and commercial solid non-hazardous industrial waste and currently has an estimated 20 years of remaining capacity.

Operating buildings on the site include an administration building for landfill operations and McIntyre Roads staff, a garage and maintenance shop housing landfill and roads equipment, a weigh scale building and an attendant shelter at the onsite transfer station. The SWRF has two sets of weigh scales including a single, 80 foot automated (i.e., RFID tag based) commercial account scale and a tandem set of 80 foot inbound and outbound weigh scales for the general public.

The site also has an active landfill gas collection system which was installed between 2009 and 2010 consisting of 104 vertical wells, 3 horizontal wells, lateral and header piping, condensate traps, an abstraction plant, a candlestick flare and a 3.2 megawatt power generation plant. The power generating plant is equipped with two Caterpillar G3520C engines and electricity generated from the plant is exported to the grid.

3.2 Waste Diversion Operations

3.2.1 Blue Bag Recycling Collection

Single-family household recycling is set out by residents in translucent blue or clear plastic bags and collected bi-weekly by GFL Environmental Inc. (GFL), under contract to the City, in a 'two-stream' format (i.e., recyclable containers are collected separately from paper and paper products). Cardboard is typically bundled for collection where there is sufficient quantity. There are no volume limits associated with recycling set outs from single-family households.

Multi-family buildings are also eligible to receive bi-weekly recycling collection services of unlimited volumes from each site. As with garbage collection for multi-family buildings, the City requires that recyclables be stored in locked sheds on site.

Residents can divert excess quantities of recycling at the SWRF or either of the City's two recycling depots located at Front Street. and Mountdale Avenue. The two sites in the City are operated six days per week by GFL utilizing front end loader (FEL) containers. It is noteworthy that, collectively, these sites receive significant traffic averaging an estimated 300 vehicles per day.

Local businesses are not eligible for City recycling services. The City does, however, provide recycling services to almost 30 different municipal properties including various community centres, golf courses, parks, works yards and public buildings. Collection is primarily done using rear packers supplemented with FEL service for large cardboard generators.

3.2.2 Leaf & Yard Waste Collection

Leaf and yard waste (excluding grass clippings) is collected curbside twice a year (i.e., once in the spring and once in the fall) from single-family and multi-family residences by GFL. Throughout the remainder of the year, leaf and yard waste can be dropped off at the SWRF composting facility at the regular tipping fee or collected as garbage at the curb. The City also operates nine seasonal sites throughout the

community where, for a three week period, it receives and chips Christmas trees. Pumpkins are collected seasonally at three collection sites between November 1st and November 10th of each year.

Businesses are not eligible for leaf and yard waste collection. Collection of leaf and yard waste generated at municipal buildings and public spaces is managed by other City departments or private haulers.

3.2.3 Additional Diversion Services

The City provides a range of supplemental diversion options for residents including depot based collection of tires, household hazardous waste (HHW), discarded electronics (e-waste), fluorescent tubes, and scrap metal including 'white goods' (e.g., CFC-free refrigerators, freezers, air conditioners). HHW, fluorescent tubes and e-waste is received at the City's HHW transfer facility located at the SWRF. Tires and scrap metal is received at the SWRF tire transfer station and public drop off area bins respectively.

3.2.4 Waste Diversion Infrastructure

In addition to the two recycling depots operated in the City, the SWRF also includes a recycling depot, HHW transfer facility, tire transfer station, and leaf and yard waste composting facility. The yard waste receiving area and compost pad has a 4.65 acre pad and is an open windrow composting operation licensed to receive 6,000 MT (i.e. metric tonne) per year.

Collected recyclables are delivered to, and processed at, GFL's local Materials Recycling Facility (MRF) at 3000 Highway 61, Slate River, Ontario.

3.3 Current Collection Fleet

The City's waste collection fleet consists of 15 International packers and one ½ tonne pickup. The packers range in age from 2007 to 2016 of which five are rear load packers (Figure 1) and 10 are side loading packers.

The fleet operates on a four-day week (Tuesday to Friday). Nine side loading trucks are dedicated to residential collection Tuesday to Thursday and eight on Friday. In addition, the City dedicates one rear loading packer to multi-family collection and two rear loading packers to IC&I collection. The ½ tonne pickup operates as a customer service vehicle collecting missed collections and locations the primary fleet is unable to collect from due to space constraints (e.g., narrow roadways). It averages 30-50 stops per day.

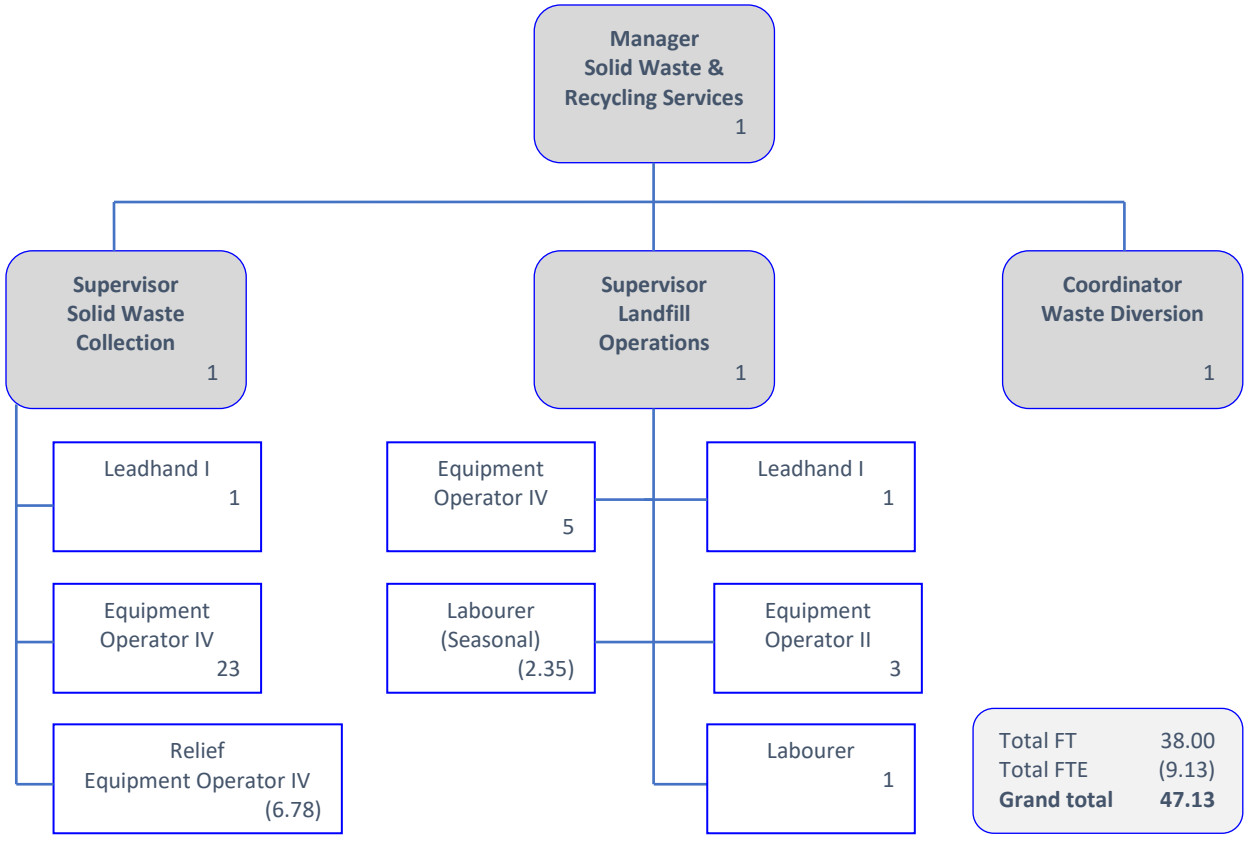
Figure 1: Rear Packer

The City also maintains three spare vehicles and has ordered four new side loaders. Two vehicles arrived in 2022 and two are scheduled to arrive in 2023. Supply chain issues resulting from the current Covid 19 pandemic have delayed vehicle deliveries out as much as 24 months from the order date and increased costs dramatically. As a result, funds have been budgeted in 2022 for two new side loaders and one rear loader but delivery is not expected before 2024. The two vehicles delivered in 2022 are 'kitted' out to be automated cart (auto cart) capable subject to having the hydraulic arm purchased and installed. The latter two vehicles will come with arms already installed. City staff has confirmed that the vehicles scheduled for delivery in 2023 can also be retrofitted to incorporate split bodies as required to allow for separate compartmentalization of different waste streams. The solid waste collection unit's Supervisor and Leadhand also have dedicated pickup trucks.

3.4 Staffing

The City's Solid Waste and Recycling Services (Section) oversees the City's waste collection, diversion and landfill operations. The Section consists of a manager and two supervisors as noted in Figure 2. They are supported by a waste diversion coordinator who, amongst other duties, is responsible for day-to-day management of processing, collection and educational service contracts, statistical analysis and regulatory reporting. The Section includes a total of 38 full time (FT) staff and 9.13 full time equivalents (FTEs).

Figure 2: Solid Waste Management and Recycling Services Organization Chart



The City's waste collection staff include 23 full time operators and up to 15 relief operators (equivalent to 6.78 full time staff). Sixteen full time staff and two relief staff manage single-family household collection, an additional six full time staff manage multi-family and IC&I collection and the remaining full time staff operates the customer service pickup. The remaining relief operators cover off vacation and sick leave as required.

The solid waste collection unit is overseen by a Supervisor who is supported by a Leadhand. The Leadhand's primary responsibilities are intended to focus on direct support and guidance of the collection staff in the field with a portion of their time spent on administrative duties. The Section also receives indirect support from a number of other City departments to support its operations (e.g., Fleet, Clerks, Human Resources, Finance).

3.5 Contracted Services

The Section currently manages ten service contractors including GFL, Titan Contracting, Miller Environmental, Tim Walters Trucking and Equipment Rentals, Junk Away Inc., Mike Jewett Construction, Enviroshred, Rutter Urban Forestry and EcoSuperior.

GFL provides collection of recyclables and yard waste to the City's single-family and multi-family properties along with recycling collection from municipal buildings. They are also responsible for administering the City's event recycling program, operation of the City's two 'downtown' recycling depots and for processing of collected recyclables at their local MRF.

Junk Away operates under contract to the Section to collect items left illegally as litter (e.g., couches, brush and general garbage) and deliver them for disposal to the City landfill on an 'on demand' basis.

Tim Walters Trucking and Equipment Rentals provides rental of up to two landfill D7 bulldozers with skilled operators to assist with daily landfilling operations. Mike Jewett Construction provides one excavator rental with operator for landfill daily cover support.

Titan Contracting is responsible for grinding of yard waste at the City's SWRF and also manages the composting operations. Rutter provides seasonal tree chipping services at the City's temporary tree collection sites and mulch delivery to the SWRF.

Miller Environmental is responsible for operation of City's Household Hazardous Waste facility at the SWRF.

The Section maintains a contract with Enviroshred to provide secure on-site shredding services to the various City departments. EcoSuperior is unique in that it supports the City in the delivery of four key waste management educational programs and waste diversion related services.
The City has a long-term partnership with Synergy North Inc. (Thunder Bay Hydro Renewable Inc.) for the supply of landfill gas and operation of its power generation station.

Table 1: Contracted Services

Contractor	Service	Contract Term
EcoSuperior Environmental Programs	'Spring up to Clean up' litter campaign; Waste Reduction Week activities; school waste reduction education program; storefront sale of backyard composters	Annual purchase order
Enviroshred	Secure on-site shredding services.	Expires: March 31, 2023 Two 1yr renewal options
GFL	Single-family and multi-family recycling collection; Processing of collected recyclables; operation of the Front St. and Mountdale Ave. recycling depots	Start: July 1, 2020 7 yrs + two 1 yr renewal options Expires: Jun 30, 2027
GFL	Single-family and multi- family yard waste collection	Expires: April 30, 2023
Junk Away Inc.	Pick up/disposal of debris as it relates to items left illegally as litter (e.g. couches, brush and general garbage). On demand/as required.	Expires: December 31, 2022 Two 1 yr renewal options
Mike Jewett Construction	Provides one excavator rental with operator for landfill daily cover support.	Expires: September 30, 2023
Miller Environmental	Operation of HHW facility.	Expires: June 30, 2023
Rutter Urban Forestry	Christmas tree grinding at 9 seasonal municipal drop off sites and mulch delivery to City landfill.	Expires: December 25, 2022
Synergy North Inc.	Operation of landfill gas power generation station.	Expires: 2030
Tim Walters Trucking and Equipment Rentals	D7 bulldozer rental service with operator for assisting with daily landfill tip face operations.	Expires: September 30, 2022
Titan Contracting	Yard Waste grinding and composting operations at City SWRF.	Starts: May 1, 2021 3 yrs + two 1 yr renewal options Expires: April 30, 2024

3.6 Current Operating Costs

The City's waste management system is currently funded through several sources including tipping fees at the SWRF, property taxes, revenue from power generation, the sale of recyclables, and funding from operation of extended producer responsibility programs (e.g., diversion of recyclables, electronic waste and household hazardous waste). Landfill site operations are rate supported by tipping fee revenues. Collection services and waste diversion program operating and capital costs are supported through tax-based funding.

The City's waste management system has three primary activities including landfill operations, solid waste collection and solid waste diversion. The 2022 gross budget for these activities is $10,049,000 with a projected net cost of $5,226,000. Landfill operations represents the single largest gross expenditure (i.e., 29% of gross costs) and in 2020 the use of Federal-Provincial 'Safe Restart' funding was necessary to offset the negative impacts of the current economy downturn. Stabilization reserve funds were used in 2021 and are predicted to be necessary in 2022 to cover pandemic related short falls. Garbage and recycling collection represent the largest system costs (i.e., 57% of gross costs). It is

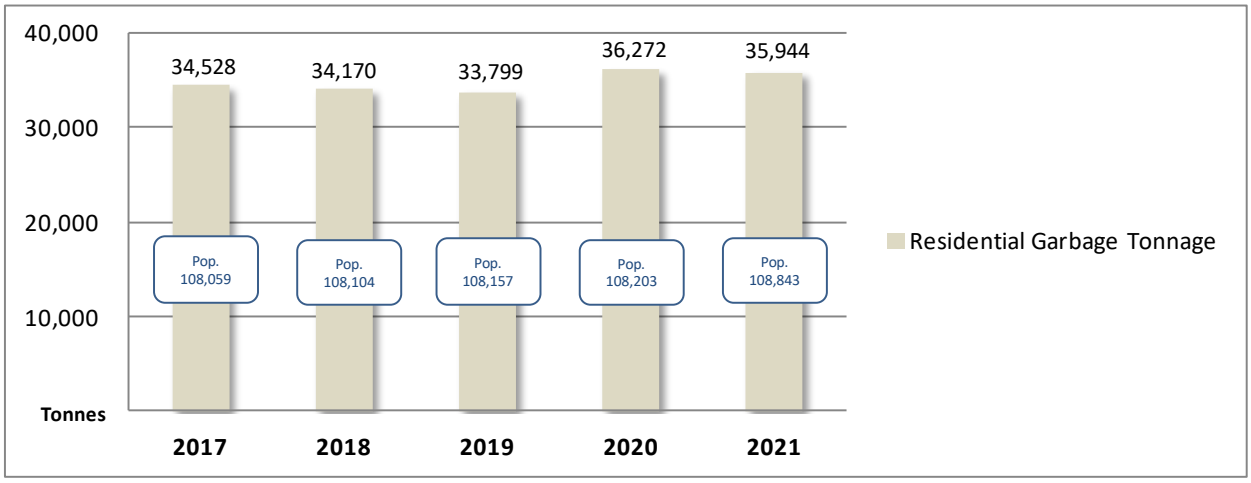
notable that labour represents a significant proportion of the Section's budget. In particular, labour represents 73% of the 2022 gross garbage collection budget.

It should also be noted that there are currently no tipping fees collected on household or commercial waste brought to the landfill site by the City' solid waste collection packers, which means disposal revenues from the landfill site are all drawn from residential and IC&I customers who bring their waste over the scales.

4. Waste Stream Analysis

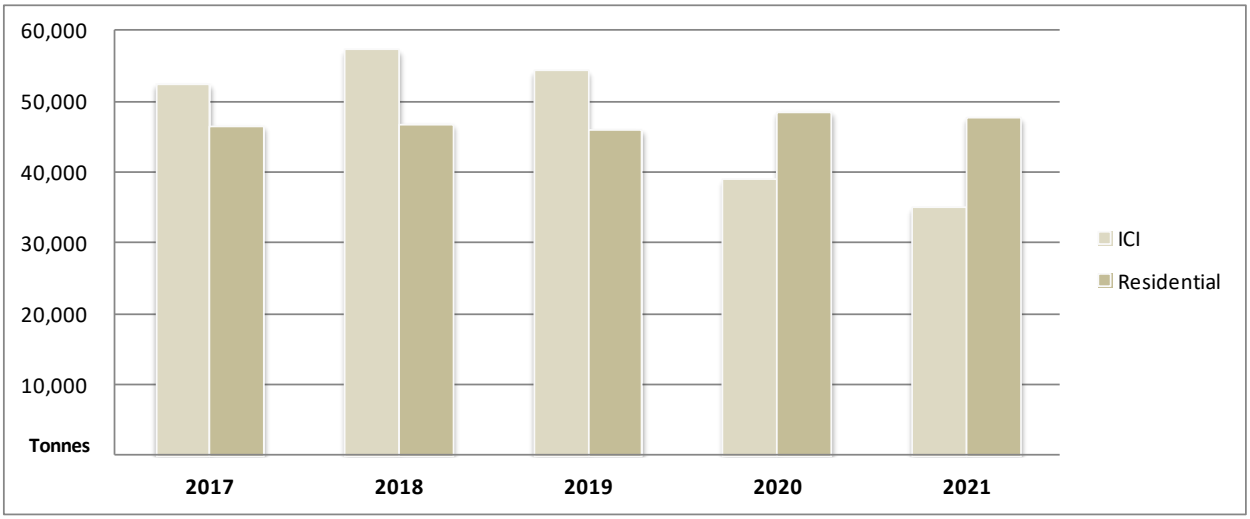
As previously noted, the City's population has remained relatively stable year over year. Chart 1 shows that residential garbage disposal quantities have trended consistently with the City's population except in 2020 and 2021. Between 2017 and 2019 there was a decline in tonnage of approximately 2% which is consistent with typical variances in yard waste volumes and the overall global trend to light weighting and reduction of consumer packaging. The noticeable increase in residential disposal in 2020 and 2021 can be directly attributed to the COVID 19 pandemic. Municipalities across Ontario reported similar increases due to travel restrictions and employees working from home.

Chart 1: Residential Garbage Tonnage versus Population (2017-2021)



By comparison, Chart 2 shows the marked negative impact of both the declining economic conditions of 2019 and the pandemic in 2020 and 2021 had on local businesses; many of whom were forced to curtail operations for much of both years. The extent to which these quantities will return to historical norms as the global economy recovers from the current pandemic is as of yet unknown.

Chart 2: Residential versus IC&I Total Waste Generation (2017-2021)



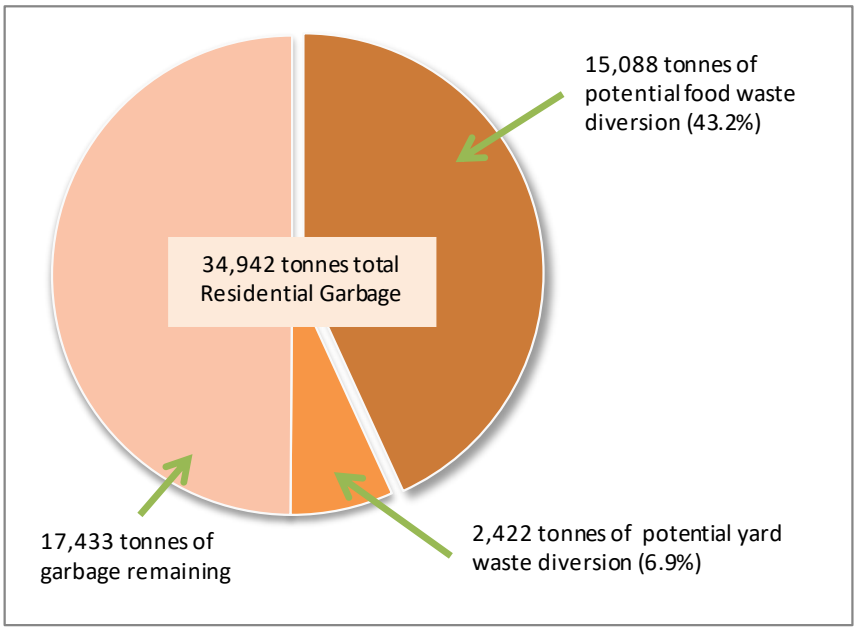
As noted, waste quantities from the residential sector have been relatively consistent and predictable prior to the pandemic. Data from the past five years show the City collected and/or received an average of 47,096 MT/yr of residential waste (i.e., including both garbage and recyclables). A review of the last five years of landfill data shows that quantities by material type have not changed dramatically with the exception of materials that normally vary by season or participation (e.g., yard waste).

Analysis of the City's residential waste composition also shows that garbage represented 74% (i.e., 34,942 MT/yr) of the reported total average annual residential waste quantity. The remaining 26% (i.e., 12,154 MT/yr) was diverted through the City's various waste diversion initiatives.

5. Food and Organic Waste Generation Estimates

Based on a four season waste composition study undertaken by AET Consulting Ltd. between 2018 and 2019, kitchen food waste represented 43.2% of curbside collected garbage which, based of an average landfilled quantity of 34,942 MT/yr, equates to 15,088 MT/yr of food waste.

Chart 3: Food Waste in Residential Waste Stream (2017-2021 Average)



It should be noted, however, that the study in question was based on curbside single-family households. In reality, garbage collected and landfilled by the City includes a mix of quantities from residential and multi-family sources. By comparison, multi-family households typically generate 8 to 10% less food waste than their single-family counterparts. As a consequence this preliminary estimate is likely overstated.

As previously noted, the City currently collects from approximately 37,018 single-family households and 9,133 multi-family units located in 439 buildings. Adjusting for the proportion of the population in multi-family dwelllings and the lower food waste generation estimates for this group, it is expected that approximately 12,371 MT/yr of food waste is generated by single-family households and 2,717 MT/yr from multi-family households and would be potentially available for diversion.

By comparison, the March 2014 City of Thunder Bay Comprehensive Solid Waste Management Strategy (Waste Management Strategy) estimated there was 11,500 MT of food waste available for diversion. The lower number found in the Waste Management Strategy is likely due to assumptions made by its authors about the types of organics that might be collected and/or reasonable capture rates.

The AET study also identified that approximately 7% of the residential waste was leaf and yard waste suggesting there is an additional 2,422 MT/yr of yard waste available to be diverted from disposal. Yard waste volumes vary dramatically from one year to another. Historically, the City has diverted roughly 1,825 to 2,720 MT/yr (i.e., ~ 2,100 MT/yr on average) as shown in Table 2, which would suggest the City could divert an average of 4,500 MT/yr with an expanded program. This range is somewhat lower but consistent with the Waste Management Strategy which had predicted the City could capture approximately 5,800 MT of yard waste annually with an expanded leaf and yard waste collection program.

Table 2: Collected Yard Waste Volumes (2018-2021)

Year	Direct Drop Off at Site (leaf/yard waste)	Curbside Collection Spring	Curbside Collection Fall	Christmas Tree Program	Pumpkin Collection	Total
2018	1,599	558	500	34	27	2,718
2019	1,122	459	305	47	28	1,961
2020	881	591	435	18	30	1,955
2021	950	453	381	18	23	1,825

Note: Leaf and yard waste tonnages are approximations only

6. Policy Statement Compliance

As outlined in Section 2, the City is required to establish and provide a curbside food and organic waste collection program for single-family dwellings and divert 50% of its food and organic waste by 2025. In general, food waste consists of common materials such as kitchen scraps and discarded food. Organic waste represents a broader range of materials such as leaf and yard waste, pet waste, paper towels, tissue paper and other biodegradable materials.

While the City has an obligation to provide a curbside organics collection program, it can achieve the diversion goal through the collection of both food waste (aka Green Bin program) and yard waste. As noted in Section 5, a recent curbside waste composition study undertaken in the City suggests there is approximately 15,088 MT/yr of food and organic waste present in the curbside wastestream. The same waste composition study suggests the City generates approximately 4,500 MT of yard waste (including approx. 2,100 MT/yr currently being diverted). Assuming the single-family households generate 12,371 MT/yr and effectively all the available yard waste, the City would need to divert 8,435 MT/yr of food and organic waste to meet the provincial requirements. Should the City wish to assist multi-family property owners with their obligations under the Policy Statement, the City would likely need to divert approximately 9,794 MT/yr to ensure compliance with the provincial requirement.

Table 3: Policy Statement Requirement of 50% Diversion for Single & Multi-Family Sources

Source	Available Food & Organic Waste (Tonnes/yr)	Available Yard Waste (Tonnes/yr)	Policy Statement Obligation (Tonnes/yr)
Single Family Only	12,371	4,500	**8,435**
Single & Multi-Family	15,088	4,500	**9,794**

7. Program Design Considerations to Meet the Policy Statement Obligations

There are a number of parameters and options that will need to be considered in designing a program that meets the obligations of the Policy Statement. They include:

Service level considerations:

- Mandatory collection of food waste and yard waste from single-family households
- Optional collection of food waste and yard waste from multi-family households
- Optional collection of food waste and yard waste from local businesses

Options for achieving the 50% diversion target:

- Expanded yard waste collection;
- Weekly collection of food waste;
- Every other week garbage collection;
- Garbage item limits; and
- Types of acceptable organic waste

Other program design considerations:

- Co-collection of yard and food waste
- Choice of collection containers for containing food waste
- Use of new technologies such as automated cart collection

7.1 Service Level Considerations

As noted, the City must provide a curbside program collecting both food and organic waste from single-family households and achieve the required diversion rate. It does not, however, have to provide this service to multi-family households or local businesses and institutions. Those property owners are responsible for meeting their obligations under the Policy statement. Nonetheless, it is recognized the City curently provides garbage and blue bag collection service to both multi-family properties and garbage collection service to selected businesses. It is proposed therefore, that the City plan to provide Green Bin service to multi-family buildings no later than 2026. Delaying roll out of service to this group is proposed in order to allow staff time to ensure the successful launch of the curbside single-family collection service and give staff time to develop an appropriate service policy. This latter point is important because of issues with material storage and contamination which, if not considered carefully, could jeopardize the entire program.

It is further recommended that consideration be given to expanding Green Bin collection service to local businesses and institutions on a cost recovery basis after rollout of the residential program is complete. Expanding the program to include local businesses and institutions may allow for improvements in economies of scale on processing costs and even collection services.

This proposed approach will spread out the cost impact on the City's customers and give staff more time to refine delivery of the program.

7.2 Options for Achieving the 50% Diversion

Food waste diversion programs, more commonly known as Source Separated Organics (SSO) or Green Bin programs, are commonplace throughout southern Ontario and in many cities throughout Canada.

They have been in operation in the Greater Toronto Area (GTA) since 2002 and as of 2016, roughly 70% of Ontario's population had access to Green Bin service[1].

The programs in question collect a broad range of organic materials including yard waste, food waste, soiled paper, and pet waste but vary in how the materials are collected and what is included in their program. Food waste, because of its unique characteristics, is a challenging material to divert and many lessons have been learned by other communities suggesting implementation requires careful planning and effective communications. Numerous factors affect program performance. Key considerations include collection frequency, collection policies, materials collected, container selection and communications.

7.2.1 Expanded Yard Waste Collection

As noted in Section 5, the City currently diverts roughly 2,100 MT/yr of yard waste and both the Waste Management Strategy and AET waste compostion study identified that at least an additional 2,422 MT/yr of yard waste may be available for diversion from the residential wastestream. While the Policy Statement requires collection of both food and organic waste, expanding the City's yard waste collection program is the least expensive and easiest option available to partially meeting its diversion requirement.

Yard waste is significantly less expensive to process than food waste. Doubling the City's yard waste collection to four events annually from two, at a minimum, is expected to capture an additional 920 MT/yr (i.e., 3,035 MT/yr on average). Expansion of the yard waste collection services in 2023 is recommended to allow staff to assess the diversion potential of this option and reflect this information in upcoming collection and processing contracts. Negotiations would be required with the City's yard waste collection and processing contractors whose contracts end in 2023 (i.e., GFL – collection) and 2024 (i.e., Titan – processing) but is not expected to be an issue.

Expansion of the City's yard waste program to four collection events annually is expected to increase collection costs by approximately $157,000 per annum and processing costs by $5,000 per annum assuming an average cost of $170/MT. Review of the service in subsequent years to consider further expansion or refinement is also recommended.

7.2.2 Green Bin Collection - Weekly

The Policy Statement does not specify a collection frequency for food waste collection. However, resident participation in Green Bin programs is driven primarily by convenience and the effective use of public policy. Almost all municipalities providing Green Bin service offer weekly collection to minimize the generation of unpleasant odours, sanitation issues, and attraction of vectors resulting from food storage in the household between collection cycles. Every other week Green Bin collection was tried in the past but faced strong public opposition, suffered from poor particiation and is not expected to meet the diversion requirements of the City. Weekly collection is, therefore, recommended.

7.2.3 Weekly versus Every Other Week Garbage Collection

[1] Ontario Ministry of the Environment and Climate Change, 2017

Past experience throughout Ontario has also unequivocally demonstrated that residents will not fully participate in food waste diversion programs unless the program is accompanied by strict garbage set out limits. While bag or item limits can be useful to some extent, the better practice has been proven to be coupling weekly Green Bin collection with every other week garbage collection. This fact is borne out in capture rate data for the two types of programs. Communities with weekly garbage and Green Bin service will typically achieve capture rates of 80kg/household to 140kg/household whereas those providing every other week garbage and weekly Green Bin collection often divert as much as 110kg/household to 340kg/household as shown in Table 4.

Table 4: Impact of Garbage Collection Frequency on Green Bin Participation

Municipality	Kg/year Single-Family Households	Percentage Diversion of Total Residential Waste	Green Bin Sizes in Use (litres)	Garbage Collection Frequency
Guelph, City of	340	18%	80	Bi-weekly
Toronto, City of	340	20%	97	Bi-weekly
York, Region of	310	26%	45	Bi-weekly
St. Thomas, City of	300	23%	240*	Weekly
Ottawa, City of	260	22%	46, 80	Bi-weekly
Peel, Region of	180	12%	100	Bi-weekly
Waterloo, Region of	170	13%	46	Bi-weekly
Halton, Region of	160	14%	46	Bi-weekly
Dufferin, County	140	15%	46	Weekly
Durham, Region of	130	11%	46	Bi-weekly
Barrie, City of	110	8%	46	Bi-weekly
Simcoe County	90	9%	46	Bi-weekly
Hamilton, City of	80	6%	46, 120	Weekly
Kingston, City of	80	9%	80	Weekly
Niagara, Region of	70	6%	46	Bi-weekly

*St. Thomas co-collects yard waste and food waste in their green bin[2]

Of particular interest are the experiences of Sudbury, Waterloo and Niagara Regions. All three initially offered weekly garbage and Green Bin service only to switch to every other week garbage collection. In 2021 Sudbury switched to every other week garbage collection and saw an immediate 16% increase in Green Bin program participation. Waterloo switched in the spring of 2017 and saw an immediate 150% increase in food waste diversion, a 26% increase in yard waste diversion and a 5% increase in Blue Box recycling. Niagara Region, which was still offering weekly garbage collection at the time the data found in Table 4 was developed, switched to every other week garbage collection in 2021 and observed a 24% increase in food waste diversion and an 8% increase in Blue Box recycling.

[2] City of London, Civic Works Committee Report, November 17, 2020, Community Engagement on Green Bin Program Design

Every other week garbage collection does not generate a net savings since the same amount of waste is still being handled irrespective of which week it is collected in. However, when the City transitions out of provision of Blue Box (blug bag) service in July of 2024 as required under O.Reg 391/21, it will no longer be obliged to manage the cost of Blue Box (blue bag) recycling. As a result, it will be in the City's best interest to maximize the diversion of recyclables out of the residential garbage stream. It is recommended, therefore, that the City move to every other week garbage collection along with implementation of a Green Bin program in 2025 as a means of ensuring the success of the Green Bin program.

7.2.4 Garbage Item Limits and "Pay as You Throw"

The City currently permits a weekly set out limit of two items of waste per household with an allowable additional tagged (i.e., for a fee) item for overflow. Recognizing that over 43% of the garbage set out by residents consists of food waste and 7% is yard waste, implementation of a Green Bin program and an expanded yard waste collection program has the potential to cut garbage volumes by half. With this in mind, the City could combine implementation of a weekly Green Bin program with an expanded yard waste collection program along with a garbage set out of two items every other week without having any negative impact on its current level of service. Moreover, with the City's recent expansion of its blue bag program to include additional plastics, the majority of residents will produce far less than one item per week (i.e., two items every other week) of non-putrescible (i.e., non-organic) waste with no negative impact to the public on set out volumes.

Irrespective of whether the City moves to every other week garbage collection, it is recommended that the City reduce allowable item limits by 50% (1 item per week). Recognizing that some residents, such as those with large families, may continue to be challenged with strict volume limits, consideration should be given to continuing the City's policy of permitting residents to purchase tags for extra volumes of waste. Should there be a preference to allowing the continued use of bag or item tags, it is recommended that the City amend its waste collection by-law to require mandatory participation in waste diversion programs and consider adopting a clear garbage bag policy, at some point in the future, as a condition for receiving garbage collection services. This approach prevents residents from 'buying their way' out of participating in diversion programs. It should be noted that, while bag or item limits can be used as an alternative means of encouraging participation, every other week garbage collection has been demonstrated to be a more effective means of achieving participation in Green Bin programs.

7.2.5 Acceptable Materials

The types of materials accepted in a Green Bin program can impact both the quantity and quality of materials collected. As shown in Table 5, municipalities collecting quantities in excess of 250kg/household are typically collecting materials other than food waste in their Green Bin program. Top performing programs typically collect pet waste as part of their acceptable materials and may include diapers and sanitary products or have separate weekly collection for such materials. Inclusion of pet waste can increase organics diversion by an additional 20% and diapers by another 10%. Some municipalities, such as St. Thomas, allow their residents to include yard waste in their Green Bin program. Ultimately, the types of materials that can be accepted in a municipality's Green Bin program will be determined by their organic waste processor. It is recommended that the City prioritize a processing solution that includes pet waste and kitty litter in its process to maximize its diversion efforts.

Table 5: Green Bin Programs – Acceptable Materials Comparison[3]

Municipality	Food waste, soiled paper, cooking oils & grease, household plants	Pet Waste	Diapers, Sanitary Products	Yard Waste
Toronto, City of	✓	✓	✓	
York, Region of	✓	✓	✓	
Guelph, City of	✓	✓		
Niagara, Region of	✓	✓		
Ottawa, City of	✓	✓		✓
Simcoe, County	✓	✓		
St. Thomas, City of	✓	✓		✓
Waterloo, Region of	✓	✓		
Barrie, City of	✓			
Dufferin, County	✓			
Durham, Region of	✓			
Hamilton, City of	✓			
Halton, Region of	✓			
Kingston, City of	✓			✓
Peel, Region of	✓			

7.2.6 Projected Diversion Rate of Recommended Options

In summary, it is proposed that the City adopt the following recommendations:

- Expanded leaf and yard waste collection to four events per year
- Weekly Green Bin collection from single-family households
- Every other week garbage collection
- Garbage set out limit of three items per household every other week
- Green bin waste to include food, soiled paper, household plants and pet waste
- Weekly Green Bin collection from multi-family households no later than 2026
- Weekly Green Bin collection from local business and not-for-profits for future consideration

As noted in Section 7.2.1, an expanded yard waste collection program is expected to conservatively capture 3,035 MT/yr of yard waste.

Currently almost 20% of the residential dwellings serviced by the City are multi-family sites (i.e., 9,133 units). Multi-family properties are known to generate less food waste although exact generation rates vary by occupancy (e.g., retirement complex versus young families in rental units). Provincial waste composition studies suggest it is reasonable to assume the City's multi-family housing stock will generate 9% less food waste. Thus, as noted in Section 6, it is estimated that the City generates approximately 15,088 MT/yr of food waste from its single-family and multi-family residences combined.

[3] City of London, Civic Works Committee Report, November 17, 2020, Community Engagement on Green Bin Program Design

However, it is unlikely that the City's future Green Bin waste processor will be able to receive diapers and incontenence products directly. As a result, at least 10% of this total available organic waste currently discarded by residents is expected to be be ineligible for inclusion in the City's Green Bin program at this time. As a consequence, roughly 13,579 MT/yr is assumed to be available for diversion.

Past studies show Green Bin capture rates for single-families average between 55%-65% of available material depending on what incentives are used to encourage participation (e.g., every other week garbage service). Multi-family properties tend to have lower participation rates ranging between 15%-35% depending, again, on building demographics.

Based on these assumptions, the City could reasonably expect to divert approximately 6,680 MT/yr of food waste from its single-family households and an additional 660 MT/yr from its multi-family households. Combined with its current yard waste diversion program which collects an average of 2,100 MT/yr, this would amount to a diversion rate of approximately 9,440 MT/yr which would come close to meeting the calculated Policy Statement diversion requirement of 9,794 MT/yr as shown in Table 6.

However, as shown in Table 6, expanding the City's yard waste program as proposed and including every other week garbage collection, would allow the City to achieve the provincial diversion target without immediate implementation of multi-family Green Bin service. It is recommended, therefore, that implementation of multi-family Green Bin service be deferred until 2026 subject to council approval of the proposed yard waste collection service expansion.

Table 6: Predicted Capture Rate of Green Bin Program with Expanded Yard Waste Program

Housing Type	HHLDs*	Predicted Generation Rates (Tonnes/Yr)**	Anticipated Participation Rate***	Predicted Capture Rate (Tonnes/Yr)	Per capita Capture Rate (kg/hh/yr)	Provincial Target (Tonnes/Yr)
Single-Family	37,018	11,134	60%	6,680	180	
Multi-Family	9,133	2,445	27%	660	72	
Yard Waste	N/A	4,500	70%	3,150	N/A	
			Total Single-Family only	**9,830**		**8,435**
			Total including Multi-Family	**10,491**		**9,794**

*Households
**Excludes diapers and incontinence products
***Assumes every other week garbage collection

If, however, the City opts to retain its current weekly garbage collection service and defer expansion of its yard waste collection services, it is expected that it would divert approximately 6,079 MT/yr of combined food and yard waste and fail to meet the Policy Statement requirements as shown in Table 7.

Table 7: Predicted Generation and Capture Rates with Green Bin Implementation Only

Housing Type	HHLDs*	Predicted Generation Rates (Tonnes/Yr)**	Anticipated Participation Rate***	Predicted Capture Rate (Tonnes/Yr)	Per capita Capture Rate (kg/hh/yr)	Provincial Target (Tonnes/Yr)
Single-Family	37,018	11,134	30%	3,340	90	
Multi-Family	9,133	2,445	20%	489	54	
Yard Waste	N/A	4,500	50%	2,250	N/A	
			Total Single-Family only	**5,590**		**8,435**
			Total including Multi-Family	**6,079**		**9,794**

*Households
**Excludes diapers and incontinence products
***Assumes weekly garbage collection

7.3 Other Program Design Considerations

While the issues identified in Section 7.2 are key drivers of program diversion, there are a number of other issues that affect operating costs and public acceptance of Green Bin programs. They include factors such as collection containers, use of liners and co-collection of yard waste and food waste.

7.3.1 Collection Containers

For most municipal Green Bin programs, wheeled carts, commonly known as “Green Bins”, are provided to participating households along with a small (typically 7.5 litre) kitchen-sized food waste container (see Figure 3 for examples).

Green Bins can come installed with a locking mechanisms on them to prevent access by vectors such as raccoons. Green Bins can range in size from 45 litres to 240 litres. The largest capacity carts are normally offered in municipalities co-collecting leaf and yard waste with food waste. Weight is a significant factor in determining collection container size. An 80 litre Green Bin can easily exceed typical municipal health and safety policies and collection by-law weight restrictions (i.e., normally 22 kg max) if filled with high moisture content waste (e.g., fruit, grape pressings or pet waste). As a consequence, most collection fleets picking up larger Green Bins utilize trucks equipped with a mechanical lift device known as a lift assist. The largest capacity bins (i.e., 240 litre) would normally only be picked up by fully automated collection vehicles using a mechanical arm to lift and dump the containers.

These choices have significant financial implications to a municipality’s fleet and are discussed later in this report. Given that one 45 litre container is typically sufficient to meet the needs of the average householder, it is recommended that the City adopt this size of container as its program standard and provide additional containers on an ‘as needed’ basis. An exception to this recommendation would be if the City opted to move to automated cart collection in which case larger 80 litre bins would be more cost effective.

Figure 3: Examples of Proposed New Garbage and Organics Containers

Automated Collection Cart
Uline (65 gallon/245 litre)

Automated Collection Cart
Orbis NPL 285 (21 gallon/80 litre)

Kitchen Bin
Enviro World Kitchen Organics Bin

7.3.2 Container Liners

As part of the City's plans to roll out a food diversion program, it will select a contractor to provide organics processing services or plan to build its own processing operations. The selected processing system and operating licence will ultimately determine the types of materials that can be included in the City's Green Bin program and any restrictions in collection methodology. Based on past experience in Ontario, it is likely that the contractor will not want, or be permitted by the Ministry of the Environment, Conservation and Parks (MECP), to accept food waste collected in plastic bags.

This limitation has two important impacts on the design of the City's Green Bin program:

1. It will prevent the City from collecting diapers and other sanitary products as part of its Green Bin program; and
2. It also means that food waste will need to be collected loose or with a non-plastic liner bag.

Most municipalities encourage their residents to use paper liners. This can take the form of lining a Green Bin with sheets of newspaper or paper bags that are designed to line the resident's Green Bin or kitchen food waste containers.

Some allow the use of certified compostable/biodegradable non-paper liners (see Figure 4 for examples of allowed certification logos). Use of the latter can be problematic because they can be difficult to differentiate from regular plastic grocery bags. However, restricting the use of liners to paper products can have a negative impact on participation rates, as most residents object to managing food waste in unlined containers and find the cost of paper bags to be an issue.

Allowing the use of compostable plastic bags inevitably results in some level of cross contamination with regular plastic bags, which may result in surcharges or fines from the composting facility or outright rejection of loads. In general, most Ontario municipalities opt to achieve higher levels of diversion by allowing residents to include both types of liners.

Should the City pursue this option, an additional promotion and education budget to educate residents and local stores on the correct types of bags should be considered for the program. It is recommended that input from the City's processing contractor be sought before a final decision is made.

Figure 4: Compostable Liners

Certified Compostable Logos

Certifies that the bag is made from plant-based material and is tested to ensure it can compost fully.

7.3.3 Co-Collection with Yard Waste

Food waste and other types of organic waste can have very high moisture levels as noted above, compared to leaf and yard waste. As a consequence, composting facilities managing food waste will often use large volumes of leaf and yard waste as a bulking agent. This fact has led some municipalities, as shown in Table 5 above, to co-collect food waste and yard waste. In other instances, municipalities opt to collect leaf and yard waste separately and may or may not transport it to their organics processing facility for use as a bulking agent. Generally, favourable processing costs can be obtained if a municipality commits both their food and yard waste to the same facility because of the symbiotic nature of the waste streams.

That said, it is usually more cost effective to collect leaf and yard waste separately because of the significant difference in processing costs between the two materials (i.e., food waste composting costs are typically three times that of leaf and yard waste). It is recommended that this issue be considered as part of discussions with vendors developing processing solutions for the City prior to finalizing program details such as bin size.

7.3.4 Program Implementation and Communications

Green Bin programs have been successfully launched in numerous communities to date throughout Ontario. The Waste Management Strategy plan also noted that the most recent public survey undertaken by the City *"found that 67% of respondents favour the implementation of an SSO collection program".* It also noted that, *"One of the most common responses when residents were asked about the top issues with respect to waste management was that too much organic material is being landfilled."*

Nonetheless, these programs represent a significant change in the way waste is managed in the household and as such require careful pre-planning to ensure public concerns are addressed effectively and a smooth roll out is achieved. Past experience shows that successful programs have involved high levels of public engagement in advance of the program launch and throughout the first year of operations. For this reason it will be necessary for the City to allocate additional staff resources to the development, implementation and ongoing maintenance of the new program as further described in Section 9 of this report.

An analysis of recent program launches by other municipalities suggests the City also set a preliminary budget of $0.90 per household per year as a baseline communications budget over a five year period starting in 2024 to support the program launch. This is a conservative amount compared with the recommendations of the Waste Management Strategy which cited a KPMG best practices report[4] recommending $3 to $4 per household for new program launches and an ongoing communications budget of $1 per household. The City may also wish to consider the potential involvement of local partners like EcoSuperior and local schools in supporting communications about the new program and aiding in meeting elements of the Provincial policy statement related to the development of local food waste diversion options.

8. Fleet Modifications and New Technology

Roll out of a Green Bin diversion program will also have a dramatic impact on waste collection from single and multi-family households in the City. Green Bin collection is traditionally done using 45 litre carts and trucks fitted with either 'lift assist' tippers or automated collection arms. Mechanical assistance is necessary because the weight of the containers typically exceeds safe manual lifting limits.

Additionally, with the potential to divert over 30% of the residential waste currently collected by the City, consideration will need to be given to undertaking separate collection of the new waste stream or employment of split body vehicles to allow co-collection of garbage and Green Bin waste aboard the same truck but in separate compartments. Driver training will also be necessary irrespective of the selected collection system.

8.1 Separate Trucks versus Co-collection

The City currently collects garbage and blue bag recycling with separate fleets. Introduction of a third collection truck at the curb to collect Green Bin waste is an option but would run counter to the City's climate change policy goals and increase traffic congestion on City streets. Instead, it is proposed that the City begin purchasing split body side loading trucks that would allow for the co-collection of garbage and Green Bin waste, in separate compartments, onboard the same truck. Given that there is no change in the actual volume of waste being managed, there should be no need to change the number of trucks deployed by the City. Instead, it is recommended that split body trucks be procured by the City as it replaces its existing fleet in the coming years.

The City's waste collection fleet currently consists of 15 International packers and one ½ tonne dump box pickup truck. As noted in Section 3.3, the packers range in age from 2007 to 2016. It is anticipated that by the time the new Green Bin program is rolled out in 2025, all but two of the vehicles will have been replaced.

It should be noted that if the City commits to every other week garbage and weekly Green Bin collection, the varying collection schedules would require reworking existing collection routes and a period of adjustment by its collection crews. This exercise will also help with workload leveling across current routes and improve collection route efficiency.

[4] Blue Box Program Enhancement and Best Practices Assessment Project, KPMG, 2007

8.2 Lift Assists versus Automated Cart Based Collection Service

Given that introduction of a Green Bin program necessitates use of carts with some sort of mechanical lift assist and that co-collection of garbage and Green Bin waste is the most likely collection methodology, a move to automated collection of garbage in carts should be considered.

Automated cart-based collection, or 'auto-cart' collection, is commonplace throughout much of the USA and Europe. It is becoming increasingly popular in Ontario with municipalities such as Toronto, Peel Region, Guelph, Timmins, Temiskaming Shores, Sault Ste. Marie and Bluewater Recycling Association having already made the switch. The benefits of auto-cart service include significant improvements in collection efficiency, worker safety and satisfaction, reductions in injuries and climate change impacts.

Figure 5: Lift Assist (left) and Automated Collection (right)[5]

Historically many municipalities have been reluctant to switch from manual collection because they collect Blue Box (blue bag) materials in a 'two stream' format (i.e., keeping fibres separate from containers). Switching to auto-cart collection typically involves shifting to 'single stream' Blue Box (blue bag) material collection (i.e., where the fibres and containers are fully co-mingled). For many municipalities doing so was not possible because their recycling facility was unable to accept co-mingled recyclables and single stream auto-cart programs exhibit high contamination problems.

However, the passage of O.Reg 391/21 will allow municipalities to transition out of the provision of residential recycling service across Ontario in the coming years. As municipalities prepare for this fundamental change in service, many are considering the opportunity to switch to auto-cart service for the continued collection of garbage and Green Bin materials. The City transitions out of the blue bag program in July of 2024 creating an ideal opportunity to roll out a fully automated Green Bin and garbage collection service in the following year.

8.2.1 Auto-cart Efficiencies

Auto-cart collection's ability to achieve significantly greater collection efficiencies over manual collection is well documented. Typically, single operator collection trucks are capable of achieving 650-850 stops per day depending on the streetscape and housing density. The same driver operating an automated

[5] http://www.theglobeandmail.com/news/toronto/winningbidder-for-toronto-garbage-contract-no-stranger-to-controversy/article559012/; http://www.guelphmercury.com/newsstory/2790723-challenges-encountered-on-first-day-ofguelph-waste-cart-pick-up/

collection vehicle in the same conditions can easily exceed a route efficiency of 1,100-1,500 stops per day. The City currently achieves an average of 1,100 stops per day but does so with two operators on each truck and overtime costs, on average, of $50,000 per year. Moving to automated trucks would allow the Section to reduce its net operating costs by as much as 16% or almost $827,000 per year.

More importantly, a transition to auto-cart collection would significantly improve the safety of its drivers. The waste management industry, as a whole, pays amongst the highest WSIB premiums of any industry in Ontario. Over the last five years, the City has incurred average costs of $200,000 per year as a result of WSIB claims and these costs continue to rise. Eliminating the manual collection service will go a long way to reducing these costs and protecting the associated staff.

8.2.2 Cost Implications of Lift Assists versus Automated Cart Systems

Whether the City opts for manual split body trucks with lift assists or automated split body trucks with cart collection arms, the base cost of the truck remains the same. Split body trucks with lift assists cost approximately $55,000 more per vehicle than standard body trucks. By comparison a truck equipped with an automated arm would be approximately $80,000 more per vehicle. If the City were to convert its entire fleet of 15 trucks to automated collection, the one-time incremental difference in the cost of the two types of vehicles would be $360,000 (i.e., $40,000 per vehicle). However, as noted above, switching to automated collection is expected to result in a conservative savings of almost $827,000 per year. While lift assists offer protection to staff from injury, they are slower to load and operate and could result in increased overtime costs.

The savings offered by moving to auto-cart collection are significant but must also be weighed against the significant upfront costs of buying additional carts for garbage for each household and upgraded Green Bin carts capable of being picked up by automated collection arms. Careful advanced planning of routes and driver training is also required to successfully launch an auto-cart program. The planning cycle for a City-wide program launch is typically two years and requires a significant capital outlay. Nonetheless, the savings opportunities for local taxpayers make this option worth considering.

It is recommended, therefore, that the City move to auto-cart based collection for organic waste and garbage in concert with the roll out of its Green Bin program and that a redeployment plan for affected staff be developed to minimize the negative impact on the City's collection workforce. This recommendation is consistent with the Waste Management Strategy and other past reports. Should the City commit to moving to auto-cart collection in 2025, it is also recommended all vehicles purchased in the interim be procured to be auto-cart ready to minimize retrofit requirements.

8.3 Front End Loader Service

The City currently requires that multi-family properties store their garbage and blue bag recycling in locked sheds. Multi-family properties are eligible to receive collection of up to 3.75 m^3 (or 66 items) of waste per site at a time. Garbage is emptied manually by City staff, and recycling by the City's contractor, on the appropriate collection day.

Shed-based collection is not commonly practiced elsewhere in the waste industry but offers a number of benefits such as site security, vector control and protection from the elements. By comparison, standard practice in the industry is to provide front end loader (FEL) or cart-based service in this sort of environment. Should the City opt to provide Green Bin service to its multi-family properties,

consideration should be given to explore moving to FEL or cart-based service at the same time. A preliminary assessment of the City's multi-family garbage collection costs suggests there is opportunity to reduce operating costs and improve driver safety by eliminating direct handling of these sorts of waste volumes.

Recognizing that the City has required property owners to install these sheds at their cost as a condition of service, conversion to an FEL or cart-based system will require extensive discussion with affected property owners. It is recommended that the City develop an inventory of its multi-family properties prior to implementation of Green Bin service in the City, assess the potential savings of converting suitable properties to either form of automated service and report back to City council with recommendations on future garbage and organic waste collection standards for this sector. Consideration should also be given to reviewing local businesses serviced by the City to assess the potential of converting suitable properties over to FEL or cart-based collection service for the same reasons.

9. Staffing Implications

The City's Solid Waste and Recycling Services consists of a manager, two supervisors, a waste diversion coordinator and the associated operating staff as outlined in Section 3.4. Implementation of a Green Bin program and automated cart-based collection will require significant changes to how waste is currently managed throughout the City. The current organizational structure of Solid Waste and Recycling Services can not support the successful implementation and sustained operation of these new programs. As outlined in Section 7.3.4, different staffing roles are required to support the roll out and long-term success of the new programs including:

- One permanent full time Promotion & Education Coordinator to design, implement and maintain the ongoing communications that will be required to ensure success of our integrated solid waste system;
- One permanent full time Solid Waste Compliance Officer to support public compliance and proper ongoing curbside segregation of waste streams (and also address existing problems like sharps in the waste stream);
- One temporary full time Solid Waste Project Coordinator to assist in coordinating program development and implementation; and
- Two temporary full time Customer Service Advisory staff to assist with program rollout and respond to public questions/concerns.

The temporary full time positions are expected to be two to three year contracts subject to final decisions on the program design and implementation schedule.

These recommendations are consistent with the Waste Management Strategy which recommended hiring a promotion and education coordinator, by-law enforcement officer and support staff to assist with program implementation. The new roles are also consistent with other municipalities' experience in rolling out similar programs which has demonstrated that adequate resourcing is required for implementation and long-term success of solid waste programing. These findings are supported by waste diversion program performance data collected annually across the province which has shown a direct linkage between appropriate staffing resources and programs with high waste diversion and low contamination rates.

Despite the need for these new staffing roles, the proposed conversion to automated cart-based collection is projected to result in a net reduction of up to 5.34 FTEs in Solid Waste and Recycling Services. The main driver in this reduction is that automated cart collection only requires one driver per collection vehicle, as opposed to the current two-person crew required for manual collection. Detailed discussion will be required with the Human Resources and Corporate Safety Division and the union on these proposed changes.

10. Processing Options

Numerous technologies have been trialed to process various types of food and organic wastes. Generally, technologies fall into two categories including aerobic (decomposition in the presence of oxygen) and anaerobic (decomposition in the absence of oxygen) systems. Each has their advantages and disadvantages.

In the fall of 2021, the City released a Request for Information (RFI) to solicit information about technologies and capacity from prospective vendors. The City received feedback from vendors representing the primary types of composting technologies confirming their interest in providing a solution for the City.

The following section provides a brief overview of technologies outlined by the respondents and others that the City may wish to consider. Capital costs are presented as a cost per tonne ($/MT) of annual design capacity (i.e., capital construction cost divided by the annual design capacity of the facility). Operating costs are presented as a cost per tonne ($/MT) of Green Bin waste managed.

10.1 Home-Based Solutions

Home based solutions for food and organic waste traditionally involve methods such as backyard composting or more high-tech approaches such as garburators (in-sink grinders), vermicomposters and dehydrators. Garburators are not permitted under the City's sewer use by-law.

Backyard composting is using the natural process of decomposition to convert organic material into "humus", more commonly known as 'compost', which is a rich soil amendment. The City currently has a "Composting at Home" program which involves subsidization and distribution of backyard composters through EcoSuperior. This program distributes an average of 241 units per year and is estimated to divert approximately 1,992 tonnes of organic waste annually. Backyard composters are, however, limited in their efficacy because repeated studies have shown that residents rarely use them during the winter months. Additionally, composting certain food wastes (e.g., bones) in a home environment can be challenging.

Garburators were commonly used throughout the 60's and 70's. While ideal for apartment settings, they were found to cause significant problems to municipal wastewater collection and treatment systems. As a consequence, they have been banned in many parts of Canada including under the City's sewer use by-law.

Vermicomposters (composting using worms in a box) were offered to residents as an alternative. These systems, while technically viable, require close monitoring and only ever appealed to 2-3% of the population.

Food waste dehydrators are an example of a more 'high-tech' approach to managing food waste at home. This is still a somewhat new approach that to date has not been widely implemented in municipalities. Food waste is ground, aerated, heated and in some cases, compressed into a block. This process decomposes and sterilizes the food waste reducing the volume of food waste by about 90%. The resulting material can be used as a soil amendment[6]. As an example, FoodCycler offers its FC-50 for sale in partnership with Vitamix at a retail of $450[7].

Figure 6: The 'FoodCycler'[8]

Each of these technologies represents a viable means of managing certain food and organic wastes in a home setting. However, while the Policy Statement does allow for consideration of alternatives, it does prioritize curbside collection of a food and organic for single family homes. For this reason, it is recommended that the City focus on provision of a curbside collection system but promote the use of this class of options as an alternative for homeowners who are unable or unwilling to use a cart-based collection system.

10.2 Open Windrow Composting

Open windrow composting is one of the most common methods of processing solid organic waste in North America. Its prevalence is mainly due to its ability to manage a wide range of feedstocks with minimal infrastructure requirements and at a low operating cost. Windrow composting involves forming the feedstock into piles known as windrows approximately 30 metres long with a typical height of 2.5 metres and base of 4 metres. The composting process goes through two stages known as the active or 'thermophilic' phase followed by a less active stage known as the 'curing' phase. The compost is then screened to remove contaminants and produce a uniformly sized material for market.

[6] FoodCycler. How it Works: The Science behind the Magic. https://www.foodcycler.com/how-it-works

[7] Vitamix. https://www.vitamix.com/ca/en_us/shop/compact-food-recycling?COUPON=06-860&cjevent=20b69afa700f11ec825d1ccc0a82b82c&cjdata=MXxOfDB8WXww

[8] FoodCycler Operating Manual. https://www.foodcycler.com/how-it-works

Windrows are commonly used for leaf and yard waste but can also be used for a range of food and organic waste. The City currently uses open windrow composting to manage its yard waste. Incorporation of food and organic waste does, however, introduce additional challenges in managing odour and run off (commonly known as leachate) and requires the availability of sufficient bulking material (such as yard waste) to mix with and ensure the right moisture levels are achieved.

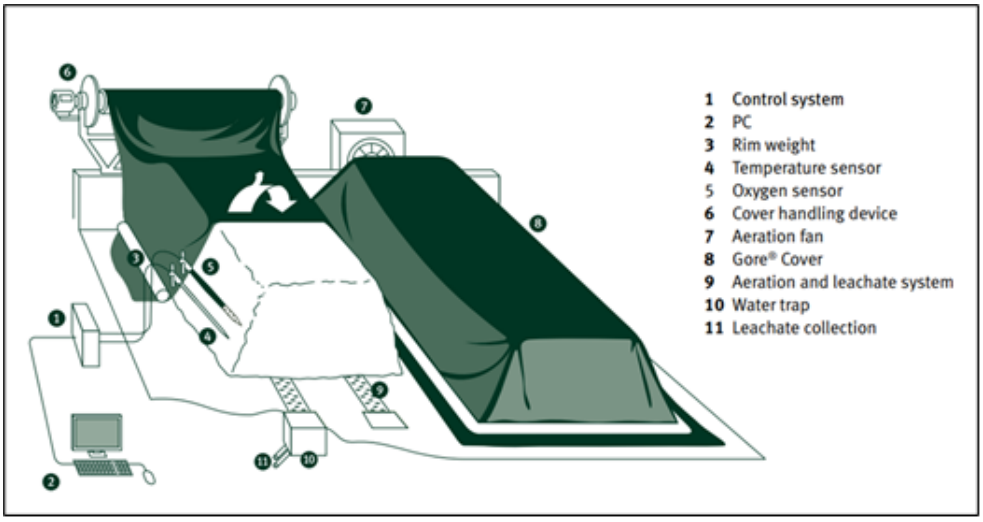
Figure 7: Open Windrow Composting

10.3 Aerated Static Piles and Membrane Covered Windrows

Similar to open windrow composting, aerated static pile or membrane covered windrow systems typically involve mixing Green Bin waste with ground yard waste and arranging it in either a series of piles or windrows overtop of a perforated concrete pad. Air is distributed by a blower and manifold through a network of pipes under the pad to force air up through the pile or windrow as shown in Figure 8. They often incorporate computerized monitoring and control equipment for oxygen, heat and moisture levels, as well as a collection system for water and leachate.

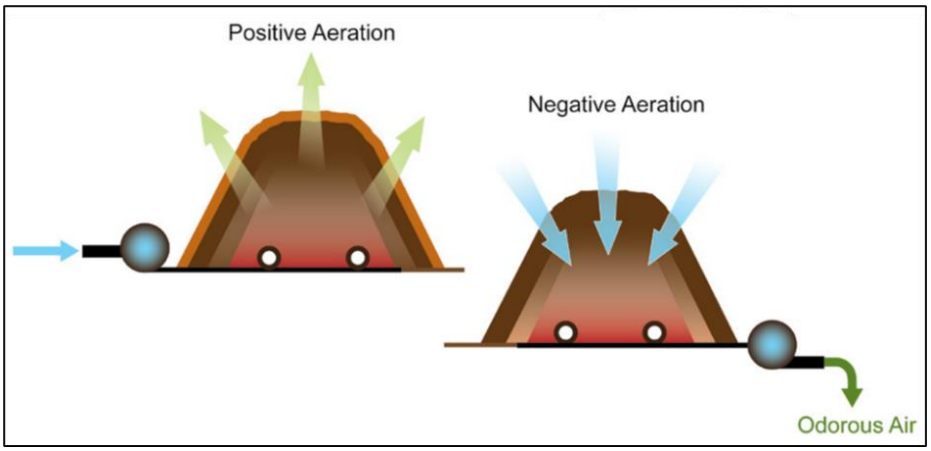
In more basic systems, the perforated piping is laid directly into the pile as it is built up. This approach is, however, significantly more labour intensive and is typically only used for small volume operations or where labour is inexpensive.

Figure 8: Membrane Covered Windrow[9]



Depending on the complexity of the system and type of material being composted, the piles may simply be covered with finished compost (see Figure 9) or a membrane to trap and contain odours from the decomposing material. Air flow can also be directed positively, negatively or bi-directionally to control fugitive odours and manage oxygen and moisture levels.

Figure 9: Positive and Negative Aeration[10]



Based on a literature review, the capital costs for typical food waste aerated static pile or windrow systems range from $140 to $180/MT of design capacity, subject to the size and complexity of the system. Operating costs for such a facility with an annual capacity of approximately 10,000 MT/yr or less would be in the order of $45 to $65/MT.

[9] W. L. Gore & Associates. The Principle of Organic Waste treatment with GORE® Cover. https://www.gore.com/sites/g/files/ypyipe116/files/2016-04/gore-cover-composting-en.pdf

[10] Environment Canada. Technical Document on Municipal Solid Waste Organics Processing. 2013

10.4 In-Vessel Aerobic Systems

In-vessel composting systems typically process Green Bin waste within an enclosed system, such as a rotating drum, aerated box or tunnel, or aerated concrete channels within an enclosed building. These systems are normally modular in design but are typically used for larger volumes of Green Bin waste because they can be capital intensive compared to outdoor systems. They typically involve an intensive aerated composting phase lasting two to four weeks within the enclosed system followed by several months of standard open windrow composting outside to 'cure' or stabilize the resulting compost. Managing the initial, odorous phase of the composting process within an enclosed system has obvious benefits. It allows for optimal control of environmental conditions such as temperature, moisture, airflow and odours.

Aerobic channel systems include both static pile and actively turned systems. Static pile systems are very similar to outdoor aerated static piles except that the indoor systems consist of concrete channels three to 10 metres wide and upwards of 50 metres long with aerated concrete floors running the length of the channel and reside within a climate-controlled building. Actively turned systems have solid concrete floors in the channels and use a compost turning machine to turn the compost to aerate it. The compost turner will either be mounted on an overhead gantry crane or sit on rails running the length of the channel walls.

In some systems, the channels are replaced by a series of enclosed tunnels with airtight doors at either end to provide better climate and odour control. Given the level of capital investment required, this type of technology is more suitable for facilities that process more than 25,000 MT/yr.

Modular versions of these types of in-vessel systems use enclosed bins or containers. Organic waste is loaded into the container through doors located on either the top or side. Once filled, the containers are sealed and moved to an outdoor pad and connected to a stationary aeration system. Air is pumped into the base of the container and exhausted through the top. The exhausted air can then be collected and treated if desired. These systems are most appropriate for facilities that process less than 15,000 MT/yr but have a limited track record in managing municipal food waste.

The estimated capital cost for an in-vessel system is between $330 to $585/MT of annual design capacity, depending on the size and type of in-vessel system used. Operating costs tend to be in the range of $50 to $100/MT, with per tonne operating costs decreasing as tonnage increases due to economies of scale. Operating costs for such a facility with an annual capacity of approximately 10,000 MT/yr or less are estimated to be in the order of $80 to $100/MT.

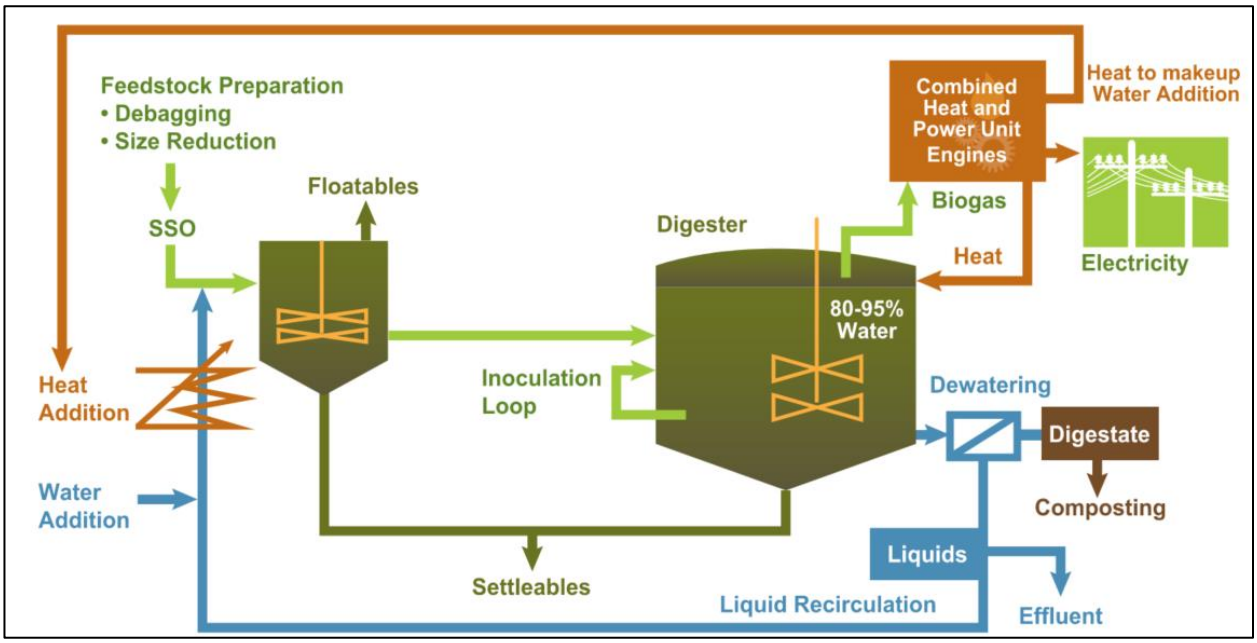
10.5 Anaerobic Digestion

Anaerobic digestion (AD) is a relatively new method for managing Green Bin waste but is the basis of standard sewage treatment operations. AD is a biological process where organic wastes are broken down by anaerobic microorganisms in the absence of, or low levels of, dissolved oxygen. Energy (in the form of heat and 'biogas') are outputs of anaerobic digestion. For every pound of organic matter digested, approximately 4 cubic metres of biogas are produced. Biogas can contain from 50% to 70% methane gas, depending on the type of material being digested. The remainder of the biogas consists of CO^2 and trace volumes of sulfur compounds. There are many different types of anaerobic digesters, and while the time required to completely process the waste can vary, this initial process typically has an

average duration of eight weeks. AD systems can be generally categorized into “Wet” or “Dry” systems. Wet (or low solids) AD systems typically operate at liquid to solids level of less than 10% solids. Dry AD systems have higher solids levels.

Figure 10 depicts a typical wet AD system. Green Bin feedstock is debagged (i.e., if collected in plastic bags) and shredded and fed into a mixing tank along with ‘make up’ water. Lightweight materials such as plastics are skimmed off while heavier materials such as glass and stones settle to the bottom and are removed prior to introduction of the slurry to the digestion process. The slurry is continuously stirred in the digester and biogas is removed from the tank and burnt to convert it to heat and ‘green’ energy. The processed waste liquid is dewatered to produce a semi-solid material called ‘digestate’. The liquid is then treated and discharged as effluent. The digestate is then either sent to landfill or a composting facility where it will need to be reprocessed with leaf and yard waste to produce a finished product. Direct land application is possible subject to provincial licensing restrictions and public acceptance. Currently the City’s digestate from its wastewater treatment plant (WWTP) is landfilled.

Figure 10: Typical Wet Anaerobic Digestion Process Flow[11]



AD systems are popular because of their ability to handle a full range of Green Bin materials (including pet waste, diapers and incontinence products) and allow residents to use non-biodegradable plastic bags as container liners. Unfortunately, they are also the most expensive composting systems to build and operate and typically more cost competitive for quantities approaching 50,000 MT/yr.

The approximate capital cost for an AD system would be $1,000 to $1,500/MT of annual design capacity and operating costs would be in the range of $100 to $200/MT. It is expected that the capital and operating costs for a facility sized to meet the City’s requirements would be in the higher end of the cost range due to low economies of scale.

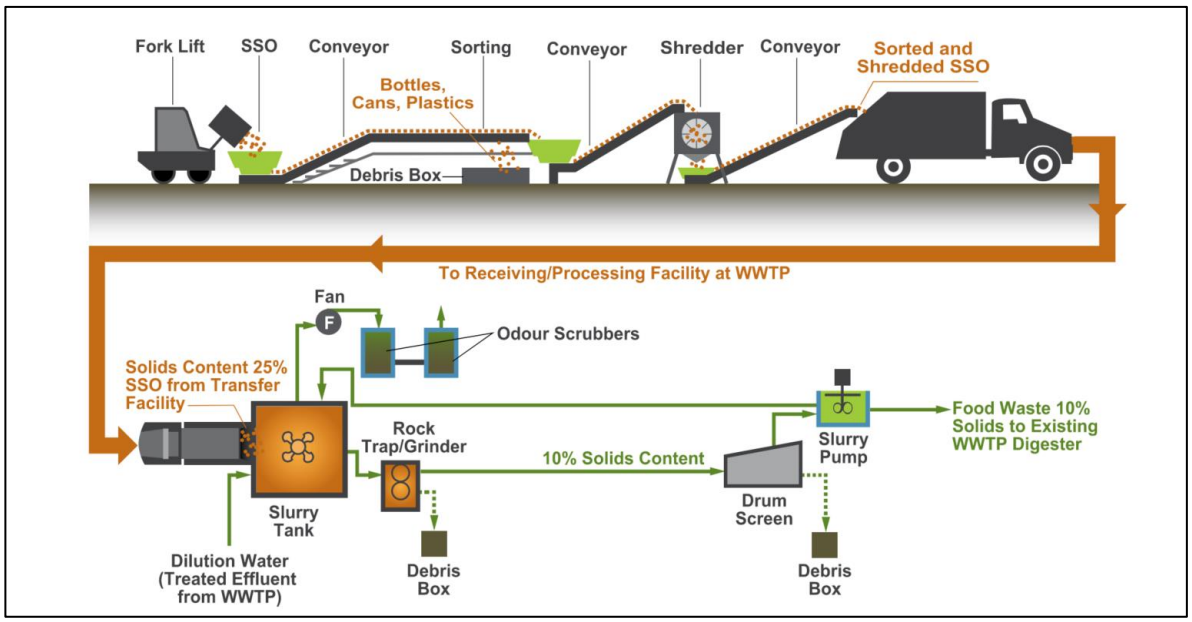
[11] Environment Canada, Technical Document on Municipal Solid Waste Organics Processing, 2013

10.6 WWTP Co-digestion

More recently, municipalities have been considering the feasibility of co-digesting Green Bin waste at their existing WWTPs. This option can be appealing if the WWTP has spare capacity as a means of minimizing capital construction costs. Subject to the capacity limits of the existing WWTP, such systems include equipment for the receiving, pre-treatment of the Green Bin waste and injection of the resulting slurry into the existing WWTP digester. Figure 11 illustrates a typical pretreatment system for Green Bin waste.

The capital cost to update a WWTP facility to accommodate food waste processing is estimated to be between $10M to $20M, or between $1,000 to $1,500/MT of design capacity with operating costs similar to that of an AD facility. It is expected that the capital and operating per tonne costs for a facility sized to meet the City's requirements would be in the higher end of the cost range due to low economies of scale.

Figure 11: Typical Pre-treatment System for Green Bin Waste[12]



11. Processing Capacity and SWRF Infrastructure Requirements

Based on the program design assumptions noted earlier, it is expected that the City will require a minimum of 7,300 MT/yr of food waste processing capacity to service its immediate single-family and multi-family needs. Should it expand service to local businesses and institutions, and with population growth, additional capacity may be required in the future.

Expansion of leaf and yard waste collection services is also expected to capture an additional 920 MT/yr of additional material which would need to be managed at the SWRF composting operations. The

[12] Environment Canada, Technical Document on Municipal Solid Waste Organics Processing, 2013

current operations are licensed to receive up to 6,000 MT/yr so accommodating additional quantities of yard waste at the City's SWRF would not be an issue subject to negotiation of costs with the current contractor.

As noted in Section 10.5, the choice of Green Bin processing technology that the City procures may result in the operator needing the City's leaf and yard waste for use as a bulking agent in their operation. If digestate from anaerobic treatment of Green Bin waste is to be accommodated at the SWRF, the current ECA would need to be amended to accommodate this operation on site. Similarly, operation and maintenance of the composting pad would need to be scaled up to accommodate the new volumes. Consideration may also need to be given to construction of a highway trailer loading ramp and pad if ground yard waste is to be shipped offsite for use as a bulking agent at the Green Bin processing facility. These issues will be a point of future discussions with prospective processing vendors to determine which option is the best.

Recognizing that the City landfills an average of 82,561 MT of waste per year, the proposed program has the potential to reduce landfill tonnages by over 10%. Institution of bag or item limits will also encourage diversion of blue bag materials, which could result in a further reduction in landfilling requirements. A review of landfill staffing and operational requirements in future years may be necessary. Additionally, should the City opt to move to automated cart collection, consideration will need to be given to operational considerations such as specialized truck maintenance and construction of purpose-built storage areas for carts at the SWRF.

12. Evaluation of Processing Options

12.1 Methodology

The various technology options were comparatively evaluated against a suite of weighted criteria that considered environmental, social, financial and technical factors as well as risk. This evaluation included:

- Providing a relative weighting of the various evaluation criteria based on their level of criticality in the decision making process;
- Assessment of the technology against each criteria;
- Assignment of a value on a scale of 1 to 5 for the technology based on the assessment; and
- Calculating the numerical score based on the weighting.

Table 8 presents the evaluation criteria and the definitions for the evaluation scale. Table 9 provides the relative weighting of the evaluation criteria with rationale.

An assessment of technologies based on the evaluation criteria is provided in Section 12.2.

Table 8: Evaluation Criteria and Scale

Criteria	Evaluation Scale				
	1 (Worst Performance)				5 (Best Performance)
Environmental					
GHG Emissions Reduction	Least emissions reduction				Most emissions reduction
Diversion Potential	Least diversion potential				Most diversion potential
Social					
Odour Avoidance	Greatest risk of odours				Least risk of odours
Customer Convenience	Least customer convenience				Greatest customer convenience
Traffic Impact Avoidance	Most traffic impacts				Least traffic impacts
Financial					
Capital Cost	Highest Cost per Annual Tonne Capacity				Least Cost per Annual Tonne Capacity
Operating Cost	Highest Cost per Annual Tonne				Least Cost per Annual Tonne
Technical					
Proven Technology	Not a proven technology / relatively new technology				Widely used technology
Scalability (for population growth)	Limited scalability; requires significant upgrades to scale				Very scalable; modular technology
Integration with Municipal Programs	Limited ability to integrate with other municipal programs				Able to integrate or integrate other municipal programs
Footprint	Large footprint required				Small footprint required
Risk Management					
Compliance with Policy Statement	Not fully compliant				Fully compliant
Approvals	Minimal approvals needed				Greatest level of approvals required
Ability to meet Timeline	Unable to meet diversion timeline				Comfortably able to meet timelines with little risk
Technical Complexity	High degree of complexity				Low degree of technical complexity

Table 9: Technology Evaluation Scale and Weighting

Criteria	Weighting (1 to 5)	Weighting Rationale
Environmental		
GHG Emissions Reduction	3	The potential for reducing greenhouse gas emissions is considered a very important component of this program.
Diversion Potential	3	The potential for diverting the most waste from disposal is considered a very important component of this program.
Social		
Odour Avoidance	3	Odours from a waste processing facility can be very disturbing to a community. As such, this criterion has an elevated level of importance.
Customer Convenience	3	Overcoming barriers to participation is a key element to the success of a Green Bin program. As such, this criterion has an elevated level of importance.
Traffic Impact Avoidance	1	The type of technology used will have little impact on potential traffic impacts, which would be expected to be minor. As such, this criterion has a relatively low weighting.
Financial		
Capital Cost	5	The affordability of the technology is a key factor in its suitability for the municipality. As such, this criterion has the maximum level of importance.
Operating Cost	5	The affordability of the technology is a key factor in its suitability for the municipality. As such, this criterion has the maximum level of importance.
Technical		
Proven Technology	3	To limit risk, the municipality wishes to use technologies that have a proven track record, including within Ontario. Widely used technology is a key factor in its suitability for the municipality. As such, this criterion has an elevated level of importance.
Scalability (for population growth)	1	Ability of the technology to accommodate future growth is important and is considered in the evaluation. However, given the opportunity to manage facility sizing during detailed design, this criterion is weighted relatively lower than the others.
Integration with Municipal Programs	1	Ability of the technology to integrate with other municipal programs is important and is considered in the evaluation. However, its weighting is relatively lower compared to the other criteria.
Footprint	1	The potential footprint of the technology is important and is considered in the evaluation. However, its weighting is relatively lower compared to the other criteria.
Risk Management		
Compliance with Policy Statement	5	The Municipality seeks to ensure compliance with the Province's Policy Statement. As such, the technology's ability to help ensure this compliance has the maximum level of importance.
Approvals	3	The quantity and complexity of required approvals can increase the length of time required for implementation as well as lead to increased design and engineering costs. As such, this criterion has an elevated level of importance.
Ability to meet Timeline	5	The ability for the technology to be implemented within the Municipality's desired timeline is critical. As such, this criterion has the maximum level of importance.
Technical Complexity	3	The complexity of the technology can increase the length of time required for implementation as well as lead to increased design and engineering costs. As such, this criterion has an elevated level of importance.

12.2 Technology Assessment

This section summarizes the assessment of the primary types of food and organic waste processing technologies considered in this report.

12.2.1 Environmental Considerations

12.2.1.1 Greenhouse Gas Emissions

Composting or digesting Green Bin waste in controlled conditions reduces greenhouse gas (GHG) emissions compared to landfilling. Organics disposed in landfill break down anaerobically and generate landfill gases, including methane gas. Methane is a potent GHG with 25 times as much global warming potential compared to carbon dioxide. Methane is known as a short-lived climate pollutant. As such, reducing the emission of short-lived climate pollutants can reduce the atmospheric levels of GHGs at a much quicker pace than comparable reductions from longer-lived GHGs. This means that actions that reduce these particular GHGs can have significant benefits for curbing near-term climate warming[13].

The anticipated GHG reduction potential for home-based composting systems is low compared to the other options. While home-based technologies would avoid the GHG emissions that are generated by the transport of organics to a processing facility, the potential diversion through such an approach is likely to be less compared to a centralized approach. Therefore, a greater proportion of the City's organics would continue to be landfilled and potentially release methane emissions to the atmosphere even with the City's landfill gas collection system.

The anticipated GHG reduction potential is expected to be greater in a centralized Green Bin system because it has greater potential for diverting Green Bin waste from disposal. GHG reduction is greatest with anaerobic digestion or WWTP co-digestion as it allows for the capture and use of biogas and thus the offsetting of fossil fuels. Aerobic composting processes result in uncontrolled generation of carbon dioxide with limited potential for capture of emissions. Co-digestion at the City WWTP does have the potential to involve an additional trucking element to ship the resulting digestate to an aerobic composting facility or landspreading operation and would also potentially require separate haulage of the slurry and residue depending on the set up. This additional haulage would increase GHG emissions for this option. Similarly, any option involving setup of a facility outside of the City SWRF will involve additional trucking of collected materials and resultant residue.

Evaluation Results - GHG Emissions Reduction						
Home-based Solutions	**Open Windrow**	**Aeration Static Pile/ Windrow**	**Membrane Covered Aeration Systems**	**In-vessel Aerobic Composting**	**Anaerobic Digestion**	**WWTP Co-digestion**
1	2	2	3	3	5	4

[13] Environment Canada. Greenhouse gas emissions: drivers and impacts. https://www.canada.ca/en/environment-climate-change/services/environmental-indicators/greenhouse-gas-emissions-drivers-impacts.html.

12.2.1.2 Diversion Potential

Of the various technologies under consideration, the home-based composting methods are expected to have the lowest diversion potential because of the voluntary nature of their use. Diversion through backyard composting would rely heavily on participation which would wane during winter months. Meat and bone scraps also cannot be processed in many home-based systems.

A centralized composting program using any of the aerobic and anaerobic technologies described above would have a greater diversion potential than home-based systems as they could potentially allow a municipality to compost a broader spectrum of organic waste such as pet waste and diapers.

Evaluation Results - Diversion Potential						
Home-based Solutions	**Open Windrow**	**Aeration Static Pile/ Windrow**	**Membrane Covered Aeration Systems**	**In-vessel Aerobic Composting**	**Anaerobic Digestion**	**WWTP Co-digestion**
1	3	3	3	3	5*	5*

* *The score of 5 is based on the assumption that the resulting digestate from these technologies is successfully diverted from landfill.*

12.2.2 Social Considerations

12.2.2.1 Odour Potential

Green Bin waste processing has significant potential to produce odours if managed incorrectly. Home-based approaches such as backyard composting can produce odours if the feedstock mix is unbalanced or if there is insufficient aeration. While the level of odour generation would not impact the broader neighbourhood, it can solicit complaints and discourage participation.

Windrow and static pile composting systems also have the potential for odour issues, particularly during the turning of windrows. These impacts can be mitigated through proper operational procedures and by siting of the processing site away from possible receptors (e.g., households). Membrane covered systems are less likely to generate odours because their design typically includes an emissions collection and treatment system such as a 'biofilter'.

The enclosed nature of in-vessel and digestion technologies tend to lower the risk of odours escaping from the composting or digestion process. Additionally, these facilities often have odour control systems to minimize the risk of fugitive odours but these sites can still generate odours and site location is a key factor in odour management. Co-digestion at the City WWTP does have the potential to involve an additional trucking element to ship the resulting digestate to an aerobic composting facility or landspreading operation which could result in additional odour generating potential. An AD facility may also have similar trucking requirements depending on how the digestate is disposed.

Evaluation Results - Odour Avoidance						
Home-based Solutions	**Open Windrow**	**Aeration Static Pile/ Windrow**	**Membrane Covered Aeration Systems**	**In-vessel Aerobic Composting**	**Anaerobic Digestion**	**WWTP Co-digestion**
2	3	3	4	4	5	4

12.2.2.2 Customer/Resident Convenience

Waste diversion programs require a level of convenience for the resident or "customer" to be successful. Home-based systems require active participation by homeowners and, as a result, tend to appeal to a limited portion of the population. Backyard composters, for example, are known to generally not be used during winter months. Curbside collection systems based on weekly collection are common throughout Ontario and are generally found to be the most convenient option for managing Green Bin wastes. Anaerobic digestion and co-digestion options offer the added convenience of potentially being able to accept diapers.

Evaluation Result - Customer/Resident Convenience						
Home-based Solutions	**Open Windrow**	**Aeration Static Pile/ Windrow**	**Membrane Covered Aeration Systems**	**In-vessel Aerobic Composting**	**Anaerobic Digestion**	**WWTP Co-digestion**
1	3	3	3	3	4	4

12.2.2.3 Traffic Impacts

Home-based technologies would not have any traffic impacts as the food waste would be managed on the homeowner's property. Co-collection of Green Bin waste with garbage would also mitigate any potential implications associated with a curbside collection program. Haulage of the collected materials to the associated processing facility does have the potential to have traffic impacts but cannot be fully evaluated until the City selects a vendor and processing site location. AD facilities and co-digestion at the City WWTP have the potential to involve additional trucking elements to ship the resulting digestate to an aerobic composting facility or landspreading operation and residue to the landfill.

Evaluation Results - Traffic Impacts						
Home-based Solutions	**Open Windrow**	**Aeration Static Pile/ Windrow**	**Membrane Covered Aeration Systems**	**In-vessel Aerobic Composting**	**Anaerobic Digestion**	**WWTP Co-digestion**
5	4	4	4	4	4	3

12.2.3 Financial Considerations

12.2.3.1 Capital Cost

The capital costs for the home-based solutions are high relatively compared with certain other technologies under consideration on a cost per tonne diverted basis. For example, the estimated capital cost of distributing a dehydrator to 75% of households is approximately $14.5M. The anticipated lifespan of the appliance is unclear. It is, however, reasonable to assume that they will have a similar lifespan to most household appliances after which a second capital investment will be required.

Capital costs are lowest for the windrow-type technologies, generally in the order of $150/MT of annual design capacity. Capital costs are moderate for in-vessel type technologies, ranging between $300 to $585/MT of annual design capacity. The digestion technologies would have the highest capital cost, ranging between $1,000 to $1,500/MT of annual design capacity. In all cases, the range depends largely on the design capacity and is generally lower with larger scale facilities. The small volume of organic

waste available from the City is expected to cause these systems to be built out at the high end of their cost bands.

Evaluation Results - Capital Cost						
Home-based Solutions	Open Windrow	Aeration Static Pile/ Windrow	Membrane Covered Aeration Systems	In-vessel Aerobic Composting	Anaerobic Digestion	WWTP Co-digestion
1	5	5	5	3	1	1

12.2.3.2 Operating Cost

Operating costs for home-based solutions are the lowest of the systems under consideration because they rely on the resident to undertake the work. In all other cases, costs are incurred by the City for both collection and processing. Operating costs for windrow-type technologies are generally low ($50 to $200/MT).

Operating costs for membrane-covered and in-vessel aerobic composting systems are generally higher than windrow-type technologies due to the operational and maintenance requirements of the facility but become more cost competitive in larger capacity operations. Digestion type technologies generally have a higher operational cost ($100 to $200/MT) than the other technologies because of the complexity of their operations. The small volume of organic waste available from the City is expected to cause these systems to operate at the high end of their respective cost bands.

Evaluation Results - Operating Costs						
Home-based Solutions	Open Windrow	Aeration Static Pile/ Windrow	Membrane Covered Aeration Systems	In-vessel Aerobic Composting	Anaerobic Digestion	WWTP Co-digestion
5	4	4	3	3	1	1

12.2.4 Technical Considerations

12.2.4.1 Proven Technology

Home-based technologies such as backyard composting are well-established practices within their inherent limitations. Food dehydrators and similar in-house options are relatively new technologies but pilots in the surrounding communities of Thunder Bay are reportedly generating positive results.

With the exception of WWTP co-digestion, the technologies under review are all commonly used for managing Green Bin waste. The open windrow, however, is more suitable for leaf and yard waste rather than household organics. WWTP co-digestion is a known practice but has not been widely implemented in Ontario.

Evaluation Results - Proven Technology						
Home-based Solutions	Open Windrow	Aeration Static Pile/ Windrow	Membrane Covered Aeration Systems	In-vessel Aerobic Composting	Anaerobic Digestion	WWTP Co-digestion
4	3	5	5	5	5	3

12.2.4.2 Scalability for Population Growth

Home-base practices can certainly be scaled to meet the homeowner's needs provided their property or household has sufficient space.

Windrow composting operations can be easily scaled up subject to possible space constraint issues since they require the largest footprint of the various options. Static pile and membrane-covered systems have similar issues but benefit from the flexibility of their design and slightly smaller footprint. The modular nature of most in-vessel aerobic composting technologies make this type of technology well suited for scalability.

Anaerobic digester and co-digestion options generally have some degree of modularity to their design but their complexity makes expansion more complicated. This concern can be mitigated through appropriate capacity planning during the design process.

Evaluation Results - Scalability						
Home-based Solutions	**Open Windrow**	**Aeration Static Pile/ Windrow**	**Membrane Covered Aeration Systems**	**In-vessel Aerobic Composting**	**Anaerobic Digestion**	**WWTP Co-digestion**
4	4	4	5	5	3	3

12.2.4.3 Integration with Municipal Programs

Home-based solutions have good potential for integration with existing municipal programs as a complimentary option. Technologies such as food dehydrators and worm composting have potential for use in certain types of housing such as multi-residential buildings but are not likely to be viable solutions for the City's IC&I sector.

Any of the aerobic composting technologies could be easily integrated into the City's existing yard waste composting operation. This approach would minimize the need to ship materials elsewhere if the Green Bin waste was co-collected with garbage since both materials would be hauled to the City's landfill. The City's yard waste would also be required as a feedstock for the composting process making this approach particularly appealing.

The digestion technologies would not be suitable for the management of yard waste and would, therefore, require separate processing. Co-digestion of Green Bin waste at the City's WWTP would potentially allow for its integration into the City's wastewater treatment system. City staff responsible for the WWTP have indicated the facility is at capacity. Expansion of the system would, therefore, be necessary to accommodate the additional material volumes. As noted earlier, the resultant digestate would still need to be managed separately as it cannot be landfilled if these options are to comply with the Provincial Policy Statement.

Evaluation Results - Integration with Municipal Programs						
Home-based Solutions	**Open Windrow**	**Aeration Static Pile/ Windrow**	**Membrane Covered Aeration Systems**	**In-vessel Aerobic Composting**	**Anaerobic Digestion**	**WWTP Co-digestion**
3	5	5	5	5	3	4

12.2.4.4 Footprint

Home-based technologies require minimal footprint subject to their limited ability to manage the full range of materials requiring diversion under a food and organic waste diversion program.

Windrow composting systems tend to require the largest footprint of the technologies being reviewed as noted under Scalability considerations. Static pile and membrane-covered aerated systems require a somewhat smaller footprint. In-vessel aerobic composting technologies have a similar footprint or larger compared to a membrane-covered system depending on the specific technology used and any required infrastructure. Digestion technologies tend to have the smallest footprint but if the resulting digestate needs to be aerobically composted afterwards, the resulting footprint can end up being comparable.

Evaluation Results - Footprint						
Home-based Solutions	**Open Windrow**	**Aeration Static Pile/ Windrow**	**Membrane Covered Aeration Systems**	**In-vessel Aerobic Composting**	**Anaerobic Digestion**	**WWTP Co-digestion**
5	1	1	4	3	3	3

12.2.5 Risk Management Considerations

12.2.5.1 Compliance with Ontario Food and Organic Waste Policy Statement

As noted earlier in this report, the Policy Statement requires that the City provide curbside collection for food and organic waste to single-family dwellings in the urban settlement area and achieve 50% waste reduction and resource recovery of food and organic waste by 2025. It does, however, allow for the use of alternative systems provided the same diversion level can be achieved. Unfortunately, there is an absence of curbside performance data on the efficacy of home-based solutions as the sole means of diverting Green Bin waste at a municipal or city level.

As previously noted, the Policy Statement requires diversion of 50% of the available food and organic waste. Managed correctly the various aerobic and anaerobic technologies should be able to produce a finished product that can be diverted from landfill. Anaerobic systems and options involving co-digestion at the WWTP produce a digestate which may require additional treatment and/or permitting to be diverted to beneficial use.

Evaluation Results - Compliance with Ontario Food and Organic Waste Policy Statement						
Home-based Solutions	**Open Windrow**	**Aeration Static Pile/ Windrow**	**Membrane Covered Aeration Systems**	**In-vessel Aerobic Composting**	**Anaerobic Digestion**	**WWTP Co-digestion**
1	5	5	5	5	4	4

12.2.5.2 Permits and Approvals

Home-based solutions generally do not require any permits or approvals making them one of the easiest options to implement.

All of the other technologies under review will require a valid Environmental Compliance Approval (ECA) from the Ministry of Environment, Conservation and Parks (MECP). As part of the ECA application review process, the Ministry would consider the following objectives for composting facility management:

- Prevention and control of off-site environmental impacts, especially odour, water contamination, dust, noise and vermin and vectors;
- Protection of public health;
- Prevention of emergency situations;
- Anticipation of seasonal effects that may impact the composting process; and
- Production of compost that meets the Ontario Compost Quality Standards[14].

Studies and documentation that describe how a composting facility siting and design will meet these objectives (e.g., design and operations plan, contingency plan, odour impact assessment) would be required as part of the ECA application. Generally, the simpler options, such as open windrow systems and technologies that can be sited at existing waste management facilities, will be easier to get permitted provided there are no pre-existing issues at those locations.

Evaluation Results - Permits and Approvals						
Home-based Solutions	**Open Windrow**	**Aeration Static Pile/ Windrow**	**Membrane Covered Aeration Systems**	**In-vessel Aerobic Composting**	**Anaerobic Digestion**	**WWTP Co-digestion**
5	1	1	1	1	1	1

12.2.5.3 Ability to Meet Timeline

Roll out of one or more home-based options as a supplementary program is not expected to be an issue, subject to resident interest given that the City already provides subsidized backyard composters through EcoSuperior.

The windrow-style technologies have the greatest potential to meet the City's timelines as the capital construction requirements are not complex. Potential integration with the City's existing composting operations may aid in meeting this timeline, however, the technical feasibility of this would need to be further examined.

Both in-vessel aerobic composting and the digestion technologies should be able to meet the City's timelines barring any unforeseen delays. The need to undertake feasibility studies and risk of unforeseen delays associated with getting required approvals and undertaking construction amidst a pandemic, however, makes these higher risk options.

Evaluation Results - Ability to Meet Timeline						
Home-based Solutions	**Open Windrow**	**Aeration Static Pile/ Windrow**	**Membrane Covered Aeration Systems**	**In-vessel Aerobic Composting**	**Anaerobic Digestion**	**WWTP Co-digestion**
1	5	5	5	4	3	3

[14] Government of Ontario. Guideline for the production of compost in Ontario. https://www.ontario.ca/page/guideline-production-compost-ontario.

12.2.5.4 Technical Complexity

Technical complexity increases the risk of implementation delay and operational failure. The windrow-style aerobic composting technologies have the least technical complexity of the technologies being reviewed. In-vessel aerobic composting has increased technical complexity compared to the windrow methods, followed by the digestion technologies which are most complex. Home-based solutions are also of limited technical complexity from the perspective of design and operation requirements of the City.

Evaluation Results - Technical Complexity						
Home-based Solutions	**Open Windrow**	**Aeration Static Pile/ Windrow**	**Membrane Covered Aeration Systems**	**In-vessel Aerobic Composting**	**Anaerobic Digestion**	**WWTP Co-digestion**
5	5	4	4	3	2	1

12.3 Evaluation Summary

As outlined in Section 12.1 Methodology, the scores for each technology are multiplied by the assigned weighting for the relevant criterion to arrive at a weighted score. Table 10 presents the weighted scores of each technology for each criterion and in total. The technology with the highest score is the membrane-covered aeration system, followed by the open windrow and aerated static pile systems. Based on the review, the advantages of the membrane-covered aeration system include:

- avoids generation of methane and controls fugitive emissions better than open windrows;
- capital and operating costs are reasonable based on the anticipated processing volumes;
- proven technology and commonly used in Ontario;
- can be easily integrated into the City's composting operations;
- good flexibility with respect to the required footprint and scalability; and
- low technical complexity should help to ensure the design, approvals and construction process will occur within the City's required timeline.

Table 10: Weighted Score of Green Bin Processing Technologies

Criteria	Home-based Solutions	Open Windrow	Aeration Static Pile/ Windrow	Membrane Covered Aeration Systems	In-vessel Aerobic Composting	Anaerobic Digestion	WWTP Co-digestion
Environmental							
GHG Emissions Reduction	3	6	6	9	9	15	12
Diversion Potential	3	9	9	9	9	15	15
Social							
Odour Avoidance	6	9	9	12	12	15	12
Customer Convenience	3	9	9	9	9	12	12
Traffic Impact Avoidance	5	4	4	4	4	4	3
Financial							
Capital Cost	5	25	25	25	15	5	5
Operating Cost	25	20	20	15	15	5	5
Technical							
Proven Technology	12	9	15	15	15	15	9
Scalability (for population growth)	4	4	4	5	5	3	3
Integration with Municipal Programs	3	5	5	5	5	3	4
Footprint	5	1	1	4	3	3	3
Risk Management							
Compliance with FOW Policy Statement	5	25	25	25	25	20	20
Permits and Approvals	15	3	3	3	3	3	3
Ability to meet Timeline	5	25	25	25	20	15	15
Technical Complexity	15	15	12	12	9	6	3
Total Score	**114**	**169**	**172**	**177**	**158**	**139**	**124**

13. Environmental Sustainability Implications

The City has produced a number of strategies and plans focusing on climate change, energy conservation and environmental sustainability. These initiatives are broadly supported through the City's current Strategic Plan. Introduction of a Green Bin program in the City has the potential to help the City meet its goals as outlined in its Net-Zero Strategy and Sustainability Plan. The City's Net-Zero

Strategy, in particular, supported the use of anaerobic digestion as a means of diverting the City's organic waste and improving its carbon footprint. Review of the City's various policies and plans also suggests that implementation of a Green Bin diversion program and use of new waste collection technologies (e.g., automated cart collection) would be consistent with, and support, the City's climate change and strategic objectives.

13.1 Fleet Considerations

Several of the City's strategies and plans also make note of the opportunities to consider changes to the City's fleet as a means of reducing its carbon footprint. The Net-Zero Strategy recommends that 100% of heavy-duty commercial vehicles be converted to low-carbon fuels by 2040 and the municipal fleet be converted to 100% electrical powered vehicles within the same time frame. While alternative use fuels are still in their infancy for waste collection, it is recommended that consideration be given to piloting their use as the City's waste collection fleet as trucks are replaced at end of life.

13.2 Processing Considerations

The City currently hauls garbage and yard waste to it SWRF. Co-collection of Green Bin waste and garbage is proposed to avoid any increase is traffic and GHG emissions from collection activities. Processing options which can be built and operated at the SWRF would, similarly, avoid any additional hauling costs associated with delivering the Green Bin waste to a separate location.

Of the technologies considered in Section 10, the aerobic composting systems represent the lowest cost options for the quantities of Green Bin and yard waste the City anticipates diverting and are most easily integrated into the City's existing yard waste composting operations. They do not, however, provide any sort of green energy or carbon offset unlike the anaerobic digestion options. Nonetheless, the anaerobic digestion options would require separate diversion and management of the resulting digestate from their systems in order to be compliant with the requirements of the Policy Statement. This likely involves separate co-composting of the digestate with the City's yard waste or landspreading of the material if a suitable host site can be found. Management of the digestate adds cost and complexity to these options and additional GHG emissions which must be accounted for if considered.

13.3 Impact of Proposed Technologies and Program on the City's Carbon Footprint

In January 2020, the City declared a climate emergency and set an ambitious goal of becoming net-zero by 2050. Since then it has been implementing a Community Energy and Emissions Plan (CEEP). The City has been inventorying and monitoring its greenhouse gas (GHG) emissions for several years and waste management is known to be a key contributor to the City's overall emissions profile. Waste emissions include both emissions produced from solid waste and wastewater treated at the central wastewater plant. In 2016, waste emissions were estimated to be 48 ktCO2e and were projected to increase to 65 ktCO2e by 2050.

In anticipation of development of a food and organic waste diversion program, emissions from the City's current solid waste management program were reviewed and updated. A summary of current gas emissions from the landfilling and collection of waste and subsequent capture and treatment of landfill gas can be found in Appendix A. Appendix A also summarizes the change in emissions from the impact of implementation of a Green Bin program on landfill and waste hauling activities. There is the potential

to further reduce these emissions subject to the selection of processing technologies and operating site. At a minimum, it is expected that implementation of a Green Bin program will reduce the City's carbon footprint by 5,380 tCO2e per year.

14. Financial Implications

Table 11 summarizes anticipated incremental costs of rolling out a Green Bin program to: single family households in 2025, multi-family households in 2026 and the provision of two additional leaf and yard waste collection events per year starting in 2023. Table 11 also summarizes the cost of transitioning to automated cart-based collection starting in 2025.

Implementation of Green Bin program costs are expected to peak in 2025 at an average cost of almost $47 per household driven largely by the on-boarding of program staff, purchase and delivery of containers and initial processing costs. Post implementation program costs are expected to average $1.5 million per year or $33 per household as shown in 2028. Addition of the two yard waste collection events would increase this cost by $3.50 per household. Converting to automated cart-based collection results in an incremental cost impact of $3.8 million between 2022-2025 largely driven by the capital cost of upgraded trucks, Green Bins and purchase of garbage carts. As previously noted, this initiative results in a projected saving of $827,000 per year for a projected pay back of under six years.

Table 11: Summary of Anticipated Incremental Green Bin Program Implementation Costs

Green Bin Program	2022	2023	2024	2025	2026	2027	2028
Administration							
Temporary staff		$61,435	$170,112	$309,806	$319,100	$95,191	
Permanent staff			$171,848	$227,451	$234,274	$241,303	$248,542
Communications Campaign			$18,509	$97,112	$50,596	$21,657	$18,460
Waste & Participation Audits				$20,000	$20,000	$10,000	
Single Family Implementation Costs							
Containers - Green Bin, Kitchen Catcher			$1,092,031				
Container Delivery				$222,108			
Manual Collection Vehicle Upgrades	$195,000	$330,000					
Driver Training			$10,000				
SSO Processing				$999,450	$1,029,434	$1,060,317	$1,092,126
Multi-Family Implementation Costs							
Containers - Green Bin, Kitchen Catcher				$269,424			
Container Delivery					$54,798		
Manual Collection Vehicle Upgrades					$55,000		
SSO Processing					$121,140	$124,774	$128,517
Sub Total	**$195,000**	**$391,435**	**$1,462,500**	**$2,145,350**	**$1,884,342**	**$1,553,241**	**$1,487,646**

Expanded Yard Waste Collection Service	2022	2023	2024	2025	2026	2027	2028
Two Additional Collection Days per Year		$156,646	$159,779	$162,974	$166,234	$169,559	$172,950
Yard Waste Processing		$5,000	$5,100	$5,202	$5,306	$5,412	$5,520
Sub Total		**$161,646**	**$164,879**	**$168,176**	**$171,540**	**$174,971**	**$178,470**

Auto Cart Program	2022	2023	2024	2025	2026	2027	2028
Administration							
Supplemental P&E			$27,764	$41,585	$22,954	$13,821	$11,538
Single Family Implementation Costs							
Garbage Carts			$2,480,206				
Container Delivery (Garbage Cart & Green Bins)				$37,018			
Auto Cart Green Bin			$962,468				
Upgrade nine curbside trucks with hydraulic arm	$100,000	$150,000					
Multi-Family Implementation Costs							
Garbage Carts				$611,911			
Container Delivery (Garbage Cart & Green Bins)					$9,133		
Auto Cart Green Bin				$237,458			
Cost Savings							
Conversion to Auto Cart				($826,788)	($851,592)	($877,139)	($903,454)
Sub Total	$100,000	$150,000	$3,470,438	$101,184	($819,505)	($863,318)	($891,916)

Grand Total	$295,000	$703,081	$5,097,817	$2,414,710	$1,236,377	$864,894	$774,200

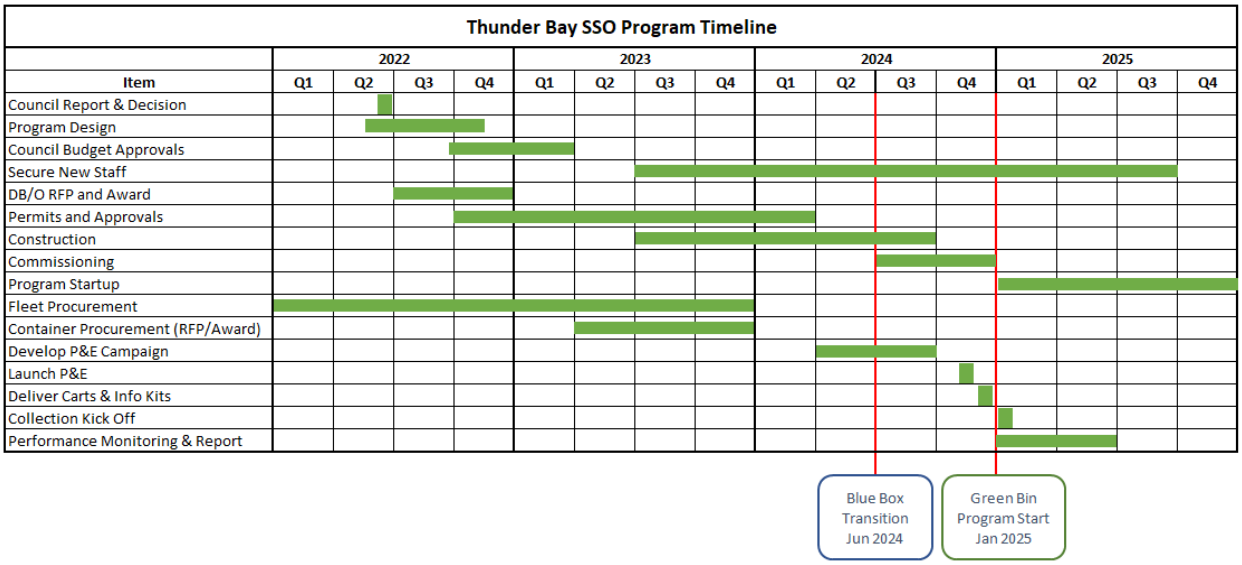
Note: assumes CPI rate of 3% annually

15. Program Critical Path

Planning for complex programs such as Green Bin or auto-cart service is normally initiated a minimum of two years in advance of the launch date. This period allows for adequate time to undertake critical work such as: advance review of streetscapes and properties, route planning, policy and licensing review and amendment, communications planning, public consultation, negotiation with and procurement of contractors. Recognizing that there is no operational Green Bin facility in close proximity to the City, time will also be needed to procure a contractor to either build a facility for the City or provide capacity at a private site. Preliminary feedback received from respondents to the RFI indicated that the City's requirement to have a functional Green Bin processing facility operational by 2025 was possible

provided contracts could be executed in 2022. With this in mind, Table 12 outlines a proposed timeline for program development and delivery.

Table 12: Green Bin Program Timeline



16. Recommendations

The provincial Policy Statement requires that the City provide curbside food and organic waste collection services to single-family dwellings by 2025 and achieve a diversion rate of 50% for this waste stream. In order to ensure the provincial diversion target is met, the following recommendations are proposed:

1) Expand Current Leaf and Yard Waste Services in 2023

Expand the City's leaf and yard waste collection program from the current level of two events per year to a total of four collection events beginning in 2023 to provide staff with sufficient time to assess the efficacy of this service level enhancement prior to launch of the required Green Bin progam.

Consider further expansion or refinement of the leaf and yard waste collection service in subsequent years, as required, to ensure the City achieves its required diversion target under the provincial Policy Statement.

2) Implement a Curbside Green Bin Program in 2025

Design and implement a curbside food and organic waste collection program with the following key components based on proven best practices:

- Weekly curbside Green Bin collection;
- Bins and kitchen containers to be provided to residents free of charge by the City;
- Residents to be permitted to use paper and certified compostable liners in bins and kitchen containers;
- Allowable materials to include pet waste and kitty litter;

- Diapers and incontenence products be excluded unless the City's selected processing solution is capable of receiving such material; and
- Future collection vehicles be procured with split body compartments to accommodate co-collection of garbage and Green Bin materials.

3) Phase in Green Bin Collection Services Over Time

Roll out of Green Bin waste collection services to City residents and businesses based on the following schedule:

- Provision to curbside single-family households in 2025;
- Provision to multi-family properties no later than 2026; and
- Provision to local businesses and institutions for future consideration;

4) Optimize Garbage Collection Service to Achieve Required Diverion Targetsand Reduce Costs

Amend garbage services as follows:

- Reduce collection to three items of garbage every other week to ensure participation in diversion programs;
- Residents be permitted to set out one additional garbage bag or item every other week subject to purchase of a bag or item tag from the City for the selected bag or item;
- The City to amend its waste collection by-law to reflect the new program and require mandatory participation in waste diversion programs; and
- Direct staff to explore development of a clear garbage bag policy for set out of overflow volumes used in conjunction with bag tags.

5) Hire Staff to Support Roll out of Green Bin Services

Hire necessary staff to support the implementation and long term success of the new program:

- One permanent full time Promotion & Education Coordinator to design, implement and maintain the ongoing communications that will be required to ensure success of our integrated solid waste system;
- One permanent full time Solid Waste Compliance Officer to support public compliance and proper ongoing curbside segregation of waste streams (and also address existing problems like sharps in the waste stream);
- One temporary full time Solid Waste Project Coordinator to assist in coordinating program development and implementation; and
- Two temporary full time Customer Service Advisory staff to assist with program rollout and respond to public questions/concerns.

6) Implement Automated Cart-Based Collection of Garbage and Green Bin Materials

Convert to automated cart-based collection of garbage and Green Bin materials from single-family households starting in 2025 to reduce operating costs based on the following parameters:

- Provision of garbage and Green Bin auto-carts to residents free of charge by the City;
- Collection vehicles purchased between 2023 and 2025 to be spec'd to be auto-cart ready;
- Consideration be given to piloting the use of electric collection vehicles as trucks are replaced at end of life;

- Review and optimize collection vehicle routing;
- Development of a redeployment plan for affected staff in cooperation with the City Human Resources and Corporate Safety Division and the union; and
- Direct staff to review multi-family properties and current service levels to assess cost benefit of shifting to auto-cart, Front End Loader or other technologies to reduce collection costs and report back to Council with recommendations of future service policy to this sector.

7) Finalize Program Costs and Design Parameters as a Next Step

Finally, it is recommended that Council direct staff to release an RFP for the procurement of an aerobic Green Bin processing solution based on the requirements of this report, finalize program costs and design parameters and report back to Council with the results.

17. Conclusions

The recommendations included in this report are intended to ensure the City achieves compliance with the provincial Policy Statement. They are also intended to ensure equitable service levels are provided to residents and businesses while options such as the adoption of an automated cart-based collection program will help mitigate the long term cost of the required Green Bin program. While the proposed recommendations will have significant financial and social implications for the City, they will also allow the City to make significant progress towards its stated environmental goals.

Appendix A

Comparison of Pre & Post Green Bin Program Implementation on the Current Greenhouse Gas (GHG) Emission Profile for the City of Thunder Bay's Landfill and Waste Collection System

Program	Commercial Landfilled Waste (tonnes)[4]	Residential Landfilled Waste (tonnes)[4]	Total Waste (tonnes)[4]	Commercial Diverted Waste (tonnes)[4]	Commercial Diverted Waste (%)	Residential Diverted waste (tonnes)[4]	Residential Diverted waste (%)	Total Diverted Waste (tonnes)[4]	Total Diverted Waste (%)	Landfill Waste GHG (tCO2e) [1,2]	Number of Collection Trucks	Truck Efficiency (km/ltr) [6]	Total Kilometers Traveled	Waste Transport GHG (tCO2e) [1,2]	Gas Capture (m3)/day [7]	Gas GHG (Removed) [1,3] (tCO2e)	**Total GHG Emissions** (tCO2e) [1]
Current Program Operations[5]	39,026	48,504	87,530	5,073	13.00%	13,568	27.97%	18,641	21.30%	112,092	13	2.008	102,800	525	38,465	30,000	82,617
Green Bin Program Implementation[8]	39,026	48,504	87,530	5,073	13.00%	20,904	43.10%	25,977	29.68%	107,395	13	2.008	102,800	525	38,465	30,000	77,920

Notes:

1. Greenhouse gas emissions are primarily characterized as tonnes (tCO2e), Kilotonnes (Kt) or Megatonnes (Mt) of carbon dioxide equivalents (KtCO2e) (a Mt is a thousand Kt). 1 MtCO2 = 1,000,000 tCO2e, 1 KtCO2e = 1,000 tCO2e
2. Greenhouse gas emissions for waste and transportation were derived from the ICLEI April 2018 report. Waste was used in whole and transportation was calculated as ~20% of the total.
3. Greenhouse gas emissions for methane gas removed is based upon the landfill Golder Associates testing report from February 2006. This value was not escalated and is left at a conservative number.
4. Waste generation and diversion rates were derived from the City of Thunder Bay 2020 Landfill Annual Report dated April 1, 2021.
5. Current program operations is based upon the reports from the City (April 2018 report by ICLEI) and focused on total waste received, how much of that waste was diverted, the transportation of that waste to the City landfill and methane production at that landfill.
6. Trucking efficiency derived from "Fuel Consumption, Emissions Estimation, and Emissions Cost Estimates Using Global Positioning Data" article by Betsy J. Agar , Brian W. Baetz & Bruce G. Wilson
7. No reduction in gas production is expected to occur until 3 to 5 years after introduction of the new organic waste diversion program. From ATSDR [Agency for Toxic Substances and Disease Registry] - Landfill Gas Basics.
8. Assumes 0% population growth for comparitive purposes.