2021

CIF 984: Mixed Waste Processing

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Abstract

In 2018, the City of Toronto initiated a Mixed Waste Processing (MWP) Study to assess whether a MWP facility with a focus on recycling and organics recovery can support the achievement of a 70 per cent residential diversion target. The Study included waste forecasting and characterization studies to assess the quantity and composition of various waste streams, and a jurisdictional scan and viability assessment of existing MWP technologies. The Study's findings differed significantly from what was expected. Namely, the composition of Single family and Multi-residential garbage was much more similar than expected, and that the difference in waste diversion rates between the two groups may be due to a difference in consumption habits. Neither garbage stream contained a significant amount of clean recyclables; and, the recovery of recyclables from garbage through MWP would have minimal impact on the City's diversion from landfill metric. Additionally, the inbound contamination rate of Multi-residential Blue Bin recycling was within the City's processing contract limits and therefore did not support re-directing material to a MWP facility from collection routes with historically high contamination. The City also learnt that MWP facilities are purpose-built for their specific operating context. Feedstock composition, local waste programs, legislation, culture, and geographic location along with available end markets are key factors that are taken into consideration during facility design and should be considered when comparing facilities and their efficacy.

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Appendix A

Jurisdictional Scan

Glossary of terms

Acceptable Organics – All material accepted in the City of Toronto's Green Bin Organics program

Clean Recycling – Material accepted in the City of Toronto's Blue Bin Recycling market that meets current end-market quality parameters.

Contaminated Recycling – Material accepted in the City of Toronto's Blue Bin Recycling market that does not meet current end-market quality parameters due to contamination.

Fines - Audit stream comprised of the material that fell through the 25mm openings of the 25mm trommel

Large Fines – Audit stream comprised of the material that fell through the 100mm openings of the 100mm trommel

Non-Divertible Material – Material that is not accepted in the City of Toronto's Blue Bin Recycling or Green Bin Organics Program

Overs – Audit stream comprised of material that did not pass through the 100mm trommel openings

1.0 Background

In 1974, East Toronto Beaches was home to Project One Recycling, one of the first recycling programs in the Province of Ontario collecting, glass, cans, and newspapers from 80,000 households weekly[1]. The City of Toronto (the "City") now operates one of the most comprehensive integrated waste management systems in North America and manages more than 786,000 tonnes of residential waste each year[2].

The City developed a Long Term Waste Management Strategy (the "Strategy") that was approved by Toronto City Council in 2016 as a road map for how to manage waste in Toronto over the next 30 to 50 years. Based on the difference in waste diversion rates between Single Family (66%) and Multi-residential (26%) customers in 2014 (when development of the Strategy began), the Strategy suggested the study of Mixed Waste Processing (MWP) as a potential technology solution to increase the Multi-residential Waste Diversion Rate by recovering recycling and organics from Multi-residential Garbage and marketing them with materials recovered from the City's Blue Bin Recycling and Green Bin Organics programs respectively.

In 2018, China enacted the National Sword policy which significantly reduced the availability of end markets for Blue Bin Recycling (BBR) and decreased the overall tolerance for contamination in marketable recycling globally. Re-directing highly contaminated recycling to a MWP facility was identified as a potential solution to manage inbound contamination at the City's contracted recycling processing facility.

The City developed a scope of work for the study of MWP (the Study) that was awarded to HDR Corporation through a competitive call in 2018. The study concluded in October 2021. In 2020 & 2021, the City also contracted AET Group Inc. to conduct waste characterization audits to further inform the study of MWP.

As the Province transitions to an Extended Producer Responsibility (EPR) model, the role of the City in the recycling system is in flux, and as such the viability of recovering recyclables from garbage is currently unknown.

1.1. CIF Funding

The City applied to the Continuous Improvement Fund (CIF) for a grant to support its efforts in researching MWP. The grant was approved for the Blue Box related project costs, which constitutes only a portion of the full scope of work conducted by the project team.

This report has been authored by City of Toronto staff drawing from the findings of the City's MWP efforts, in fulfillment of the CIF grant requirements. The findings presented in this report are only those that are pertain to recycling recovery and do not reflect the complete data, findings, and recommendations generated for all the City's efforts towards the study of MWP to date.

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[1] http://stewardshipontario.ca/wp-content/uploads/2013/02/Blue-Box-History-eBook-FINAL-022513.pdf

[2] https://www.toronto.ca/services-payments/recycling-organics-garbage/solid-waste-reports/

2.0 Waste Audits

Waste audits specific to the MWP study were conducted to gain a better understanding of the resources available for recovery in Toronto's waste streams. The original intent was to conduct a single set of audits to confirm the waste profile of the City (based on past audits and diversion rate data). These audits took place in November and December 2018 at the City-owned Scarborough Transfer Station using material sampled from all four City collection districts, sorting approximately 6,300 kg of material from over 60 garbage, recycling and organics collection routes.

An initial assumption of the Study was that the discrepancy in waste diversion rates between Single Family and Multi-residential buildings was due to poor participation in waste diversion programs by Multi-residential households. As such, it was assumed that the Multi-residential Garbage stream would contain significantly higher amounts of mis-directed recyclables (and organics) than the Single family Garbage stream. As will be discussed in Section 2.2.2, the 2018 audit results did not support this assumption and showed similar waste composition in the Single Family and Multi-residential Garbage streams. To confirm these findings and to account for seasonality, the City conducted audits in September 2020, March 2021 and July 2021 at its Commissioners Transfer Station. The four season results are summarized below.

While the audit methodology aimed to represent the City's diverse customer base, it is important to note that the sample size was not statistically significant. As such, the results are only directional in nature as an indication of the City's overall waste profile. It is likely that the audit results in 2020 and 2021 were influenced by the COVID-19 pandemic through its impacts on consumer behaviour, however the magnitude of the impact cannot be assessed at this time due to the lack of historic data to compare against. The City made several programmatic changes as a result of the pandemic (for instance, requiring that residents dispose of tissue and towelling to the garbage stream instead of the organics stream) though none of these changes were tied to the Blue Bin Recycling program. That said, the programmatic changes would most likely impact the overall composition of the City's garbage stream. The City intends to continue auditing its waste streams using the same methodology as the MWP study to continue to gain a better understanding of the City's residential waste profile.

2.1 Audit Methodology

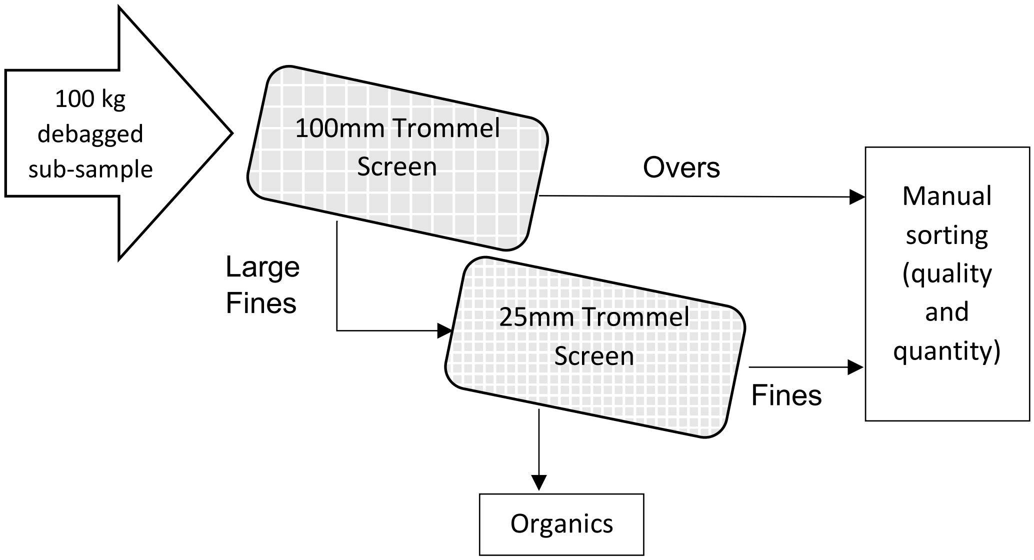
Each audit took place over a three week period and samples were taken from collection routes across all four of the City's waste collection districts. The City's Single Family customers are serviced by curbside (cart) collection only and Multi-residential customers receive either front-end (bin) or curbside (cart) collection. When selecting routes to sample for the waste audits, staff ensured that both collection methods were represented. Once a collection vehicle completed its entire collection route, the load was tipped at the transfer station and a 300-400 kg sample was taken by a front end loader to the audit area. A 100 kg audit sample was then extracted from the sub sample by the audit team using the cone and quarter method[3]. The City collects non-residential materials from City Divisions and Agencies as well as registered charities, institutions, and religious organizations. Although the City selected audit routes that were primarily residential, material from these non-residential sources may have been collected as well.

[3] https://thecif.ca/projects/documents/803-MRF_Audit_Guide.pdf

The audit methodology was developed to produce preliminary data that could inform future design decisions. To separate material by size (a common first step in MWP facilities) two trommel screens (100mm and 25mm openings) were borrowed from the Region of Peel and after de-bagging, all material was passed through the two trommel screens (**Error! Reference source not found.**). Based on common characteristics of recyclables and organic materials, it was assumed that the majority of recyclables would be in the Overs and Large Fines streams (as defined in **Error! Reference source not found.**). The Overs fractions from both screens were manually sorted for composition. The quality of the recyclables was assessed based on the contamination tolerance of the City's current recycling processing contract. **Error! Reference source not found.** illustrates the process used for the sorting of recyclables.

Figure 1: 100mm trommel screen being operated by audit staff

Figure 2: Schematic of Blue Bin Recycling processing for MWP Audits



2.2 Audit Results

2.2.1 Multi-residential Recycling

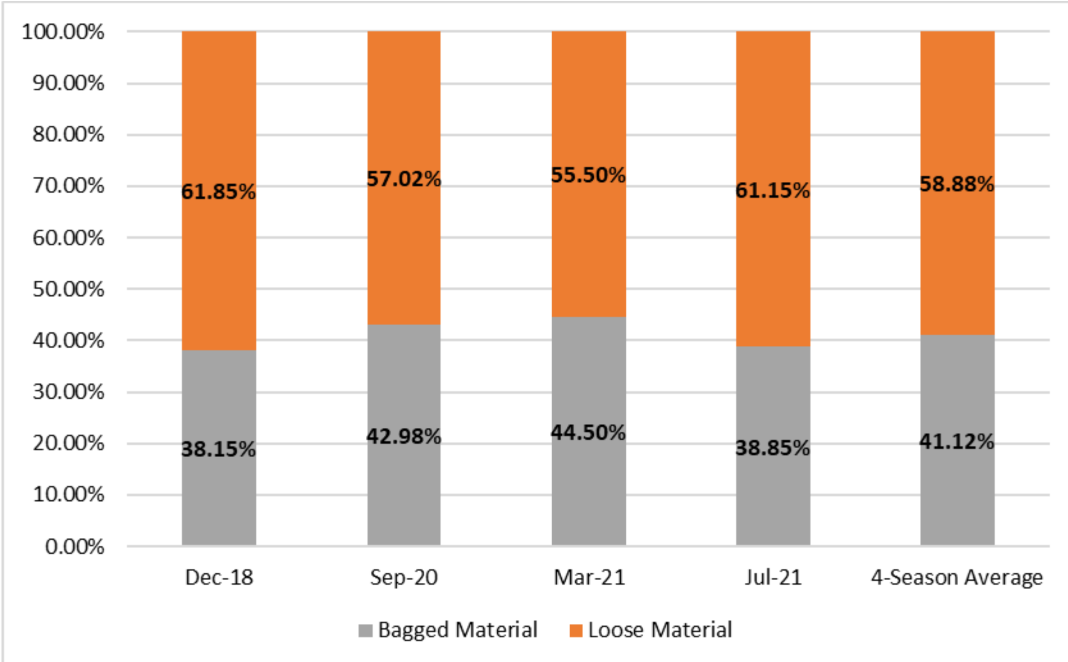
Over four seasons, a total of 62 Blue Bin Recycling loads from historically high contamination routes were audited.

Bagged Material

Residents are permitted to put their recycling in bags or place them directly in their collection receptable. To gain a better understanding of the amount of material that is bagged versus loose, the number of bags containing material and the corresponding weight of total bagged and loose material in each 100 kg sample was recorded. Recognizing that the City accepts plastic bags in its recycling program, only bags that contained material were included in this count (empty plastic bags were not).

Overall, there were an average of 45 bags in each 100 kg sample. As seen Figure 3, this represents approximately 41.1% of the total sample

Figure 3: Bagged vs. Loose Material in Blue Bin Recycling



Separation by size

As indicated Figure 4, when processing Blue Bin Recycling through the trommels, the majority of material (80.0%) passes through the 100 mm screen into the Overs fraction. As seen in Figure 5, this stream is comprised of predominately clean recyclables (67.6%).

Based on these findings, and when compared to the overall stream composition in Figure 6, after an initial de-bagging step, size separation (by trommel or similar) could be a way to reduce contaminants (both organics and non-divertible material) in contaminated recycling.

Figure 4: Multi-residential Recycling Distribution by Size

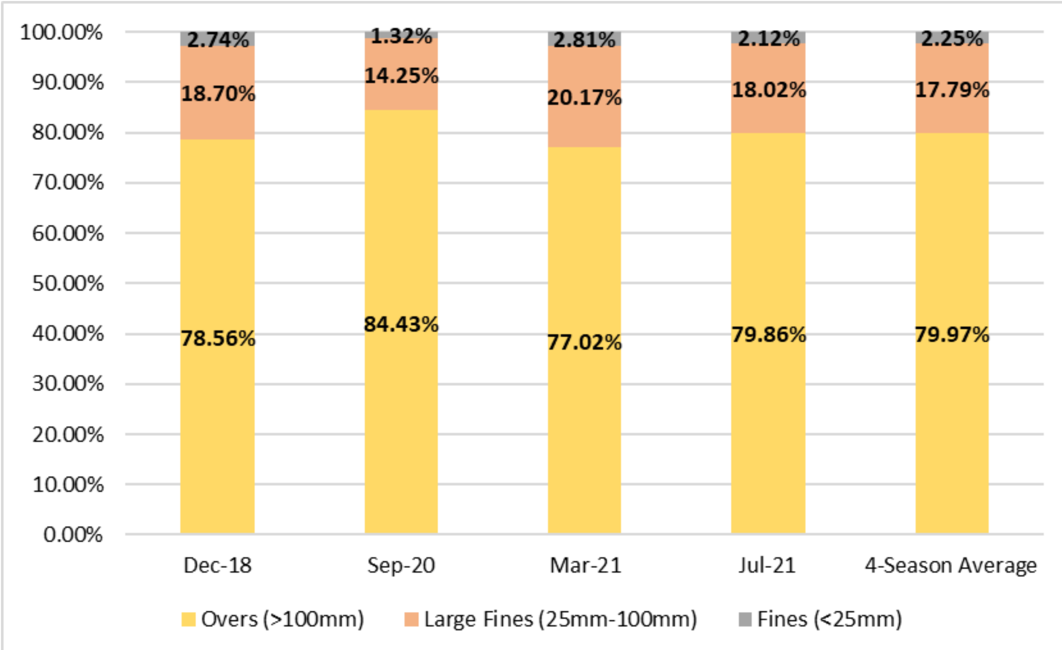


Figure 5: Composition of Multi-residential Recycling[4] "Overs" Fraction

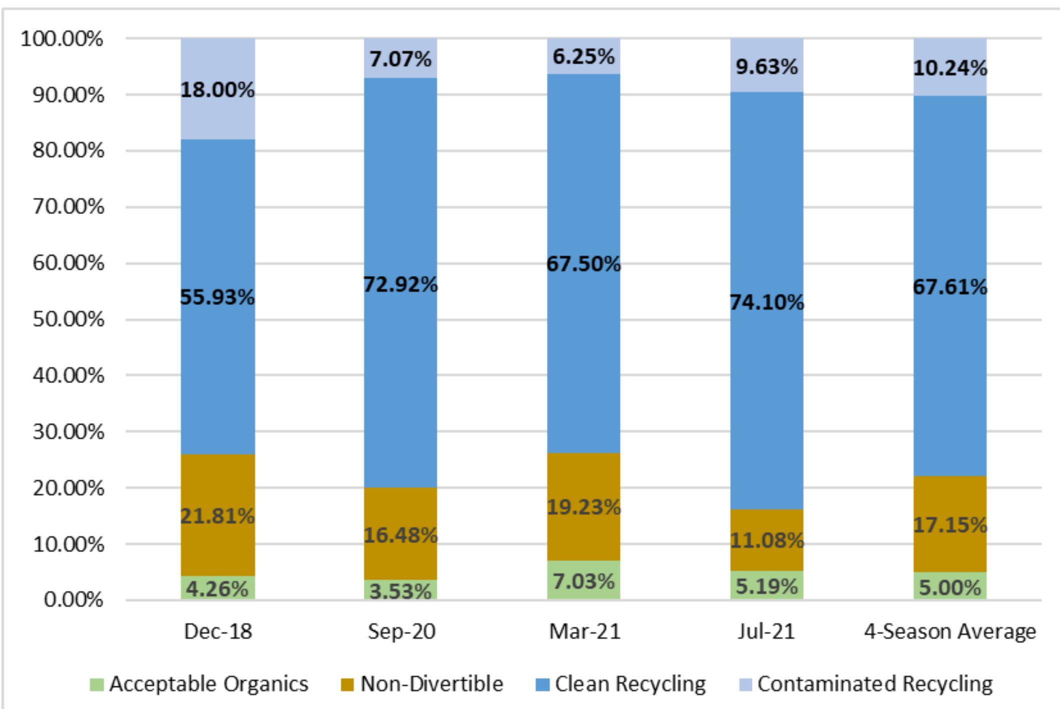
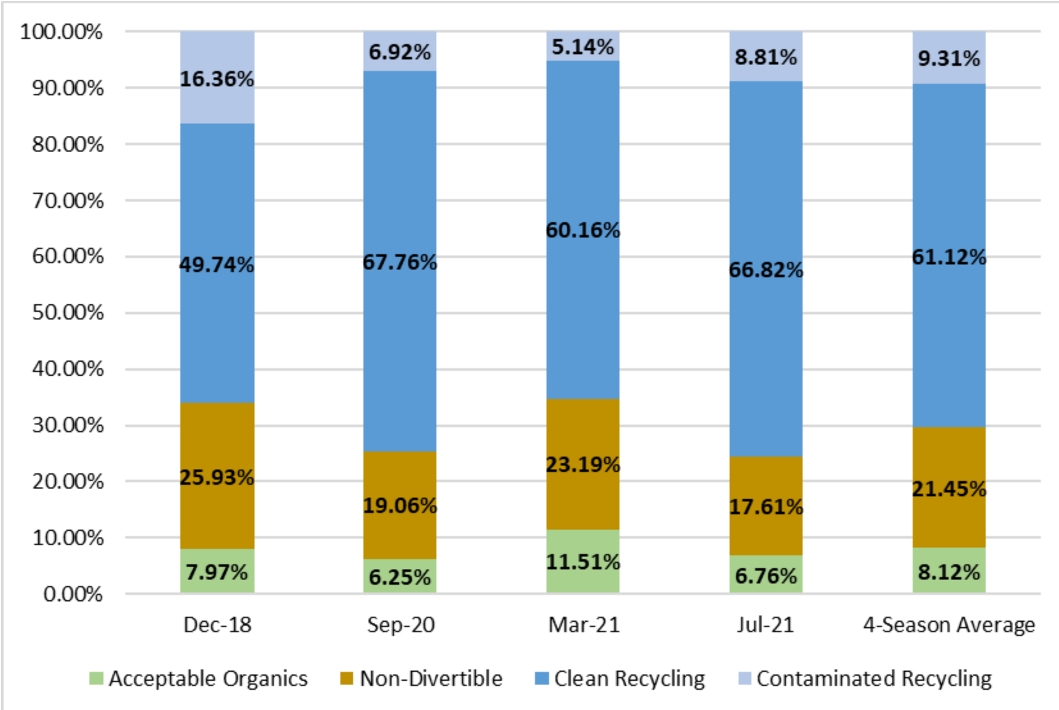


Figure 6: Overall composition of Multi-residential Recycling[4] from Historically High Contamination Routes



Overall the four seasons of MWP Audits have indicated that the Blue Bin Recycling stream from historically high contamination routes is within the contractual tolerances of the City's recycling processing contract. It can be assumed that if this material was mixed with garbage on a MWP tip floor, the quality of recyclables would further decrease due to cross contamination. As such, the City would not consider redirecting historically high contamination recycling routes to a MWP facility that also processes garbage.

2.2.2 Multi-residential and Single Family Garbage

Based on the City's historically lower Multi-residential waste diversion rate (26% in 2014) when compared to Single Family Garbage diversion (66% in 2014), it was assumed that Multi-residential buildings were misdirecting more resources (recyclables and organics) to the garbage stream. For this reason, the Study assumed that Multi-residential waste should be targeted for resource recovery through MWP. Both Single Family and Multi-residential garbage were audited to develop waste profiles for each stream. Over the course of the four audits, 58 Single Family (curbside) and 71 Multi-residential (curbside and front end) Garbage trucks were sampled. As shown in Figure 7, there was no significant difference in the amount of clean recycling in Multi-residential Garbage compared to Single Family Garbage.

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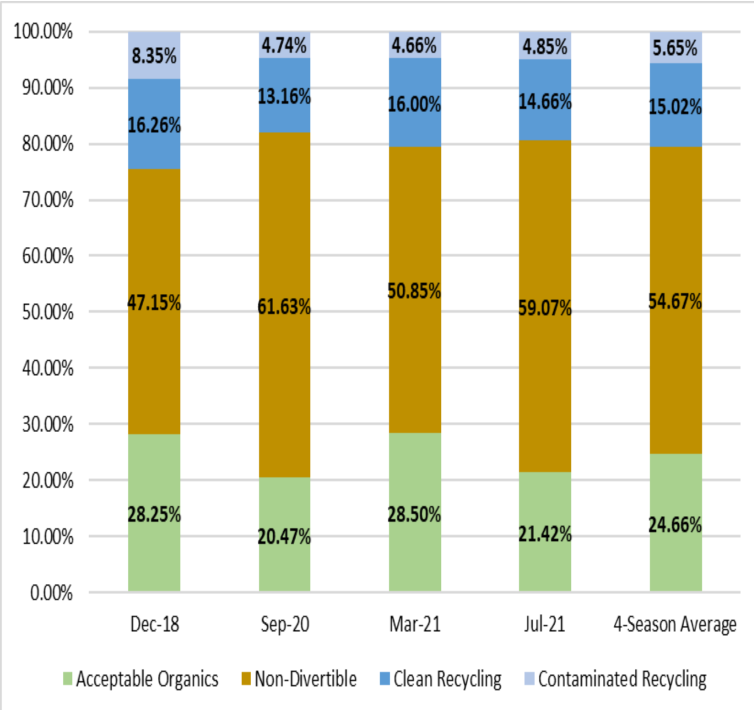
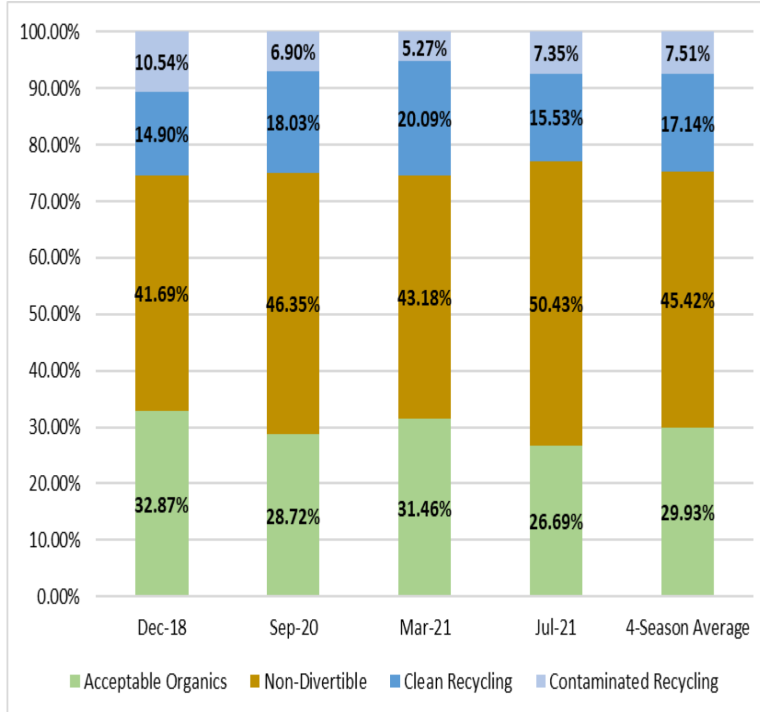
[4] *At the transfer station, dedicated handling and audit equipment was not available for the processing of recycling samples and as such cross contamination from the handling of garbage and organics may have contributed to Contaminated Recycling.*

Figure 7: Overall Garbage Composition



Single Family Garbage

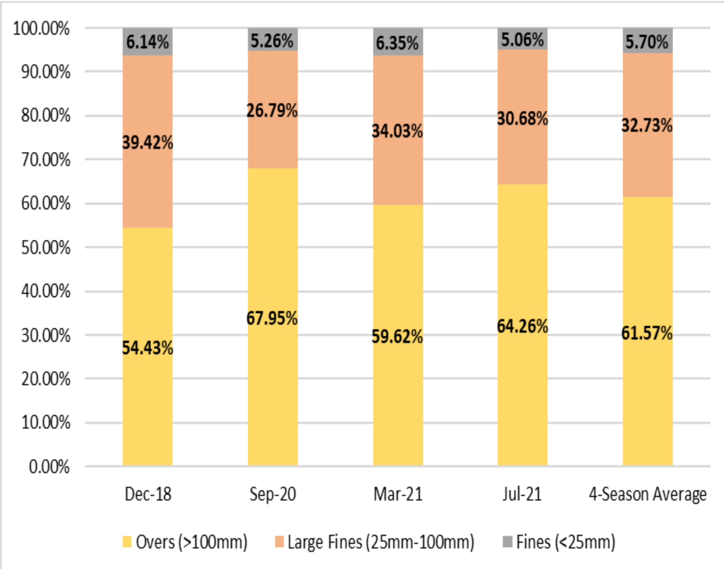


Multi residential Garbage

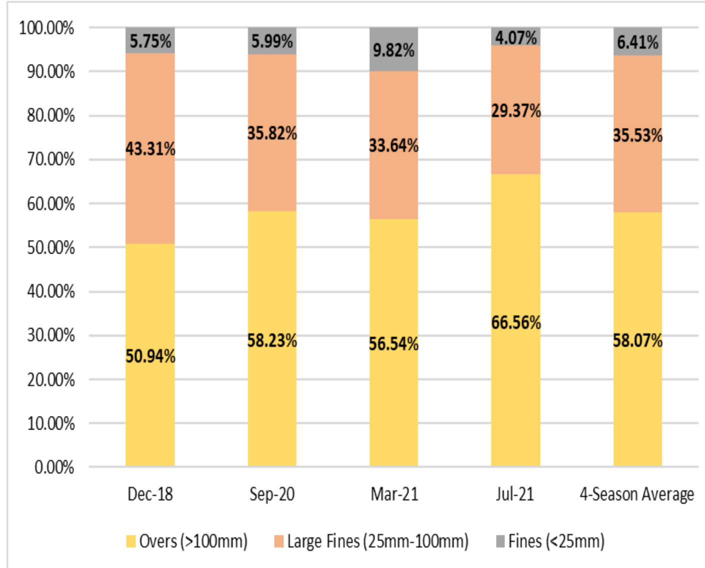
The fact that the two garbage streams had similar composition was a significant finding for MWP planning. If the City were to pursue MWP, it is possible that recovery could be maximized by processing both garbage streams together to reduce the tonnes sent for disposal. For this reason, the Study's analysis on facility throughput and material recovery assumed that both Multi-residential and Single Family Garbage would be managed as a combined stream if processed via MWP. As such, while the audits identified the two sources separately, all analysis with respect to tonnes and materials recovered was conducted on both garbage streams combined.

Figure 8, Figure 9 and Figure 10 indicate that, after initial size classification, the “Overs” stream contains the highest percentage of clean recycling available for further processing and recovery. To be classified as clean, the material had to meet current end market standards. It was not possible to determine if a piece of contaminated recyclable material was placed in the garbage because it was contaminated or if it became contaminated from co-mingling with other materials in the garbage. As outlined in Section 2.2.1, cross contamination is always an issue when recyclables are mixed with non-recyclable material.

Figure 8: Overall Garbage Distribution by Size

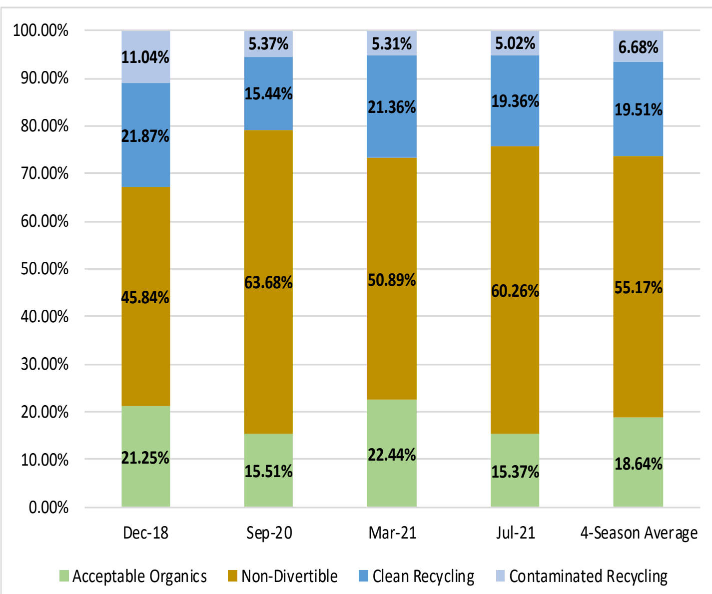


Single Family Garbage

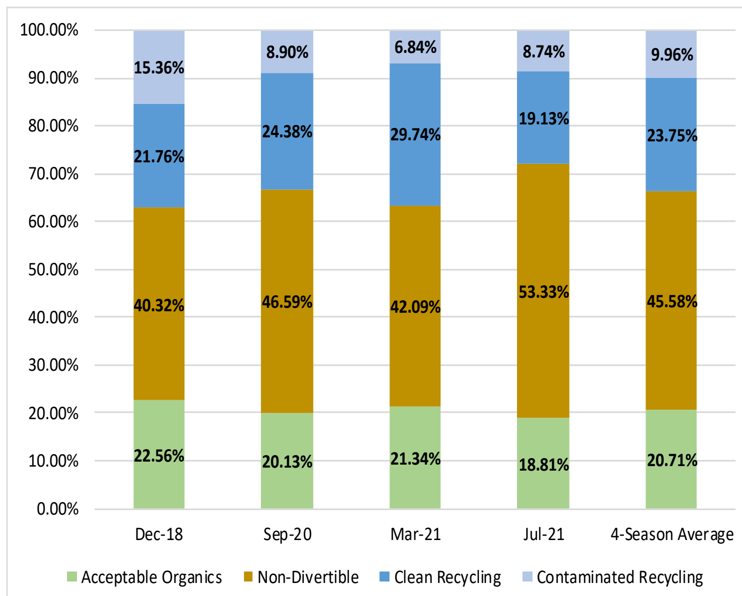


Multi-residential Garbage

Figure 9: Breakdown of Garbage "Overs"

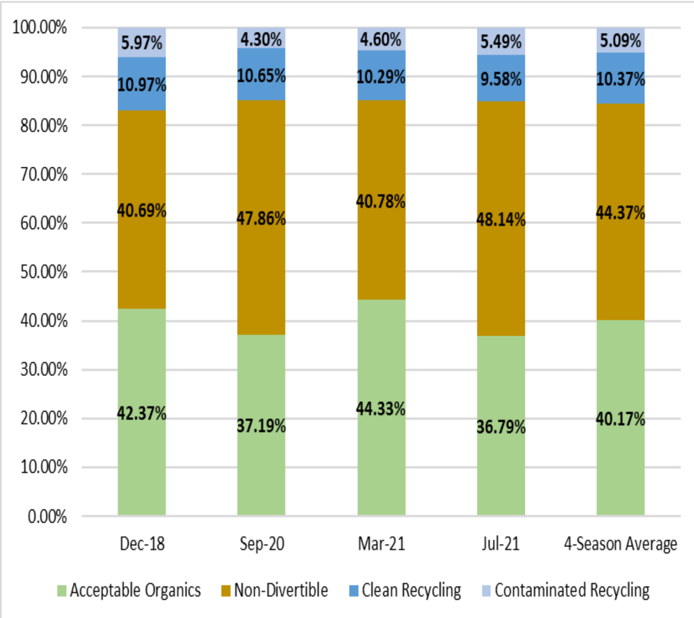


Single Family Garbage

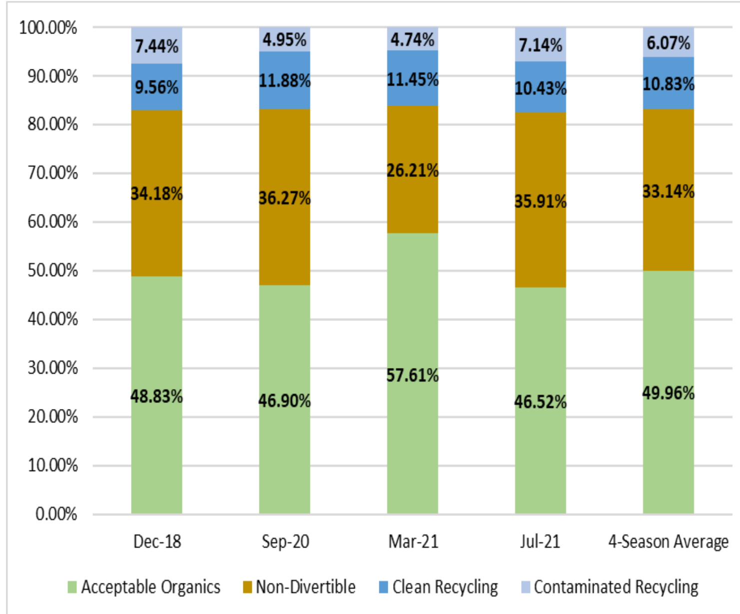


Multi-residential Garbage

Figure 10: Breakdown of Garbage "Large Fines"

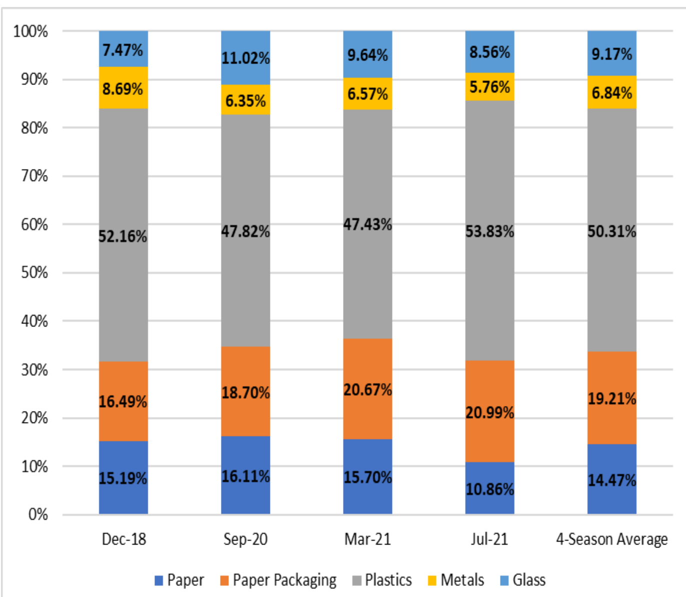


Single Family Garbage

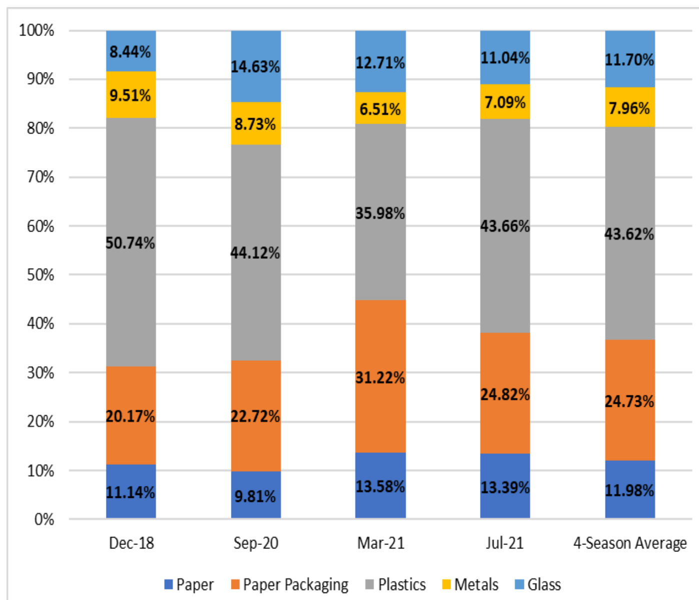


Multi-residential Garbage

Figure 11: Breakdown of Clean Recycling in Garbage

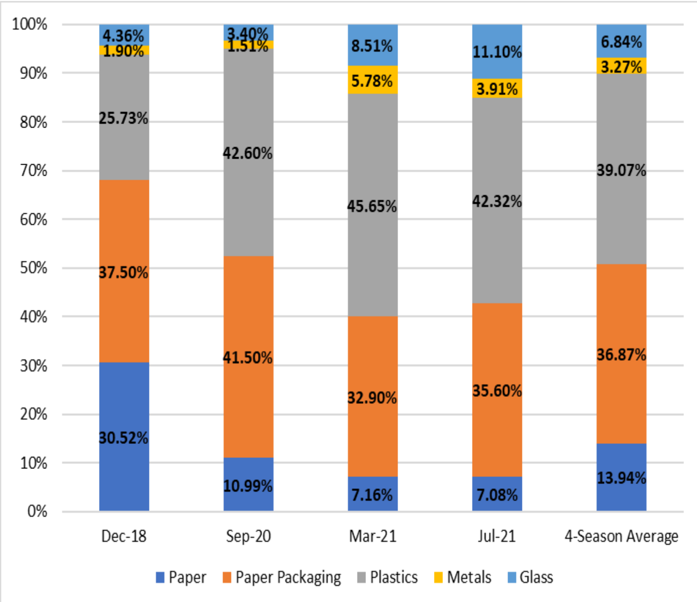


Single Family

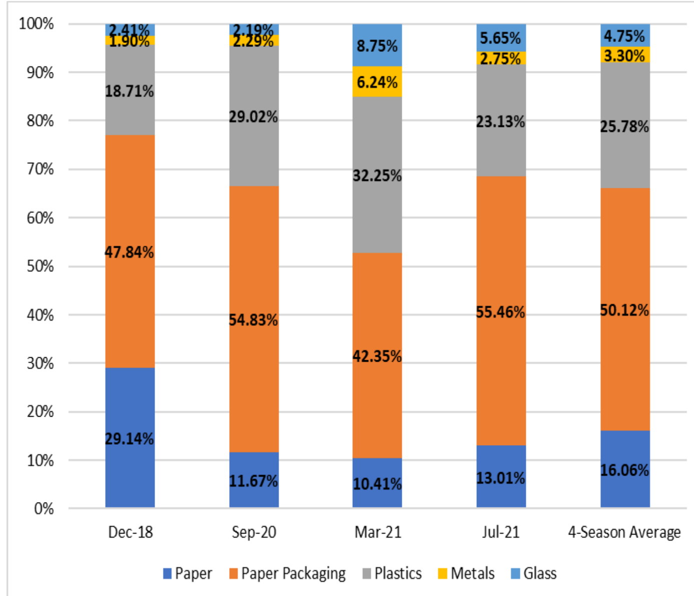


Multi residential

Figure 12: Breakdown of Contaminated Recycling in Garbage



Single Family



Multi-residential

Table 2 (corresponding to Figure 11 and Figure 12, respectively) represent the average overall amount of clean and contaminated recycling in Single Family and Multi-residential Garbage over the four audit seasons.

Table 1: Overall Composition of Clean Recycling in Garbage

	Single Family 4-Season Average	**Multi-residential 4 Season Average**
Paper	2.17%	2.06%
Paper Packaging	2.88%	4.31%
Plastics	7.56%	7.38%
Metal	1.04%	1.35%
Glass	1.37%	2.04%
Total Proportion of Clean Recycling in the Garbage Stream	**15.02%**	**17.14%**

As seen in Table 1, plastics are the greatest portion of those materials categorized as clean recycling. This material category consisted mainly of polyethylene (PE) plastic bags & film – packaging (grocery bags, milk bags, bread bags, etc.), other mixed rigid plastics, High Density Polyethylene (HDPE) bottles and jugs (detergent jugs, shampoo bottles, etc.) and Polyethylene terephthalate (PET) bottles & jars.

Table 2: Overall Composition of Contaminated Recycling in Garbage

	Single Family 4-Season Average	**Multi-residential 4 Season Average**
Paper	0.94%	1.35%
Paper Packaging	2.09%	3.78%
Plastics	2.09%	1.84%
Metal	0.17%	0.22%
Glass	0.37%	0.32%
Total Proportion of Contaminated Recycling in the garbage stream	**5.65%**	**7.51%**

Waste diversion is currently calculated based on the total annual tonnes of waste collected through diversion programs (such as the City's Blue Bin Recycling and Green Bin Organics Programs) divided by the total tonnes of waste (divertible and non-divertible) generated by each customer group. When the Single Family and Multi-residential values for Clean Recycling (Table 1) and Contaminated Recycling (

Table 2) in the garbage are compared, it appears that the two garbage streams have similar potential for recycling recovery. The data and analysis suggest that it is possible that the difference in waste diversion between the two groups is due to a difference in consumption habits, rather than waste sorting and disposal practices. The ratio of divertible versus non-divertible tonnes consumed by each group may not be the same, and may be contributing to the difference in diversion rates.

Overall, the data suggests that the City of Toronto is unlikely to achieve a significant reduction in the tonnes sent to landfill if it only targets clean recyclables currently in the garbage for recovery through a MWP facility. Like any processing facility, it is not possible to achieve a 100% capture rate for all recoverable materials for a variety of reasons, even with optimal performance of equipment, which is further discussed in Section 5.0.

3.0 Waste Forecasting

Waste projections are a key element in any City planning process as it allows decision makers and planners to identify the long-term needs of the system and effectively plan their City's waste management programs. By understanding how the City's waste management needs may change in the short to long term, the City can make effective and efficient decisions about waste management programs and services and ensure that the proper supporting programs and infrastructure are in place.

The City has maintained an in-depth dataset of the tonnes of materials it manages for the past 18 years. As part of the MWP study analysis, two multiple linear regression models were developed, coupling the historical data with economic indicators, to develop short and long term projections of the tonnes of waste the City will need to manage over the next 20 years. While the historical data includes the impacts of past program, policy and behaviour changes, it is not possible to quantify the exact magnitude of a single change in a constantly evolving system such as Toronto's. As such, the projections are based on maintaining the current status-quo of City waste management programs and do not attempt to predict the impact of future program, policy and behavioural changes.

The City maintains a large data repository of economic indicators covering the Census Metropolitan Area, Greater Toronto Area, provincial and national levels. Annual and quarterly values for key economic indicators from the Conference Board of Canada and Moody's were analyzed to determine which would be appropriate for forecasting. The economic indicators that most closely matched the trends of the City's waste generation data to date were labour force unemployment rate and median family income.

The two models were:

- Full Data Series Model - a long-term model that describes the relationship between waste generation and the economic indicators of unemployment rate and median family income. It was used to develop waste generation projections for the years 2019 to 2039.
- Recent Data Series Model - intended for short-term forecasts as it makes predictions solely on historical waste quantities. It was used to develop waste generation projections for the years 2019 to 2023.

Results were allocated by waste stream using assumptions derived from reviewing the City's waste and household data and are presented in Figures 13 and Figures 14.

Figure 13: Projected Annual Waste Tonnes for Single family Customers

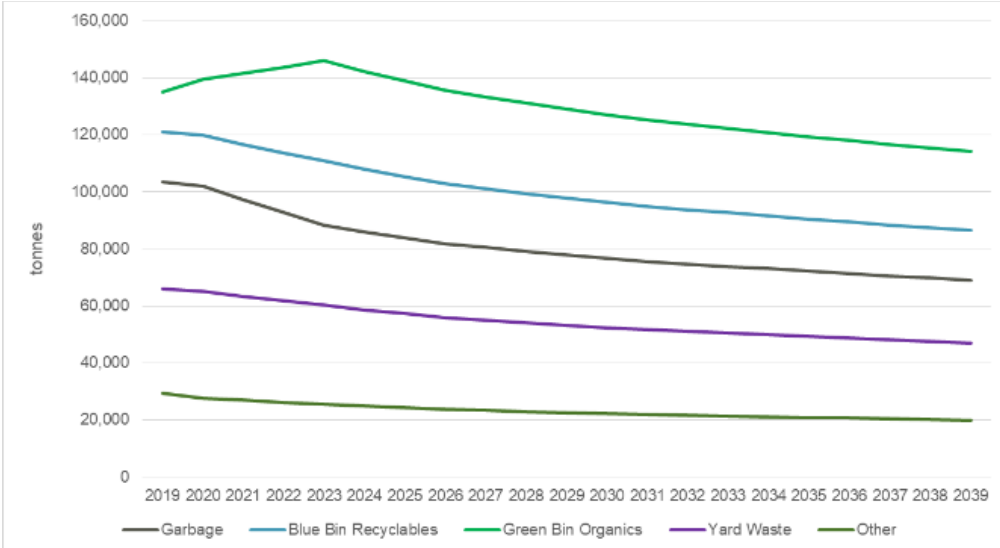
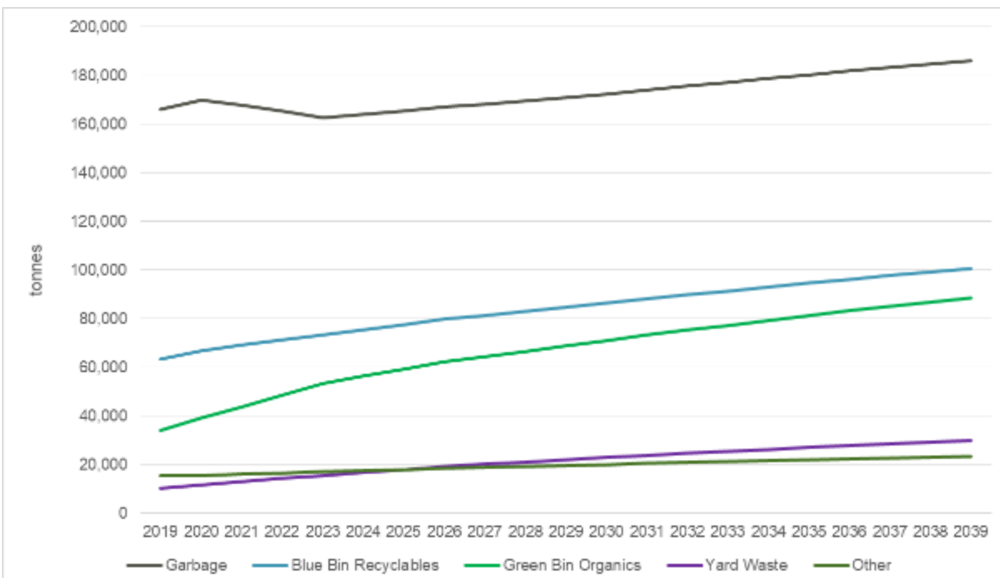


Figure 14: Projected Annual Waste Tonnes for Multi-residential Customers



Overall the City's waste tonnes appear to remain constant in the short and long term planning horizon. Based on available land and the City's development trajectory, it is assumed that going forward, the number of Single Family customers is likely to remain static (or decrease slightly). The downward trend in Single Family tonnes could be a result of the ongoing trend of light-weighting of recyclables, where containers are being made lighter and thinner than in the past. Lighter materials result in a lower weight being recorded for the same volume of material. Since waste data is recorded on a tonnage basis, this change can present itself as a downward trend.

If the City were to design a MWP facility to process both Single Family and Multi-residential Garbage tonnes, an annual throughput of approximately 270,000 tonnes would be required. Based on the waste composition outlined in Section 2, if all clean recycling was recovered, the City would divert approximately 40,000 additional tonnes annually (assuming end markets are available to accept the material).

4.0 Jurisdictional Scan

To gain a better understanding of MWP technologies, a jurisdictional scan was conducted to identify operational facilities that recover recyclables and/or organics. The scan also sought certain high level parameters about the context in which the facilities operate. 58 individual facilities were identified and were grouped in the following categories (the complete list of facilities is available in Appendix A and all data identified was obtained from publicly available sources):

• Mixed Waste Processing with Recyclables Recovery	MWPwRR
• Mixed Waste Processing with Organics Recovery	MWPwOR
• Mixed Waste Processing with Recyclables and Organics Recovery (usually via composting)	MWPwRR, OR
• Mixed Waste Processing with Recyclables and Organics Recovery with recovery of energy (often via Anaerobic Digestion)	MWPwRR, OR plus Alternative Energy
• Mixed Waste Processing with Recyclables and RDF Recovery	MWPwRR, RDFR
• Mixed Waste Processing with Recyclables and Organics Recovery (usually via composting) and RDF Recovery	MWPwRR, OR, RDFR
• Mixed Waste Processing with Recyclables and Organics Recovery and RDF Recovery with recovery of energy (often via AD processing of organics or use of RDF as a feedstock for generation of a renewable alternative fuel)	MWPwRR, OR, RDFR plus Alternative Energy
• Mixed Waste Processing with Recyclables Recovery and biostabilization of the remaining waste stream prior to disposal	MWPwRR and biostabilization
• Mixed Waste Processing with Recyclables and RDF Recovery with energy recovery (generally recovered through generation of a gaseous or liquid fuel)	MWPwRR, RDFR plus Alternative Energy[5]
• Mixed Waste Processing with RDF Recovery and energy recovery (through generation of a gaseous or liquid fuel)	MWPwRDFR plus Alternative Energy[6]

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[6] In these facility categories, use of RDF as a feedstock for combustion as a fuel in an EfW facility or as an industrial fuel was not categorized as "plus Alternative Energy" as the renewable content of this fuel stream can vary significantly. The use of the term "plus Alternative Energy" was reserved for generation of gaseous (e.g. biogas) or liquid fuels (synthetic diesel etc.).

4.1 Analysis

Upon reviewing the facilities identified in the jurisdictional scan and the materials they recover, the Study determined that each facility is purpose-built for its operating context. Common drivers that impact the decision to pursue MWP and how facilities are designed appear to be:

- Local waste program – it appears uncommon for MWP facilities to target materials that are already being collected through a source separated program. In jurisdictions where significant source separation is not present, an increased investment in equipment to recover higher value recyclables was evident.

- Waste legislation – legislation governing residue disposal (such as landfill tariffs and bans), incineration, production of fuel from waste, ability to use materials recovered through MWP, etc. directly impact the materials targeted and facility design.

- Cultural behaviour – local culture impacts consumption and waste generation patterns. Waste composition directly impacts processing technology selection as well as the decision on which materials to target for recovery.

- Geography and climate – In jurisdictions with higher urban densities where space is at a premium, the focus of MWP design is on the reduction of tonnage overall as opposed to targeting individual resources for recovery (which would most likely require a larger facility footprint). Jurisdictions with significant seasonal variability are designed to accommodate fluctuation in waste composition and tonnage since seasonality has been shown to impact waste generation patterns.

It is interesting to note that 40 of the 58 facilities identified in the jurisdictional scan included a thermal process as part of their approach to reduce the amount of material sent to landfill and manage materials that are not marketable due to contamination and/or a lack of available end markets (e.g., generating a refuse derived fuel product for thermal treatment at an off-site facility). The types of materials directed to thermal treatment include contaminated paper and low value/non-recyclable plastics.

5.0 Viability Assessment

The facilities examined in the Jurisdictional Scan were designed to meet the waste processing needs of their host jurisdiction, and the policies and drivers that informed the development of those facilities could very well be different from the City of Toronto. The study team worked with Subject Matter Experts (SMEs) from within the City of Toronto's Solid Waste Management Services Division to develop Performance Objectives to evaluate the technology groupings identified in the jurisdictional scan and better understand if they would be suitable in the City's context. The Performance Objectives were identified as minimum acceptable recovery thresholds to screen a technology for consideration in this analysis, and not as a performance specification for potential future facility development. For the recovery of Blue Bin Recycling, the following Performance Objectives were identified:

- All recovered material must meet the same quality standards as current Blue Bin Recycling end markets
- Minimum 75% recovery rate for metals (ferrous and non-ferrous)
- Minimum 40% recover rate for HDPE and PET
- Minimum 30% recovery of Polypropylene
- Minimum 30% recovery of Old Corrugated Cardboard

Based on available information, the following eight facilities appeared to meet the Performance Objectives outlined above (due to the recent change in end markets due to China's National Sword policy, some facilities are in the process of seeking out new end markets). The feedstock for the facilities were not compared to the City's waste profile or Ontario's end market quality parameters (which would impact the recovery rate)

- Facility 1: Kielce, Poland (MWPwRR, OR & RDF)
- Facility 2: Milton Keynes, UK (MWPwRR, OR with alternative energy (gasification))
- Facility 3: BDR Manvers, UK (MWPwRR, OR & RDF)
- Facility 4: Glasgow, UK (MWPwRR, OR, RDF with alternative energy (gasification))
- Facility 5: Lanarkshire, UK (MWPwRR & RDF)
- Facility 6: Sunnyvale SMaRT Station, U.S. (MWPwRR, OR)
- Facility 7: Newby Island Resource Recovery Park, U.S. (MWPwRR, OR)
- Facility 8: Edmonton Waste Management Centre, Canada (MWPwRR, OR, RDF with alternative energy (waste to biofuels))

6.0 Costing

Based on the findings of waste characterization studies, a high level, rough order of magnitude costing exercise was conducted to determine the capital cost of a MWP facility sized to process both Single Family and Multi-residential Garbage.

While the costing exercise was technology agnostic and based primarily on throughput, it was assumed that the facility will sort and recover recyclables on the front end followed by organics processing. The minimum performance objectives from Section 5.0 were taken into consideration when determining the complexity of recyclable recovery infrastructure, however when combined with the waste profile identified through the audits it is assumed only 4,000 tonnes of recyclables would be recovered by the facility. Additional tonnes could be diverted from landfill through the production of fuel products and organics recovery; however, this infrastructure is outside of the scope of this report and was not considered as part of the costing.

Operating costs for recycling recovery were not calculated at this time due to the uncertainty in end markets and the inability to estimate the revenue from the sale of recovered recyclables.

The exercise resulted in a conservative estimate of $50 million for the design and construction of the front end recycling recovery components of a MWP facility capable of processing 270,000 tonne per year. The costing was done on an integrated system that included organics sorting and processing and as such includes efficiencies achieved through the integrated system. A standalone recycling recovery plant with the equivalent throughput could hypothetically cost more.

7.0 Lessons Learned

The findings of the City's Mixed Waste Processing efforts have been significantly different than anticipated. In 2020, Toronto City Council adopted *IE.12.4: Mixed Waste Processing Study Update* from Solid Waste Management Services outlining some of the key findings to date. MWP audits have shown that Single Family and Multi-residential waste profiles are quite similar and that the difference in waste diversion rate between the two groups may be due to a difference in consumption habits. Neither garbage stream contained a significant amount of clean recyclables; and, the recovery of recyclables from garbage through MWP would have minimal impact on the City's diversion from landfill metric. Additional diversion could be achieved if recycling recovery is coupled with the recovery of organics. Leveraging MWP to generate a fuel product could further reduce the number of tonnes sent to landfill.

The fact that the two garbage streams had similar composition is a significant finding for MWP planning. If the City were to pursue MWP, it is possible that recovery could be maximized by processing both garbage streams together to reduce the tonnes sent for disposal. Technology to sort clean recycling from a mixed feedstock was identified through the jurisdictional scan. Additionally, the waste audits demonstrated that size separation after an initial de-bagging step could be a way to reduce contaminants (both organic and non-divertible material) from contaminated recycling. However, for the City of Toronto, the overall inbound contamination rate of Blue Bin recycling does not appear to be high enough for there to be a benefit to using MWP to recover recyclables. Technology selection is also driven by the context in which each individual facility operates. Feedstock composition, local waste programs, legislation, culture and geographic location along with available end markets are some of the key factors that should be considered when comparing facilities and their efficacy.

Finally, the Study made important observations about the diversion potential of different customer groups. The data and analysis suggests that the difference in diversion rates among Single Family customers when compared to Multi-residential customers may be due to a difference in consumption habits, rather than waste sorting and disposal practices. The ration of divertible versus non-divertible tonnes consumed by each group may not be the same, and may be contributing to the difference in diversion as calculated in the Province of Ontario.

Overall, the data suggest that the City of Toronto is unlikely to achieve a significant reduction in the tonnes sent to landfill if it only targets clean recyclables currently in the garbage for recovery through a MWP facility.