LONG TERM WASTE STRATEGY

Technical Memorandum No. 2

Needs Assessment: Vision & Guiding Principles; Gaps, Challenges and/or Opportunities; and Long-Term Projections

TORONTO

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1 Importance of Having a Waste Strategy

Waste management and diversion programs in the City of Toronto (the City) have evolved from simple garbage collection to a complex system of collecting source separated materials including Blue Bin materials, Green Bin organics, garbage, Oversized and Metal Items, Electronic Waste and Household Hazardous Waste, as well as a range of other items.

The most recent diversion plan approved by Toronto City Council in 2007, Target 70, outlined a strategy to achieve the goal of 70% diversion by 2010. The plan outlined a number of programs and initiatives including:

- source reduction initiatives;
- development of reuse centres;
- replacement of blue boxes with Blue Bins;
- addition of new recyclable materials;
- implementation of Green Bin organics programs for multi-residential buildings;
- education and enforcement of the City's diversion by-law;
- introduction of a volume-based rate structure;
- investigation of emerging source separation techniques; and,
- development of a residual waste processing facility to recover resources from mixed residual waste.

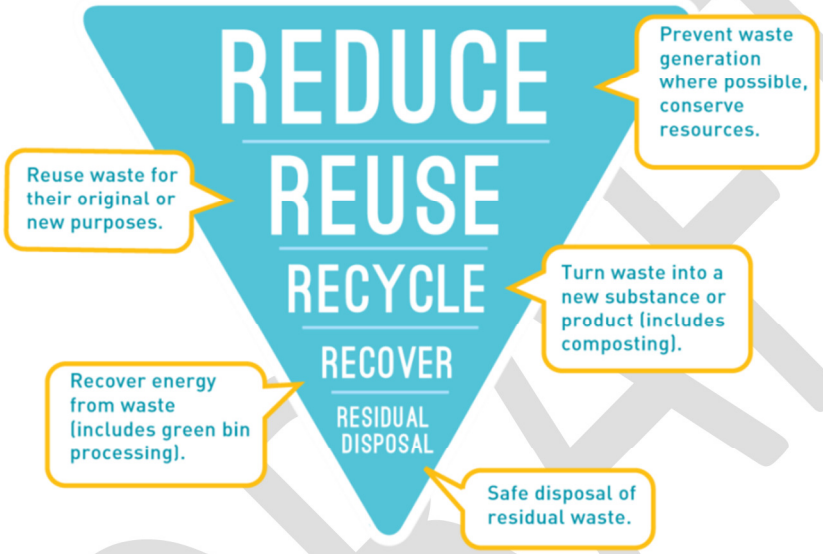
In 2013, Solid Waste Management Services (SWMS) presented a report to Public Works and Infrastructure Committee (PWIC), which provided a status update of the Target 70% initiatives; an explanation of why 70% diversion was not achieved. It also described plans for moving forward on diversion initiatives in 2013, including the development of a Long Term Waste Management Strategy.

Recognizing the need for an updated comprehensive long-term waste management plan to set the foundation for future planning and coordinated decision making, the City of Toronto commissioned the development of a Long Term Waste Management Strategy in 2013[1].

[1] http://app.toronto.ca/tmmis/viewAgendaItemHistory.do?item=2013.PW21.1

The draft Long Term Waste Management Strategy (the draft Waste Strategy) recommends waste reduction, reuse, recycling, recovery and residual disposal (the 5Rs) (see Figure 1-1 below for a more complete description of the 5Rs) policies and programs that are cost-effective, socially acceptable and environmentally sustainable for the long term. This is a "triple bottom line" approach that gives consideration to each component during the development of the draft Waste Strategy. The draft Waste Strategy anticipates the future needs of the City and identifies options to meet the needs for all of the City's customers.

Figure 1-1: 5Rs Waste Management Hierarchy



2 Developing the Waste Strategy

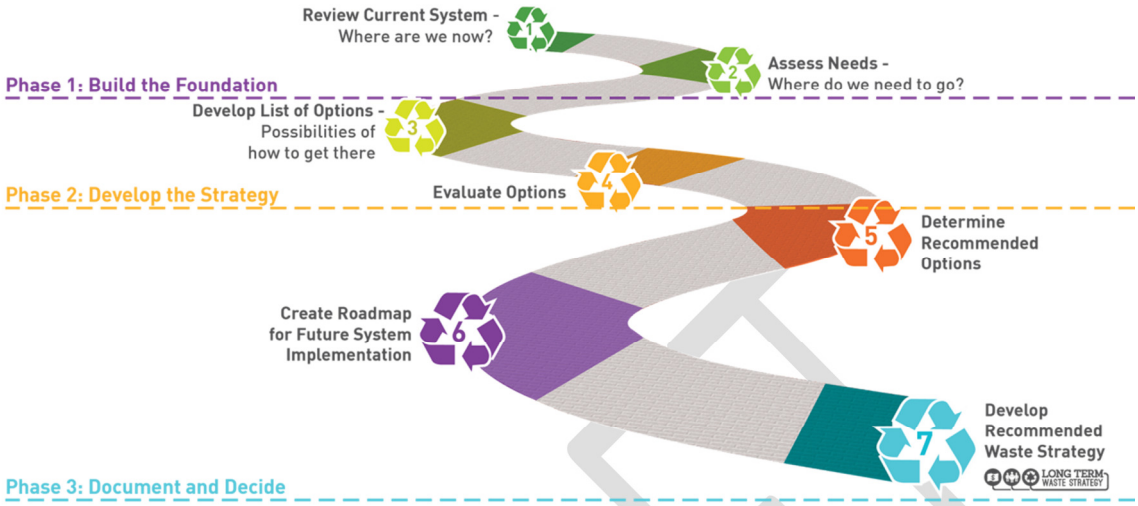
Development of a Long Term Waste Management Strategy is Strategic Action #7 in Council's 2013-2018 Strategic Action Plan. The Long Term Waste Management Strategy is to be developed in partnership with community and divisional stakeholders that are environmentally sustainable and economically viable. The intent of the draft Waste Strategy is to provide a high level decision making document to guide SWMS' policy decisions for the duration of the planning horizon of 30 to 50 years.

The development of the draft Waste Strategy has been governed by five guiding principles that were approved by City Council:

1. Consideration of options which support waste reduction, reuse, recycling and recovery before final disposal;
2. Consideration of all other environmentally approved disposal options to extend the life of Green Lane Landfill;
3. An open and transparent review of the options;
4. Innovation and flexibility to adapt to emerging technologies and changes to the regulatory environment; and,
5. Development of policies and opportunities for collaboration.

The draft Waste Strategy was prepared in three phases with each phase being supported by comprehensive consultation with the public, input from a stakeholder advisory group and key stakeholders including members of City Council. The overall draft Waste Strategy development process is presented in Figure 2-1 with a brief description of each phase of the draft Waste Strategy development process.

Figure 2-1: Waste Strategy Development Process



Phase 1 - BUILDING THE FOUNDATION

Building the foundation included establishing a comprehensive baseline to identify the current state of all aspects of the City's integrated waste management system and also identified the long-term need of the system in the future.

Deliverable 1 –"Where are we? Establishing a Comprehensive Baseline"

The purpose of this phase was to document the existing waste reduction, reuse, collection, transfer, processing, disposal and financial systems used to manage waste in the City. This baseline was used as the foundation upon which future programs, policies and facilities' recommendations are based. As part of the baseline, previous strategies that have been developed were taken into consideration, including outstanding recommendations for change such as development of a Mechanical Biological Treatment (MBT) facility. Phase 1 sets the baseline from which future options and recommendations were assessed in

the Waste Strategy. The baseline has been documented in Technical Memorandum No. 1[2].

Deliverable 2 – "Where do we need to go? Identifying the Long-Term Needs" **(SUBJECT OF THIS DOCUMENT)**

Once a baseline had been established, projections for the future were developed in order to estimate requirements for waste management for the next 30 to 50 years. Variables that could impact the system including population growth, housing trends, economic growth, product design, packaging changes, City planning initiatives, and potential changes to legislation were reviewed in this phase. Technical Memorandum No. 2 documents the gaps, challenges and opportunities in Toronto's integrated waste management system. It includes projections for the future quantities of waste to be managed and the vision and guiding principles to guide the implementation of the Waste Strategy in the future.

Phase 2 - DEVELOP THE WASTE STRATEGY

In order to develop the Waste Strategy, a critical review of the current system will be completed. This will be done in order to identify areas of opportunity for improvement, as well as to consider policies, programs, and technologies that may help to improve the current system and provide for a stable long-term outlook.

Deliverable 3 – "How do we get there? Consideration of Options"

A range of policies, programs, and facility/technology options will be reviewed to identify options the City could consider in the future. Options will include additional waste reduction and reuse programs and services, other waste diversion techniques and practices, renewable energy projects, waste technologies (e.g. Mixed Waste Processing (MWP)), Energy from Waste (EFW), alternative disposal options (e.g. redirecting waste to other landfills), and long-term opportunities for Green Lane Landfill. Where appropriate, separate options will be identified to manage waste from the single family residential and multi-residential sectors since these two sectors have different waste management needs and in some cases may require different programs and infrastructure. Technical Memorandum No. 3 will identify and discuss a list of options available

[2] http://www1.toronto.ca/wps/portal/contentonly?vgnextoid=98fc8005b7ae7410VgnVCM10000071d60f89RCRD

to the City and describe the evaluation methodology and criteria used to evaluate each option.

Deliverable 4 – "Evaluate the possibilities. Identifying the Best Options for the City"

During this phase, a detailed evaluation of the options identified in Phase 2 will be conducted from an environmental, social and financial perspective to identify a series of recommended long-term options for the City. Technical Memorandum No. 4 will document the evaluation process and resulting recommended options for the City.

Phase 3 – DOCUMENT AND DECIDE

Once the recommendations for change have been determined, a Draft Waste Strategy document will be prepared to identify what the new system will look like, the timing for any proposed changes, the financial requirements to support the new system and the roles and responsibilities of all those involved.

Deliverable 5 – "Prepare and draft the Long Term Waste Strategy document"

The Draft Waste Strategy will be developed using the results of the evaluation process. It will include an implementation "roadmap" to help guide the City's integrated waste management system for the next 30 to 50 years. The final Waste Strategy will also include a consultation report documenting the consultation activities conducted and feedback received during development of the Waste Strategy. Reports on consultation completed to date can be found on the City's website[3].

In parallel to the completion of the three phases, a comprehensive consultation plan has been and will continue to be implemented to present information, solicit feedback, and provide an opportunity for the community to help guide the development of their future waste management system. Throughout the process, City staff will provide regular updates to PWIC on the development of the Waste Strategy.

The following Figure 2-2 shows how the consultation plan developed for the Waste Strategy was incorporated into the three phases described above.

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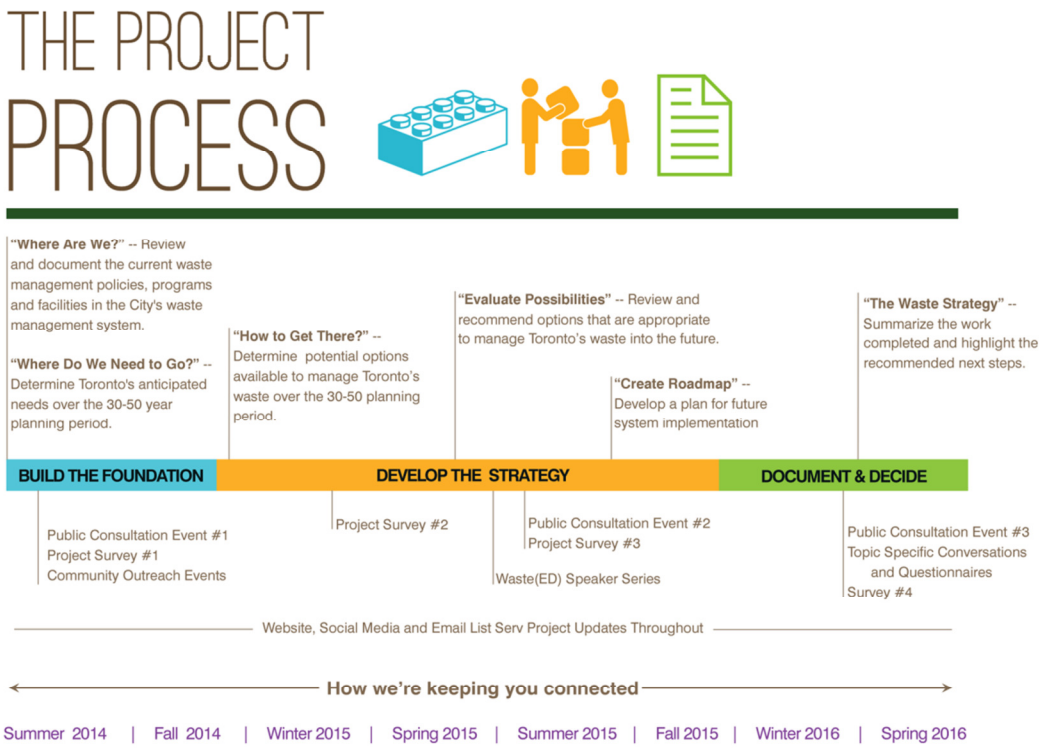
[3] http://www1.toronto.ca/wps/portal/contentonly?vgnextoid=98fc8005b7ae7410VgnVCM10000071d60f89RCRD98fc8005b7ae7410VgnVCM10000071d60f89RCRD

Figure 2-2: The Project Process



2.1 Purpose of this Technical Memorandum

This technical memorandum is to document the results of Step 2 as described in the section above. The following provides a brief overview of the content of each section:

Vision and Guiding Principles Development – a long-term waste management strategy must include a vision for the ultimate objective of the system. It should also include key guiding principles to follow as it moves from the current system through implementation to the future system. The development of the vision and guiding principles seek to establish the future direction of the system allowing for a "work-back" to better understand what will need to be done in the short term to ultimately achieve the long-term vision.

Gaps, challenges and/or opportunities Assessment – this assessment reviews the current system and identifies the primary needs,

challenges and/or opportunities for the City's waste management system that are being experienced or may be experienced in the future. This assessment focuses the options identification process to ensure it includes key areas where gaps, challenges and/or opportunities do/or are anticipated to exist in the future.

Projections Development – long-term waste quantity and composition projections have been developed to identify the future system needs (including policies, programs, facilities and contracts). This task helps to identify potential short comings or opportunities in the system's capacity over the duration of the planning period.

The completion of Step 2 and the corresponding three activities will help further the understanding of the baseline developed in Step 1 and allow for the identification and evaluation of potential options to be identified in later steps of the Waste Strategy development process.

3 Vision and Guiding Principles Development

A successful Waste Strategy reflects the interests of the community that it serves now and in the future. It is driven by a Vision Statement and Guiding Principles that express a philosophy of what the Waste Strategy will strive to achieve.

A draft Vision Statement and supporting Guiding Principles were developed from input received through the consultation process, including input from residents, stakeholders, business and industry representatives, and City staff. In addition, a dedicated survey (Survey #2) was utilized to seek specific input on this topic. Engagement and consultation activities were designed to, in part, identify potential components of the draft Vision and Guiding Principles as well as seek feedback on draft content prepared in advance. These events and meetings included:

- Stakeholder Advisory Group Meetings;
- Key Stakeholder Meetings;
- Public Consultation Events (PCEs) – June 9, 15, 20, 24, 2015; and,
- Survey #2 on the Vision and Guiding Principles

The Phase 2 Consultation Summary Report includes a more detailed description of all the content related to input received regarding the draft Vision and Guiding Principles from each of these groups and events.

3.1 Vision Statement

Survey #2 in particular was dedicated to seeking input on Vision themes and the relative importance of suggested Guiding Principles. Input on the Vision themes was then utilized to create a draft Vision Statement. The following provides the original draft Vision Statement, the recommended Vision Statement based on feedback, and the rationale for the changes as proposed.

Original Draft Vision Statement for Consultation:

"Together we will reduce the amount of waste we generate, reuse what we can, and recycle and recover the valuable resources in our waste that remain. We will embrace a waste management system that is user-friendly, convenient and accessible with programs and facilities that balance the needs of the community and the environment with long-term financial sustainability. Together, we will ensure a clean, beautiful and green City in the future."

Through the consultation process, feedback was received on the vision statement, which can be condensed into four main points for revision:

1. Introduce the concept of a circular economy and the importance of this type of thinking with respect to waste management in the future;
2. Increase readability and reduce some redundancy in the message;
3. Consider removing some generic and/or vague words like "green" that can be open to interpretation; and,
4. Include additional themes around safety and health.

Overall, participants in the consultation process were very supportive of the Vision Statement as presented.

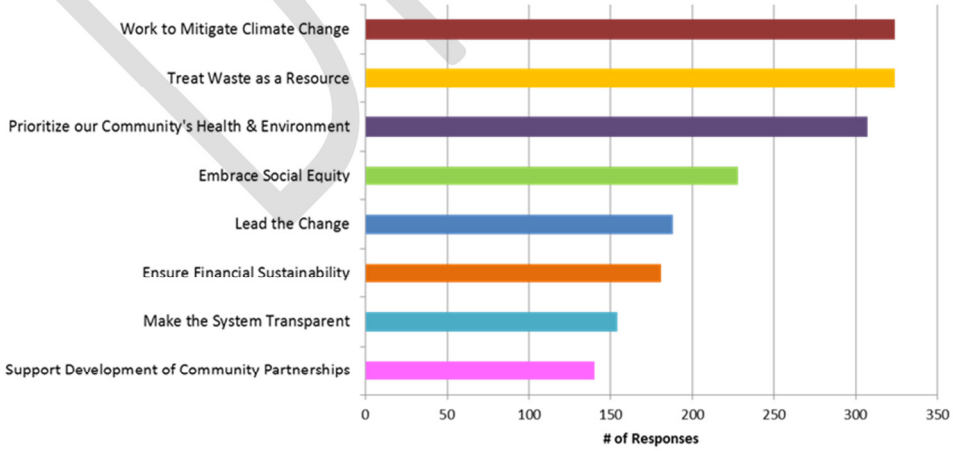
The above changes have resulted in the following being recommended:

Recommended New Vision Statement:

"Together we will reduce the amount of waste we generate, reuse what we can, and recycle and recover the remaining valuable resources to reinvest back into our City. We will embrace a waste management system that is user-friendly, with programs and facilities that balance the needs of the community and the environment with long-term financial sustainability. Together, we will ensure a safe, clean, beautiful and healthy City for the future."

3.2 Guiding Principles

Through Survey #2 as well as the other consultation activities identified above, input was gathered on a series of suggested guiding principles. Participants were asked what Guiding Principles were most important to them. The figure below shows the results of how principles were viewed by survey participants. The top three principles selected were: work to mitigate climate change, treat waste as a resource and prioritize our community's health and environment.



The figure above also shows that although there are three guiding principles that are clearly identified as more important by the majority of stakeholders, there is support for all the guiding

principles suggested. In addition, through the consultation process, there were no comments received in opposition to any of the guiding principles, nor were there suggestions that would support removing some from the list. As a result, it is recommended that the original list of guiding principles be carried forward as follows:

Recommended Guiding Principles:

1. Work to Mitigate Climate Change Impacts - To reduce our impact on climate change we will find solutions that reduce greenhouse gas emissions associated with our waste management system.
2. Treat Waste as a Resource - Waste is an asset that needs to be conserved. We should make best use of our waste by recovering materials and energy remaining after reducing, reusing, and recycling.
3. Prioritize our Community's Health and Environment - The health of our residents and the environment is a priority in decision making to minimize negative impacts and to maximize the benefits.
4. Embrace Social Equity - Create an easy-to-use system that all residents and the community can understand and participate in.
5. Lead the Change - Strong leadership is taking ownership, leading by action and being responsible for the waste we produce.
6. Ensure Financial Sustainability - Financially sustainable solutions that are easy and affordable to maintain by future generations and also help to stimulate economic growth within our community.
7. Make the Future System Transparent - Future decisions on the implementation of the Waste Strategy will be open, accessible and based on best practices and facts to find solutions that benefit all.
8. Support Development of Community Partnerships - Working together with local community groups and organizations will help us reach our goals and reduce waste more effectively and efficiently.

4 Gaps, Challenges and/or Opportunities Assessment

The purpose of this section of the memo is to identify the preliminary gaps, challenges and/or opportunities for the City's solid waste management system. The gaps, challenges and/or opportunities include those components of the system that are either being currently experienced, or will likely be experienced in the future, an ability for enhancement and/or need of improvement in the future. These gaps, challenges and/or opportunities have been identified through a combination of stakeholder consultation, City staff review and input, a jurisdictional review of other similar systems, and the expertise of the consultant team.

This section outlines these gaps, challenges and/or opportunities and begins the process of identifying potential options for some of the more critical areas of the City's waste management system.

The following sections have been organized by solid waste management system component and also in accordance with the 5Rs (reduce, reuse, recycle, recovery, residual waste) hierarchy as exemplified in Table 4-1 below. For each gap, challenge and/or opportunity identified, the following has been included:

1. An overview of the gap, challenge and/or opportunity, why it has been included, and the real/potential impact on the system; and,
2. Preliminary options to the address the gap.

These items have been organized into "profiles" designed to highlight the gaps, challenges and/or opportunities with more detailed analysis to come later in the Waste Strategy development process. The preliminary options identified represent potential options, based on the current state of the Waste Strategy development process that could be considered to address the respective gaps, challenges and/or opportunities. The respective lists of preliminary options may be expanded and/or reduced, depending on input from a range of stakeholders through the consultation process.

A total of 19 primary gaps, challenges and/or opportunities have been identified and are listed in Table 4-1 below (in no particular order). These gaps, challenges and/or opportunities have also been categorized as either "Programmatic", "Facilities/Infrastructure" or "Internal & External Influences/Pressures" to assist with the evaluation in later stages of the Waste Strategy.

Table 4-1: Gaps, Challenges and/or Opportunities and Waste System Components

	Gap, Challenge and/or Opportunity	Promotion & Education	Generation, Reduce & Reuse	Collection & Drop-off	Transfer	Recycling & Processing	Recovery	Residual Disposal	System Financing
	Programmatic Gaps/Challenges/Opportunities								
1	Public Education and Engagement	X	X	X	X	X	X	X	X
2	Enhanced Enforcement Opportunities	X	X	X		X			
3	Waste Reduction & Reuse	X	X	X		X			X
4	Value of Food and Food Waste	X	X						X
5	Performance Measures	X	X	X	X	X	X	X	X
6	Multi-residential Waste Diversion (Program Components)	X	X	X					X
	Facilities/Infrastructure Gaps/Challenges/Opportunities								
6	Multi-residential Waste Diversion (Facility Components)				X	X	X	X	X
7	Drop-off Facilities	X		X	X				X
8	Commissioners Street Transfer Station			X	X				X
9	Dufferin Waste Management Facility				X	X	X		X
10	Future Waste Processing Capacity					X			X
11	Waste Recovery Technologies						X	X	X
12	Residual Waste Disposal Capacity							X	X
13	Solid Waste Services for the CRD Sector	X		X		X			
	Internal & External Influences/Pressures Gaps/Challenges/Opportunities								
14	Regulatory, Control and Role/Responsibility Challenges	X	X	X	X	X	X	X	X
15	Waste Financing System	X	X	X	X	X	X	X	X
16	Solid Waste Services for the IC&I Sector	X	X	X	X	X	X	X	X
17	Impacts of Energy Costs on the Waste Management System	X	X	X	X	X	X	X	X
18	Impacts of Intensification	X	X	X	X	X	X	X	X
19	Impacts of a Changing Waste Stream	X	X	X	X	X	X	X	X

4.1 Public Education and Engagement

Overview:

Toronto's cultural diversity presents a challenge in delivering a solid waste management public communications campaign and in engaging all residents to the greatest extent possible. In these challenges, targeting single family residential and multi-residential audiences and all other customers can require different approaches, although the goal of improving waste management system performance is the same.

Solid Waste Management Services Division (SWMS) spends approximately $1.00 per resident on waste related communications activities annually. A variety of tactics are used including various media (social media, radio, website, Waste Wizard search tool, videos and other online resources) and printed resources (collection calendars, direct mail campaigns, advertisements). SWMS also utilizes options for direct engagement through speaking engagements, community outreach, and other innovative programs such as the 3Rs Ambassador program and Community Environment Days.

Gap, Challenge and/or Opportunity:

A challenge facing the City is being able to reach out to a diverse community to educate its customers on program changes, good waste management practices, and where possible, how to better reduce and reuse.

The gaps, challenges and/or opportunities facing the City with respect to public education and engagement, include:

- Competition against other media and news outlets;
- Traditional public education campaigns (e.g. newspaper ads, radio, direct mail) have become competitive with increased use of online media sources and social media;
- Ensuring a balance between education and engagement resources for communication with residents who prefer traditional media sources and those who prefer online resources;
- Resourcing to maintain an active and engaging online social media presence;
- Accommodating cultural diversity through the delivery of educational materials in other languages;
- Continual education and engagement efforts as multi-residential buildings can have high turnover rates of residents and building management/staff;
- Difficulty measuring the effectiveness of public education and engagement campaigns;
- Competing with other City divisions when reaching out to the public – working as one organization and having other departments be advocates for all divisions;
- Development of tools and policies to support behavioural change and encourage participation in programs; and,
- Issue fatigue.

The City also faces challenges with the lack of customer awareness on the complexity of the City's waste management system and sometimes simplified understanding of waste related

issues. For example:

- Consumers may not understand the impact of their purchases and how those purchases are managed in the waste system.
- What kind of influence can the City exert to encourage customers to purchase more sustainable products and fewer single-use convenience products that may not be as readily recycled?
- How can the City's complex solid waste management system be presented for better understanding and effect behavioural change?
- How to convey that, although recycling is good, reduction and reuse are even better.

Potential Options to Address Gap, Challenge and/or Opportunity:

Some options that could be considered include:

- Develop an interactive online and mobile waste management tool which can provide sorting information, collection schedules, changes/updates to the waste management program and opportunities for reuse, recycling and safe disposal;
- Develop an environmental impacts calculator (e.g.; an app for mobile phones or an online calculator that can provide consumer information on the life cycle impact of different products (e.g.; single use beverage pods);
- Additional resources dedicated to increasing the City's online presence through social media;
- Collaborate with college/university programs to develop new and innovative outreach programs;
- Leveraging Live Green Toronto resources to further extend messaging and program communications
- Mobilize 3Rs Ambassador Hubs and facilitate community networks to collaborate on outreach opportunities
- Recognition/ incentive programs to encourage participation and establish community leaders (e.g.; City of Hamilton Gold Box Program, Green Schools Program) for both the residential and non-residential sectors;
- Further develop programs geared to schools and educating youth along with school boards and their educational curriculum;
- Improve enforcement of current by-laws and policies;
- Develop a targeted communications strategy to provide direction and focus for marketing, communications, outreach and education activities specifically related to the final Waste Strategy and current programs/ services, and continue to update it;
- Further explore opportunities for integrating the approach for communications and customer service across multiple service channels; and,
- Develop a community partnerships unit within the SWMS division to coordinate and liaise with other organizations for volunteer efforts, events, etc.

4.2 Enhanced Enforcement Opportunities

Overview:

The City has enacted a number of by-laws that pertain to solid waste matters, namely Toronto Municipal Code Chapters 441, 442, 548, 604, 629, 841, 844, and 846, which may be used in situations where outreach, education and engagement have not been successful.

The City's Municipal Licensing & Standards Division (ML&S) collaborates with SWMS to resolve by-law infractions where required. To a large extent, investigations into by-law infractions are complaint driven (especially for residential issues), however, ML&S may discover infractions by the commercial sector while out on duty (e.g. illegal dumping). Violations of the various City by-laws that pertain to solid waste matters can lead to prosecution by the City pursuant to the *Ontario Provincial Offenses Act* for set fines or other outcomes.

As part of the development of the Waste Strategy, a number of options related to greater diversion of residential waste (including single family and multi-residential) and non-residential waste (including Industrial, Commercial and Institutional (IC&I) and Construction, Renovation and Demolition (CRD) waste) will be considered. Successful implementation of these initiatives and increasing waste diversion will be in part contingent on enforcement of the corresponding by-laws and policies.

Gap, Challenge and/or Opportunity:

A challenge for the City is to maximize the effective and efficient use of its current programs, services and facilities. To date, significant effort and success has been realized through promotion and education;, however, there are still areas of the system where voluntary compliance is not at the desired level, requiring strategic consideration of mandatory measures. The gaps, challenges and/or opportunities facing the City with respect to enhancing enforcement opportunities include:

- Enforcement staff are part of City's ML&S Division and are not part of SWMS;
- The impacts of intensification (i.e. increased urban density) and the changes required to manage additional waste generated by housing units with typically lower waste diversion performance records and in areas that are more difficult to collect using traditional methods;
- Identifying a legally permissible mechanism to require greater waste diversion from the IC&I and CRD sector for waste materials being generated within the City of Toronto;
- How to better promote and facilitate the reduction and reuse of waste materials to prevent waste from entering the system and requiring management through collection, processing and/or disposal;
- Resources required to enforce existing City waste by-laws (i.e. number of staff);
- Diversity of City customers (i.e. language barriers), particularly in multi-residential buildings (further discussed in Section 4.6);
- High turnover of tenants and building managers/staff in multi-residential buildings; and,
- Different service providers for collection of IC&I and multi-residential waste.

Potential Options to Address Gap, Challenge and/or Opportunity:

Some options that could be considered include:

- Greater emphasis on reduction and reuse to prevent materials from entering waste stream;
- Enhanced promotion and education for City customers to increase awareness of City programs;
- Increasing enforcement efforts of existing applicable waste diversion by-laws and/or enacting new, legally permissible by-laws to mandate City-wide waste diversion requirements (Blue Bin materials and Green Bin organics service, etc.) to all multi-residential buildings including buildings that receive private collection;
- More effective enforcement of existing City by-laws that apply to multi-residential customers and/or exploring joint enforcement efforts with the Province regarding O. Reg. 103/94 requirements;
- Exploring whether and how greater waste reduction and diversion might result from undertaking one or more of the following City-wide controls, where legally permissible: banning certain packaging and other material; mandating recycling separation and processing; imposing levies; implementing disposal bans (e.g. construction, renovation and demolition materials); and developing local Extended Producer Responsibility measures;
- Consideration of policies and legislation as well as providing economic incentives to drive construction, renovation and demolition (CRD) materials waste diversion in Toronto's CRD industry. These could include policies such as mandatory source separation and processing requirements and economic incentives (e.g. differential tipping fees, CRD debris deposit, requirement of proof of recycling to get occupancy permit etc.) to encourage greater reuse and recycling of CRD waste. This could be supplemented by a phased in disposal ban at City Transfer stations.
- Enacting new, legally permissible by-laws to;
    - mandate City-wide waste diversion requirements (Blue Bin materials and Green Bin organics service, etc.) for all IC&I establishments in the city for separate management and diversion through new by-laws, policies and enforcement to achieve IC&I waste diversion objectives; and,
    - require service providers to provide source separated recyclable and organics collection service and annual quantity reporting as a condition of licensing.

4.3 Waste Reduction and Reuse

Overview:

Reducing the amount of waste generated and reusing materials before they become waste have significant potential to reduce the overall burden on the waste management system in the future. These approaches essentially work to keep waste out of the system and therefore can have the beneficial impact of extending the life of assets like Green Lane Landfill, reducing waste collection and processing costs, as well as significant environmental benefits not only related to managing waste but throughout the lifecycle of a product. Reduction and reuse is present currently, however, recently there has been an increase in the introduction of more single-use, and "designed for disposal" products.

Gap, Challenge and/or Opportunity:

A challenge facing the City is how to better promote and facilitate the reduction and reuse of waste materials to prevent waste from entering the system and requiring management through collection, processing and/or disposal.

The gaps, challenges and/or opportunities associated with promoting and facilitating waste reduction and reuse, include:

- Public education and awareness of the importance of waste reduction and reuse;
- Availability and accessibility of current waste reuse opportunities;
- Material condition standards as it relates to waste reuse; and,
- Lack of municipal control over consumer purchasing habits, product packaging, etc.

Potential Options to Address Gap/Challenge and/or Opportunity:

Some options that could be considered to support additional waste reduction and reuse activities include:

- Textile collection and reuse strategy;
- Sharing libraries;
- Community composting sites;
- Support curbside/common area giveaway/events to enable residents to give away reusable items in good condition, structured to not contribute to litter;
- Facilitation of greater communication between similar non-profit organizations;
- Establish a waste exchange centre and/or partner with existing organizations that collect gently used materials; and,
- Establish a circular economy/waste reduction committee to inform on-going waste planning/implementation process.

4.4 Value of Food and Food Waste

Overview:

Canadians represent about 0.5% of the global population, produce about 1.5% of the food in the world, and consume about 0.6% of world food production[4]. According to some statistics, Canadians throw away approximately half of all food produced which is equivalent to throwing about $27 billion dollars into the trash[5]. In Toronto, single family residential and multi-residential households discard about 74 kilograms of food waste each year in the garbage[6].

Based on the statistics above, it is clear that a significant opportunity exists for the City of Toronto to reduce the amount of food waste going to landfill either by a) reducing the amount of food waste generated at source; and/or, b) capturing additional food waste through the Green Bin organics (or other recovery options) program.

Recognizing that the City's Green Bin organics stream includes materials other than just food waste, as is common in many other municipalities, there are significant quantities of organic material that could be diverted from landfill. The table below presents the percentage of Green Bin organics in single family[7] and multi-residential[8] garbage and Blue Bins based on waste audits. There are approximately 59,000 tonnes of Green Bin organics potentially available in single family garbage and Blue Bins. As well there are approximately 122,000 tonnes of Green Bin organics available in multi-residential garbage and Blue Bins. In total, an additional 181,000 tonnes of Green Bin organics are potentially available for diversion in the City's waste stream.

Table 4-2: Tonnes of Green Bin Organics Potentially Available

	% Green Bin Organics in Garbage	Garbage Collected (2013) (tonnes)	Green Bin Organics Potentially Available (tonnes)	% Green Bin Organics in Blue Bin Materials	Blue Bin Materials Collected (2013) (tonnes)	Green Bin Organics Potentially Available (tonnes)	Total Green Bin Organics Potentially Available (tonnes)
Single Family	38%	137,154	52,118	5%	140,171	7,009	59,127
Multi-residential	55%	212,552	116,904	8%	63,361	5,069	121,973
Total		350,066	169,022			12,078	181,100

As of 2014, the City diverted 138,340 tonnes of Green Bin organics from single family, multi-residential and commercial sources. Significant resources (e.g. labour, budget etc.) are spent on

[4] http://www.statcan.gc.ca/pub/16-201-x/2009000/part-partie1-eng.htm

[5] http://www.thestar.com/life/food_wine/2011/01/14/food_waste_an_unappetizing_27b_problem.html

[6] Food waste comprised approximately 24% of garbage in single family waste and 28% of garbage in multi-residential waste. Source: City of Toronto 2012/2013 Single Family Audits and 2014 Multi-residential Waste Audits.

[7] 2010-2013 Single family waste audit

[8] 2010-2011 Multi-residential waste audit

collection and processing of Green Bin organics; however, diversion of this material reduces the generation of greenhouse gases through methane generation in landfills and by avoided transportation impacts to Green Lane Landfill. As presented in Table 4-2, there remains a significant amount of Green Bin organics in the garbage which may produce Greenhouse Gas emissions through the generation of methane and through transportation of this material to landfill. The Waste Strategy will identify options to address food wastage and diversion of additional material through the Green Bin program.

Gap, Challenge and/or Opportunity:

A challenge facing the City is the need to 1) decrease the amount of food that is being wasted, and 2) increase the amount of food waste that is being captured for diversion.

The gaps, challenges and/or opportunities associated with reducing food waste, include:

- Measuring food waste and food waste reduction;
- Lack of knowledge about where food waste occurs;
    - Household
    - Retail
    - Workplace
    - Food Service/Restaurants
- Lack of education/knowledge/awareness of food waste and its financial and environmental impact;
- Opportunity to educate residents how to avoid food waste;
- Public perception that cosmetic appearance of food relates to quality or nutritional value leads increased food waste;
- Potential for increased participation in the Green Bin organics program, specifically in multi-residential buildings; and,
- Opportunity to highlight environmental benefits, including in particular, greenhouse gas (GHG) emissions from landfill that can be reduced.

Potential Options to Address Gap, Challenge and/or Opportunity:

Some options that could be considered include:

- Quantify the amount and type of food waste, as well as where the majority of food is wasted by conducting food waste audits and surveys to help identify the types of food being waste and where and why food is being wasted;
- Outreach and education;
- Organic material disposal bans;
- Greater enforcement;
- Establish a food waste reduction strategy; and,
- Alternative processing technologies.

4.5 Performance Measures

Overview:

The City of Toronto has set an aggressive target of 70% diversion of residential waste from landfill, however to date has only been able to reach a combined total of 53% (66% in single family residential, 26% in multi-residential). In support of this, the City has an extensive system of measurement, monitoring and data collection pertaining to the solid waste management services it provides. Analysis of the data assists the City with the on-going assessment of the performance of aspects of its solid waste management services[9] and guides important decision-making on program and/or system changes.

Currently, Ontario municipalities (including the City of Toronto) are highly focused on achievement of waste diversion (defined by Waste Diversion Ontario (WDO): diversion = mass of waste diverted ÷ mass of waste generated[10]) as the primary metric to judge the performance and future direction of their waste management systems.

$$\text{Residential Waste Diversion Rate} = \frac{\text{Tonnes Diverted}}{\text{Tonnes Diverted + Tonnes Disposed}} \text{ X } 100$$

Current regulations and financial incentives drive this focus. Historically, this approach has been successful at increasing municipal residential diversion rates in Ontario from values in the range of 0% to 30% at the outset of the Blue Box programs in the 1980s, to current rates ranging from 2.3% to 69.2% (2013)[11]. This is an impressive achievement, particularly considering the population and economic growth that occurred during the same time frame.

In recent years, there has been a growing recognition that the WDO and other performance measures' definition of diversion, while an important and useful tool, do not necessarily provide a comprehensive or holistic measure of what might be defined as “the big picture” of success in solid waste management.

[9] Performance Measurement and Benchmarking Reports; Collections and Operations Reports; WDO Datacall; Waste audits; Municipal Performance Measurement Program; and, Ontario Municipal CAO’s Benchmarking Initiative; OMBI; Global City Indicators

[10] http://www.wdo.ca/files/8413/9040/6230/Datacall_Diversion_Rates_2012.pdf

[11] 2013 Ontario Residential Waste Diversion Rates. www.wdo.ca

Gap, Challenge and/or Opportunity:

A challenge facing the City is having a group of performance metrics that will more accurately measure waste management system performance and account for changing waste streams, composition, community demographics, etc.

The gaps, challenges/opportunities facing the City with respect to performance measures and monitoring, include:

- The City's 70% diversion target has not been achieved. This target needs to be reviewed;
- Manufacturers of packaging and products are moving to achieve efficiencies by reducing the weight of their products and changing the materials they utilize; this means that while the volume and number of pieces of waste materials continues to grow in pace with consumer market demands, the weight of many of those items is declining which is problematic for a system whose performance is largely measured by tonnes diverted;
- Differences in how diversion is calculated between the City, Waste Diversion Ontario, and other organizations and/or municipalities;
- Shifting roles and responsibilities that municipalities and producers have historically had in delivering waste management services to consumers;
- Emerging technologies which seek to capture valuable materials, by-products and energy from our garbage; this is contributing to a growing recognition of the inherent resource value contained in the materials our society has historically defined as waste;
- High priorities are placed on protection of the environment (such as greenhouse gas emissions and climate change implications), ecology, human health and social values to avoid burdening future generations with our problems;
- Ever changing nature of waste: for example more online shopping contributes to more corrugated cardboard; more online readers contribute to fewer newspapers, etc;
- Anticipated new legislation (for example, under the Province's new *Waste-Free Ontario Act,* the City may have the option to leave collection of Blue Bin materials to producers who will be obligated under the legislation when printed paper and packaging regulations are promulgated);
- Reduce and reuse tactics/achievements are not captured in the current weight-based metric; and,
- Capturing other metrics such as collection service requests or complaints, health and safety record, etc.

It is against this backdrop that waste managers everywhere are striving to continue to achieve system performance improvements, meet service delivery expectations and deal with the increasing costs for more sustainable waste management approaches.

Potential Options to Address Gap, Challenge and/or Opportunity:

Some options that could be considered include:

- Review and confirm or replace the 70% diversion target with consideration of refining the current performance measurement metrics for the solid waste management system to

align with the environmental, social and financial pillars of sustainability as well as the waste management hierarchy;

- Review and update where applicable the performance criteria and objective metrics applicable to the City's solid waste management system, within the categories of environment, social and financial; any changes and/or additional performance assessment measures should be integrated with those currently being utilized by the City; and,
- Build upon existing performance metrics to develop a full suite of key criteria and metrics to reflect the City's priorities. The metrics for each criterion would be measured and calculated for the entire City's waste management system with appropriate targets being set to measure success. Appropriate target setting for metrics needs to take into account the degree to which the City can control or influence the outcomes embedded in the criteria.

4.6 Multi-Residential Waste Diversion

Overview:

Diversion (both Blue Bin materials and Green Bin organics) in multi-residential buildings is well less than half of the diversion achieved by single-family households because of a combination of technical, processing, contamination, participation, communications and competitive challenges that are all well known to the City. Multi-residential buildings already represent over 50% of the total households in the City and will continue to grow more quickly than single family homes into the future. A flexible, innovative and cost effective approach to this issue is greatly needed.

Gap, Challenge and/or Opportunity:

A challenge facing the City is the need for increased waste diversion in the multi-residential sector to support its diversion goals, and reduce the amount of material currently being landfilled.

The gaps, challenges/opportunities facing the City with respect to multi-residential waste diversion, include:

- High turnover of tenants and building managers/staff;
- Difficulty in educating tenants directly;
- Contamination of material;
- Lack of participation;
- Anonymity;
- Enforcement in non-City serviced buildings to ensure they participate in the same diversion programs;
- Language and cultural barriers for new residents to effectively communicate program requirements;
- Increased density and serviceability;
- Guarantee of future waste supply (i.e. opting out of City services);
- Loss of funding (through loss of buildings to private collection haulers); and,
- Enforcement of development standards during planning and application process.

Potential Options to Address Gap, Challenge and/or Opportunity:

Some options that could be considered include:

- On-site organics processing technologies at multi-residential buildings (including in-sink technologies);
- Implement by-laws to support common waste diversion requirements regardless of collection service provider;
- Increase (multi-lingual and multi-media) communications;
- Performance based financial incentives for landlords and building managers or building management companies to increase diversion levels, such as fees based on diversion performance;
- Modern technology for more efficient container management such as live tracking of container volumes to indicate when container is full;

- Alternative technologies for source separation (e.g. coloured bags) to increase convenience for participants;
- Increase enforcement resources and powers for existing infrastructure (in City and non-City serviced buildings);
- Expand on-site workshops/seminars/outreach to building managers to improve participation, recovery and reduce contamination (>25% for multi- residential Green Bin organics programs);
- Support expanded drop–off and re-use options for multi- residential residents;
- Multi-residential workshops and outreach for non-City serviced buildings;
- Identify the implications of increased numbers of multi- residential buildings leaving the City system (overlap with financing tasks – Section 4.15);
- Improve customer database management (central data repository for activity logs/actions taken against buildings);
- Implement options that do not require participation of residents and management (e.g. processing mixed waste (with or without recyclables or organics removed at source) (see Section 4.11 and 4.12));
- Discontinue provision of multi-residential waste collection services;
- Use smaller collection vehicles to collect waste; and,
- Review and revise where appropriate, the multi-residential development standards and introduce new requirements that are being implemented in other jurisdictions such as common area drop-off depot requirements, flexible space requirements to allow for the addition of future programs, etc.

4.7 Future Role of and Need for Drop-off Facilities

Overview:

The City has public Drop-off facilities located at all seven transfer stations (TS) accepting a variety of materials including divertible material and residual waste from the residential and non-residential sectors. The City also provides curbside or scheduled (e.g. Household Hazardous Waste) collection of many of the materials accepted at Drop-off facilities (Household Hazardous Waste (HHW), Waste Electronics and Electrical Equipment (WEEE), bulky, white goods, and scrap metal) which provides a convenient option for residents who may not be able to access the Drop-off facilities. The following provides a table of acceptable materials by Drop-off facilities location:

Material	Bermondsey	Commissioners	Disco	Dufferin	Ingram	Scarborough	Victoria
Garbage	✓	✓	✓	✓	✓	✓	✓
HHW	✓	✓	✓		✓	✓	✓
WEEE	✓	✓	✓		✓	✓	✓
Yard Waste	✓	✓	✓	✓	✓	✓	✓
Blue Bin materials	✓	✓[1]	✓		✓	✓	✓
Drywall (up to one tonne)	✓	✓			✓		
Tires (up to 5)	✓	✓		✓	✓		
Scrap metal	✓	✓			✓		

[1] Residential Drop-off only

The future role of Drop-off facilities in the context of the development of the Waste Strategy needs to be addressed to ensure facilities are:

- Meeting their intended purpose in the future;
- Accessible to a changing demographic and urban form; and,
- Not competing with other City and or not-for-profit options to manage the same materials.

Gap, Challenge and/or Opportunity:

A challenge facing the City is to provide its customers with convenient options which promote greater diversion and are flexible to accommodate changing waste streams and resident accessibility.

The gaps, challenges and/or opportunities facing the City with respect to Drop-off facilities, include:

- Providing flexibility to accept different waste materials in the future as waste streams change over time;
- Moving away from a car-centric model (where appropriate) as the urban form continues to move towards greater emphasis on public transit;

- Minimizing overlap with current curbside services which are already a more convenient option; and,
- Promoting greater safety at existing Transfer Stations by separating residential traffic from curbside truck traffic and/or prioritizing transfer station use.

Potential Options to Address Gap, Challenge and/or Opportunity:

Some options that could be considered include:

- Implement alternative service delivery models, such as those used in other jurisdictions that could include scheduled stops in neighbourhoods, kiosks to accept small quantities of certain wastes or the creation of a network of smaller Drop-off facilities located throughout the City utilizing high traffic areas;
- Evaluate the type of materials collected curbside since residents have alternate ways to dispose of some materials (e.g. HHW, WEEE), and metal items which are usually collected privately (in some cases through scavenging activities at the curbside); currently the City is competing for materials;
- Assess hours for drop-off, traffic, queuing, number of vehicles accessing Drop-off facilities on a daily basis, peak times, signage, targeted promotion and education campaign, quantities and composition of materials collected;
- Develop, implement and operate a network of large scale, one-stop drop-off and reuse centres (i.e. like a Community Recycling Centre or Community Environmental Centre);
- Promote greater use of Toxic Taxi;
- Incentives (financial or other including such things as reverse vending machines);
- Partnerships/collaboration with not-for-profits to collect/manage materials;
- Review and revise where appropriate, the multi-residential development standards and introduce new requirements such as common area drop-off depot requirements, flexible space requirements to allow for the addition of future programs, etc.;
- Develop, implement and operate a network of permanent, small scale neighbourhood waste diversion stations at convenient locations; and,
- Develop a mobile drop-off service for targeted divertible materials such as resetting the framework for environment days or to provide accessible service for persons with disabilities or seniors.

4.8 Commissioners Street Transfer Station

Overview:

Commissioners Street Transfer Station (TS) is one of seven transfer station facilities owned by the City. It handles a smaller volume of waste (just over 71,000 tonnes in 2013) compared to the other transfer stations but is strategically located near the densely populated downtown core. Commissioners TS manages approximately 7% of the total tonnes of waste managed at all Toronto's transfer stations, predominantly generated by the multi-residential sector located in the downtown core. Residential and small commercial waste is also accepted at this transfer station, typically consisting of construction and demolition (C&D) or renovation waste. For the purposes of waste transfer, only garbage from curbside collection vehicles is accepted at Commissioners TS. Blue Bin materials and, Green Bin organics are not accepted from curbside collection vehicles at the TS. Additionally, materials such as yard waste, tires, drywall, recyclables, scrap metal and HHW delivered by residents are collected here. The Commissioners TS weigh scales are also utilized for the weighing of all materials destined for the Durable Goods Processing Facility.

The facility is located on the site of a now closed incinerator which was operated from the 1950s until the late 1980s. Because of this, the layout of the transfer station presents some operational challenges; there is no drive-through lane for drop-off of residential HHW, vehicles exiting to the street after unloading on the tip floor must drive offsite and back around to the entrance to weigh out, and private and curbside collection vehicles cross paths due to a lack of segregated tipping areas for private and commercial vehicles.

The City is currently undertaking a major planning study for the Port Lands area where the Commissioners TS is located. A transfer station may not be compatible with the future plans for the area due to the potential for nuisance impacts such as odour, vermin, noise and truck traffic in a mixed use or residential area. As part of this ongoing planning process, it has been preliminarily determined that the optimum scenario for the proposed Film Studio District would be to relocate Commissioners TS. It was suggested that the facility could be retrofitted; however, that plan is hampered by the fact that it is a heritage building and even with modifications, is still unlikely to fit into the plans for the area.

Gap, Challenge and/or Opportunity:

A challenge facing the City is the decision needed about the future of the Commissioners TS; whether it should be relocated or closed. If the facility is relocated, there are options to construct a new facility that may or may not include a residential drop-off facility. If the facility is closed, the City will need to decide how the current services available at the Commissioners TS will be replaced.

The gaps, challenges and/or opportunities facing the City with respect to the relocation or closure of Commissioners TS, include:

- Requirement for transfer capacity of waste collected from downtown core and future expanded Port Lands area;

- Requirement for a transfer station in the vicinity of the downtown core/Port Lands area with increasing intensification for basic infrastructure needs;
- Accessibility of Drop-off facilities for residents in the downtown core and developed Port Lands area;
- Identification of a compatible site within a suitable hauling distance and associated permitting and approvals processes;
- Routing of collection vehicles from the downtown core and Port Lands area to other transfer facilities and associated issues with traffic congestion, wear and tear on roads etc., if Commissioners TS was to close; and,
- Ability of other transfer stations to manage additional traffic and tonnages, if Commissioners TS was to close.

Potential Options to Address Gap, Challenge and/or Opportunity:

Some options that could be considered include:

- Relocate transfer station within the Port Lands area, either in the short to mid term or designation of land for long-term relocation;
- Develop a Drop-off facility for residents on the existing site or within the Port Lands area and find alternatives for the curbside waste collection vehicles;
- Redirect waste to an existing transfer station(s) (e.g. Ingram or Bermondsey) which will require the facility(ies) to be updated/expanded; and,
- Procure transfer capacity at a private transfer station in vicinity of the Port Lands area (if available).

4.9 Dufferin Waste Management Facility

Overview:

The Dufferin Waste Management Facility (WMF) consists of a transfer station; a Materials Recovery Facility (MRF) which closed in November 2014; an organics processing facility (anaerobic digester) which is currently closed and slated for expansion; and, a Drop-off facility for yard waste, tires and scrap metal.

Transfer Station: In 2013, the Dufferin transfer station managed just over 67,000 tonnes of waste (approximately 7% of the waste managed at the City's transfer stations[12]), predominantly waste collected by the City and City-contracted service providers.

Material Recycling Facility: In 2014, the City awarded a contract to Canada Fibres Ltd. (CFL) for processing the remainder of the Blue Bin materials that was previously processed at the Dufferin MRF. These materials will be sent to CFL's Arrow Road facility for processing instead. As a result of the commencement of that contract in November 2014, there are now potential alternative options for the closed Dufferin MRF facility.

Organics Facility: The Dufferin Anaerobic Digestion (AD) organics processing facility was commissioned in 2002, making Toronto the only city in North America at the time to use AD technology (with the potential to produce biogas and green energy) for processing Green Bin organics. Originally designed as a pilot project, with a capacity of 25,000 tonnes/year, the Dufferin facility had a number of improvements over the years and is currently decommissioned. It will be expanded to receive 55,000 tonnes/year of the City's Green Bin organics.

Gap, Challenge and/or Opportunity:

The City has a MRF that closed in November 2014 with no current long-term plan for its future use. A challenge facing the City is to examine the function and role of the entire Dufferin WMF to identify future roles within the City's integrated solid waste management system.

The gaps, challenges and/or opportunities facing the City with respect to the future role of the Dufferin WMF, include:

- The MRF is now inactive but still contains processing equipment which could potentially be used as part of an alternative processing technology;
- Transfer station capacity is still required in that area of the City, and may be required to manage additional waste if Commissioners St. transfer station closes; and,
- The remaining infrastructure (e.g. transfer station, AD facility, administrative offices) is still required as part of the City's waste management services.

Potential Options to Address Gap, Challenge and/or Opportunity:

Some options that could be considered include:

[12] Information provided by the City of Toronto (2013 tonnages managed at Transfer Station by Transaction Type)

- Convert the MRF to a "mixed waste facility" to process waste:
    - predominantly from the multi-residential sector (note that greater control over this waste stream would be required to support this option); or, from the entire residential sector.
- Decommission the MRF and use the space for other SWMS functions (e.g. a new processing facility; a new Drop-off facility; or, other SWMS functions (e.g. collection yard, Durable Goods processing facility).

4.10 Future Waste Processing Capacity

Overview:

Over the 30 to 50 year planning period, new facilities will be required to replace the facilities currently operated/utilized by the City. The timing of when these new facilities and/or contracted capacities will be required will be determined as part of the Waste Strategy development process.

Gap/Challenge and/or Opportunity:

A challenge facing the City is to maximize the use of its facilities and infrastructure, in particular waste processing capacity, and maintain sufficient capacity in the system to address its future demands.

The gaps/challenges and/or opportunities associated with future waste processing capacity include:

- Additional Blue Bin processing capacity will be required as the quantity of Blue Bin material collected for processing increases;
- Additional Green Bin processing capacity will be required as the quantity of organics material collected for processing increases;
- Additional processing capacity will be required as new materials are added, or existing programs are expanded;
- The impact of the proposed *Waste-Free Ontario Act* makes it difficult to determine future processing capacity, particularly for Blue Bin materials; and,
- The proposed development of the Port Lands area may impact the City's future ability to maintain the Durable Goods Processing Facility located on Cherry Street.

Potential Options to Address Gap, Challenge and/or Opportunity:

Some options that will need to be considered include:

- Future Blue Bin materials processing capacity;
- Future Green Bin organics processing capacity; and,
- Future durable goods processing capacity.

4.11 Waste Recovery Technologies

Overview:

In order to extend the life of Green Lane Landfill (GLL), the City could consider alternative processing technologies to reduce the amount of residual waste requiring disposal. Some of these processing technologies could be geared toward waste generated by certain sectors, such as multi-residential waste, which still contains a significant quantity of divertible material. One option for multi-residential waste has been discussed in Section 10; a mixed waste processing facility to remove certain recyclables and organic material from residual waste prior to disposal.

Alternative waste processing technologies can extend the life of GLL, produce energy, heat, biogas, fuel and/or other outputs, recover additional materials (e.g. recyclables, metals) from the waste stream and may have the ability to process other currently not divertible materials (e.g. carpet) depending on the technology. The requirement for additional waste recovery facilities will be evaluated as the recommended options for the Waste Strategy are implemented and additional diversion achieved.

Gap, Challenge and/or Opportunity:

A challenge the City is facing is diminishing landfill disposal capacity. Alternative processing technologies could divert additional materials from disposal and extend the life of Green Lane Landfill.

The gaps, challenges and/or opportunities associated with alternative processing technologies, include:

- Public resistance to new or expanded waste processing facilities;
- Proven performance/reliability;
- Diminished social responsibility as the onus on the generator to take responsibility for waste is reduced/removed through mechanical processing;
- Capital and operating costs (including a long-term sustainable rate model);
- Facility siting if required;
- Timing associated with permitting/approvals;
- Ability to reduce GHG emissions and potentially their potential value in a future carbon market.
- End-use of output from technologies (e.g. compost from Mechanical Biological Treatment (MBT) or Mixed Waste Processing); and,
- Continued need for final residuals disposal for a certain portion of waste stream.

Potential Options to Address Gap, Challenge and/or Opportunity:

Some options that could be considered include:

- Other waste processing technologies which would divert additional material from disposal, for example:
    - Mixed waste processing, with or without organics recovery;

- Direct combustion;
- Gasification (conventional);
- Hydrolysis;
- Organics Recycling Biocell or Landfill Biomodule;
- Plasma Arc Gasification;
- Pyrolysis;
- Refuse Derived Fuel (RDF) production;
- Thermal and catalytic depolymerisation; and,
- Waste to liquid fuel.

4.12 Residual Waste Disposal Capacity

Overview:

Residual waste is currently disposed of at the City-owned Green Lane Landfill (GLL) located near London, Ontario (approximately 200 km from downtown Toronto). In 2014, the City disposed of 603,795 tonnes of residual waste of which 490,961 tonnes was received at GLL. The remaining tonnes were diverted to three Ontario-based landfill sites with which the City has contracts. Approximately 87% of the waste landfilled in 2014 originated from City of Toronto transfer stations (the remaining waste originated from Toronto's municipal sewage treatment plants, street sweepings, paid public and private customers and other municipalities). Assuming the same total annual air space required based on this total tonnage in future years, it is estimated that GLL has approximately 14 to 19 years of capacity remaining.

Gap, Challenge and/or Opportunity:

A challenge facing the City is to extend the life of Green Lane Landfill and find new waste disposal options to cover the disposal needs for the 30 to 50 year planning period of the Waste Strategy.

- The gaps, challenges and/or opportunities associated with extending the life of Green Lane landfill and finding new waste disposal options, include:
- Public resistance to new or expanded landfills;
- Lack of sufficient capacity in public/private landfills in Ontario;
- Restrictions and risks associated with solid waste disposal in the United States;
- Current contractual commitments to supply a minimum amount of waste each year;
- Provision of long-term financial predictability with respect to solid waste disposal;
- Facility siting;
- Timing associated with permitting/approvals; and,
- Cost.

Potential Options to Address Gap, Challenge and/or Opportunity:

Some options that could be considered to extend the life of Green Lane landfill include:

- Optimize and/or enhance GLL;
    - Expand vertically and/or horizontally in the existing footprint and on separate landforms.
    - Mine a portion of the existing landfill.
    - Install a bio-reactor in the expanded landfill area to increase the rate of decomposition.
    - Install a high-rate bioreactor in a dedicated cell to handle residual waste specifically from the multi-residential sector which typically has higher organic content.
- Redirect residual waste to other processing and/or disposal facilities for:
    - Preserving disposal capacity at GLL and/or;

    - Managing residual waste once GLL has reached its approved disposal capacity.
- Minimize materials being landfilled to expand existing landfill site life through tools such as materials bans;
- Mine other closed landfills owned by the City to recover additional resources and reclaim land;
- Develop a Greenfield Landfill;
- Utilize alternative waste processing technologies to minimize volume (e.g. Mixed Waste Processing, Energy from Waste, etc.); and,
- Acquire another landfill site in Ontario.

4.13 Solid Waste Services for the Construction, Renovation & Demolition Sector

Overview

The City provides limited waste management services for Construction, Renovation & Demolition (CRD) materials. Typically these waste materials are managed by the private sector outside of the City of Toronto waste management system:

It is estimated that there are approximately 360,000 tonnes of CRD waste generated annually within the City of Toronto. In 2014, Toronto diverted 2,733 tonnes of scrap metal from paid private loads at its depots and curbside collection programs[13]. Currently, the City diverts limited quantities of drywall (less than 1 tonne per customer permitted) and scrap metal at three of its seven transfer stations for a fee. The City accepts other CRD waste from smaller renovation companies for a fee at transfer stations but it is treated as garbage.

The current barrier to higher CRD diversion is that markets cannot be found for many dropped off materials (e.g. asphalt shingles are dropped off with nails and wood attached; however, markets want clean asphalt, etc.).

The City has developed the Toronto Green Development Standard for public and private construction projects. These standards set requirements for Tier 1 (mandatory) and Tier 2 (voluntary) performance measures. There are no CRD waste diversion requirements under Tier 1 and 75% diversion under Tier 2.

Although the City is not obligated or mandated to provide waste management services to the CRD sector, a portion of the waste stream generated by these sectors could potentially require management by the City under certain circumstances.

Provision of services for the CRD sector, particularly for home renovators and small/medium enterprises who have limited access to diversion opportunities, will assist with diversion of CRD materials, boosting existing CRD recycling markets and encouraging the development of new markets for materials.

Gap, Challenge and/or Opportunity:

A challenge facing the City is to address residential renovation waste and provide its renovator customers with convenient options which promote greater diversion and are flexible to accommodate changing waste streams and accessibility.

An additional challenge facing the City is how to better promote and facilitate diversion of CRD materials generated by the CRD sector, which comprises a significant amount of the total waste stream generated in the City.

[13] Technical Memorandum No. 1.

The gaps, challenges and/or opportunities facing the City with respect to provision of services to the CRD sector include:

- The City demonstrates leadership in helping the renovation industry and do-it-yourself (DIY) home renovators address diversion;
- The City helps a sector that does not currently have easy access to diversion opportunities;
- Under the proposed *Waste-Free Ontario Act*, the Province may impose provincial disposal bans on many CRD materials over time. This will have a number of consequences for the management of CRD waste by generators, who may be more interested in source separating and dropping off waste loads at City drop-offs;
- The Province may also require municipalities to implement a range of policies targeting various materials including CRD wastes. The details will not be known until draft regulations are released for comment which are not expected until after 2017;
- Need to determine availability and stability of markets for processed CRD materials, and plan for market volatility and periods of low demand for the materials produced;
- Potential opportunities to develop local jobs and green economy with policies that drive diversion;
- An education/outreach program will be needed to notify CRD industry and small renovation companies of policies as well as opportunities at City transfer stations;
- Need to determine availability and stability of markets for the materials targeted in a disposal ban as well as to establish that suitable CRD waste processing capacity exists within the GTA or within a reasonable distance from the GTA for targeted banned materials;
- Additional enforcement will be required; and,
- Mandatory diversion policies may increase the potential for illegal dumping.

Potential Options to Address Gap, Challenge and/or Opportunity:

Some options that could be considered include:

- Establishing Drop-Off Depots for CRD Waste (mixed and source separated) at City transfer stations;
- Constructing or purchasing a CRD Waste Processing Facility to process CRD wastes for end markets;
- Implementing policies such as mandatory separation and economic incentives for developers and CRD companies (e.g. deposit/return programs to encourage CRD waste recycling) to encourage CRD waste generators to bring their materials to the drop-offs and processing facility; and,
- A phased-in disposal ban on CRD materials at City transfer stations ensuring that well established and stable markets are available for the diverted materials.

4.14 Regulatory, Control and Role/Responsibility Challenges

Overview:

The City provides collection, processing and disposal of waste generated by the single family residential sector within the City and offers (although not legally required to) waste management services to multi-residential and other non-residential sectors. All of the City's customers, including single family residents, have the ability to opt out of City-provided services and utilize a private service provider. The City has more control over collection, processing and disposal of waste generated by its single family residential customers as it is unlikely that they would receive service from the private sector.

The City faces uncertainty in terms of impending legislative changes and changes to packaging and materials requiring management with the announcement of the proposed *Waste-Free Ontario Act*. The City, along with other municipalities in Ontario, have limited control over the materials they must manage and are charged with both the management of these materials as well as developing mechanisms to drive behavioural change to divert material from disposal. There are options for the City to assume different roles in the future management of waste; in terms of how and what materials are managed, for whom they manage waste, and the manner in which the waste is managed (i.e. consistent waste diversion programs regardless of service provider).

Gap, Challenge and/or Opportunity:

A challenge facing the City is having a system where some waste management responsibilities are outside of the City's control and therefore subject to uncertainty and risk with respect to external parties making changes that can impact the City's system.

The gaps, challenges and/or opportunities facing the City with regulatory control and role/responsibility challenges, include:

- The City's role in Reduction/Reuse;
- Lack of a mandatory recycling by-law regardless of waste collection service provider;
- Provision of waste management services to multi-residential buildings and non-residential sectors by the City even though they are not required to;
- A need to ensure the long-term sustainability of the facilities the City is investing in (capital investments) and the ability to ensure flow of material to those facilities;
- Non-City customers may not consider the benefit of provision of Blue Bin materials and Green Bin organics collection as part of the decision making process when comparing prices for garbage collection;
- Social and political perceptions of the City assuming responsibility for sorting waste from multi-residential buildings; there would be a reduced onus on the generator to do sorting and less awareness of waste generation, however higher diversion rates could be achieved; and,
- Ability of the City to assume responsibility for managing a greater portion of its waste within its own footprint.

4.15 Waste Financing System

Overview:

Toronto's waste management system costs approximately $354 million/year (based on 2014 Approved Budget). This budget is financed by three main sources of income: volume based user fees (76%); tipping and processing fees and recyclables revenue (14%); and stewardship fees paid by industry (5%).

In 2008, a volume based rate structure was implemented which replaced the previous property tax based structure (with some user fee provisions). The rate structure was intended to provide the funds required to pay for the programs and initiatives to achieve the City's 70% waste diversion goal and where possible, drive waste reduction and diversion. At the same time, a rebate system was implemented due to the complexity of removing the solid waste management related costs from the property tax system. In 2010, a revised rate structure was implemented for multi-residential buildings to stem the loss of customers to the private sector.

The City needs to develop a financing system which provides adequate funding for current and future waste management programs. Not only is the marginal cost of diverting the next tonne of waste more expensive, but also as citizens strive to generate less waste, the per capita costs of disposal also rise, due to a reduction in economies of scale as smaller amounts of waste are disposed. The three key financing issues that need to be addressed in the Waste Strategy are:

- What will the future solid waste management system cost?
- Who pays these costs? and,
- How are the funds to be collected?

Gap, Challenge and/or Opportunity:

A challenge facing the City is the development of a new financing strategy that will allow the City to move toward greater waste diversion while balancing program sustainability and in support of the need for long-term infrastructure investments.

The gaps, challenges and/or opportunities associated with developing a revised solid waste management financing system in Toronto, include:

- Uncertainty around future sources of waste and revenues (e.g. multi-residential sector) with respect to future processing facility capacity and need;
- Impact of increased diversion and waste reduction on revenue currently generated through fees;
- Setting the price of tipping fees to achieve the correct balance between cost and revenue generation;
- Providing a deterrent to illegal dumping;
- Variable fuel costs and increased traffic congestion, which may lead to higher collection costs;
- Balancing operating and capital costs (vehicle replacement schedule) and service request/customer service levels;

- Unstable or unpredictable markets for some recovered materials which can impact revenues/costs from the sale of recovered recyclables;
- Need to offset higher cost of processing diverted materials (e.g., organics, recyclables)
- Procurement processes that limit innovation;
- Blue Box funding/legislation changes (i.e. proposed *Waste-Free Ontario Act*) and complex funding systems;
- Highly variable commodity prices for recyclables;
- Achieving a revenue/cost/environmental performance balance (i.e. cost vs. sustainability vs. social impact);
- Implementing changes or increases to the rate structure while retaining its customers;
- Legal issues related to a fully independent utility within the current City of Toronto structure;
- Provision of many services by SWMS that benefit the City as a whole (e.g. litter collection) currently funded through SWMS budget but could be funded through property taxes; and,
- Longer term viability of the current financing model where fees are placed on garbage only, although meant to cover costs for all streams.

Potential Options to Address Gap, Challenge and/or Opportunity:

Some options that could be considered for the future system financing include:

- Moving towards a fully independent waste utility with no rebate;
- Public-private partnerships for major capital works;
- Debt financing;
- Increases to the rate base/customer base;
- Examine services that are "City-wide" (e.g. litter bin collection, special events, etc.) provided by SWMS that could be transferred to the City and funded through alternative means (e.g. property taxes);
- Allocating costs for waste management to applicable waste streams; and,
- Alternative revenue generation options (e.g. building additional capacity into facilities and then selling the capacity to other public or private sector entities).

4.16 Solid Waste Services for the IC&I Sector

Overview:

The City of Toronto provides solid waste management services to a small portion of the Industrial, Commercial & Institutional (IC&I) sector including: businesses, offices, small commercial/retail stores, charities, religious organizations and other establishments. Services provided to the IC&I sector by the City include:

- Collection of waste materials (curbside or front end load);
- Receipt of waste materials at the City's transfer stations; and,
- Subsequent transferring, processing and disposal of the IC&I waste materials received above.

For the purposes of the Waste Strategy, IC&I waste does not include multi-residential waste although it is important to note that the Province of Ontario's definition of IC&I includes multi-residential buildings.

In 2013, the City's transfer stations received a total of 85,444 tonnes[14] of waste materials from IC&I and other private sector customers. IC&I and other private sector waste materials received at the City's transfer stations represent approximately 11% of all City managed waste materials received within Toronto[15].

IC&I customers are not required to obtain waste management services from the City. A large majority of the IC&I market in Toronto is serviced by private sector waste management firms, the exact number of IC&Is that are serviced privately is unknown and data on this waste stream is limited. In Technical Memorandum #1, it is conservatively estimated that approximately 840,000 tonnes of IC&I waste is generated in Toronto annually.

While it is not possible to accurately determine IC&I diversion rates because the IC&I sector is not held to the same monitoring and reporting requirements as municipalities, the Province has suggested that the overall provincial IC&I diversion rate may be as low as 13%[16].

Gap, Challenge and/or Opportunity:

A challenge facing the City is trying to find a mechanism to allow the City to influence greater waste diversion in the IC&I sector for waste materials being generated within the City of Toronto, but managed outside the City of Toronto waste management system.

[14] 2014 Tonnage Map

[15] Excludes materials received directly at Green Lane Landfill from IC&I and other municipal sources.

[16] Statistics Canada's Waste Management Industry Survey, 2008

The gaps, challenges and/or opportunities related to the City's influence over waste diversion in the IC&I sector, include:

- Differences between municipalities and the IC&I sector in terms of application of Provincial solid waste management requirements for data collection, monitoring, reporting and performance;
- A lack of reliable and available information regarding solid waste management in the IC&I sector, frustrating efforts to assess current performance and future potential;
- A highly price competitive private sector market for waste management services, with disposal as the cheapest option;
- Private sector waste management service providers are not required to provide the full suite of waste management, diversion and support services that the City provides;
- The inability of the City to influence the behaviour of its IC&I customers to increase diversion, primarily due to the lack of a Provincially enforced regulatory framework to motivate IC&I diversion; and,
- The material composition varies significantly between industrial/commercial businesses and is not a homogenous stream that is readily recyclable.

Potential Options to Address Gap, Challenge and/or Opportunity:

Some options that could be considered include:

- Maintain the status quo, where the City continues to capture a portion of IC&I market share with limited ability to influence the remaining waste being generated;
- Expand the City's IC&I market share to gain control over waste stream to influence/enforce behaviour;
- Re-focus the role of the City in the IC&I waste sector to influence behavior without taking over control, through measures such as licensing and by-laws; and,
- Exit the IC&I market completely and allow the private sector to take over all aspects of IC&I waste management.

4.17 Impacts of Energy Costs on the Waste Management System

Overview:

The City's waste management system is heavily dependent on a collection, transfer, processing and disposal system that utilizes large amounts of energy, whether diesel, gasoline, or electrical energy. In particular, collection and transfer vehicles use large amounts of fossil fuels, the price of which has fluctuated dramatically in the last few years. Uncertainty regarding fuel prices may result in higher costs as contractors try to mitigate risk. As a result, alternatives to fossil fuels are being investigated and implemented in many areas of Canada for vehicles and facilities. Conversion of landfill gas and biogas into other fuels, such as compressed natural gas (CNG), and renewable natural gas (RNG) is becoming a viable option. The City owns facilities that have the potential to generate future sources of energy which could be considered in an effort to minimize the impacts of energy costs on the waste management system.

Gap, Challenge and/or Opportunity:

A challenge facing the City is that the system is heavily dependent on energy, in particular for the collection of waste, and energy costs are expected to continue to increase in the future.

The gaps, challenges and/or opportunities associated with the impacts of future energy costs, include:

- Heavy reliance and dependence of fossil fuels for transportation; and,
- Uncertainty with respect to future fuels supply and associated costs

Potential Options to Address Gap, Challenge and/or Opportunity:

Some options that could be considered to address the impacts of future energy costs include:

- Energy from waste to reduce transportation and enable local use of energy (including district heating). For example, the Port Lands development could be a more sustainable re-development if this was done, reducing vehicle traffic as well as using waste as a fuel;
- Utilize biogas to produce Renewable Natural Gas; and,
- Coordinated and/or alternative contracts (e.g. contracts that combine collection and processing or collection and transfer).

4.18 Impacts of Intensification

Overview:

The City of Toronto has experienced significant growth over the last decade, with a population growth rate of 18% since 2006. The downtown area, where a large number of multi-residential buildings have been constructed, is growing four times faster than Toronto as a whole[17].

The predominant modes of transportation downtown are biking, walking and public transit compared to other areas of the City which are more car-centric. Approximately 65% of the housing in the downtown area is composed of rental units (TO Core presentation, April 21, 2015). The City is undergoing a planning study of the downtown area, considering transportation, water and wastewater, and energy among some of the study components. The impact of this intensification on waste also needs to be considered.

There are many challenges associated with waste diversion in multi-residential buildings (also discussed in Section 4.6: Multi-Residential Waste Diversion) including storage and collection of waste collection containers and the high turnover of tenants. Increasing numbers of multi-residential buildings may have an impact on the City's diversion targets with historical lower waste diversion participation and performance compared to single family homes. Intensification also requires consideration of accessibility for collection of other materials not collected at the curb (e.g. renovation waste etc.) for residents without a car and the impact to collection vehicles with increased traffic and reduced large truck accessibility.

With a significant number of council-approved units pending construction, the City will need to look at strategies to address these issues.

Gap, Challenge and/or Opportunity:

A challenge facing the City is the impacts of intensification and the changes required to manage additional waste generated by housing units with typically lower waste diversion performance records and in areas that are more difficult to collect using traditional methods.

The gaps, challenges and/or opportunities associated with the impacts of intensification, include:

- Reduced storage space for a range of waste diversion containers;
- Fewer residents with cars which makes access to existing drop-off depots difficult;
- Increased traffic and reduced large truck accessibility and the impacts on the waste collection system; and,
- Historical lower waste diversion participation and performance in multi-residential buildings.

Potential Options to Address Gap, Challenge and/or Opportunity:

[17] TOcore – Planning Toronto's Downtown

Some options that could be considered to address the impacts of intensification include:

- Coordinated and/or alternative contracts (e.g. contracts that combine collection and processing or collection and transfer);
- Ongoing review / update planning and development requirements; and,
- Pilot alternative collection systems, e.g. removing curbside collection and providing drop-off depots, smaller collection vehicles, vacuum systems, etc.

4.19 Impacts of a Changing Waste Stream

Overview:

The Blue Box program has changed dramatically since its introduction in Ontario in 1983. Changes to lifestyles and technology have had the biggest impact on recyclables quantities and composition. With increasing use of technology and online reading/shopping, quantities of newspaper have decreased, cardboard has increased, and quantities of waste electronics have skyrocketed with the proliferation of affordable electronics and consumer appetite for the "latest and greatest". Rising fuel costs, changing lifestyles and advancements in processing technologies have also resulted in lightweighting of plastic containers, replacement of glass and other materials with plastic, and multi-layered plastics (e.g. resealable pouches etc.). At the same time, our society has moved towards more single person households and more people in the workplace leading to a rise in convenience, take-out and pre-packaged foods.

From a processing standpoint, Material Recovery Facilities (MRFs) have had to adapt by installing new processing technologies and also have had to process more units on a per tonne basis since there are more lightweight materials. From the City's perspective, revenue from recyclables has been affected with changes in pricing for recyclables, variable markets, less revenue from those materials traditionally making up the largest proportion of recyclable material (i.e. newspaper) and changes to processing costs due to changing waste composition.

Gap, Challenge and/or Opportunity:

A challenge facing the City is the constant changing of the waste stream and the ability for programs and infrastructure to adapt.

The gaps, challenges and/or opportunities associated with impacts of a changing waste stream, include:

- Introduction of more single-use or "designed for disposal" products;
- Changes to the types of materials used for packaging of products;
- Shifts to more electronic based communications has resulted in less paper fibre being recycled and more WEEE being generated; and,
- Changes to processing costs and recyclable revenue.

Potential Options to Address Gap, Challenge and/or Opportunity:

The potential options to address this gap, challenge and/or opportunity have been discussed where appropriate as they relate to other specific gaps, challenges and/or opportunities.

5 Projections Development

The waste generation projections presented in this section are for baseline waste quantities, meaning the amount of waste which will be produced if current programs, facilities and level of service remain the same as today in Toronto. Sensitivity analyses, as well as the impacts of future policies and programs on the waste projections, will be addressed in later steps in the Waste Strategy development process and in the development of the Road Map for Implementation.

These projections help to establish the long-term need of the solid waste management system and its customers.

5.1 Approach to Baseline Waste Projections

The following projections were developed using two different approaches for different planning horizons.

1. Current Day to 2021 - Waste projections to 2021 were developed using trending analysis developed through a statistical model of waste generation data from 2001 to 2014; and,
2. 2022 to 2050 - Waste projections from 2022 to 2031 were based on population and household projections obtained from the City of Toronto Planning Department and projections from 2032 to 2050 were developed assuming a steady state growth rate similar to the growth rate projected for the 2022 to 2031 period.

Taking this approach was necessary to reflect the accuracy of the projection and availability of data to support the projection. For example, the accuracy of the shorter term projections is much higher given the supporting data that is available, versus longer term projections that include many more variables and assumptions.

Historical waste generation data from 2001 to 2014 was analyzed and a model was developed to forecast quantities of waste to 2021, the latest date for which detailed employment and other economic forecasts are currently available. A simple projection model was used to extend the waste projections to 2050 for planning purposes[18].

5.2 Projected Waste Quantities Current to 2021

The following section describes the economic waste projection model developed using the City of Toronto quarterly data for waste tonnages since 2001, and projecting to 2021, which is the date to which economic forecasts for the City are currently available.

[18] The planning timespan has been extended to 2050 as recommended by the Stakeholder Advisory Committee (SAG), in order to correlate with the City Greenhouse Gas (GHG) inventory, also being developed at this time.

Data Sources Used

The City was able to provide 14 years of detailed monthly data for the following five waste streams received at the City's transfer stations:

- Garbage: including, garbage from residential and a portion of the non-residential sector; and residue from Blue Bin materials and Green Bin organics;
- Blue Bin materials;
- Green Bin organics;
- Yard Waste ; and,
- Other Material: including non-recyclable and recyclable durable goods (e.g. couches, mattresses); street sweepings, IC&I (industrial, commercial and institutional) garbage dropped off at City transfer stations, old corrugated cardboard, electronic waste, drywall, scrap metal, log/branches, Christmas trees, woodchips and tires.

Information provided by the City for the five waste streams represents the total amount of waste managed at curbside and through the City's transfer stations and depots, from both residential and non-residential sources (agencies and corporations, charities, institutions, religious organizations, schools and small commercial establishments). It does not include any additional waste received at Green Lane Landfill beyond that collected and delivered by the City. For the purposes of this model, there was no delineation of waste by source (e.g. single family homes or multi-residential buildings) given the time period being considered. Delineation between sectors has been completed for the longer term projections to identify over time how the housing sector is projected to change and the corresponding projected change in waste quantities. Longer term projections are discussed in later sections.

The detailed waste quantity information was consolidated into quarterly and annual totals to develop the Waste Quantity Forecasting Model. Summary historical data is presented in Technical Memorandum #1 (Current System Summary). Key information of relevance to the waste projections is included in a series of appendices to this Memorandum.

The City maintains a large data set of economic indicators for future growth including:

- for the City of Toronto only;
- for the Census Metropolitan Area (CMA);
- for the Greater Toronto Area (GTA);
- provincial economic forecasts; and,
- national economic forecasts.

Information available on key economic indicators such as employment, unemployment and labour force participation rates extend back to the 1980's. Key economic indicators are available at the quarterly level to 2021, and were used to develop quarterly waste projections to the end

of 2021. The quarterly economic data provided by City staff include the following seasonally adjusted indicators from the Conference Board of Canada (CBOC) and Moody's[19]:

Conference Board of Canada

1. Toronto CMA Population ('000s)
2. Toronto CMA Labour Force ('000s)
3. Toronto CMA Employment by Industry ('000s)
4. Toronto CMA Unemployment ('000s)
5. Toronto CMA Participation Rate
6. Toronto CMA Employment Rate
7. Toronto CMA Unemployment Rate
8. Toronto CMA GDP at Basic Prices by Industry - All Industries (Millions $ 2007)

Moody's

1. Toronto CMA Population 15 years and Greater ('000s)
2. Toronto CMA Labour Force ('000s)
3. Toronto CMA Labour Force Total Employed ('000s)
4. Toronto CMA Labour Force Total Unemployed ('000s)
5. Toronto CMA Participation Rate
6. Toronto CMA Employment Rate
7. Toronto CMA Labour Force Unemployment Rate
8. Toronto CMA Gross Product: Total (Billions, 2007 CAD) for Toronto

The data from Moody's provided quarterly forecasts for employment indicators until Q4 2021. The Gross Domestic Product (GDP) forecast provided by Moody's extended to Q4 2024. Since the comparable forecasts from CBOC ended in Q4 2018, the information from Moody's was used to develop detailed waste tonnage forecasts to Q4 2021.

The Toronto CMA (Census Metropolitan Area) data includes those municipalities considered by Statistics *Canada "to have a high degree of integration with the City of Toronto, as measured by commuting flows derived from census place of work data."* While the borders of the Toronto CMA extend beyond the City of Toronto borders, economic activity generated at the Toronto CMA level influences waste generation within the City of Toronto, and was used in developing the waste projections model.

5.3 Development of the Waste Projection Model Based on Economic Data and Waste Quantity Data

Gross Domestic Product (GDP), employment and population statistics were correlated with variances in quarterly municipal waste generation. The trends between quarterly residential

[19] Data provided by Kim Nguyen, City of Toronto, August 5, 2014: Labour Force Stats & GDP from Moody's and Conference Board.xlsx

waste generation, GDP and population were found to be statistically significant[20] and are presented in Figure 5-1. The trend in quarterly waste generation in Figure 5-1 shows a steep decline starting in 2001 and ending in 2009. A "structural break" occurs in the trend in 2009. The trend from 2001 to 2009 is referred to as a negative relationship between the two variables, meaning that as one increases in value, the other decreases in value. Intuitively, this relationship appears counter-intuitive and not logical as more people and higher economic activity should signal more waste generation, resulting in what is referred to as a "positive" statistical relationship (when one increases, the other increases).

Some aspects of the trend noted from 2001 to 2009 are consistent with what has been found in other cities across Canada and the US, and are related to changing lifestyles and other trends which have been on-going in the economy and also in residential waste generation since 2001. These trends and lifestyle changes were documented in the Toronto Future Blue Bin Study (2010)[21], and include:

- a move away from printed material to an increasing use of electronic communications, particularly in younger demographic groups, resulting in a reduction in printed paper quantities, including newspapers, telephone books, magazines and flyers, etc;
- changes in packaging formats and a move away from heavier glass packaging to lighter plastic packaging, leading to lower tonnages of packaging;
- light-weighting of packaging which reduces the weight of packaging produced; and,
- increasing purchases and consumption of prepared foods, resulting in lower amounts of food preparation wastes, etc.

The slowdown in the economy in late-2008 and 2009 also had an impact on the waste generated.

Other trends impacting on waste quantities are related to various policies implemented in City of Toronto to encourage waste reduction, including:

- bi-weekly garbage collection for single family households; and,
- the Volume Based Rate System (VBRS) introduced in 2008.

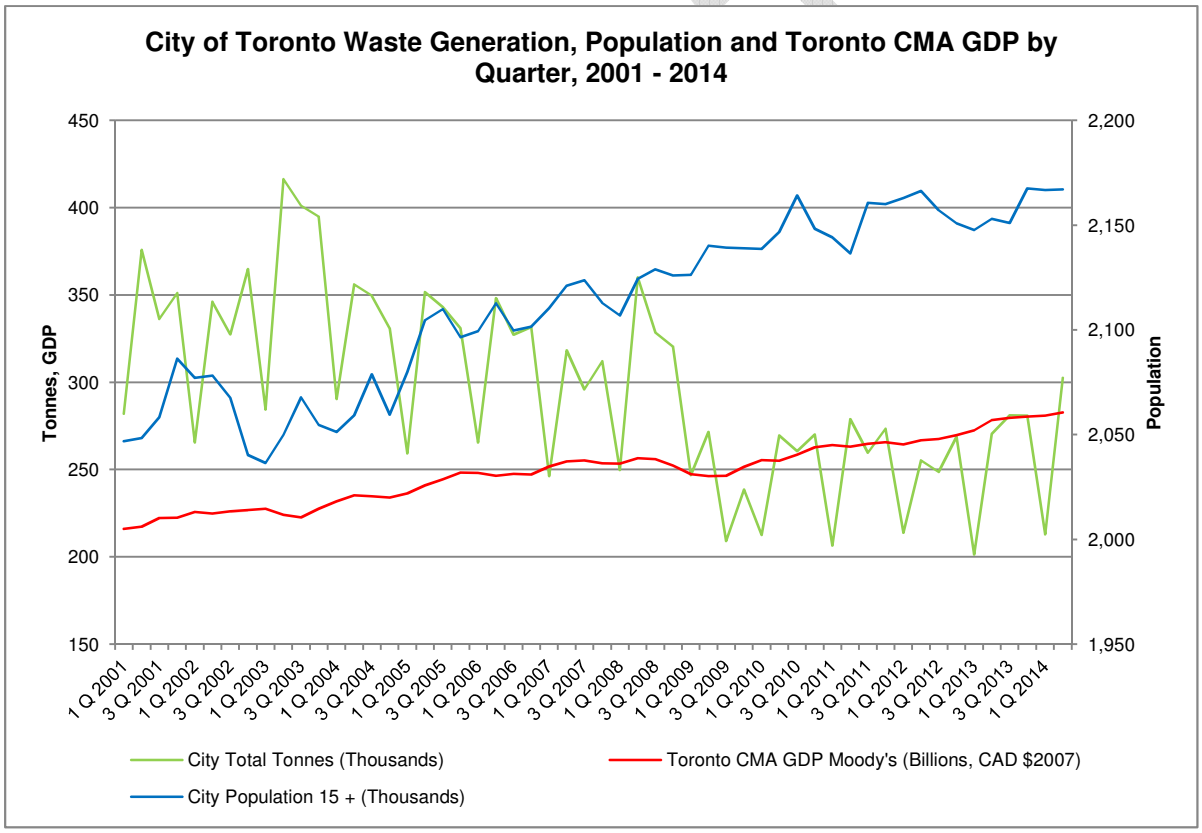
With the VBRS, the City began charging single family households and multi-residential buildings for waste disposal based on the volume of waste set out and requiring disposal. Single family residents could choose from a range of container sizes, with smaller containers costing less than larger containers. Multi-residential buildings on front-end collection were charged based on the number of garbage containers set out, whereas Green Bin organics and Blue Bin materials

[20] Statistically significant: There is confidence at the 95 percent level that observed trends between tonnage and the economic indicators are real and not due to random fluctuations. Because of this confidence models can be used to predict tonnage.

[21] City of Toronto Future Blue Bin Study, Kelleher Environmental in association with Love Environment and Robins Environmental, December, 2010. Available at http://www1.toronto.ca/city_of_toronto/solid_waste_management_services/divisional_profile/reports/files/pdf/kell_env_tor_bb_tech_memo.pdf

collection were provided at no charge. As the VBRS was introduced some multi-residential buildings switched to private waste collection in 2008 and 2009 in an effort to reduce their costs. This decreased the amount of multi-residential waste managed by the City. With a change to the multi-residential VBRS in 2010, which reduced the amounts charged to multi-residential buildings, most multi-residential buildings in the City continue to use City services. Figure 5-1 shows that since 2009 there has been a direct correlation between waste generation, GDP and population in City of Toronto. The economic models used for waste forecasting to 2021 are based on the statistical correlations identified for 2009 to 2014. While a 10-year dataset with consistent statistical correlations would be preferable for this type of forecasting, it was not available for the City of Toronto and therefore the available 5-year time series has been used. This data can be updated over time.

Figure 5-1: Trends of Waste Generation, GDP and Population by Quarter, 2001 – 2014



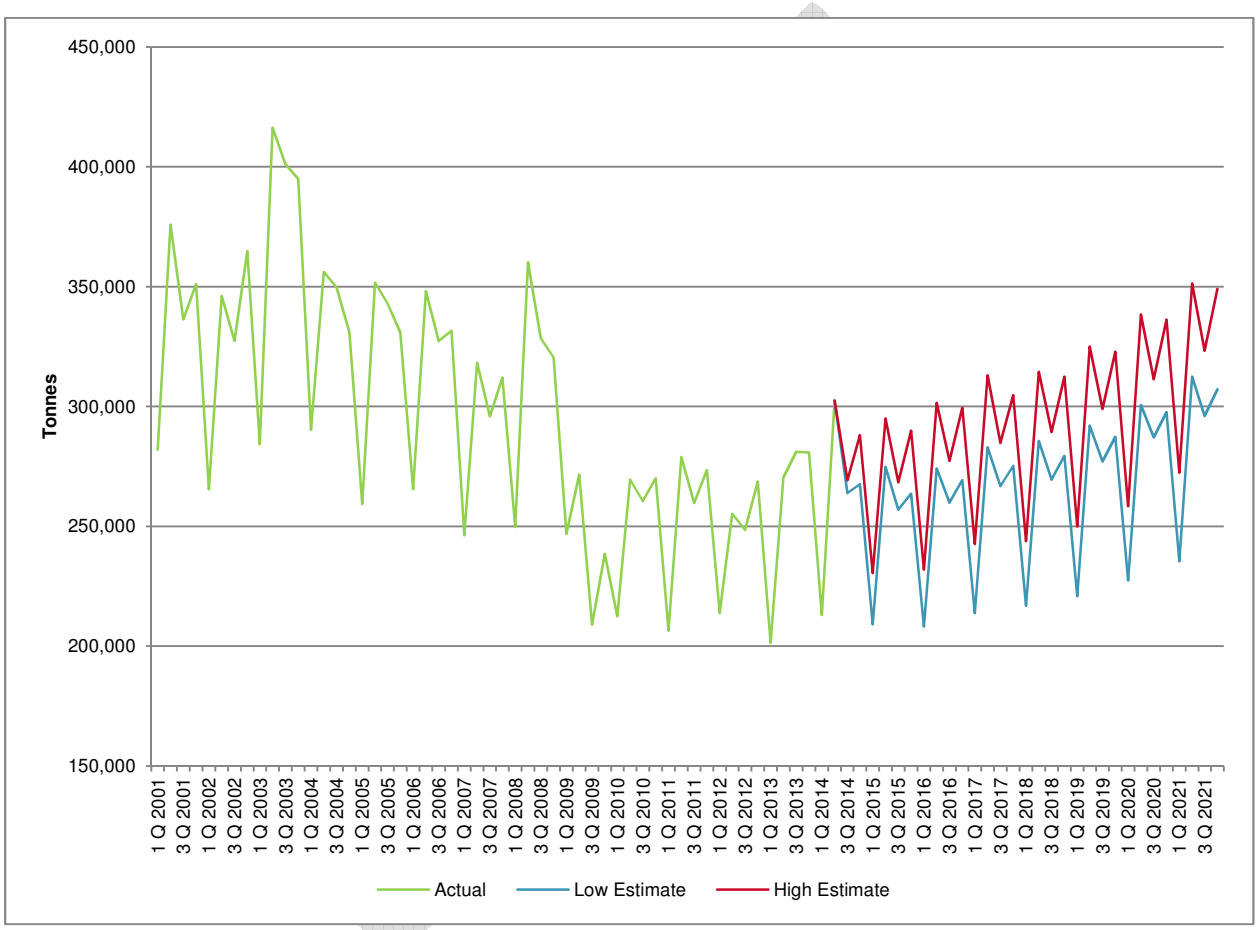
Sources: City of Toronto. Waste data was extracted from Excel files: tbl_LTWS-_ 2001.xlsx, 2002_LTWS.xlsx - 2009_LTWS.xlsx, LTWMS 2010-2014.xlsx provided by Derek Sawyer over the period of July 17, 2014 to October 6, 2014. GDP was extracted from the Excel file Labour Force Stats & GDP from Moody's and Conf Board.xlsx provided by Kim Nguyen, August 5, 2014 and population 15 years and older was extracted from the Excel file LFS.xlsx provided by Peter Viducis, sent January 7, 2015.

Ordinary linear squares regression techniques were used to identify which of the economic variables could explain changes in waste generation over time. Statistical descriptions of the modelling activities are contained in **Appendix A** of this Technical Memorandum, along with the summary results from fitting the models to the full data series and the recent data series.

Waste Projections Based on Economic Models

Two models (the Full Data Series Model and the Recent Data Series Model – both described in **Appendix A**) were used to develop waste generation projections for the years 2015 to 2021. Figure 5-2 shows historical waste generation information for the City from 2001 to 2014, and the high/low[22] quarterly forecasts from 2015 to 2021. Detailed values for the quarterly forecasts are presented in **Appendix A** of this Technical Memorandum. Figure 5-2 shows the seasonal variation of waste generation, with lowest values typically in the winter months. Annual historical data and projections to 2021 are presented in Figure 5-3 and Table 5-1.

Figure 5-2: Actual and Forecasted City of Toronto Quarterly Total Waste Generation 3 Q 2014 to 4Q 2021



[22] The full data series used all 54 quarterly observations since 2001 and results in more conservative (low) estimates. The recent data series uses data since 2009 and has higher estimates.

Figure 5-3: Historical and Projected High/Low Total Annual Waste Generation (2001 to 2021), Based on Economic Indicators and Population Growth

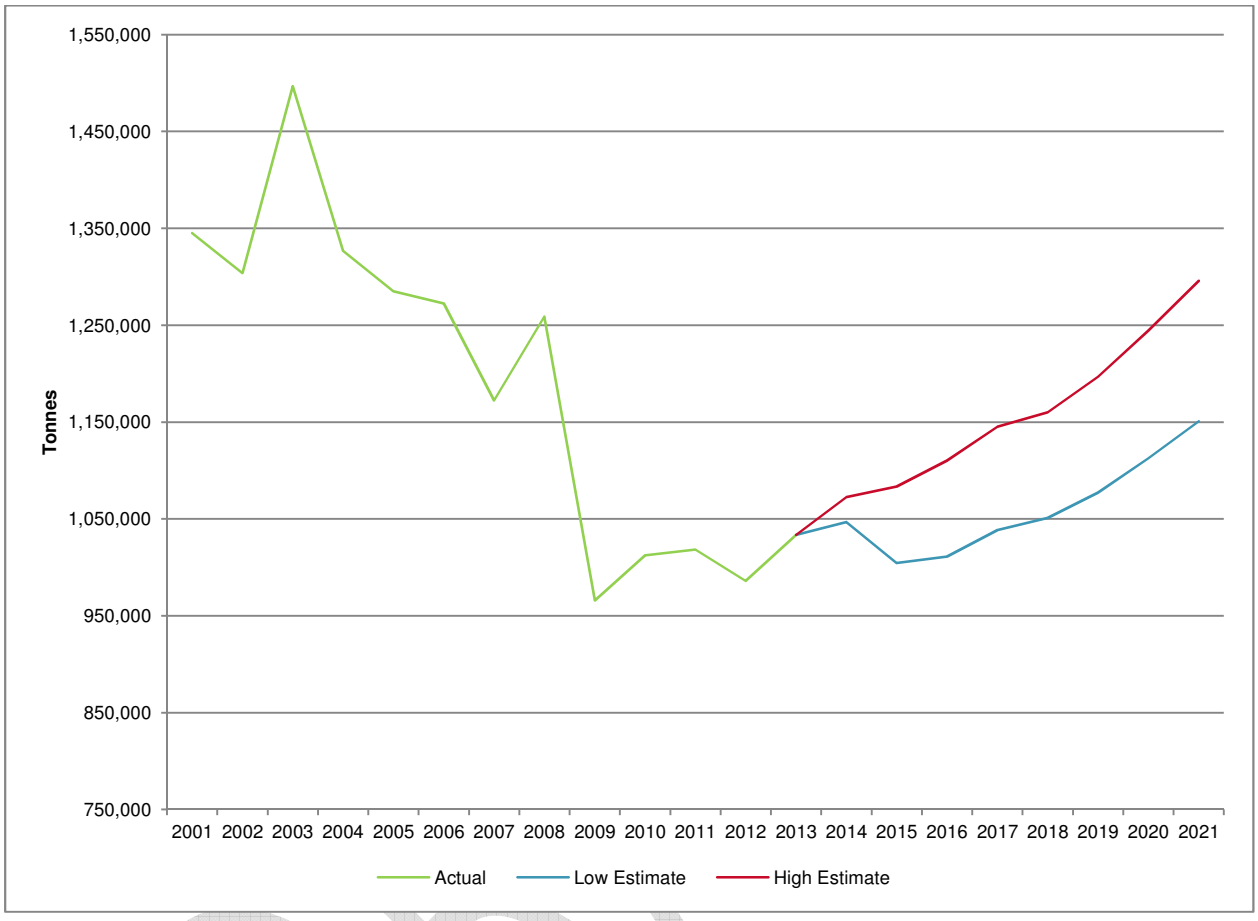


Table 5-1: Total Waste Generation Projections for City of Toronto, 2015 to 2021 (Tonnes Per Year)

Year	Waste Generation Projection All Waste Streams Managed By City of Toronto (tonnes per year)	
	Low Waste Generation Projection (tonnes per year)	High Waste Generation Projection (tonnes per year)
2014	1,046,632	1,072,514
2015	1,004,467	1,083,532
2016	1,011,248	1,110,138
2017	1,038,625	1,145,068
2018	1,051,219	1,160,034
2019	1,077,196	1,196,777
2020	1,112,649	1,244,208
2021	1,150,973	1,295,910

Modelled Contribution of Five Waste Streams to City of Toronto Total Waste Stream, 2015 to 2021

The contribution of the five streams (garbage, Blue Bin materials, Green Bin organics, Leaf and Yard Waste and Other) to the total waste managed by City of Toronto changed over time was statistically analysed. The actual tonnage of each of the five waste streams is needed for the long-term plan, so that waste management infrastructure can be developed to accommodate the likely tonnages to be produced over time. The assumptions used to allocate the total waste stream to the five main categories are presented in **Appendix A**. Table 5-2 below presents the estimated tonnages of each category to the end of 2021.

High and low forecasts were modelled for all five waste streams. Two additional scenarios of high and low forecasts for Other waste were also produced since the recent quarterly trends in percent composition for other waste appeared unrealistic. To produce these scenarios, the recent quarterly average percent composition of other waste was increased by 40 percent and then decreased by 40 percent. Since the total percent composition from all streams must equal 100 percent, HDR allowed the percent composition for garbage to change to accommodate the assumptions for other waste in the other two scenarios.

Unlike total waste, modelling the contribution of different streams to the total waste stream is not as reliable since a change in policy or pricing can dramatically increase or decrease tonnages for a given stream in one direction or another. Also, production of yard waste is less related to the economy, and more related to weather, with a wet season producing more yard waste than a dry season.

While the analysis presented provides projected tonnages for each of the five main waste streams for the next six years (to the end of 2021), these tonnages are considered a baseline estimate which will require modification as the Long Term Waste Management Strategy progresses, and the impacts of the recommended programs and facilities on waste quantities are analyzed in more detail.

Table 5-2: Annual Waste Projections by Five Waste Streams (Garbage, Blue Bin, Green Bin, Yard Waste and Other) 2015 to 2021

Year	Yard Waste		Blue Bin Materials		Green Bin Organics		OTHER - Scenario 1		GARBAGE - Scenario 1		OTHER - Scenario 2		GARBAGE - Scenario 2		OTHER - Scenario 3		GARBAGE - Scenario 3	
	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High
2015	91,113	98,398	215,209	232,276	135,915	146,669	127,574	137,627	434,656	468,563	178,603	192,678	383,627	413,512	76,544	82,576	485,686	523,614
2016	92,093	101,249	216,579	237,837	136,787	150,184	128,366	140,958	437,422	479,911	179,713	197,341	386,076	423,528	77,020	84,575	488,769	536,294
2017	94,537	103,954	222,439	245,441	140,483	154,982	131,869	145,461	449,297	495,232	184,616	203,645	396,550	437,047	79,121	87,276	502,045	553,416
2018	95,694	105,652	225,152	248,579	142,198	156,970	133,456	147,296	454,719	501,538	186,839	206,214	401,336	442,620	80,074	88,377	508,101	560,456
2019	98,206	109,151	230,672	256,399	145,687	161,905	136,730	151,958	465,902	517,365	191,422	212,742	411,210	456,582	82,038	91,175	520,594	578,148
2020	101,520	113,633	238,240	266,504	150,472	168,283	141,204	157,978	481,213	537,809	197,685	221,169	424,732	474,618	84,722	94,787	537,695	601,001
2021	104,993	118,027	246,447	277,696	155,648	175,356	146,098	164,549	497,787	560,283	204,538	230,368	439,347	494,464	87,659	98,729	556,226	626,103

Updating the Economic Waste Projection Forecasting Model

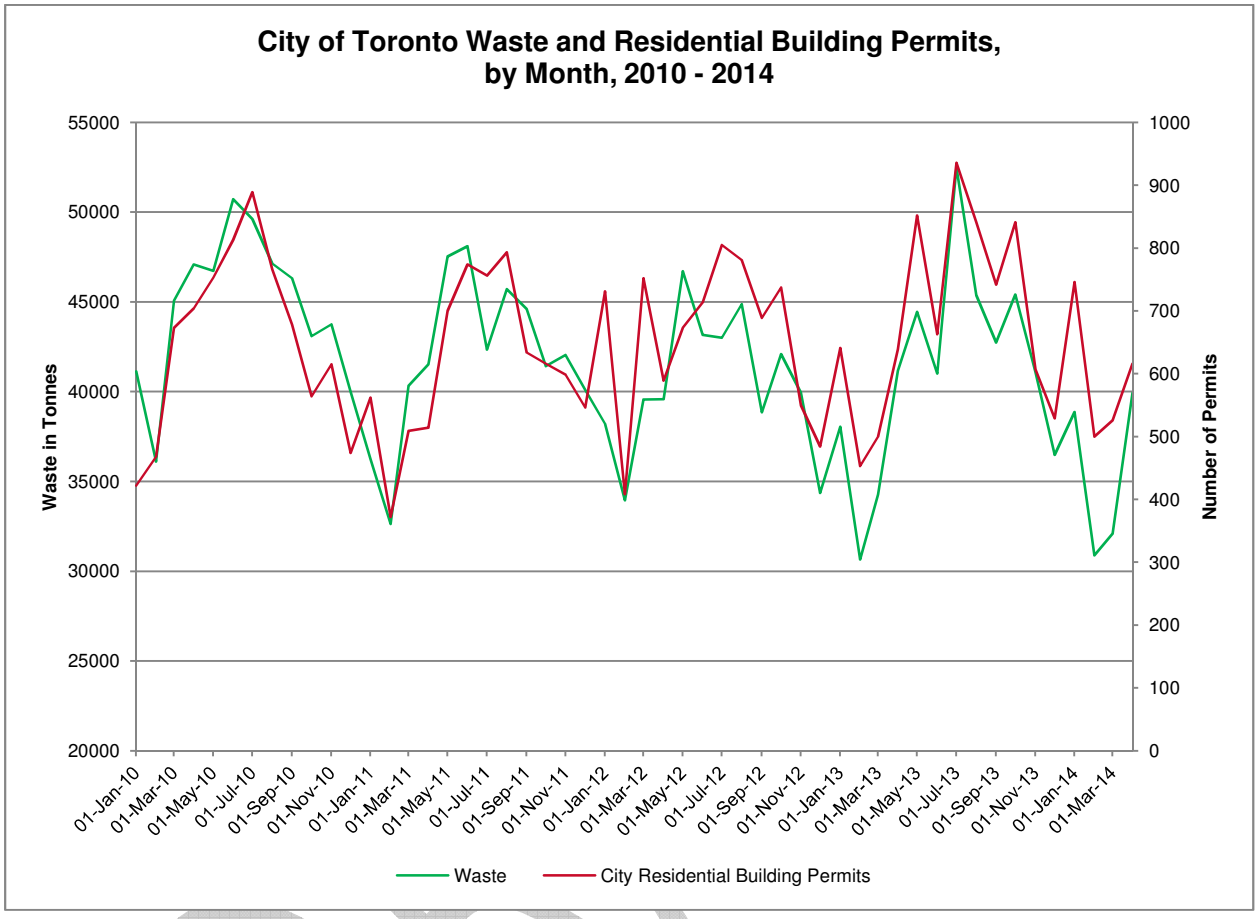
The waste and economic data collected and managed by the City of Toronto provides quality information for the purpose of building statistical regression equations. These models use historical patterns in waste generation to forecast future amounts of waste on a quarterly and annual basis. The models developed provide lower and upper ranges of quarterly forecasts commencing in Q3 2014 and ending in Q3 2021. Aggregating these forecasts on a yearly basis (calendar year) provides the annual forecasts from 2001 to 2021. When additional quarterly forecasts are available for participation[23], employment and unemployment rates, these models' forecasts can be extended.

The forecasts provided are static using the latest available quarterly total tonnage and quarterly economic forecasts from Moody's. The model rule can be programmed into Excel and will allow the forecasts to be automatically updated with every new observation of quarterly total tonnage and with any new updates on the economic indicators used in the model. It is not necessary that the same source for the economic variables be used as long as the scale and units of the economic variables remain unchanged. For example, if Moody's stops producing quarterly labour force participation rates, the City can use CBOC's quarterly labour force participation rates as long as the definition for CBOC's labour force participation rate is identical to that used by Moody's. It is recommended that the forecasting models be coded into an accessible user tool such as Excel to allow City staff to easily update the model's forecasts.

The City has the opportunity to develop predictive models, which can forecast near term waste generation on a monthly basis. Long-term monthly forecasts can only be produced if monthly economic indicators are forecasted on a long-term basis (more than five years into the future). Relationships between monthly waste generation and monthly economic indicators using the recent data series were also explored. The strongest relationship, presented in Figure 5-4, was found to be between monthly waste generation and monthly City residential building permits. This knowledge can be used to possibly build a "near-term" prediction model, which can predict the amount of waste generated in the upcoming months. It is recommended that the City continue to explore using its detailed datasets of waste generation and economic indicators (e.g. information from the Conference Board of Canada and Moody's (see Section 5.2)) to develop waste generation forecasting models for near and long-term planning purposes.

[23] Participation rate is the number of persons in the labour force divided by the population of persons 15 years of age or older. The labour force consists of persons who are unemployed and employed. According to the standard definition employed by Statistics Canada, the employed are persons having a job or business, whereas the unemployed are without work, are available for work, and are actively seeking work.

Figure 5-4: Relationship Between City of Toronto Waste and Residential Building Permits By Month, 2010 to 2014



Sources: Excel file LTWMS 2010-2014.xlsx provided by Derek Sawyer, City of Toronto (received July 17, 2014) and Excel file May 2014 Indicators Out.xlsx provided by Peter Viducis, City of Toronto (received June 25, 2014)

While the current models provide very good fits to the historic data, either for the full data series since 2001 or the more recent data series commencing in 2010, as new waste generation data is collected under the current policy conditions, the quarterly waste generation forecasting models based on data post-2009 can be improved upon. In order to reliably forecast decades into the future, at least ten years of quarterly data should be available. With the passing of each year and the expansion of its sample of monthly and quarterly waste generation data, the City has the opportunity to update and refine the model rule to yield even greater accuracy of its waste generation forecasts.

Eight to ten years of data is required to build strong forecasting models. It is important that monthly tonnage is organized by waste stream in a consistent manner over the years with the waste stream definitions formally stated. Additionally, the geographical boundaries need to be documented per report to maintain consistency and that the source of waste is known (e.g. City of Toronto, Greater Toronto Area (GTA), Toronto CMA, etc.).

5.4 Projected Waste Quantities 2022 to 2050

While the economic models developed for this study provide waste generation forecasts to 2021, the economic projections on which they are based are not available beyond 2021, therefore a population based approach was used to develop waste projections to 2050 for planning purposes.

Waste projections for the period 2022 to 2050 were developed for two different waste types:

1. Residential waste which includes all waste generated by single family and multi-residential households; and,
2. Non-residential waste, which includes waste from City Divisions, Agencies and Corporations and as well as IC&I (industrial, commercial and institutional) waste dropped off at City of Toronto transfer stations.

Residential Waste Projections, 2022 to 2050

Residential waste projections were estimated by applying future population increase rates to currently managed residential waste quantities. This approach assumes a "status quo" in terms of existing policies and programs, and that the City involvement in various stewardship programs (tires, Blue Box, Municipal Hazardous or Special Waste (i.e. Household Hazardous Waste), Waste Electronic and Electrical Equipment (WEEE) stays at current levels. While this assumption is reasonable for the short and possibly medium term, in the longer term, the proposed *Waste Free Ontario Act* may change the program and policy framework and on-going involvement in Extended Producer Responsibility (EPR) programs and funding for Ontario municipalities as well as the quantity and composition of waste generated. In the absence of firm information on future regulatory changes, a long-term baseline has been developed assuming a "business as usual" scenario.

Population projections for 1991 to 2031 are presented in Table 5-3 and were obtained from City of Toronto staff and the Flashforward Report, which is used as the basis for planning by City of Toronto Planning Division staff.

Table 5-3: City of Toronto Population Projections to 2031[24]

Age	1991*	1996*	2001	2006	2011	2016	2021	2026	2031
0 – 14	389,452	439,398	465,530	473,932	475,135	480,872	490,573	499,337	501,061
15 – 24	329,462	306,299	329,396	361,910	393,179	384,288	372,304	373,662	384,210
25 – 34	477,526	460,920	431,245	445,037	472,373	467,266	467,849	469,542	468,025
35 – 44	363,779	402,200	443,565	443,777	439,997	438,433	435,324	432,433	436,151
45 – 54	254,700	299,240	343,936	375,443	403,326	398,323	387,753	388,254	388,207
55 – 64	234,660	225,072	232,729	267,454	300,175	318,975	335,452	333,810	328,006
65 – 74	179,385	196,662	193,786	189,293	195,779	217,771	238,053	253,441	266,994
75+	121,224	133,683	154,017	167,938	175,120	179,107	187,357	206,896	227,638

[24] Source: GTAC, 2000; Toronto City Planning Division, Policy and Research, 2002; *Flashforward: Projecting Population and Employment to 2031 in a Mature Urban Area.* For undercoverage.

Age	1991*	1996*	2001	2006	2011	2016	2021	2026	2031
Total	2,350,188	2,463,474	2,594,204	2,724,784	2,855,084	2,885,035	2,914,665	2,957,375	3,000,292
5-Year Increase (%)		4.80%	5.30%	5.00%	4.80%	1.00%	1.00%	1.50%	1.50%
*Note:	1991 and 1996 figures are from Statistics Canada.								

The table shows that from 2016 onwards, a relatively modest annual increase in population is forecasted for the City of Toronto, with the projected population increase of about 40,000 people over each five year increment, or about 8,000 people per year. This is in contrast to much higher growth rates up to 2016. The table shows that the population in older demographic groups (65+ years) will increase more than in younger demographic groups. This will impact on the future housing stock in Toronto, which is trending towards more multi-residential units and away from single family homes.

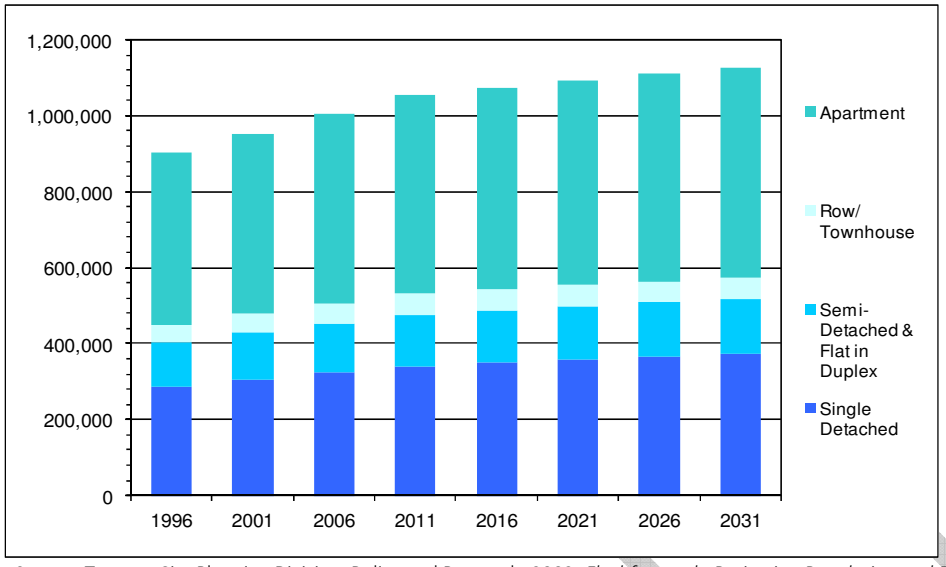
The following Table 5-4 and Figure 5-5 present the City's projected household demand projections from the Flashforward document.

Table 5-4: Household Projections for City of Toronto to 2031 – Household Demand By Dwelling Type

	Single-Detached	Semi-Detached & Flat	Row/-Town-house	Apartment	Total Change	Total Housing	Percent Change
1996*	285,360	117,125	46,405	454,345	0	903,235	0.00%
2001	305,113	123,603	49,444	475,506	50,431	953,666	5.60%
2006	322,661	130,075	52,077	498,344	99,922	1,003,157	11.10%
2011	340,047	136,936	54,651	523,249	151,648	1,054,883	16.80%
2016	348,921	139,430	55,323	530,518	170,956	1,074,191	18.90%
2021	356,779	141,278	55,625	536,779	187,226	1,090,461	20.70%
2026	364,865	143,269	56,034	545,600	206,533	1,109,768	22.90%
2031	371,722	145,014	56,413	554,695	224,609	1,127,844	24.90%
*Note:	1996 figures are from Statistics Canada.						
Source:	Toronto City Planning Division, Policy and Research, 2002;						

Figure 5-5 presents the housing projections to 2031. Both the table and the figure show the significant growth in multi-residential housing between now and 2031.

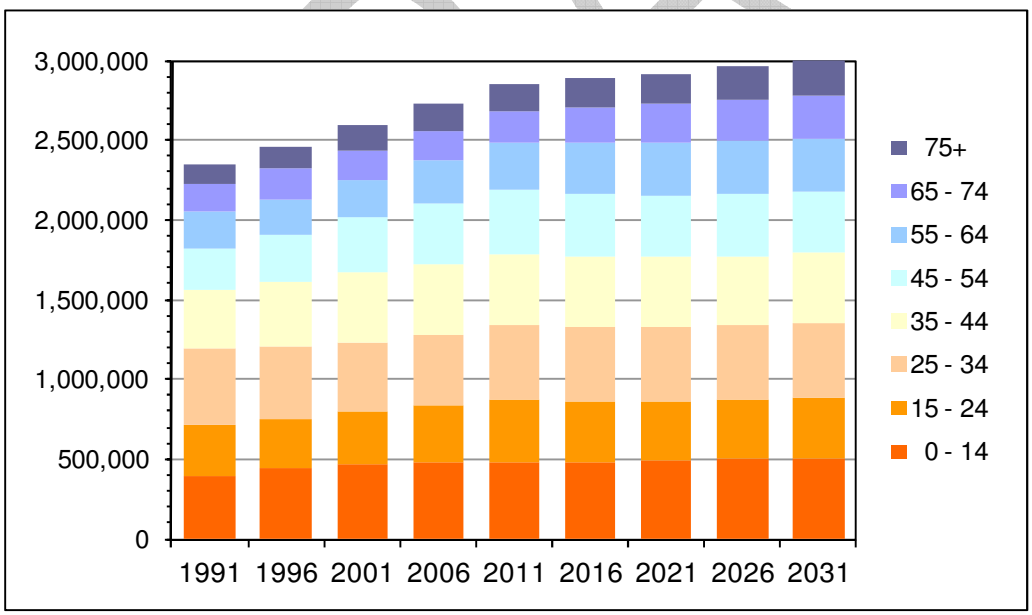
Figure 5-5: Household Projections (Household Demand By Dwelling Type) in City of Toronto to 2031



Source: Toronto City Planning Division, Policy and Research, 2002; *Flashforward: Projecting Population and Employment to 2031 in a Mature Urban Area*

The contribution of different age groups to future population growth in City of Toronto is presented in Figure 5-6.

Figure 5-6: City of Toronto Population Projection to 2031 (with Undercount[25])



[25] Undercount is the portion of the population missed by the Census or who did not participate. The City has confirmed that undercount is the same as undercoverage.

Source: GTAC, 2000; Toronto City Planning Division, Policy and Research, 2002; *Flashforward: Projecting Population and Employment to 2031 in a Mature Urban Area*

Residential waste projections for 2022 to 2050 are presented in Table 5-5. In the absence of any official City of Toronto forecasts beyond 2031, it was assumed that the population would continue to increase at a rate of about 0.25% per year, or 1.25% over each 5-year period to 2050 and that waste generation rates would increase at the same rate as population.

The residential waste generation projections in Table 5-5 are baseline projections, which assume that no program or policy changes are implemented during the planning period beyond what is in place in the City in 2015. These baseline residential waste generation projections will be refined as the Waste Strategy is developed and the impacts of proposed new policies and programs on future waste quantities are estimated.

Table 5-5: Baseline Residential and Non-Residential Waste Generation Projections for City of Toronto, 2022 to 2050 (tonnes)

	2014	2022	2026	2031	2036	2041	2046	2050	% Increase from 2022 to 2050
Residential Waste[1]									
Blue Bin Materials	141,206	170,785	183,470	198,561	211,114	219,599	226,566	231,161	35%
Leaf/yard/Xmas trees	96,068	118,297	126,677	136,371	143,999	148,518	151,690	153,344	30%
Green Bin Materials	106,040	132,584	142,073	153,119	161,924	167,314	171,265	173,485	31%
Other[2]	80,503	99,168	106,407	114,932	121,888	126,389	129,918	132,108	33%
Total Diverted	423,817	520,835	558,627	602,983	638,925	661,820	679,439	690,098	32%
Garbage	380,552	452,008	487,336	530,543	568,362	596,665	622,229	640,973	42%
Total Generated	804,369	972,844	1,045,964	1,133,526	1,207,288	1,258,485	1,301,668	1,331,072	37%
Non-Residential Waste	143,382	160,307	162,656	165,016	167,089	169,188	171,314	173,033	8%
Total Projected Residential and Non-residential Waste		1,133,620	1,208,619	1,298,542	1,374,377	1,427,673	1,472,981	1,504,105	33%

Sources: Flashforward Tables: Projected Population of Toronto (with undercoverage), Tonnage Map (2014), 2014 Diversion Tonnes

[1]Note: Tonnages for residential waste do not account for residue from processing.

[2] Other includes backyard composting, environment days/depots, WEEE, large appliances, scrap metal, grasscycling, HHW, Beer Store Deposit Return, and tires.

Non-Residential Waste Projections 2022-2050

Non-residential garbage managed by the City includes commercial waste and litter bins on the streets and in parks, as well as street sweepings, waste from City Divisions, Agencies & Corporations, paid tonnes at transfer stations residential as well as non-residential customers (all are counted as commercial transactions) and processing residues. The quantities handled for the last four years at City facilities are presented in **Appendix B**.

This waste stream will vary depending on many factors, including the tipping fee that the City charges at transfer stations for commercial waste, the comparative tipping fee charged at private sector transfer stations, diversion levels achieved at City Divisions, Agencies & Corporations over time, the economy, as well as policies implemented as a result of the Waste Strategy. These policies and programs will be identified, analysed and developed through the Waste Strategy, and the impacts of each potential option on non-residential waste quantities will be estimated more accurately when the options are fully assessed. An average rate of 55kg/capita/year of non-residential waste was managed by the City in the years 2010 to 2013 (see **Appendix B** for details). This rate has been applied to future population values to estimate the baseline BAU (business as usual) non-residential waste for planning purposes.

The non-residential waste projections are presented in Table 5-5 also (see above), and range from a predicted 160,307 tonnes in 2022 to 173,033 tonnes in 2050.

5.5 Single Family and Multi-residential Waste Projections 2026-2050

Residential waste (single family and multi-residential) was projected to 2050 based on housing demand for single family and multi-residential dwelling types. The projections for housing demand were calculated in the Flashforward document in five-year increments from 1996 to 2031 for single detached homes, semi-detached, flat in duplex and row/townhouse (all categorized as single family homes) and multi-residential buildings (apartments). The percent change in the demand for single family homes and multi-residential buildings was applied to the tonnes generated by single family homes and multi-residential buildings[26]. As the projections in the Flashforward document only went to 2031, a time series regression model was used to estimate the percent change in both these housing types to 2050[27] and applied these same percent changes to tonnes of material generated to estimate the total quantities of waste diverted and disposed to 2050.

[26] Source: City of Toronto, File entitled "SF MF Diversion" which provides a breakdown of the tonnes of garbage, Blue Bin materials, Green Bin organics, Yard waste and other material diverted and disposed from single and multi-family residences.

[27] The regression models are significant at the 5% level of significance.

Table 5-6 presents the projections for single family waste from 2022 to 2050, based on estimates of housing demand for this sector from Flashforward. 2014 tonnages have been included as a base year for comparison. Overall, tonnages increased by 28% from 2022 to 2050.

Table 5-6: Projections for Single Family Waste (tonnes) (2014 to 2050)

Single Family	2014	2022	2026	2031	2036	2041	2046	2050
Blue Bin Materials	102,204	123,076	131,700	141,613	149,306	153,697	156,620	157,992
Leaf/yard/Xmas trees	91,265	112,352	120,226	129,274	136,297	140,306	142,974	144,227
Green Bin Materials	94,659	119,432	127,802	137,421	144,886	149,148	151,984	153,315
Other[28]	65,113	79,941	85,543	91,981	96,978	99,830	101,729	102,620
Total Diverted	353,241	434,801	465,271	500,289	527,467	542,981	553,306	558,154
Garbage	181,404	209,024	223,672	240,507	253,572	261,030	265,994	268,324
Total Generated	534,645	643,825	688,943	740,796	781,039	804,011	819,299	826,478

Note: Other includes backyard composting, environment days/depots, WEEE, large appliances, scrap metal, grasscycling, HHW, Beer Store Deposit Return, and tires.

Source: City of Toronto, historicaldiversionMFSF14 (for 2014 tonnages)

Table 5-7 presents the projections for multi-residential waste from 2022 to 2050, based on estimates of housing demand for this sector from Flashforward. 2014 tonnages have been included as a base year for comparison. Overall, tonnages increased by 53% from 2022 to 2050.

Table 5-7: Projections for Multi-residential Waste (tonnes) (2014-2050)

Multi-Residential	2014	2022	2026	2031	2036	2041	2046	2050
Blue Bin Materials	39,002	47,710	51,770	56,948	61,809	65,901	69,946	73,169
Leaf/yard/Xmas trees	4,803	5,945	6,451	7,096	7,702	8,212	8,716	9,118
Green Bin Materials	11,381	13,152	14,271	15,698	17,038	18,166	19,281	20,170
Other	15,390	19,228	20,864	22,951	24,910	26,559	28,189	29,488
Total Diverted	70,576	86,034	93,356	102,694	111,459	118,839	126,133	131,944
Garbage	199,148	242,984	263,664	290,037	314,791	335,635	356,235	372,649
Total Generated	269,724	329,018	357,020	392,731	426,249	454,474	482,368	504,593

Note: Other includes backyard composting, environment days/depots, WEEE, large appliances, scrap metal, grasscycling, HHW, Beer Store Deposit Return, and tires.

Source: City of Toronto, historicaldiversionMFSF14 (for 2014 tonnages)

Table 5-8 presents the projected total tonnage for the single family and multi-residential sectors based on estimates of housing demand for this sector from Flashforward. 2014 tonnages have been included as a base year for comparison.

Table 5-8: Residential Waste Projections (tonnes) (2013-2050)

Total Residential	2014	2022	2026	2031	2036	2041	2046	2050	% change 2022 - 2050
Blue Bin Materials	141,206	170,785	183,470	198,561	211,114	219,599	226,566	231,161	35%
Leaf/yard/Xmas trees	96,068	118,297	126,677	136,371	143,999	148,518	151,690	153,344	30%
Green Bin Materials	106,040	132,584	142,073	153,119	161,924	167,314	171,265	173,485	31%
Other	80,503	99,168	106,407	114,932	121,888	126,389	129,918	132,108	33%
Total Diverted	423,817	520,835	558,627	602,983	638,925	661,820	679,439	690,098	32%
Garbage	380,552	452,008	487,336	530,543	568,362	596,665	622,229	640,973	42%
Total Generated	804,369	972,844	1,045,964	1,133,526	1,207,288	1,258,485	1,301,668	1,331,072	37%

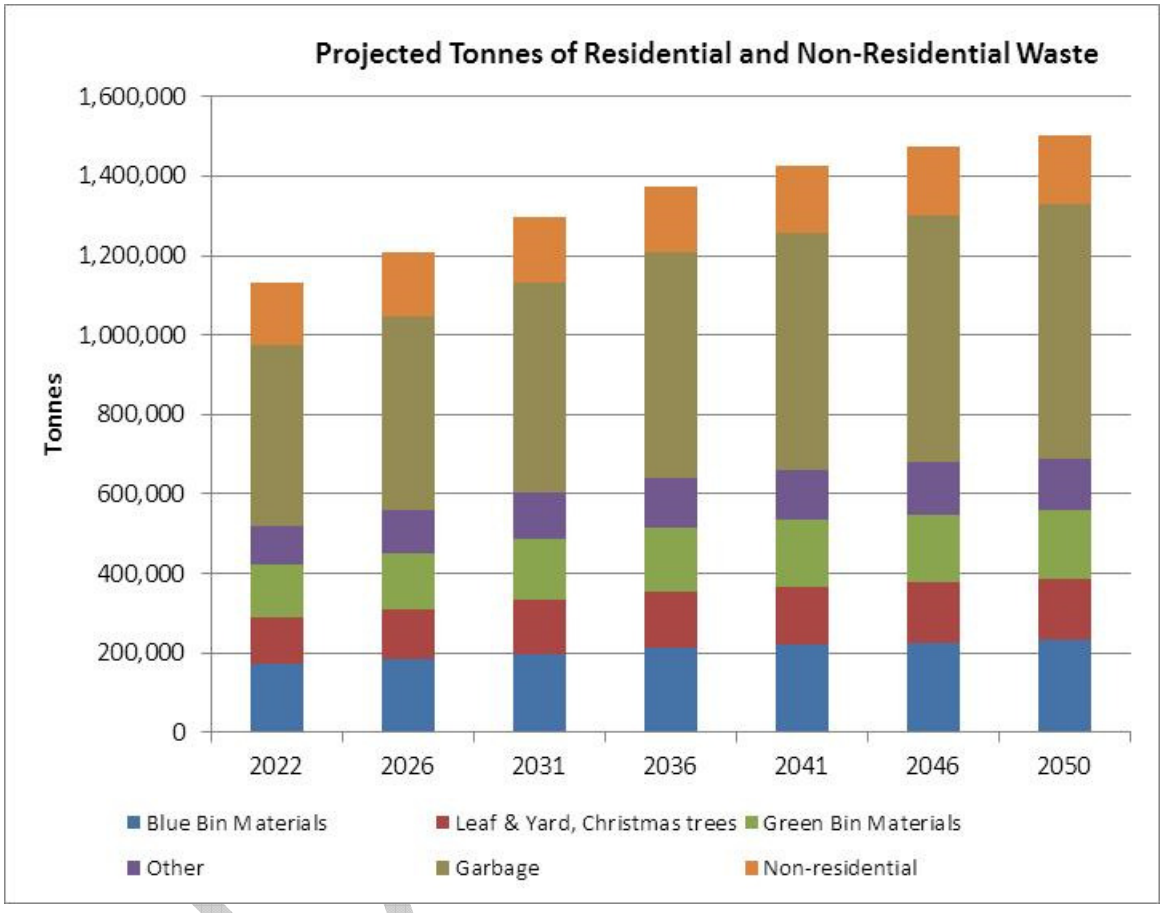
Note: Other includes backyard composting, environment days/depots, WEEE, large appliances, scrap metal, grasscycling, HHW, Beer Store Deposit Return, and tires.

Source: City of Toronto, historicaldiversionMFSF14 (for 2014 tonnages)

5.6 Projections of Total Waste Managed

Based on the quantities of waste as presented in Table 5-5 (residential and non-residential waste), it is estimated that the City will be managing approximately 1.5 million tonnes of residential and non-residential waste by 2050 as presented in Figure 5-7 below.

Figure 5-7: Projected Total Annual Waste Generation (2022 to 2050), Based on Population Growth



5.7 Disposal and Processing Capacity Projections

The 2014 tonnage map and the projections described in previous sections were used to consolidate information used to determine the future capacity requirements for garbage, Blue Bin materials and Green Bin organics. The tonnage map can be found in Technical Memorandum No. 1. and **Appendix C**. Table 5-9 presents a summary of the 2014 tonnage map according to the same categories used in the previous sections. The figures in the table below represent the material that is collected, either in curbside bins at the curb or by front-end collection (Blue Bin materials, Green Bin organics, yard waste, garbage) as well as material delivered to transfer stations and to Green Lane Landfill. Curbside collection includes waste collected from single family, non-residential, schools and charities, and represents predominantly single family waste.

For the purposes of the projections, it was assumed that waste from the multi-residential sector forms the bulk of the front-end collection; some waste from this sector is also collected curbside.

Table 5-9: Tonnes of Residential and Non-residential Waste Managed (2014 Actuals)

	Curbside Collection (Single Family)	Front-end and curbside collection (Multi-residential)	Residential Waste	Non-residential Waste	Other waste accepted at GLL	Total
Garbage	136,935	205,692		182,822	79,289	603,739
Blue Bin	137,205	63,880		14,604		215,689
Green Bin	111,364	13,390		13,586		138,340
Yard Waste	90,438			42,908		133,346
Other			12,601			12,601
Total	475,942	282,962	12,601	252,920	79,289	1,103,715

Source: 2014 Tonnage Map

Note: Other includes WEEE, durable goods, depot and other material. Other waste accepted at Green Lane includes other municipal waste, paid private waste, paid private (displacing aggregates), Disco and Dufferin processing residue, waste water material and waste related to ice storm from Parks, Forestry and Recreation.

The amounts relating to residential waste were escalated by the percentage growth estimated in the Flashforward documents until 2031.

Green Lane Landfill

In 2014, when the Waste Strategy development process was initiated, the remaining lifespan potential of Green Lane Landfill (GLL) was assessed to be approximately 16 years resulting in an estimated closure date based on the current approved capacity of 2029. This estimate was prepared using the best available data at the time and based on current site operating conditions, estimated annual tonnes to be managed in the future, and an array of other inputs and estimations on future usage by paid private customers, waste generation, and degree of contracting out to other landfills (all of which have been the subject of significant variability over the past several years).

The 2029 estimate was deemed to be an appropriately conservative estimate for both long-term planning and budgeting efforts to ensure that sufficient financial resources would be available at the appropriate time to add additional capacity to manage residual waste into the future and provide for sufficient funding to maintain and monitor GLL once closed. Over the past two years, through a number of ongoing activities, primarily related to the completion of the Waste Strategy, these estimates and assumptions have been revised to reflect new data sources that have become available and a more detailed analysis of potential future quantities to be managed. Additionally, trends experienced over the past five years in terms of waste generation and disposal requirements such as the shift towards light weighting of materials/packaging and possibly due to increased use of online media and moving away from print materials (i.e. magazine, books, newspapers etc.), have also impacted the tonnages requiring management at GLL. The following summarizes some of the key findings that have led to a change in the anticipated closure date of GLL.

1. A review of GLL actual operating conditions has revealed a trend that indicates that settlement in the site is occurring at a rate greater than that initially estimated. Settlement is a result of continually layering the waste as it is landfilled and as the weight of the material increases plus waste decomposition, the layers towards the bottom of the site compress, resulting in additional airspace at the top for further landfilling. Settlement is highly dependent on the composition of the waste that is being landfilled and over the past few years, with significant changes in waste composition, the rate of settlement appears to be increasing. The analysis of this trend suggests that this will continue in the future and is something that should be monitored as it has the potential to further extend the life of the landfill by a number of years.
2. The initial projections of material to be received at the site have been refined as part of the Waste Strategy. Based on the introduction of new, more sophisticated modelling, which now includes a correlation to economic growth factors of the City, the estimates of waste disposal requirements have been determined to be lower than originally estimated. In other words, although the amount of waste requiring landfill in the future will continue to rise, based on the new projections, it will not

increase to the same extent originally envisioned. Therefore, in future years, less landfill capacity will be required annually over what was originally projected.

3. The Waste Strategy will be recommending a series of new waste reduction, reuse, recycling, recovery and residual programs and facilities that have the potential to further extend the life of GLL by up to an additional 8 to 12 years over the original projections and in addition to the additional capacity described in the two points above.

Based on the above three items and assuming the approval of the components of the Waste Strategy as recommended, it estimated that the GLL closure date could be extended to at least 2040.

Blue Bin Materials Processing Capacity

The City currently holds two contracts with Canada Fibers Ltd. (CFL) for processing Blue Bin materials;

1. 110,000 to 140,000 tonnes annually from 2013 to 2020 with one additional extension of up to 2 years.
2. Up to 120,000 tonnes annually from 2014 to 2021 with two, one year extensions.

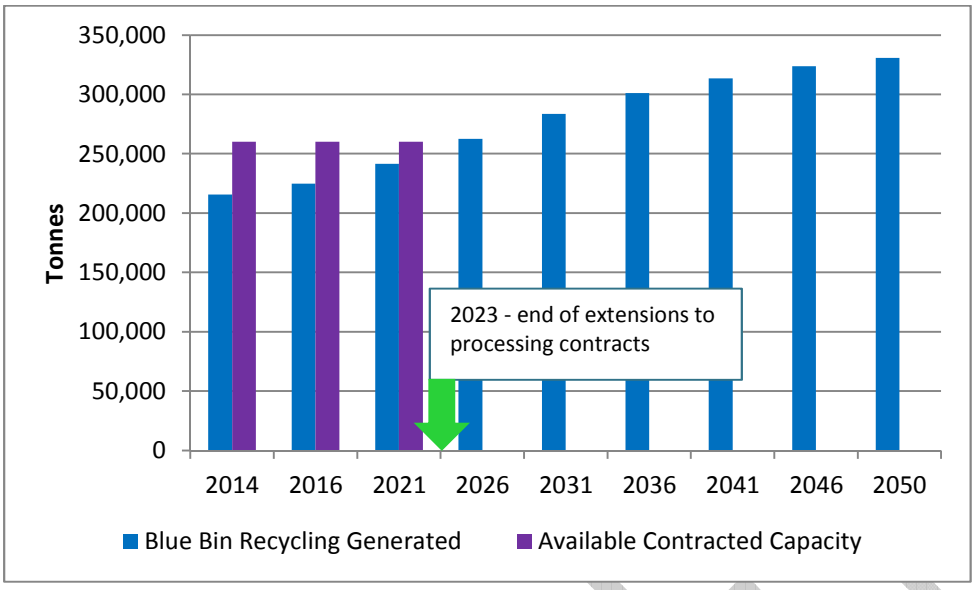
Therefore, currently, the City has a minimum of 230,000 tonnes and a maximum of 260,000 tonnes of Blue Bin materials processing capacity, which currently is sufficient to process the 215,689 tonnes of Blue Bin materials collected in 2014 from residential and non-residential sources.

The first contract could end as soon as 2020, and could be extended to 2022. The second contract could end in 2021 and with extensions, could end in 2022 or 2023.

Based on the projections developed, and barring any changes to the current system, it appears that there is sufficient capacity for the amount of Blue Bin materials collected until the end of the contract period. In 2026, the projected tonnes of Blue Bin materials will exceed 260,000 tonnes, based on the current system, and the current level of diversion. The potential impact of implementing future waste program and facility options on the current Blue Bin processing situation will be assessed as part of the evaluation of long-term options and Waste Strategy development.

Figure 5-8 presents the projected required capacity for Blue Bin material processing, the available contracted capacity based on current contracts and extensions and the projected capacity required to process future quantities of Blue Bin material.

Figure 5-8: Blue Bin Materials Capacity Required



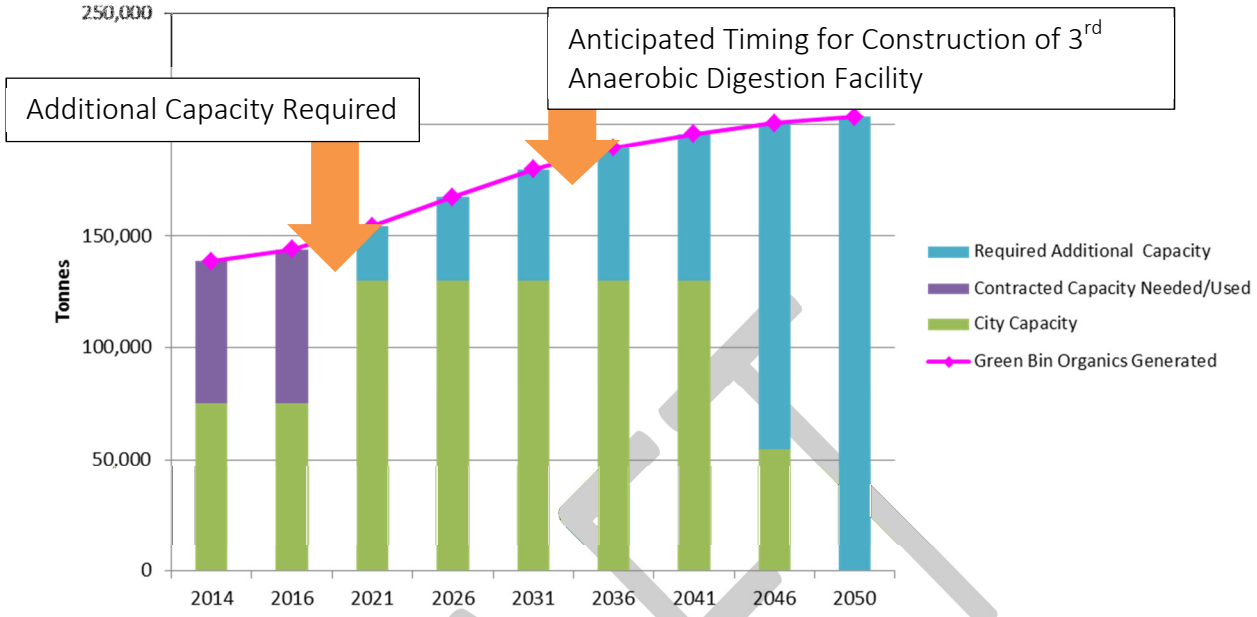
Green Bin Organics Processing Capacity

The City has a number of contracts with the private sector for processing Green Bin organics. Contracts with two large City contracted service providers were just renewed in May 2015, each with capacity for 37,500 tonnes per year (tpy) for three years with two, one year extensions. The City also holds a contract with a smaller City contracted service provider for 10,000 tpy until 2017 with two, one year extensions. All contracts have a 70% put-or-pay provision. As of 2014, the Dufferin Organics Processing Facility has been decommissioned while undergoing an expansion and is expected to be operational in 2018 with a capacity of 55,000 tpy and the Disco AD facility is fully operational with a capacity of 75,000 tpy.

Figure 5-9 presents City and contracted processing capacity for Green Bin organics, based on the projections described in previous sections. Estimates of processing capacity were developed assuming that 100% of the contracted processing capacity is used, all extensions are exercised and that City facilities will last for 30 years[29]. After 2020, the City will require additional capacity as the City's AD facilities will not have sufficient capacity to process the estimated tonnes generated (assuming the Status Quo scenario). As it is difficult to speculate what the future status of the City facilities may be by 2050, it was assumed that the Disco AD facility would no longer be operational in 2044 and that the Dufferin AD facility would no longer be operational in 2048 and thus the City may require processing capacity for most, if not all, Green Bin organics at that time.

[29] Communication with D. Sawyer, City of Toronto

Figure 5-9: Projected Green Bin Organics Requiring Processing Capacity



5.8 Key Findings

1. In order to develop a model to forecast waste generation, the economic indicators needed to be established that could be correlated with waste generation data. The trends between quarterly residential waste generation, Gross Domestic Product (GDP) and population were found to be statistically significant[30]. Some aspects of the downward trend in waste generation noted from 2001 to 2009 (see Figure 5-1) are consistent with what has been found in other cities across Canada and the US, and are related to changing lifestyles and other trends, which have been on-going in the economy and also in residential waste generation since 2001.
2. Because the recent data series is less than 5 years long, it is insufficient for producing long-term forecasts. It is recommended that at least 10 years of observations (ideally without structural breaks) for long-term forecasting purposes. As more observations are collected, the recent data series model can be updated and eventually be the sole model for forecasting waste generation.
3. A series of quarterly waste projections by stream from 2014 to 2021 were developed for a variety of scenarios. These scenarios can be updated with new values for economic indicators and quarterly tonnage data. The City has the opportunity to develop predictive models, which can forecast near term waste generation on a monthly basis. Long-term monthly forecasts can only be produced if monthly economic indicators are forecasted on a long-term basis (more than five years into the future). Relationships between monthly waste generation and monthly economic indicators using the recent data series were also explored. The strongest relationship was found to be between monthly waste generation and monthly city residential building permits. This knowledge can be used to possibly build a "near-term" prediction model, which can predict the amount of waste generated in the upcoming months.
4. Based on projections developed using planning information generated by the City (waste projections from 2022 to 2031 were based on population and household projections obtained from the City of Toronto Planning Division) and projections from 2032 to 2050 (developed assuming a steady state growth rate similar to the growth rate projected for the 2022 to 2031 period), it is estimated that by the end of the planning period, the City could be managing over 1.5 million tonnes of material annually generated by the residential and non-residential sectors.
5. With the implementation of the recommended series of new waste reduction, reuse, recycling, recovery and residual programs and facilities as part of the Waste Strategy, the life of Green Lane Landfill could be extended to at least 2040.

[30] Statistically significant: There is confidence at the 95 percent level that observed trends between tonnage and the economic indicators are real and not due to random fluctuations. Because of this confidence models can be used to predict tonnage.

Based on the projections developed for quantities of Blue Bin materials, and barring any changes to the current system, it appears that there is sufficient capacity for the amount of Blue Bin materials collected until the end of the contract period in 2022. Based on the projections developed for tonnages of Green Bin organic materials requiring processing, it is anticipated that the City will require additional processing capacity after 2020 when current contracts with private sector facilities expire.

6 Next Steps

Now that a Vision for the future has been established, the long-term needs clearly defined and the existing and/or projected gaps, challenges and/or opportunities for the future are understood, a list of options can be developed that reflect this understanding. The development of the list of options is Step 3 in the process and will be documented in the next Technical Memorandum to be prepared entitled "*Technical Memorandum #3 – Options Identification and Evaluation Process*".

A

Economic Models used for Waste Projections

Appendix A -Economic Models Used for Waste Projections

A regression model relates a dependent variable which in this study is a function of quarterly waste generation in tonnes to a set of independent variables which include observations on economic or demographic variables tested to be statistically significant. The independent variables are also referred to as explanatory variables. Because the data series is a time series and has a large seasonality component, the issue of autocorrelation of the model's errors had to be addressed. HDR compensated for seasonality in waste production by including quarterly indicators in the model. An indicator to capture the change in waste generation due to the introduction of the VBRS in the third quarter of 2008 was also included in the model. Transformations on the dependent and independent variables were done to conform to normality assumptions where possible. Examples of such transformations include taking natural logarithms of the variables, lagging time periods and taking differences in observations between consecutive quarters.

HDR tested many transformations for the dependent variable and the possible independent variables to find ones which produced the model with the best fit to the data and had minimal issues with autocorrelation of errors. The results of HDR's modelling activities using the full data and recent data series are discussed in the following sections.

A.1 Full Data Series Model Design

The model HDR developed to relate quarterly waste tonnage trends to trends in economic variables is based on differencing observations between two consecutive quarters. A two step process was necessary to control for autocorrelation common when regressing on time series data. The initial model is formulated as follows:

$$LN(Y_t) = \beta_0 + \beta_1 LN(X1_{(t-1)}) + \beta_2 LN(X2_{(t-1)}) + Q2_t + Q3_t + Q4_t + VBRS_t + e_t$$

Y_t represents the total waste in tonnes for a given quarter at time t, $X1_{(t-1)}$ represents the quarterly participation rate for the Toronto CMA at time t-1 or the previous quarter and $X2_{(t-1)}$ represents the quarterly unemployment rate for the Toronto CMA at time t-1 or the previous quarter. The LN is the natural logarithm function. $Q2_t, Q3_t$, and $Q4_t$ are indicators to denote quarters 2, 3 and 4 respectively at time t. For example, if at a given point of time, it is quarter 2, then the variable $Q2_t$ has a value of one; otherwise, it is zero. If at a point in time, the quarter is quarter 1, then its effect is captured by the constant coefficient β_0. VBRS is an indicator to denote if at any time period, the VBRS was in effect. If the system was in effect at a given point in time, VBRS is one; otherwise it is zero. The parameter e_t captures the error in the model.

While the model is statistically significant based on the F statistic having a significance level less than 1% as shown in Tables A-1 and A-2, the Durbin-Watson test statistic of 0.913 indicates that there is autocorrelation in the model's errors. If autocorrelation were not a series problem

then the Durbin-Watson test statistic would have to be greater than 1.8 based on Durbin-Watson critical values at the 5% significant level[1]. Since ordinary least squares regression assumptions require independence of a model's errors, remedial measures are needed to reduce the effect of autocorrelation. Ideally, if one could find every explanatory variable which would explain the variances in quarterly waste generation in this time series, then autocorrelation of the errors would be non-existent. None of the other available variables from Moody's quarterly indicators tested for statistical significance. It is possible that different variables, if they were available, could explain the variances in quarterly waste generation, however, it is rarely possible that every piece of information is available or can even be collected.

Step 1 Regression Output

Table A - 1: Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.934	.872	.856	.06926	.913

Table A - 2: Model ANOVAModel ANOVA

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1.541	6	.257	53.560	.000
	Residual	.225	47	.005		
	Total	1.767	53			

Table A - 3: Model Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients			95.0% Confidence Interval for B	
		B	Std. Error	Beta	t	Sig	Lower Bound	Upper Bound
1	(Constant)	13.657	.469		29.125	.000	12.714	14.600
	F(Participation Rate)	5.236	1.119	.316	4.679	.000	2.985	7.487
	F(Unemployment Rate)	-.312	.103	-.230	-3.019	.004	-.519	-.104
	Quarter 2 indicator	.280	.026	.679	10.665	.000	.227	.333
	Quarter 2 indicator	.220	.027	.519	8.218	.000	.166	.273
	Quarter 2 indicator	.245	.027	.579	9.167	.000	.191	.299
	Volume Based Rate System Indictor	-.110	.033	-.301	-3.318	.002	-.176	-.043

[1] The critical value for the Durbin-Watson statistic at the 5% level of significance for a model with 6 parameters not including the coefficient and 55 observations is 1.8. See Table A-6 Durbin-Watson test bounds, p.530 from Neter, John and William Wasserman, Michael Kutner, *Applied Linear Regression Models*, Homewood, Illinois, Richard Irwin, Inc, 1983.

To improve the situation arising from correlated errors, HDR differentiated the dependent and independent variables and re-ran the regression[2].

Formally the model can be expressed by the following equation:

$$Y_t' = \beta_0 + \beta_1 X1'_{(t-1)} + \beta_2 X2'_{(t-1)} + Q2_t + Q3_t + Q4_t + VBRS_t + u_t$$

Where

$$Y_t' = LN(Y_t) - \rho LN(Y_{(t-1))}$$

$$X1'_{(t-1)} = LN(X1_{t-1)}) - \rho LN(X1_{(t-2)})$$

$$X2'_{(t-1)} = LN(X2_{t-1}) - \rho LN(X2_{(t-2)})$$

The parameter μ_t captures the error in this model. The parameter ρ is the correlation coefficient of 0.52 estimated using the errors produced from the initial model:

$$\rho = \frac{\sum_{t=2}^{54} e_{(t-1)} e_t}{e^2_{(t-1)}}$$

A way to interpret the final model is to consider for the third quarter (Q) of any given year, if one knew the difference in the quarterly participation rates between Q2 and Q1, and the difference in the quarterly unemployment rates between Q2 and Q1, then one could predict the difference in waste between Q3 and Q2. If Q2 waste data were available, then through simple algebra, one would have a forecast of the waste produced in Q3. As new quarterly forecasts of economic rates are produced and new observations on quarterly waste generation are recorded, waste forecasts can be produced and updated.

The regression outputs from HDR's full series model show that the model is statistically significant based on its F-statistic score in

Table A - 5: Model ANOVA since its significance level is less than 0.0. The adjusted R-square of 0.856 captures how well the model rule explains the data. If one could build a perfect model with no error, the R-square would be equal to one. The Durbin-Watson statistic of 1.506 is still not greater than 1.8, however, the larger statistic does show improvement in reducing the effect of autocorrelation.

[2] Neter, John and William Wasserman, Michael Kutner, *Applied Linear Regression Models*, Homewood, Illinois, Richard Irwin, Inc, 1983, pp. 454-460.

Step 2 Regression Model

Table A - 4: Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.950	.903	.891	.05631	1.506

Table A - 5: Model ANOVA

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1.364	6	.227	71.700	.000
	Residual	.146	46	.003		
	Total	1.510	52			

Table A - 6: Model Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients			95.0% Confidence Interval for B	
		B	Std. Error	Beta	t	Sig.	Lower Bound	Upper Bound
1	(Constant)	6.093	.274		22.225	.000	5.541	6.645
	F(Participation Rate)	3.123	1.270	.130	2.460	.018	.567	5.679
	F(Unemployment Rate)	-.273	.147	-.114	-1.852	.070	-.570	.024
	Quarter 2 indicator	.406	.022	1.062	18.701	.000	.363	.450
	Quarter 2 indicator	.201	.022	.511	9.063	.000	.156	.245
	Quarter 2 indicator	.261	.022	.665	11.753	.000	.216	.306
	Volume Based Rate System Indictor	-.073	.023	-.214	-3.145	.003	-.119	-.026

A.2 Recent Data Series Model Design

Using the more recent series since 2009, HDR found that differences in quarterly employment rates could model trends of differences in quarterly waste trends. Population and GDP variables did have a positive relationship with waste trends; however, their trends were not statistically significant at the 5% level of significance. Over time, as more data points are collected, GDP and other demographic variables may prove to be statistically significant.

The model which HDR developed using the recent data series is as follows:

$$Y_t' = \beta_0 + \beta_1 X1'_{(t-1)} + Q2_t + Q3_t + Q4_t + e_t$$

Where

$$Y_t' = LN(Y_t) - LN(Y_{(t-1)})$$

$$X1'_{(t)} = LN(X1_{t)}) - LN(X1_{(t-1)})$$

$Q2_t, Q3_t$, and $Q4_t$ are indicators to denote quarters 2, 3 and 4 respectively at time t. The parameter e_t captures the error in the model. The model has a high adjusted R-square of 0.876 and its Durbin-Watson statistic passes the test of no evidential autocorrelation (Table A - 7: Model Summary)[3]. The model is statistically significant since the F-statistic has a significance level of less than 0.01 (see Table A - 8: Model ANOVA below)

Table A - 7: Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.949	.900	.876	.07190	1.783

Table A - 8: Model ANOVA

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	.788	4	.197	38.114	.000
	Residual	.088	17	.005		
	Total	.876	21			

Table A - 9: Model Coefficients

Model	Unstandardized Coefficients		Standardized Coefficients			95.0% Confidence Interval for B	
	B	Std. Error	Beta	t	Sig.	Lower Bound	Upper Bound

[3] The critical value for the Durbin-Watson statistic at the 5 percent level of significance for a model with 4 parameters not including the coefficient and 22 observations is 1.797. See Table A-6 Durbin-Watson test bounds, p.530 from Neter, John and William Wasserman, Michael Kutner, *Applied Linear Regression Models*, Homewood, Illinois, Richard Irwin, Inc, 1983.

Model		Unstandardized Coefficients		Standardized Coefficients			95.0% Confidence Interval for B	
		B	Std. Error	Beta	t	Sig.	Lower Bound	Upper Bound
1	(Constant)	-.217	.031		-7.053	.000	-.282	-.152
	F(Employment Rate)	6.023	2.218	.230	2.715	.015	1.342	10.703
	Quarter 2 indicator	.468	.042	1.044	11.123	.000	.379	.556
	Quarter 3 indicator	.117	.048	.246	2.440	.026	.016	.218
	Quarter 4 indicator	.280	.044	.588	6.321	.000	.187	.373

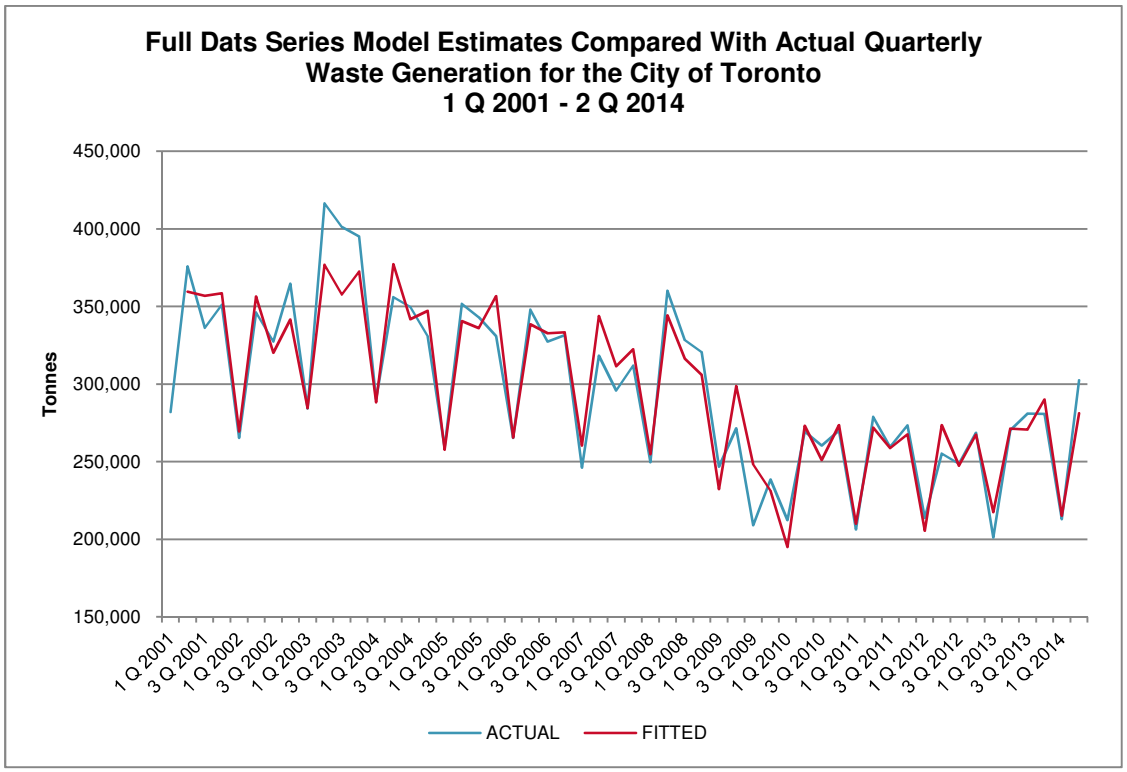
A.3 Results of Waste Generation Model Based on 2001 to 2014 City of Toronto Waste Data and Economic Indicators (Full Data Series Model)

The Full Data Series Model which uses all 54 quarterly observations since 2001 (covering the period 2001 to 2014) is based on comparing differences between two consecutive quarters. HDR found a statistically significant model which related changes in the quarterly differences of total waste generation in tonnes to changes in quarterly differences for labour force participation rate[4] and unemployment rate. The analysis found that waste generation lagged employment trends by a three month period (one quarter). This means that employment and other economic data can be used to predict waste generation into the future with reasonable reliability.

Figure A - 1 compares the actual amounts of waste generated in City of Toronto with the amounts predicted by the Full Data Series Model.

[4] Participation rate is the number of persons in the labour force divided by the population of persons 15 years of age or older. The labour force consists of persons who are unemployed and employed. According to the standard definition employed by Statistics Canada, the employed are persons having a job or business, whereas the unemployed are without work, are available for work, and are actively seeking work.

Figure A - 1: Comparison of Full Data Series Model Waste Estimates for City of Toronto to Actual Waste Generation Tonnage by Quarter (2001 to 2014)



A.4 Results of Waste Generation Model Based on 2009 to 2014 City of Toronto Waste Data and Economic Indicators (Recent Data Series Model)

Using the more recent data series since 2009, HDR found that differences in employment rates[5] between two consecutive quarters was the best predictor of differences in total waste generation between the same two consecutive quarters. Population and GDP variables did have a positive relationship with waste trends; however, the analysis carried out for this study found that their relationship was not statistically significant. Over time, as more data points are collected, GDP and other demographic variables may yet prove to be statistically significant.

Figure A - 2: Comparison of the Recent Data Series Model's Predictions to Actual Waste Generation Tonnage by Quarter in City of Toronto (2009 to 2014) demonstrates how well the Recent Data Series Model's estimates compare with actual total waste generation, except for

[5] Employment rate is the number of employed persons in the labour force divided by the population of persons 15 years of age or older. According to the standard definition employed by Statistics Canada, the employed are persons having a job or business.

the most recent quarter where the prediction for the second quarter (Q2) 2014 is lower than the actual value by 38,000 tonnes. However, the actual value appears to be an aberration or anomaly compared to the other quarters recorded. Figure A - 2: Comparison of the Recent Data Series Model's Predictions to Actual Waste Generation Tonnage by Quarter in City of Toronto (2009 to 2014) shows that waste tonnages are predicted to be considerably lower in the first quarter of each year from 2009 to 2014, and much higher for the other three quarters in each year. This trend occurred as predicted by the model in City of Toronto facilities.

Figure A - 2: Comparison of the Recent Data Series Model's Predictions to Actual Waste Generation Tonnage by Quarter in City of Toronto (2009 to 2014)

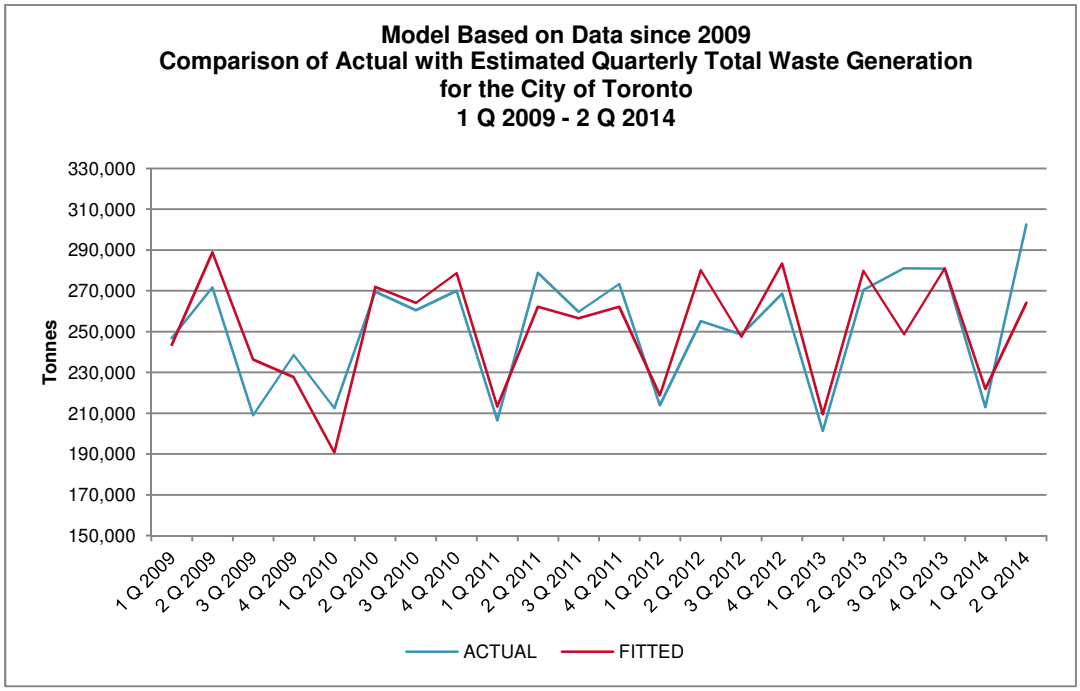


Table A - 10: Total Waste Quantity Projections By Quarter, 2015 to 2021 (Tonnes) below presents the projections for waste generation by quarter for 2015 to 2021. The annual totals are presented in the body of the memo.

Table A - 10: Total Waste Quantity Projections By Quarter, 2015 to 2021 (Tonnes)[6]

Quarter	Total Waste Forecast (tonnes)	
	Low	**High**
1 Q 2015	209,151	230,402
2 Q 2015	274,773	294,915
3 Q 2015	256,928	268,373
4 Q 2015	263,616	289,842
1 Q 2016	208,160	231,874
2 Q 2016	274,109	301,436
3 Q 2016	259,839	277,321
4 Q 2016	269,140	299,507
1 Q 2017	213,717	242,601
2 Q 2017	282,978	312,955
3 Q 2017	266,772	284,789
4 Q 2017	275,158	304,724
1 Q 2018	216,813	243,779
2 Q 2018	285,604	314,475
3 Q 2018	269,466	289,317
4 Q 2018	279,336	312,463
1 Q 2019	220,851	249,970
2 Q 2019	291,973	324,961
3 Q 2019	277,023	298,964
4 Q 2019	287,349	322,881
1 Q 2020	227,330	258,305
2 Q 2020	300,562	338,380
3 Q 2020	287,097	311,309
4 Q 2020	297,660	336,214
1 Q 2021	235,346	272,333
2 Q 2021	312,444	351,310
3 Q 2021	296,062	323,205
4 Q 2021	307,120	349,062

[6] After the regression models had been completed, HDR received the current waste generation for the third and fourth quarters in 2014. The total for the third quarter was 285,350 tonnes. HDR's model had forecasted 263,777 to 269,162 tonnes (-7.6 to -5.7 percent difference). The fourth quarter waste generation was 285,713. HDR's model had forecasted 267,505 to 288,003 tonnes (-6.4 to 0.1 percent difference).

A.5 Comparison of HDR Economic Model Forecast with Tonnes per Capita Approach, 2015 to 2021

Traditionally, waste management planners have used per capita waste generation rates to develop waste projections. This approach does not capture economic growth or lack of economic growth in a community, both of which can significantly impact on waste generation. Table A - 11: Comparison of Per Capita Forecasts to HDR's Model Forecasts compares forecasts using the HDR model and the per capita waste generation rate for 2006, 2011 and 2021 as an example.

If a waste projection for 2011 was developed in the year 2007, a per capita waste generation rate could be calculated from 2006 and 2007 data. Applying this per capita generation rate to a 2011 forecasted population (as would be done in traditional waste planning exercises), results in an estimated waste generation value which is approximately 315,000 tonnes greater than what was actually generated.

Waste generation projections in the mid- to long term are also difficult to determine with any degree of certainty. As shown for 2021, the projected waste generated using the per capita waste generation method is even lower than in 2011 since the per capita rate in 2011 dropped by almost 25% compared to the rate in 2006 despite the growth in population. This change in per capita waste generation is attributed to a number of factors discussed in the body of this Memorandum (changing lifestyles; less printed media; a move to light-weighted packaging, economic incentives to reduce waste as a result of the volume based rate structure, and very significantly for City of Toronto, the move to a higher percentage of residences in multi-residential units rather than single family households.

HDR's modelled forecasts for 2011 are significantly closer to the actuals since they are based on changes in the economy. The high forecast is within 1% of the actual value. Economic activity stuttered at times over the period 2006 to 2011 impacting the amount of waste generation. HDR's forecasts in 2021 are higher than the forecast from the latest per capita estimate since the economic forecasts for 2021 are higher than seen in 2011 and the forecasted growth rates are higher than the population growth rates. If there are any revisions to the economic forecasts for 2021, the model's forecasts should be revised accordingly.

Table A - 11: Comparison of Per Capita Forecasts to HDR's Model Forecasts

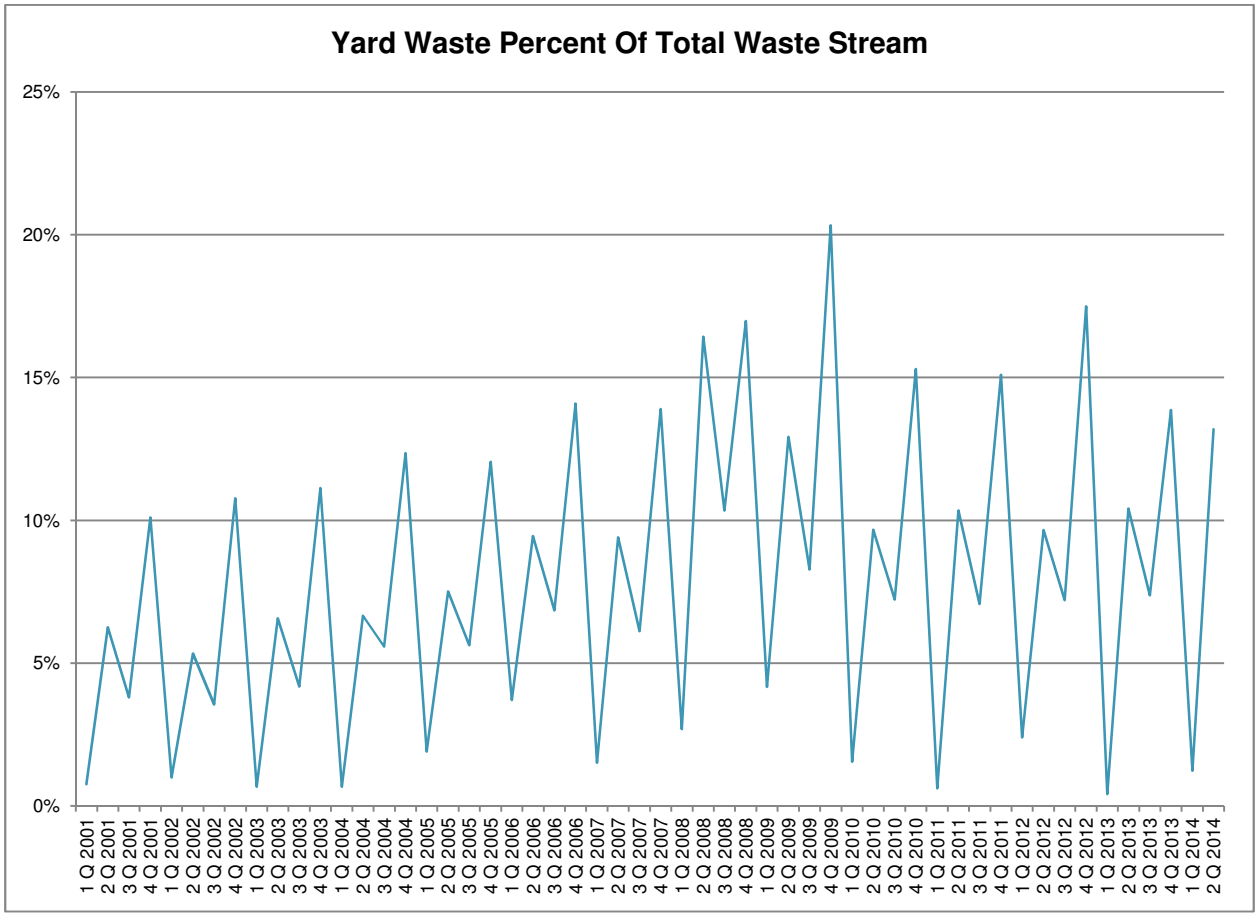
Year	Population	Actual Waste Generated (tonnes)	Per Capita Waste Generation Rate tonnes/capita	Forecasted Waste Generated based on previous per capita rate	HDR Model Forecast Low	HDR Model Forecast High
2006	2,724,784	1,272,405	.467			
2011	2,855,084	1,018,355	.357	1,333,252	994,280	1,008,029
2021	2,957,375			1,054,840	1,150,973	1,295,910

*2006 and 2011 population from Statistics Canada, 2021 population based on Flashforward projections

A.6 Historical Contribution of Five Waste Streams to Total City of Toronto Waste Stream

Figures 10 to 14 show how the contribution of each of the five waste streams to the total waste stream has changed over time on a quarterly basis. For each of the five waste streams the value is expressed as a percentage of the total waste generated. The quarterly percentages that yard waste, Blue Bin materials and Green Bin organics represent of the total waste stream are relatively stable since 2010/2011. The "other[7]" category has increased significantly since 2009, predominantly from increases in IC&I waste managed by the City. A stabilized percentage contribution for the other waste stream to the total waste stream was assumed from 2015 on, as a continued growth rate for this stream was not considered realistic for waste projections.

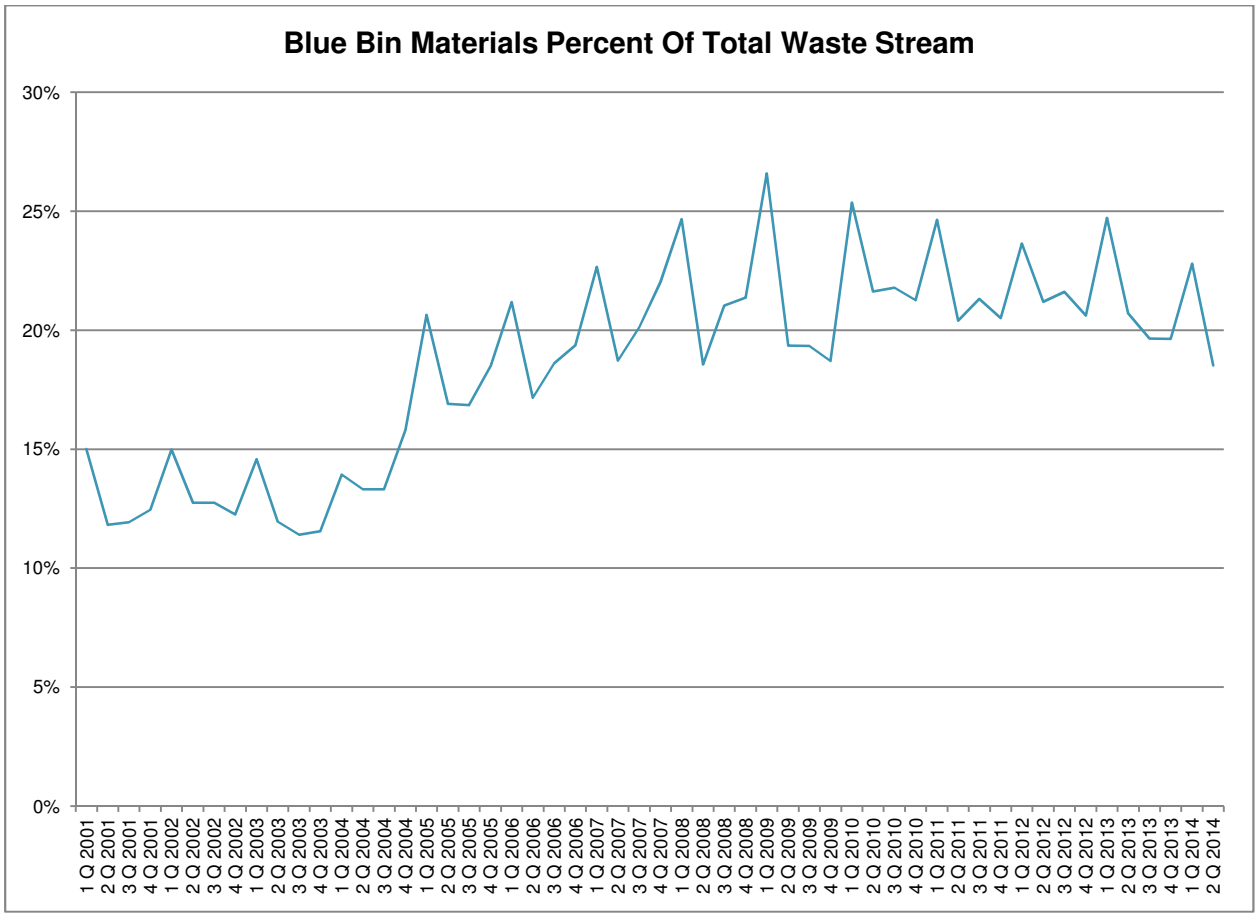
Figure A - 3: Yard Waste Quarterly Contribution to Total City of Toronto Waste Stream (% for Q1 2001 to Q2 2014



[7] Other includes non-recyclable and recyclable durable goods (e.g. couches, mattresses); street sweepings, IC&I waste, OCC, e-waste, drywall, scrap metal, log/branches, Christmas trees, woodchips and tires..

The figure shows that as would be expected, the generation of yard waste is very seasonal in nature with highest tonnages in spring and fall.

Figure A - 4: Blue Bin Materials: Quarterly Percent of Total Waste Stream Managed, City of Toronto (Q1 2001 to Q2 2014)



This figure shows that Blue Bin materials have been increasing as a percentage of the total waste generation managed by City of Toronto, with significant seasonal peaks and valleys each year. The contribution increased after 2007, as the VBRS was rolled out across the City and incentives were provided to decrease garbage and increase participation and capture in the Blue Bin program.

Figure A - 5: Green Bin Organics: Quarterly Percent Contribution to City of Toronto Total Waste Stream (Q1 2001 to Q2 2014) shows the increase in the Green Bin organics as a percentage of all City of Toronto tonnes managed. The dramatic increase in 2007 to 2010 is as a result of the rollout of the Green Bin program to single family homes and multi-residential buildings and the VBRS.

Figure A - 5: Green Bin Organics: Quarterly Percent Contribution to City of Toronto Total Waste Stream (Q1 2001 to Q2 2014)

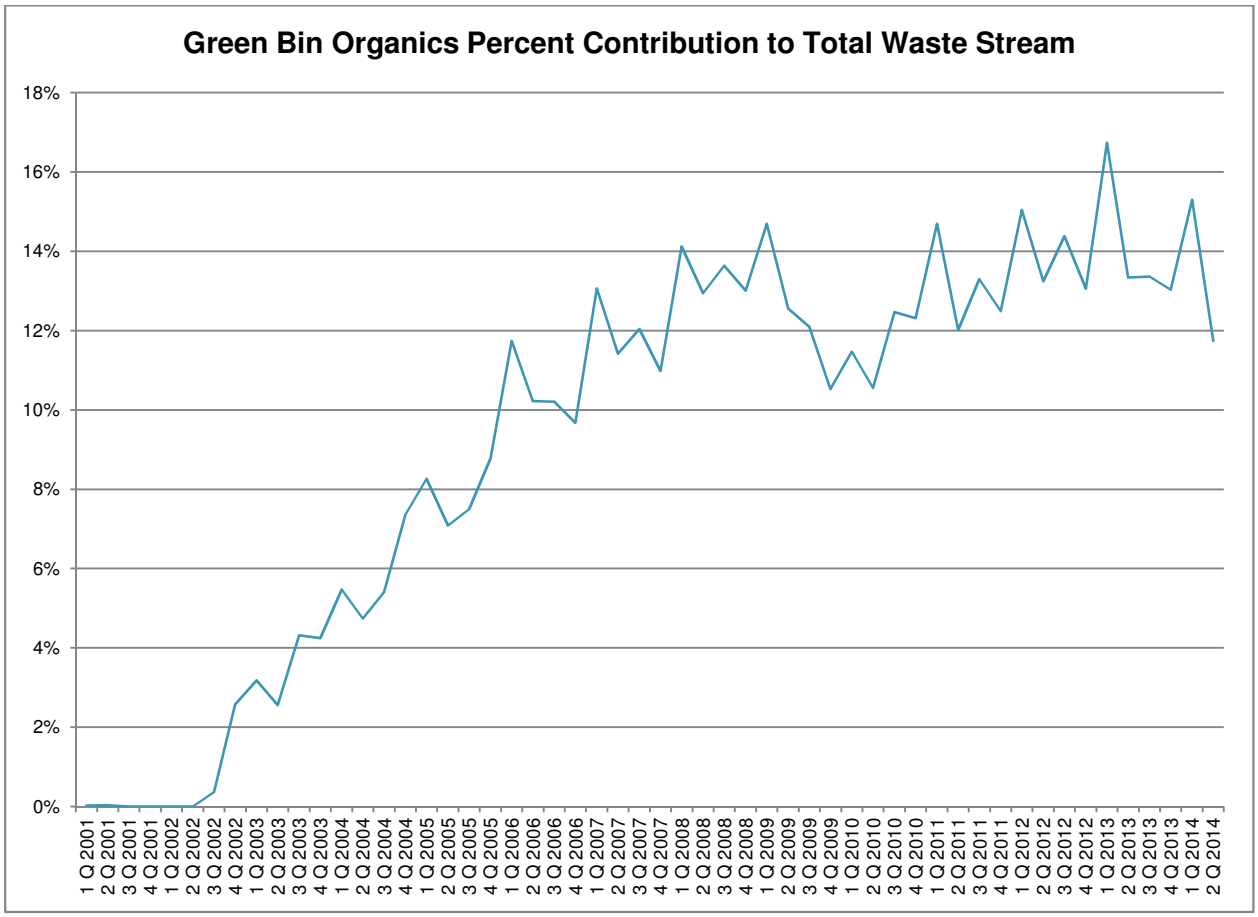
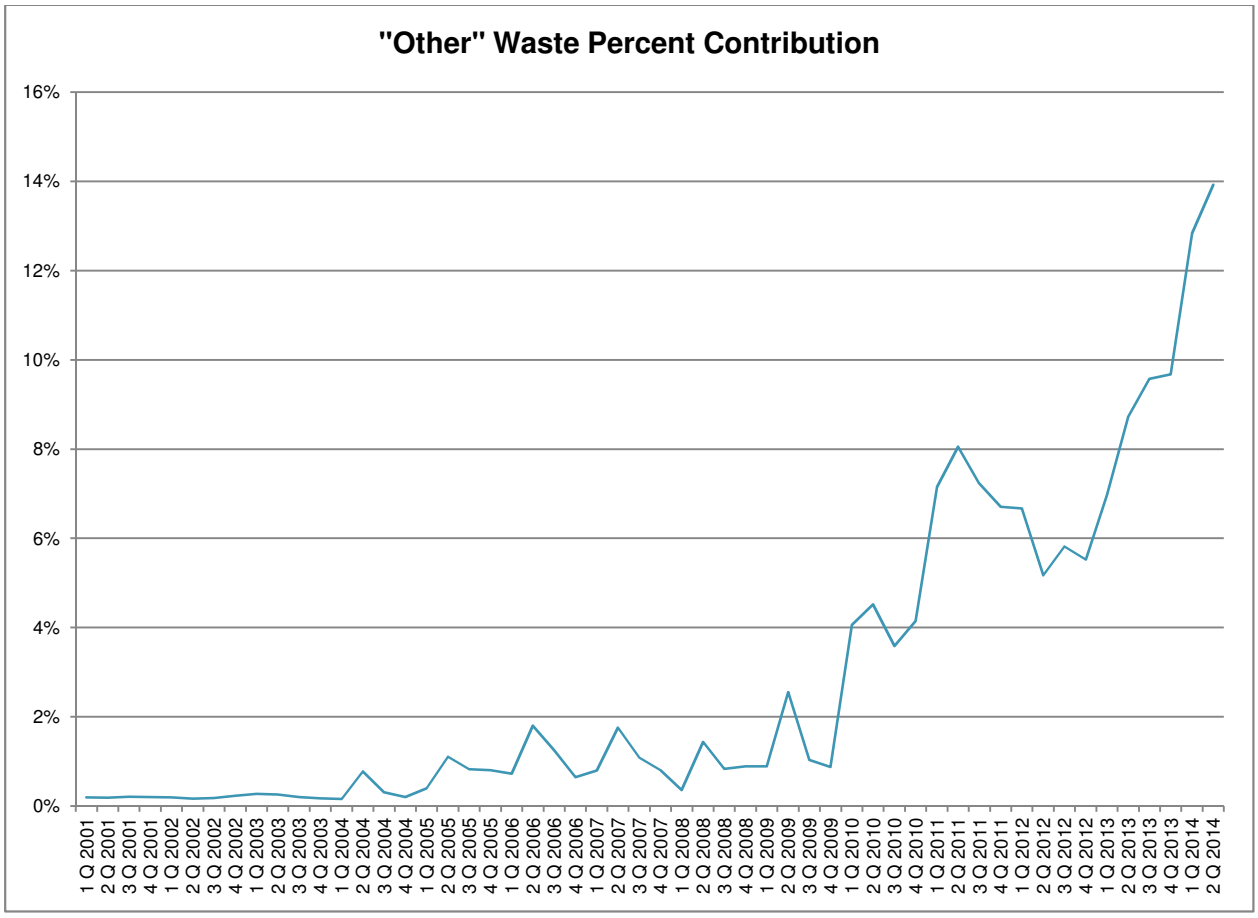


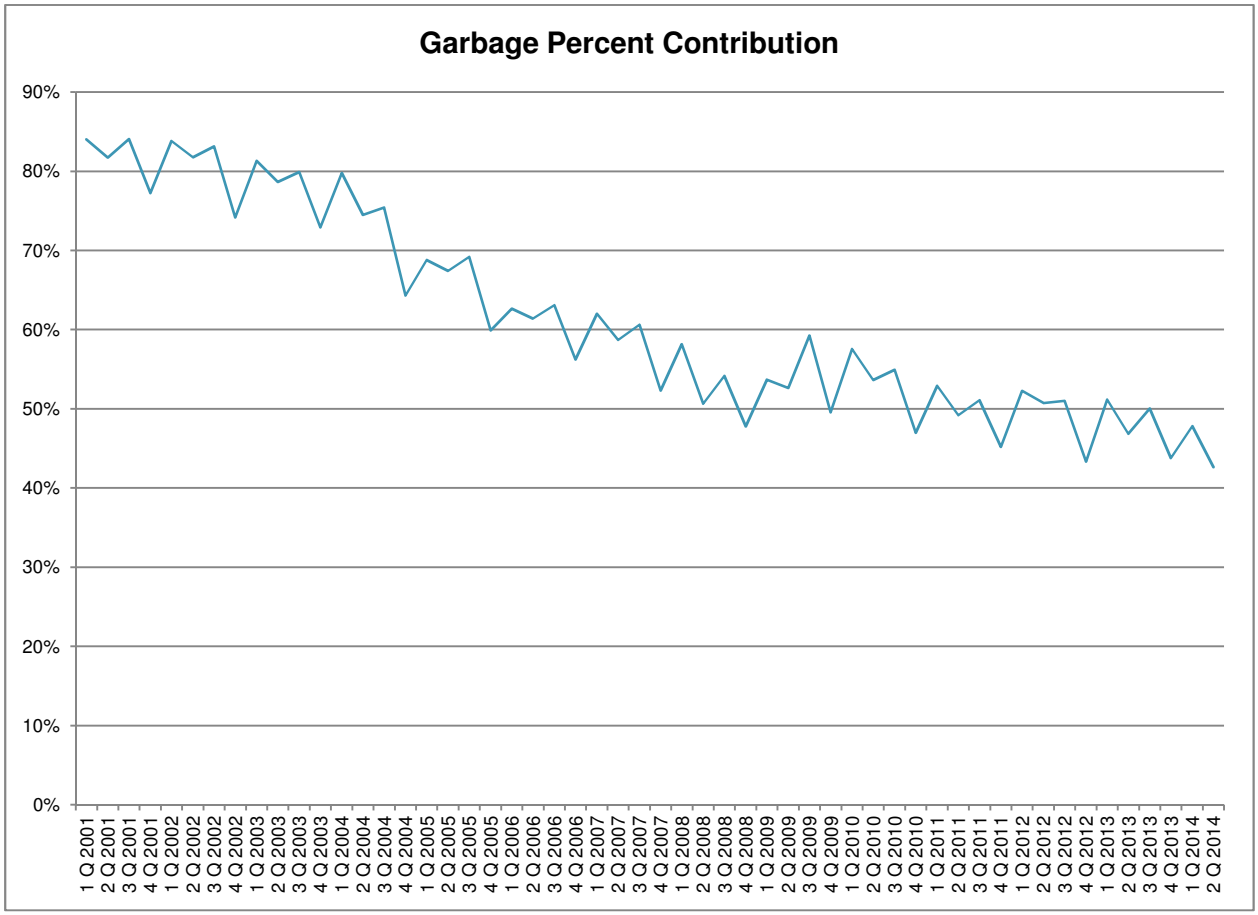
Figure A - 6: Other Material: Quarterly Percent Contribution to Total City of Toronto Waste (Q1 2001 to Q2 2014) shows the significant increase in the percentage contribution of the "other[8]" material category to total City of Toronto waste. Note that the large increase in 2013 may be attributed to larger quantities of street sweepings, IC&I waste and woodchips being managed by the City. Similarly, in 2014, another spike may be attributed to large increases in quantities of IC&I waste and woodchips.

Figure A - 6: Other Material: Quarterly Percent Contribution to Total City of Toronto Waste (Q1 2001 to Q2 2014)



[8] Other includes non-recyclable and recyclable durable goods (e.g. couches, mattresses); street sweepings, IC&I waste, OCC, e-waste, drywall, scrap metal, log/branches, Christmas trees, woodchips and tires..

Figure A - 7: Garbage Contribution to Total Waste Stream (Q1 2001 to Q2 2014)



Garbage is calculated as the total minus the contribution of the other four waste streams. It has decreased from a value of around 80% in 2001 to a value of around 50% for the last few years, and continues to trend downwards as waste diversion and waste reduction increases over time.

A.7 Modelled Contribution of Five Streams to the Total Waste Stream

Using the economic modelling approach to allocate quarterly and annual estimates across the five different waste streams, the quarterly rates for yard waste, Blue Bin materials, and Green Bin organics were fixed based on averaging each season's percent contribution over the 2010/2011 – 2014 period, as these series had the most stable trends over this period.

It was assumed that the 'other' category would make up 13% to 14% of the total managed waste stream in the first two quarters of each year, based on 2014 data, and 1% less in the third and fourth quarters based on 2012 data. Two other scenarios where the quarterly 'other'

percent would be higher than the average steady state by 40% and lower than the average steady state by 40% were also modelled

Garbage contribution to the total waste stream was calculated as the difference between 100 % and the sum of the contributions of the other 4 streams[9].

The quarterly percent contribution estimates for yard waste, Blue Bin materials and Green Bin organics are presented in Table A - 12: Assumptions on Quarterly Percent Contribution to Total Waste Stream for Yard Waste, Blue Bin materials and Green Bin Organics along with the assumptions used to set these values. The percent contribution estimates for 'other' waste stream under the average steady state scenario are in Table A - 13: Quarterly Percent Contribution Assumptions for Other Material and Garbage: Average Steady State Scenario while the higher and lower steady state scenarios are in Table A - 14: Quarterly Percent Contribution Assumptions for Other Material and Garbage: High and Low Steady State Scenarios.. Quarterly and annual forecasts from 2014 to 2021 per stream are in the tables below.

Table A - 12: Assumptions on Quarterly Percent Contribution to Total Waste Stream for Yard Waste, Blue Bin materials and Green Bin Organics

Quarter	Waste Stream	Contribution to Total Waste Stream (%)	Comment
1	Yard Waste	1%	Average of first qtrs over 2010 - 2014
2	Yard Waste	11%	Average of second qtrs over 2010 - 2014
3	Yard Waste	7%	Average of third qtrs over 2010 - 2013
4	Yard Waste	15%	Average of fourth qtrs over 2010 - 2013
1	Blue Bin materials	24%	Average of first qtrs over 2010 - 2014
2	Blue Bin materials	20%	Average of second qtrs over 2010 - 2014
3	Blue Bin materials	21%	Average of third qtrs over 2010 - 2013
4	Blue Bin materials	21%	Average of fourth qtrs over 2010 - 2013
1	Green Bin Organics	15%	Average of first qtrs over 2011 - 2014
2	Green Bin Organics	13%	Average of second qtrs over 2011 - 2014
3	Green Bin Organics	14%	Average of third qtrs over 2011 - 2013
4	Green Bin Organics	13%	Average of fourth qtrs over 2011 - 2013

Table A - 13: Quarterly Percent Contribution Assumptions for Other Material and Garbage: Average Steady State Scenario

Scenario 1: Average Steady State					
Quarter	**Waste Stream**	**Composition**	**Comment**	**Waste Stream**	**Contribution to Total Waste Stream**

[9] Note that the average percent for garbage for quarters 1, 2, 3 and 4 since 2010 are 51%, 47%, 51%, and 44% of the total waste stream respectively.

Scenario 1: Average Steady State					
1	Other	13%	Value from first quarter 2014	Garbage	46%
2	Other	14%	Value from second quarter 2014	Garbage	42%
3	Other	12%	Estimate based on 2012 trend where qtrs 3 and 4 are one percent lower than than qtr 1	Garbage	46%
4	Other	12%	Estimate based on 2012 trend where qtrs 3 and 4 are one percent lower than than qtr 1	Garbage	39%

Table A - 14: Quarterly Percent Contribution Assumptions for Other Material and Garbage: High and Low Steady State Scenarios.

Quarter	Scenario 2: High Steady State		Scenario 3: Low Steady State	
	Other	**Garbage**	**Other**	**Garbage**
1	18%	41%	8%	51%
2	19%	37%	8%	48%
3	17%	41%	7%	51%
4	17%	34%	7%	44%

The percent contribution estimates under Scenario 2 are 40% higher than used in Scenario 1. The percent contribution estimates under Scenario 3 are 40% lower than used in Scenario 1.

The estimates by quarter are presented in Table A - 15: Quarterly City of Toronto Waste Projections by Stream, 2015 – 2021 Using Modelling Approach below and annual estimates are presented in the body of the Memorandum.

Table A - 15: Quarterly City of Toronto Waste Projections by Stream, 2015 – 2021 Using Modelling Approach

Quarter	Yard Waste		Blue Bin materials		Green Bin Organics		OTHER - Scenario 1		GARBAGE - Scenario 1		OTHER - Scenario 2		GARBAGE - Scenario 2		OTHER - Scenario 3		GARBAGE - Scenario 3	
	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High
1 Q 2015	2,598	2,862	50,679	55,828	32,295	35,577	26,853	29,581	96,726	106,555	37,594	41,414	85,985	94,722	16,112	17,749	107,467	118,387
2 Q 2015	29,275	31,421	56,298	60,425	34,573	37,108	38,256	41,060	116,371	124,902	53,558	57,484	101,069	108,478	22,953	24,636	131,673	141,326
3 Q 2015	18,552	19,378	54,185	56,599	35,144	36,709	30,831	32,205	118,215	123,481	43,164	45,087	105,883	110,600	18,499	19,323	130,548	136,363
4 Q 2015	40,689	44,737	54,047	59,424	33,902	37,275	31,634	34,781	103,344	113,625	44,287	48,694	90,690	99,713	18,980	20,869	115,997	127,538
1 Q 2016	2,586	2,880	50,438	56,184	32,142	35,804	26,726	29,770	96,268	107,235	37,416	41,678	85,578	95,327	16,035	17,862	106,958	119,143
2 Q 2016	29,204	32,115	56,162	61,761	34,490	37,928	38,163	41,968	116,090	127,663	53,428	58,755	100,824	110,876	22,898	25,181	131,355	144,451
3 Q 2016	18,762	20,024	54,799	58,486	35,542	37,933	31,181	33,279	119,555	127,599	43,653	46,590	107,083	114,287	18,708	19,967	132,028	140,910
4 Q 2016	41,542	46,229	55,179	61,405	34,613	38,518	32,297	35,941	105,509	117,414	45,216	50,317	92,591	103,038	19,378	21,565	118,428	131,790
1 Q 2017	2,655	3,014	51,785	58,784	33,000	37,460	27,439	31,147	98,838	112,196	38,415	43,606	87,862	99,737	16,463	18,688	109,814	124,655
2 Q 2017	30,149	33,343	57,979	64,121	35,606	39,378	39,398	43,572	119,846	132,542	55,157	61,000	104,087	115,113	23,639	26,143	135,605	149,970
3 Q 2017	19,262	20,563	56,261	60,061	36,490	38,955	32,013	34,175	122,745	131,035	44,818	47,845	109,940	117,365	19,208	20,505	135,550	144,705
4 Q 2017	42,471	47,034	56,413	62,475	35,387	39,189	33,019	36,567	107,869	119,459	46,227	51,194	94,661	104,832	19,811	21,940	121,076	134,086
1 Q 2018	2,693	3,028	52,535	59,069	33,478	37,642	27,837	31,299	100,270	112,741	38,971	43,818	89,135	100,221	16,702	18,779	111,404	125,260
2 Q 2018	30,429	33,505	58,517	64,433	35,936	39,569	39,764	43,783	120,958	133,186	55,669	61,297	105,053	115,672	23,858	26,270	136,864	150,699
3 Q 2018	19,457	20,890	56,829	61,016	36,859	39,574	32,336	34,718	123,984	133,118	45,270	48,605	111,050	119,231	19,402	20,831	136,919	147,006
4 Q 2018	43,115	48,229	57,270	64,061	35,924	40,184	33,520	37,496	109,506	122,493	46,928	52,494	96,098	107,495	20,112	22,497	122,914	137,491
1 Q 2019	2,743	3,105	53,514	60,569	34,102	38,598	28,355	32,094	102,137	115,604	39,697	44,931	90,795	102,767	17,013	19,256	113,479	128,441
2 Q 2019	31,107	34,622	59,822	66,581	36,738	40,888	40,650	45,243	123,656	137,627	56,911	63,340	107,396	119,529	24,390	27,146	139,916	155,724
3 Q 2019	20,003	21,587	58,423	63,051	37,893	40,894	33,243	35,876	127,462	137,557	46,540	50,226	114,164	123,207	19,946	21,525	140,759	151,907
4 Q 2019	44,352	49,837	58,912	66,197	36,955	41,524	34,482	38,746	112,648	126,577	48,275	54,244	98,855	111,079	20,689	23,247	126,440	142,076
1 Q 2020	2,824	3,209	55,083	62,589	35,102	39,885	29,187	33,164	105,133	119,459	40,862	46,429	93,459	106,193	17,512	19,898	116,808	132,724
2 Q 2020	32,022	36,051	61,582	69,331	37,818	42,577	41,846	47,111	127,293	143,310	58,585	65,956	110,555	124,465	25,108	28,267	144,032	162,154
3 Q 2020	20,730	22,478	60,548	65,654	39,271	42,583	34,452	37,357	132,097	143,237	48,232	52,300	118,316	128,294	20,671	22,414	145,878	158,180
4 Q 2020	45,944	51,895	61,026	68,931	38,281	43,239	35,719	40,346	116,690	131,804	50,007	56,484	102,402	115,666	21,431	24,207	130,977	147,942
1 Q 2021	2,924	3,383	57,026	65,988	36,340	42,051	30,216	34,965	108,841	125,946	42,303	48,951	96,755	111,960	18,130	20,979	120,927	139,932
2 Q 2021	33,288	37,429	64,017	71,980	39,313	44,204	43,500	48,912	132,325	148,786	60,901	68,476	114,925	129,221	26,100	29,347	149,725	168,351

Quarter	Yard Waste		Blue Bin materials		Green Bin Organics		OTHER - Scenario 1		GARBAGE - Scenario 1		OTHER - Scenario 2		GARBAGE - Scenario 2		OTHER - Scenario 3		GARBAGE - Scenario 3	
	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High
3 Q 2021	21,377	23,337	62,439	68,163	40,497	44,210	35,527	38,785	136,222	148,711	49,738	54,298	122,011	133,197	21,316	23,271	150,433	164,224
4 Q 2021	47,404	53,878	62,966	71,565	39,497	44,891	36,854	41,887	120,398	136,841	51,596	58,642	105,657	120,086	22,113	25,132	135,140	153,595

B

Historical Waste Quantity Data Used for Waste Projections

Appendix B: Historical Waste Quantity Data Used for Waste Projections

Table B - 1: Residential Waste Managed by City of Toronto, 2001 to 2014 (tonnes) summarizes residential waste management information for the City for 2001 to 2014.

The data are presented in Figure B - 1: Historical Residential Waste Generation, Diversion and Disposal, City of Toronto, 2001 to 2014 which shows that the residual waste requiring disposal has declined steadily since 2001 even though the population of the city has steadily increased. This is a result of diligent efforts by City of Toronto to continuously implement policies and programs that encourage waste diversion.

Appendix B– Historical Waste Quantity Data Used for Waste Projections

Table B - 1: Residential Waste Managed by City of Toronto, 2001 to 2014 (tonnes)

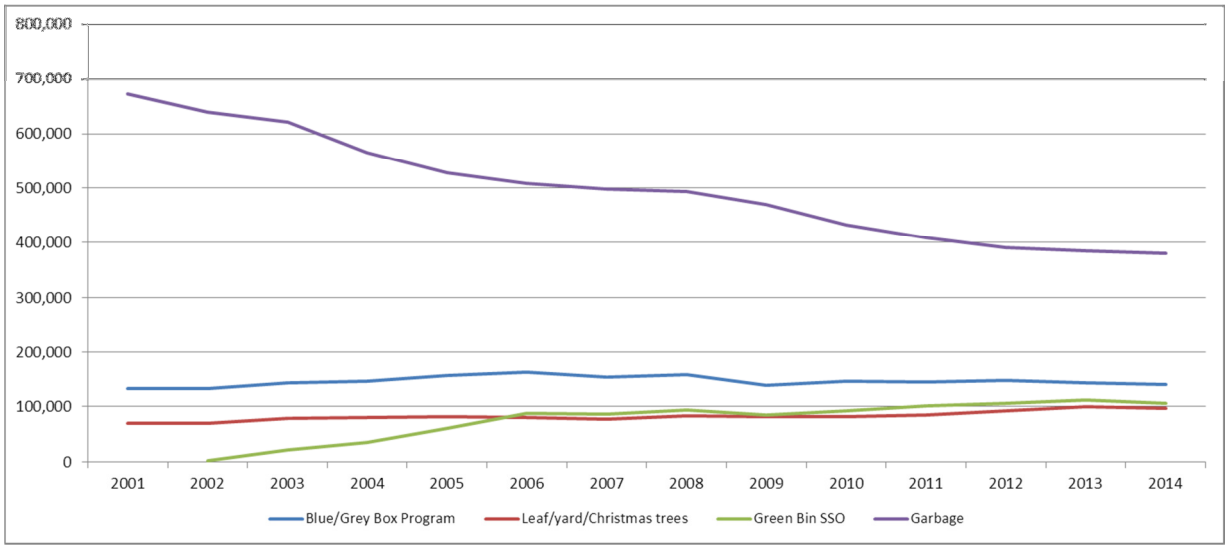
Residential Waste Stream	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	**2014**
Single Family Households[10] (units)			497,000	506,800	511,034	525,846	525,846	442,546	444,480	453,048	457,257	459,511	459,441	460,303
Multi Residential Households[11] (units)			461,979	473,372	492,632	524,724	540,467	554,347	499,314	441,058	425,011	419,824	421,740	416,815
Residential Blue Bin Program	133,922	134,623	143,853	147,936	158,116	163,385	154,799	158,747	139,757	147,236	146,538	148,336	143,935	141,206
Residential L&YM/Xmas trees	69,124	69,778	78,598	80,069	81,574	80,069	77,509	82,766	82,084	82,470	84,297	92,474	99,822	96,068
Backyard Composting	17,340	17,791	18,171	18,324	18,460	18,554	18,652	18,739	18,826	18,899	18,970	19,045	19,120	19,179
Residential Green Bin		2,976	21,929	35,808	60,273	87,505	85,552	94,201	84,674	92,715	100,663	105,491	111,848	106,040
Environment Days/Depots (Res)	2,184	2,112	2,408	2,858	843	768	860	900	1,455	1,992	2,713	2,119	3,610	1,681
Residential WEEE								910	1,095	1,834	1,719	979	849	937
Residential Large Appliances/Scrap Metal	3,504	2,678	2,773	6,036	7,450	5,908	4,422	4,837	4,983	4,238	3,641	2,860	3,290	3,826
Grass-cycling	10,051	10,085	11,650	11,635	11,936	11,680	11,296	12,085	15,977	16,054	17,166	18,095	19,964	19,214
Residential MHSW	1,220	781	865	863	808	1,015	1,086	1,162	1,175	1,563	1,544	1,531	1,622	1,844
Beer Store Deposit Return (allow for res)	6,457	6,535	6,588	6,629	6,690	6,737	6,545	13,841	13,865	13,889	14,409	14,532	14,655	14,779
LCBO Deposit Return (allowance for res)							6,570							
Residential Tires												18,726	20,507	19,043
Residential Diversion	243,802	247,359	286,835	310,158	346,150	375,621	367,291	388,188	363,891	380,890	391,660	424,188	439,222	423,817
Residential Waste	671,062	639,443	621,322	565,910	527,878	509,403	497,809	494,539	470,379	432,539	408,202	391,262	384,521	380,552
Diversion and Waste	914,864	886,802	908,157	876,068	874,028	885,024	865,100	882,727	834,270	813,429	799,862	815,450	823,743	804,369
Overall Diversion Rate	27%	28%	32%	35%	40%	42%	42%	44%	44%	47%	49%	52%	53%	53%

Source: City of Toronto, Year over Year Comparison of Residential Diversion

[10] Note that numbers of single family and multi-residential households were adjusted in 2007 to 2009 when the VBRS was introduced and actual households served by the City were confirmed.

[11] Number of multi-residential households were revised when the VBRS was introduced in 2008-2009. Numbers from 2010 indicate actual units served by the City.

Figure B - 1: Historical Residential Waste Generation, Diversion and Disposal, City of Toronto, 2001 to 2014



Source: City of Toronto, Year over Year Comparison of Residential Diversion

Non-residential garbage managed by the City includes commercial waste and litter bins at streets and parks, as well as street sweepings, waste from City Agencies and Commissions, paid tonnes at transfer stations (residential as well as non-residential customers (all are counted as commercial transactions)) and processing residues. The quantities of both residential and non-residential waste handled for the last four years at City of Toronto facilities are presented in Table B - 2: Residential and Non-Residential Waste Managed By City of Toronto, 2010 to 2014 below.

Table B - 2: Residential and Non-Residential Waste Managed By City of Toronto, 2010 to 2014

Source	2010	2011	2012	2013	2014
Residential and Non-Residential Garbage Quantities					
Single family	150,257	144,724	135,805	137,154	136,935
Large multi-family	217,170	199,817	190,561	189,582	181,382
Small multi-family	28,841	26,863	27,893	30,676	24,310
Total Residential Garbage Collected	**396,268**	**371,404**	**354,258**	**357,412**	**342,627**
Commercial	5,000	4,862	4,641	6,015	13,470
Litter Bins	3,119	2,585	2,491	2,631	4,921
Garbage collected by Parks Department	754	2,970	3,194	3,474	3,240
Total Non-Residential Garbage Collected	**8,873**	**10,417**	**10,326**	**12,120**	**21,631**
Total Garbage Collected	**405,141**	**381,821**	**364,584**	**369,532**	**364,258**
Garbage Managed at Transfer Stations					
Agencies/Commissions/CIRO Drop-Offs	23,177	27,578	20,988	16,890	16,329
Street Sweepings collected by Transportation Department				14,071	20,125
Garbage from Residential and Non-Residential Drop-off (Paid Tonnes)	67,699	63,201	64,927	68,554	77,411
Total Garbage Managed at Transfer Stations	**496,017**	**472,600**	**450,499**	**469,046**	**478,123**
Processing Residue	55,894	51,932	51,019	56,110	47,166
Total Garbage Inbound	**551,911**	**524,532**	**501,517**	**525,156**	**525,289**
Difference between Inbound and Outbound	8,327	1,219	437	517	840
Total Garbage Outbound	**560,238**	**525,752**	**501,954**	**525,673**	**524,449**

Source: *Technical Memorandum #1 Draft – Current System Summary, 2014 Tonnage Map*

C

Historical Tonnes Managed and Diverted

Appendix C– Historical Tonnes Managed and Diverted

Table C- 1: 2014 Tonnage Map

	2010 Actuals	2011 Actuals	2012 Actuals	2013 Actuals	2014 Actuals
Total (TS -Waste & Diversion Services)	958,400	940,281	923,473	946,015	978,099
Garbage Quantities					
Curbside Collection (Single family, non-residential, schools, non-profits)	150,257	144,724	135,805	137,154	136,935
Front-end Collection (Multi-residential, schools, Agencies & Corporations)	217,170	199,817	190,561	189,582	181,382
Multi-residential - Contracted	217,128	199,669	190,440		
Curbside Collection (Multi-residential)	28,841	26,863	27,893	22,970	24,310
Multi-residential Total	*246,011*	*226,680*	*218,454*	*212,552*	*205,692*
Commercial	5,000	4,862	4,641	13,720	13,470
Litter Bins	3,119	2,585	2,491	2,631	4,921
Collection - Parks	754	2,970	3,194	3,474	3,240
Total Collection	*405,141*	*381,821*	*364,584*	*369,531*	*364,258*
Agencies & Corporations/Non-Profit Drop-Offs	23,177	27,578	20,988	16,890	16,329
Street Sweepings collected by Transportation Department				14,071	20,125
Garbage from Residential and Non-Residential Drop-off (Paid Tonnes)	67,699	63,201	64,927	68,554	77,411
Total Waste (TS) Inbound	*496,017*	*472,600*	*450,499*	*469,046*	*478,123*
Total Processing Residue	55,894	51,932	51,019	56,110	47,166
Total Waste (TS) Inbd incl. residue	*551,911*	*524,532*	*501,517*	*525,155*	*525,289*
Difference between Inbound and Outbound	**8,327**	1,219	437	**517**	**840**
Total Waste (TS) Outbound	*560,238*	*525,752*	*501,954*	*525,672*	*524,449*

Appendix C– Historical Tonnes Managed and Diverted

Table C- 1: 2014 Tonnage Map

	2010 Actuals	2011 Actuals	2012 Actuals	2013 Actuals	2014 Actuals
Blue Bin materials Quantities					
Curbside Collection (Single family, non-residential, schools, non-profits)	153,680	144,915	140,258	140,171	137,205
Front-end Collection (Multi-residential, schools, Agencies & Corporations)	44,518	48,621	53,786	55,415	55,776
Curbside Collection (Multi-residential)	12,979	11,802	7,055	7,946	8,104
Total Residential - Blue Bin materials	*211,177*	*205,338*	*201,099*	*203,550*	*201,085*
Commercial (including Special Events)	12,000	9,843	8,521	8,070	10,255
Litter Bins	1,346	2,123	2,216	2,242	1,883
Blue Bin Materials Collected by Parks Department	69	496	508	878	890
Total Non-Residential -Blue Bin Materials	*13,415*	*12,462*	*11,245*	*11,190*	*13,028*
Agencies & Corporations/Non-Profit Drop-Offs	868	640	606	561	635
Paid Tonnes at Transfer Stations	808	737	729	797	941
Total Blue Bin Materials at Transfer Stations	*1,676*	*1,377*	*1,335*	*1,358*	*215,689*
Total Blue Bin Materials Collected	*226,268*	*219,177*	*213,679*	*216,098*	*213,671*
Blue Bin Materials - Processed Tonnes Paid		*167,595*	*184,635*	*188,897*	*199,629,*
Blue Bin Materials - Tonnes Marketed	*168,702*	*167,595*	*169,137*	*163,835*	*163,988*

Green Bin Organics Quantities					
Curbside Collection (Single family, non-residential, schools, non-profits)	105,178	112,716	116,033	118,597	111,364
Front-end Collection (Multi-residential, schools, Agencies & Corporations)	2,969	4,850	6,549	8,067	9,963
Curbside Collection (Multi-residential)	930	876	1,525	4,923	3,427
Multi-residential Total	*3,899*	*5,726*	*8,074*	*12,990*	*13,390*
Commercial (including Special Events)	9,423	14,067	12,663	12,291	13,586
Total Collection	*118,500*	*132,509*	*136,770*	143,878	138,340

Appendix C– Historical Tonnes Managed and Diverted

Table C- 1: 2014 Tonnage Map

	2010 Actuals	2011 Actuals	2012 Actuals	2013 Actuals	2014 Actuals
Total Green Bin Organics at Transfer Stations	*118,500*	*132,509*	*136,770*	*143,878*	*138,340*
Total Green Bin Organics Processed	*108,331*	*125,614*	*129,129*	*131,751*	*130,970*
Yard waste Quantities					
Total Curbside Collection	67,022	68,333	70,385	74,850	90,438
Other Munic/ Agencies & Corporations Drop-offs/ Non Profit	15,985	14,867	19,052	20,356	22,688
Paid Tonnes at TS	4,628	5,660	7,830	8,373	13,098
Asian Longhorn Beetle (ALHB)	12,855	10,754	10,500		7,122
Total Leaf & Yard Waste (L&YW @ TS)	*100,490*	*99,614*	*107,767*	*103,580*	*133,346*
Total Yard Waste Processed (incl. ALHB)	*98,423*	*94,567*	*106,147*	*99,755*	*124,472*
Electronics					
Residential Curbside (including Multi-residential)	840	798	178	288	40
Multi-residential (Contracted)	13	52	27		54
Depots/Environment Days	994	905	774	566	843
Total Electronics	*1,847*	*1,755*	*979*	*854*	*937*
Durable Goods					
Porcelain	229	578	316	554	377
Carpet			72	66	
Mattresses	1,330	1,814	1,468	2,731	1,119
Clean Wood	9	10	14	1	
Plastic Bins	119	22	26	23	30
Bulky Rigid Plastic	68	96	54	45	58

Appendix C– Historical Tonnes Managed and Diverted

Table C- 1: 2014 Tonnage Map

	2010 Actuals	2011 Actuals	2012 Actuals	2013 Actuals	2014 Actuals
Total Durable Goods Collected	*5,521*	*5,787*	*5,708*	*4,434*	*3,068*
Total Durable Goods Marketed	*1,755*	*2,520*	*1,950*	*3,422*	*1,584*
Depot and Other					
Drywall		630	574	642	512
OCC Nights	815	5,427	5,338	5,037	5,206
White Goods/Scrap Metal (Res. curbside, Multi-residential In-house, Direct delivery to TS)	5,827	2,563	2,021	2,350	2,733
White Goods/Scrap Metal (Multi-residential - Contracted)	3,015	38	23		
Election Signs	12	3			38
Books	12	34	7		
Roofing Materials	76				
Tires (including E-Days)		143	109	98	107
Total Other Material Collected (Drywall, OCC Nights, WG/SM etc)	*9,757*	*8,838*	*8,072*	*8,126*	*8,596*
Diversion Rate					
Diversion Rate calculated according to GAP- includes tonnes not identified on tonnage map (e.g.,grasscycling, deposit return, SSO residue from external processors, etc.)	47%	49%	52%	53%	53%
Green Lane Landfill					
Other Municipal	152,070	65,068	60,016	53,392	37,877
Paid Private	105,062	117,022	143,927	71,816	1,840
Paid Private (Displacing Aggregates)		14,076	24,227	33,437	15,001
Toronto WW	17,853	22,852	14,313	11,194	11,979
Toronto SWMS	560,238	525,752	501,954	511,602	524,449

Table C- 1: 2014 Tonnage Map

	2010 Actuals	2011 Actuals	2012 Actuals	2013 Actuals	2014 Actuals
Street Sweepings Transportation				14,071	20,125
Disco SSO Processing Residue					11,322
Dufferin SSO Processing Grits					654
Other (ice storm from Parks)					617
Total Green Lane	***835,223***	***744,769***	***744,437***	***695,511***	***603,739***
Inert Non-Waste Materials/Redirecting to Other Landfills	*4,983*	*4,045*	*1,997*	*12,626*	*132,778*
Net Green Lane Landfilled Material	***830,240***	***740,724***	***742,440***	***682,885***	***470,961***