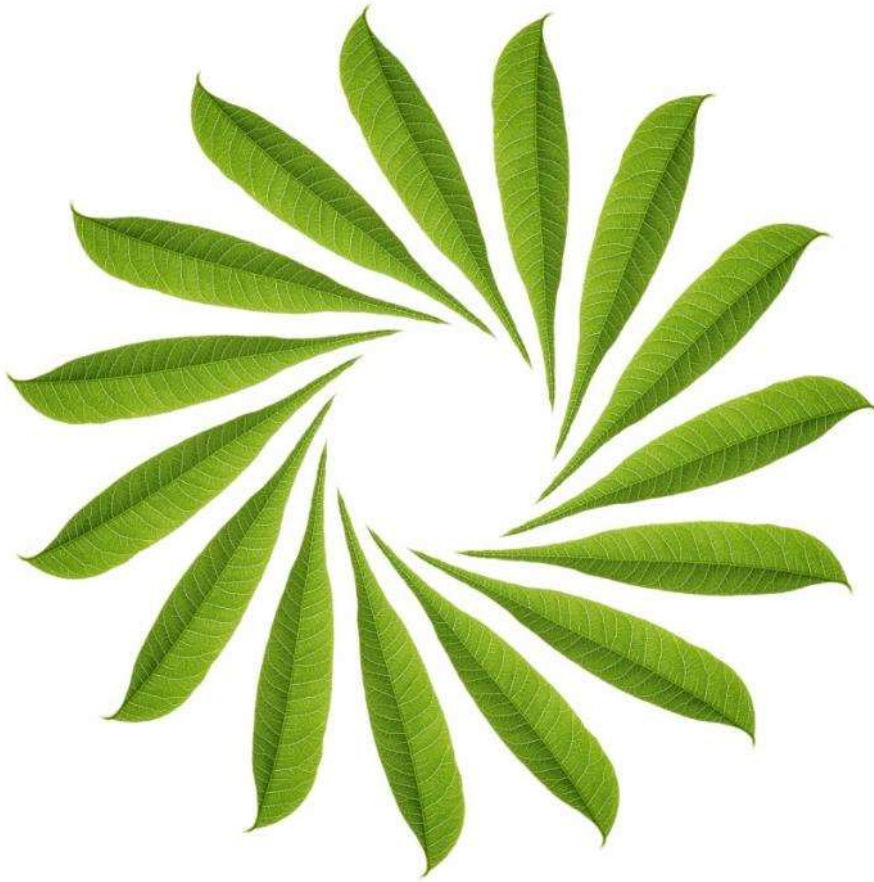


Waste to Resource Assessment



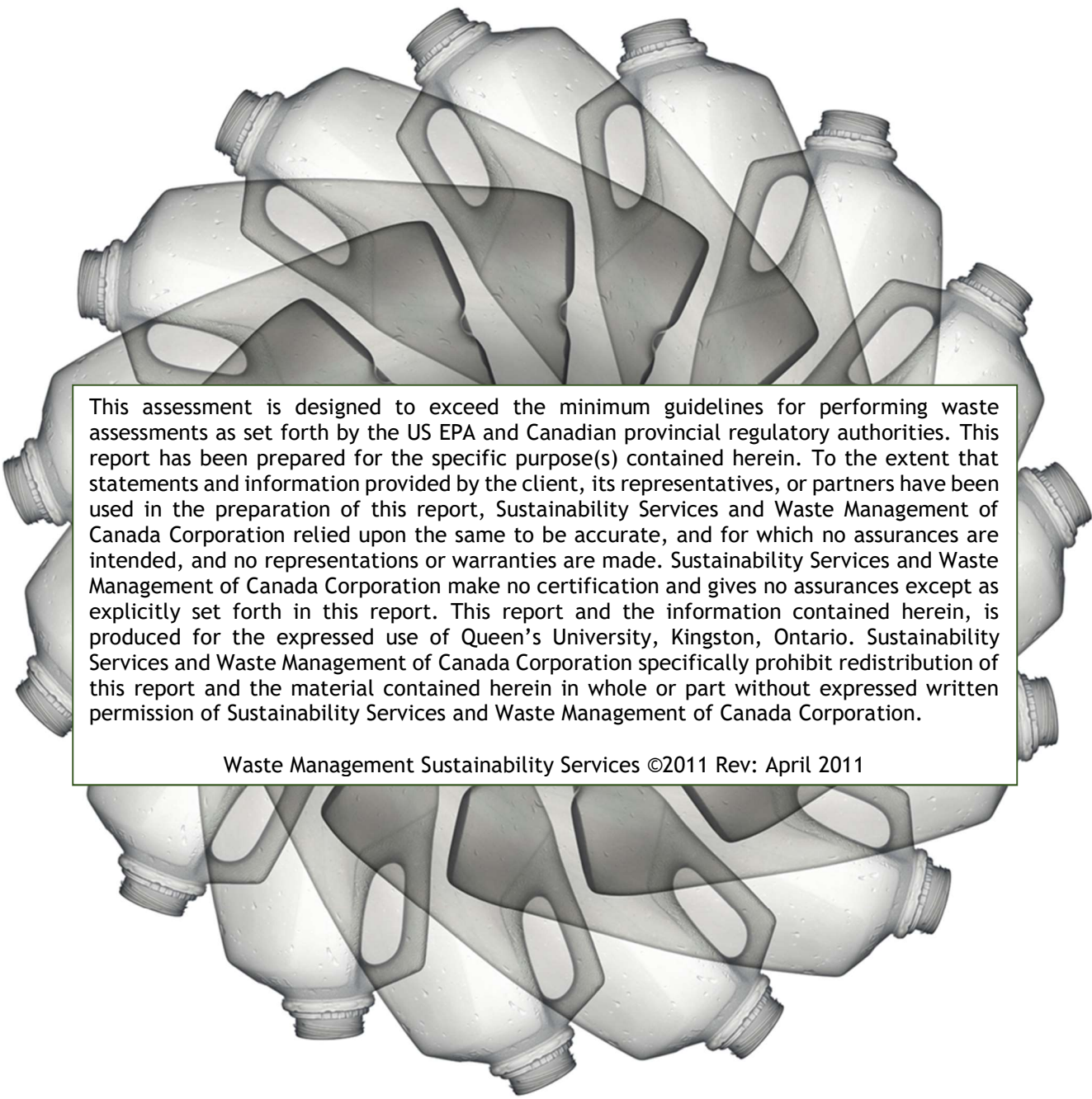
Prepared for:



Queen's University
207 Stuart Street, Kingston, Ontario
October 2, 2019

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This assessment is designed to exceed the minimum guidelines for performing waste assessments as set forth by the US EPA and Canadian provincial regulatory authorities. This report has been prepared for the specific purpose(s) contained herein. To the extent that statements and information provided by the client, its representatives, or partners have been used in the preparation of this report, Sustainability Services and Waste Management of Canada Corporation relied upon the same to be accurate, and for which no assurances are intended, and no representations or warranties are made. Sustainability Services and Waste Management of Canada Corporation make no certification and gives no assurances except as explicitly set forth in this report. This report and the information contained herein, is produced for the expressed use of Queen's University, Kingston, Ontario. Sustainability Services and Waste Management of Canada Corporation specifically prohibit redistribution of this report and the material contained herein in whole or part without expressed written permission of Sustainability Services and Waste Management of Canada Corporation.

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Executive Summary

Overview

On October 2, 2019, Waste Management and Queen's University student volunteers conducted a waste audit for five locations from Queen's University in Kingston, Ontario. A few goals of the assessment were as follows:

- ♻ To identify and quantify waste composition and commodity of five areas on the campus
- ♻ To determine the recovery performance of existing programs
- ♻ Identify opportunities to increase diversion and reduce cost
- ♻ Develop recycling strategies that could be implemented throughout the institution

During the waste audit, visual inspections of waste generation points throughout the campus resulted in the discovery of additional diversion opportunities. The assessment identified three primary opportunities that should occur to improve the campus' overall waste diversion rate. The following are our recommendations:

- ♻ Increase Awareness of Current Diversion Programs
- ♻ Student and Employee Education and Engagement
- ♻ Continual Improvement and Additional Recommendations

Photographs 1 and 2 - Waste and Recycling Sample and Audit Sort Location



Assessment Information

Table 1 - Facility Information

Item	Comments
Facility Name:	Queen's University
Description:	Queen's University at Kingston is a public research university, in 2018 the total enrollment was over 28,000 students.
Address:	207 Stuart Street, Kingston, Ontario
Contact Name:	Llynwen Osborne
Contact Number:	(613) 533-3396

Table 2 - Assessment Summary

Item	Comments
Performed By:	Christopher Doyle
Performed On:	October 2, 2019
Report Written:	Christopher Doyle
Report Reviewed:	Julie Miller
Assessment Type:	Waste to Resource Assessment - Waste Audit
Assessment Level:	<div><input checked="" type="checkbox"/> Basic Material Characterization</div> <div><input checked="" type="checkbox"/> Basic Options Analysis</div> <div><input type="checkbox"/> Carbon Analysis</div> <div><input checked="" type="checkbox"/> Implementation Feasibility Analysis</div> <div><input type="checkbox"/> Detailed Material Characterization</div> <div><input checked="" type="checkbox"/> Detailed Option Analysis</div> <div><input type="checkbox"/> Material Process Mapping</div> <div><input checked="" type="checkbox"/> Action Plan</div>
Account Manager:	Sylvain Lavoie

Limitations

Five locations with varied operations were included in the Assessment and used to represent the composition of the entire campus.

Hazardous, Industrial, and Liquid Industrial Wastes were not included within the scope of this assessment. These materials are not typically included in MOE Reg. 102/94 solid waste audits and specialized processes are required to handle these materials due to the health and safety concerns associated.

Options Overview








Three options were identified during the audit. The table below lists key options that represent the most significant opportunities.

Table 3 - Options Summary Table

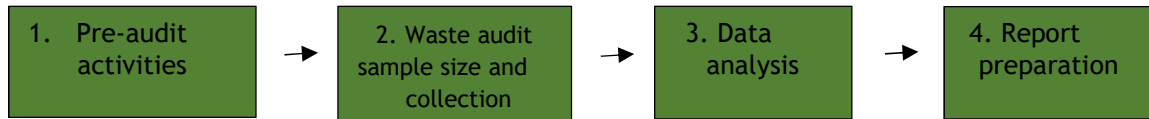
Option	Description	Benefit	Rationale
Increase Awareness of Current Diversion Programs	Stakeholders need receive consistent messages about current diversion programs.	✓ Increase diversion and capture rates ✓ Reduced waste spend	Majority of the materials generated throughout the campus can be diverted from landfill through current reuse, recycling or compost programs.
Student and Employee Education and Engagement	Promote, re-educate and expand recycling program within the campus to those who use it.	✓ Increase recycling and diversion rate through participation and awareness	All employees and students need to be encouraged and re-educated regarding waste and recycling procedures within the campus. Dedicated stakeholders will create the opportunity for the campus to achieve superior recycling rates and manage an effective program.
Continual Improvement and Additional Recommendations	Continually improve waste management program on site. Monitor and effectively manage all programs and methods in place at the campus.	✓ Expand programs available ✓ Ensure the tools and infrastructure are in place to support waste management goals	Control decision-making and input regarding materials brought into the campus. Determine how best to capture non-traditional materials for recycling or reuse.

Goals, Objectives, and Other Factors

The following is a list of Queen's goals, objectives, or other factors considered during this assessment.

-  Apply findings from the waste audit to reduce waste, maximize collection of recycling materials and optimize waste management efficiencies
-  Set goals, monitor waste generation and track recovery levels on a regular basis
-  Streamline and standardize handling routines of materials throughout the campus
-  Reduce waste spend and disposal costs
-  Provide ongoing and improved student and employee training and education avenues
-  Identify areas of new or enhanced diversion opportunity
-  Increase capture rate of divertible materials and reduce overall generation of non-recyclable materials

Sampling Method



1. **Pre-audit activities** - Collecting historical data/ diversion reports, service receptacle information, etc. Establishing the plan for the assessment. Conducting a site tour of the campus to review procedures and infrastructure.
2. **Waste audit and sample size** - To characterize the material stream, visual observations and waste samples were obtained from various collection areas throughout the campus. These collection areas were identified from labels placed on the waste bags or collection receptacle. For the purposes of this assessment, a sample generation area is a combination of a specific waste collection area and/or waste generating process. The sample material was collected in a safe, designated location separate from other waste collection areas for the assessment.

During this assessment, samples were collected from 5 unique source areas throughout the campus over a 24-hour period. The materials were sorted and divided into waste categories and weights of each material sub-category were recorded.

3. **Data analysis** - Analysis of on and off-site data. Calculation of diversion and capture rate for the site. Annual calculations were determined using the weights of the samples provided projected against the campus's operational days, as follows:
 - a. MACKINTOSH - CORRY HALL, 186 days.
 - b. TAPS, 241 days.
 - c. STAUFFER LIBRARY and LOJA / LOBBY, 353 days.
 - d. JDUC, AMS OFFICE, 241 days.
 - e. COMMON GROUND, 241 days.
4. **Report preparation** - Full report prepared including site specific recommendations.

Diversion Opportunities

Increased diversion opportunities represent the largest potential cost savings and landfill diversion opportunity for Queen's University. While diversion programs are currently in operation, the audit shows that they are not working at their optimal efficiency.

Diversion rate is calculated as follows:

$$\text{Diversion Rate} = \frac{\text{Weight of recovered material}}{\text{Total weight of material generated on-site}} \times 100\%$$

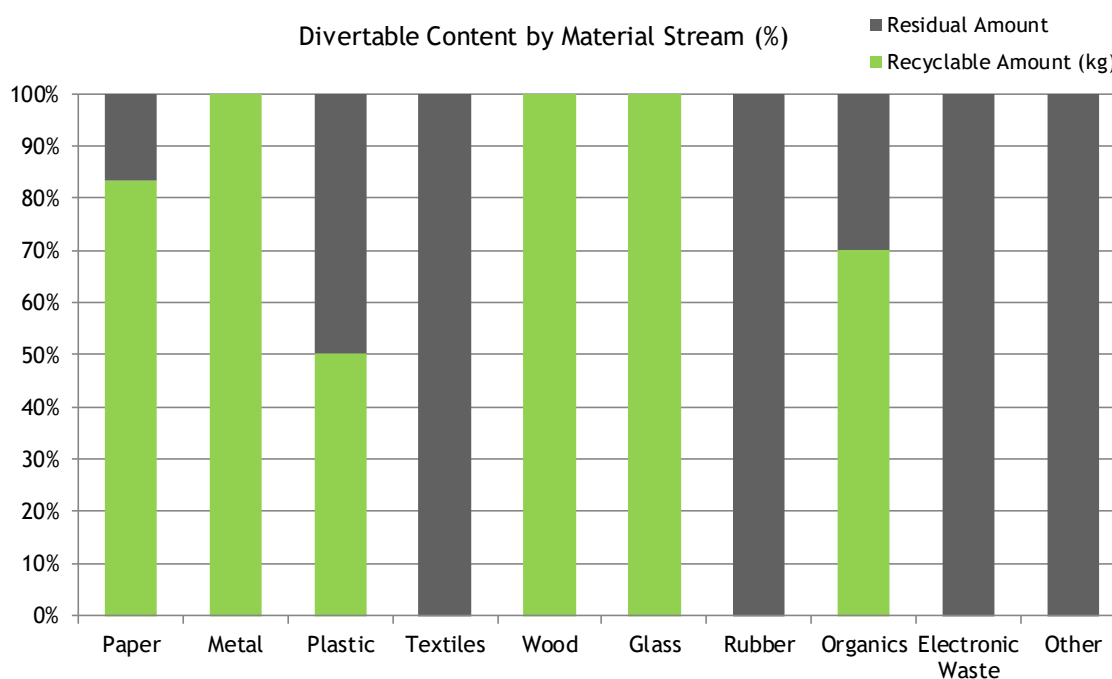
Based on the five locations audited and the diversion program currently in place 69.8% of the material generated at the campus is recyclable or divertible, therefore, there is room for improvement within the diversion program.

The capture rate indicates the percentage of a material (i.e. office paper, organics) that is being disposed of via one of the sites recovery programs (i.e. mixed recycling, organics). A 100% capture rate indicates that all recoverable materials being produced on-site has been placed in the correct receptacle and the landfill garbage contains no recoverable materials.

$$\text{Capture Rate} = \frac{\text{Recovered material (e.g. paper in mixed recycling)}}{\text{Recovered material (e.g. paper in mixed recycling)} + \text{Waste material (e.g. paper in garbage)}} \times 100\%$$

Figure 3, outlines the material in each category which could potentially be diverted.

Figure 3 - Diversion Opportunity by Material Category



Diverted Material Information

Queen's University has programs to capture and reuse the following; but service and weight information was not available for these specific locations at the time of the assessment.

- Cardboard
- Mixed Papers
- Bottles & Cans
- Organics
- Confidential Shredding
- E-Waste
- Batteries
- Scrap Metals
- Scrap Wood
- Light Bulbs
- Toner, Ink Cartridges
- Grease

Photographs 3 to 4 - Receptacle and Signage Examples in Campus

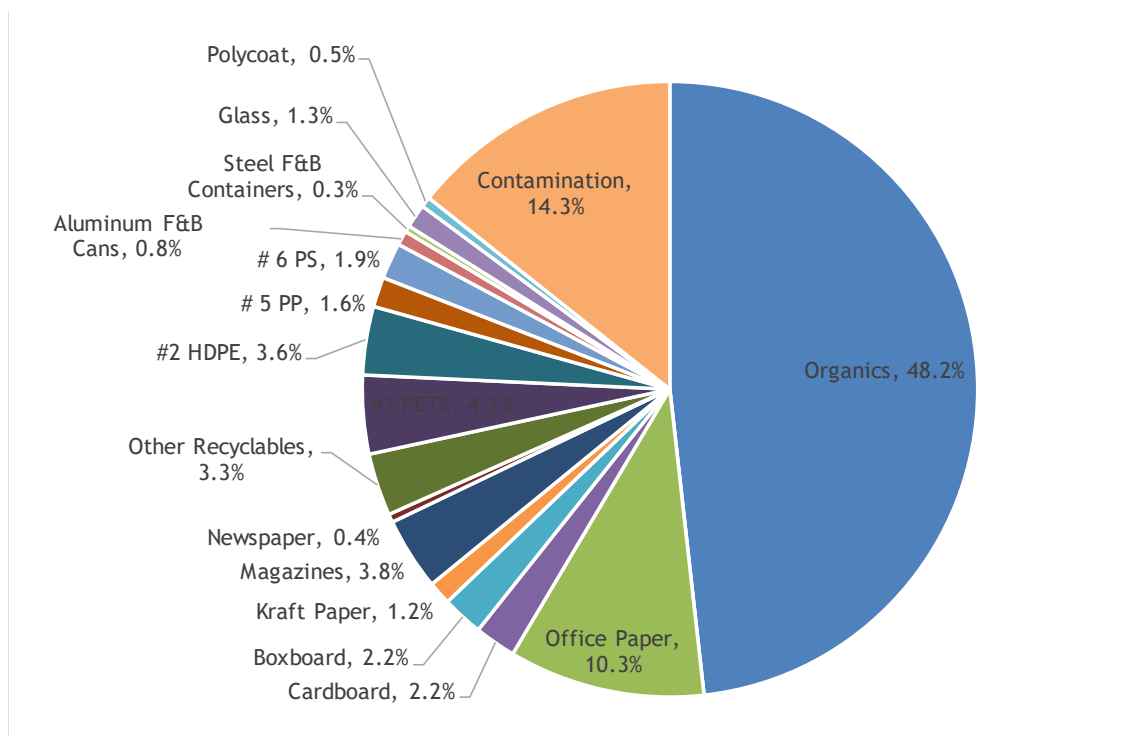


Contamination Identified in Recycling Stream

A sample of recycling and compost materials from the five audited source locations was collected and reviewed during the assessment. It was determined that approximately 14.3% of the sample was various forms of contamination. This included liquids, food, polyfoam, waxy paper, beverage pods and wrappers identified in the recycling bags.

As well, there was a small amount of cross contamination, wherein potentially recyclable or compostable materials were placed in the wrong collection bag, for example 3.4% of the recycling stream included paper towels and compostable containers which were identified as a contaminant in the recycling stream and were not placed correctly in the organics collection stream.

Figure 4 - Breakdown of Audited Material Collected for Recycling and Compost





Diversion Recommendations

Recommendations Overview

Several options have been identified that can help Queen's University make its operations more sustainable. Each option should be carefully reviewed for operational, financial, social, and strategic fit.

- ♻️ Increase Awareness of Current Diversion Programs
- ♻️ Student and Employee Education and Engagement
- ♻️ Continual Improvement and Additional Recommendations

Photographs 5 to 6 - Collection Receptacle and Signage Examples on Campus



Area by Area Review

The following section outlines the findings of the five locations included this waste audit report. The largest generation area identified in the audit sample was the STAUFFER LIBRARY accounting for 64.72 kg when combined or 46% of the audited sample.

The MacCorry Cafeteria generation area representing 39.2% of the audited sample.

Table 5 - Audited Waste Sources

Generation Area	Total Audited Waste (kg)	Material Composition (%)
MacCorry Cafeteria	55.04	39.2%
STAUFFER LIBRARY - FLOOR 2	16.26	11.6%
STAUFFER LIBRARY - FLOOR 1	14.65	10.4%
STAUFFER LIBRARY - FLOOR 4	10.10	7.2%
STAUFFER LIBRARY - FLOOR 3	10.09	7.2%
TAPS	9.20	6.6%
STAUFFER LIBRARY - BASEMENT	7.37	5.2%
STAUFFER LIBRARY - LOJA / LOBBY	6.25	4.4%
JDUC, AMS OFFICE	5.96	4.2%
COMMON GROUND	5.53	3.9%
Grand Total	140.45	100.0%

Increase Awareness of Current Diversion Program



Papers

The predominant paper material found in the landfill was **paper towel**. This subcategory includes hand towels, facial tissue and similar materials. Paper towel is typically accepted in organic collection programs and could be included in the program already in place at the campus in certain areas. The campus offers both hand towels and hand dryers in most washroom areas. The institution should consider reducing the hand towel dispensers and focusing on providing hand dryers to reduce these materials where generated. The campus should ensure that these materials are clearly noted on educational signage.

Boxboard (e.g. tissue or cereal boxes) was identified in notable quantities. These materials are currently accepted the campus' current recycling program. Students and employees should be made aware of the recyclability of these items through signage and labelling in order to eliminate these items from the landfill stream and in turn reduce disposal costs.

Paper cups (non-waxed coffee cups) were found throughout the sample. Paper cups are not accepted in this campus's diversion program, although they were accepted in previous years. Specific signage and promotion may be created to update staff and students that this common material is no longer recyclable at campus. The campus should promote the use of reusable mugs and containers to its staff and to be incentivized through on-site food vendors.

White (office) paper was identified, continued education for staff and students should be provided to increase engagement for users to make the effort to sort these materials.

Photographs 7 to 10 - Paper Material Examples in Landfill Sample (paper towel, cardboard, office paper, cups)



Organics

A program currently exists at the campus to capture organic materials for compost, receptacles are found in most buildings on campus for collection.

Organic material was identified primarily as **post-consumer food waste** and was the most significant material category in the audited sample. **Pre-consumer food waste** included pre-purchased food and prep waste, **Coffee grounds** and **compostable containers** contributed to the organics category.

When combined with other potentially compostable materials in the sample such as paper towel, compostable paper plates and wood stir sticks these materials when combined accounted for nearly half of the waste stream for the five units audit.

Photographs 11 to 12 - Organic Material Examples in Landfill Sample (pre and post consumer food scraps)





Plastics

The campus currently has programs in place to capture bottles and cans throughout the campus. All plastic material will be marked with a number indicating the type of plastic that was used to make the item. This number can be used to determine if recycling programs exist for that item. Most commonly, recycling programs will exist for #1, #2 & #5. Limited recycling programs exist for #3, #4 and #6 plastics.

#4 LDPE film bags & packaging was identified. At this time, LDPE materials are not accepted in mixed recycling programs. Much of the LDPE identified was contaminated with food or liquid waste.

PS#6 was a contributor, this most often included food packaging, take out containers, beverage lids (excluding Styrofoam). If clean, clear containers are accepted as part of mixed recycling programs. While coffee cup lids, disposable cutlery are low grade plastics and are not recyclable.

PETE#1 plastic materials included water, juice and beverage containers are the most common sources of #1 PETE and most users are aware that these types of products are recyclable, but these items are being found in the waste stream. Examples of these materials should be included in educational signage. The campus has a ban on the sale of these containers from vendors on site. Refill stations are commonly found on site to allow staff and students access to water without using disposable containers and students should be reminded to use it.

PP #5 was also a potentially recyclable plastic found in the landfill waste stream. Juice, yogurt, fruit containers are the most common sources of #5 and users should be aware that these products are recyclable, examples of these materials should be included in educational signage.

Photographs 13 to 16 - Plastic Material Examples in Landfill Sample (PETE, PS, polyfoam, LDPE)



Other Materials

Currently there are no programs in place to capture most of these materials from landfill, programs may be available for construction & demolition on an as needed basis;

The most predominant material in this category was **significant liquids** which represented a notable amount of the campus's disposal weight and included soaps, water and coffee and other beverages most often unfinished in the original containers.

The **miscellaneous category** and included feminine hygiene items, elastics, pencils, stationary, binders, mixed-material packaging, popcorn bags, sunglasses, art supplies, tape and other mixed waste.

A program is available at the campus to donate **office supplies**.

Photographs 17 to 18 - Other Material Examples in Landfill Sample (mixed packaging, miscellaneous items)





Metals

The campus has programs in place to capture most metal food and beverage containers.

Aluminum food and beverage cans (0.3%) are recyclable materials, clearly labeled and easily accessible recycling receptacles are key to ensure that staff and students can participate.

Photograph 19 - Metal Material Examples in Landfill Sample (cans)





Rubber

There are currently no programs in place to capture these items. This category was primarily composed of various work gloves, including **nitrile style work gloves**, most of which originated in a food preparation setting. A program is available at Queen's to collect nitrile gloves for diversion through Kimberly Clark.



Glass

The campus has programs in place to capture most glass food and beverage containers. Glass bottles (0.5%) all recyclable materials, clearly labeled and easily accessible recycling receptacles are key to ensure that students, employees and visitors can participate.



Wood

Scrap Wood materials may be captured through a select program in specific areas of the campus.

Wood was primarily identified as **stir/chop sticks** in the audited sample and these materials would be accepted in the organic collection program on site.



Textiles

There is currently no program in place to capture these materials.

Blue rags accounted for 0.3% of the audited sample much of these originated from a restaurant setting and would not be recyclable. The campus should consider if reusable materials are a viable option.

Textiles identified in the landfill waste stream are not currently recyclable. The campus should ensure the employees are trained to fully use all resources such as mop heads prior to disposal.

Photograph 20 - Textile Material Examples in Landfill Sample (blue rags)



Electronic Waste

Electronic Waste materials sent to landfill accounted for <0.1% of the campus' total waste; nearly 382 kg of Electronic Waste will be sent to landfill annually. Programs and collection containers are readily available throughout the campus for e-waste, batteries and toner cartridges to be diverted through qualified haulers or through supplier take-back programs. Staff and students should be encouraged and reminded to divert these materials from landfill to avoid negative environmental issues.

Joseph S. Stauffer Library, Library Administration Overview

Note: **green** text indicates that the material is accepted in a diversion program on site.

It is estimated that the Library will generate over 22.85 tonnes of waste and divert 26.61 tonnes of recyclables annually.

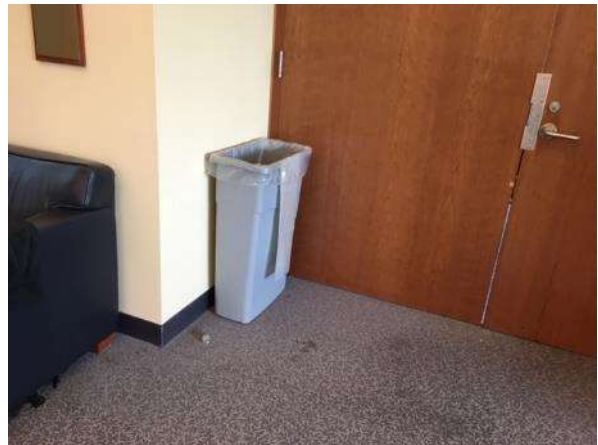
- The current diversion rate for this unit is 53.8%;
- The potential diversion rate could have been 88.3% if all potentially recyclable or compostable materials were captured and diverted through currently available diversion programs;
- The estimated capture rate at this unit was determined to be 60.9%;
- The most significant material category identified is Organics at 35% of the audited landfill waste stream, while Papers accounted for 20.5%;
- The significant material subcategories identified in the waste stream are:
 - **Organic Food Waste at 31.9%**
 - Significant Liquid at 14.2%
 - **Paper Towels at 8.3%**
 - Paper Cups at 7.8%
 - **Polypropylene at 3.3%**
 - **Cardboard at 3.1%**
 - **Compostable Containers at 3.1%**
 - #1 PETE at 2.7%

Table 8 - Landfill Audit Results - Library

Area	Paper	Metal	Plastic	Textile	Wood	Glass	Rubber	Organic	Electric	Other	Total
STAUFFER LIBRARY - FLOOR 2	4.10	0.08	1.74	0.00	0.06	0.22	0.00	5.58	0.00	4.48	16.26
STAUFFER LIBRARY - FLOOR 1	6.00	0.04	1.48	0.00	0.05	0.44	0.00	4.30	0.02	2.32	14.65
STAUFFER LIBRARY - FLOOR 4	3.60	0.08	1.38	0.00	0.02	0.00	0.00	3.10	0.00	1.92	10.10
STAUFFER LIBRARY - FLOOR 3	3.00	0.06	1.72	0.00	0.02	0.00	0.00	4.22	0.00	1.07	10.09
STAUFFER LIBRARY - BASEMENT	1.53	0.34	0.94	0.00	0.00	0.00	0.00	2.38	0.00	2.18	7.37
STAUFFER LIBRARY - LOGGIA / LOBBY	1.49	0.00	0.81	0.00	0.00	0.00	0.00	3.06	0.00	0.89	6.25
Grand Total	19.72	0.60	8.07	0.00	0.15	0.66	0.00	22.64	0.02	12.86	64.72
Material Composition (%)	30.5%	0.9%	12.5%	-	0.2%	1.0%	-	35%	<0.1%	19.9%	100.0%

Photographs 21 to 23 - Site Visit Photos

Below are examples of a few instances where landfill receptacles had no recycling receptacles in the immediate area. In most cases the Library was equipped with multi-stream receptacles (example below), all landfill receptacles should be paired with recycling options to ensure that users have easy access to participate.



AMS Office - Alma Mater Society Overview

It is estimated that the AMS Office - Alma Mater Society will generate over 1.44 tonnes of waste and divert 1.85 tonnes of recyclables annually.

- The current diversion rate for this unit is 56.3%;
- The potential diversion rate could have been 84.3% if all potentially recyclable or compostable materials were captured and diverted through currently available diversion programs;
- The estimated capture rate at this unit was determined to be 66.8%;
- The most significant material category identified is Organics at 32.2% of the audited landfill waste stream, while Other accounted for 31.2%;
- The significant material subcategories identified in the waste stream are:
 - Organic Food Waste at 31.2%
 - Miscellaneous at 31.2%
 - Office Paper at 13.1%
 - Other Recyclable Paper at 6.7%
 - Paper Towels at 4.0%
 - Boxboard at 3.0%

Table 9 - Landfill Audit Results - JDUC / AMS Office

Area	Paper	Metal	Plastic	Textile	Wood	Glass	Rubber	Organic	Electric	Other	Total
JDUC, AMS OFFICE	1.66	0.00	0.38	0.14	0.00	0.00	0.00	1.92	0.00	1.86	5.96
Material Composition (%)	27.9%	-	6.4%	2.3%	-	-	-	32.2%	-	31.2%	100.0%

Photographs 24 to 25 - Site Visit Photos

Below are examples of multi-stream receptacles where signage is missing. The University may explore promoting an email or phone number where students or staff can inform campus management which equipment requires updates.



Photographs 26 - Site Visit Photos

Below is an example where landfill receptacles were prominent, but no recycling receptacles were identified in the immediate area.



Taps Overview

It is estimated that the Taps will generate over 2.22 tonnes of waste and divert 6.81 tonnes of recyclables annually.

- The current diversion rate for this unit is 75.4%;
- The potential diversion rate could have been 90.4% if all potentially recyclable or compostable materials were captured and diverted through currently available diversion programs;
- The estimated capture rate at this unit was determined to be 83.5%;
- The most significant material category identified is Organics at 38.3% of the audited landfill waste stream, while Plastics accounted for 36.3%;
- The significant material subcategories identified in the waste stream are:
 - Organic Food Waste at 25.2%
 - Mixed Paper Towel/ Food at 13.0%
 - PS Food Packaging at 19.6%
 - LDPE at 12.6%
 - Food Paper at 8.7%
 - Paper Towel at 8.0%
 - Office Paper at 5.2%

Table 10 - Landfill Audit Results - Taps

Area	Paper	Metal	Plastic	Textile	Wood	Glass	Rubber	Organic	Electric	Other	Total
Taps	2.20	0.00	3.34	0.00	0.00	0.00	0.14	3.52	0.00	0.00	9.20
Material Composition (%)	23.9%	-	36.3%	-	-	-	1.5%	38.3%	-	-	100.0%

Photographs 27 to 28 - Site Visit Photos

This location would benefit from signage that indicates to staff which materials are recyclable in their workspace. It is recommended that all containers are directly labelled to indicate which stream they are intended to collect. Additionally, staff should be trained to separate organics into organic receptacles as they clear plates and dishes.



Common Ground Overview

It is estimated that the Common Ground will generate over 1.33 tonnes of waste and divert 7.16 tonnes of recyclables annually. The sample from this location is specific to the back of house process.

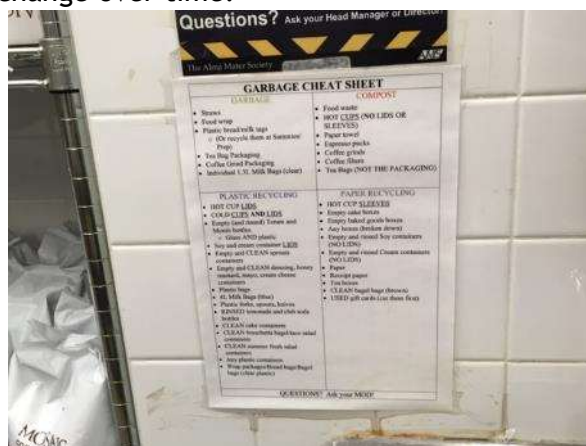
- The current diversion rate for this location is 84.3%;
- The potential diversion rate could have been 89.2% if all potentially recyclable or compostable materials were captured and diverted through currently available diversion programs;
- The estimated capture rate at this unit was determined to be 91.4%;
- The most significant material category identified is Plastics at 55.5% of the audited landfill waste stream, while Papers accounted for 22.1%;
- The significant material subcategories identified in the waste stream are:
 - LDPE at 41.6%
 - Blue Rags at 7.6%
 - Paper Towel at 11.2%
 - Foil Bags at 7.6%
 - HDPE at 4.0%
 - Cardboard at 3.6%
 - Kraft Paper at 3.6%

Table 11 - Landfill Audit Results - Common Ground

Area	Paper	Metal	Plastic	Textile	Wood	Glass	Rubber	Organic	Electric	Other	Total
Common Ground	1.22	0.00	3.07	0.42	0.00	0.00	0.00	0.16	0.00	0.66	5.53
Material Composition (%)	22.1%	-	55.5%	7.6%	-	-	-	2.9%	-	11.9%	100.0%

Photographs 29 to 30 - Site Visit Photos

Below are examples of receptacles in this generation area, it is recommended that bins be colour coded or have bold labelling to help users identify the correct container quickly. It is recommended that educational signage be reviewed on a quarterly basis with the Sustainable Queens staff as markets for recyclable materials change over time.



MacCorry Cafeteria Overview

It is estimated that the MacCorry Cafeteria will generate over 19.43 tonnes of waste and divert 17.81 tonnes of recyclables annually. The sample collected from this location was targeted at the back of house staff operations.

- The current diversion rate for this unit is 47.8%;
- Of all the material generated on site, up to 72% potentially could have been diverted through currently available diversion programs;
- The estimated capture rate at this unit was determined to be 66.5%;
- The most significant material category identified is Organics at 56.7% of the audited landfill waste stream, while Papers accounted for 21.8%;
- The significant material subcategories identified in the waste stream are:
 - Pre-Consumer Food Waste at 30.2%
 - Coffee Grounds at 14.9%
 - Organic Food Waste at 9.1%
 - LDPE at 6.7%
 - Boxboard at 7.7%
 - Paper Towel at 5.9%
 - Food Paper/ Blue at 6.4%

Table 11 - Landfill Audit Results - MacCorry Cafeteria

Area	Paper	Metal	Plastic	Textile	Wood	Glass	Rubber	Organic	Electric	Other	Total
MacCorry Cafeteria	12.00	0.26	5.72	0.00	0.60	0.00	2.00	31.22	0.00	3.24	55.04
Material Composition (%)	21.8%	0.5%	10.4%	-	1.1%	-	3.6%	56.7%	-	5.9%	100.0%

Photographs 31 to 33 - Site Visit Photos

This location would benefit from signage posted in the workspace that indicates to staff which materials they handle are recyclable. It is recommended that all containers, such as those in the photos below are directly labelled to indicate which stream they are intended to collect. Also, staff should separate organics into organic receptacles as they clear plates and dishes and be reminded as part of their training.



Student and Employee Education and Engagement

There are three critical factors to necessary to ensure that diversion programs are effective. These factors are education and engagement; as well as providing a program infrastructure that is set up for success.

For school staff (faculty):

Regular training demonstrates the University's commitment to diversion programs, update staff on policy changes and accounts for changes in workforce.

- Staff should be trained on all the streams available in the campus diversion program and where they can access them, and staff should be able to communicate the program to students;
- Targeted training sessions and regular reminders, can ensure that staff understands the steps that are being taken to achieve environmental sustainability and their roles to achieve success;
- Staff should be trained to notify a point of contact if receptacles or signage is missing;

For students:

- The University should create a **slogan or branding** to help promote their recycling program and create continuity for all promotional or educational materials.
- Awareness posters are available on the University's website and such posters should be placed on bulletin boards to increase engagement.



- For **courses that include environmental themes**, students should be encouraged to participate in environmental events on campus, such as waste audits or to take field trips to recycling plants for hands on education.
- Sustainability groups could create art projects using waste and recycling captured at the school to be displayed as an education exercise on waste reduction.

There are several activities, events and practices that educational institutions have implemented, which have proven to work well to promote environmental efforts in a campus setting. The following are some examples of campus wide activities involving students:

- A. A student run Environmental Committee and Campus Green Team can take the lead and provide energy and ideas to the campus.
 - a. Booth displays or events on campus can help engage students this may include an Orientation Week Promotion to educate new students. An Environmental Themed Day/ Assembly, for Earth Day in April or Waste Reduction Week in October are other examples to increase and maintain awareness on campus;
 - b. The Green Team may also as part of their duties ensure that the infrastructure described in this report is in place;
- B. Waste Free Lunches - Events or specific days can be arranged for students and staff to bring their own lunches in reusable containers. Those who bring their own containers and purchase their meals from an onsite food vendor may receive a modest price discount.
- C. Waste Reduction Competitions - Recyclemania is program is designed to engage students and promote recycling at Colleges and Universities. Schools can measure their recycling results during a given period. Schools who sign up are able to access material to promote a Recyclemania event; as well to compare their results to similar schools in the United States and Canada.
Source: <http://recyclemaniacs.org/>
- D. Green Sporting Events - The school may set up green events during well-attended sporting or community events. All food vendors for the event must provide biodegradable plates, containers, cutlery for food service or easily recyclable containers. During the event, volunteers may help attendees to sort materials into the correct receptacles.
Source: <http://gamedaychallenge.org/>
- E. Pizza Box Project
Some universities have used audits and other means to identify the most common materials produced at their campus and created targeted programs to capture specific materials, most common is pizza boxes in residence areas. North Carolina State University in Raleigh has one of the more robust programs. Collection Bins with giant pizza emblems are placed outside of dorms to encourage composting. The pilot will allow students to compost pizza boxes, pizza slices/crust, napkins and paper plates that would otherwise be thrown in the trash. Specific signage and promotional materials are provided in the dorms to create awareness and encourage participation.
Source: <https://housing.ncsu.edu/pizza-box-composting-project>

For maintenance, janitorial staff:

The management team and custodial supervisors should regularly meet with the maintenance staff (or custodians) as they may be able to provide hands on insight into aspects of the diversion program and provide feedback on potential areas of improvement.

Continual Improvement and Additional Recommendations

The following are suggested actions to help the institution improve their internal processes and strive to reach higher diversion rates while maintaining a strong, efficient diversion program.

i. Material Substitution

A variety of materials including non-recyclable materials were identified throughout the assessment, including containers or tableware such **Styrofoam/ polyfoam**. The Campus should regulate and promote the use of compostable containers or recyclable plastics (#1, #5) over non- recyclable plastics. Composting or recycling services are available to capture many of these items. Many facilities have implemented purchasing policies with their contractors and suppliers, which ban Styrofoam as well as reduce the use of single use items to focus on those that may be diverted through programs already available at their sites.

It should be included in future lease contracts for food vendors on site that only recyclable or compostable take out containers be provided to students.



ii. Data Management

It is only possible to measure the performance of the waste and recycling programs if they are measured. Each unit/ department should set up a regular program to map the materials generated on site and regularly track progress over time, including batteries, fluorescent light tubes, etc. All managers, who arrange for these services, should track and provide the information to a centralized location or person. By reviewing this information on a monthly or quarterly basis, the company will be able to better track the success of the waste management Program.

This is vital if successes are to be communicated to staff and stakeholders, and further necessary to understand the opportunities that exist within the waste and recycling systems at the campus.

iii. Data and Service Management

Building managers and facility operators around campus should continually review the waste services on site, including the number and the size of waste bins, location and frequency. Should the receptacles be found to be at less than capacity on their service day, or filled up before service day, services should be adjusted, as required, to match the amount of material generated and to be most cost effective.

Below are examples of recycling and organic collection totes on site. See example on below of material which could not fit in existing containers. Note: this is due notably to the collection of additional sample material for the waste audit.

At the time of the site visit the containers were overflowing with bags of material. It is recommended that a building manager on site, observe these collection totes on a periodic basis. If this is a common occurrence, the site should increase the number of totes on site or add an additional pick up. If bins are often overflowing staff may be forced to place sorted materials into landfill bins, wasting the efforts of those who separated their materials at the source. Totes could be replaced with larger front-end containers or front-end containers could be upgraded with small compaction units to meet the needs of the campus.

Photographs 34 to 36 - Site Visit Photos



iv. Contamination in Recycling Sample

Some non-recyclable materials were identified within the recycling and compost samples. This included a significant amount of liquids, food, polyfoam, waxy paper, beverage pods and wrappers identified in the recycling bags. Based on the assessment about 14.3% of the mixed recycling sample could be considered contamination.

As part of the contamination noted above, there was a small amount of cross contamination, wherein potentially recyclable or compostable materials were placed in the wrong collection bag. For example, 3.4% of the recycling stream included paper towels and compostable containers which were identified as a contaminant in the recycling stream and were not placed correctly in the organics collection stream.

Education and awareness should be provided to ensure staff and students know that these materials may contaminate the recycling and compost streams and, in some instances, force the material to be sent to landfill, thus wasting the efforts of others who made efforts to recycle. It is recommended that recycling receptacles be equipped with labelling reminding users that “garbage not accepted” here.

It is recommended that the campus regularly check with their waste hauler to confirm what materials are recyclable in their jurisdiction. As some of these materials may be integral to the operations of the campus, it is recommended that you regularly review opportunities to reduce or substitute these materials in the campus’ operations.



v. Capture Additional Materials

Some non-traditional recyclable materials were identified in the landfill waste sample. This included pens and markers. Programs are available from companies like Terracycle in to provide the resources to set up a collection station at the campus, for such materials which can be dropped off at a nearby Staples location.

<https://www.terracycle.ca/en-CA/brigades/writing-instrument-retail-based-brigade>

In addition, Terracycle offer other recycling programs for common non-conventional materials which were identified during the audit. These include single use beverage pods, creamer containers, plastic wrappers, plastic cutlery and nitrile gloves.

Example of non-conventional materials which can be recycled by Terracycle



vi. Bin Assessment

Facility Management should, as part of their duties, periodically and routinely tour the campus to monitor the infrastructure of the waste management program. By ensuring recycling stations are present, and conveniently available throughout the campus, the recycling participation rate will improve. Ensuring that there are recycling receptacles in every area of the campus, where waste is generated, will allow for the proper source separation of materials.

The team should ensure that all receptacles are clearly labelled, and pictorial guidelines are present to educate staff, as described above.

The university should consider offering an email address or phone number for students or staff to call to request that broken equipment or missing signage be updated.

Black bags should never be used in recycling receptacles as they can often be confused as landfill waste and there is a risk that already sorted recyclables are disposed incorrectly.

Photographs 37 to 38 - Site Visit Photos

Below are examples of receptacles which should have clear and consistent labels, most receptacles in the campus were labelled. Labels should be accompanied by guidelines that list all the acceptable materials that staff, and students may handle during the school day.



Photographs 39 to 40 - Site Visit Photos

Below is an example where landfill receptacles were identified, with no recycling receptacles were identified in the immediate area. As well, signage was identified indicating paper cups are recyclable. This is a recent change to the program and signage will need to be updated to avoid contamination issues.



Waste Management Sustainability Services

2018 Recycling Benefits for Queens University

In 2018, we recycled 640,231 tons of aluminum, cardboard/paper, scrap metals, plastics, wood pallets, and glass.

These recycling efforts conserved the following resources/prevented these emissions:



7,761,880 Mature Trees

Represents enough saved timber resources to produce
131,951,956,300 sheets of printing and copy paper!

1,682,023 Cubic Yards of Landfill Airspace

Enough airspace to fulfill the annual municipal waste
disposal needs for 1,918,404 people!

1,471,487,583 Kw-Hrs of Electricity

Enough power to fulfill the annual
electricity needs of 136,679 homes!

**Avoided 1,626,126 Metric Tons
(MTCO₂E) of GHG Emissions**

The recycling of these materials
prevented these GHG emissions!

1,359,182,419 Gallons of Water

Represents enough saved water to meet the daily fresh
water needs of 18,122,432 people!

Sources: U.S. Environmental Protection Agency, U.S. Energy Information Administration, Environmental Paper Network-Paper Calculator V4.0, Domtar Paper, Gaylord Corporation, U.S. Forest Products Laboratory, and Waste Management. © Waste Management 2019
Notes: GHG = Greenhouse Gas; MTCO₂E = Metric Tons of Carbon Dioxide Equivalent



Appendix 2 - Ontario's 3Rs Regulations



Ontario's 3Rs Regulations

Ontario's 3Rs Regulations governing non-hazardous solid waste from residential, industrial, commercial and institution sources became law in March 1994. Designated IC&I organizations are now required to conduct annual waste audits and update annual waste reduction work plans. This documents overviews the regulatory requirements for IC&I sector organizations.

Regulation	Intent	Requirements	Who Must Comply
Ontario Regulation 102/94 Waste Audits Waste Reduction Work Plans	<p>To understand the amount and composition of all waste produced, how the waste is produced including relevant management policies and practices, and how the waste is managed</p> <p>A waste reduction work plan seeks to establish concrete goals to reduce waste</p>	<p>Annual waste audit must be completed in which the types of waste and quantities of waste are assessed.</p> <p>A waste reduction work plan must contain a strategy for reducing, reusing and recycling waste, identify who is responsible for implementation and provide a summary of timing and expected results from the waste reduction projects. This plan must be communicated with all employees</p>	<ul style="list-style-type: none"> Retail shopping complexes of 10,000+ m² floor area Class A, B or F hospitals under Ontario Reg. 964 Schools with 350+ students at a location or campus Restaurants with gross annual sales of \$3,000,000+ Office buildings with 10,000m² of floor area Hotels and motels with 75+ units Building construction projects of 2,000+ m² Building demolition projects of 2,000+ m² Manufacturing sites with 16,000 employee hours per month
Ontario Regulation 103/94 Source Separation Programs	<p>To promote the source separation of materials throughout the facility</p>	<p>Handling and storage facilities must be provided for recyclable materials. Efforts must be made to ensure the system is used and that source-separated materials are reused or recycled.</p> <p>Employees must be instructed on the use of the program</p>	<ul style="list-style-type: none"> Manufactures or packagers of packaged food, beverage, paper or chemical products with total employee hours of 16,000+ per month Importers of packaged food, beverage, paper or chemical products for sale in Ontario with value of goods imported \$20,000,000 per year
Ontario Regulation 104/94 Packaging Audits Packaging Reduction Work Plans	<p>To examine the impact of packaging on the waste management system and identify waste reduction plans.</p> <p>Packaging refers to all materials used to protect, contain or transport a product.</p>	<p>Bi-annual audit must address: types and quantities of packaging used, reusability or recyclability of packaging, the environmental impact of the waste and the lifecycle of the packaging materials.</p> <p>Reduction work plan must identify ways to reduce packaging used, increase reuse or recyclability content, reduce the environmental impact and reduce the burden of waste for the consumer.</p>	<ul style="list-style-type: none"> Manufactures or packagers of packaged food, beverage, paper or chemical products with total employee hours of 16,000+ per month Importers of packaged food, beverage, paper or chemical products for sale in Ontario with value of goods imported \$20,000,000 per year

THINK GREEN!

Appendix 3 - Detailed Waste Breakdown by Generation Area

Area	Paper	Metal	Plastic	Textile	Wood	Glass	Rubber	Organic	Electric	Other	Total
MACKINTOSH - CORRY HALL	12.00	0.26	5.72	0.00	0.60	0.00	2.00	31.22	0.00	3.24	55.04
STAUFFER LIBRARY - FLOOR 2	4.10	0.08	1.74	0.00	0.06	0.22	0.00	5.58	0.00	4.48	16.26
STAUFFER LIBRARY - FLOOR 1	6.00	0.04	1.48	0.00	0.05	0.44	0.00	4.30	0.02	2.32	14.65
STAUFFER LIBRARY - FLOOR 4	3.60	0.08	1.38	0.00	0.02	0.00	0.00	3.10	0.00	1.92	10.10
STAUFFER LIBRARY - FLOOR 3	3.00	0.06	1.72	0.00	0.02	0.00	0.00	4.22	0.00	1.07	10.09
TAPS	2.20	0.00	3.34	0.00	0.00	0.00	0.14	3.52	0.00	0.00	9.20
STAUFFER LIBRARY - BASEMENT	1.53	0.34	0.94	0.00	0.00	0.00	0.00	2.38	0.00	2.18	7.37
STAUFFER LIBRARY - LOGGIA / LOBBY	1.49	0.00	0.81	0.00	0.00	0.00	0.00	3.06	0.00	0.89	6.25
JDUC, AMS OFFICE	1.66	0.00	0.38	0.14	0.00	0.00	0.00	1.92	0.00	1.86	5.96
COMMON GROUND	1.22	0.00	3.07	0.42	0.00	0.00	0.00	0.16	0.00	0.66	5.53
Grand Total	36.80	0.86	20.58	0.56	0.75	0.66	2.14	59.46	0.02	18.62	140.45

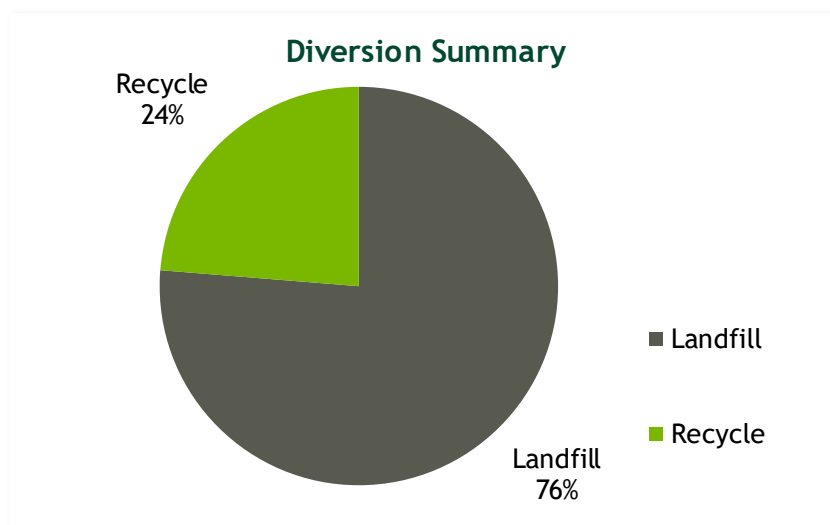
Appendix 4 - Diversion Report



Diversion Overview Queen's University, Kingston, Ontario

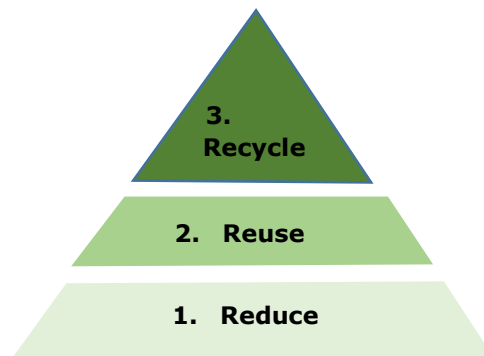
Please note: the following information represents the overall facility diversion information at the time of the assessment and is not exclusive to the samples used in this audit.

Diverted Materials	Annual Projected Volume (kg)	% of Diverted Materials
Mixed Recycling	648,090	77.7%
Organics	121,580	14.6%
Metal	63,980	7.7%
Total	833,650	100.0%



Appendix 5 - The Three R's Program

The three R's waste hierarchy gives an order of priority of actions to be taken to reduce the overall amount of waste generated at the site



Studies indicate that between 2 and 5 percent of waste streams are reusable. There are many ways to prevent waste, at the source, and reuse products to reduce waste, including:

	Material	Reduction Strategies	Reuse Strategies	Recycling Strategies
Papers	Cardboard / boxboard	Encourage suppliers to use reusable packaging (e.g. plastic totes) Purchase reusable products	Re-use of cardboard for storage and packaging	Provide enough receptacles, information and signposting for OCC and mixed recycling programs
	Office paper	Encourage use of electronic communications Encourage tenants to print two sided	Encourage one sided printed paper for scrap paper Creation of scrap pads Utilize centralized notice boards	
	Paper towels	Install hand-dryers in washrooms and dish cloths in kitchens		
	Newsprint / Magazines	Provide communal newspapers in break out areas and spaces	Encourage staff to share magazines and newspapers Donate used magazines and newsprint Use newsprint for packaging materials	
	Paper cups	Place reusable coffee cups in kitchen areas Encourage users to bring reusable coffee cups Incentivize the use of own cups (discounts, loyalty cards)	Provide coffee making facilities in kitchens and encourage users to refill reusable coffee cups	Encourage tenants to use compostable and recycling coffee cups which are accepted in organics/mixed recycling programs
Plastics	PETE	Encourage building users to bring reusable water bottles Ensure sufficient water fountains for building users	Encourage building users to reuse plastic bottles Use refundable recycling schemes at the site	Provide enough receptacles, information and signposting for mixed

	HDPE	Encourage bulk buying of goods to reduce volume of packaging Purchase products with minimal packaging		recycling programs
	LDPE	Train custodial staff to empty individual waste receptacles into single black garbage bag		
	Polystyrene	Develop procurement policies which require on-site retailers to use compostable and recyclable packaging and cutlery		
	Organics	Set up partnerships and donation programs with local charities		Implement organics program
Containers	Beverage Cans	Encourage use of drinks dispensers at food courts and in kitchens	Use refundable recycling schemes at the site	Provide enough receptacles, information and signposting for mixed recycling programs
	Glass Bottles/Jars	Encourage use of drinks dispensers at food courts and in kitchens		
	Single Use Beverage Pods	Encourage use alternative coffee making facilities (i.e. filter coffee, pod free coffee machines)	Use reusable k-cups	Set up k-cup recycling programs with local supply companies
	Office supplies	Set up communal stationary points in offices for building users	Establish donation programs with local schools	Set up recycling programs with specialist companies such as Teracycle

Appendix 6 - Material Descriptions

Material	General Descriptions
#1 PETE	Polyethylene Terephthalate, Water Bottles, Soft Drink Bottles
#2 HDPE	High Density Polyethylene Containers, Chemical Containers or Jugs; High Density Polyethylene Bags or Film, Strong "crispy" Bags
#4 LDPE	Low Density Polyethylene Bags and Film, Garbage Bags, Shopping Bags
#5 PP	Poly Propylene, Yogurt Containers, Straws
#6 PS	Poly Styrene, Beverage Containers, Packaging Materials, Take-out Food Containers, Packing Popcorn
#7 Other	Products Labeled #7, Unlabeled Plastic Items
Aluminum	Aluminum Parts and Products
Aluminum F & B Cans	Aluminum Food and Beverage Cans, Pop Cans
Aluminum Foil / Wrappers	Food Wrappers and Packaging
Boxboard	Cereal, Tissue Box Material
Clear Glass	Clear Beverage Bottles and Jars
Electronics	Electronic Products, Toasters, TV's, Cell Phones
Floor Sweepings	Debris, Dust
Kraft Paper	Paper Bags, Heavy Brown Paper
Magazines	Glossy Magazines and Newspapers
Metal Clothes Hangers	Clothes Hangers
Misc. Textiles	Rags
Napkins	Paper Napkins
Newsprint	Newspapers, Weekly Flyers
OCC	Old Corrugated Cardboard
Paper Cups	Paper or Polycoated Cups
Paper Towels	Paper Hand Towels, Napkins, Tissue
Personal Clothing	Used Shirts, Uniforms, Hats
Photo Paper	Glossy Paper
Plastic Strapping	Plastic Shipping Straps
Polycoat	Milk Cartons, Tetra Packs
Polyfoam	Foam Protective Packaging Materials, Styrofoam
Post-Consumer Waste	Scrap Food Waste
Pre-Consumer Waste	Food Preparation Waste
Scrap Wood	Construction Materials
Shipping Bags	Strong or Thin Shipping Bags
Steel	Steel Parts and Products
Steel Fixtures	Hardware for Facility Displays
Tissue Paper	Thin Packing Paper
Wax Paper	Paper for Wrapping or Packaging
White/ Ledger/ Office Paper	White Paper, Printer Paper
Wood Shavings	Scrap Construction Shavings and Debris