

Final Report

City of Yellowknife Solid Waste Composition Study and Waste Reduction Recommendations



Prepared for
City of Yellowknife

Submitted by
Gartner Lee Limited

July 2007

Final Report

**City of Yellowknife
Solid Waste Composition Study
and Waste Reduction
Recommendations**

Prepared for

City of Yellowknife

July 2007

Reference: **GLL 70-346**

Distribution:

4 City of Yellowknife

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Gartner Lee



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July 31, 2007

Mr. Bruce Underhay
Solid Waste Facility Manager
City of Yellowknife
4807 52nd Street
Yellowknife, NT X1A 2N1

Dear Bruce:

Re: GLL 70-346 – City of Yellowknife Solid Waste Composition Study and Waste Reduction Recommendations

We are pleased to submit our report on the solid waste composition study and waste reduction recommendations for the City of Yellowknife. This report provides a description of the methodology employed to conduct the waste composition study at the Yellowknife Solid Waste Facility and presents the findings from the study and the waste reduction recommendations.

We trust you will find our report informative and to your satisfaction.

We appreciate this opportunity to be of service.

Yours very truly,
GARTNER LEE LIMITED

Karen Asp
Senior Environmental Planner

MJO:gc

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Executive Summary

Introduction

In 2007, the City of Yellowknife commissioned a study to further understand the composition of the city's solid waste stream and to make recommendations regarding opportunities for waste reduction. This is the first time a solid waste composition study has been undertaken in Yellowknife. The study will help the City of Yellowknife understand the nature of the present day solid waste stream, both in terms of the potential for waste reduction and for setting program and budget priorities.

Waste Composition Study Findings

The primary objectives of the waste composition study were to determine the overall composition of the municipal solid waste stream by material type, and by the type of waste generator. The waste composition study was conducted in 2007 at the City of Yellowknife Solid Waste Facility. The study findings show that, overall, the largest components of the solid waste stream include:

- paper products (37%);
- organic waste (26%) – the largest component of which is food waste (23% of the total waste stream);
- plastics (12%); and
- household hygiene (5%), representing waste materials such as diapers.

Waste was sampled from three waste generator sectors. The study findings show that, within each sector, the largest components of the solid waste stream include:

- **Multi-Family / Small Commercial:**
 - paper products (38%), organic waste (22%) and plastic (11%);
- **Large Commercial:**
 - paper products (50%), organic waste (25%) and plastic (13%); and
- **Single Family:**
 - organic waste (40%), paper products (21%) and plastic (16%).

Table E1 presents a summary of the overall findings of the waste composition study, including the primary types of materials found in the waste stream and the estimated annual tonnes disposed by material type.

Table E1. Summary of Composition by Material

Material Categories	Waste Stream Composition (%)	Estimated Annual Disposal (Tonnes)
Paper Products	37.1%	3,341
Organics	26.1%	2,353
Plastic	12.4%	1,120
Household Hygiene	5.1%	455
Ferrous Metal	3.4%	306
Textiles	3.2%	284
Wood Waste	2.9%	261
Glass	2.4%	220
Bulky Items	2.3%	206
Composites	1.8%	165
Inorganic (soils)	0.8%	71
Other Unspecified	0.6%	57
Aluminum	0.5%	46
Fines	0.5%	44
Special Care Waste	0.5%	41
Renovation Waste	0.3%	25
Rubber	0.1%	7
Tires	0.0%	-
Totals	100.0%	9,001

Waste Reduction Assessment Recommendations

Based on the findings of the Waste Composition Study and an analysis of the existing waste management system in Yellowknife, the following strategic objectives and priorities are presented for consideration:

Objective # 1: Enhance Programs for Marketable Recyclables

Enhancing diversion programs for the City's currently marketable recyclable materials is identified as the top objective for the City's waste diversion strategy. They comprise 31% of waste disposed and increasing diversion of them is generally compatible with the City's existing processing facility and established markets. Within the context of this objective, increasing diversion from the commercial sector should be the highest priority, as the commercial sector generates 80% of recyclable, marketable waste disposed.

Prioritized Recommendations

1. Adopt a City of Yellowknife 'Zero Waste' goal, to be promoted in outreach materials and initiatives as a Zero Waste challenge intended to foster increased public participation in the City's waste reductions programs.
2. Design and implement a cardboard disposal ban program that targets the Large Commercial sector. The cardboard ban program should include:
 - Extensive pre-ban education, promotion and outreach, including meetings with stakeholders, advertisements, and distribution of workplace recycling information kits;
 - Provision of a call-in technical support service, with City staff providing over the phone information on how to set up a recycling program;
 - Enforcement measures, such as application of a significant surcharge on tipping fees for Large Commercial loads.
3. Expand the cardboard disposal ban to the Small Commercial sector when the potential operational impacts of increased handling and processing at the Waste Management Facility have been assessed and addressed.
4. Expand the ban to include newspaper, fine paper and other currently recyclable materials from the Commercial sector when the capacity of the private sector to service commercial establishments with on-site collection programs has been confirmed and the potential operational impacts at the Waste Management Facility have been assessed and addressed.
5. Assess the costs and benefits of enhancing the existing residential depot recycling program compared to shifting to curbside collection for the single family dwellings sector and on-site recycling for the multi-family sector.

Objective #2: Organic Waste Management - Focus on Food Waste

Developing a program for significantly increasing the diversion of food waste is identified as the second strategic objective for the City of Yellowknife. Food waste comprises 23% of waste disposed, making it the single largest category identified in the waste stream. Yard waste on the other hand, is only 2.7% of waste disposed. In jurisdictions where food waste is diverted from disposal, it is typically composted in a centralized facility along with other organic materials, such as yard waste, wood waste, non-recyclable paper (i.e. tissue paper) and biosolids. A primary objective of compost facilities is to produce a soil enhancement product (compost) for utilization in residential and commercial landscaping and land remediation projects. Available information indicates that there is likely potential demand for soil amendment in Yellowknife due to the existing geological conditions of the area, and as well, there is long term need for landfill cover material. As such, a focus on diversion of food waste and related organic material is warranted in terms of conserving landfill space and meeting local need for soil amendment.

Prioritized Recommendations

1. Continue to promote backyard composting and utilization, by all sectors, of the yard waste drop off area at the Waste Management Facility.
2. Undertake a preliminary technical and economic assessment of the options for centralized food waste processing in Yellowknife. The assessment should investigate and make recommendations regarding:
 - a. Feedstock potential from commercial, residential and other sources;
 - b. Technology options and costs;
 - c. Facility siting options;
 - d. End use options/market capacity;
 - e. Regulatory considerations and approvals requirements for establishing a facility; and
 - f. Collection program options, and costs for public service delivery where relevant.

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1. Introduction to Report

In 2007, the City of Yellowknife commissioned a waste composition study and waste reduction assessment in order to assist the City in understanding the waste stream and defining strategic priorities for waste reduction in the near to medium future. The City has operated a recycling program since 1994 and has made numerous enhancements over the years. Looking forward, the City is trying to determine where to focus resources in the next few years. This report presents the findings of both the waste composition study and the waste reduction assessment. The waste composition study methodology and findings are presented in Section 2. The waste reduction assessment approach and analysis is presented in Section 3. The resulting recommended strategic objectives and priorities are presented in Section 4.

2. Solid Waste Composition Study

2.1 Introduction

The primary objectives of the waste composition study were to determine the overall composition of solid waste disposed by material type, and by the type of waste generator. The waste generator sectors studied include:

- single family residential waste generators;
- multi-family buildings and small commercial waste generators; and
- large commercial waste generators.

The waste composition study was conducted from June 18 to 22, 2007 at the City of Yellowknife Solid Waste Facility in Yellowknife, Northwest Territories. The City of Yellowknife Public Works and Engineering Department operate the solid waste facility. The Yellowknife Solid Waste Facility serves a population of 18,700 who live in 6,616 dwellings¹.

The study sampled municipal solid waste (MSW) disposed by the residential and commercial sectors, accounting for 9,001 tonnes in 2006. The waste sampled included commercially hauled loads discharged at the Yellowknife Waste Management Facility baler for processing, as well as loads of commercial 'wet' waste discharged directly at the landfill. The study did not sample construction and demolition waste or self-hauled residential and commercial waste.

The waste composition study represents a one-time sampling of the solid waste disposed at the City of Yellowknife Solid Waste Facility. As this study represents a "snap-shot" of the solid waste stream, the resultant data may not reflect seasonal variations. However, based on discussions with

¹ *Statistics Canada 2006*

City of Yellowknife staff and the City's waste hauler, it is understood that the composition of the waste stream does not vary substantially throughout the year. Given this information, the study data is believed to provide a fair representation of the composition of the City of Yellowknife solid waste stream.

This section of the report provides a description of the methodology employed to conduct the waste composition study, presents summary data and findings from the study, and provides an analysis of the data as it relates to current waste diversion initiatives and opportunities for additional diversion. Detailed datasheets are presented in Appendix A.

2.2 Approach

The following tasks outline the work performed during the solid waste composition study:

3. **Composition Study Set Up** – This task required City of Yellowknife staff to arrange for consultant access and space to conduct the waste sorting exercise in an inactive area of the baling facility. Additionally, Gartner Lee staff (GLL) worked with the Manager of Solid Waste and the Baling Facility Cashier to obtain background data and to select the most appropriate days for the study.
4. **Waste Sort Categories** – To ensure consistency with Canadian Council of Ministers of the Environment (CCME) waste composition data, and to identify emerging waste streams, GLL worked with the Solid Waste Manager to establish forty-five material categories for the waste sort. Appendix B provides the material categories utilized during the study.
5. **Sampling** – The Canadian Council of Ministers of the Environment (CCME) Guidelines was used to determine the target sample size from each waste generator sector (single family units, multi-family units and small commercial and large commercial). Statistical analysis determined that the results of this study are accurate to an 83% confidence +/-20%, which is consistent with the ASTM (American Society for Testing and Materials) "Standard Test Method for Determination of the Composition of Unprocessed Solid Waste".

Based on 2006 scalehouse data, it was identified that, by weight, the multi-family (MFU) and small commercial sector represented approximately 59% of the waste stream, the large commercial (LC) sector represented 22% and the single-family residential (SFU) sector represented 19% of 9,001 tonnes² of waste handled at the Solid Waste Facility. The study examined twenty-five 125 kg samples of waste at the City of Yellowknife Solid Waste Facility. The total number of samples was divided proportionately by the contribution to the waste stream of each waste generator sector. Therefore the study included:

- 14 samples from the multi-family (MFU) and small commercial sector;

² City of Yellowknife data (2006)

- 6 samples from the large commercial (LC) sector; and
- 5 samples from the single-family residential (SFU) sector.

Visual stratification and quartering methodology were used to obtain each sample from the target loads. Each sample was hand-sorted into 45 categories and weighed. The material weights for all of the categories and the 2006 scalehouse data were used to develop a profile of the overall waste composition of the City of Yellowknife.³



Photo 1. Sorting Waste at City of Yellowknife Solid Waste Facility, June 2007

2.3 Multi-Family and Small Commercial Solid Waste Stream

The composition of the multi-family and small commercial solid waste stream in Yellowknife was determined through examination of fourteen (14) samples of waste from commercial front-load trucks at the Yellowknife Landfill. The data from each sample can be found in Appendix A.

Figure 1 illustrates the composition of the multi-family and small commercial solid waste stream in Yellowknife. As shown, the primary components of the waste stream are:

³ The study did not examine self-haul waste or construction and demolition (CD) waste.

- Paper products (38%) represented the largest component of the multi-family and small commercial solid waste stream. This category consisted of mixed paper (16%), corrugated cardboard (14%), newspaper (3%), tissue paper (>3%), other paper (>3%) and paper based beverage containers (>1%).
- Organic materials (22%) represented the second largest component, food waste (19%) and yard waste (3%).
- Plastics (11%) represented the third largest component. The primary constituents are non-recyclable other plastic (4.6%), plastic film (3.7%) and rigid plastic (1.9%).

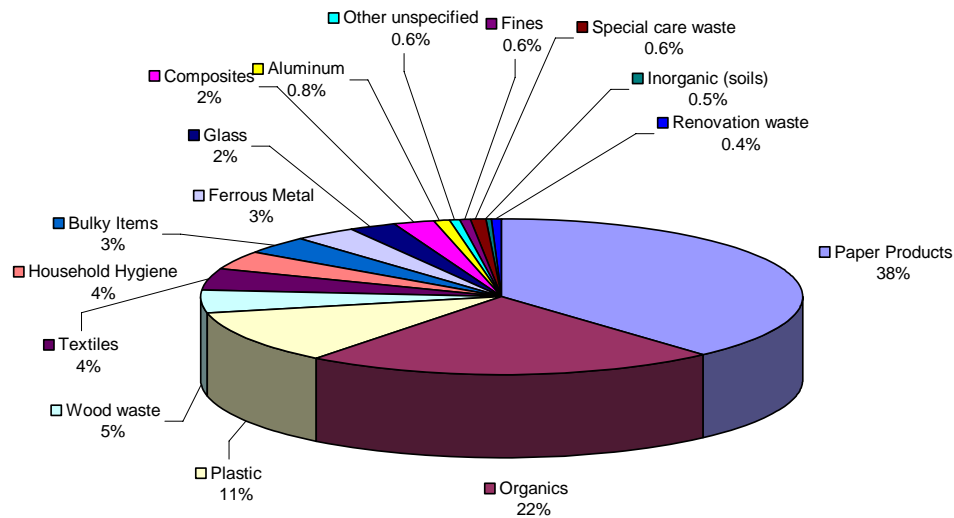


Figure 1. Multi-Family and Small Commercial Waste Composition

Table 1 shows the composition, by weight and percentage, of the multi-family and small commercial solid waste stream in Yellowknife. The percentage column is based on the results of the waste composition study as shown in Figure 1, while the weight is extrapolated from the 2006 annual waste disposed by this waste sector.

Table 1. MFU and Small Commercial Waste Composition by Weight

Material Category	Waste Stream Composition (%)	Estimated Annual Disposal (Tonnes)
Paper Products	38.4%	2,132
Newspaper (including flyers)	2.8%	154
Magazines	0.1%	4
Corrugated Cardboard	14.5%	806
Boxboard	2.4%	132
Fine Paper	13.2%	732
Tissue Paper	2.6%	147
Polycoat Beverage (deposit)	0.1%	7
Polycoat Beverage (non-deposit)	0.1%	8
Other Paper	2.6%	143
Plastic	11.1%	616
Beverage Containers (deposit)	0.7%	38
Beverage Containers (dairy)	0.3%	14
Rigid (HDPE & PET)	1.9%	104
Plastic Film	3.7%	205
Other	4.6%	255
Glass	2.4%	134
Ferrous Metal	3.4%	188
Aluminum	0.8%	45
Textiles	4.4%	244
Organics	22.2%	1,233
Food Waste	18.9%	1,051
Yard & Garden	3.3%	182
Special Care Waste	0.6%	31.5
Batteries	0.0%	1.2
Paint/Solvents/Aerosols (full)	0.5%	30
Other Wastes	15.6%	865
Bulky Items	3.5%	193
Composites	2.3%	130
Household Hygiene	4.1%	230
Inorganic (soils)	0.5%	29
Tires	0.0%	-
Rubber	0.0%	3
Wood Waste	4.6%	256
Renovation Waste	0.4%	25
Fines	0.6%	32
Other Unspecified	0.6%	35
Totals	100.0%	5,556

2.4 Large Commercial Solid Waste Stream

The composition of the Large Commercial waste stream was determined by examining six solid waste samples from large commercial waste bins at the Yellowknife solid waste facility.

Figure 2 shows the composition of the large commercial solid waste stream. The primary components of the large commercial solid waste stream are paper products (50%), organics (25%), and plastic (13%).

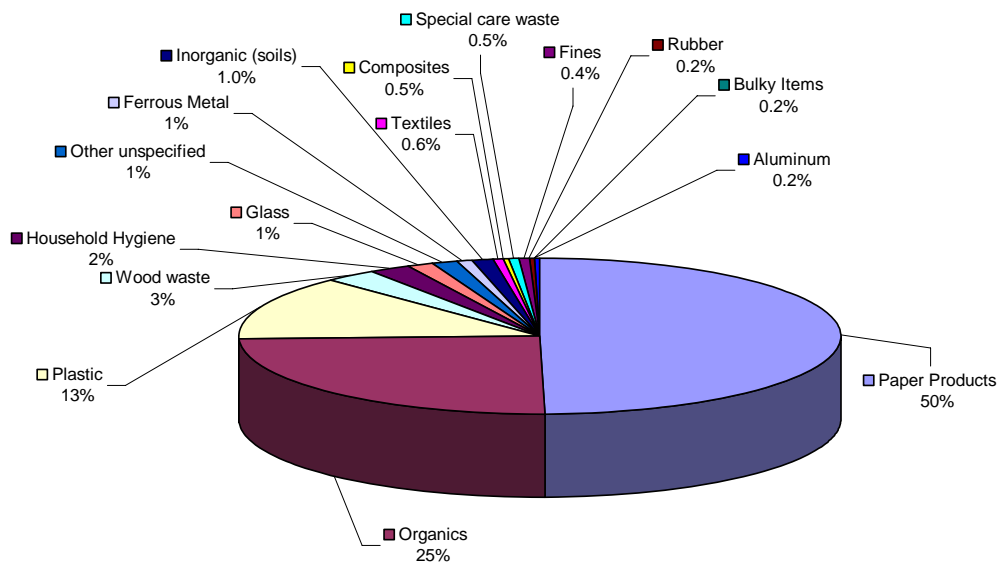


Figure 2. Large Commercial Waste Stream Composition

- Paper products (50%) observed consisted of cardboard (21%), newspaper (12%), mixed paper (6%), other paper (6.5%), tissue paper (3.8%) and paper based beverage containers (>1%).
- Organics (25%) consisted of primarily of food waste (24.5%) and a small quantity of yard waste (0.3%).
- Plastics (13%) consisted primarily of non-recyclable mixed plastics (6%), film plastic (3%), rigid containers (3%). Beverage containers observed represented less than 1% of the large commercial waste stream.

Table 2 provides the composition by weight and percentage of the large commercial waste stream in Yellowknife. The percentage column is based on the results of the waste composition study, while the weight is extrapolated from the 2006 annual waste disposed. Detailed data sheets can be found in Appendix A.

Table 2. Large Commercial Solid Waste Stream Composition

Material Category	Waste Stream Composition (%)	Estimated Annual Disposal (Tonnes)
Paper Products	49.7%	841
Newspaper (including flyers)	11.8%	199
Magazines	0.2%	3
Corrugated Cardboard	21.4%	362
Boxboard	2.3%	39
Fine Paper	3.6%	60
Tissue Paper	3.8%	65
Polycoat beverage (deposit)	0.0%	1
Polycoat beverage (non-deposit)	0.2%	3
Other Paper	6.5%	110
Plastic	13.2%	224
Glass	1.4%	24
Ferrous Metal	1.0%	17
Aluminum	0.2%	3
Textiles	0.6%	9
Organics	24.7%	419
Food waste	24.5%	414
Yard & Garden	0.3%	4
Special Care Waste	0.5%	8
Batteries	0.0%	0
Paint/Solvents/Aerosols (full)	0.5%	8
Other Wastes	7.1%	119
Bulky Items	0.2%	4
Composites	0.5%	9
Household Hygiene	2.4%	40
Inorganic (soils)	1.0%	16
Tires	0.0%	-
Rubber	0.2%	4
Wood Waste	2.8%	47
Renovation Waste	0.0%	-
Fines	0.4%	8
Other Unspecified	1.2%	20
Totals	100.0%	1,693

2.5 Single Family Units (SFU) Solid Waste Stream

The composition of the single family residential waste stream in Yellowknife was determined through examination of five samples from a cross-section of neighbourhoods in the City of Yellowknife. Single-family residential waste samples were examined from Range Lake, Downtown, Oldtown, Ndilo and Frame Lake north and south. The data from these samples can be found in Appendix A.

Figure 3 illustrates the composition of the single-family solid waste stream in Yellowknife. As shown, the primary components of the waste stream are organic waste (40%), paper products (21%), plastic (16%), household hygiene (11%), ferrous metals (3%), glass (3%), textiles (2%), and aluminum (>1%).

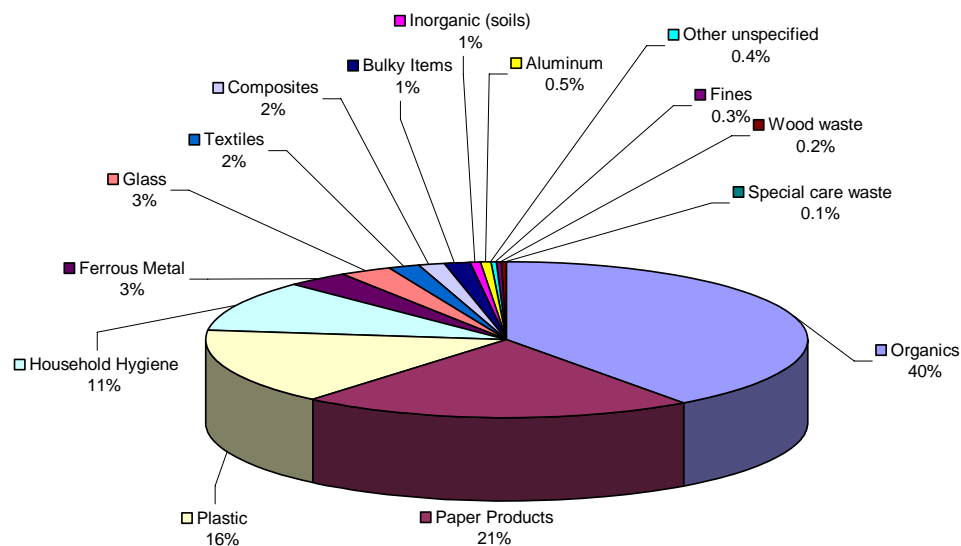


Figure 3. Yellowknife Single Family Waste Stream Composition

- Organic waste (40%) comprised the largest component of the single family solid waste stream. This category consisted primarily of food waste(37%) and yard waste (3%)
- Paper products represented the second largest category (21%). This category consisted of mixed paper (8%), newspaper (4%), cardboard (2%), tissue paper (3%), other paper (4%) and paper based beverage containers (>1%).
- Plastic (16%), the third largest category was comprised of plastic film (6%), non-recyclable plastic (6%), recyclable rigid containers (4%) and plastic beverage containers (>1%).

Table 3 shows the composition, by percentage and weight, of the single family solid waste stream in Yellowknife. The percentage column reflects the study results, as shown in Figure 3, while the weight is extrapolated from the 2006 annual waste disposed by the SFU waste sector.

Table 3. Single Family Solid Waste Composition

Material Category	Waste Stream Composition (%)	Estimated Annual Disposal (Tonnes)
Paper Products	21.0%	367
Newspaper (including flyers)	3.9%	68
Magazines	0.2%	4
Corrugated Cardboard	1.7%	30
Boxboard	3.3%	58
Fine Paper	4.1%	72
Tissue Paper	3.2%	56
Polycoat Beverage (deposit)	0.4%	8
Polycoat Beverage (non-deposit)	0.4%	7
Other Paper	3.7%	64
Plastic	16.0%	280
Beverage Containers (deposit)	0.5%	9
Beverage Containers (dairy)	0.2%	4
Rigid (HDPE & PET)	3.6%	64
Plastic Film	5.9%	104
Other	5.7%	99
Glass	2.7%	47
Ferrous Metal	3.2%	56
Aluminum	0.5%	8
Textiles	1.7%	30
Organics	40.0%	702
Food Waste	36.7%	644
Yard & Garden	3.3%	58
Special Care Waste	0.1%	1
Batteries	0.0%	1
Paint/Solvents/Aerosols (full)	0.0%	0
Other Wastes	14.3%	250
Bulky Items	1.3%	23
Composites	1.5%	26
Household Hygiene	10.6%	186
Inorganic (soils)	0.6%	11
Tires	0.0%	-
Rubber	0.0%	-
Wood Waste	0.2%	3
Renovation Waste	0.0%	1
Fines	0.3%	4
Other Unspecified	0.4%	6
Totals	100.0%	1,752

2.6 Summary of Yellowknife Solid Waste Composition

The composition of the City of Yellowknife solid waste stream sampled was determined by combining the waste composition data for each of the waste generation sectors (Single Family Units (SFU), Multi-Family Units (MFU) and Small Commercial and Large Commercial) disposing of solid waste at the landfill. The data indicate that the largest components of the waste stream, by weight, are paper products (37%), organics (26%), plastic (12%), household hygiene (5%), wood waste (3%), textiles (3%), ferrous metal (3%), glass (2%) and bulky items (2%). Figure 4 illustrates the overall composition of the solid waste sampled at the Yellowknife solid waste facility.

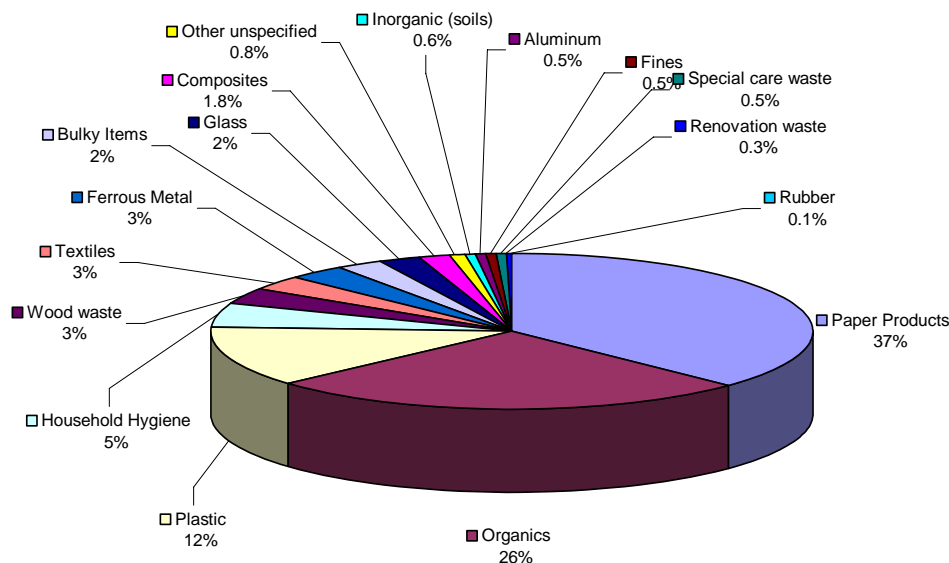


Figure 4. Yellowknife Solid Waste Composition

- Paper products (37%) consisted of recyclable cardboard (13%), mixed paper (12%), newspaper (5%), other paper (3%), tissue paper (3%) and paper based beverage containers (>1%).
- Organic materials represented 26% of the Yellowknife solid waste stream. This category consisted primarily of food waste (23%) and yard waste (3%).

Table 4 presents the composition of the City of Yellowknife solid waste stream, by percentage and weight. The percentage column is based on the results of the waste composition study, while the weight is extrapolated from the 2006 annual waste disposed for each waste sector.

Table 4. Yellowknife Solid Waste Stream by Weight

Material Category	Small Commercial / MFU	Large Commercial	SFU	Total Estimated Disposal (Tonnes)	Waste Stream Composition (%)
Paper Products	2,132	841	367	3,341	37.1%
Organics	1,233	419	702	2,353	26.1%
Plastic	616	224	280	1,120	12.4%
Household Hygiene	230	40	186	455	5.1%
Wood Waste	256	47	3	306	3.4%
Textiles	244	9	30	284	3.2%
Ferrous Metal	188	17	56	261	2.9%
Bulky Items	193	4	23	220	2.4%
Glass	134	24	47	206	2.3%
Composites	130	9	26	165	1.8%
Other Unspecified	45	20	6	71	0.8%
Inorganic (soils)	29	16	11	57	0.6%
Aluminum	35	3	8	46	0.5%
Fines	32	8	4	44	0.5%
Special Care Waste	31	8	1	41	0.5%
Renovation Waste	25	-	1	25	0.3%
Rubber	3	4	-	7	0.1%
Tires	-	-	-	-	0.0%
Totals	5,556	1,693	1,752	9,001	100.0%

3. Waste Reduction Assessment

3.1 Introduction

The purpose of this waste reduction assessment is to assist the City of Yellowknife in defining strategic priorities for waste diversion in the near to medium future. The City has operated a recycling program since 1994 and has made numerous enhancements over the years. Looking forward, the City is trying to determine where to focus resources in the next few years. The main purpose of the assessment is to identify opportunities that can be defined as “low hanging fruit” in so far as there would be significant gains in diversion, while taking into consideration issues and drivers associated with the existing waste management system, and the degree of technical system development and operational adjustment needed to move ahead with an initiative.

The assessment is primarily focused on the municipal solid waste stream defined in the Waste Composition Study. The assessment was conducted according to the following steps:

- a situation analysis was conducted to contextualize and understand the existing waste management system, and to identify issues and drivers relevant to the identification of waste diversion opportunities;
- strategic objectives for waste diversion were identified and prioritized, based on reviewing the findings of the Waste Composition Study and taking into consideration the issues and drivers identified in the situation analysis;
- program options associated with these strategic objectives were identified and discussed;
- a waste diversion strategy, including prioritized recommendations, was developed based on program option considerations.

The research conducted for this assessment included the following activities:

- review of available reports and web based documents regarding waste management and recycling in the City of Yellowknife.
- site visits and discussions with City waste management personnel to understand the current recycling program managed by the City of Yellowknife, including the recycling depot facilities and the handling and processing operation at the landfill.
- interviews with key respondents regarding public and private sector recycling initiatives, recycling issues, barriers and suggestions for enhancing waste diversion in the city. The list of interview respondents is presented in Appendix D.

The next section of this report (Situation Analysis) describes the main elements of the recycling programs and facilities in Yellowknife, and identifies issues, barriers and drivers identified through review of available documents and discussions with key respondents.

3.2 Situation Analysis

3.2.1 Overview of Yellowknife

The City of Yellowknife, capital city of the Northwest Territories, is located on the North Arm of Great Slave Lake, 1,508 km north of Edmonton and 1,789 km north of Calgary. Winters are long (i.e. November through March) and cold, with an average high of -25° C in January, the coldest month of the year. First and last occurrences of 0°C in a 24 hour period (freezing) typically occur in May and October respectively. July is the warmest month of the year, with average highs around 20°C and sometimes as high as 30°C. The city receives on average 15 cm of rainfall and 135 cm of snowfall annually.⁴

Statistics Canada census data shows that the total population of the City of Yellowknife was 18,700 persons in 2006, a 13% increase in population compared to the 2000 Census data.⁵ The population is project to grow to 23,000 by 2019.⁶ The total number of permanently occupied private dwellings in the city, as determined in the 2006 Census, was 6,616. For the purposes of delivering residential garbage collection services, as defined in the City bylaws, there are 3,696 single family dwellings in the city. It is assumed that the remainder, approximately 2,900 units, are classified as multi-family dwellings. Fifty-four percent of homes in the city are owned and 46% are rented; the majority of multi-family units (apartments) are rented.

In addition to being home to 50% of the territorial population, Yellowknife is the administrative and commercial service centre for the Northwest Territories. Major employers in the city include the Government of NWT, Government of Canada, City of Yellowknife, school boards, two diamond mining companies and three transportation companies. A wide range of retail services is evident, including four shopping mall complexes and a number of big box retail chains such as Wal-Mart, Canadian Tire, Northern Direct Charge Co-op, and Extra Foods. Economic growth, 5% in 2004, is driven by the resource extraction and tourism industries.⁷

3.2.2 Solid Waste Management System

3.2.2.1 Municipal and ICI Garbage Collection

The City of Yellowknife provides weekly curbside garbage collection to 3,696 single family dwellings in the city. The service is delivered under contract by Kavanaugh Bros Ltd, which uses two purpose built compactor trucks for this service. As of 2006, the city discontinued providing garbage collection services to multi-family dwellings and commercial/institutional units. Owners/occupants of these building types are currently required to self haul their waste to the disposal facility or make private arrangements with a hauling company. Kavanaugh Bros Ltd., the only solid waste hauling company in Yellowknife, provides standard, volume and frequency based,

⁴ City of Yellowknife. 2006 Community Profile.

⁵ Statistics Canada. 2007. Yellowknife, Northwest Territories (table). 2006 Community Profiles. 2006 Census.

⁶ City of Yellowknife. 2006 Community Profile.

⁷ City of Yellowknife. 2006 Community Profile.

collection services to multi-family and commercial clients using overhead dump and roll off container systems.



Photo 2. Recycling Depot

3.2.2.2 City Residential Depot Recycling Program

The City maintains a depot recycling system for the collection of recyclables from residents of single and multi-family dwellings. Depots have been established at five locations, including the Yellowknife Solid Waste Management Facility, Yellowknife Civic Arena parking lot, Yellowknife Co-op parking lot, parking area at the corner of Franklin and Schooldraw Avenues, and 52nd Street at 54th Avenue at the Bison Estates.

The Civic Arena and Co-op depots are located on major roads at sites characterized by high retail or community traffic. The Co-op site is reported to receive the highest volume of recyclables, and is now equipped with two cardboard bins as well as bins for other recyclables. The Civic Arena depot is the second most frequently serviced due to high demand. The Franklin Avenue depot is located at the intersection of two major roads feeding the Old Town and Schooldraw residential areas. The

52nd Street depot was recently established and was intentionally located in the vicinity of a number of high-rise buildings in the downtown area.

The depot collection system is designed to facilitate user cooperation in the segregation of recyclables into commodity streams. The types of commodities collected in the depot system include cardboard, newspaper, office/computer paper, boxboard/mixed paper, HDPE (#2) natural plastic containers, tin cans, and glass containers. The collection of aluminum containers was recently discontinued as the majority of these containers were being collected in the deposit refund program.

Each depot (except at the landfill) has a minimum of four thirty yard covered roll off containers. At least one container at each site is dedicated to cardboard, and some have dedicated newspaper containers. The other containers are compartmentalized to accommodate smaller volumes of HDPE and tin containers, office paper and boxboard. The boxboard/mixed paper stream was recently added to reduce the incidence of contamination of accepted paper grades by users eager to recycle all grades of paper. The depots are un-staffed, but they are outfitted with large type instructional signage to guide residents in the appropriate use of the system. A waste receptacle is also provided to accommodate carry bags and small quantities of non-recyclable discards. The frequency of service is weekly for the Co-op cardboard bins, and every two to three weeks for other bins at the Co-op and other sites. The City of Yellowknife owns the bins, and Kavanaugh Bros Ltd. is contracted to service the recycling depots on a regular basis.

3.2.2.3 *Private Recycling Collection Services*

Three companies in Yellowknife provide fee-for-service recycling collection services to customers. Kavanaugh Bros Ltd primarily offers cardboard collection services to the ICI sector, and can supply a wide range of bin sizes (two cubic yard to 40 cubic yard) and collection frequencies to meet customer needs. Their cardboard collection rates are differentially structured to reflect the lower tipping fee for cardboard at the landfill. For example, the cost for rental and weekly hauling of a six cubic yard bin of garbage is currently \$131.94 per month, whereas the cost for a six cubic yard bin for cardboard hauled weekly is \$90.85 per month. Available information indicates that 30 businesses and organizations in the city received cardboard collection services, including a number of Large Commercial waste generators such as Canadian Tire, Extra Foods and the Co-op.

YK Recyclers Ltd provides recycling collection services to the residential and commercial sectors. Materials collected are hauled to the landfill where they are deposited into the appropriate recycling bins. YKR has contracts with 160 homes in the city, and charges them \$179 per year (\$15/month) for weekly collection of recyclables. The company has contracts with 40 businesses, and charges \$100 per employee per year for businesses with fewer than 100 employees, for the collection of cardboard, newspaper, office paper, glass and cans. Different charges apply for larger businesses. One person is employed for two days per week to collect recyclables from clients, using a pick up truck as transportation. These collection services are reported to be in high demand, but YKR does not intend to expand its business.

DSS (Document Shredding Service) collects and shreds office paper from government offices and private businesses throughout Yellowknife. The shredded paper is hauled to the Waste Management Facility for baling and is then stockpiled. DSS arranges and covers the cost of shipping its shredded paper to markets in Alberta.

3.2.2.4 Yellowknife Waste Management Facility

Balefill/Landfill

The City of Yellowknife operates the Yellowknife Landfill/Balefill, located on 40 hectares of leased land two kilometres north of the city and three kilometres from the Yellowknife Airport. According to the most recent consolidated data, approximately 13,400 tonnes of waste, excluding contaminated soil, is disposed annually at the facility.⁸ The site, active since the early 1970's, is presently nearing capacity. Investigations are underway with respect to developing a new landfill in the quarries adjacent to the existing site. The location of the proposed site has not been confirmed as yet. The proximity of the proposed facility to the airport has been identified as a concern due to the increased incidence of wild birds attracted to garbage as a food source.

Waste Baling Facility

Waste baling was introduced as a processing technology at the landfill in the early 1990s. Currently, the majority of municipal solid waste received at the site is baled prior to being hauled to the active face for disposal. Construction and demolition loads, large volume 'wet' commercial waste loads and some self-hauled residential waste is disposed directly at the active face. Recyclable materials, such as cardboard, mixed paper, plastic containers, tin cans, White Goods and light steel items are also baled at this facility prior to shipment to markets. The baling operation consists of a gravity fed Mosley baler, purchased in 1993, and an automatic wire tying unit. The baler is designed to process at least ten bales per hour, 60 bales per shift. However, actual productivity is in the range of 56 bales per day due to irregularities in the flow of incoming waste, and mechanical failures.⁹ The baler is housed in a 12,000 sq ft split level building with a tipping floor on the upper level and the baler and bale handling area on the lower level. A bobcat is used to load the hopper on the upper floor; a loader with forklift tines is used to move bales produced by the baler.

Baled garbage is loaded onto a tandem dump truck and hauled to the active face designated for baled waste. Cover is applied daily while weather permits; cover is not applied during winter months. Long term supply of cover material, both for the impermeable and vegetative layers, is an issue. The operation currently stockpiles various waste materials such as glass and concrete, for potential use as cover materials

Based on a review of operations conducted in 2005, the City plans to continue operating the garbage baling facility as the central means of waste compaction at the new landfill. The plans

⁸ Dillon Consulting Ltd. 2005.

⁹ Dillon Consulting Ltd. 2005.

include continuing to use the existing building but replacing the existing baler with a new, higher capacity (36 bale per hour or greater) system for processing garbage and recyclables.¹⁰ Replacing the waste baling technology with a landfill compactor and dedicated recycling baler housed in the existing building was considered to be a more expensive and less effective method, from a landfill operations perspective. Purchase of a dedicated recycling baler to separate the waste baling and recycling processing systems was not considered feasible due to redundancy and the need for a new building to house the recycling operation.

Recycling Drop Off Depot and Recyclables Handling

Self haul and small commercial vehicles with small quantities of marketable recyclables are directed to the recycling drop off depot. Segregated recyclables are placed into designated bins or in a designated area (for batteries, left over paint, appliances, etc.). Large loads of recyclables collected by Kavanaugh, including City-owned recycling depot roll-off bins and loads from commercial clients, are primarily received on Tuesdays. Large loads of incoming cardboard and other materials are dumped directly on the tipping floor for baling. Materials such as HDPE natural containers are stockpiled in bins until enough material has accumulated to produce one or more bales. Container glass collected in bins is hauled to a designated area of the landfill where it is deposited for future use as landfill cover material. On Tuesdays, the baler is dedicated to processing recyclables. For quality control, staff work the tipping floor, spotting and segregating contaminants found in loads of recyclables. To minimize contamination of recyclable commodities due to contact with garbage, the baler is 'cleaned' by processing bales of low value fibre (usually shredded paper). Contamination of this nature has not been identified as a significant issue.

Other Recycling at Landfill

A range of other products and materials are collected at the landfill for consolidation and transport to recycling markets in Alberta. These include white goods, scrap metal, vehicles, lead acid batteries and used oil.

<i>Product/Material</i>	<i>Handling</i>
Refrigerators and Other Appliances	<ul style="list-style-type: none">■ A local company is contracted to remove and store refrigerant gas.■ Units are stockpiled, baled at the baling facility, and shipped annually.
Scrap Metal	<ul style="list-style-type: none">■ Light steel is stockpiled and processed in the baling facility on an ongoing basis. The baler is not designed to process heavy steel and metal items.■ Heavy steel/metal is stockpiled. A 2005 pilot project examined the feasibility of crushing and shipping the materials to southern markets.
Scrap Vehicles	<ul style="list-style-type: none">■ Stockpiled, crushed and shipped to market every two years by a processor with a mobile vehicle crushing unit.

¹⁰ Dillon Consulting Ltd. 2005.

- Lead Acid Batteries
 - Stored undercover on pallets.
 - Packaged and shipped to market annually or as needed.

- Used Oil
 - Stockpiled in storage tanks for collection by Alberta used oil recycling collector.

Hazardous Waste

In addition to used oil, the facility provides for the segregation and appropriate management of left over paint and anti-freeze. A paint exchange area is maintained at the site for the potential redistribution of usable product. Unclaimed oil based paint is allowed to harden and is then disposed. Anti-freeze is stored in tanks for collection by a hazardous waste processing company based in Alberta.

Wood Waste

Source segregated loads of tree branches, stumps and logs are received at the landfill for a charge of \$65 per tonne, the same rate charged for mixed waste. At present this material is stockpiled. Christmas trees and brush are chipped and used as landfill cover. An area at the landfill has been designated for the deposit of wood products, such as pallets and dimensional lumber. Source segregated loads of wood are scaled in as Construction Waste at a charge of \$40 per tonne. As a result, data on the quantity of wood received is not available. The wood scrap pile is accessible to scavenging, providing a source of free firewood and construction material for some users. The majority of this material is not salvaged and is ultimately buried as regular waste. Clean wood and branches received at the landfill would likely constitute a significant source of amendment material needed for composting food waste.

Reuse and Salvaging at the Landfill

Salvaging is a popular activity at the Waste Management Facility and areas of the landfill have been specifically designated for this purpose. Customers to the facility can drop off reusable or salvageable items at the designated salvaging areas. Salvagers have unrestricted access to these areas on selected days. The drop off areas are not sheltered or designed to protect reusable products and materials from damage due to exposure or mixing with waste and residue. The quantity of items deposited or removed from the site for reuse is not tracked. Based on a review of operations conducted in 2005, City staff have recommended shifting the operational model for salvaging from open access to a rotating cell concept for better management and control of the site.

Other Materials Management at Landfill

A range of other wastes and materials are separately managed at the landfill, including oil tanks, tires, concrete and asphalt, clean wood and branches. Oil tanks are steam cleaned, crushed and stockpiled as they are too large as is to be processed in a metal baler. In the future, this material

may be shipped for recycling. Tires are baled and stockpiled indefinitely due to lack of economically feasible markets. Consideration is being given to the use of shredded tires as part of the leachate collection system in the new landfill. Old concrete is stockpiled for potential crushing and use as a landfill cover material. Asphalt is stockpiled for potential re-application as road surfacing material.

Yard Waste Management

A passive yard waste composting area has been established at the landfill. Grass and leaves are mixed with chipped wood and allowed to decompose. The product is used for landfill cover. The yard waste area is un-staffed and subject to contamination due to the deposition of both bagged yard waste and conventional garbage.

3.2.2.5 Backyard Composting

The City has promoted backyard composting and worm composting in its solid waste outreach literature for a number of years. In 2006, through a grant from the Shell Environment Fund, the City initiated a pilot project to facilitate the distribution of free backyard compost units (Earth Machines) to city residents. To date, one hundred composters have been distributed to residents; public interest in the initiative has led to the establishment of a waiting list.

3.2.2.6 Costs of Recycling

The 2005 External Review of the Solid Waste Facility Operations (Dillon 2005) provides estimates of the net cost (or profit) of recycling marketable materials processed at the Waste Management Facility. The study took into consideration the costs of collection, handling, baling, shipping materials to markets, and the revenues from material specific tipping fees and commodities sales. The commodities sales revenues were calculated based on five-year average prices.

On a cost per tonne of material basis, the study found that white goods, lead acid batteries and aluminum cans were revenue positive, whereas cardboard, newspaper, mixed paper, and tin and plastic containers were all revenue negative. Overall, the study found that the recycling program was costing the City money (\$17,700 in 2005) but the net total cost to recycle was significantly lower than the net cost to process and dispose of the same amount of waste (\$60,400 in 2005). Based on these findings, the report recommended continuing with the recycling program due to the overall economic value it provided, as well as other benefits including the savings in landfill space.

The Dillon Report provides valuable insight into the costs of recycling associated with the City's programs. However, it is important to note that, as the study was conducted in 2005, the estimates may not reflect current costs due to factors such as operational changes and changing market values. Going forward, the financial picture will likely change significantly if efforts are made to significantly increase the diversion of recyclables.

3.2.2.7 Waste Management User Fees

In 2006, the City implemented a user fee system with the objectives of shifting the public waste management system to a full cost recovery model and creating financial incentives to encourage waste reduction and diversion. Based on an assessment of the lifecycle costs of managing the landfill, a standard tipping fee of \$65/tonne was introduced for residential and commercial waste. This rate was considered to be lower than the actual cost of disposal, assessed at \$75/tonne at the existing facility. However, the lower rate was implemented in order to mitigate the significant budgetary impacts the new charge would have on commercial users (referred to as “rate shock”). Sorted recyclables from private facilities and operations are charged at a significantly lower rate of \$30/tonne, which is estimated to cover the costs of baling. Most other incoming waste, as well as scrap metal, white goods, oil tanks, clean wood waste, tires and lead acid batteries, has a tipping fee applied, either on a per tonne, per unit or volume basis. Recyclables items brought in by residents for deposit at the recycling depot area do not have fees applied.

For single family dwellings receiving curbside collection, the City established a three bag set out limit and required users to purchase tags for the disposal of additional bags. Single family dwellings are charged \$11 per month for the curbside collection service and the additional bags cost \$1 each. For the multi-family and ICI sectors, the introduction of the user fee system entailed shifting from a publicly managed collection service assessed on a square footage basis to direct engagement of private sector hauling services, assessed on the basis of waste volume and frequency of pick up. This shift, combined with the new tipping fees, resulted in significant waste collection and disposal cost increases for some users, whereas others experienced a decline in overall costs.

3.2.2.8 Markets

The costs and benefits associated with shipping recyclables to market is a major factor determining the types of materials currently collected or handled by the City for the purposes of recycling. Recycling processors for standard recyclables such as paper products, plastics, glass, ferrous and non-ferrous metals are all located in other jurisdictions, notably Alberta. Given that commodity prices fluctuate, most of these types of materials typically have a positive value on commodities markets, thus contributing a revenue stream that can off-set, at least in part, the costs of collection and processing.

The main challenge for Yellowknife, a small remote community, is the high cost of transportation to distant markets. Information presented in the 2005 Dillon Report indicates that the costs of shipping ranged from \$41/bale for paper products to \$135/pallet of lead acid batteries. In addition to this, the City has found that many buyers will not accept partial loads of recyclable materials – such as a partially loaded trailer of shredded paper or plastics. This situation arises for those types of materials that are present in relatively small amounts in the waste stream and/or where the quantity of waste diverted is low. The City manages the situation to the extent possible by stockpiling bales of recyclables and by limiting the range of materials recycled to those they can reliably ship annually. Metro Materials in Edmonton has supported Yellowknife’s endeavours by accepting single bales of HDPE natural included in shipments of cardboard and newspaper.

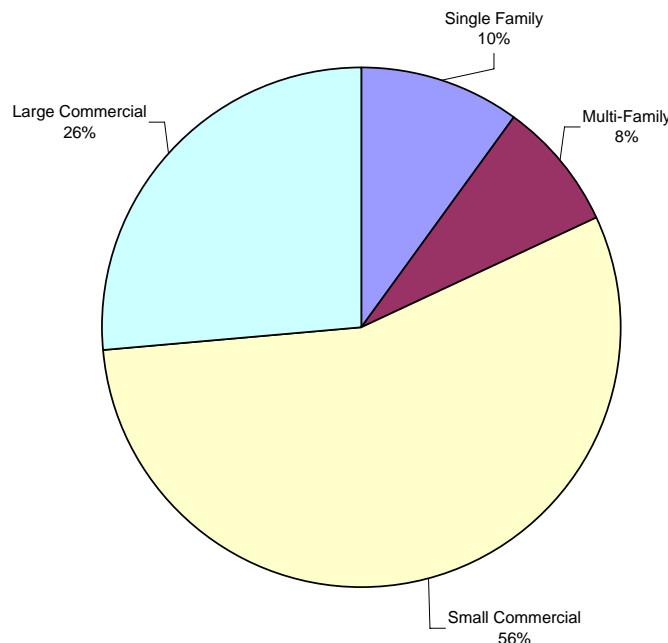
3.2.2.9 City Recycling Program Performance

Quantity of Marketable Recyclables Disposed

Review of the Waste Composition Study findings shows that currently *marketable* recyclables managed in the City’s recycling depot program, including newspaper, cardboard, boxboard, fine paper, HDPE natural containers, and metal food containers, comprise 31% of waste disposed in all sectors sampled, accounting for 2,800 tonnes. As such, these currently marketable recyclable materials can be considered one of the largest categories of waste disposed overall. Of this amount, 30% consists of recyclable paper products while the remainder consists of HDPE natural containers (accounted for primarily in the category called HDPE Beverage – Dairy), and metal food cans. Within the recyclable paper products group, cardboard is largest component, followed by fine paper, newspaper and boxboard. These estimates do not include food container glass, which comprises 0.7% of waste disposed (64 tonnes) but is not marketed. Nor does it include other types of recyclable materials normally received as special waste (appliances, scrap metal, lead acid batteries), which together account for less than 2% of waste disposed.

For the purpose of this study, further analysis of the waste composition study data was undertaken to generate estimates of the quantities of the currently marketable, recyclable materials handled in the depot program that are being disposed by each sector. The waste composition study data presents findings for the Large Commercial, Single Family and Small Commercial/Multi-Family sectors. Using a range of assumptions, the data for the Small Commercial and Multi-Family sectors have been separated. The assumptions and resulting calculations used to separate the Small Commercial and Multi-Family data are presented in Appendix E. Based on these assumptions, Figure 5 illustrates that the Small Commercial sector discarded more than 56% of currently recyclable materials, followed by the Large Commercial Sector at 26%, the Single Family sector at 10% and the Multi-Family sector at 8%.

Figure 5. Recyclable Materials Disposed by Sector



Current Diversion Rate

With caution, the waste composition study data can be used to provide insight into the effectiveness of the City's existing recycling programs and initiatives, which will help in determining where and how to focus efforts at enhancing waste diversion. As shown in Table 5, this is done by using the waste composition study projections to estimate the quantity of waste diverted overall, and by material stream. In general, it may be said that approximately 7% of waste generated in the residential and ICI waste streams sampled is sent to markets for recycling, and that white goods and batteries (lead acid batteries), both managed under special waste handling requirements at the Waste Management Facility, have very high diversion rates. This diversion rate was calculated by dividing the estimated amount recycled (671 tonnes) by the sum of estimated amount disposed and the amount recycled (9,001 + 671 = 9,672).

Table 5. Current Waste Diversion

Material Category	Total Waste Disposed		Waste Diversion		
	Waste Stream Composition (%)	Estimated Annual Disposal (Tonnes)	2006 Recycling (Bales)	2006 Recycling (Tonnes)	Overall Waste Diversion by Material Stream
Newspaper (including flyers)	4.7%	421	91	69	14.1%
Corrugated Cardboard	13.3%	1,198	663	333	21.8%
Boxboard	2.6%	230	9	28	10.9%
Fine Paper	9.6%	865			
Beverage Containers (dairy)	0.3%	26	16	4	13.1%
Metal Food Containers	0.8%	74	10	10	12.0%
Composite Aluminum (White Goods)	0.0%	2	137	137	98.7%
Batteries	0.0%	2	44	90	97.4%
Totals	100.0%	9,001	970	671	6.9%

Source: 2007 Waste Composition Study; 2006 City of Yellowknife recycling data. Assumptions used to convert the number of bales recycled to tonnes recycled (for tin cans, White Goods, batteries) are shown in Appendix F.

With respect to the range of materials collected in the residential depot and private recycling collection programs, the findings suggest that 22% of cardboard generated is diverted to recycling, followed by newspaper, HDPE natural plastic containers, tin cans and mixed paper (boxboard and fine paper). Overall, these findings indicate that there is significant room for improvement in the effectiveness of the existing recycling collection system.

It is important to state the limitations of the waste diversion rate calculations presented above:

- The diversion rate calculation takes into consideration 9,001 tonnes of municipal solid waste disposed at the facility by the residential and commercial sectors. As previously mentioned, other wastes such as construction and demolition waste are also disposed at the facility. If the

entire quantity of waste disposed at the Yellowknife landfill were considered (i.e. 13,400 tonnes in 2005), then the diversion rate would be lower than 6.9%.

- The waste diversion rate takes into consideration only those types of diverted/recycled materials for which volume or weight estimates associated with diversion are recorded: diversion of yard waste, clean wood waste, and salvaged goods at the landfill cannot be assessed using available data.
- The waste diversion rate associated with the residential sector is likely higher than 6.9% because the satellite depots are intended specifically for residential use.

Yard Waste Disposal

The Waste Composition Study findings showed that yard waste comprised 2.7% of waste disposed (244 tonnes). Of this, 75% originated in the Small Commercial/Multi-Family Sector. Overall, this finding shows that yard waste is a small fraction of the waste stream even during the growing season when the Waste Composition Study was undertaken. As the quantity of yard waste handled at the Waste Management Facility yard waste site is unknown, a diversion estimate is not possible.¹¹

3.2.3 Territorial Beverage Container Program

The Northwest Territories Beverage Container Program, implemented in 2005 and managed by the Department of Environment and Natural Resources, covers all types of ready to drink beverages except milk and milk substitutes. The program sets a minimum deposit of ten cents on containers other than wine and spirits. Wine and spirit containers carry a 25 cent deposit. The beverage containers also have a non-refundable handling fee of five to ten cents. The deposit is intended to provide consumers with a financial incentive to return the container for recycling and the handling fee is intended to cover the program costs, including the costs of collecting, processing and hauling recovered containers and materials. More than 25 bottle depots and three processing centres have been established in three regions of the territory. The bottle depots are privately owned and operated, and responsible for the redemption of containers from consumers. The processing centres, also bottle depots, are responsible for collecting containers from satellite depots, as well as consolidating and shipping materials to markets. Aluminum and plastic are shipped to markets in Alberta. Polycoat containers are ultimately shipped to China for processing due to the lack of processing options in Western Canada. Reusable beer containers are packed and shipped to Alberta. Non-refillable glass is crushed and stockpiled until local, feasible recycling options can be found.

In Yellowknife, beverage containers can be returned to the Yellowknife bottle depot (The Bottle Shop) for redemption. The depot, also a processing centre, is located on Old Airport road. The depot is currently handling 13 million containers per year, including containers collected from

¹¹ For comparison, a May 2007 waste composition study conducted in Maple Ridge, BC, found that yard waste comprised 20% overall of waste disposed from residential loads, despite the fact that the city provides a yard waste drop off facility at its transfer station. The Greater Vancouver Regional District 2005 waste composition study showed that yard waste comprised 8% of waste disposed from the residential and commercial sectors, in a context where most municipalities provide curbside yard waste collection as well drop off depots.

satellite depots in five communities in the vicinity of Yellowknife. The facility has two balers to process cans and paper/plastic containers. These products, as well as reusable beer bottles, are stored and shipped to Alberta via Northwest Transport. Non-refillable glass is crushed and hauled to the Yellowknife landfill for stockpiling. The owner of the facility has designed the operation to allow for expansion to handle other products and materials that might be included in future product stewardship programs initiated by the territorial government.

The waste composition study findings indicate that 2.4% of total waste disposed, an estimated 200 tonnes per year, consisted of polycoat, plastic, glass and aluminum containers under deposit in the Beverage Container Program.

3.2.4 Waste Diversion Plans Under Consideration

The Yellowknife Solid Waste Management Committee (SWMAC) has been considering a number of initiatives with respect to enhancing waste diversion in the city.¹² As of 2007, the Committee's work plan has included consideration of:

- banning the disposal of cardboard generated in the commercial sector;
- residential curbside recycling collection if warranted;
- seasonal food waste compost pilot project; and
- establishing a more controlled – three cell – approach to public salvaging at the landfill.

3.2.5 Summary of Issues and Drivers

Based on the review of programs, policies and plans presented in this section, a number of issues and drivers associated with current and potential waste diversion opportunities in Yellowknife were identified:

- The existing landfill is nearing capacity. The current plan is to site a new landfill adjacent to the existing facility, allowing for continued operation of the Waste Management Facility in its existing location. However, the site has not been finalized yet, with approval dependent on a federal/territorial decision regarding the proximity of the operation to the airport. Establishment of an alternate site may have an impact on the economics of waste diversion and disposal.
- The City plans to continue baling garbage and using the baler to process recyclables. Purchase of a new waste baler with a higher capacity is planned. The new baler will be located in the existing building; the City has not planned to expand the existing building or build a new one to accommodate dedicated recycling processing operations or to provide storage for baled recyclables.
- Contamination in switching from baling garbage to recyclables is not considered to be an issue.
- Contamination, by users, of the depot recycling bins is an issue.
- The existing baling facility is working at 85% efficiency, with the principal inefficiency identified as delays in the receipt of incoming garbage leading to slow downs in production. Increasing the throughput of recyclables may require a reconfiguration of hauler scheduling, and may

¹² City of Yellowknife. 2007. *Solid Waste Advisory Committee Work Plan 2007 (Draft)*.

require additional shifts to operate the baler. Installation of a larger capacity baler may ameliorate this situation.

- The baling facility building is too small to bale waste, while also managing materials received from multi-compartment recycling vehicles.
- High transportation costs significantly erode the financial benefits associated with selling recyclables to processors in Western Canada.
- Even though some types of materials are marketable, it has been challenging for the City to find processors willing to take small quantities, limiting the potential to access revenue-positive markets.
- Salvaging is a popular activity at the landfill, but there is no means of protecting valuable resources from damage.

3.3 Identifying Waste Reduction Objectives

Taking into consideration the findings of the Waste Composition Study and the assessment of issues and drivers associated with the existing waste management system, two strategic objectives for increasing waste diversion in Yellowknife in the near to mid term, have been identified. In order of priority, these are:

1. Enhance Programs for City's Currently Marketable Recyclables; and
2. New Initiatives for Large Quantity Wastes: Focus on Food Waste.

The rationales for these two objectives are discussed in the following subsections.

3.3.1 Enhance Programs for City's Marketable Recyclables

Enhancing diversion programs for the City's currently marketable recyclable materials is identified as the priority objective for the City's waste diversion strategy. These materials comprise 31% of waste disposed, indicating that there is potential to significantly increase diversion of these materials, and they are, in general, compatible with the City's established processing facility and established markets.

Assessment of the Waste Composition Study data indicates that recyclable paper products are the largest component of waste disposed, comprising 30% of the total waste stream sampled. Cardboard is the largest component of the recyclable paper products category. Finding from the Waste Composition Study show that the Commercial sector is the largest generator of currently recyclable materials, particularly cardboard and mixed paper. Based on these observations, increasing diversion of currently recyclable materials in the Commercial Sector, particularly cardboard and mixed paper, is identified as the top priority, followed by diversion of paper products from the Residential Sector.



Photo 3. Cardboard in the Solid Waste Stream

Within this context, the nature and degree of change that may be needed in existing programs to enhance diversion of targeted materials is a key consideration in identifying and prioritizing the most readily achievable diversion opportunities. Notable in this regard is whether significant gains can be achieved through enhancing existing collection systems and where, based on information acquired during the course of the study, the private sector appears to be most readily positioned to expand existing services. Further discussion of program options and how these may influence prioritization within the sectors is presented in Section 3.4.2.

3.3.2 New Initiatives: Focus on Food Waste

Consideration was given to identifying large volume materials in the waste stream for which there may be significant markets or end uses, but for which processing and/or collection systems are not currently available in Yellowknife. Initiatives associated with this type of material would focus on investigation of the technical, economic and administrative options, requirements and challenges associated with establishing diversion programs.

In this regard, assessment of the Waste Composition Study data indicates that food waste is the second largest component of the solid waste stream, at 23% of waste disposed. In jurisdictions where food waste is diverted from disposal, it is typically composted in a centralized facility along with other organic materials, such as yard waste, wood waste, non-recyclable paper (i.e. tissue paper) and biosolids. A primary objective of compost facilities is to produce a soil enhancement product (compost) for utilization in residential and commercial landscaping and land remediation projects. Available information indicates that there is likely potential demand for soil amendment in Yellowknife due to the existing geological conditions of the area, and as well, there is long term need for landfill cover material. As such, a focus on diversion of food waste and related organic materials is warranted both in terms of conserving landfill space and meeting local demand for soil amendment.

The next section of the report focuses on identifying and assessing program options for the two strategic objectives identified here.

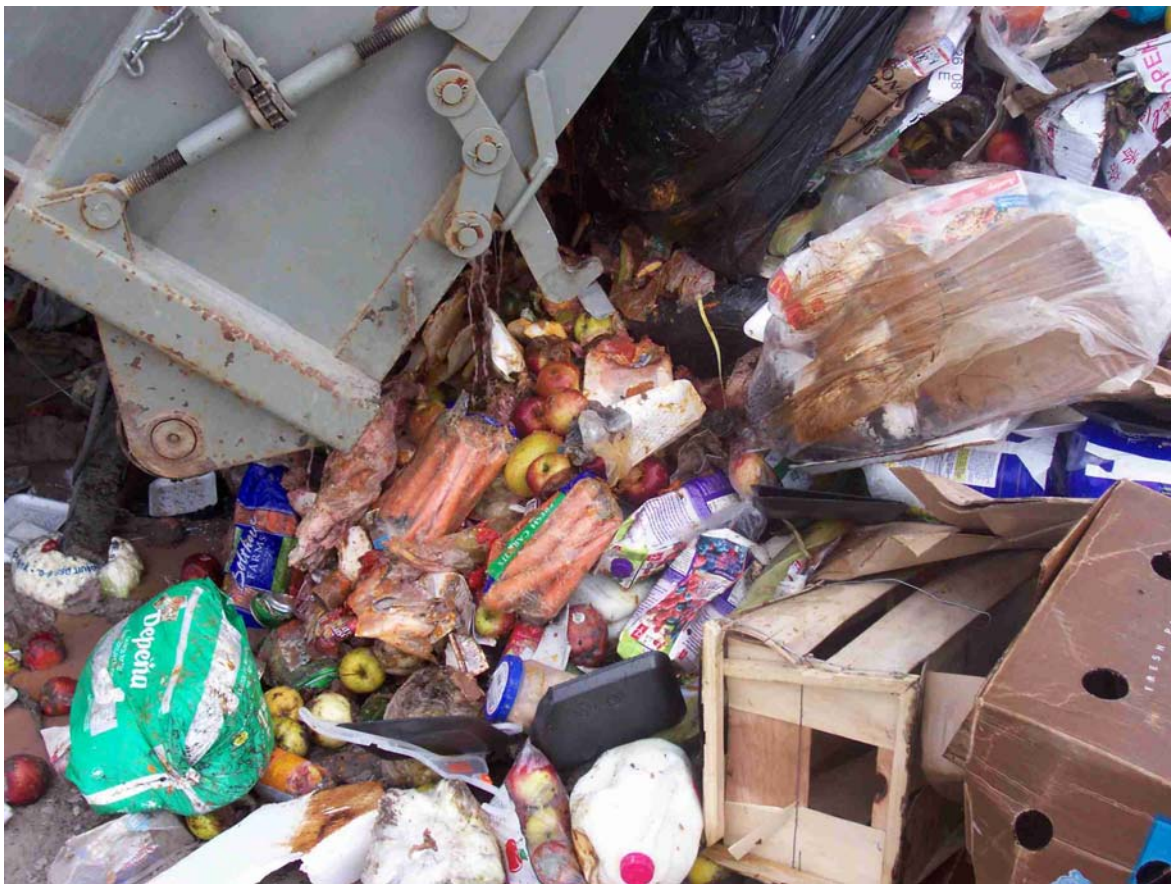


Photo 4. Food Waste

3.4 Options for Enhancing Current Recycling

3.4.1 Introduction

This section presents options for enhancing the diversion of currently marketable, recyclable materials in Yellowknife, with a particular focus on paper products. The commercial sector is addressed first, followed by the residential sector. Each section presents a summary of options, an assessment of diversion potential, and a discussion of key considerations pertaining to the design and implementation of program options.

3.4.2 Commercial Sector

The commercial sector is estimated to contribute as much as 80% of currently marketable recyclables to the waste stream, of which more than 50% is estimated to arise from the small commercial sector. Among these recyclables, cardboard is the major recyclable material evident in the commercial waste stream, followed by fine paper and newspaper.

3.4.2.1 Options

Assuming continuation of the private sector service delivery model recently implemented for the commercial sector, the City can employ a number of tools, either separately or in a package, to facilitate increased diversion of cardboard and other paper from the commercial sector:

Enhanced Education and Outreach to Support the User Fee System

- Focus on supporting the user fee system through enhancing promotion and providing technical support to the commercial sector. Elements of an enhanced program might include:
 - city adoption of a Zero Waste goal promoted to the commercial sector as a Zero Waste challenge linked to the new recycling recognition program;
 - production and distribution of a workplace recycling tool kit with information relevant to different sub-sectors (what to recycle, how to recycle, how to conduct a waste audit, model waste management plan tool, tips on how to make the user fee system pay off, who to contact for technical assistance);
 - development of a business recycling page on the Yellowknife website, including the workplace recycling tool kit and a posting of recipients of the recently initiated recognition program; and
 - call-in technical support service, with City staff providing over the phone information on how to set up a recycling program.
- In this context, consideration might also be given to further reducing the tipping fee for cardboard to increase the financial incentive for waste generators to divert cardboard.

Phased-in Disposal Bans, Supported by Promotion and Technical Assistance Program

- Phase-in bans on the disposal of recyclable materials from the commercial sector to further support the financial incentives approach already adopted by the City.

- Elements of a ban program should include:
 - extensive pre-ban education, promotion and outreach, including meetings with stakeholders, advertisements, and distribution of information kits (workplace recycling kits);
 - provision of a call-in technical support service, with City staff providing over the phone information on how to set up a recycling program; and
 - meaningful enforcement measures, such as application of a significant surcharge on tipping fees for commercial loads found to contain banned recyclables.

3.4.2.2 *Diversion Potential*

Table 6 provides a summary of estimated additional diversion potential associated with the two types of options presented for paper products (as well as other recyclables) generated in the commercial sector. Additional diversion potential refers to the estimated additional tonnes that may be recycled as a result of implementing these two options. These rough estimates are based on our experience and are presented to provide high level insight into the potential performance of options, and to assist in assessing the potential impacts on the collection and processing infrastructure. The following assumptions were used to make these estimates:

- For the voluntary outreach and education initiatives, where waste generators are encouraged to increase their recycling activities in the context of existing user pay incentives, it was assumed that the additional diversion potential for paper products would be in the range of 10% of each material stream, and 5% for containers, as containers require additional preparation for recycling and are generally not generated in large volumes; the diversion potential would be higher if differential tipping fees at the landfill were further reduced.
- For the comprehensive ban option where the commercial sector has access to private on-site recycling collection services and bans have been progressively implemented and are being enforced, the diversion rates are estimated to be 50% for paper products and 25% for containers.

Based on these assumptions, the diversion potential ranges from 2% to 10% additional diversion of the total waste stream sampled in the Waste Composition Study, as defined in Section 3.2.2.9. The Education and Promotion approach would result in the diversion of an estimated additional 100 tonnes of cardboard, if cardboard alone is targeted, and 200 tonnes of recyclables if and when all materials streams are targeted. For the Disposal Ban Program, an additional 480 tonnes of cardboard recycling is estimated if cardboard alone is targeted and more than 1,000 tonnes if and when all materials streams are targeted. A third option would be the combination of a comprehensive ban on cardboard combined with a voluntary initiative for other types of materials. In this case, the diversion potential would be 480 tonnes of cardboard plus 110 tonnes of other materials, for a total of 590 tonnes of recyclables.

Table 6. Commercial Sector - Estimated Additional Diversion

Material Category	Commercial Waste Disposed		Additional Diversion Potential			
	Small Commercial	Large Commercial	Education & Outreach Program		Disposal Ban Program	
	Estimated Annual Disposal (Tonnes)	Estimated Annual Disposal (Tonnes)	Total Additional Tonnes Diverted	Total Additional Bales Recycled	Total Additional Tonnes Diverted	Total Additional Bales Recycled
Newspaper	116	199	31	41	157	207
Corrugated Cardboard	606	362	97	194	484	968
Boxboard	99	39	14	18	69	91
Fine Paper	551	60	61	80	306	402
Beverage Containers (Dairy)	11	8	2	7	7	26
Metal Food Container	36	2	2	2	10	10
Totals	1,419	671	207	343	1,033	1,705

Note: The assumptions used to segregate the multi-family disposal data from the small commercial data are presented in Appendix E.

3.4.2.3 Considerations

- As an approach aimed at supporting a user fee system with differential tipping charges for recyclables, recycling ban programs are likely to result in greater diversion of recyclables than voluntary programs. However, the effectiveness of bans is highly dependent on the level of awareness among affected stakeholders, ready access to collection services and the consistent application of enforcement measures at the point of disposal.
- A ban might be further supported by the adoption of mandatory recycling targets for designated materials, as has been undertaken by the Halifax Regional Municipality, as well as some jurisdictions in the United States.
- Pre-ban education and outreach is critical to the effectiveness of implementation and to mitigate the potential for increased illegal dumping. Education should start at least six months in advance of a ban to raise awareness and allow stakeholders sufficient time to set up recycling programs.
- A critical component to the success of the differential tipping fee approach adopted by the City is that waste generators have the information needed to select the appropriate size of cardboard and garbage bins, and the appropriate scheduling frequency, to ensure that they benefit from lower tipping fees for recyclables. Developing materials that would assist waste

generators in analyzing their situation accordingly would comprise a key part of any education and outreach program.

- Bans are not typically applied unless the targeted waste generators have a reasonably convenient range of options available for handling recyclables generated on site. Preliminary information acquired during the course of this study suggests that there is limited access to on-site collection services for newspaper, office paper and other recyclables at present in Yellowknife. Therefore, the general phase-in of bans should start with cardboard, followed by other paper products when there is evidence of sufficient on-site collection capacity in the private sector.
- In the event of a cardboard ban, the City may see a significant increase in the use of the City residential depots for disposal of small quantity generator commercial cardboard, resulting in increased hauling costs for the City. As well, there will likely be a significant increase in self-haul to the recycling depot at the Waste Management Facility, resulting in increased traffic, increased use of the recycling bins and thus increased handling costs. Therefore, consideration should be given to phasing in a cardboard ban starting with the large commercial sector first, allowing time for the City to assess the potential impacts on its depot collection system and make any operational adjustments necessary. Similar impacts on the depot collection system may arise with the implementation of bans on other commercial recyclables.
- Given the large amount of cardboard being disposed in the commercial sector, a ban could result in a significant increase in the throughput of this material at the Waste Management Facility, as shown in Table 6. The potential increase of newspaper and office or mixed paper could be significant as well. The City may need time to assess and adjust to the potential impacts these volumes may have on current operations.
- In general, the direct costs of implementing an enhanced education and outreach program would be lower than for a comprehensive ban program. The education/outreach initiative would require additional staff time to prepare outreach materials, conduct outreach meetings and respond to calls for technical support. Costs would also be associated with the design and production of outreach materials. Additional direct costs associated with implementation of a ban would include the costs of designing the key elements of the ban, pre-ban advertising, staff training and staff time on implementation in terms of monitoring and enforcement at the baling facility and materials management.

3.4.3 Single Family Residential

At 256 tonnes, the quantity of currently recyclable materials disposed by the single family sector represents just 10% of recyclable materials disposed by all sectors, with the vast majority being generated in the commercial sector. In this context, and given that the City already provides a depot-based collection system for the residential sector, enhancing or changing the existing approach to increase the diversion of these recyclables from disposal should be considered a lower priority than increasing diversion in the commercial sector. However, enhancing diversion from the SFU sector is important both in terms of contributing to the City's overall strategy of diverting waste from disposal and in terms of fostering public engagement with, and commitment to, waste reduction and the broader objectives of environmental sustainability.

3.4.3.1 Options

Enhanced Residential Depot Recycling

- The aim of this approach is to increase waste diversion by improving the level of convenience associated with the depot system and fostering utilization through additional education and the application of supporting policies. The following elements may be considered for this approach:
 - establishing more depots in neighbourhoods and high traffic areas;
 - reducing the garbage bag collection limit from three to two bags per household;
 - banning disposal of recyclables collected at depots (enforced at curbside and referred to as a collection ban); and
 - enhancing education and outreach to residents through initiatives such as promotion of a Zero Waste challenge to invigorate participation, and development of a Master Recycler/Composter training program to build capacity for volunteer driven outreach and communication at the community level.

Curbside Recycling Collection

- The aim of this approach is to replace the depot system (for this sector) with a significantly more convenient curbside collection program. Elements of the program would include:
 - weekly or bi-weekly door-to-door curbside collection of marketable recyclables;
 - reducing the garbage bag collection limit from three to two bags per household;
 - banning disposal of recyclables (enforced at curbside and referred to as a collection ban); and
 - enhancing education and outreach to residents through initiatives such as promotion of a Zero Waste challenge to invigorate participation, and development of a Master Recycler/Composter training program to build capacity for volunteer driven outreach and communication at the community level.

3.4.3.2 Diversion Potential

Table 7 provides a summary of estimated additional diversion potential associated with the two types of options presented for the SFU sector. Additional diversion potential refers to the estimated additional tonnes that may be recycled as a result of implementing these options. These rough estimates are based on our experience and are presented to provide high-level insight into the potential performance, and to assist in assessing the potential impacts on the collection and processing infrastructure. The following assumptions were used to make these estimates:

- for the Enhanced Depot initiative, it was assumed that the additional diversion potential would be in the range of 15% of each material stream; and
- for the curbside collection option, it was assumed that the additional diversion potential would be in the range of 65% of each material stream.

Table 7. Single Family Residential – Estimated Additional Diversion

Material Category	SFU Waste Disposed		Enhanced Depot Initiative		Curbside Recycling	
	Waste Stream Composition (%)	Estimated Annual Disposal (Tonnes)	Additional Tonnes Diverted	Additional Bales Recycled	Additional Tonnes Diverted	Additional Bales Recycled
Newspaper	3.9%	68	10	13	44	58
Corrugated Cardboard	1.7%	30	4	9	19	39
Boxboard	3.3%	58	9	11	38	50
Fine Paper	4.1%	72	11	14	47	62
Beverage Containers (Dairy)	0.2%	4	1	2	3	10
Metal Food Container	1.4%	24	4	4	16	16
Totals	14.6%	256	38	54	166	234

Based on these assumptions, the estimated additional diversion potential ranges from 0.4% to 2% of waste generated, as defined in Section 3.2.2.9. For the Enhanced Depot option, an estimated 38 additional tonnes of recyclables would be diverted, compared to an estimated 166 additional tonnes for the curbside approach.

3.4.3.3 Considerations

- In general, curbside collection programs will yield higher diversion rates because of the increased convenience and greater effectiveness in applying policy tools such as reduced bag limits.
- This generalization was substantiated recently in a City of Calgary pilot project on the comparative effectiveness of the city’s existing residential depot system compared to a pilot curbside collection program. The city found that the diversion of recyclables (paper and containers) increased from 15% to 25% of residential waste generated. Similarly, the City of Chilliwack (BC) recently saw a significant increase in diversion when they shifted from a residential depot system to curbside collection, with the diversion rate increasing from 13% to 30%. However, the degree of increased effectiveness is dependent on program design and implementation factors such as the range of materials collected, the number of materials streams that residents are required to sort to and the extent of promotion and education.

- The service delivery costs for curbside collection programs are typically higher than for depot-based programs. How much so is case specific, and depends on variables such as the type of collection vehicles used and degree of mechanization, number of materials sorts required at curb and types of materials collected, and the offsetting value of commodities revenues.¹³
- Deciding between an enhanced depot system and curbside collection options will require an assessment of the actual costs and benefits of specific options, as well as the broader system level implications and the threshold for public acceptability.
- Information acquired during the course of this study indicates that the local hauler is not at present equipped to implement a curbside program, but is in the process of assessing options and costs should they be requested to move in that direction.
- The City would need to assess whether to retain the satellite depots to service the multi-family sector, or to shift to an on-site program for them as well;
- The design of a curbside program would have to address the operational constraints at the Waste Management Facility, notably that the existing building does not have the capacity to house a sorting line, and the building is too small to continue baling waste while also having a three or four compartment recycling vehicle offloading recyclables.
- Other operational considerations:
 - whether to continue collecting glass at the depots and/or whether to collect it at all at curbside due to the costs, low/negative revenue, and contamination issues; and
 - whether to add HDPE colour containers, due to the higher quantities and relatively high commodities price.

¹³ For example, the City of Calgary has announced that it will implement an \$8 per household per month charge in 2009 to cover the costs of weekly curbside collection of commingled recyclables (with each resident receiving one wheeled cart) plus continuation of its depot system. The City of Red Deer charges (as of 2005) a \$3.49 per month utility fee for curbside and multi-family (on-site) collection, using a single stream, weekly blue box collection system.



Photo 5. Plastic Containers (HDPE #2, colour)

3.4.4 Multi-Family Residential

Similar to the Single Family sector, the Multi-Family sector is estimated to dispose of a small fraction (estimated at 8%) of the total amount of currently recyclable materials found in the Yellowknife waste stream, compared to the commercial sector. In this context, enhancing diversion from this sector is a lower priority compared to the commercial sector, although it remains important in terms of the City's overall waste management strategy and fostering participation in waste reduction.

3.4.4.1 Options

Enhanced Residential Depot Recycling

- As with the single family residential sector, the aim of this approach is to increase waste diversion by improving the level of convenience associated with the depot system and fostering

utilization through additional education and the application of supporting policies. The following elements may be considered for this approach:

- establishing more depots in the vicinity of multi-family buildings, as well as in high traffic areas;
- encourage buildings to subscribe to private recycling collection services if available;
- banning disposal of recyclables; and
- targeted education and outreach to property managers and residents of multi-family units: meetings/workshops with property managers to gain support and on-site leadership; production and distribution of building/apartment recycling posters and flyers; promotion of a Zero Waste challenge to invigorate participation.

On-Site Recycling Collection

- The aim of this approach would be to replace the depot system (for this sector) with a significantly more convenient on-site collection program delivered to all buildings. Elements of the program would include:
 - weekly or bi-weekly on-site collection of marketable recyclables;
 - banning disposal of recyclables; and
 - targeted education and outreach to property managers and residents of multi-family units: meetings/workshops with property managers to gain support and on-site leadership; production and distribution of building/apartment recycling posters and flyers; promotion of a Zero Waste challenge to invigorate participation.

3.4.4.2 *Diversion Potential*

Table 8 provides a summary of estimated additional diversion potential associated with the two types of options presented for the MFU sector. Additional diversion potential refers to the estimated additional tonnes that may be recycled as a result of implementing these options. These rough estimates are based on our experience and are presented to provide insight into the potential performance, and to assist in assessing the potential impacts on the collection and processing infrastructure. The following assumptions were used to make these estimates:

- for the Enhanced Depot initiative, it was assumed that the additional diversion potential would be in the range of 10% of each material stream - lower than the single family participation rate due to higher itinerancy; and
- for the on-site collection option, the additional diversion potential was assumed to be in the range of 55% of each material stream – lower than the single family participation rate due to higher itinerancy.

Table 8. Multi-Family Residential – Estimated Additional Diversion

Material Category	Multi-Family Waste Disposed		Enhanced Depot Initiative		On-Site Collection	
	Waste Stream Composition (%)	Estimated Annual Disposal (Tonnes)	Additional Tonnes Diverted	Additional Bales Recycled	Additional Tonnes Diverted	Additional Bales Recycled
Newspaper (including flyers)	3.9%	53	5	7	29	38
Corrugated Cardboard	1.7%	23	2	5	13	26
Boxboard	3.3%	46	5	6	25	33
Fine Paper	4.1%	57	6	7	31	41
Beverage Containers (Dairy)	0.2%	3	0	1	2	7
Metal Food Container	1.4%	19	2	2	10	10
Totals	14.6%	201	20	28	110	155

Note: The assumptions used to segregate the multi-family disposal data from the small commercial data are presented in Appendix E.

Based on these assumptions, the estimated additional diversion potential ranges from 0.2% to 1.1% of as defined in Section 3.2.2.9. For the Enhanced Depot option, an estimated 20 additional tonnes of recyclables would be diverted, compared to an estimated 110 additional tonnes for the on-site approach.

3.4.4.3 Considerations

- As with the Single Family sector, higher diversion rates can be expected by shifting to an on-site program but the costs of service delivery will go up as well. The benefits and costs need to be defined and assessed in order to determine which approach is preferable.
- On site collection system options would be defined and investigated as part of assessing the benefits and costs of depots versus on-site collection, taking into consideration the number of materials sorts, container types (wheeled carts and/or overhead bins), collection vehicle options, and collection frequencies, among other things. The current capacity and readiness of the private sector to deliver this type of service would also require investigation.
- The design of an on-site collection system is in part determined by the space constraints within buildings to accommodate recycling containers, and vehicle access limitations to buildings.
- Gaining participation and cooperation of residents in multi-family buildings is often more challenging than in the single family sector. Outreach initiatives should target building

managers/owners, as well as residents, in order to foster participation and compliance with disposal bans.

- The design of an on-site program would have to address the operational constraints at the Waste Management Facility, notably that the existing building does not have the capacity to house a sorting line, and the building is too small to continue baling waste while also having a three or four compartment recycling vehicle offloading recyclables.
- An on-site collection program could be provided by the City, or, as an alternative, the City could consider a bylaw requiring all multi-family buildings to subscribe to privately operated collection services.

3.5 Food Waste Composting Options

3.5.1 Introduction

The Waste Composition Study showed that 2,100 tonnes of food waste were disposed from the residential and commercial sectors in 2006, accounting for 23% of the total waste stream. By sector, the residential sector disposes of 55% to 60% of food waste while the commercial sector disposes of 40% to 45%. A fraction of single family residential food waste (uncooked fruit and vegetable scraps), as well as yard waste, can be managed through a backyard composting program for a low cost and without the need for new or enhanced public infrastructure. However, achieving significant diversion of food waste from the various sectors will require the development of a centralized organic waste processing facility, as well as the collection systems needed for containing and hauling this type of material. As the City has already initiated a pilot backyard composter distribution program, this section focuses on identifying considerations for the development of a centralized composting program.

3.5.2 Centralized Food Waste Composting

A significant degree of technical and economic investigation and analysis is required in order to identify centralized food waste composting options that would be viable and feasible within the local context. This report does not attempt to define these program options, and the associated diversion potential. Rather, this section focuses on providing an overview of important questions and considerations that should be investigated through a preliminary technical and economic assessment of centralized composting options for Yellowknife.

3.5.2.1 Considerations

- Determining whether to develop a source segregated organic (SSO) composting system or a mixed organic waste (MOW) composting system is a preliminary step in defining the system. Each approach has its advantages and disadvantages.
- Assuming that the main type of organic waste to be composted is source segregated food waste, the Waste Composition Study findings indicate that the maximum theoretical size of facility would be 4,200 tonnes per year, assuming recovery of 100% of food waste disposed from all sectors and including equal amounts of food waste and carbon rich amendment (clean

wood waste, yard waste, paper). Defining the specific scale of facility will depend on assessing a range of variables, such as what sectors will be targeted, the effectiveness of collection systems, whether other organic wastes such as biosolids are available.

- Municipal food waste is typically composted in systems that provide for the containment and covering of the feedstock during processing. Examples of technologies being used to compost food waste in North America include Wright Environmental Management Inc., Gore Systems, and Christiaens Controls Composting System. The technical feasibility of alternative technologies needs to be assessed in the context of Yellowknife's extremely cold winter weather conditions.
- At a small scale (> 5,000 tonnes per year), 'off the shelf' systems typically cost at least \$150/tonne all in for amortized capital and operating. Whether the economics of such technologies are acceptable compared to the current and long term economics of baling and land disposal in Yellowknife needs to be assessed.
- A less costly, custom built processing system may be possible for a small scale project such as might be designed for Yellowknife. However, the costs are highly dependent on factors such as whether the facility could be built at a site that already has leachate containment features (i.e. lined landfill); the extent of odour control management required based on proximity of the site to residential areas; and the feasibility of seasonal operation.
- The Waste Composition Study findings indicate that more than 50% of food waste disposed originated in the residential sector and the remainder originated in the small and large commercial/institutional sectors. Determining whether to target some or all of these sectors, including assessing the viability of residential and commercial source segregated food waste collection systems in Yellowknife's cold climate conditions, is an important consideration affecting the scale and feasibility of a centralized facility.
- To compost food waste, which is a nitrogen rich material, an additional quantity of carbon based amendment is required. Carbon based amendments are carbon rich materials such as clean wood waste and paper. As a rule, the ratio of carbon to nitrogen material is 1:1 although some systems may require less carbon material per unit of food waste. Thus, for 2,100 tonnes of food waste, an additional 2,100 tonnes of wood chips, woody yard waste, paper and other carbon rich materials would be needed. A feedstock assessment would be required to determine if there are sufficient quantities of clean wood waste and other material available.
- Low value recyclable paper, notably boxboard, as well as tissue paper and other paper such as coffee cups can be considered for composting. Given the low commodity value for boxboard and the high costs of shipping to market, composting may be a preferred management approach.

Given these considerations, centralized food waste composting should be considered as a potential mid to longer term objective for Yellowknife, and subject to a preliminary technical and economic assessment to determine the suitability of this approach for the community.

4. Waste Reduction Strategy and Recommendations

The purpose of the waste composition study and diversion assessment presented in this report was to assist the City of Yellowknife in defining strategic priorities for waste diversion in the near to medium future. The City has operated a recycling program since 1994 and has made numerous enhancements over the years. Looking forward, the City is trying to determine where to focus resources in the next few years. Based on the findings of the waste composition study and the analysis of the existing waste management system in Yellowknife, two strategic priorities were identified and further elaborated in terms of program options and key considerations. As a result of this assessment, this section presents a set of recommendations, organized and prioritized under the two strategic objectives.

Enhance Programs for Marketable Recyclables

Enhancing diversion programs for the City's currently marketable recyclable materials is identified as the top objective for the City's waste diversion strategy. They comprise 31% of waste disposed and increasing diversion of them is generally compatible with the City's existing processing facility and established markets. Within the context of this objective, increasing diversion from the commercial sector should be the highest priority, as the commercial sector generates 80% of the marketable recyclable waste disposed.

Prioritized Recommendations

1. Adopt a City of Yellowknife 'Zero Waste' goal, to be promoted in outreach materials and initiatives as a Zero Waste challenge intended to foster increased public participation in the City's waste diversion programs.
2. Design and implement a cardboard disposal ban program that targets the Large Commercial sector. The cardboard ban program should include:
 - a. extensive pre-ban education, promotion and outreach, including meetings with stakeholders, advertisements, and distribution of workplace recycling information kits;
 - b. provision of a call-in technical support service, with City staff providing over the phone information on how to set up a recycling program; and
 - c. enforcement measures, such as application of a significant surcharge on tipping fees for Large Commercial loads found to contain more than 10% cardboard.
3. Expand the cardboard disposal ban to the Small Commercial sector when the potential operational impacts of increased handling and processing at the Waste Management Facility have been assessed and addressed.
4. Expand the ban to include newspaper, fine paper and other currently recyclable materials from the Commercial sector when the capacity of the private sector to service commercial establishments with on-site collection programs has been confirmed and the potential operational impacts at the Waste Management Facility have been assessed and addressed.

5. Assess the costs and benefits of enhancing the existing residential depot recycling program compared to shifting to curbside collection for the single family dwellings sector and on-site recycling for the multi-family sector.

Organic Waste Management - Focus on Food Waste

Developing a program for significantly increasing the diversion of food waste is identified as the second strategic objective for the City of Yellowknife. Food waste comprises 23% of waste disposed, making it the single largest category identified in the waste stream. Yard waste on the other hand, is only 2.7% of waste disposed. In jurisdictions where food waste is diverted from disposal, it is typically composted in a centralized facility along with other organic materials, such as yard waste, wood waste, non-recyclable paper (i.e. tissue paper) and biosolids. A primary objective of compost facilities is to produce a soil enhancement product (compost) for utilization in residential and commercial landscaping and land remediation projects. Available information indicates that there is likely potential demand for soil amendment in Yellowknife due to the existing geological conditions of the area, and as well, there is long term need for landfill cover material. As such, a focus on diversion of Food Waste and related organic material is warranted both in terms of conserving landfill space and meeting local demand for soil amendment.

Recommendations

1. Continue to promote backyard composting and utilization, by all sectors, of the yard waste drop off area at the Waste Management Facility.
2. Undertake a preliminary technical and economic assessment of the options for centralized food waste processing in Yellowknife. The assessment should investigate and make recommendations regarding:
 - a. feedstock potential from commercial, residential and other sources;
 - b. technology options and costs;
 - c. facility siting options;
 - d. end use options/market capacity;
 - e. regulatory considerations and approvals requirements for establishing a facility; and
 - f. collection program options, and costs for public service delivery where relevant.

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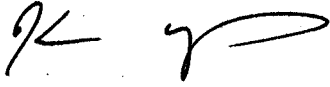
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6. Closure

Report Prepared By:



for Mary Jean O'Donnell

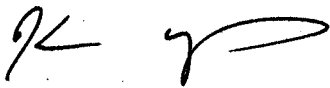
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Appendix A

Waste Composition Study Data Sheets

Table A-1. Yellowknife Summary Table - Estimated Annual Disposal (Tonnes)

Material Category	Sm Comm / MFU		Large Commercial		SFU		Totals	
	Waste Stream Composition (%)	Estimated Annual Disposal (Tonnes)	Waste Stream Composition (%)	Estimated Annual Disposal (Tonnes)	Waste Stream Composition (%)	Estimated Annual Disposal (Tonnes)	Waste Stream Composition (%)	Estimated Annual Disposal (Tonnes)
Paper Products	38.4%	2,132	49.7%	841	21.0%	367	37.1%	3,341
Newspaper (including flyers)	2.8%	154	11.8%	199	3.9%	68	4.7%	421
Magazines	0.1%	4	0.2%	3	0.2%	4	0.1%	10
Corrugated Cardboard	14.5%	806	21.4%	362	1.7%	30	13.3%	1,198
Boxboard	2.4%	132	2.3%	39	3.3%	58	2.6%	230
Fine Paper	13.2%	732	3.6%	60	4.1%	72	9.6%	865
Tissue Paper	2.6%	147	3.8%	65	3.2%	56	3.0%	268
Polycoat Beverage (deposit)	0.1%	7	0.0%	1	0.4%	8	0.2%	16
Polycoat Beverage (non-deposit)	0.1%	8	0.2%	3	0.4%	7	0.2%	17
Other Paper	2.6%	143	6.5%	110	3.7%	64	3.5%	317
Plastic	11.1%	616	13.2%	224	16.0%	280	12.4%	1,120
Beverage Containers (deposit)	0.7%	38	0.6%	10	0.5%	9	0.6%	56
Beverage Containers (dairy)	0.3%	14	0.5%	8	0.2%	4	0.3%	26
Rigid (HDPE & PET)	1.9%	104	2.9%	50	3.6%	64	2.4%	218
Plastic Film	3.7%	205	3.2%	55	5.9%	104	4.0%	364
Other	4.6%	255	6.0%	101	5.7%	99	5.1%	455
Glass	2.4%	134	1.4%	24	2.7%	47	2.3%	206
Beverage Containers (deposit)	1.6%	88	0.3%	6	0.4%	8	1.1%	101
Food Containers	0.5%	28	0.7%	12	1.4%	24	0.7%	64
Non-container Glass	0.3%	19	0.4%	7	0.8%	15	0.5%	41
Ferrous Metal	3.4%	188	1.0%	17	3.2%	56	2.9%	261
Metal Food Container	0.9%	48	0.1%	2	1.4%	24	0.8%	74
Aerosol (empty)	0.1%	5	0.0%	-	0.0%	1	0.1%	6
Paint Cans and Lids (empty)	0.3%	17	0.4%	7	0.0%	-	0.3%	24
Other Ferrous	2.1%	119	0.4%	7	1.7%	30	1.7%	156
Composite Ferrous	0.0%	-	0.0%	-	0.1%	2	0.0%	2
Aluminum	0.8%	45	0.2%	3	0.5%	8	0.6%	56
Aluminum Beverage (deposit)	0.5%	26	0.2%	3	0.2%	3	0.4%	32
Aluminum Food Containers	0.0%	0	0.0%	-	0.2%	4	0.0%	4
Foil	0.1%	5	0.0%	-	0.1%	1	0.1%	6
Other Aluminum	0.2%	12	0.0%	-	0.0%	-	0.1%	12
Composite Aluminum	0.0%	2	0.0%	-	0.0%	-	0.0%	2
Textiles	4.4%	244	0.6%	9	1.7%	30	3.2%	284
Organics	22.2%	1,233	24.7%	419	40.0%	702	26.1%	2,353
Food Waste	18.9%	1,051	24.5%	414	36.7%	644	23.4%	2,109
Yard & Garden	3.3%	182	0.3%	4	3.3%	58	2.7%	244
Special Care Waste	0.6%	31.5	0.5%	8	0.1%	1	0.5%	41
Batteries	0.0%	1.2	0.0%	0	0.0%	1	0.0%	2
Paint/Solvents/Aerosols (full)	0.5%	30	0.5%	8	0.0%	0	0.4%	38
Other Wastes	15.6%	865	7.1%	119	14.3%	250	13.7%	1,235
Bulky Items	3.5%	193	0.2%	4	1.3%	23	2.4%	220
Composites	2.3%	130	0.5%	9	1.5%	26	1.8%	165
Household Hygiene	4.1%	230	2.4%	40	10.6%	186	5.1%	455
Inorganic (soils)	0.5%	29	1.0%	16	0.6%	11	0.6%	57
Tires	0.0%	-	0.0%	-	0.0%	-	0.0%	-
Rubber	0.0%	3	0.2%	4	0.0%	-	0.1%	7
Wood Waste	4.6%	256	2.8%	47	0.2%	3	3.4%	306
Renovation Waste	0.4%	25	0.0%	-	0.0%	1	0.3%	25
Fines	0.6%	32	0.4%	8	0.3%	4	0.5%	44
Other Unspecified	0.6%	35	1.2%	20	0.4%	6	0.7%	62
Totals	100.0%	5,556	100.0%	1,693	100%	1,752	100.0%	9,001

Table A-2. Small Commercial and Multi-Family Solid Waste Composition Data - City of Yellowknife (June 2007)

Material	SC1	SC2	SC3	SC4	SC5	SC6	SC7	SC8	SC9	SC10	SC11	SC12	SC13	SC14	Totals	Waste Stream Percentage
Paper Products	42.30	43.96	13.56	74.60	47.00	33.54	16.60	73.72	37.30	30.06	34.10	42.70	77.50	38.80	605.74	38.4%
Newspaper (including flyers)	2.10	3.80	2.10	3.10	2.10	2.50	0.80	3.80	10.90	1.50	2.70	1.50	3.90	3.00	43.80	2.8%
Magazines	-	1.00	-	-	-	-	-	-	-	-	-	-	-	-	1.00	0.1%
Corrugated Cardboard	17.70	21.00	2.70	5.40	18.40	8.80	7.20	18.60	16.10	5.30	15.30	16.30	65.90	10.20	228.90	14.5%
Boxboard	2.90	3.60	3.40	2.30	3.40	3.40	1.80	0.60	3.30	2.10	3.40	1.60	2.10	3.60	37.50	2.4%
Fine Paper	-	7.30	1.50	56.70	15.70	11.40	1.50	49.60	2.60	15.30	7.80	19.30	2.50	16.70	207.90	13.2%
Tissue Paper	4.00	3.10	1.20	3.00	4.50	4.80	3.50	1.10	1.60	4.80	3.70	2.20	1.70	2.60	41.80	2.6%
Polycoat Beverage (deposit)	0.10	0.08	0.06	0.20	0.70	0.20	-	-	0.20	0.06	0.20	0.10	-	0.20	2.10	0.1%
Polycoat Beverage (non-deposit)	-	0.08	0.40	0.10	0.30	0.14	0.20	0.02	0.30	-	-	0.30	0.10	0.20	2.14	0.1%
Other Paper	15.50	4.00	2.20	3.80	1.90	2.30	1.60	-	2.30	1.00	1.00	1.40	1.30	2.30	40.60	2.6%
Plastic	26.00	8.30	8.40	12.70	14.40	10.04	18.20	15.60	12.40	10.24	9.40	11.80	6.40	11.20	175.08	11.1%
Beverage Containers (deposit)	0.70	1.30	1.30	1.40	0.50	1.00	0.30	0.10	1.20	0.30	1.00	1.00	0.30	0.30	10.70	0.7%
Beverage Containers (dairy)	0.20	0.40	0.30	0.10	0.30	0.14	0.30	-	0.70	0.14	0.60	0.40	0.10	0.30	3.98	0.3%
Rigid (HDPE & PET)	5.00	1.90	1.00	0.70	0.70	1.90	1.80	7.90	1.60	3.50	0.90	1.80	-	0.90	29.60	1.9%
Plastic Film	10.10	3.00	3.40	2.90	6.90	4.60	3.90	1.50	2.90	3.10	4.30	2.60	4.00	5.10	58.30	3.7%
Other	10.00	1.70	2.40	7.60	6.00	2.40	11.90	6.10	6.00	3.20	2.60	6.00	2.00	4.60	72.50	4.6%
Glass	2.80	5.20	2.50	0.20	2.30	4.90	0.40	-	5.20	3.30	4.60	3.70	1.00	2.10	38.20	2.4%
Glass Beverage Containers (deposit)	2.40	3.80	-	0.20	2.10	2.60	0.40	-	4.40	1.50	3.80	3.70	-	-	24.90	1.6%
Glass Food Containers	-	-	1.50	-	-	1.50	-	-	-	1.80	-	-	1.00	2.10	7.90	0.5%
Non-container Glass	0.40	1.40	1.00	-	0.20	0.80	-	-	0.80	-	0.80	-	-	-	5.40	0.3%
Ferrous Metal	1.55	3.10	9.60	1.00	1.70	4.40	16.20	0.30	3.10	3.20	2.20	5.40	0.80	0.80	53.35	3.4%
Metal Food Container	1.05	0.50	0.50	0.50	0.60	3.80	1.20	0.30	1.40	1.10	0.40	1.00	0.40	0.80	13.55	0.9%
Aerosol (empty)	0.10	-	-	-	-	-	-	-	-	-	0.90	-	0.40	-	1.40	0.1%
Paint Cans and Lids (empty)	-	-	1.10	-	-	-	-	-	1.70	-	0.30	1.60	-	-	4.70	0.3%
Other Ferrous	0.40	2.60	8.00	0.50	1.10	0.60	15.00	-	-	2.10	0.60	2.80	-	-	33.70	2.1%
Composite Ferrous	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0%
Aluminum	0.15	1.40	4.90	0.10	0.20	0.90	0.08	0.35	0.50	1.70	0.60	0.20	0.30	1.30	12.68	0.8%
Aluminum Beverage (deposit)	-	1.40	1.40	0.10	0.20	0.90	0.08	0.10	0.50	1.60	-	0.10	0.20	0.70	7.28	0.5%
Aluminum Food Containers (non-deposit)	-	-	-	-	-	-	-	-	-	0.10	-	-	-	-	0.10	0.0%
Foil	0.15	-	-	-	-	-	-	0.25	-	-	0.10	0.10	0.10	0.60	1.30	0.1%
Other Aluminum	-	-	3.50	-	-	-	-	-	-	-	-	-	-	-	3.50	0.2%
Composite Aluminum	-	-	-	-	-	-	-	-	-	-	0.50	-	-	-	0.50	0.0%
Textiles	1.70	14.30	4.20	2.10	9.00	6.40	4.40	-	10.60	3.40	3.70	0.40	1.00	8.10	69.30	4.4%
Textiles	1.70	14.30	4.20	2.10	9.00	6.40	4.40	-	10.60	3.40	3.70	0.40	1.00	8.10	69.30	4.4%
Organics	43.00	15.40	30.20	15.70	15.10	34.90	21.70	24.00	24.90	19.20	35.50	25.00	14.60	31.10	350.30	22.2%
Food Waste	38.80	15.40	27.20	15.70	15.10	31.30	21.70	-	24.40	19.20	25.60	19.00	14.60	30.60	298.60	18.9%
Yard & Garden	4.20	-	3.00	-	-	3.60	-	24.00	0.50	-	9.90	6.00	-	0.50	51.70	3.3%
Special Care Waste	-	0.02	1.64	-	-	-	1.80	-	-	1.20	3.98	0.30	-	-	8.94	0.6%
Batteries	-	0.02	0.04	-	-	-	-	-	-	0.20	0.08	-	-	-	0.34	0.0%
Paint/Solvents/Aerosols (full)	-	-	1.60	-	-	-	1.80	-	-	1.00	3.90	0.30	-	-	8.60	0.5%
Other Wastes	12.60	22.90	44.00	12.45	13.10	8.80	12.10	-	17.80	3.60	32.40	33.70	9.70	22.60	245.75	15.6%
Bulky Items	8.50	5.30	2.00	1.20	4.90	3.10	-	-	-	0.20	13.90	7.00	-	8.70	54.80	3.5%
Composites	0.40	9.20	-	6.40	0.50	-	5.80	-	2.60	-	2.10	9.20	0.80	-	37.00	2.3%
Household Hygiene	3.70	0.50	1.40	3.20	3.70	5.70	1.20	-	8.60	3.10	15.30	0.50	8.90	9.40	65.20	4.1%
Other	-	-	-	-	-	-	-	-	-	-	-	5.80	-	2.50	8.30	0.5%
Tires	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0%
Rubber	-	-	-	0.75	-	-	-	-	-	-	-	-	-	-	0.75	0.0%
Wood Waste	-	7.90	40.60	0.90	2.50	-	5.10	-	6.60	0.30	1.10	7.70	-	-	72.70	4.6%
Renovation Waste	-	-	-	-	1.50	-	-	-	-	-	-	3.50	-	2.00	7.00	0.4%
Fines	0.45	-	0.30	1.10	-	0.50	0.60	-	0.70	2.90	0.30	0.70	1.30	0.30	9.15	0.6%
Fines	0.45	-	0.30	1.10	-	0.50	0.60	-	0.70	2.90	0.30	0.70	1.30	0.30	9.15	0.6%
Other Unspecified	1.00	-	0.50	5.60	-	-	-	-	-	-	0.80	0.30	1.70	-	9.90	0.6%
Other Unspecified	1.00	-	0.50	5.60	-	-	-	-	-	-	0.80	0.30	1.70	-	9.90	0.6%
Totals	131.55	114.58	119.80	125.55	102.80	104.38	92.08	113.97	112.50	78.80	127.58	124.20	114.30	116.30	1,578.39	100.0%

Table A-3. Large Commercial Solid Waste Composition Data - City of Yellowknife (June 2007)

Material	LC1	LC2	LC3	LC4	LC5	LC6	Totals	Waste Stream Percentage
Paper Products	74.14	77.90	53.90	28.00	79.72	52.20	365.86	49.7%
Newspaper (including flyers)	0.50	0.50	2.80	-	64.50	18.20	86.50	11.8%
Magazines	1.20	-	-	-	-	-	1.20	0.2%
Corrugated Cardboard	66.80	48.00	28.80	13.00	-	0.80	157.40	21.4%
Boxboard	1.00	9.00	1.90	-	1.80	3.40	17.10	2.3%
Fine Paper	3.60	1.50	3.90	-	8.60	8.70	26.30	3.6%
Tissue Paper	0.40	3.50	6.20	-	4.10	13.90	28.10	3.8%
Polycoat Beverage (deposit)	0.04	-	0.10	-	0.10	-	0.24	0.0%
Polycoat Beverage (non-deposit)	-	-	0.40	-	0.02	0.90	1.32	0.2%
Other Paper	0.60	15.40	9.80	15.00	0.60	6.30	47.70	6.5%
Plastic	4.72	12.60	15.50	17.80	25.60	21.10	97.32	13.2%
Beverage Containers (deposit)	-	-	0.60	-	0.40	3.20	4.20	0.6%
Beverage Containers (dairy)	0.06	-	0.80	-	-	2.80	3.66	0.5%
Rigid (HDPE & PET)	0.50	-	2.20	16.40	1.70	0.90	21.70	2.9%
Plastic Film	0.66	4.50	6.00	1.40	5.00	6.30	23.86	3.2%
Other	3.50	8.10	5.90	-	18.50	7.90	43.90	6.0%
Glass	-	3.70	1.20	-	0.10	5.60	10.60	1.4%
Glass Beverage Containers (deposit)	-	-	1.20	-	-	1.20	2.40	0.3%
Glass Food Containers	-	3.70	-	-	-	1.40	5.10	0.7%
Non-container Glass	-	-	-	-	0.10	3.00	3.10	0.4%
Ferrous Metal	0.30	-	0.60	-	3.20	3.10	7.20	1.0%
Metal Food Container	0.30	-	0.60	-	-	-	0.90	0.1%
Aerosol (empty)	-	-	-	-	-	-	-	0.0%
Paint Cans and Lids (empty)	-	-	-	-	-	3.10	3.10	0.4%
Other Ferrous	-	-	-	-	3.20	-	3.20	0.4%
Composite Ferrous	-	-	-	-	-	-	-	0.0%
Aluminum	-	-	0.30	-	0.20	0.70	1.20	0.2%
Aluminum Beverage (deposit)	-	-	0.30	-	0.20	0.70	1.20	0.2%
Aluminum Food Containers (non-deposit)	-	-	-	-	-	-	-	0.0%
Foil	-	-	-	-	-	-	-	0.0%
Other Aluminum	-	-	-	-	-	-	-	0.0%
Composite Aluminum	-	-	-	-	-	-	-	0.0%
Textiles	-	2.10	-	-	1.20	0.80	4.10	0.6%
Textiles	-	2.10	-	-	1.20	0.80	4.10	0.6%
Organics	33.20	13.90	34.20	54.80	9.00	37.00	182.10	24.7%
Food Waste	33.20	12.00	34.20	54.80	9.00	37.00	180.20	24.5%
Yard & Garden	-	1.90	-	-	-	-	1.90	0.3%
Special Care Waste	-	-	3.10	-	-	0.50	3.60	0.5%
Batteries	-	-	0.20	-	-	-	0.20	0.0%
Paint/Solvents/Aerosols (full)	-	-	2.90	-	-	0.50	3.40	0.5%
Other Wastes	4.40	3.20	0.30	27.20	13.50	3.30	51.90	7.1%
Bulky Items	0.30	1.30	-	-	-	-	1.60	0.2%
Composites	-	-	-	-	3.50	0.30	3.80	0.5%
Household Hygiene	-	-	0.30	11.00	3.00	3.00	17.30	2.4%
Other	-	-	-	-	7.00	-	7.00	1.0%
Tires	-	-	-	-	-	-	-	0.0%
Rubber	1.80	-	-	-	-	-	1.80	0.2%
Wood Waste	2.30	1.90	-	16.20	-	-	20.40	2.8%
Renovation Waste	-	-	-	-	-	-	-	0.0%
Fines	-	0.30	0.20	-	0.50	2.30	3.30	0.4%
Fines	-	0.30	0.20	-	0.50	2.30	3.30	0.4%
Other Unspecified	-	8.00	0.70	-	0.10	0.10	8.90	1.2%
Other Unspecified	-	8.00	0.70	-	0.10	0.10	8.90	1.2%
Totals	116.76	121.70	110.00	127.80	133.12	126.70	736.08	100.0%

Table A-4. Single Family Solid Waste Composition Data - City of Yellowknife (June 2007)

Material	SFU1	SFU2	SFU3	SFU4	SFU5	Totals	Waste Stream Percentage
Paper Products	24.20	28.10	19.20	25.50	25.90	122.90	21.0%
Newspaper (including flyers)	2.50	4.30	6.00	6.60	3.20	22.60	3.9%
Magazines	1.40	-	-	-	-	1.40	0.2%
Corrugated Cardboard	2.30	1.40	2.50	2.00	1.80	10.00	1.7%
Boxboard	4.50	5.20	3.30	3.40	3.10	19.50	3.3%
Fine Paper	1.30	8.00	1.10	6.10	7.70	24.20	4.1%
Tissue Paper	6.70	4.10	1.40	1.70	5.00	18.90	3.2%
Polycoat beverage (deposit)	0.90	0.10	0.40	1.00	0.20	2.60	0.4%
Polycoat beverage (non-deposit)	0.30	0.70	0.60	-	0.60	2.20	0.4%
Other Paper	4.30	4.30	3.90	4.70	4.30	21.50	3.7%
Plastic	24.30	27.64	12.90	10.70	18.10	93.64	16.0%
Beverage Containers (deposit)	0.30	1.20	0.60	0.10	0.70	2.90	0.5%
Beverage Containers (dairy)	0.50	0.04	0.30	0.10	0.40	1.34	0.2%
Rigid (HDPE & PET)	7.20	5.70	2.30	1.60	4.60	21.40	3.6%
Plastic Film	8.80	11.60	4.30	4.00	6.10	34.80	5.9%
Other	7.50	9.10	5.40	4.90	6.30	33.20	5.7%
Glass	3.80	3.30	1.80	0.60	6.20	15.70	2.7%
Glass beverage containers (deposit)	1.10	0.80	-	-	0.70	2.60	0.4%
Glass food containers	2.70	1.30	1.00	0.60	2.60	8.20	1.4%
Non-container glass	-	1.20	0.80	-	2.90	4.90	0.8%
Ferrous Metal	8.50	1.50	2.60	3.40	2.90	18.90	3.2%
Metal food container	2.20	-	1.60	2.70	1.50	8.00	1.4%
Aerosol (empty)	-	-	-	0.20	-	0.20	0.0%
Paint cans and lids (empty)	-	-	-	-	-	-	0.0%
Other ferrous	5.70	1.50	1.00	0.50	1.40	10.10	1.7%
Composite ferrous	0.60	-	-	-	-	0.60	0.1%
Aluminum	0.10	1.40	-	0.29	1.00	2.79	0.5%
Aluminum beverage (deposit)	0.10	0.40	-	0.04	0.60	1.14	0.2%
Aluminum food containers (non-deposit)	-	1.00	-	0.25	-	1.25	0.2%
Foil	-	-	-	-	0.40	0.40	0.1%
Other aluminum	-	-	-	-	-	-	0.0%
Composite aluminum	-	-	-	-	-	-	0.0%
Textiles	2.30	3.80	1.40	1.40	1.20	10.10	1.7%
Textiles	2.30	3.80	1.40	1.40	1.20	10.10	1.7%
Organics	45.90	43.20	52.10	47.00	46.70	234.90	40.0%
Food waste	43.30	34.40	50.50	44.00	43.30	215.50	36.7%
Yard & Garden	2.60	8.80	1.60	3.00	3.40	19.40	3.3%
Special care waste	0.30	-	-	-	-	0.30	0.1%
Batteries	0.25	-	-	-	-	0.25	0.0%
Paint/solvents/aerosols (full)	0.05	-	-	-	-	0.05	0.0%
Other wastes	17.46	13.00	16.60	24.30	12.40	83.76	14.3%
Bulky Items	0.06	1.30	-	6.40	-	7.76	1.3%
Composites	6.80	1.00	0.30	-	0.70	8.80	1.5%
Household Hygiene	10.60	10.60	16.30	16.90	7.80	62.20	10.6%
Inorganic (soils)	-	-	-	-	3.80	3.80	0.6%
Tires	-	-	-	-	-	-	0.0%
Rubber	-	-	-	-	-	-	0.0%
Wood waste	-	-	-	1.00	-	1.00	0.2%
Renovation waste	-	0.10	-	-	0.10	0.20	0.0%
Fines	0.30	-	1.90	0.90	0.30	3.40	0.6%
Fines	0.30	-	1.90	0.90	0.30	3.40	0.6%
Other unspecified	-	0.20	-	-	-	0.20	0.0%
Other unspecified	-	0.20	-	-	-	0.20	0.0%
Totals	127.16	122.14	108.50	114.09	114.70	586.59	100.0%

Appendix B

Waste Material Categories

Table B-1. Material Categories

Date/Time:		SFU	MFU/Small Comm	Large Comm	Sample #
Auditors:		Sample Source:		Sample Weight:	
Comments:		Audit Location:			
Primary	Secondary	Tally	Net Weight	Comments	
Paper	Newspapers (including flyers)				
	Magazines (including catalogues)				
	Corrugated Cardboard (incl. paper bags)				
	Boxboard (incl. cereal boxes, shoe boxes)				
	Telephone Books/Directories				
	Fine Paper (incl. envelopes, office paper)				
	Tissue Paper / Paper Towel				
	Polycoat Beverage Containers (deposit)				
	Polycoat Beverage Containers (non-deposit)				
	Other Paper				
Plastics	Plastic Beverage Containers (deposit)				
	Plastic Beverage Containers (non-deposit)				
	Rigid Plastics (PET and HDPE)				
	Rigid Plastics (other)				
	Plastic Film				
	Other Plastics				
Glass	Glass Beverage Containers (deposit)				
	Glass Food Containers				
	Non-container Glass				
Ferrous Metal	Metal Beverage Containers (deposit)				
	Metal Food Containers				
	Aerosol (empty)				
	Paint Cans and Lids (empty)				
	Other Ferrous (coat hangers, nails and screws)				
	Composite (mostly ferrous, small appliances)				

Table B-1. Material Categories

Date/Time:		SFU	MFU/Small Comm	Large Comm	Sample #
Aluminum	Aluminum Beverage Container (deposit)				
	Aluminum Food Containers (non-deposit)				
	Foil (flexible and semi-flexible)				
	Other Aluminum				
	Composite (mostly aluminum w other materials)				
Textiles	Fabric				
Organics	Food Waste				
	Yard and Garden Waste				
	Other				
Special Care Waste	Batteries				
	Paint/Solvent/Aerosols (with contents)				
	Waste Oils/Filters				
	Bio-hazardous (first aid wastes, diapers, animal litter, feminine hygiene)				
Other Wastes	Bulky Items (furniture, white goods, electronics)				
	Composites				
	Tires				
	Rubber				
	Wood Waste				
	Renovation Waste (drywall, insulation, shingles, tile, brick, concrete, other)				
Fines					
Other Unspecified					

Appendix C

Statistical Analysis

Table C-1. Statistical Analysis of Yellowknife Solid Waste Composition Data - July 2007

Material	Kilograms													
	SC1	SC2	SC3	SC4	SC5	SC6	SC7	SC8	SC9	SC10	SC11	SC12	SC13	SC14
Paper Products	42.30	43.96	13.56	74.60	47.00	33.54	16.60	73.72	37.30	30.06	34.10	42.70	77.50	38.80
Newspaper (including flyers)	2.10	3.80	2.10	3.10	2.10	2.50	0.80	3.80	10.90	1.50	2.70	1.50	3.90	3.00
Magazines	-	1.00	-	-	-	-	-	-	-	-	-	-	-	-
Corrugated Cardboard	17.70	21.00	2.70	5.40	18.40	8.80	7.20	18.60	16.10	5.30	15.30	16.30	65.90	10.20
Boxboard	2.90	3.60	3.40	2.30	3.40	3.40	1.80	0.60	3.30	2.10	3.40	1.60	2.10	3.60
Fine Paper	-	7.30	1.50	56.70	15.70	11.40	1.50	49.60	2.60	15.30	7.80	19.30	2.50	16.70
Tissue Paper	4.00	3.10	1.20	3.00	4.50	4.80	3.50	1.10	1.60	4.80	3.70	2.20	1.70	2.60
Polycoat Beverage (deposit)	0.10	0.08	0.06	0.20	0.70	0.20	-	-	0.20	0.06	0.20	0.10	-	0.20
Polycoat Beverage (non-deposit)	-	0.08	0.40	0.10	0.30	0.14	0.20	0.02	0.30	-	-	0.30	0.10	0.20
Other Paper	15.50	4.00	2.20	3.80	1.90	2.30	1.60	-	2.30	1.00	1.00	1.40	1.30	2.30
Plastic	26.00	8.30	8.40	12.70	14.40	10.04	18.20	15.60	12.40	10.24	9.40	11.80	6.40	11.20
Beverage Containers (deposit)	0.70	1.30	1.30	1.40	0.50	1.00	0.30	0.10	1.20	0.30	1.00	1.00	0.30	0.30
Beverage Containers (dairy)	0.20	0.40	0.30	0.10	0.30	0.14	0.30	-	0.70	0.14	0.60	0.40	0.10	0.30
Rigid (HDPE & PET)	5.00	1.90	1.00	0.70	0.70	1.90	1.80	7.90	1.60	3.50	0.90	1.80	-	0.90
Plastic Film	10.10	3.00	3.40	2.90	6.90	4.60	3.90	1.50	2.90	3.10	4.30	2.60	4.00	5.10
Other	10.00	1.70	2.40	7.60	6.00	2.40	11.90	6.10	6.00	3.20	2.60	6.00	2.00	4.60
Glass	2.80	5.20	2.50	0.20	2.30	4.90	0.40	-	5.20	3.30	4.60	3.70	1.00	2.10
Glass Beverage Containers (deposit)	2.40	3.80	-	0.20	2.10	2.60	0.40	-	4.40	1.50	3.80	3.70	-	-
Glass Food Containers	-	-	1.50	-	-	1.50	-	-	-	1.80	-	-	1.00	2.10
Non-container Glass	0.40	1.40	1.00	-	0.20	0.80	-	-	0.80	-	0.80	-	-	-
Ferrous Metal	1.55	3.10	9.60	1.00	1.70	4.40	16.20	0.30	3.10	3.20	2.20	5.40	0.80	0.80
Metal Food Container	1.05	0.50	0.50	0.50	0.60	3.80	1.20	0.30	1.40	1.10	0.40	1.00	0.40	0.80
Aerosol (empty)	0.10	-	-	-	-	-	-	-	-	-	0.90	-	0.40	-
Paint Cans and Lids (empty)	-	-	1.10	-	-	-	-	-	1.70	-	0.30	1.60	-	-
Other Ferrous	0.40	2.60	8.00	0.50	1.10	0.60	15.00	-	-	2.10	0.60	2.80	-	-
Composite Ferrous	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Aluminum	0.15	1.40	4.90	0.10	0.20	0.90	0.08	0.35	0.50	1.70	0.60	0.20	0.30	1.30
Aluminum Beverage (deposit)	-	1.40	1.40	0.10	0.20	0.90	0.08	0.10	0.50	1.60	-	0.10	0.20	0.70
Aluminum Food Containers	-	-	-	-	-	-	-	-	-	0.10	-	-	-	-
Aluminum Foil	0.15	-	-	-	-	-	-	0.25	-	-	0.10	0.10	0.10	0.60
Other Aluminum	-	-	3.50	-	-	-	-	-	-	-	-	-	-	-
Composite Aluminum	-	-	-	-	-	-	-	-	-	-	0.50	-	-	-
Textiles	1.70	14.30	4.20	2.10	9.00	6.40	4.40	-	10.60	3.40	3.70	0.40	1.00	8.10
Textiles	1.70	14.30	4.20	2.10	9.00	6.40	4.40	-	10.60	3.40	3.70	0.40	1.00	8.10
Organics	43.00	15.40	30.20	15.70	15.10	34.90	21.70	24.00	24.90	19.20	35.50	25.00	14.60	31.10
Food Waste	38.80	15.40	27.20	15.70	15.10	31.30	21.70	-	24.40	19.20	25.60	19.00	14.60	30.60
Yard & Garden	4.20	-	3.00	-	-	3.60	-	24.00	0.50	-	9.90	6.00	-	0.50
Special Care Waste	-	0.02	1.64	-	-	-	1.80	-	-	1.20	3.98	0.30	-	-
Batteries	-	0.02	0.04	-	-	-	-	-	-	0.20	0.08	-	-	-
Paint/Solvents/Aerosols (full)	-	-	1.60	-	-	-	1.80	-	-	1.00	3.90	0.30	-	-
Other Wastes	12.60	22.90	44.00	12.45	13.10	8.80	12.10	-	17.80	3.60	32.40	33.70	9.70	22.60
Bulky Items	8.50	5.30	2.00	1.20	4.90	3.10	-	-	-	0.20	13.90	7.00	-	8.70
Composites	0.40	9.20	-	6.40	0.50	-	5.80	-	2.60	-	2.10	9.20	0.80	-
Household Hygiene	3.70	0.50	1.40	3.20	3.70	5.70	1.20	-	8.60	3.10	15.30	0.50	8.90	9.40
Inorganic (soils)	-	-	-	-	-	-	-	-	-	-	-	5.80	-	2.50
Tires	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rubber	-	-	-	0.75	-	-	-	-	-	-	-	-	-	-
Wood Waste	-	7.90	40.60	0.90	2.50	-	5.10	-	6.60	0.30	1.10	7.70	-	-
Renovation Waste	-	-	-	-	1.50	-	-	-	-	-	-	3.50	-	2.00
Fines	0.45	-	0.30	1.10	-	0.50	0.60	-	0.70	2.90	0.30	0.70	1.30	0.30
Fines	0.45	-	0.30	1.10	-	0.50	0.60	-	0.70	2.90	0.30	0.70	1.30	0.30
Other Unspecified	1.00	-	0.50	5.60	-	-	-	-	-	-	0.80	0.30	1.70	-
Other Unspecified	1.00	-	0.50	5.60	-	-	-	-	-	-	0.80	0.30	1.70	-
Totals	131.55	114.58	119.80	125.55	102.80	104.38	92.08	113.97	112.50	78.80	127.58	124.20	114.30	116.30

Table C-1. Statistical Analysis of Yellowknife Solid Waste Composition Data - July 2007

Material	Kilograms										
	LC1	LC2	LC3	LC4	LC5	LC6	SFU1	SFU2	SFU3	SFU4	SFU5
Paper Products	74.14	77.90	53.90	28.00	79.72	52.20	24.20	28.10	19.20	25.50	25.90
Newspaper (including flyers)	0.50	0.50	2.80	-	64.50	18.20	2.50	4.30	6.00	6.60	3.20
Magazines	1.20	-	-	-	-	-	1.40	-	-	-	-
Corrugated Cardboard	66.80	48.00	28.80	13.00	-	0.80	2.30	1.40	2.50	2.00	1.80
Boxboard	1.00	9.00	1.90	-	1.80	3.40	4.50	5.20	3.30	3.40	3.10
Fine Paper	3.60	1.50	3.90	-	8.60	8.70	1.30	8.00	1.10	6.10	7.70
Tissue Paper	0.40	3.50	6.20	-	4.10	13.90	6.70	4.10	1.40	1.70	5.00
Polycoat Beverage (deposit)	0.04	-	0.10	-	0.10	-	0.90	0.10	0.40	1.00	0.20
Polycoat Beverage (non-deposit)	-	-	0.40	-	0.02	0.90	0.30	0.70	0.60	-	0.60
Other Paper	0.60	15.40	9.80	15.00	0.60	6.30	4.30	4.30	3.90	4.70	4.30
Plastic	4.72	12.60	15.50	17.80	25.60	21.10	24.30	27.64	12.90	10.70	18.10
Beverage Containers (deposit)	-	-	0.60	-	0.40	3.20	0.30	1.20	0.60	0.10	0.70
Beverage Containers (dairy)	0.06	-	0.80	-	-	2.80	0.50	0.04	0.30	0.10	0.40
Rigid (HDPE & PET)	0.50	-	2.20	16.40	1.70	0.90	7.20	5.70	2.30	1.60	4.60
Plastic Film	0.66	4.50	6.00	1.40	5.00	6.30	8.80	11.60	4.30	4.00	6.10
Other	3.50	8.10	5.90	-	18.50	7.90	7.50	9.10	5.40	4.90	6.30
Glass	-	3.70	1.20	-	0.10	5.60	3.80	3.30	1.80	0.60	6.20
Glass Beverage Containers (deposit)	-	-	1.20	-	-	1.20	1.10	0.80	-	-	0.70
Glass Food Containers	-	3.70	-	-	-	1.40	2.70	1.30	1.00	0.60	2.60
Non-container Glass	-	-	-	-	0.10	3.00	-	1.20	0.80	-	2.90
Ferrous Metal	0.30	-	0.60	-	3.20	3.10	8.50	1.50	2.60	3.40	2.90
Metal Food Container	0.30	-	0.60	-	-	-	2.20	-	1.60	2.70	1.50
Aerosol (empty)	-	-	-	-	-	-	-	-	-	0.20	-
Paint Cans and Lids (empty)	-	-	-	-	-	3.10	-	-	-	-	-
Other Ferrous	-	-	-	-	3.20	-	5.70	1.50	1.00	0.50	1.40
Composite Ferrous	-	-	-	-	-	-	0.60	-	-	-	-
Aluminum	-	-	0.30	-	0.20	0.70	0.10	1.40	-	0.29	1.00
Aluminum Beverage (deposit)	-	-	0.30	-	0.20	0.70	0.10	0.40	-	0.04	0.60
Aluminum Food Containers	-	-	-	-	-	-	-	1.00	-	0.25	-
Aluminum Foil	-	-	-	-	-	-	-	-	-	-	0.40
Other Aluminum	-	-	-	-	-	-	-	-	-	-	-
Composite Aluminum	-	-	-	-	-	-	-	-	-	-	-
Textiles	-	2.10	-	-	1.20	0.80	2.30	3.80	1.40	1.40	1.20
Textiles	-	2.10	-	-	1.20	0.80	2.30	3.80	1.40	1.40	1.20
Organics	33.20	13.90	34.20	54.80	9.00	37.00	45.90	43.20	52.10	47.00	46.70
Food Waste	33.20	12.00	34.20	54.80	9.00	37.00	43.30	34.40	50.50	44.00	43.30
Yard & Garden	-	1.90	-	-	-	-	2.60	8.80	1.60	3.00	3.40
Special Care Waste	-	-	3.10	-	-	0.50	0.30	-	-	-	-
Batteries	-	-	0.20	-	-	-	0.25	-	-	-	-
Paint/Solvents/Aerosols (full)	-	-	2.90	-	-	0.50	0.05	-	-	-	-
Other Wastes	4.40	3.20	0.30	27.20	13.50	3.30	17.46	13.00	16.60	24.30	12.40
Bulky Items	0.30	1.30	-	-	-	-	0.06	1.30	-	6.40	-
Composites	-	-	-	-	3.50	0.30	6.80	1.00	0.30	-	0.70
Household Hygiene	-	-	0.30	11.00	3.00	3.00	10.60	10.60	16.30	16.90	7.80
Inorganic (soils)	-	-	-	-	7.00	-	-	-	-	-	3.80
Tires	-	-	-	-	-	-	-	-	-	-	-
Rubber	1.80	-	-	-	-	-	-	-	-	-	-
Wood Waste	2.30	1.90	-	16.20	-	-	-	-	-	1.00	-
Renovation Waste	-	-	-	-	-	-	-	0.10	-	-	0.10
Fines	-	0.30	0.20	-	0.50	2.30	0.30	-	-	0.90	0.30
Fines	-	0.30	0.20	-	0.50	2.30	0.30	-	-	0.90	0.30
Other Unspecified	-	8.00	0.70	-	0.10	0.10	-	0.20	1.90	-	-
Other Unspecified	-	8.00	0.70	-	0.10	0.10	-	0.20	1.90	-	-
Totals	116.76	121.70	110.00	127.80	133.12	126.70	127.16	122.14	108.50	114.09	114.70

Table C-1. Statistical Analysis of Yellowknife Solid Waste Composition Data - July 2007

Material	Percentage												
	1	2	3	4	5	6	7	8	9	10	11	12	13
Paper Products	32%	38%	11%	59%	46%	32%	18%	65%	33%	38%	27%	63%	68%
Newspaper (including flyers)	2%	3%	2%	2%	2%	2%	1%	3%	10%	2%	2%	0%	3%
Magazines	0%	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	1%	0%
Corrugated Cardboard	13%	18%	2%	4%	18%	8%	8%	16%	14%	7%	12%	57%	58%
Boxboard	2%	3%	3%	2%	3%	3%	2%	1%	3%	3%	3%	1%	2%
Fine Paper	0%	6%	1%	45%	15%	11%	2%	44%	2%	19%	6%	3%	2%
Tissue Paper	3%	3%	1%	2%	4%	5%	4%	1%	1%	6%	3%	0%	1%
Polycoat Beverage (deposit)	0%	0%	0%	0%	1%	0%	0%	0%	0%	0%	0%	0%	0%
Polycoat Beverage (non-deposit)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Other Paper	12%	3%	2%	3%	2%	2%	2%	0%	2%	1%	1%	1%	1%
Plastic	20%	7%	7%	10%	14%	10%	20%	14%	11%	13%	7%	4%	6%
Beverage Containers (deposit)	1%	1%	1%	1%	0%	1%	0%	0%	1%	0%	1%	0%	0%
Beverage Containers (dairy)	0%	0%	0%	0%	0%	0%	0%	0%	1%	0%	0%	0%	0%
Rigid (HDPE & PET)	4%	2%	1%	1%	1%	2%	2%	7%	1%	4%	1%	0%	0%
Plastic Film	8%	3%	3%	2%	7%	4%	4%	1%	3%	4%	3%	1%	3%
Other	8%	1%	2%	6%	6%	2%	13%	5%	5%	4%	2%	3%	2%
Glass	2%	5%	2%	0%	2%	5%	0%	0%	5%	4%	4%	0%	1%
Glass Beverage Containers (deposit)	2%	3%	0%	0%	2%	2%	0%	0%	4%	2%	3%	0%	0%
Glass Food Containers	0%	0%	1%	0%	0%	1%	0%	0%	0%	2%	0%	0%	1%
Non-container Glass	0%	1%	1%	0%	0%	1%	0%	0%	1%	0%	1%	0%	0%
Ferrous Metal	1%	3%	8%	1%	2%	4%	18%	0%	3%	4%	2%	0%	1%
Metal Food Container	1%	0%	0%	0%	1%	4%	1%	0%	1%	1%	0%	0%	0%
Aerosol (empty)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	1%	0%	0%
Paint Cans and Lids (empty)	0%	0%	1%	0%	0%	0%	0%	0%	2%	0%	0%	0%	0%
Other Ferrous	0%	2%	7%	0%	1%	1%	16%	0%	0%	3%	0%	0%	0%
Composite Ferrous	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Aluminum	0%	1%	4%	0%	0%	1%	0%	0%	0%	2%	0%	0%	0%
Aluminum Beverage (deposit)	0%	1%	1%	0%	0%	1%	0%	0%	0%	2%	0%	0%	0%
Aluminum Food Containers	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Aluminum Foil	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Other Aluminum	0%	0%	3%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Composite Aluminum	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Textiles	1%	12%	4%	2%	9%	6%	5%	0%	9%	4%	3%	0%	1%
Textiles	1%	12%	4%	2%	9%	6%	5%	0%	9%	4%	3%	0%	1%
Organics	33%	13%	25%	13%	15%	33%	24%	21%	22%	24%	28%	28%	13%
Food Waste	29%	13%	23%	13%	15%	30%	24%	0%	22%	24%	20%	28%	13%
Yard & Garden	3%	0%	3%	0%	0%	3%	0%	21%	0%	0%	8%	0%	0%
Special Care Waste	0%	0%	1%	0%	0%	0%	2%	0%	0%	2%	3%	0%	0%
Batteries	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Paint/Solvents/Aerosols (full)	0%	0%	1%	0%	0%	0%	2%	0%	0%	1%	3%	0%	0%
Other Wastes	10%	20%	37%	10%	13%	8%	13%	0%	16%	5%	25%	4%	8%
Bulky Items	0%	5%	2%	1%	5%	3%	0%	0%	0%	0%	11%	0%	0%
Composites	0%	8%	0%	5%	0%	0%	6%	0%	2%	0%	2%	0%	1%
Household Hygiene	3%	0%	1%	3%	4%	5%	1%	0%	8%	4%	12%	0%	8%
Inorganic (soils)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Tires	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Rubber	0%	0%	0%	1%	0%	0%	0%	0%	0%	0%	0%	2%	0%
Wood Waste	0%	7%	34%	1%	2%	0%	6%	0%	6%	0%	1%	2%	0%
Renovation Waste	0%	0%	0%	0%	1%	0%	0%	0%	0%	0%	0%	0%	0%
Fines	0%	0%	0%	1%	0%	0%	1%	0%	1%	4%	0%	0%	1%
Fines	0%	0%	0%	1%	0%	0%	1%	0%	1%	4%	0%	0%	1%
Other Unspecified	1%	0%	0%	4%	0%	0%	0%	0%	0%	0%	1%	0%	1%
Other Unspecified	1%	0%	0%	4%	0%	0%	0%	0%	0%	0%	1%	0%	1%
Totals	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

Table C-1. Statistical Analysis of Yellowknife Solid Waste Composition Data - July 2007

Material	Percentage											
	14	15	16	17	18	19	20	21	22	23	24	25
Paper Products	33%	63%	64%	49%	22%	60%	41%	19%	23%	18%	22%	23%
Newspaper (including flyers)	3%	0%	0%	3%	0%	48%	14%	2%	4%	6%	6%	3%
Magazines	0%	1%	0%	0%	0%	0%	0%	1%	0%	0%	0%	0%
Corrugated Cardboard	9%	57%	39%	26%	10%	0%	1%	2%	1%	2%	2%	2%
Boxboard	3%	1%	7%	2%	0%	1%	3%	4%	4%	3%	3%	3%
Fine Paper	14%	3%	1%	4%	0%	6%	7%	1%	7%	1%	5%	7%
Tissue Paper	2%	0%	3%	6%	0%	3%	11%	5%	3%	1%	1%	4%
Polycoat Beverage (deposit)	0%	0%	0%	0%	0%	0%	0%	1%	0%	0%	1%	0%
Polycoat Beverage (non-deposit)	0%	0%	0%	0%	0%	0%	1%	0%	1%	1%	0%	1%
Other Paper	2%	1%	13%	9%	12%	0%	5%	3%	4%	4%	4%	4%
Plastic	10%	4%	10%	14%	14%	19%	17%	19%	23%	12%	9%	16%
Beverage Containers (deposit)	0%	0%	0%	1%	0%	0%	3%	0%	1%	1%	0%	1%
Beverage Containers (dairy)	0%	0%	0%	1%	0%	0%	2%	0%	0%	0%	0%	0%
Rigid (HDPE & PET)	1%	0%	0%	2%	13%	1%	1%	6%	5%	2%	1%	4%
Plastic Film	4%	1%	4%	5%	1%	4%	5%	7%	9%	4%	4%	5%
Other	4%	3%	7%	5%	0%	14%	6%	6%	7%	5%	4%	5%
Glass	2%	0%	3%	1%	0%	0%	4%	3%	3%	2%	1%	5%
Glass Beverage Containers (deposit)	0%	0%	0%	1%	0%	0%	1%	1%	1%	0%	0%	1%
Glass Food Containers	2%	0%	3%	0%	0%	0%	1%	2%	1%	1%	1%	2%
Non-container Glass	0%	0%	0%	0%	0%	0%	2%	0%	1%	1%	0%	3%
Ferrous Metal	1%	0%	0%	1%	0%	2%	2%	7%	1%	2%	3%	3%
Metal Food Container	1%	0%	0%	1%	0%	0%	0%	2%	0%	1%	2%	1%
Aerosol (empty)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Paint Cans and Lids (empty)	0%	0%	0%	0%	0%	0%	2%	0%	0%	0%	0%	0%
Other Ferrous	0%	0%	0%	0%	0%	2%	0%	4%	1%	1%	0%	1%
Composite Ferrous	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Aluminum	1%	0%	0%	0%	0%	0%	1%	0%	1%	0%	0%	1%
Aluminum Beverage (deposit)	1%	0%	0%	0%	0%	0%	1%	0%	0%	0%	0%	1%
Aluminum Food Containers	0%	0%	0%	0%	0%	0%	0%	0%	1%	0%	0%	0%
Aluminum Foil	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Other Aluminum	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Composite Aluminum	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Textiles	7%	0%	2%	0%	0%	1%	1%	2%	3%	1%	1%	1%
Textiles	7%	0%	2%	0%	0%	1%	1%	2%	3%	1%	1%	1%
Organics	27%	28%	11%	31%	43%	7%	29%	36%	35%	48%	41%	41%
Food Waste	26%	28%	10%	31%	43%	7%	29%	34%	28%	47%	39%	38%
Yard & Garden	0%	0%	2%	0%	0%	0%	0%	2%	7%	1%	3%	3%
Special Care Waste	0%	0%	0%	3%	0%	0%	0%	0%	0%	0%	0%	0%
Batteries	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Paint/Solvents/Aerosols (full)	0%	0%	0%	3%	0%	0%	0%	0%	0%	0%	0%	0%
Other Wastes	19%	4%	3%	0%	21%	10%	3%	14%	11%	15%	21%	11%
Bulky Items	7%	0%	1%	0%	0%	0%	0%	0%	1%	0%	6%	0%
Composites	0%	0%	0%	0%	0%	3%	0%	5%	1%	0%	0%	1%
Household Hygiene	8%	0%	0%	0%	9%	2%	2%	8%	9%	15%	15%	7%
Inorganic (soils)	2%	0%	0%	0%	0%	5%	0%	0%	0%	0%	0%	3%
Tires	0%	0%	0%	0%	0%	0%	2%	0%	0%	0%	0%	0%
Rubber	0%	2%	0%	0%	0%	0%	2%	0%	0%	0%	0%	0%
Wood Waste	0%	2%	2%	0%	13%	0%	0%	0%	0%	0%	1%	0%
Renovation Waste	2%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Fines	0%	0%	0%	0%	0%	0%	2%	0%	0%	0%	1%	0%
Fines	0%	0%	0%	0%	0%	0%	2%	0%	0%	0%	1%	0%
Other Unspecified	0%	0%	7%	1%	0%	0%	0%	0%	0%	2%	0%	0%
Other Unspecified	0%	0%	7%	1%	0%	0%	0%	0%	0%	2%	0%	0%
Totals	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

Table C-1. Statistical Analysis of Yellowknife Solid Waste Composition Data - July 2007

Material	Statistical Analysis							
	Mean Percentage	Number of Samples	Standard Deviation	% Standard Deviation	Estimated Number of samples at 10% precision - 90% confidence	Estimated Number of samples at 20% precision - 90% confidence	% Confidence with which we can estimate the mean with 20% precision based on thirty-seven samples	% Precision with which we can estimate the mean with 90% confidence based on thirty-seven samples
Paper Products	38.7%	25	0.1801	46%	63	16	97.94	15.88
Newspaper (including flyers)	4.9%	25	0.0958	194%	1093	273	69.50	66.13
Magazines	0.2%	25	0.0038	235%	1609	402	66.31	80.22
Corrugated Cardboard	15.5%	25	0.1820	117%	402	100	79.89	40.09
Boxboard	2.5%	25	0.0144	57%	93	23	95.54	19.32
Fine Paper	8.5%	25	0.1187	139%	564	141	76.07	47.49
Tissue Paper	3.0%	25	0.0237	78%	177	44	89.46	26.60
Polycoat Beverage (deposit)	0.2%	25	0.0024	140%	573	143	75.89	47.88
Polycoat Beverage (non-deposit)	0.2%	25	0.0022	116%	394	99	80.11	39.72
Other Paper	3.7%	25	0.0367	101%	295	74	83.51	34.38
Plastic	12.4%	25	0.0519	42%	52	13	98.74	14.35
Beverage Containers (deposit)	0.6%	25	0.0056	98%	280	70	84.12	33.49
Beverage Containers (dairy)	0.3%	25	0.0044	151%	662	165	74.36	51.45
Rigid (HDPE & PET)	2.4%	25	0.0285	117%	396	99	80.05	39.81
Plastic Film	4.0%	25	0.0217	55%	87	22	96.02	18.70
Other	5.1%	25	0.0320	63%	116	29	93.75	21.52
Glass	2.1%	25	0.0180	84%	208	52	87.65	28.82
Glass Beverage Containers (deposit)	0.9%	25	0.0120	130%	489	122	77.63	44.25
Glass Food Containers	0.7%	25	0.0094	126%	462	115	78.29	42.98
Non-container Glass	0.5%	25	0.0071	157%	717	179	73.53	53.57
Ferrous Metal	2.7%	25	0.0368	135%	534	134	76.67	46.22
Metal Food Container	0.8%	25	0.0087	109%	350	87	81.52	37.40
Aerosol (empty)	0.1%	25	0.0016	300%	2618	655	62.94	102.33
Paint Cans and Lids (empty)	0.2%	25	0.0058	285%	2363	591	63.59	97.22
Other Ferrous	1.7%	25	0.0345	208%	1265	316	68.24	71.12
Composite Ferrous	0.0%	25	0.0009	500%	7294	1824	57.85	170.81
Aluminum	0.6%	25	0.0090	152%	678	170	74.11	52.08
Aluminum Beverage (deposit)	0.4%	25	0.0050	141%	577	144	75.83	48.03
Aluminum Food Containers	0.0%	25	0.0017	361%	3809	952	60.79	123.44
Aluminum Foil	0.1%	25	0.0013	233%	1586	397	66.42	79.65
Other Aluminum	0.1%	25	0.0058	500%	7294	1824	57.85	170.81
Composite Aluminum	0.0%	25	0.0008	500%	7294	1824	57.85	170.81
Textiles	3.0%	25	0.0337	112%	369	92	80.88	38.43
Textiles	3.0%	25	0.0337	112%	369	92	80.88	38.43
Organics	26.8%	25	0.1083	40%	48	12	98.97	13.81
Food Waste	24.5%	25	0.1140	46%	63	16	97.94	15.87
Yard & Garden	2.3%	25	0.0447	197%	1134	284	69.18	67.35
Special Care Waste	0.5%	25	0.0093	203%	1202	300	68.67	69.33
Batteries	0.0%	25	0.0007	236%	1629	407	66.21	80.72
Paint/Solvents/Aerosols (full)	0.4%	25	0.0089	209%	1271	318	68.20	71.30
Other Wastes	12.0%	25	0.0867	72%	152	38	91.11	24.64
Bulky Items	1.7%	25	0.0284	168%	827	207	72.11	57.51
Composites	1.4%	25	0.0231	169%	833	208	72.04	57.72
Household Hygiene	5.0%	25	0.0461	93%	253	63	85.35	31.80
Inorganic (soils)	0.4%	25	0.0127	296%	2555	639	63.09	101.09
Tires	0.1%	25	0.0036	500%	7294	1824	57.85	170.81
Rubber	0.2%	25	0.0055	249%	1810	453	65.42	85.10
Wood Waste	3.0%	25	0.0710	235%	1605	401	66.33	80.12
Renovation Waste	0.1%	25	0.0044	321%	3001	750	62.11	109.55
Fines	0.5%	25	0.0079	159%	739	185	73.23	54.35
Fines	0.5%	25	0.0079	159%	739	185	73.23	54.35
Other Unspecified	0.7%	25	0.0156	229%	1529	382	66.70	78.21
Other Unspecified	0.7%	25	0.0156	229%	1529	382	66.70	78.21
Totals	100%	25	0.0660	7%	499	125	83.38	2.26

Appendix D

List of Interview Respondents

Appendix D

List of Interview Respondents

- Bruce Underhay, City of Yellowknife
- Tracy Oldfield, Kavanaugh Bros Ltd
- Adam Pich, The Bottle Shop
- Doug Ritchie, Ecology North
- John Kavanaugh, Canadian Tire
- Craig Charles, Metro Materials Ltd (Edmonton)
- Patrick Hough, Beverage Container Program, Government of Northwest Territories
- Ben Walker, Northern Direct Charge Co-op
- Richard Farquhar, Wal-Mart
- Ben Nind, YK Recyclers Ltd.

Appendix E

Multi-Family and Small Commercial Waste

Appendix E

Multi-Family and Small Commercial Waste

Using the Waste Composition Study findings and a number of assumptions, this Appendix presents rough estimates of the quantity of waste disposed separately in the Small Commercial and Multi-Family sectors to aid in identifying diversion opportunities and challenges. These estimates are intended to provide a rough, overall picture of the quantity of waste disposed by sector and by material category and are not considered definitive.

The following assumptions were used to segregate these two sectors:

- It was assumed that the composition of waste generated in the multi-family sector was the same as in the single family sector;
- It was assumed that the quantity of waste generated per household in the multi-family sector was the same as in the single family sector. The quantity of waste generated per household in the single family sector is estimated to be 470 kilograms per household, assuming 1,752 tonnes disposed and 3,696 households. It is likely that single family dwellings generate more waste per household than multi-family dwellings due to greater numbers of persons per household and different consumption patterns. However, the estimate is considered sufficient for the purposes of providing a rough overall picture of disposal.
- Using the assumption of 474 kgs per household per year and the assumption that there are 2,900 multi-family dwellings, the quantity of waste disposed in the multi-family sector was estimated to be 1,375 tonnes.
- To estimate the quantity of waste disposed in the Small Commercial sector, the estimated quantity of waste disposed in the multi-family sector was subtracted from the total amount of waste disposed for both sectors (5,556 tonnes – 1,375 tonnes = 4,181 tonnes). This resulted in an estimate of 4,182 tonnes disposed in the Small Commercial sector.

It needs to be stated that by extracting these two sectors and applying the single family waste composition percentages to the multi-family sector, the totals for all sectors (defined as Total Waste Disposed in the Waste Composition Study) will differ somewhat from those presented in the Waste Composition Study.

Table E-1. Multi-Family and Small Commercial Waste

Material Category	Single Family		Multi Family		Small Commercial		Large Commercial	
	Waste Stream Composition (%)	Estimated Annual Disposal (Tonnes)	Waste Stream Composition (%)	Estimated Annual Disposal (Tonnes)	Waste Stream Composition (%)	Estimated Annual Disposal (Tonnes)	Waste Stream Composition (%)	Estimated Annual Disposal (Tonnes)
Paper Products	21.0%	367	21.0%	288	38.4%	1,605	49.7%	841
Newspaper (including flyers)	3.9%	68	3.9%	53	2.8%	116	11.8%	199
Magazines	0.2%	4	0.2%	3	0.1%	3	0.2%	3
Corrugated Cardboard	1.7%	30	1.7%	23	14.5%	606	21.4%	362
Boxboard	3.3%	58	3.3%	46	2.4%	99	2.3%	39
Fine Paper	4.1%	72	4.1%	57	13.2%	551	3.6%	60
Tissue Paper	3.2%	56	3.2%	44	2.6%	111	3.8%	65
Polycoat Beverage (deposit)	0.4%	8	0.4%	6	0.1%	6	0.0%	1
Polycoat Beverage (non-deposit)	0.4%	7	0.4%	5	0.1%	6	0.2%	3
Other Paper	3.7%	64	3.7%	50	2.6%	108	6.5%	110
Plastic	16.0%	280	16.0%	219	11.1%	464	13.2%	224
Beverage Containers (deposit)	0.5%	9	0.5%	7	0.7%	28	0.6%	10
Beverage Containers (Dairy)	0.2%	4	0.2%	3	0.3%	11	0.5%	8
Rigid (HDPE & PET)	3.6%	64	3.6%	50	1.9%	78	2.9%	50
Plastic Film	5.9%	104	5.9%	82	3.7%	154	3.2%	55
Other	5.7%	99	5.7%	78	4.6%	192	6.0%	101
Glass	2.7%	47	2.7%	37	2.4%	101	1.4%	24
Beverage Containers (deposit)	0.4%	8	0.4%	6	1.6%	66	0.3%	6
Food Containers	1.4%	24	1.4%	19	0.5%	21	0.7%	12
Non-container Glass	0.8%	15	0.8%	11	0.3%	14	0.4%	7
Ferrous Metal	3.2%	56	3.2%	44	3.4%	141	1.0%	17
Metal Food Container	1.4%	24	1.4%	19	0.9%	36	0.1%	2
Aerosol (empty)	0.0%	1	0.0%	0	0.1%	4	0.0%	-
Paint Cans and Lids (empty)	0.0%	-	0.0%	0	0.3%	12	0.4%	7
Other Ferrous	1.7%	30	1.7%	24	2.1%	89	0.4%	7
Composite Ferrous	0.1%	2	0.1%	1	0.0%	0	0.0%	-
Aluminum	0.5%	8	0.5%	7	0.8%	34	0.2%	3
Aluminum Beverage (deposit)	0.2%	3	0.2%	3	0.5%	19	0.2%	3
Aluminum Food Containers	0.2%	4	0.2%	3	0.0%	0	0.0%	-
Foil	0.1%	1	0.1%	1	0.1%	3	0.0%	-
Other Aluminum	0.0%	-	0.0%	0	0.2%	9	0.0%	-
Composite Aluminum (including White Goods)	0.0%	-	0.0%	0	0.0%	1	0.0%	-
Textiles	1.7%	30	1.7%	24	4.4%	184	0.6%	9
Organics	40.0%	702	40.0%	551	22.2%	928	24.7%	419
Food Waste	36.7%	644	36.7%	505	18.9%	791	24.5%	414
Yard & Garden	3.3%	58	3.3%	45	3.3%	137	0.3%	4
Special Care Waste	0.1%	1	0.1%	1	0.6%	24	0.5%	8
Batteries	0.0%	1	0.0%	1	0.0%	1	0.0%	0
Paint/solvents/Aerosols (full)	0.0%	0	0.0%	0	0.5%	23	0.5%	8
Other Wastes	14.3%	250	14.3%	196	15.6%	651	7.1%	119
Bulky Items	1.3%	23	1.3%	18	3.5%	145	0.2%	4
Composites	1.5%	26	1.5%	21	2.3%	98	0.5%	9
Household Hygiene	10.6%	186	10.6%	146	4.1%	173	2.4%	40
Inorganic (soils)	0.6%	11	0.6%	9	0.5%	22	1.0%	16
Tires	0.0%	-	0.0%	0	0.0%	0	0.0%	-
Rubber	0.0%	-	0.0%	0	0.0%	2	0.2%	4
Wood Waste	0.2%	3	0.2%	2	4.6%	193	2.8%	47
Renovation Waste	0.0%	1	0.0%	0	0.4%	19	0.0%	-
Fines	0.3%	4	0.3%	4	0.6%	24	0.4%	8
Other Unspecified	0.4%	6	0.4%	5	0.6%	26	1.2%	20
Totals	100.0%	1,752	100.0%	1,375	100.0%	4,181	100.0%	1,693

Appendix F

Conversion Factors for Recyclable Materials

Appendix F

Conversion Factors for Recyclable Materials

Table F-1. Conversion Factors for Recyclable Materials

Material	2006 Recycling Bales	2006 Recycling Tonnes	Conversion Factor	Sources
Newspaper (including flyers)	91	69	0.76	Number of bales - City of Yellowknife; tonnes recycled - Metro Materials; conversion factor - calculated
Corrugated Cardboard	663	333	0.5	Number of bales - City of Yellowknife; tonnes recycled - Metro Materials; conversion factor - calculated
Boxboard	9	28	0.76	Number of bales - City of Yellowknife; tonnes recycled - Metro Materials; conversion factor - calculated
Fine Paper				
Beverage Containers (Dairy)	4	4	0.25	Number of bales - City of Yellowknife; tonnes recycled - Metro Materials; conversion factor - calculated
Metal Food Container	10	10	1	Number of bales - City of Yellowknife; tonnes recycled - calculated using conversion factor from Dillon 2005 Operations Report
Composite Aluminum (White Goods)	137	137	1	Number of bales - City of Yellowknife; tonnes recycled - calculated using conversion factor from Dillon 2005 Operations Report
Lead Acid Batteries	44	90	2.04	Number of pallets - City of Yellowknife; tonnes recycled - calculated using conversion factor from Dillon 2005 Operations Report