The University of Calgary

SOLID WASTE MANAGEMENT: RESIDENTIAL YARD WASTE DIVERSION PROGRAMS AND THEIR USE IN CANADA AND THE NORTHERN UNITED STATES

by

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A Master's Degree Project submitted to the Faculty of Environmental Design in partial fulfillment of the requirements for the degree of Master of Environmental Design (Environmental Science)

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ABSTRACT

Solid Waste Management: Residential Yard Waste Diversion Programs and Their Use in Canada and the Northern United States

by Karen Scoulding

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The purpose of this Master's Degree Project is to gather information regarding current residential yard waste management strategies in Canada and the northern United States. This was achieved through a mail out survey that covered all facets of residential yard waste management, from collection and processing to the application or end use of the yard waste materials. The survey was sent to 124 communities in the research area. Ninety-three communities responded which resulted in a 75% return rate.

Part I highlights the residential yard waste diversion program survey and summarizes the survey results. Part II provides background information that reviews current City of Calgary residential yard waste diversion programs, yard waste source reduction options, residential yard waste collection strategies and pertinent composting information. Recommendations for the City of Calgary to consider for future expansion of their residential yard waste diversion program are presented in Part II. Highlighted recommendations include:

- Implementing residential source reduction programs, for instance, backyard composting and grasscycling;
- expanding the current residential leaf drop-off program to include grass and brush; and,
- exploring the opportunities for marketing compost and/or giving it to residents.

A wide variety of yard waste diversion programs are used in Canada and the northern United States. Rarely do communities overlap with similar programs as each one has unique characteristics.

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CHAPTER 1: INTRODUCTION

The purpose of this Master's Degree Project is to determine and provide the City of Calgary with the most current information available on residential yard waste diversion programs in Canada and the northern United States. The main emphasis of this project is centred on yard waste collection strategies. In order to address this objective, a survey based on residential yard waste diversion programs was sent to 124 communities in Canada and the northern United States. As well, various yard waste diversion options and strategies applicable to the City of Calgary were examined in a background information review. Both methods assisted in the development of recommendations for future expansion of the City's current residential yard waste diversion program.

This Master's Degree Project is divided into two parts. The separation of information highlights the survey results in order to stress its importance in this study. Part I and Part II contain a detailed methodology pertaining to each section. Part I is strictly dedicated to a summary of the residential yard waste diversion survey results. Part II discusses current City of Calgary residential yard waste diversion programs and provides background information applicable to the City regarding yard waste source reduction options, residential yard waste collection strategies and pertinent composting information. Recommendations for the City of Calgary to consider when expanding their current residential yard waste diversion program are presented in Part II.

Over the years, increased environmental awareness has lead to changes in public attitudes towards waste management. This along with landfill bans, decreasing landfill space, siting problems for new landfills, and pressure by the public to consider alternatives has resulted in municipalities looking at a variety of waste diversion options.

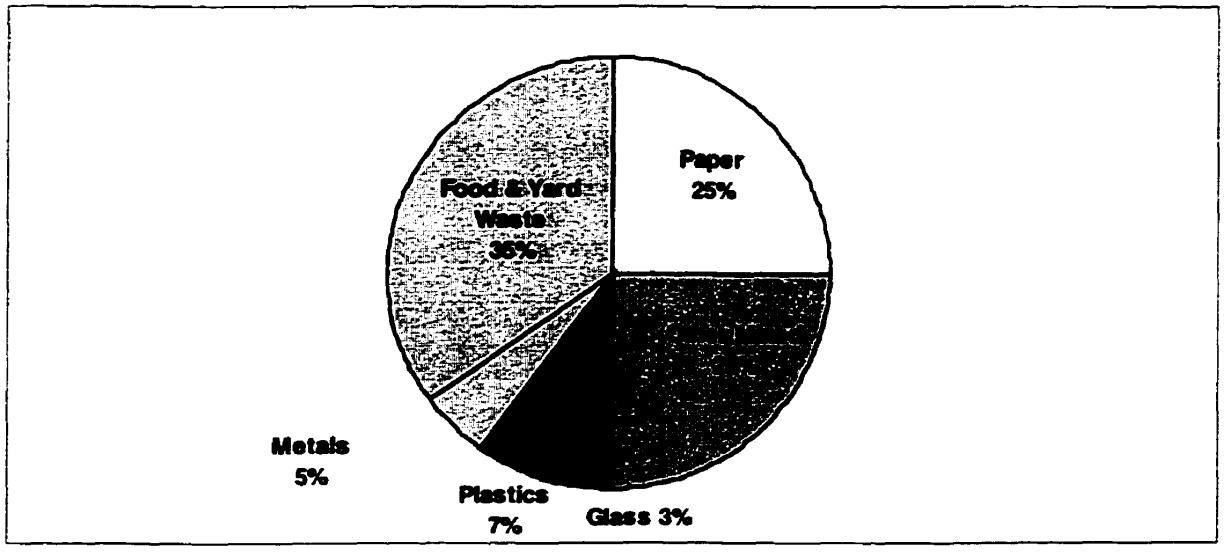
Yard waste (e.g. branches, grass clippings, and leaves) accounts for an estimated 20%-40% of the residential waste stream (City of Calgary, 1995a). This variation is due to a number of factors including climate, yard size, and the percentage of the population in single family housing. Yard waste can be the largest component of municipal solid waste during the summer and fall. With seasonal peaks, yard waste material has become an area of interest for municipal waste diversion initiatives (Griffiths, 1998). Municipalities must plan for peak demand as yard waste is largely responsible for spikes in truck and worker requirements.

Waste diversion options generally involve one or more of the "4 R's": reduce, reuse, recycle, and recover. Yard waste diversion programs would involve the reduction and recycling options. Reduction of residential yard waste centres on homeowners decreasing the amount of yard waste material that is set out for collection. This would involve such initiatives as backyard composting, grasscycling, mulching, and yard waste minimization principles. Decreasing the amount of yard waste that is collected from the household in turn reduces the amount that is landfilled. Recycling pertains to yard waste composting; this can be viewed as the ideal form of recycling since organic materials are returned to the land.

Some provinces and states have banned yard waste from traditional waste disposal facilities (Bauld, 1998; The Composting Council, 1996b). This has resulted in the implementation of central yard waste diversion programs and the development of numerous composting operations. In Canada 162 facilities (municipal and private) compost yard waste while the United States have a total of 3,260 facilities (The Composting Council of Canada, 1995; The Composting Council, 1997). At these facilities yard waste is the principal feedstock. However, kitchen waste, biosolids, and manure along with a variety of other organics may be included in the composting process.

The Calgary Perspective

Alberta's solid waste is comprised of 3 waste streams: residential; construction and demolition; and industrial, commercial, and institutional (Alberta Environmental Protection, 1997a). Residential solid waste generates 33% of the entire Alberta waste stream while yard and food waste combined accounts for 35% of Alberta's residential solid waste composition (Alberta Environmental Protection, 1997a, 1997b) (Figure 1).



Note: These figures reflect a provincial average for waste components, but will vary according to season and municipality.

Figure 1: Alberta's Average Residential Waste Composition (percent by weight) (Alberta Environmental Protection, 1997b)

Solid waste composition data for the City of Calgary are not available. However in 1990, the City of Edmonton noted that 24.7% of refuse was from residential areas while 32.1% of residential solid waste was comprised of yard waste (City of Edmonton, 1991b).

Calgary has significant yard waste peaks throughout the year. The highest peaks are in May and June which coincide with spring cleanup (Figure 2).

Throughout the summer yard waste collection is relatively constant with the disposal of grass. During the fall another peak occurs with the addition of leaves. As expected, little yard waste is collected during the winter. Calgarians generate an estimated 26 kg of solid waste per household per week over the summer compared to 15 kg per week in the winter (Dempster, 1998). Roughly 7 kg - 10 kg of solid waste is comprised of yard waste during the summer months (City of Calgary, 1995a).

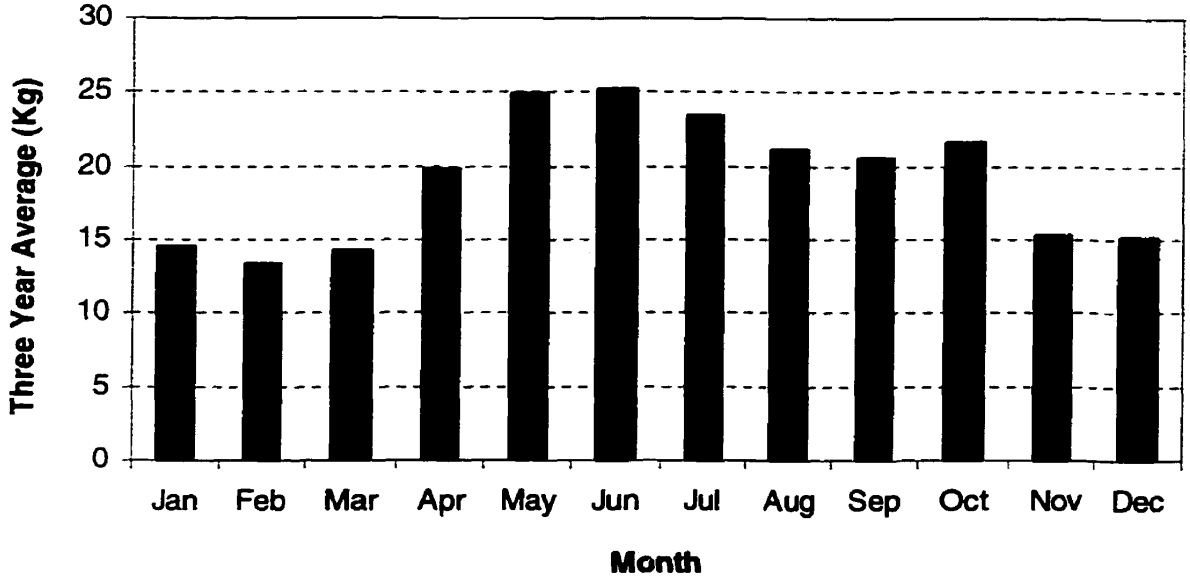


Figure 2: City of Calgary – Three Year Average Refuse Disposal Per Household (1994-1996) (City of Calgary, 1997)

Even though Calgary has 50 - 85 years of landfill space available, the City is considering expanding its yard waste diversion program (City of Calgary, 1995b). With a 1998 population of 819,334, an annual growth rate of 3.65% (1997), and an anticipated population increase of almost 200,000 during the next decade, the City must explore potential yard waste diversion options (Collins, 1998; Collins and Pommer, 1998).

PART I

RESIDENTIAL YARD WASTE DIVERSION PROGRAMS IN CANADA AND THE NORTHERN UNITED STATES - SURVEY RESULTS

PART I: RESIDENTIAL YARD WASTE DIVERSION PROGRAMS IN CANADA AND THE UNITED STATES – SURVEY RESULTS

The primary focus of the research conducted for this Master's Degree Project was to determine how communities in Canada and the northern United States have addressed residential yard waste management. This includes all facets of management, from the collection and processing to the application or end use of the yard waste materials. Part I is dedicated to a discussion of the residential yard waste diversion survey results.

Methodology

The principal research strategies implemented to achieve the study objective were a mail survey and informal telephone interviews. The main component for data collection was a mail survey (Appendix A). This strategy was selected due to the large amount of information requested from communities and because some of this information may not be readily available on the telephone, for instance yard waste curbside collection costs. A survey gives the respondent time to find the answer. Before the survey was developed, background information regarding community yard waste diversion programs and confirmation that a survey response would be received was obtained over the telephone. This survey was designed, to the greatest extent possible, in a "check-box" format to minimize the amount of time it took respondents to complete. The City of Calgary was actively involved in the survey question selection and preparation. Much of the survey centres on yard waste collection strategies at the City of Calgary's request.

In total 124 communities throughout Canada and the northern United States were sent a survey in June of 1998. The rationale behind community selection was based on communities with populations over 100,000 above the 38th parallel. The 38th parallel was selected as the research area border in order to include Colorado Springs, CO. Since Calgary, AB and Colorado Springs, CO are

both located close to the east side of the Rocky Mountains, Colorado Springs, CO was considered to be a pertinent community to survey. Focus areas for the survey included the northeastern United States and Ontario. Yard waste bans have been invoked in these regions to divert yard waste from a variety of disposal facilities (Appendix B). This in turn indicates that communities are likely to have implemented residential yard waste diversion programs. In order to create a geographical balance, smaller communities and provincial/state capitals with populations less than 100,000 were included. A minimum of community per province/state was selected over the research area. This provided a full sample of yard waste diversion programs across Canada and the northern United States. Several communities were selected based on suggestions made by other communities as having successful yard waste diversion programs.

Ninety-three communities responded to this survey which resulted in a 75% return rate (Table 1). Follow up telephone calls were made, as appropriate, to clarify community responses. Informal interviews were also conducted over the telephone in order to obtain information regarding private composting facilities.

	Number of Surveys Sent	Number of Surveys Returned	Response Rate (%)
Canada	49	39	79.6
United States	75	54	72
Total	124	93	75

Table 1: Response Rate for the Residential Yard Waste Diversion Programs Survey

Results from the residential yard waste diversion survey were complied in a database and divided into the following categories for ease of handling:

- Solid waste disposal and residential solid waste diversion characteristics;
- residential yard waste diversion programs and collection strategies;
- yard waste curbside collection characteristics;
- yard waste drop-off collection characteristics;
- composting facility characteristics and end markets;
- yard waste collection and composting facility costs; and,
- yard waste diversion promotion and public education.

This database provides a detailed overview of current residential yard waste management programs in Canada and the northern United States. Information gathered from the survey was reviewed and then summarized in the following chapter. For ease of direct comparison all imperial measurements were converted to metric and all American costs were converted to Canadian dollars at an exchange rate of 1.57. Original data given in cubic yards per year and in dollars per cubic yard were converted to tons using a 4:1 ratio (cubic yard:ton) (Minear, 1998) then to tonnes, and into Canadian dollars where applicable.

CHAPTER 2: RESIDENTIAL YARD WASTE DIVERSION PROGRAMS IN CANADA AND THE NORTHERN UNITED STATES SURVEY RESULTS

In total 93 communities responded to this survey resulting in a 75% return rate. The population of these communities range from 6,000 to 2,732,000 and the number of households vary from 3,000 to 1,021,000. It is noted that the community examples referred to in this chapter are not intended to highlight any one program but to give the reader an idea where specific initiatives and program characteristics take place.

Full survey results are contained in Appendices C-H. Several respondents did not complete the entire survey. In these cases information is considered not available and is denoted by ****. Not applicable (NA) is utilized when a specific question or set of questions is not relevant to a particular community, for instance, the surveyed community does not have a yard waste drop-off program in place. In many cases the category selected for discussion may total over 100%. For example, communities may use more than one solid waste disposal facility, or may allow residents to use several curbside set out methods (e.g. bundles, kraft paper bags, plastic garbage bags, and roll-out carts).

For the readers' convenience the survey question(s) that will be discussed in each section are located at the beginning of the section. All percentages in the following chapter are based on the total number of communities that responded to this survey. Percentages are rounded to the nearest percent.

Solid Waste Disposal and Diversion Characteristics

What is the current method for solid waste disposal?
What is the tipping fee for municipal solid waste at this disposal facility?

By far landfilling is the most popular method of community solid waste disposal followed by waste-to-energy plants and incinerators (Table 2). Tipping fees for municipal solid waste at these disposal facilities range from $0 /t to $133 /t.

Disposal Facility	Number of Communities	Percent of Communities	Minimum / Maximum Tipping Fee (Dollars*/Tonne)
Landfill	85	91%	$0 to $133
Waste-to-Energy	10	11%	$26 to $88
Incinerator	5	5%	$50 to $82
Resource Recovery Facility	1	1%	$34
Information Not Available	1	1%	NA

* Rounded to the nearest dollar NA = Not Applicable

Table 2: Solid Waste Disposal Facilities

Bag Limits and Volume-Based Systems

Are there any seasonal or year round bag/can limits in place?
How is municipal solid waste collection financed?

Of the communities surveyed 29% have invoked some form of a seasonal or year round residential bag/can limit. Calgary, AB is unique, it has implemented a temporary 5-bag/can limit during the fall in order to ensure that collection routes are completed on time. Extra bags are left behind for pick-up on the next scheduled collection day. Bag/can limits may also be in conjunction with a volume-based collection system. Both strategies encourage residential recycling, backyard composting, and grasscycling.

Two basic volume-based refuse systems exist. Firstly, residents are charged on a per bag/can basis, for instance, residents of St. Cloud, MN purchase specially marked 114 L refuse bags from City Hall and local stores for $2 /bag. In this way residents are paying directly for each bag disposed. Barrie, ON and the Regional Municipality of the Central Okanagan, BC both have a 2-bag/can limit per refuse pick-up. Residents of Barrie, ON pay an additional fee of $1 per bag/can for more than the limit and the Regional Municipality of the Central Okanagan allows

residents to purchase 2 additional bag/can tags for $1.50-$3.50 depending on the community. Secondly, residents select among a variety of container sizes for refuse; the larger the container the higher the monthly charge. Portland, OR and Lansing, MI have both implemented this system. In Portland, OR, if requested, haulers provide residents with 227 L and 345 L roll-out carts with rates of $36 and $43.25 per month respectively. Vancouver, WA has adopted a linear rate structure with a volume-based system. One 121 L can with weekly pick-up is $18 per month, 2-can service is $36 per month and extra cans are $7.25 per month. This rate structure is an incentive to reduce waste disposal to one can.

Most surveyed communities either incorporate the refuse fee into residential property taxes (53%) or charge a flat fee on the residential utility bill (23%). In contrast, volume-based systems are centred on the amount of waste generated.

Residential Solid Waste Diversion Programs

What waste diversion programs are available to residents other than yard waste diversion programs?

Residential solid waste diversion programs (not including yard waste diversion) are commonly observed with the surveyed communities. A clear majority (83%) of the respondents have implemented 4 or more diversion programs. Communities collect residential recyclables either through curbside collection, drop-off collection, or both collection strategies (Table 3). Other promoted diversion initiatives include: household hazardous waste, tire recycling, oil recycling, plastic recycling, paint exchanges, beverage container depots, and construction/demolition recycling programs (Table 3). Twenty-five percent of the communities have implemented some form of a kitchen waste diversion program. Seventy-four percent of these initiatives take place in communities with populations under 185, 000.

Residential Solid Waste Diversion Program	Number of Communities	Percent of Communities
Household Hazardous Waste	71	76%
Recycling – Curbside and Drop-off	58	62%
Tire Recycling	56	60%
Oil Recycling	55	59%
Plastic Recycling	52	56%
Paint Exchange	44	47%
Beverage Container Depots	33	35%
Recycling – Curbside	17	18%
Recycling – Drop-off	17	18%
Kitchen Waste – Curbside	12	13%
Kitchen Waste – Vermicomposting	6	7%
Kitchen Waste – Drop-off	5	5%
Construction/Demolition Recycling	1	1%
Information Not Available	1	1%

Table 3: Residential Solid Waste Diversion Program
(excluding yard waste diversion programs)

Appendix C contains the full survey results for solid waste disposal and diversion characteristics.

Yard Waste Bans and Diversion Programs

What average annual percentage of the total municipal solid waste stream and the residential solid waste stream is yard waste?

Survey results indicate that yard waste comprises of 1% to 40% of the total municipal solid waste stream and between 1% and 53% of the residential waste stream. Many of the responses are estimates as numerous communities have not completed waste composition studies.

Yard Waste Bans

Are there any yard waste bans at the solid waste disposal facility? If yes, please describe.

Forty-eight percent of the communities surveyed have yard waste bans in place. Various levels of government can ban yard waste materials from solid waste disposal facilities (e.g. landfills, waste-to-energy plants, and incinerators). At the provincial/state level Minnesota (1992), Nova Scotia (1996), and South Dakota (1995) have all banned yard waste from landfills while West Virginia (1996) has banned it from all disposal facilities (Bauld, 1998; The Compost Council, 1996b). Wisconsin (1993), on the other hand, bans yard waste from landfills but allows burning with energy recovery (The Compost Council, 1996b). Ohio's legislation (1995) is different, it states that all source separated yard waste must go to a composting facility (The Composting Council, 1996b). At the county level, the Jefferson County Waste Management Board (1994) banned leaves and grass from the landfill used by Louisville, KY (City of Louisville, 1994). At the city level, Augusta, ME and Seattle, WA have ordinances. The former states that leaves and grass clippings must be separated from all waste and placed in a leaf composting area while the latter prevents yard waste from being placed in the garbage (Jones, 1998; Uhlar-Heffner, 1998).

Yard Waste Diversion Programs

What types of yard waste diversion programs are promoted?
Do any of these programs offer incentives for residents to participate?

The surveyed communities are currently practicing a wide variety of yard waste diversion initiatives. Ninety-seven percent offer some form of yard waste collection while 88% have a Christmas tree recycling program. Source reduction programs include backyard composting, grasscycling, mulching, and yard waste minimization principles respectively (Table 4). Of the 93 communities that responded, 2% do not have any yard waste diversion programs in place.

Yard Waste Diversion Program	Number of Communities	Percent of Communities
Curbside and/or Drop-off Collection	90	97%
Christmas Tree Recycling	82	88%
Backyard Composting	68	73%
Grasscycling	51	55%
Mulching	32	34%
Yard Waste Minimization Principles	14	15%
Not Applicable	2	2%
Information Not Available	1	1%

Table 4: Yard Waste Diversion Programs

Numerous communities offer incentives for residents to participate in yard waste diversion initiatives. For instance, Albany, NY; Peoria County, IL; Philadelphia, PA, and Rochester, NY all give compost from their composting facilities to residents at no charge. Lethbridge, AB offers free swim/skate/public transit passes to individuals who participate in the Christmas tree recycling program while Great Falls, MT gives residents a certificate for one free tree on Arbor Day as a replacement. Other Christmas tree recycling programs offer free wood chips once the trees are processed. Source reduction incentives include subsidizing backyard composters or selling them at a reduced rate. Billings, MT; Brantford, ON; Burlington, VT; the Capital Regional District, BC; Chico, CA; Springfield, MA, and Tillsonburg, ON all have active backyard composter programs to encourage residential participation. Mulching mower rebates and discounts are another option. Sacramento, CA and Tacoma, WA both offer this opportunity. Peterborough, ON has a similar program, instead of a purchase rebate for a new lawn mower, it will pay 50% of the cost of the blade, installation, and taxes for a mulching blade conversion. Yard waste minimization principles have built in incentives centreing on lower costs and less maintenance.

Appendix D contains the survey full results for yard waste bans and diversion programs.

Yard Waste Collection Strategies

What yard waste collection strategy is utilized?
What yard waste materials are included in the collection program?
Are there any size limitations for yard waste material in the collection program?
Are there specific yard waste materials that are not allowed or banned from the collection program?

As previously mentioned 97% of the communities collect yard waste. This is achieved through curbside collection, drop-off collection, or both collection strategies (Table 5).

Yard Waste Collection Strategy	Number of Communities	Percent of Communities
Curbside and Drop-off Collection	58	62%
Curbside Collection	19	20%
Drop-off Collection	13	14%
Not Applicable	2	2%
Information Not Available	1	1%

Table 5: Yard Waste Collection Strategies

Numerous yard waste materials are gathered through these strategies: leaves, Christmas trees, grass, branches, weeds, sod, wood waste, and tree stumps (Table 6). Some communities collect only one specific material while others collect a wide variety of materials.

Several communities have size limitations and/or banned certain yard waste materials from their program. In most limitation cases branches have diameter and/or length restrictions. For example, Omaha, NE accepts branches up to 5 cm in diameter and 1 m in length while Richmond, BC accepts branches up to

15 cm in diameter. The reasons behind branch size limitations generally centre on the maximum size allowed by processing equipment and ease of handling for the collector. Sod and tree stumps are the most commonly banned yard waste materials. This is due to weight constraints and processing limitations. Other bans include branches and grass clippings. Brooks, AB has banned branches for fear of excessive processing costs. Dayton, OH; London, ON, and Oakville, ON all ban grass from their collection programs while Markham, ON only bans grass from curbside collection. Odour issues may be a concern leading to grass bans. However, London, ON and Markham, ON ban grass simply to help promote environmentally sustainable lawn care through source reduction (e.g. backyard composting, grasscycling, and mulching).

Yard Waste Materials Collected	Number of Communities	Percent of Communities
Leaves	84	90%
Christmas Trees	82	88%
Grass	75	81%
Branches	72	77%
Weeds	65	70%
Sod	29	31%
Wood Waste	4	4%
Tree Stumps	3	3%
Not Applicable	2	2%
Information Not Available	1	1%

Table 6: Yard Waste Materials Collected

Appendix D contains the full survey results for yard waste collection strategies.

Yard Waste Curbside Collection Characteristics

What year did the curbside collection program start?
How many households are serviced by curbside collection?
Who collects residential yard waste?
Is curbside collection seasonal or year round?
What is the yard waste collection frequency?
Is yard waste collected on the same day as residential solid waste?
What type of equipment is used for curbside collection?
How is yard waste set out for the collector?
How is curbside collection financed?

Of the 93 communities surveyed, 82% have established a yard waste curbside program (Table 5). On the whole, most communities initiated their curbside collection throughout the 1990's with Sacramento, CA (1953) and Madison, WI (1980) having the oldest programs. Surveyed communities indicate that curbside programs collect from between 400 and 740, 000 households, and that many communities serve a limited number of households. Public collection (50%) is the most common followed by contracted private collection (31%) and residential subscriptions to private collectors (10%).

Table 7 reviews a variety of yard waste curbside collection characteristics. Seasonal collection is noted to be more popular than year round collection. The former can be a fall leaf program (October-November) and/or a Christmas tree collection in January. Seasonal and year round programs may collect yard waste using one or more of the following curbside collection frequencies: weekly, biweekly, or monthly. Forty-eight percent of the communities have weekly collection, 23% biweekly, and 4% monthly. Specific yard waste materials can be collected at different times during the month. For example, in Madison, WI leaves and grass are collected biweekly while brush is collected on a monthly basis. Seasonal programs also can have a dedicated number of pick-ups over the programs running time. For instance, London, ON has 6 yard waste pick-ups from March to October, residents receive a garbage and recycling calendar so they know when to set out yard waste. Another option available is call-in service, residents of Huntington, WV and Milwaukee, WI specifically request collection.

Yard Waste Curbside Collection Characteristic	Number of Communities	Percent of Communities
Collection Period		
Seasonal	50	54%
Year Round	26	28%
Not Applicable	15	16%
Information Not Available	2	2%
Pick-up Frequency		
Weekly	45	48%
Biweekly	21	23%
Dedicated Number of pick-ups (over a specific period of time)	9	10%
Monthly	4	4%
Call In	2	2%
Not Applicable	15	16%
Information Not Available	7	8%
Same Day Collection as Solid Waste		
Yes	44	47%
No	24	26%
Varies	6	7%
Not Applicable	15	16%
Information Not Available	4	4%

Table 7: Yard Waste Curbside Collection Characteristics

Yard waste may or may not be collected on the same day as solid waste. Forty-seven percent of the communities have same day collection while 26% do not. Seven percent of the respondents have collection days that may vary

depending on the private collectors' schedule. For example, the franchised-based system in Portland, OR assigns residents to subscribe directly to a specific collector. In this free market system 44 different haulers service the City; each private hauler decides if refuse and yard waste collection is on the same day (McLaughlin, 1998).

To collect yard waste communities often utilize existing public equipment such as rear/side loader compactors, dump trucks, and front-end loaders. This equipment can be specifically dedicated to yard waste or may be shared with refuse collection. Markham, ON uses dedicated side loader compactors for yard waste collection while Montreal, PQ utilizes regular refuse rear/side loader compactors. Meanwhile, Chicago, IL co-collects clear blue bag yard waste and recyclables with refuse in the same rear loader compactor. Depending on the type of yard waste material, specialized collection equipment (e.g. vacuums and street sweepers) may be required.

Sets out methods vary greatly among the surveyed communities. It is noted that the majority of communities use more than one set out option. The type of material collected can determine the set out method, for example, branches require bundles whereas leaves can be placed in bags/containers or swept loose to the curb. Of the communities surveyed, the most popular set out methods include: bundles, kraft paper bags, open containers, and clear plastic bags (Table 8). Boise, ID; Columbus, OH, and Peterborough, ON all promote the use of bundles, kraft paper bags, and open containers. Chicago, IL, on the other hand, uses clear blue plastic bags for its Blue Bag Recycling Program (Keane, 1998) while the Regional Municipality of Halifax, NS and Salem, OR utilize only roll-out carts. Less common set out methods involve biodegradable plastic bags and jute bags. Augusta, ME; Surrey, BC; Portland, OR, and Whitehorse, YK utilize the former while Guelph, ON has implemented the latter as one option.

Set Out Method	Number of Communities	Percent of Communities
Bundles	39	42%
Kraft Paper Bags	32	34%
Open Containers	30	32%
Clear Plastic Bags	20	22%
Roll-out Carts	16	17%
Plastic Garbage Bags	13	14%
Piled on Curb	13	14%
Piled on Street	7	8%
Biodegradable Plastic Bags	4	4%
Closed Containers	3	3%
Jute Bags	1	1%
Not Applicable	15	16%
Information Not Available	5	5%

Table 8: Yard Waste Curbside Collection Set Out Methods

Curbside collection is financed in a variety of ways, the most popular options include: residential property tax (37%), a flat rate on the residential utility bill (17%), and private collectors billing residents directly (10%).

Appendix E contains the full survey results for yard waste curbside collection characteristics.

Yard Waste Drop-off Collection Characteristics

What year did the drop-off collection program start?
Is drop-off collection seasonal or year round?
How many drop-off locations are there?
Is the drop-off depot(s) supervised at all times?
How is the yard waste received at the drop-off location(s)?
Are plastic bags accepted at the drop-off depot(s)?
What collection equipment is used to service the drop-off location(s)?
How is the drop-off program financed?

Seventy-six percent of the communities surveyed have established drop-off collection (Table 5). Madison, WI was the first community to implement a yard waste drop-off program (1980); the majority of communities developed programs during the 1990's.

Table 9 reviews a variety of yard waste drop-off collection characteristics. Fifty percent of the surveyed communities have year round drop-off sites while 23% offer seasonal locations during the peak growing period. Communities with seasonal collection offer more drop-off depots (1-27) than year round sites (1-5). Bismarck, ND and Calgary, AB, by far, have the most seasonal drop-off locations with 25 and 27 respectively. It is noted that 53% of the communities with drop-off collection have full-time supervision during the hours of operation. This assists in the prevention of illegal dumping. When residents bring yard waste to these sites most place the material in piles as opposed to bins. Sixty-one percent of drop-off programs do not accept plastic bags. Of these 57 communities, 19 (33%) request that residents debag their own yard waste. Brantford, ON; Milwaukee, WI, and Seattle, WA all require residents to debag and place yard waste in bins.

Standard equipment used by the surveyed communities to transport yard waste to the composting facility include: front-end loaders, rear/side loader compactors, roll-off trucks, dump trucks, trailers, and vacuums. Eight of the respondents have their drop-off site located at the composting facility, this results in no feedstock transfers. Drop-off depots are generally financed through tipping fees, residential

property taxes, flat entrance rates, and/or per container charges on a residential utility bill.

Appendix F contains the full survey results for yard waste drop-off collection characteristics.

Yard Waste Drop-off Collection Characteristic	Number of Communities	Percent of Communities
Collection Period		
Year Round	47	50%
Seasonal	21	23%
Not Applicable	21	23%
Information Not Available	4	4%
Drop-off Depot Supervised at All Times		
Yes	49	53%
No	18	19%
Not Applicable	21	23%
Information Not Available	5	5%
Plastic Bags Accepted		
No	57	61%
Yes	11	12%
Not Applicable	21	23%
Information Not Available	4	4%

Table 9: Yard Waste Drop-off Collection Characteristics

Compost Facility Characteristics and End Markets

Is the yard waste material composted?
Who owns and operates the composting facility?
What composting method(s) is used at the composting facility?
Does the composting facility co-compost yard waste with other organics?
What is the tipping fee for yard waste at the composting facility?
What is the design capacity of the composting facility?
What quantity of yard waste was processed at the composting facility during 1997?
What equipment is used at the composting facility?
How is the composting facility financed?

Eighty-six percent of the surveyed communities compost yard waste while 9% use all of the yard waste, or a portion of it, for direct land application. Columbus, OH and Sacramento, CA are noted to mulch part of their yard waste. Three main options exist for compost facility ownership and operation, 37% are public facilities, 33% are private facilities, and 14% are owned by the public but privately operated (Table 10). The remaining composting facilities are described as other (e.g. public/private partnerships, cooperatively developed and municipally operated, or a partnership between a private non-profit foundation and the public).

Surveyed communities may implement more than one yard waste composting method. Windrows are the primary composting method followed by static piles, channel composting, and in-vessel systems respectively (Table 10). It should be noted that 12% of the communities' co-compost yard waste with other organic feedstocks (Table 10). Charlottetown, PEI and the Halifax Regional Municipality, NS co-compost with kitchen waste. Davenport, IA; Fort Wayne, IN; Provo, UT and Rapid City, SD all co-compost with biosolids, while Quebec City, PQ co-composts with manure and pulp and paper residue.

Tipping fees at these composting facilities range from $0 /t to $78 /t (residential and/or commercial yard waste). Facility design capacities vary from 2,000 t to an estimated 200,000 t, while the minimum quantity processed by a community in

1997 was 232 t and the maximum was 181,400 t. The most commonly used equipment at composting facilities include: front-end loaders, screens, temperature probes, grinders, windrow turners, chippers, and shredders. Other equipment options involve debaggers, dump trucks, excavators, manure spreaders, moisture probes, and watering trucks. Tipping fees and end product sales play an important role in financing composting facilities, this is especially true for private businesses. Residential property taxes and utility bills along with end product sales and government grants assist in funding public facilities.

Composting Facility Characteristic	Number of Communities	Percent of Communities
Facility Ownership/Operation		
Public	34	37%
Private	31	33%
Public Ownership / Private Operation	13	14%
Other	3	3%
Not Applicable	11	12%
Information Not Available	1	1%
Composting Method		
Windrow	66	71%
Static Pile	19	20%
Channel	2	2%
In-vessel	2	2%
Not Applicable	10	11%
Information Not Available	4	4%

Table 10 continued on the next page

Table 10 continued

Composting Facility Characteristic	Number of Communities	Percent of Communities
Co-composting With Other Organics		
Yes	11	12%
No	57	61%
Not Applicable	21	23%
Information Not Available	4	4%

Table 10: Compost Facility Characteristics

Compost End Markets

What is the compost product end market(s)?

Compost is either sold in bulk, is bagged, or is given away. Survey results indicate that communities have more than one desired end market. Selling compost to landscapers is the primary market, followed by municipal use and residential purchases (Table 11). Some communities give compost away to residents as a thank you for participating in the yard waste program. Other end markets include: soil blenders, nurseries, land reclamation, golf courses, landfills, and farmers. El Paso County, CO utilizes compost for a quarry reclamation project to restore mountain vegetation and enhance Rocky Mountain Sheep habitat as well as to increase the aesthetic quality of the area (Fisher, 1998).

End Market	Number of Communities	Percent of Communities
Sold to Landscapers	33	36%
Municipal Use	31	33%
Sold to Residents	25	27%
Given to Residents	16	17%

Table 11 continued on the next page

Table 11 continued

End Market	Number of Communities	Percent of Communities
Sold	10	11%
Sold to Soil Blenders	5	5%
Sold to Nurseries	4	4%
Land Reclamation	3	3%
Sold to Golf Courses	3	3%
Landfills	2	2%
Sold to Garden Centres	2	2%
Sold to Contractors	2	2%
Sold to Farmers	1	1%
Sold to Community	1	1%
Given to Farmers	1	1%
Not Yet Determined	1	1%
Information Not Available	11	12%
Not Applicable	7	8%

Table 11: Compost End Markets

Appendix G contains the full survey results for compost facility characteristics and end markets.

Yard Waste Diversion Program Promotion and Public Education

How are yard waste diversion programs publicized and promoted?

By far the most recognized technique for publicizing yard waste diversion programs is through the newspaper (Table 12). This is followed by the radio, flyer drops, utility bill inserts, television, and billboards (Table 12). A variety of promotional techniques are utilized by a small number of communities, these include: community publications, composter sales, kiosks in public locations, phone books, posters, and special events (e.g. expos and trade shows).

Yard Waste Diversion Program Promotion	Number of Communities	Percent of Communities
Newspaper	79	85%
Radio	41	44%
Flyer Drop	34	37%
Utility Bill Insert	33	35%
Television	30	32%
Billboards	9	10%
Special Events	5	5%
Community Publications	4	4%
News Releases	4	4%
Composter Sale	3	3%
Posters	2	2%
Phone Book	1	1%
Kiosks	1	1%
Information Not Available	3	3%
Not Applicable	2	2%

Table 12: Yard Waste Diversion Program Promotions

Public education tools including brochures, seminars, websites, school programs, telephone hotlines, and demonstration gardens are utilized by respondents (Table 13). Several communities have established Master Composter and Master Gardener public education programs. Baltimore, MD; Edmonton, AB; Madison, WI, and Seattle, WA have implemented the Master Composter program. At this time Saskatoon, SK is presently working with the Waste Reduction Council of Saskatchewan to initiate this program in the future (Ashton, 1998). Ramsey County, MN and Seattle, WA both have Master Gardner programs while El Paso County, CO is scheduled to implement this program in 1999 (Fisher, 1998).

Yard Waste Public Education Tools	Number of Communities	Percent of Communities
Brochures	74	80%
Public Seminars	53	57%
Websites	40	43%
School Programs	39	42%
Telephone Hotline	39	42%
Demonstration Gardens	38	41%
Information Not Available	3	3%
Not Applicable	2	2%

Table 13: Yard Waste Diversion Program Public Education Tools

Appendix H contains the full survey results for yard waste diversion program promotion and public education.

Yard Waste Collection and Composting Facility Costs

What is the cost of operating the drop-off depot(s) to the community?
What is the cost of curbside collection to the community?
What is the operational cost for processing the compost materials?
(All responses requested in overall cost and/or cost per tonne/ton)

Minimal responses, various accounting practices, and the diverse methods in which communities collect and determine costs have resulted in a lack of comparable data for a discussion on yard waste collection and composting facility costs. It is noted that in numerous cases little or no data were given for private composting facilities. Only the following basic cost ranges are available from the survey results: operating costs for drop-off collection range from $11 /t - $65 /t, curbside collection of yard waste is from $28 /t - $356 /t, and operating costs for the composting facility vary from $7 /t - $60 /t. For further information on specific program costs consult the community contact list for Canada and the United States (Appendices J and K). Individuals on this list will be able to assist

with determining who the best person is, at that community, to speak with regarding yard waste diversion program costs.

Current and Future Pilot Projects

Are any pilot projects implemented at this time or are any planned for the future?

A variety of current and future organic pilot projects are described in Table 14. Tomorrow's strategy can be viewed by knowing what communities are researching, testing, and implementing today. Surveyed communities indicate that kitchen waste diversion is the main trend of the future.

Community	Pilot Project
Boise, ID	• Compost bin sales • Development of classes for local landscape maintenance personnel to encourage commercial yard waste diversion activities
Burlington, VT	• Collection program for food waste and non-recyclable paper diversion
Calgary, AB	• Expand yard waste collection to grass clippings and possibly branches
Cheyenne, WY	• Variable rate system
Eugene, OR	• Biweekly collection of yard waste with service provided by one hauler for the entire city
Grand Rapids, MI	• Cart collection (1, 000 households)
Great Falls, MT	• Roll-off containers placed in neighbourhoods on collection day • Presently having problems with containers being contaminated with non-compostables
Kingston, ON	• Collection of both yard and kitchen waste
Lansing, MI	• Testing biodegradable bags
London, ON	• Outreach program in conjunction with the Composting Council of Canada
Manchester, NH	• Promotional/educational program for backyard composting
Markham, ON	• Expand collection to include kitchen waste • Experiment with a variety of different collection systems (e.g. 2-stream and 3-stream)

Table 14 continued on the next page

Table 14 continued

Community	Pilot Project
Montreal, PQ	• Kitchen waste and yard waste programs (20, 000 households)
Ottawa-Carlton RM, ON	• Yard waste, food waste and other residential organic collection in a 341 L cart • Semi-automated pilot project (2, 500 households)
Peterborough, ON	• Examine kitchen waste set out methods
Rapid City, SD	• In-vessel composting
Red Deer, AB	• Examine kitchen waste options
Sacramento, CA	• Automated containerized yard waste collection (325 households)
Salem, OR	• Addition of residential vegetative food waste to curbside collection and composting
Saskatoon, SK	• Front street automated collection of yard waste (excluding branches) • Truck will collect garbage and yard waste on separate days from the same container
Whitehorse, YK	• Waste Watch organics collection, based after Charlottetown, PEI (230 households)

Table 14: Current and Future Community Pilot Projects

Critical Lessons Learned

What critical lessons were learned during the development and implementation of the yard waste diversion program? Include successes and failures that might be of importance for other communities when developing similar programs.

This is perhaps the most pertinent information obtained from the entire survey as it centres on problem areas and issues that communities have identified. Numerous respondents spent the time to give suggestions and helpful hints on the lessons they learned during their yard waste program implementation and development in order to assist others that are considering similar programs. Table 15 discusses the compiled responses. It is noted that some responses are conflicting since different communities have had different experiences.

Potential Concerns	Suggestions
Bans	• Mandatory bans on yard waste from refuse collection would improve program success rate
Curbside Collection	• Increase number of pick-ups over summer months • Scaling back weekly collection to monthly during the summer has caused problems • Loose-leaf pick-up is hard to keep up with in the fall (residents complain) • Greater participation if yard waste collection is the same day as refuse • Skid loaders with packer produce maximum loads • Residents have not embraced the subscription service (too expensive)
Compost Facility Siting Equipment	 • Locate composting facility away from any residential areas - some odours are inevitable • Integrate compost facility with other operations (e.g. landfill and MRF) • Size all equipment and compost pad for maximum tonnage plus 20% for storms • Important to have a solid base (e.g. pavement and asphalt) for operating surface • Expensive equipment is necessary to compost well (e.g. tub grinder, front-end loader, windrow turner, and chipper) • Reliable grinder is essential • When purchasing a grinder set up a "grind-off", have manufacturers compete on the same day with equal piles (look for high productivity and quality output) • Tub grinders seem to do the best job as they work faster and have less down time • Purchase a screener over a tub grinder • Ensure that contractors have equipment in place before the contract begins • On-site water source is necessary
Composting Facility Personnel	 • Ensure that there are enough workers for a full capacity operation • Seek experienced operators, consider local farmers as they have knowledge of both the equipment and compost process • Dedicate employees to the project, do not slip operators in and out of the compost facility • Must pay well to have good operators • Money spent on professional consultant/horticulturist is money well spent
Compost Quality	• Finished compost quality is generally higher if contractor is responsible for marketing the product • Important to have a consistent end product for purchasers
Drop-off Collection	• Do not let material collected at drop-off depots build up • Accepting only debagged material at depots is recommended • Drop-off locations work well with seasonal curbside collection • Do not allow commercial use unless a fee structure is in place • Need to monitor site to stop illegal dumping
End Markets	• Select a solid end market prior to composting

Table 15 continued on the next page

Table 15 continued

Potential Concerns	Suggestions
Processing	• Take care of potential odour concerns before they happen, install remedial technique(s). • Beware of grass clippings
Promotion	• Take the time to advertise as it increases residential participation • One quarter of your first year budget should be spent promoting the program, utilize all media types • Must give residents an incentive to participate
Public Education	• Strong emphasis on public education is necessary. • Messages to public must clearly state what steps they must follow in order to participate (e.g. use clear plastic bags and types of yard waste allowed) • Public needs continual reinforcement • Be prepared for high increase of participation during the second year • Do not change programs course, re-educating the public is costly both in dollars and participation • Simple programs work best with the public
Set Out Method	• Do not collect yard waste in plastic bags • Debagging costs are high and possible contamination of end product exists • Consider biodegradable bags if cost effective • Utilize kraft paper bags and open containers • Use clear bags • Do not require the use of kraft paper bags due to high cost • Loose-leaf collection reduces contamination as collectors can not see what is in bags until they are debagged
Source Reduction Programs	• Strongly recommend backyard composting and grasscycling • Concentrate on source reduction efforts prior to collection programs as it is more difficult to get residents to backyard compost and grasscycle once this program is implemented • Initiating backyard composting can be a big challenge

Table 15: Critical Lessons Learned by Surveyed Communities

Summary

The survey results indicate that a great variety of yard waste diversion programs have been implemented and that rarely do communities overlap with the exact program. Several communities are at the forefront by testing new collection strategies and composting technologies. Some will be successful and others will require time to make adjustments to meet the specific needs of their community. The critical lessons learned from respondents provides useful background information for the City of Calgary to draw upon when considering which yard waste diversion options are best suited to meet the City's requirements.

PART II

BACKGROUND INFORMATION AND RECOMMENDATIONS

PART II: BACKGROUND INFORMATION AND RECOMMENDATIONS

Part II is dedicated to a broad literature review on residential yard waste diversion options and strategies that may be applicable to the City of Calgary. It summarizes information on existing City of Calgary residential yard waste diversion programs, potential yard waste source reduction options, a variety of yard waste collection strategies, and relevant composting information. The last chapter provides recommendations that are designed to expand and complement the City of Calgary's current residential yard waste diversion programs, as well as direct the City towards topics that require further research.

Methodology

The primary research techniques utilized for this background review included a literature review, key informant interviews, site visits, and conferences.

A literature review provided current information on yard waste management issues as well as a variety of yard waste diversion programs in North America. This review centred on trade journals, government documents (federal, provincial/state and municipal), publications from composting organizations, and internet searches. The literature review was on going throughout the project to ensure that the most current information was included.

Key informant interviews were combined with site visits to the City of Calgary's composting facilities. This combination of research techniques was valuable as personal observation assisted in understanding the composting operation. It also lead to pertinent operational questions. A site visit was made to the Olds College Composting Technology Centre, but no interview took place.

During the research stage of this project, 3 conferences, the Olds College Composting Conference held in Olds, Alberta, in April 1997 and April 1998, and the Solid Waste Association of North America – Prairie Chapter Conference held

in Edmonton, Alberta, in April 1998 were attended. Both of the Olds College Composting Conferences were based mainly on composting issues in Alberta: organic waste management, environmental remediation, and integrated waste management were the underlying themes. The Solid Waste Association of North America – Prairie Chapter Conference centred on the overall business of waste management. Numerous municipal contacts were made at these conferences for the pending mail survey and for information on current residential yard waste diversion programs.

The information gathered using these research techniques was reviewed with the survey results and the author's own ideas to create the forthcoming residential yard waste diversion recommendations for the City of Calgary.

It is noted that all imperial measurements were converted to metric and all American costs were converted to Canadian dollars at an exchange rate of 1.57.

CHAPTER 3: CURRENT CITY OF CALGARY RESIDENTIAL YARD WASTE DIVERSION INITIATIVES

Once a week the City of Calgary manually collects residential refuse in plastic garbage bags and open containers for landfill disposal at the Shepard, Spyhill, and East Calgary facilities. Presently the City is exploring the possibility of transferring the $60 /household/year residential waste service fee from the residential property tax to a utility bill (Goemans, 1997). This move is expected to help educate the public on the true cost of refuse collection and disposal (Goemans, 1997).

Residential yard waste is presently collected with refuse for landfill disposal, unless homeowners utilize various City yard waste diversion programs. Current City of Calgary initiatives include: temporary bag/can limits, fall leaf drop-off collection, Christmas tree recycling, backyard composting, and grasscycling.

Temporary Bag/Can Limit

In 1997, for the first time, the City of Calgary introduced a temporary fall residential solid waste limit of 5-bags/cans per week (Frazer-Harrison, 1998). Traditionally, with the large volumes of leaves generated in the fall, it was difficult for regular solid waste collection to stay on schedule (Griffiths, 1998). Now with the seasonal bag/can limit solid waste schedules are maintained (Goemans, 1998). If collectors are running behind schedule and residents have not complied with the bag/can limit, the resident receives a notice outlining recycling alternatives and the excess bags/cans are left behind for the next collection.

Fall Leaf Drop-off Collection

Over a 6 week period, from the end of September to the beginning of November, the City of Calgary provides 27 leaf drop-off sites around the City for residents who wish to compost their leaves. Most of the drop-off locations are strategically placed within the City's leaf belt at community centres, City parks and recreation

parking lots, and landfills. Leaf litter is the only yard waste material accepted; no grass clippings or brush (woody material) are collected. During the 1997 program roughly 750 t of residential and park maintenance leaves were dropped-off and in the fall of 1998 approximately 900 t of leaves were collected (Dempster, 1998; Ohman, 1998a). This marked increase is likely due to the addition of six more leaf drop-off locations; in 1997 and 1998 there were 21 and 27 sites respectively (Goemans, 1998; Griffiths, 1998).

Residential property taxes, the landfill revenue reserve, and government grants from Alberta Environmental Protection have all funded this program; annual operational costs run at approximately $60, 000 (Goemans, 1998).

Operation and End Use

The City requests that leaves are to be bagged and placed in designated collection areas at City drop-off sites. Exceptionally clean leaf material is generally collected at these locations (Goemans, 1998). However, the odd illegal dumping may occur (Goemans, 1998). City workers manually debag and collect leaves up to twice a day, 6 days a week during the fall (Ohman, 1998b). High volume vacuum units are used to mulch and suction the leaves into specially designed leaf truck boxes at the drop-off location. The leaves are then transported to the City's composting facilities at the Spyhill and Shepard landfills. An asphalt pad with a clay liner (90x160 m) is at the Spyhill composting site while a roller compacted concrete pad with a clay sub-base (80x120 m) is at the Shepard facility (Ohman, 1998b). Windrows are created directly on the composting pads when the truck box releases the leaf load. With the exception of natural precipitation, nothing is added to the windrows during the composting process (Goemans, 1998). A local farmer, on a contractual basis, monitors and turns the windrows frequently (Goemans, 1998). During the summer the leaves are turned twice a week, in the spring once a week and during the winter the leaves sit dormant (Goemans, 1998). With Calgary's cool dry climate it takes

roughly 2 years before a usable compost end product is formed (Goemans, 1998).

At this point in time the leaf composting program does not sell or give away the end product to residents or commercial businesses. Instead finished compost is used in City parks as a nutrient rich soil.

Christmas Tree Recycling

For a 2 week period after Christmas the City of Calgary offers residents a Christmas tree recycling program. Calgarians can drop-off their "decoration-free" Christmas trees at all residential fire stations or at the Calgary Zoo's north parking lot. Christmas trees that are not part of this program go to the landfill as waste. During the 1995/1996 program 40,000 - 50,000 trees were chipped for a total cost of approximately $48,000 (City of Calgary, 1995c). At this time the City does not accept trees from tree-selling operations (City of Calgary, 1995c). These businesses must pay for proper landfill disposal (City of Calgary, 1995c).

Operation and End Use

Once Christmas trees are collected from residential fire stations they are stockpiled at the Calgary Zoo's north parking lot where a contracted tub grinder chips the trees. These chips are then screened for quality and size that meet the Zoo's requirements for animal compounds, mulching, and beautifying the grounds. Wood chips are also available to residents, free of charge, who load and transport the end product.

Backyard Composting

The City of Calgary supports backyard composting but does not have a formal program in place. There is an exhibit at the Calgary Zoo that displays a variety of backyard composting units available on the market today. This is a joint exhibit between the City of Calgary and the Calgary Zoo. Backyard composting is also promoted through brochures that the City makes available to interested parties.

Grasscycling

The City of Calgary advocates grasscycling through brochures. It encourages residents to recycle their grass clippings by asking them to leave the trimmings on their lawns. No structured grasscycling program has been established at this point in time.

Yard Waste Diversion Program Promotion

The City of Calgary recycling hotline (403) 277-7770 is used to promote all yard waste diversion initiatives. Traditionally television news clips, radio, newspaper articles, and advertisements have been used for public notification of the fall leaf drop-off program (Goemans, 1998). This form of advertising would include information regarding the program time frame, drop-off locations, what yard waste material is accepted, and how the yard waste should be handled. During the fall of 1998 the City of Calgary promoted its leaf drop-off program through a billboard campaign which was strategically placed throughout the City's leaf belt (Goemans, 1998). Door hangtags also promoted this program as well as the temporary bag/can limit (Goemans, 1998). The Christmas tree recycling initiative is publicized through newspaper advertisements and a radio campaign, while brochures promote backyard composting and grasscycling even though no structured program is in place (Goemans, 1998). Upon request, the Solid Waste Services Division's Community Relations Coordinator will supervise tours of solid waste facilities and give educational school presentations (Goemans, 1998).

Summary

At this time the City of Calgary has implemented several yard waste diversion initiatives. The City promotes these programs through various forms of public notification.

CHAPTER 4: RESIDENTIAL YARD WASTE SOURCE REDUCTION OPTIONS

Yard waste source reduction is an approach that precedes waste management. It is not a waste management tool even though it can have a positive impact on waste management programs (USEPA, 1989). This approach is essential as two provinces and numerous states have banned, or are in the process of banning, yard waste from disposal facilities (Bauld, 1998; The Composting Council, 1996b). Within these provinces/states numerous composting facilities are banning grass and municipalities are having trouble obtaining regulatory siting and development approval for composting facilities. In order to divert yard waste from disposal and composting facilities municipalities can implement source reduction programs. These programs are aimed at keeping yard waste at home thereby eliminating municipal collection and disposal costs. This chapter examines yard waste minimization principles along with backyard composting, grasscycling, and mulching residential source reduction programs.

Yard Waste Minimization Principles

Decreasing the amount of yard waste that residents produce through landscaping techniques is the first step towards source reduction. Many of the following principles also reduce the amount of water that is consumed thus creating water-conserving yards (adapted from Ball et al, 1990; Cornell Cooperative Extension, 1996):

1) **Limit Lawn Size:** Lawn should be limited to what is really necessary for children playing and entertaining. A smaller lawn size means less maintenance time, less grass set out for disposal and less water consumption.

2) **Water Efficient Plants:** Select native species or low-water-use-plants. These species tend to require minimal maintenance (pruning) resulting in minimal yard waste. Natural precipitation will be enough to maintain plant growth.

3) **Efficient Irrigation:** Generally lawns receive more water than is actually required. This can lead to rapid grass growth resulting in more yard waste. By utilizing water-efficient irrigation systems, such as drip irrigation, bubblers, and low-volume sprayers the amount of growth will decrease. It is also important to know the specific needs of the plant, for example, when and for how long a lawn or plant need watering. Limiting the watering frequency enhances deep root development which in turn increases the drought resistance of the lawn or plant (Revel, 1998).

4) **Tree Selection:** There will be no leaves to collect in the fall if coniferous trees are planted. These trees rarely need to be maintained and require only natural precipitation.

5) **Mulches:** Leaves, grass, wood chips, and pine needles along with a variety of inorganic materials (e.g. gravel and woven fabric) can all act as mulches for trees and shrubs. Mulches prevent evaporation and help to control weeds.

6) **Soil Improvement:** Organic amendments such as compost and shredded yard waste can help to improve clay and sandy soils.

7) **Appropriate Maintenance**: Utilize only minimal amounts of fertilizer as high applications lead to increased maintenance which results in more yard waste.

8) **Planning and Design:** Ensure that plants have enough room to grow. If not pruning or removal may be required in the future. Use hardscaping (e.g. paving stones, decks, patios, concrete, and fences) as aesthetic and functional features of the yard. This decreases the amount of area that is available for lawn and plants, which in turn reduces yard waste. Remember to leave space for a backyard composter.

Xeriscaping

Many of the above principles are utilized in a landscaping practice called xeriscaping (a variety of water efficient plants are used to create a lush oasis-like feeling). This landscaping practice is intended to reduce, not eliminate, water consumption through the use of native plants and introduced drought-tolerant plants. A water-conserving yard leads to a decrease in yard waste. Advantages of xeriscaping include:

1) **Saving Water:** Through the use of native and introduced drought-tolerant plants, water consumption can be significantly reduced. After the initial establishment period, the new landscape may require between 30 - 70% less water than more conventional plantings (Ball et al., 1990).
Less water = Less plant growth = Less yard waste.

2) **Saving the Environment:** Xeriscaping requires less fertilizer than conventional landscaping. This reduces the amount of plant trimmings and thus the amount of waste to be disposed. Xeriscaping also requires fewer pesticides that can inadvertently harm a wide range of organisms, as well as impact air and water quality.

3) **Saving Money:** Xeriscaping reduces the collection charges for residents that pay per bag/container as there is less waste to be collected. It also decreases water consumption and maintenance costs associated with landscaping.

4) **Saving Time:** Since plants used in xeriscaping environments are better suited to local environmental conditions, they generally require less maintenance in the form of watering, fertilizing, pruning, and mowing. After the initial establishment period, a xeriscape may require 20% of the maintenance compared to conventional landscaping (Ball et al., 1990).

Backyard Composting

Backyard composting is a source reduction option whereby residents collect household organics on their own property. Individuals can compost yard waste such as leaves, grass, weeds, and kitchen waste including vegetable and fruit peels, egg shells, and coffee grounds. Benefits of backyard composting include the following:

1) **Financial:** Reduces refuse that is disposed (important for residents who are charged per bag/container), provides a free soil amendment, and reduces the water bill as soil retains more moisture when compost is added.

2) **Ecological:** Improves chemical and physical properties of the soil, prevents erosion, and increases yields of vegetables and flowers.

3) **Environmental:** Turns organic waste into a valuable end product, nutrients are recycled back to the land, and saves limited landfill space.

Backyard composters can range from a pile in the yard, a perforated garbage can, or a plain wire bin to a wide variety of uniquely shaped composters that are available on the market. Through subsidies, grants, rebates, and education programs municipalities can encourage residents to start backyard composting.

Master Composter Program

Master Composter is an educational outreach program where volunteers take a training course and then go out into their own communities to help educate and inform the public about composting initiatives. Individuals maintain their Master Composter status by volunteering 35 - 40 hours each year with composting activities: giving classes on composting, helping people in their neighbourhoods who have requested assistance with composting problems, giving educational presentations at schools, helping staff booths at environmental expos and shopping centres, and helping with community projects such as compost give-a-ways and composter bin sales (City of Edmonton, 1997a). This has proven to be a valuable resource for helping municipalities educate residents on how to divert organic waste from disposal facilities. Edmonton, AB, for instance, has approximately 32% of its homeowners (42, 000 families) backyard composting (City of Edmonton, 1997a). This results in 10,224 t of organic waste being diverted from the landfill each year (City of Edmonton, 1997a).

Grasscycling

Leaving grass clippings on freshly mown lawn (instead of bagging) is a source reduction activity known as grasscycling. Mowing the lawn every 4 - 5 days during the spring and summer, and once a week in the late summer and fall allows effective grasscycling to take place (Olds College Composting Technology Centre, 1995). Cutting no more than one-third of the grass blade, to a maximum of 2.5 cm, along with maintaining grass height at 5 - 7 cm is important (Dickson et al, 1991; Olds College Composting Technology Centre, 1995). Grass clippings filter to the ground and act as a slow release fertilizer by naturally decomposing in approximately 3 days (City of Clagary, 1995d). This time frame

however, can vary with different climates. It is estimated that this practice can save roughly one fertilizer application per year (USEPA, 1992). Contrary to popular belief, grasscycling does not cause thatch since grass clippings decompose quickly as they contain up to 90% water (wet weight) and only small amounts of lignin (USEPA, 1992).

Grasscycling can take place with both conventional and mulching lawn mowers; rebates can act as an incentive for residents to purchase the latter. In 1996, Arlington County, VA promoted a grasscycling pilot project based on lawn mower rebates. Rebates were granted in the following amounts: $118 for purchase of an electric mulching mower, $79 for a gasoline powered mulching mower that meets stringent emissions standards, and $39 for a manual reel mower (Read and Korot, 1996). Since electric and reel mowers do the most to alleviate air quality problems their rebate as a percentage of the average purchase price was higher than gasoline mulching mowers (Read and Korot, 1996). This program proved to be popular beyond anyone's expectations as the funding for the rebates was depleted in less than a month (Read and Korot, 1996). A follow-up survey, returned by 80% of the program participants, indicated encouraging results: 79% had previously owned nonmulching mowers, 59% had previously owned high emission mowers, 46% retired their old mowers early because of the rebate, and more than half of the participants had previously bagged their clippings for all or part of the growing season (Read and Korot, 1996).

Mulching

Mulch is considered to be a blanket of organic or inorganic material that is placed at varying depths over the soil and around the roots of plants. The use of residential yard waste mulch as "soft paving" for pathways and play areas, and around plants in the garden is another form of source reduction. Benefits of mulching include the following (Campbell, 1991):

- Reduction of water loss from the soil;
- suppression of weed growth;
- protection from soil temperature extremes;
- stabilizes and improves the soil;
- promotes healthier plants;
- increases nutrient availability;
- decreases dependence on chemical herbicides; and,
- excellent way to reduce and recycle yard waste – decreases the need to be managed (collected and disposed) by the municipality.

Yard waste organic mulches (e.g. grass clippings, leaves, leaf mold, and chipped branches) act as slow release fertilizers for trees and shrubs. Ideally mulch should be applied thick enough to inhibit weeds without depriving the soil of oxygen. For winter coverage in Calgary, AB mulch should be 6 cm - 10 cm deep for tree and shrub beds, and 4 cm - 6 cm deep for perennials (Balzer, 1997). Wood chips are excellent for path and play area material since they decompose slowly and cushion the surface of the ground. The advantages and disadvantages of specific yard waste mulches are discussed in Table 16.

Yard Waste Organic Mulches	Recommended Depth	Advantages	Disadvantages
Grass Clippings	2.5 cm at a time	Readily available. Best used in small areas	May contain weed seeds. Heat up and create offensive odour if not dried first.
Leaves and Leaf Mold	5 cm – 10 cm	Lets water in and keeps it in. Holds soil. Readily available at little or no cost. Should be partly rotted before application. Improves the water-holding capacity of soil. One of the best mulches for trees, woody perennials and wildflowers.	When used exclusively can pack too heavily when applied over herbaceous perennials and may cause injury. Harbor insects, diseases, weed seeds and rodents. Nitrogen needs to be added. Matting may lead to run-off of water. Can be a fire hazard.

Table 16 continued on the next page

Table 16 continued

Yard Waste Organic Mulches	Recommended Depth	Advantages	Disadvantages
Partially Decomposed Compost	5 cm – 10 cm	Readily available (garden and kitchen waste). Minimal cost other than labour and storage. Holds some water itself, but is excellent at holding water in the soil.	Needs to be stored and aged on or near the site. Is unsightly and bulky during storage. Takes time to collect compost. Many have weed seeds.
Pine Needles	5 cm – 7.5 cm	Inexpensive, easily applied and gives favourable appearance. Increases water-holding capacity of soil. Decomposes adding humus to the soil and increases soil acidity, which helps acid loving plants.	Not always available. Lasts for only a short period of time.
Wood Chips	7.5 cm – 10 cm	Lets water in effectively. Keeps weeds down. Improves water-holding capacity of the soil. Many sizes available but the largest and smallest should be avoided.	Breaks down and disintegrates in a year or two, depending on the source of wood and type. Small sizes break down quickly and will require the addition of nitrogen to replenish what they initially took from the soil.

Table 16: Organic Mulches
(Ellefson, Stephens and Welsh, 1992)

Summary

By implementing one or more of these source reduction programs municipalities can make significant headway in decreasing the amount of yard waste that must be managed. To ensure positive results it is important to develop programs that are interesting, convenient, and inexpensive to residents.

CHAPTER 5: RESIDENTIAL YARD WASTE COLLECTION STRATEGIES

A wide variety of collection strategies are available for municipalities to select from when developing a yard waste diversion program. Climate, the length of the growing season, type of yard waste material, convenience for the public, and level of interest displayed by residents all influence yard waste collection decisions. For instance, municipalities in temperate regions may have year round collection while other municipalities may be looking at seasonal collection.

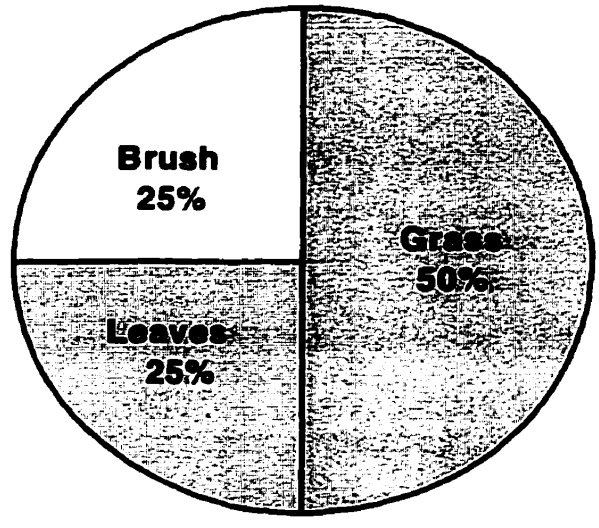
Residential yard waste is collected at the curb or at drop-off locations (Table 17). Curbside collection occurs when the municipality or a private hauler picks up yard waste materials directly from the household. Drop-off sites, on the other hand, involve residents voluntarily delivering their yard waste to a designated location. The latter option tends to have lower participation rates and the former is generally more expensive (Richard et al, 1990). High curbside costs can generally be justified by a municipality since more yard waste is diverted from traditional disposal facilities (Richard et al, 1990).

Yard Waste Collection Option	Advantages	Disadvantages
Curbside Collection	• Higher residential participation rate	• High capital and operational costs
Drop-off Locations	• No charge to residents • Smaller capital investment • Less effort • Residents responsible for delivering and possibly unloading yard waste at site	• Less personnel than curbside collection • Unwanted refuse may appear without supervision

Table 17: Curbside Versus Drop-off Collection (Richard et al, 1990)

Yard Waste Materials

Leaves, grass clippings, and brush are the dominant yard waste materials. The United States Environmental Protection Agency (1997a) indicates that yard waste composition is 50% grass, 25% leaves and 25% brush (Figure 3). Christmas trees, garden waste, sod, tree stumps, weeds, and wood waste may also be included in yard waste collection; in many cases kitchen waste may be collected as well.



Note: Numbers can vary widely according to climate and geographical location.

Figure 3: Estimated Composition of Yard Waste (by weight) (USEPA, 1997a)

Leaves

Residential source reduction options for leaves centre on backyard composting and mulching. If leaves are included in a municipal program they are generally collected in a seasonal operation, normally during the fall. The frequency of collection among municipalities may vary from weekly pick-up to only one pick-up during the fall. Collection frequency depends on the volume of leaves as well as

time and budget constraints. Leaves can be collected in a variety of ways, options include: bags, containers, and/or loose-leaf pick-up. Leaves left in plastic bags for an extended period of time may develop potent odours. Rear/side loader compactors, street sweepers, and vacuums all aid in leaf collection.

Grass Clippings

Grass clippings represent another significant seasonal operation, generally from April to October. Due to high nitrogen and moisture content grass clippings decompose quickly (Strom and Finstein, 1994). Oxygen rapidly depletes and clippings become anaerobic resulting in strong odours when they are sealed in bags for several days (USEPA, 1995). Both composting facility workers and neighbours may find these odours unacceptable when the bags are opened (Richard et al, 1990). The anaerobic nature of grass clippings poses a significant challenge for yard waste managers when they are trying to site a composting facility.

Residential source reduction options for grass clippings include backyard composting, grasscycling, and mulching. If grass is included in a municipal program there are several options available, firstly, perforated plastic bags (allows air movement to reduce anaerobic odours) and secondly, plastic containers (e.g. bins and carts). The latter are durable but must be small enough to be handled by collection crews when the grass clippings are heavy. Organic carts have perforations in the lid and sides to assist with ventilation by supplying a steady amount of oxygen to the yard waste and allowing the moisture to escape. A stainless steel grate at the cart floor allows for continuous drainage of water.

Residents are likely to mow their lawn over the weekend, therefore, scheduling yard waste collection early in the week is essential in order to eliminate the odour concerns that are associated with grass clippings. If clippings get to the compost facility quickly they can be mixed with a porous, high carbon material such as chipped brush or partially decomposed leaves to reduce anaerobic odours.

Brush

Brush is generated primarily during the spring and fall. Since it does not readily compact, curbside collection can be difficult if diameter and/or length restrictions are not established. Brush collection can be on a monthly basis or there may be specific brush collection days in order to consolidate the number of collection trips. Ideally brush should not be mixed with grass and leaves during collection without first being cut into smaller pieces (USEPA, 1995). It can either be chipped by a mobile unit on the collection route or it can be taken in bundles to a central site for chipping (USEPA, 1995).

Curbside Collection Options

Residential curbside collection offers the advantage of higher participation rates than drop-off sites; the convenience alone encourages residents to take part (USEPA, 1995).

Frequency of collection depends on several factors, type and amount of yard waste, size of the municipality, and budget (USEPA, 1995). Collection can vary from weekly year round service to once a month during the fall. Weekly collection, on the same day as regular refuse collection, usually has greater participation rates than monthly pick-ups (Richard et al, 1990). If yard waste and refuse collections are on the same day residents are less likely to forget to set out their yard waste. Separation of yard waste from residential refuse is essential if both are to be collected on the same day. Some options include separate yard waste collection vehicles and compartments in co-collection vehicles. Separated yard waste materials can be combined in the same

collection vehicle with curbside recycling efforts if colour coded bags are used for specific materials.

Selection of equipment for a curbside collection system is full of trade-offs (Table 18). Derrick Bellows (1998), Solid Waste Manager at the City of Regina states that automatic systems have far superior service whereas manual systems have superior control of the collected material. With a fully automated system there is definitely an increase in the efficiency of collection, at the same time though, the refuse is not observed for the possibility of contamination (e.g. cans and bottles).

Bags, containers, bundles, and loose collection are all set out methods for curbside collection. It is clear that the collection method will influence other aspects of the composting process, for instance, the use of plastic garbage bags may degrade the quality of the compost as plastic pieces may remain in the finished product. Researching the cost for processing and bag disposal (if applicable) is necessary when selecting a particular set out method. In addition, both climate and geography are factors that should assessed when examining yard waste curbside collection alternatives.

Collection Equipment	**Advantages**	**Disadvantages**
Dump Truck	• No specialized equipment • Workers can monitor refuse for contamination	• Small quantity per load without compaction • Increased collection costs
Compactor Truck		
Empty Bag into Compactor	• Best opportunity for removal of unwanted refuse • Efficient dumping into windrows	• Inefficient use of compactor
Empty Bag at Composting Facility	• Efficient use of compactor	• Inconvenience in emptying non-degradable bags

Table 18 continued on the next page

Table 18 continued

Collection Equipment	Advantages	Disadvantages
Semi-Automated Truck	• Allows crew to observe and monitor materials to minimize contamination • Reduces the number of work related injuries • Limits residents to the amount of refuse they can produce • Keeps curbs and back lanes cleaner	
Fully Automated Truck	• Most efficient option • Reduces work related injuries • Requires only one worker	• Possibility of more contamination in yard waste • Large capital expense

Table 18: Curbside Collection Equipment for Bags and Containers (Richard et al, 1990)

Bagged Leaves and Grass

Plastic, biodegradable plastic, and paper bags are all options that exist for handling leaves and grass (Table 19). Yard waste can be set out in plastic garbage bags or clear plastic bags that are debagged at the pick-up site or at the compost facility. Leaves and grass can also be collected in biodegradable plastic bags or kraft paper bags that decompose and become part of the compost. Overall, a bag system tends to be a neater more efficient operation with less chance of containing non-compostable material when compared to loose collection (USEPA, 1995).

Bag Type and Cost	Advantages	Disadvantages
Plastic Bags Garbage Bag $0.20 /bag Clear Plastic Bag $0.30 /bag	• Inexpensive • Readily available • Public acceptance • Use of clear bags allows crews to monitor waste materials • Opportunity to hand separate out non-compostable debris when bag is emptied • Blue bag already has recycling education instilled in public • "Limitless" volume • One-way trip to the curb • Easy handling for residents and crews • Increased litter control (bag closes) • Odour control • Less space required to store bags • Lifting bag from snow bank is not particularly difficult • Reduced amount of time collection vehicles spend on routes because the yard waste is already separated and easily handled by collectors (also true for other bags)	• High cost of debagging • Possible shortage of labour for emptying bags • Prone to tearing and puncturing, resulting in waste being scattered in the street • Odour concerns with grass clippings becoming anaerobic; some facilities ban the use of plastics • Poor quality compost if leaves are not debagged immediately • Slow and labour intensive to unload, open bags and to windrow • Extra processing step, screening plastic out after composting is completed • Litter problem during composting process, plastic pieces blow away • Plastic may remain in compost end product, reduces marketability • Disposal of empty plastic bags
Kraft Paper Bags $0.40- $0.70 /bag	• Does not need to be removed, decomposes about the same rate as compost • Can breathe, grass does not go anaerobic • Ease of unloading and windrowing • Excellent quality compost • Uses existing equipment • Lowest labour cost of bag collection systems • One-way trip to the curb • Additional holding strength over lightweight plastic bags	• More expensive than plastic bags • Bulky to store • Availability and distribution of bags • In wet climate tends to soak and weaken bags • Difficult to maneuver when full • No way to seal bags to stop spilling • Conceals bag contents (including undesirable material) • Shredding may be required • Possibility of slight increase in time needed for composting

Table 19 continued on the next page

Table 19 continued

Bag Type and Cost	Advantages	Disadvantages
Biodegradable Plastic Bags $1.20 /bag	• Supposed to degrade by microbial action or in the presence of sunlight, eventually becoming part of the compost • Convenience in bagging • Clear bags reduce the probability of debris and mixed solid wastes • One way trip to the curb • Easy to carry to curb • Increased litter control (bags seal shut) • Odour control	• High cost of bag • Availability and distribution of bags • Degrade far to slowly • Plastic can remain in end-product, even when shredded • Extra processing step, screening out plastic • After composting is completed possible negative impact on finished compost quality

Table 19: Curbside Collection Options for Bagged Yard Waste (Bull, 1994; Richard et al, 1990; USEPA, 1995)

Plastic Bags

Plastic garbage bags are inexpensive and readily available. However, the convenience of this collection method can be outweighed by the fact that the bags must be removed from yard waste at some point before the compost is processed and marketed. This may take place at the pick-up site, at the compost facility before the yard waste is mixed into the compost, and/or before the compost is marketed. Strom and Finstein (1994) strongly recommend that plastic bags be removed before delivery of the material to the composting site. In New Jersey, facilities are required to empty plastic bags before windrow formation and must properly recycle and dispose the bags (Strom and Finstein, 1994). Debagging and bag disposal can be extremely expensive and should be considered when estimating the total cost.

Biodegradable Plastic Bags

Over the years biodegradable plastic bags have received a great deal of public attention (Richard et al, 1990). Some bags are based on natural (cornstarch) additives that are inserted into polymer chains and are digested by microorganisms while other biodegradable plastic bags have an ultraviolet

accelerator that allows ultraviolet rays to energize and breakdown special linkage molecules (Richard et al, 1990). Both of these additives allow long plastic polymer chains to break apart and begin the process of physical and chemical reduction (Richard et al, 1990).

Actual biodegradation of these plastics is generally far too slow to be compatible with composting. In many cases biodegradable plastic bags must be broken apart to expose the yard waste to water and air in order to start degradation. These bags may take several years to decompose and minute fragments can still be visible at the end of the composting process. Quality issues arise when marketing the final end product as soil scientists believe that these fragments accumulate in the soil and hinder both microbial and plant growth (Garnham, 1997).

Colour Coding Plastic Bags

Since a variety of colours are available for plastic bags, colour coding waste streams can be part of the collection system. For example, blue bags for recyclables, green bags for organics (yard waste and kitchen waste) and black bags for refuse. Coloured bags make it easier for residents to place the proper material in the correct bag and for sorting at the processing facility. It is important that non-toxic ink is used as this avoids possible end product contamination (Richard et al, 1990). For yard waste, clear plastic bags have the advantage of letting the collector view the contents for any undesirable debris that may be readily visible.

Kraft Paper Bags

Kraft paper bags are more expensive than plastic bags (Richard et al, 1990). However, they do not have to be removed as they decompose at roughly the same rate as compost feedstock (Strom and Finstein, 1994). With wet strength paper (increases strength when wet) kraft bags are sturdy enough to withstand rain and snow when placed on the curb, yet they decompose in the compost pile.

Ideally, paper bags should be torn apart during compaction by front-end loaders or other equipment at the compost site. If kraft paper bags are not initially broken it may take a few extra months to produce a finished compost as unbroken bags limit air and water movement in the windrows (Richard et al, 1990).

Open/Closed Containers (Bins, Boxes, Carts, and Garbage Cans)

Containers can be picked-up by manual, semiautomatic or automatic collection systems. Table 20 discusses the advantages and disadvantages of collecting yard waste in containers. Overall, containers tend to be neater and more efficient than loose collection, they are a one time expense, and are constantly reused. In many cases yard waste stickers are placed on garbage cans and boxes for identification.

Containers-Open/Closed and Cost	Advantages	Disadvantages
Boxes & Cans $0 - $31 /container Bins & Carts $63 - $134 /container	• Reusable • No debagging required • Allows for aesthetically pleasing storage of yard waste while awaiting collection • Time that yard waste spends in anaerobic conditions is often minimized since yard waste is emptied from the bin and transported unbagged – in turn reduces odour problems • Closed containers are animal proof	• Odour concerns (closed containers) • Litter control concerns, light items may blow down street (open containers) • Initial cost is expensive (bins and carts) • May require extra collection time to empty containers and collect yard waste • Wet yard waste freezes in containers during cold spells • Over time the inside of the container gets messy, especially with wet waste – requires periodic washing • Elderly and infirm may have difficulty handling containers

Table 20: Curbside Collection for Containerized Yard Waste (Bull, 1994; Richard et al, 1990; USEPA, 1995)

Colour Coding Containers

A variety of colours are available on the market for bins and carts. This is particularly important when a municipality is considering adopting a co-collection system. For example, households in Temecula, CA each receive 3 – 227 L bins for weekly collection: blue bins collect recyclables, green bins collect yard waste, and black bins collect refuse (Steuteville, 1993). Three one-person automatic trucks with mechanical arms follow each other down the street, each collecting specific coloured bins (Steuteville, 1993).

Cost for Bags and Containers

Some municipalities may absorb the cost of yard waste bags and containers through their solid waste budget by measuring the cost against the ease (and savings) in collection and processing (Richard et al, 1990). Others may sell them to residents at full-cost or at a discounted price (Richard et al, 1990). If yard waste bags/containers are sold to residents to recover the cost, appropriate incentives to purchase them need to be provided, if not, yard waste is likely to end up mixed with refuse. Today, with the United States Environmental Protection Agency promoting Pay-As-You-Throw Programs (USEPA, 1997b), numerous municipalities are charging by the bag/container for refuse collection and disposal. This may lead to refuse being hidden in yard waste bags as a cheaper means of disposal. To minimize this problem possible solutions for municipalities include implementing an ordinance banning refuse in yard waste, invoking a rule that only separated bags will be collected, and/or stating that only clear plastic bags can be used for yard waste disposal.

Loose Leaves

Bulk collection of loose leaves (when residents rake their leaves to the curb or street) is most frequently used during the fall when large volumes of leaves are generated (Table 21). Mechanical loose-leaf collections are long and labour intensive, and may require the municipality to purchase new equipment (USEPA,

1995). When compared to the collection of bagged leaves, loose-leaf collection takes longer (Richard et al, 1990).

Location of Piles	Advantages	Disadvantages
In Street	• Most convenient for collection in absence of parked cars	• Danger to children playing in leaves • Danger of fire from catalytic converters • Either raking or repeated collection if cars are parked on the street (depends on equipment selected) • Possible contamination of leaves by oil residues • Need street sweeping for final clean-up (depends on equipment selected)
Curbside	• Avoids problems associated with leaves in the street	• Raking of leaves by collection crew, especially when collection is by front-end loader

Table 21: Curbside Collection Options for Loose Leaves (Richard et al, 1990)

Table 22 discusses the advantages and disadvantages of several bulk collection equipment options. Vacuum trucks use a hose to suck leaves into the truck but are ineffective when the leaves become wet or frozen. Front-end loaders can be used to lift leaves from the street and put them into an open truck but are not effective with dry leaves. A specialized "claw" attachment or street sweeper can also be used to collect leaves from the curb.

Collection Equipment	Advantages	Disadvantages
Vacuum Leaf Collector With discharge into wire or mesh covered box or dump truck or trailer	• Fast under ideal conditions • Leaves partially shredded and compacted especially if somewhat damp • Ease of unloading • Eliminates need for street sweeping • Allows leaves to be picked up around parked cars	• Ineffective when excessively wet or frozen leaves become clumped • Noise • Moderate expense • Dust if dry • Specialized equipment • Leaves on street awaiting collection
Front-end Loader and Dump Truck	• Specialized equipment optional • Effective with wet and/or frozen leaves • Increased efficiency if front-end loader works with claw attachment and final cleanup sweeper • Moderate labour costs • Produces relatively uncontaminated compost	• Requires that leaves be raked into the street • Inefficient with dry leaves • Possible need for street sweeping afterwards • Requires alternate side of street parking • Leaves on street awaiting collection
Front-end Loader and Compactor Truck with chute for receiving leaves	• Same as above, except effective capacity is much greater with a compactor	• Same as above
Street Sweeper	• Low labour costs • Uses existing equipment • Ease of unloading	• Leaves on street awaiting collection • Risks contaminating compost with motor vehicle exhausts, oil and debris • Requires alternate side of street parking

Table 22: Collection Equipment for Loose Leaves (Richard et al, 1990)

While loose leaves do not need to be debagged, operators must check for contaminants (e.g. cans, bottles, and paper) that may have been collected with the leaves. If yard waste is heavily contaminated with such debris, it is difficult to process and market the finished compost. Other concerns inherent with loose-

leaf collection include, dry leaves catching on fire from hot vehicle exhaust systems and collection difficulties after children have played in the leaves (leaf size breakdown). Loose-leaf collection saves residents the costs associated with bags, but the increased time and costs of loose collection can reduce the number of pick-ups a municipality can afford (Richard et al, 1990).

Bundles

Since brush does not readily compact, size (diameter and length) restricted bundles tied with twine or string may be required. A municipality may develop specific brush collection days in the spring and/or fall or may collect brush on a monthly basis.

Drop-off Locations

With drop-off collection residents are responsible for transporting yard waste to a collection site. This however, results in lower participation than with curbside systems (USEPA, 1995). Drop-off sites can complement a residential curbside collection program by providing a location for landscapers to deliver yard waste as it is generated, they also collect off-season residential yard waste.

Drop-off depots can be located at, but not limited to, landfills, transfer stations, composting facilities, city parks, public works buildings, and community centres. Collection trailers are another option, they can be left in communities for a set period of time and then rotate to other drop-off sites (Richard et al ,1990). It should be noted that supervision for these sites is essential in order to deter unwanted refuse from appearing in the yard waste material.

Public convenience is important for any drop-off collection program to succeed. For example, residents could drop-off their yard waste at one area then pick-up finished compost at another area. By offering incentives such as no residential tipping fees and reduced rates for "clean green waste" to the commercial sector more individuals may participate.

Debagging

Separating non-biodegradable plastic bags from yard waste is a major issue affecting Canadian yard waste programs (McCartney, 1996). Debagging can be time consuming and expensive, and there is the possibility that some plastic will remain in the finished compost product thereby decreasing its value.

Plastic bag removal can take place at either the source (curbside or drop-off location), a transfer station, or at a central composting facility. Debagging manually by hand using a utility knife is one option; it is an unpleasant job that gets worse the longer grass and leaves are bagged. The most efficient method is for residents to leave bags open for collection crews (McCartney, 1996). This can lead to litter control problems if the bags are left for an extended period of time. Hence, residents must be aware of their yard waste collection day and haulers must regularly collect the open bags.

Semi-automated and fully automated debagging machines range in price from $5,500 to $1,020,500 (Ballister-Howells, 1994). Before a municipality purchases a debagging system the following factors should be considered: existing collection systems, labour costs, current processing equipment, facility capacity, type of waste, end-product markets, and budget (Ballister-Howells, 1994).

Shredding and screening prior to processing removes most of the plastic but often requires municipalities to purchase additional equipment. During the composting process facility operators must be careful as windrow turners will collect pieces of plastic on their drums which can result in the bearings overheating (Richard et al, 1990). Since bits of plastic may remain in the finished compost, screening is necessary before the product can be marketed.

Municipalities can decrease operational costs by requiring residents to debag yard waste at the drop-off locations and take the empty bags back. Both public

education and drop-off site supervision is necessary to ensure that individuals debag their yard waste.

Scheduling and Public Notification

Communication with residents is essential for yard waste diversion programs to be successful. Advance notification is particularly important for seasonal programs such as leaf, brush, and Christmas tree collection. Notice of collection dates, instructions on how the yard waste should be handled, and where it should be placed are achieved in several ways (Richard et al, 1990):

1) Notify media about the program by using news releases, public service announcements, and community calendar announcements. Municipal staff can write articles to be printed in local newspapers and community newsletters.

2) Publish a map with designated areas and tentative collection dates based on favourable weather conditions.

3) Distribute information sheets describing projects in detail and general information about the composting process. This material should be presented in a nontechnical language that is easily understood. These sheets can be mailed out upon request and can be distributed at municipal events.

4) Develop a poster to publicize the program (consider that many stores will not want to display large posters in their windows so it may be wise to print small posters).

5) Direct mailing campaigns, include brochure with map and schedule of pick-ups for each neighbourhood. Residents can also be notified in their utility bills.

6) Broadcast radio public service announcements giving the locations and operating times of each collection point.

7) Post notices on area streets before collection (check whether local laws prohibit posting signs before planning a sign campaign).

High public awareness of collection procedures will help minimize the likelihood of unwanted material being collected. It also helps to eliminate the possibility of yard waste dispersing into storm drains or sitting on the street long enough to become an odour concern.

Summary

The proper collection system is an essential component of a municipal yard waste diversion program. How the yard waste material is handled has direct bearing on the quality of the finished compost product. Since collection can be one of the most expensive aspects of a yard waste diversion program, the proper collection system affecting workers, equipment, and processing should be thoroughly researched before hand. Public acceptance and participation are important considerations when developing a yard waste collection system.

CHAPTER 6: COMPOSTING

Compost topics that are pertinent to this research include the benefits and potential disadvantages of composting along with end markets. This chapter contains a detailed discussion for each of these subjects. For further reading on the composting process and central composting options consult Gouleke (1972), Richard et al (1990), Strom and Finstein (1994), and the Cornell University Cooperative Extension compost website (http://cals.cornell.edu/dept/compost/).

Compost Benefits

Compost is considered to be a soil conditioner rather than a fertilizer. Unlike chemical fertilizers, compost has a built-in time release mechanism from which both soil and plants benefit. At the municipal level, composting increases the amount of waste that is diverted from landfill disposal thus conserving landfill space.

Improvements to the Physical and Chemical Characteristics of Soil

Compost fundamentally changes the nature of soil by altering its structure and adjusting its chemistry (Table 23). It also helps to restore compacted and sterile soil so that it may be converted into a rich organic soil.

Soil Property	Application Rate (Tonnes/acre)	Changes in Property
Organic Matter	16 – 132	6 - 163% Increase
Water Holding Capacity	6 – 132	5 - 43% Increase at atmospheric pressure
Bulk Density	18 – 132	4 - 71% Decrease
pH	18 – 132	0.8 - 1.4 Increase
Cation Exchange Capacity	52 – 207	31 - 94% Increase

Table 23 continued on the next page

Table 23 continued

Soil Property	Application Rate (Tonnes/acre)	Changes in Property
Macroelements	18 – 132	2 - 136%
Trace Elements	16 – 405	0 – 500% Increase

Table 23: Effects of Municipal Solid Waste Compost Application on Chemical and Physical Soil Characteristics (McConnell et al, 1993)

Improves Soil Structure

Soil structure can be improved by applying mature compost. Normally clay soils become waterlogged which prevents both air and water filtration. With the addition of compost aeration and water filtration can increase between the finely packed clay particles. Sandy soil particles are coarser, larger, and lighter. Excessive space surrounding these particles allows water and nutrients to flow straight through them quickly. Compost can remedy both of these soil conditions by encouraging soil aggregate formation.

The amount of space surrounding a soil particle effects how well a plant roots (Ball, 1997). It also effects how much air, nutrients, and moisture the soil can make available to plant roots (Ball, 1997). Loam soils are desirable as soil particles have enough space to store air and water. Compost improves soil by increasing its water holding capacity yet it allows the soil to drain well; it is highly beneficial in areas that are prone to droughts. Martin and Gershuny (1992) note that compost soaks up water like a sponge – 45 kg of humus holds 88 kg of water.

Related to soil structure is the fact that compost application can help prevent erosion. Dr. E.P. Dark is quoted in Martin and Gershuny (1992, p. 19) to say:

> Nearly all erosion is only the end result of a progressive loss of fertility; really fertile soil is very resistant to erosion, particularly wind erosion, being bound together by its organic content into what is known as crumb structure.

Soil structure and fertility increase with the addition of compost, thus preventing soil erosion (Martin and Gershuny, 1992).

In 1993 Portland, OR implemented an erosion control demonstration project that showed how medium and coarse yard waste, and leaf compost can be used for conventional erosion prevention (Metro Solid Waste and Planning Departments, 1994). Results indicate that stable mature yard waste compost proved to be an effective alternative to conventional erosion techniques on slopes up to 42% (Ettlin and Stewart, 1993). It also proved to be very economical when used at the toe of a slope (Ettlin and Stewart, 1993). The California Department of Transportation is currently using compost for highway erosion control projects. Greater public concern of health risks from chemicals, greater availability of low cost compost and mulches resulting from the state's waste reduction goals, and the emergence of mechanical spreading equipment are all reasons for compost utilization (Haynes, 1997). It is anticipated that compost, "especially in hydroseeding applications, will soon replace much of the fiber that is currently in use in the industry" (Haynes, 1997).

Adjusts Soil Chemistry

Compost improves soil chemistry as well. Mixing compost and soil results in an elevated cation exchange capacity (CEC) which in turn keeps nutrients in the soil and decreases the chance of leaching (McConnell et al, 1993). Mays and Giordano (1989) have noted that high application rates of compost increase the CEC, while low application rates do not change, or had minimal effect on CEC.

Soil pH can change with the addition of compost. The availability of nutrients, in particular macroelements, affects soil pH. If compost is added to acidic soils it will increase the pH and reduce or eliminate aluminum and/or manganese toxicity

which can develop when soil pH is below 5.5 (McConnell et al, 1993). In general compost is neutral to slightly alkaline, this benefits both plants and soil organisms (McConnell et al, 1993). A large variety of plants grow at a pH close to 7 (Burnett, 1991). Earthworms that aerate the soil, improve soil structure, and add rich mineral content with castings prefer a neutral pH as well (Burnett, 1991).

Neutralizes Soil Toxins

Compost has the ability to neutralize soil toxins. Kirkham as cited in Martin and Gershuny (1992, p. 25) states that:

> The ability of soil organic matter to hold heavy elements necessary for plant growth for a long time, and release them as needed to crops, is one of the most important benefits derived from its presence in the soils.

This observation was tested and verified by Portland's erosion control demonstration project which reported that compost reduced heavy metal run-off from soils with high heavy metal content (Ettlin and Stewart, 1993). Compost can also help reduce pollution from nutrient run-off and nitrates leaching into the ground water (Haynes, 1997).

Increases Microbial Activity

A large variety of microorganisms are responsible for decomposing organic material in the composting process. They play a vital role in providing food and air to plants during the liquid and gas phase. Fungi, bacteria and other microbes accelerate the conversion of nitrogen, phosphorus, calcium, boron, and many trace metals and nutrients into gas and liquid states (Ball, 1997). Bacteria, found in simple compost piles also manufacture antibiotics which attack disease pathogens in the soil (Ball, 1997).

Provides Nutrition

Compost adds nutrients to soil and plants. It can be viewed not only as a source of nutrients but as a storehouse since naturally occurring nutrients are released

at a slow rate so that plants can optimally use them for growth over a extended period of time. In contrast, nutrients applied as fertilizers are frequently leached out of the soil as plants cannot use large doses of unbound fertilizers (Burnett, 1991).

Buffers Extremes of Soil Temperatures

Compost can be used as mulch to insulate soil from extreme summer and winter temperatures. During the summer root growth will cease if the soil temperature exceeds 29°C (Ball, 1997). A compost mulch will aid in decreasing the soil temperature by 9°C - 14°C thereby enabling plants to grow and produce (Ball, 1997). In the winter most plant roots will not grow unless the soil temperature warms to at least 18°C (Ball, 1997). During cold periods the dark colour of compost helps to absorb heat and stimulate plant growth.

Improvements to Plant Growth

The healthier the soil the more likely plants will vigorously grow and develop. If vegetation is improperly planted, for instance in shaded areas or in poor soil, plant growth may be minimal at best. With the addition of compost, site stresses will reduce and plant vigor will dramatically improve.

Reduces Insect Pests

A basic biological diversity (predator-prey relationship) exists in a healthy soil where soil organisms that prey on pest insects and larvae would otherwise harm plants. Ball (1997) states that compost adds fatty acids to the soil which are effective in combating certain pests such as root nematodes.

Fights Plant Disease

Soil contains viruses, bacteria, and fungi that help in the decomposition of organic material. These disease-fighting organisms tend to be more abundant in lower-temperature compost produced in a simple pile (Ball, 1997). Compost also helps to control diseases when it is used as a mulch; a layer of compost under a

plant absorbs raindrops that may spread fungal diseases like powdery mildew (Ball, 1997).

Improves Plant Colour

Both magnesium and nitrogen from the soil are used to synthesize chlorophyll. Since plants that grow in compost have a steady supply of these minerals they tend to be more richly coloured than those grown without compost (Burnett, 1991).

Discourages Weeds

If used as mulch, compost can cover weed seeds that require sunlight to germinate.

Potential Disadvantages of Composting

Composting accomplishes most of the things that environmentally minded people like to see, however, it is not problem free. Major drawbacks include odour generation, leachate and toxic contamination, the possibility of facility workers contacting *aspergillus fumigatus*, and potential animal attraction.

Odour

Even at simple leaf composting facilities strong odours can develop. With the addition of grass clippings the odour concerns are greatly intensified. Dimethyl disulphide, ammonia, and hydrogen sulphide present in composted organic waste can result in the generation of potent odours at one stage or throughout the entire composting process: mixing, processing, curing, and storage (USEPA, 1995). In order to prevent unpleasant odours a solid understanding of the characteristics of the feedstock as well as a thorough knowledge of the basic principles of the composting process must be established (Savage and Diaz, 1993). It is necessary to examine odour prevention and control measures during site planning as odours can potentially be a very serious problem that may eventually lead to facility closures.

Ideally, preventing initial odour formation is the best solution. This can be achieved by avoiding prolonged anaerobic conditions that cause severe odours. Aerobic conditions result in a mild earthy odour, but with the addition of high nitrogen content feedstock (e.g. grass clippings) ammonia odours may arise. Yard waste collection scheduled early in the week can alleviate this concern as it will decrease the amount of time that grass clippings are held in closed bags/containers. The following facility procedures can help decrease odour concerns during the compost process (USEPA, 1995):

1) Ensuring that windrows are formed promptly once yard waste material is collected.

2) Forming windrows that are small enough to allow oxygen penetration from the outside. This reduces the formation of an anaerobic core (common in large windrows). Windrows must be large enough so that the interior reaches optimal temperatures.

3) Developing a regular windrow turning schedule to mitigate odours.

4) Breaking down piles that are wet and odourous and spreading them for drying.

5) Building a roof over the compost piles to help control the facility temperatures and moisture levels.

6) Avoiding standing pools of water or ponding through proper grading and use of equipment.

A great variety of specialized odour control systems exist on the market today. These systems treat exhaust gases from decomposing organic material when simpler odour control and prevention methods are not successful. Table 24 describes and compares the effectiveness of several odour control technologies.

Technology	Description	Effectiveness
Odour Pile	Odourous gases from composting pile are diverted to flow over finished compost.	Questionable
Biofilter	Controlled application of odour pile approach, incorporating filter media to which microorganisms are attached.	90%+ removal
Wet Scrubbers Packed tower Mist scrubbers	Odourous compounds are absorbed into a liquid then extracted with chemicals.	Up to 70% per stage. <90%
Adsorption	Gases are passed over an inert medium to which the odour-causing compounds attach, thereby "cleaning" the gases.	Effective for polishing and control of volatile organic compounds
Dispersion Enhancement Site modification Tall stack	Facilitates greater dispersion of odourous gases.	Moderate Potentially good
Combustion	Gases are captured and odourous compounds burned.	99%+ removed

Table 24: Effectiveness of Composting Odour Control Technologies (USEPA, 1995)

Public Education

Pick (1996) recommends working together with the public through outreach programs. It is extremely important to educate neighbours regularly, especially when times are good; this gives the public realistic expectations of the composting facility performance. By spending time educating the public about the composting process and reassuring them that they can call the composting facility if odour problems arise is an important step towards building support and credibility. If odours develop and public education has not taken place, neighbours are not likely to sympathize (Pick, 1996). Odour problems can quickly become a public health concern, which in turn can become a public relations nightmare.

Leachate

Leachate is a liquid that has percolated through the compost pile, it contains extracted, dissolved, or suspended material. This liquid tends to form when the moisture content of the material is excessively high, >60% - 65% (Diaz et al, 1993). Odour problems, erosion concerns, and water (ground and surface) quality issues arise with leachate run-off and ponding. Even though the composting process reduces pollutant concentrations, a properly matured compost can still reduce water quality (Diaz et al, 1993). Options that can help to eliminate potential leachate concerns include (Diaz et al, 1993; Strom and Finstein, 1994):

- Constructing a cover to shelter the compost piles from unwanted moisture (e.g. rain and snow);
- monitoring and correcting the moisture levels in the composting piles;
- contouring and grading the composting pad so that the leachate can be collected and disposed of at an on-site leachate treatment facility (lagoon) or a sewage treatment facility;
- developing a leachate collection system (e.g. soil or sand barrier constructed to intercept any horizontal flow);
- excavating ditches around the facility to divert run-off around the site; and,
- designing a facility so that windrows run down slope rather than across making it easier for the water to run-off rather than accumulate between windrows.

Yard Waste Feedstock

Leachate from leaf composting is generally not contaminated, but it may deplete the dissolved oxygen in the surface water, possibly to the point where fish kills develop (Strom and Finstein, 1994; USEPA, 1995). The contamination of groundwater does not appear to be a concern with leaf composting, however, grass clippings may pose a severe problem with nitrogen contamination of both surface water and groundwater (Strom and Finstein, 1994; USEPA, 1995). This

type of contamination can be prevented by limiting the nitrogen in the leachate (e.g. control of carbon-nitrogen ratio and minimizing the amount of grass clippings) or by the addition of expensive leachate collection and treatment systems. Through the appropriate yard trimming mix ratios, methodology, and equipment use grass clippings can be successfully composted.

Toxic Contamination

Heavy metals can be found in yard waste that is co-composted with biosolids. Kirkham as cited in Martin and Gershuny (1992, p. 25) states that "organic matter has a high capacity to fix heavy metals", however, excessive amounts of heavy metals can result in contamination. Composting reduces heavy metal toxicity by binding hazardous substances into stable soil aggregates.

The presence of pesticides in grass clippings is also a concern. Generally these levels tend to be low with residential lawns and do not cause any problems (Strom and Finstein, 1994). Feedstocks including grass from golf courses, where intensive use of toxic substances takes place, may require testing for specific metals and pesticides before the material is composted and marketed for public use.

Now that the lead content of gasoline has decreased, concerns over leaf contamination from car emissions during street collection are greatly reduced.

Aspergillus fumigatus

Aspergillus fumigatus is a common bioaerosol that is found in households, potting soil, hay, grain, and vegetative material including grass clippings, leaves, and wood chips. In rare circumstances *aspergillus fumigatus* can affect the health of individuals with weakened immune systems (Maritato et al, 1992). Excessive exposure to these spores can cause allergic problems or respiratory infection to 5% - 10% of the general population (Richard et al, 1990).

Composting facilities with adequate buffer zones minimize the risk of adjacent neighbours coming in contact with *aspergillus fumigatus*. Facility operators on the other hand, can have high levels of exposure (Strom and Finstein, 1994). Studies at composting sites in Connecticut, Maine, Maryland, Ohio, Ontario and Virginia have noted higher concentrations of *aspergillus fumigatus* at compost facilities (Maritato et al, 1992; The Compost Council, 1996a). These concentrations have not resulted in any infection of workers or the surrounding public (Maritato et al, 1992; The Compost Council, 1996a). The following options can help minimize potential *aspergillus fumigatus* exposure (Epstein, 1994; Strom and Finstein, 1994; USEPA, 1995):

1) Screening employees at composting facilities for a predisposition to infection or severe allergies. These individuals should be employed in areas where exposure to dust and bioaerosols are minimal.

2) Spraying water on the windrows to keep the compost moist. This reduces dust emissions which in turn decreases the dispersion of bioaerosols.

3) Using approved respirators and dust masks when conditions are dry and dusty, especially during windrow formation, turning, and screening.

4) Cleaning air conditioner filters in loaders and turning machines regularly.

5) Minimizing dust from enclosed operations through engineering controls such as collection hoods, negative air pressure, and dust generation points.

6) Isolating workers from spore-dispersing components of the composting process such as turning (use tractors and front-end loaders with air-conditioned or heated cabs).

7) Using aeration systems instead of mechanical turning.

Animal Attraction

Animals (e.g. rodents and birds) can be attracted to compost piles for food and shelter, especially if yard waste is co-composted with kitchen waste. If a facility is properly operated this should not be a problem as the kitchen waste is immediately mixed with yard waste once it is dropped-off at the compost facility. Preventative measures include covering the food with a thin layer of soil, leaves,

or sawdust; digging food directly into the pile; and turning the pile to increase the temperature (Roulac, 1997). Cullen and Johnson (1992) note that the hotter the pile, the less likely animals will be attracted. The addition of fences surrounding the facility may help to alleviate this concern.

Compost End Markets

Landfill space can be increased if yard waste is diverted but having vast quantities of compost is not useful unless there is an end market for its distribution. There are numerous uses for compost that ultimately could produce a greater demand than the actual supply will cover. Some of the worst eroded cropland lose more than 14 t of soil per acre per year and it has been estimated that 60 t of compost is needed to add 2.5 cm of soil to an acre of land (Marinelli, 1990). Buhr et al (1993) reports that the demand for compost in the United States is 10 times greater than the potential supply.

Compost can be used to make a piece of land more productive or give it the ability to produce vegetation on mine spoils, former industrial waste lagoons, and land marginal for crops. It can also be used in place of soil for land reclamation projects from strip mines to highway construction and landfill covers. For instance, in Alberta, the landfill capping system requires a minimum of 0.2 m topsoil and 0.35 m - 0.8 m of subsoil (Alberta Environmental Protection, 1996). As soil is both expensive and can be hard to come by compost is an ideal alternative.

Landscapers, greenhouses, nurseries, residents, farmers, and municipal operations are considered to be principal compost users. Landscapers mix compost with soils as a substitute for the more expensive peat moss, they also use it for aesthetic purposes; a dark rich compost is visually pleasing, especially if the soil is a lighter colour or has a poor texture (Epstein and Engel, 1991). Greenhouses and nurseries look for fine grades of compost that can be blended with potting soil mixtures and peat moss, while residents use compost for

landscaping, gardens, and flower beds. Farmers apply compost mixes to fields to improve soil quality by increasing organic matter, reducing erosion, and providing plant nutrients. Municipal use ranges from establishing parks, playing fields, and golf courses to revegetating cemeteries and airports.

Supply and Demand

It is important to know the potential compost end market(s) before composting operations begin, this will decrease the chance of over or under production.

Factors Affecting Supply

Capacity pressures and the high costs of tipping at solid waste disposal facilities have assisted in the development of many yard diversion programs (USEPA, 1993). This has been spurred on by provincial/state governments invoking a variety of yard waste bans at disposal facilities. With the creation of more diversion programs there will be an increase in the compost supply. Knowing the end market prior to compost processing ensures that the appropriate supply of compost will be produced.

Factors Affecting Demand

Product quality and consistency are generally considered the most important factors affecting the demand of compost (USEPA, 1993). A high-quality compost is dark in colour; has uniform particle sizes; an earthy odour; has high concentrations of nutrients and organic matter; no contaminants (e.g. glass, plastic and metal); no weed seeds; and minimal levels of heavy metals, herbicides, pesticides, and other potential toxics (USEPA, 1993). The possibility of toxic contamination is generally not a concern with composted yard waste (USEPA, 1993). In many cases the quality of the end product will determine its end use.

Another factor affecting demand is the availability of compost compared to similar competing products in the marketplace. Bark mulch, potting soils, manure,

mushroom compost, blended soil mixes, peat moss, and vermiculite all have a long history of being reliable, available, and are accepted by commercial businesses and the public (USEPA, 1993). Distance also affects demand, a potential user is more likely to recognize a product that is produced nearby rather than one produced far away (USEPA, 1993).

Quality Standards

Compost quality standards have been developed in both Canada and the United States that stipulate compost end use based on product quality.

Canada

The establishment of quality standards helps to support the long-term growth of an industry. Both the Canadian government and the composting industry have developed compost quality criteria that will ensure product satisfaction and maintain customer confidence. In Canada three quality standards and regulations exist for compost and composting:

- Guidelines for Compost Quality by the Canadian Council of the Ministers of the Environment (CCME);
- *Fertilizers Act and Regulations* by Agriculture and Agri-Food Canada (AAFC); and,
- A National Standard of Canada: Organic Soil Conditioners - Composts by Bureau de normalisation du Quebec (BNQ). This is a voluntary industry initiative.

These standards have established high levels for product quality and safety while setting a national consistency by containing virtually identical technical requirements to facilitate industry competitiveness (The Composting Council of Canada, 1996). Maturity, foreign matter, trace elements, and pathogens are criteria at the centre of these compost quality standards.

Provincial and territorial governments are also responsible for the development of standards and regulations. The standards set by the CCME assist the provinces and territories, however each may have its own separate specifications for compost quality. British Columbia, for example, has its own provincial compost standards which are described in Table 25. It should be mentioned that overall yard waste compost is generally a clean product with minimal contamination.

Compost Categories	Allowable End Uses
Type Y (Yard waste alone)	Unrestricted distribution. May be applied on agricultural lands, in home gardens, horticultural operations, parks, the nursery industry and other businesses requiring a high quality product.
Type A (Mature MSW, foreign matter < or = 1% of weight, metal concentration under Code 1)	Unrestricted distribution. May be applied on agricultural lands, in home gardens, horticultural operations, parks, the nursery industry and other businesses requiring a high quality product.
Type B (Mature MSW, foreign matter < or = 2% of weight, metal concentration under Code 1 or 2)	Only applied to forested land or in parks, or used in non-food applications in the horticultural nursery industry and land reclamation projects with limited potential for public contact.
Type C (Mature MSW, foreign matter < or = 10% of weight, metal concentration under Codes 1, 2 or 3)	Only applied to commercial land, industrial land and land reclamation projects with limited potential for public contact.
Type D (MSW, foreign matter > 10% of weight, metal concentration under Code 4)	Must be disposed of in an authorized landfill.

MSW = Municipal Solid Waste

Note: Codes 1, 2, 3 and 4 are metal concentration classifications for arsenic, cadmium, chromium, cobalt, copper, lead mercury, and molybdenum.

Table 25: British Columbia Compost Categories and Allowable End Uses (British Columbia Ministry of the Environment, Lands and Parks, 1993)

United States

In the absence of specific composting legislation pertaining to yard waste and municipal solid waste composting facilities, the state and local level governments have regulated it under related environmental statutes (USEPA, 1995). Very few states have composting laws that have been fully implemented, but many states are in the process of developing regulations (USEPA, 1995). Florida's regulations governing compost quality, as described in Table 26, are some of the best defined in the United States.

Compost Categories	Compost Characteristics
Type Y	Yard waste as only feedstock; mature or semimature; fine, medium or course particle size; and low foreign matter content.
Type YM	Same characteristics as Type Y composts but can also use livestock manure as feedstock.
Type A	Municipal solid waste (MSW) as the feedstock, mature, fine particle size, and low foreign material content.
Type B	MSW as the feedstock, mature or semimature, fine or medium particle size, intermediate foreign matter content, and low metal concentrations.
Type C	MSW as feedstock; mature or semimature; fine, medium or course particle size; high foreign matter content; and high, intermediate or low metal concentrations.
Type D	MSW as feedstock; fresh; fine, medium or coarse particle size; high foreign matter content; and high, medium or low metal concentrations.
Type E	MSW as the feedstock and very high metal concentrations.

Table 26: Florida Compost Quality Regulations (USEPA, 1995)

Under Florida's regulations for compost quality, distribution of Types Y, YM and A are not restricted while types B and C are restricted to commercial, agricultural, institutional, or government use (USEPA, 1995). Distribution of Type D is restricted to landfills or land reclamation projects with little public contact and Type E is disposed of at solid waste facilities (USEPA, 1995).

Pennsylvania has adopted a case-by-case approach for regulating the quality of municipal solid waste compost (USEPA, 1995). The state requires that a chemical analysis of municipal solid waste compost be performed and submitted to the Department of the Environment before sale and distribution of the material (USEPA, 1995).

Marketing

Many municipalities make a portion of the finished compost available to residents as a thank you for supplying the feedstock. Residents can be made responsible for loading and transporting the product by allowing them to pick it up at the composting facility or another designated location. Commercial bulk users may receive compost at no cost or for a modest fee from municipalities. When private composting facilities are involved, a clause in the contract may stipulate that a certain portion of the end product is returned to the municipality, at no charge or for a minimal fee, for residential and municipal use. Private facilities can also directly charge residents and/or commercial businesses a competitive fee for the product. Proper advertising for compost distribution is essential to both public and private operations.

Bagging Option

Public and private facilities may find it effective to sell the end product, in bulk or bags, to commercial businesses. The highest economic return for compost is through bulk sales, however, bagging compost increases product acceptance and expands the market (Steuteville, 1996). Bagging compost ultimately

advertises for bulk sales as it allows small quantity users to see a name and hopefully, if they like the product, they will come back to buy in bulk.

Summary

The benefits of compost are numerous for both soil and plants. These benefits can help to market the end product as well as possibly persuade residents to implement source reduction options. Even though numerous benefits exist, potential problems during the composting process can arise. Most of these problems can be prevented or minimized by proper facility siting, design, operation, and maintenance. It is important to be aware of the overriding quality standards for the compost end product from the beginning. Determining the end market(s) before composting starts will greatly facilitate the compost operation.

CHAPTER 7: CONCLUSION AND RECOMMENDATIONS

A wide variety of yard waste diversion programs are used throughout Canada and the northern United States, rarely do communities overlap with similar programs as each one has unique characteristics. Many of these programs have been implemented due to yard waste bans at the provincial/state and municipal levels. In some cases composting facilities ban specific yard waste from their operation, this results in municipalities investigating source reduction options rather than curbside or drop-off collection.

At this time the City of Calgary has roughly 50 - 85 years of landfill space available (City of Calgary, 1995b). Through developing and initiating new yard waste diversion programs as well as expanding the current program the City of Calgary is being proactive in diverting yard waste. Not only does this help to decrease the amount of yard waste disposed at City landfills but it also ensures that regular refuse collection routes stay on schedule during the peak growing season.

The following recommendations for the City of Calgary were developed to help expand and complement the yard waste programs that already exist. As well, they are intended to give the City an idea of where further research should take place and which surveyed communities would be appropriate for future case study analysis:

1) To implement formal residential source reduction programs. It is much easier for the City to manage yard waste if there is less to manage in the first place. Encouraging residents to keep yard waste at home will decrease the amount that is disposed.

- Explore the possibility of a subsidized composter bin sale.

- Develop a Master Composter pilot project for a specific community located in Calgary's leaf belt. Contemplate employing a specific Master Composter coordinator to manage this program, or see if there is an environmental group in Calgary that would be willing to help educate the public while the City finances the program.

- Develop literature on yard waste minimization principles. Make it available to the public through the City of Calgary, garden centres and businesses that employ any of the techniques (e.g. Mountain Equipment Co-op). With Calgary's growing population it is beneficial to promote yard waste reduction with water conservation options.

- Consider expanding the backyard composter bin exhibit to include yard waste minimization techniques. Landscape the area using a variety of these techniques, then add various sample backyard composters to the display.

2) To consider expanding the leaf drop-off collection program.

- Explore the possibility of accepting grass clippings and brush.

- With the addition of grass and brush materials, consider lengthening the program time frame from May to early November. Establish 4 residential drop-off sites (one for each quadrant of the City) for collection between May and November, then open the other 23 locations for leaf collection from October to early November.

- Complement the extension of the drop-off program running time by invoking the 5-bag/can residential solid waste limit from May to early November. It is noted that employment labour issues, and health and safety benefits may develop by invoking this recommendation.

- Upon extension of the drop-off program running time and the type of yard waste materials collected, consider dedicating a City employee to operate the composting facilities.

- Investigate the possibility of allowing residents to debag yard waste at the drop-off site.

- Consider the best type of reusable bag/container that could be used as part of the drop-off collection program. Look at subsidized bag/container purchases for residents.

- Sponsor a challenge among the residential leaf drop-off locations to see which one collects that largest volume of leaves.

- During years with unseasonably warm fall temperatures, consider doing a final drop-off site collection 2–4 weeks after the programs has officially ended. This will ensure that all leaf bags are collected before the winter season.

- Look into the possibility of developing signage that removes liability from the City if any accidents occur at the unsupervised drop-off locations (e.g. school children jumping on the piles of bagged leaves).

3) To explore the possibility of a pilot project for loose-leaf pick-up with the vacuum units in mature communities that are not close to drop-off locations (e.g. Willow Park and Acadia).

4) To obtain more precise capital and operating cost data.

- Prepare a detailed, structured set of questions in order to obtain consistent data in future work with costs.

- Consult contact list (Appendices J and K) for individuals who may be able to assist or direct the City of Calgary to personnel who can answer specific questions pertaining to cost.

5) To consider other options for yard waste diversion program promotion and public education.

- Advertise leaf and Christmas tree drop-off programs before the scheduled start date. Use signs, similar to the street cleaning days signs, to notify residents of upcoming program. Set the signs out 4-5 days prior to start date.

- Consider using high profile faces for drop-off advertising campaigns (e.g. Mayor Al Duerr with a bag of leaves at a drop-off location or a Christmas tree at a fire station).

- Develop a mascot or symbol, specific to Calgary, that residents can relate to yard waste diversion programs and other solid waste diversion initiatives. Use in brochures, environmental school programs, and special events.

6) To explore the opportunities for marketing compost and/or giving it to residents. Remember to observe compost quality guidelines.

7) To conduct further research.

- The City of Calgary may wish to consult the following communities for case study research:

    1) Baltimore, MD
    2) Bismarck, ND
    3) Madison, WI
    4) Minneapolis, MN
    5) Ottawa-Carlton Regional Municipality, ON
    6) Ramsey County, MN
    7) Seattle, WA
    8) Vancouver, BC

  All of these communities have established programs that have been in place for a minimum of 3 years to a maximum of 19 years and as such have been through much of the growing pains for program implementation and development. Numerous characteristics, for instance, climate, population, yard waste materials collected, number of drop-off depots potential end markets, and the willingness to share information on their community yard waste diversion programs make these communities appropriate research resources for the future expansion of Calgary's leaf drop-off program (Appendix I). Impressive source reduction programs (e.g. Master Composter and grasscycling rebates) and curbside collection strategies employed by these communities may be off interest to the City of Calgary. Full survey results for these communities can be found in Appendices C-H.

- Continue further research on collection set out methods if the City of Calgary wishes to pursue curbside collection in the future. The economics of debagging versus biodegradable bags should be addressed.

GLOSSARY

Extracted from a variety of sources (Alberta Environmental Protection, 1993; Brady, 1990; Harrison and Richard, 1996; Municipality of Metropolitan Toronto, 1996; USEPA, 1995) or developed by the author for the purpose of this paper. This glossary is provided for the convenience of the reader.

Aerated Static Pile - composting process that uses a series of perforated pipes (or equivalent) as an air distribution system running underneath a compost pile and connected to a blower that either draws or blows air through the piles; no turning is preformed.

Aeration - bringing about contact of air and composting solid organic matter, by means of turning or ventilating to allow microbial aerobic metabolism.

Aerobic - occurring in the presence of oxygen.

Anaerobic - occurring in the absence of oxygen.

Backyard Composting - a form of yard waste source reduction that takes place at the residence.

Bioaerosols - organisms or biological agents which can be dispersed through the air and affect human health.

Biodegradable - having the ability to be broken down by organisms.

Biosolids - rich organic fertilizer that may also contain water, sand, inorganic particles, nutrients, microorganisms, trace metals and chemicals.

Brush - woody material (e.g. tree branches, limbs and twigs).

Cation Exchange Capacity - the total sum of exchangeable cations that a soil can adsorb (attraction of ions or compounds to the surface of a solid).

Channel Composting - a diverse group of composting methods in which composting materials are contained between the walls of an open-topped channel and are subject to periodic turning to improve the aeration.

Co-Collection - collection of two or more separated waste streams together (e.g. yard waste, recyclables and refuse).

Co-Composting - composting of two or more different organic materials together. Generally used to achieve a better balance of carbon and nitrogen or a favourable moisture content. Can involve mixing biosolids (nitrogen-rich) with leaves (carbon-rich).

Compost - decomposed organic matter that can be used as a soil conditioner.

Composting - biological degradation of organic matter under aerobic conditions to create an end product called compost.

Crumb Structure - a soft, porous, more or less rounded natural unit of structure from 1mm to 5mm in diameter.

Curing - last stage of composting that occurs after much of the readily metabolized material has been decomposed. Provides for additional stabilization, reduction of pathogens, and allows further decomposition of cellulose and lignin.

Decomposition - the breakdown of organic matter by microbial action.

Disposal Facilities - includes landfills, incinerators and waste-to-energy facilities.

Drought-Tolerant Plants - plants that do not require moisture inputs beyond local precipitation.

Erosion - removal of materials from the surface of the land by weathering and by running water, moving ice, and wind.

Feedstock - material that becomes a component of a treatment or manufacturing process. In context, largely waste materials that are diverted from disposal facilities to become components of a composting process.

Fertilizer - any organic or inorganic material of natural or synthetic origin added to a soil to supply certain elements essential to the plants growth.

Forced Aeration - means of supplying air to a composting pile or vessel that relies on blowers to move air through the composting materials.

Grasscycling - leaving grass clippings on the lawn.

Ground Water - water stored within the pores of soil and rock formations; often used as a primary source of drinking water.

Hardscaping - landscaping technique that uses paving stones, decks, concrete and fences as aesthetic and functional features of the landscape.

Heavy Metals (Trace Metals) - trace elements whose concentrations are regulated because of the potential for toxicity to humans, animals, or plants; includes chromium (Cr), copper (Cu), nickel (Ni), cadmium (Cd), lead (Pb), mercury (Hg), and zinc (Zn) if present in excessive amounts.

Humus - a complex aggregate, formed during the microbial decomposition or alteration of plant and animal residues and products synthesized by soil organisms; principal constituents are derivatives of lignin, proteins and cellulose combined with inorganic soil constituents.

Incineration - disposal of waste materials by controlled burning at high temperatures to reduce its volume or its toxic wastes; usually in large centralized facility which may produce power from the waste.

In-Vessel Composting - diverse group of composting methods in which composting materials are contained in a building, reactor or vessel.

Landfill - a regulated land disposal site where non-hazardous solid waste is spread thinly, compacted and covered with soil daily.

Land Reclamation - restoration of productivity to lands made barren through processes such as erosion, mining or land clearing.

Landspreading - application of yard trimmings to land; can be shredded before application.

Leachate - liquid that drains from the mix of fresh organic matter; liquid that results from the decomposition of solid waste at a landfill; it may cause ground water contamination if the facility is not secure.

Lignin - substance that, together with cellulose, forms the woody call walls of plants and the cementing material between them; resistant to decomposition.

Loam - a textural class name for soil having a moderate amount of sand, silt and clay. Loam soils contain 7-27% clay, 28-50% silt and 23-52% sand.

Master Composter - residents that are specially skilled in composting, usually backyard composting, who teach others the techniques of composting through some municipally organized program.

Master Gardner - residents who under go intensive horticultural training and then go out into the community to help educate and inform the public about horticultural issues.

Material Recovery Facility (MRF) - a facility constructed to separate recyclables into categories of material.

Moisture Content - weight of water in material divided by weight of solids in material.

Mulch - Organic or inorganic material that is applied to the surface of the soil to act as a barrier to retain moisture, to insulate and stabilize the soil, to protect plants or to control weeds.

Municipal Solid Waste (MSW) - non-hazardous solid waste managed by the community; generally residential and some industrial/commercial/institutional waste.

Native Plants - plants that are part of the local original flora.

Organic Matter - chemical substances of animal or vegetable origin, consisting of hydrocarbons and their derivatives.

Pathogen - an organism or microorganism, including viruses, bacteria, fungi and protozoa capable of producing an infection or disease in a susceptible host.

pH - measure of acidity, the concentration of hydrogen ions in a solution.

Pilot Project - scaled-down version of a planned program designed to test the operation on a sample of the feedstock or population that will be involved in the future. Takes place before commitment to a full-scale operation.

Recover - the recovery of material or energy resources (e.g. steam, electricity and heat) from mixed solid waste; sometimes referred to a the 4th R.

Recycle - to sort and process waste materials to be used in place of virgin resources (e.g. iron ore, oil and trees); the third priority of the 3R's.

Reduce - prevent waste materials through changes in lifestyle habits, product design, procedures, purchasing decisions; the first priority of the 3R's.

Residential Solid Waste - waste generated by households.

Reuse - to use a product again for its original purpose, or a different purpose; the second priority of the 3R's.

Soil Conditioner - soil additive that stabilizes the soil, improves the resistance of erosion, increases permeability to air and water, improves its texture and the resistance of its surface to crusting, makes easier to cultivate or otherwise improves its quality.

Soil Fertility - the quality of a soil that enables it to provide essential chemical elements in quantities and proportions for the growth of specified plants.

Source Reduction - reduction of waste at the point of generation (e.g. backyard composting).

Source Separation - the practice of primary generators such as households and businesses sorting recyclable material at the point of generation (e.g. bagging leaves).

Static Pile - a well-defined heap of compostable materials so formed to promote the aerobic decomposition of organic matter. It may have some aeration system built into it, either passive aeration relying on the heat generated to draw air upwards through the pile, or forced aeration using blowers.

Thatch - remaining woody portions of the grass and plants, is often the result of over-fertilizing and excessive watering.

Tipping Fees - charges for the usage of solid waste management facilities; usually assessed by weight and category of waste material.

Transfer Station - facility where solid waste is inspected, compacted and then transported to a landfill site.

Vigor - plant health.

Waste-to-Energy Facility - the burning of solid waste to produce energy (e.g. steam, electricity and heat).

Windrow - long, relatively narrow and low pile; aerates naturally or can be mechanically turned with a front-end loader, windrow turner or forced aeration.

Xeriscaping - landscaping practice that creates a visually attractive landscape using drought-tolerant plants.

Yard Waste - grass clippings, leaves, weeds, tree and shrub prunings and garden waste.

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APPENDICES

APPENDIX A

RESIDENTIAL YARD WASTE DIVERSION PROGRAMS IN CANADA AND THE NORTHERN UNITED STATES SURVEY

Before returning this survey, we request that you attach the business cards and e-mail addresses of all individuals who supplied answers. This will help if future contact for clarification is required.

Please fill out the appropriate parts that describe your current yard waste management program. Indicate if you are using tons or metric tonnes throughout this survey.

PLEASE PRINT RESPONSES

PART I: YOUR MUNICIPAL SOLID WASTE MANAGEMENT PROGRAM

1) Municipality and the name(s) of the individual(s) who answers this survey.

_____

_____

2) What is the design capacity (tons/tonnes, cubic yards) of the current solid waste disposal facility and the forecasted closure date?

Landfill	Incineration	Waste-to-energy
_____	_____	_____
_____	_____	_____

Other (define)

_____

_____

3) Does your municipality allow open burning?

Yes ☐ No ☐

4) Does your municipality designate an open burning day(s)?

Yes ☐ No ☐

5a) Is your solid waste disposal facility located:

Inside the municipal limits ☐ Outside the municipal limits ☐

b) If outside the municipal limits, how far away is the facility located?

_____

6) Please provide a schedule of tipping fees for municipal solid waste.

_____

_____

_____

_____

7a) Are there any current year round or seasonal limitations on residents for solid waste disposal (e.g. bag/can limits)?

Yes ☐ No ☐

b) If yes, please describe the limitations.

_____

_____

_____

_____

8) How is your municipal solid waste collection financed?

Residential property tax ☐

Variable rates on residential utility bill ☐

Municipality charges per bag/container on residential utility bill ☐

Flat rate on residential utility bill ☐

Private collector bills residents directly ☐

Other (define) ☐

_____

_____

9) What waste diversion programs are available to residents other than yard waste diversion programs? (Please check all relevant programs)

Recycling: curbside ☐

Please list materials included (e.g. newspaper, cardboard, glass, metal):

_____

_____

_____

Recycling: drop-off ☐

Please list materials included (e.g. newspaper, cardboard, glass, metal):

_____

_____

_____

Beverage container return depots ☐

Please list items covered by deposit:

_____

_____

_____

Kitchen waste composting (curbside collection) ☐

Paint exchange ☐

Household hazardous waste depot ☐

Kitchen waste composting (drop-off) ☐

Oil recycling depot ☐

Plastics recycling ☐

Please list plastic types:

_____

_____

Kitchen waste composting (vermicomposting) ☐

Tire recycling ☐

Other ☐

_____

_____

_____

PART II: YOUR RESIDENTIAL YARD WASTE DIVERSION PROGRAM

10) What average annual percentage of the total municipal solid waste stream is yard waste? What average annual percentage of the residential solid waste stream is yard waste? State N/A if no composition study has been completed. If N/A, do you have an estimate?

_____

_____

11a) Are there any yard waste bans, regulations or restrictions at the solid waste disposal facility?

Yes ☐ No ☐

b) If yes, please describe the bans, regulations or restrictions (e.g. from what solid waste disposal facility, type of yard waste material).

---

12) Does your municipality have a yard waste diversion program?

Yes ☐ No ☐

NOTE: If no, please go to Part VI (Page 18).

13) Which of the following yard waste diversion programs does your municipality promote?

Collection (curbside/drop-off)	☐	Backyard composting	☐	Grasscycling	☐
Mulching	☐	Xeriscaping	☐	Christmas tree recycling	☐
Other (define)	☐				

NOTE: If you promote any of the following: backyard composting, grasscycling, mulching or xeriscaping, please answer questions in Part II Section A (Page 5). **If you promote a collection program (curbside/drop-off) or Christmas tree recycling, please answer questions in Part II Section B (Page 6).** **If you promote a mixture of these programs, please answer questions in Part II Section A (Page 5) and Part II Section B (Page 6).**

PART II Continued

SECTION A: Household Yard Waste Diversion Programs

14a) Do any of the following household yard waste diversion programs have a rebate or subsidy for residents that participate?

Backyard composting	☐	Grasscycling	☐	Mulching	☐
Xeriscaping	☐	Other (define)	☐		

_____

b) Please describe the rebate or subsidy for each program (e.g. mulching mower rebate, subsidized backyard composters).

_____

_____

_____

15) How are these household yard waste diversion programs publicized and promoted? Could you please send current program literature.

Newspaper	☐	Radio	☐	Television	☐
Brochures	☐	Billboards	☐	Telephone hotline	☐
Website	☐	Public seminars	☐	Flyer drop	☐
Educational school programs	☐	Mail out in utility bill	☐	Demonstration garden	☐
Other	☐				

_____

16) How are these household yard waste diversion programs financed?

Residential property tax	☐	Residential utility bill	☐	Government grants	☐
Tipping fees	☐	Other	☐		

_____

PART II Continued

SECTION B: Collection Program for Yard Waste Diversion (Curbside/Drop-off)

17) Please indicate if this program is a pilot project, or if it is presently in the development stage.

_____

18) What year did the curbside/drop-off yard waste collection program start?

_____

19) Which of the following materials are included in your curbside/drop-off yard waste collection program?

Branches and twigs ☐ Grass clippings ☐ Leaves ☐ Weeds ☐ Sod ☐

Other ☐

_____

_____

20a) Are there specific yard waste materials that are not allowed or banned from your curbside/drop-off yard waste collection program?

Yes ☐ No ☐

b) If yes, state the type of yard waste material and the reason why it is not permitted in your curbside/drop-off yard waste collection program.

_____

_____

21) What is the overall residential yard waste diversion rate (total tonnage and % of the residential waste stream) through your municipal curbside/drop-off collection program? (Estimate is fine)

_____

22) What is the overall residential participation rate (% households) through your municipal curbside/drop-off yard waste collection program? (Estimate is fine)

_____

23a) Does your municipality have a separate Christmas tree recycling program from your curbside/drop-off yard waste collection program?

Yes ☐ No ☐

b) If yes, please describe the program (e.g. curbside collection by Boy Scouts, chipped and used by municipal parks).

_____

_____

24) How is this curbside/drop-off yard waste collection program publicized and promoted? Could you please send current literature.

Newspaper	☐	Radio	☐	Television	☐
Brochures	☐	Billboards	☐	Telephone hotline	☐
Website	☐	Information insert in utility bill	☐	Public education programs	☐
Flyer drop	☐	Other	☐		

_____

PART III: COLLECTION METHODS FOR YOUR YARD WASTE DIVERSION PROGRAM

25) Collection for the residential yard waste diversion program involves:

Drop-off depot(s) ☐ Curbside collection ☐ Both ☐

NOTE: If you have a drop-off depot(s), please answer questions in Part III Section A (Page 8).

If you have curbside collection, please answer questions in Part III Section B (Page 10).

If you have both collection methods, please answer questions in Part III Section A (Page 8) and Part III Section B (Page 10).

PART III Continued

SECTION A: Yard Waste Drop-off Depot(s)

26) How many drop-off depots are there?

_____

27) How many households have access to the drop-off depot(s)?

_____

28) Where is the drop-off depot(s) located?

City park	☐	Community centre	☐	Landfill	☐
Transfer station	☐	Public works building	☐	Other	☐

_____

_____

29) What is the residential yard waste diversion rate (total tonnage and % of the residential waste stream) at the drop-off depot(s)? (Estimate is fine)

_____

30) What is the residential participation rate (% households) at the drop-off depot(s)? (Estimate is fine)

_____

31) Is the drop-off depot(s) open seasonally or year round? If seasonally, indicate the months of operation and yard waste material collected (e.g. October-November, fall leaf drop-off).

_____

_____

32) Is your drop-off location(s) supervised at all times?

Yes ☐ No ☐

33a) Are plastic bags accepted at the drop-off location(s)?

Yes ☐ No ☐

b) If yes, please describe the debagging process (e.g. debagged by residents at the drop-off location, debagged by municipal workers at the compost facility, mechanized debagging).

_____

_____

_____

34) How is yard waste received at the drop-off depot(s)?

Single pile ☐ Multiple piles ☐

Single bin ☐ Multiple bins ☐

Other ☐

_____

35) What type of collection equipment is used to service the drop-off location(s)?

Dump truck ☐ Vacuum ☐

Rear/side loader compactor truck ☐ Front end loader compactor truck ☐

Other ☐

_____

36) What is the cost of operating the drop-off depot(s) to the municipality? (Overall cost and/or cost per ton/tonne)

_____

_____

37) How is the drop-off depot program financed?

Residential property tax	☐	Flat rate on residential utility bill	☐
Municipality charges per bag/container on residential utility bill	☐	Commercial tipping fees	☐
Government grants	☐	Other	☐

_____

_____

PART III Continued

SECTION B: Yard Waste Curbside Collection

38) What residential housing units have yard waste curbside collection?

Single family ☐ Multi-family ☐ Low-rise apartments ☐

Other ☐

Please specify
(e.g. landscaping companies that deal with higher density developments)

_____

39) How many households are serviced by yard waste curbside collection?

_____

40) What is the residential yard waste diversion rate (total tonnage and % of the residential waste stream) for curbside collection? (Estimate is fine)

_____

41) What is the residential participation rate (% households) for curbside collection? (Estimate is fine)

_____

42) Is yard waste curbside collection seasonal or all year? If seasonal, please indicate the months of operation and the material collected (e.g. March-November, leaves and grass plus small branches).

_____

_____

43) How often is yard waste collected?

Weekly ☐ Bi-weekly ☐

Monthly ☐ Other ☐

_____

44) Is yard waste collection on the same day as solid waste pickup?

Yes ☐ No ☐

45) Who collects residential yard waste?

Municipal solid waste fleet ☐ Municipality contracts to private hauler ☐

Residents subscribe to private hauler ☐ Other ☐

_____

46a) Where is the yard waste collected?

Front curb ☐ Back lane ☐

Both ☐

b) If both, please provide an estimate of the split (%).

_____

47) What type of yard waste pickup is used?

Manual ☐ Semi-automated* ☐

Automated* ☐

* Please provide a brief description

_____

_____

48) What type of equipment is used for yard waste curbside collection?

Dump truck ☐ Vacuum ☐

Street sweeper ☐ Rear/side loader compactor truck ☐

Front end loader compactor truck ☐ Co-collection vehicle ☐

Number of compartments:

_____

Other ☐

_____

_____

49) Briefly describe your yard waste collection process.

_____

_____

_____

_____

_____

50a) How is yard waste set out for the hauler?

Plastic garbage bags	☐	Clear plastic bags	☐
Biodegradable kraft paper bags	☐	Biodegradable plastic bags	☐
Open container (e.g. box, bin, garbage can, etc.)	☐	Roll out cart	☐
Bundles	☐	Piled on curb or boulevard	☐
Piled on street	☐	Other	☐

_____

b) If there has been a change on how the yard waste is set out for the collector could you explain the reasons for the change (e.g. switched from kraft paper bags to clear plastic bags, or vica versa, as a result of lower costs to the resident).

_____

_____

_____

_____

_____

51) If plastic bags are used, please describe the debagging process (e.g. debagged at the compost facility by contract workers, mechanized debagging).

_____

_____

_____

_____

52) If applicable, is yard waste and kitchen waste collected in the same bag/container/cart?

Yes ☐ No ☐ N/A ☐

53) What is the cost of the curbside collection to the municipality? (Overall cost and/or cost per ton/tonne)

_____

_____

54) How is the curbside collection program financed?

Residential property tax	☐	Flat rate on residential utility bill	☐	Private collector bills residents directly	☐
Municipality charges per bag/container on residential utility bill	☐	Commercial tipping fees	☐	Government grants	☐
Other	☐				

_____

PART IV: COMPOSTING FACILITY

55a) Is the yard waste material composted?

Yes ☐ No ☐

b) If no, please describe the processing method (e.g. yard waste is shredded then immediately landspread on agricultural fields).

_____

_____

NOTE: If you use a processing method other than composting please go to PART VI (Page 18).

56a) Is the composting facility located outside of the municipal limits?

Yes ☐ No ☐

b) If outside of the municipal limits, how far away is the facility located?

_____

57) Where is the composting facility located?

Sanitary landfill ☐ Waste water treatment plant ☐

Park ☐ Other ☐

_____

58) Which of the following best describes the facility?

Owned and operated by the municipality ☐ Owned by the municipality and operated by a private company (contract) ☐

Owned and operated by a private company ☐ Municipal and private company partnership ☐

Other ☐

_____

59) What is the design capacity (tons/tonnes, cubic yards) of the composting facility? (Estimate is fine)

_____

_____

60) What quantity (tons/tonnes) of yard waste was processed at the facility for the following years?

1997 _____ 1994 _____

1996 _____ 1993 _____

1995 _____

61a) Is there a tipping fee for yard waste?

Yes ☐ No ☐

b) If yes, what is the tipping fee for yard waste?

_____

62) What composting method is used at the facility?

Static pile (no or minimal turning)	☐	Aerated static pile	☐
Windrow (no or minimal turning)	☐	Windrow (regular turning)	☐
Aerated windrow	☐	Channel	☐
Aerated channel	☐	In-vessel	☐
Other	☐		

_____

_____

63a) Is the composting facility strictly dedicated to yard waste composting?

Yes ☐ No ☐

b) If no, state the other materials that are composted at the facility (e.g. kitchen waste, biosolids). Also mention if the yard waste is co-composted with this material or not.

_____

_____

64) What equipment is used at the composting facility?

Self-propelled windrow turner	☐	Side-mounted windrow turner	☐	Front end loader	☐
Shredder	☐	Chipper	☐	Grinder	☐
Temperature probes	☐	Screens	☐	Debagger	☐
Other	☐				

_____

65) What, if any, material is ground or chipped prior to composting (e.g. grass, branches)?

_____

_____

66a) Is there an odour management system in place at the facility?

Yes ☐ No ☐

b) If yes, please describe.

_____

_____

_____

_____

67) What is the operational cost for processing the compost materials? (Overall cost and/or cost per ton/tonne)

_____

_____

68) How is the composting facility financed?

Residential property tax	☐	Residential utility bill	☐	Municipal tipping fees	☐
Residential tipping fees	☐	Commercial tipping fees	☐	Government grants	☐
Other	☐				

_____

PART V: END PRODUCT QUALITY AND MARKET

69a) Are there quality standards that are applied to the compost end product?

Yes ☐ No ☐

b) If yes, briefly describe the quality standards. If specifications are available, please enclose.

_____

_____

_____

70) Provide a brief description of the end market(s) for the compost product (e.g. bagged and sold to public, used as landfill cover, sold by bulk to landscapers, free to residents, municipal use, land reclamation).

_____

_____

_____

_____

PART VI: YARD WASTE PILOT PROJECTS

71a) Does your municipality have any pilot projects at this time or are any planned for the near future?

Yes ☐ No ☐

b) If yes, please give a brief description.

_____

_____

_____

_____

_____

_____

_____

_____

_____

PART VII: CRITICAL LESSONS LEARNED

72) Briefly describe any critical lessons learned during your yard waste program development. Include successes and failures that might be of importance for other cities to consider when developing similar programs. As a result of these successes or failures, what changes to the present yard waste program are anticipated in the future?

PART VIII: YARD WASTE FROM COMMERCIAL AND MUNICIPAL OPERATIONS

73) While this survey focused on residential yard waste diversion programs, could you comment on how municipal and commercial yard waste is diverted from the solid waste disposal facility?

Thank you for completing this survey. Your time and effort is greatly appreciated.

If there is someone else who should be contacted to answer certain questions please fill out the following.

Name: _____

Employer: _____

Phone Number: _____

If you wish to receive a summary of the study findings please include a name and address where it should be sent to:

Name: _____

Address: _____

_____

_____

_____

APPENDIX B

YARD WASTE STATE LEGISLATION IN THE UNITED STATES – DISPOSAL BANS AND RELATED LAWS AS OF MAY 1996

State	Legislation	Description	Date
Connecticut	PA 90.220	Leaves must be composted.	Jan 1991
District of Columbia		Yard waste banned from landfills.	Oct 1989
Illinois	PA-86-1430	Yard waste banned from landfills, unless it is composted at the landfill and such compost is used as final vegetative cover or soil conditioner.	July 1990
Indiana	S 25	Yard waste from landscaping maintenance and land clearing banned from landfills, except if used as landfill cover material after composting, or if put in a landfill that produces methane and produces energy. Yard waste from landscaping maintenance and land clearing may not be mixed with solid waste.	Sept 1994 Jun 1994
Iowa	Title VII Solid Waste Managemen t & Disposal, Chapter 105	Yard waste banned from landfills, unless landfill uses it form soil conditioning or composting. Yard waste must be source separated. Municipalities that provide collection must provide yard waste collection.	Jan 1991 Mar 1991
Maryland	H 1088	Yard waste collected separately from other solid waste may be taken to a composting facility. Source separated yard waste banned from refuse disposal systems, unless the waste is to be composted or mulched.	Oct 1994
Michigan	PA 264 PA 267	Yard clippings from state and municipal land banned from landfills. Yard clippings banned from landfills and incinerators Open burning of grass clippings or leaves banned, with certain exceptions.	Mar 1993 Mar 1995 Mar 1995
Minnesota	115A.931	Yard waste banned from landfills in Twin Cities Metro Area (Minneapolis and St. Paul). Yard waste banned from landfills in entire state.	Jan 1990 Jan 1992

State	Legislation	Description	Date
Missouri	SB 530	Yard waste banned from landfills. Department anticipates and recommends that most yard wastes be composted.	Jan 1992
Nebraska	LB 1257	Yard waste banned from landfills; source separated yard waste may be accepted by a landfill for soil conditioning or composting.	Sept 1994
New Hampshire	HB 646-FN	Yard waste banned from landfills and waste-to-energy facilities.	July 1993
New Jersey	PL 1987, C.102 PL 1989, C 151	Only composting facilities or recycling centres may accept truckloads or roll-off containers of leaves. Leaves collected by a municipality must be taken to an approved composting facility or recycling centre. Leaves may not be taken to any out-of-state facility except as approved. Municipalities must provide for collection of leaves at residences, and require source separation of leaves by residents, or, municipalities may require residents to compost or mulch their leaves.	Aug 1988 Apr 1989
New York		Yard waste must be source separated if economically feasible.	Sept 1992
Ohio		Source separated yard waste banned from landfills, incinerators and transfer stations in counties with composting facilities. All source separated yard waste must go to a composting facility.	Feb 1995 Aug 1995
Oregon	SB 66	Yard waste should be collected and composted, home composting should be promoted.	July 1992
Pennsylvania	101	Truckloads consisting primarily of leaves banned from landfills and waste-to-energy facilities.	Sept 1990
South Dakota	HB 1001	Yard waste banned from landfills.	Jan 1995
Virginia	HB 198	Any country, city, or town may ban leaves or grass clippings from landfills, if they have a suitable composting program.	Jan 1995
West Virginia	SB 18	Yard waste banned from solid waste facilities.	June 1996
Wisconsin	1989 Act 335	Yard waste banned from land disposal; it may not be burned without energy recovery.	Jan 1993

*** Some counties, municipalities and composting facilities also have bans.

(The Composting Council, 1996b)

APPENDICES C-H

RESIDENTIAL YARD WASTE DIVERSION PROGRAMS IN CANADA AND THE NORTHERN UNITED STATES

FULL SURVEY RESULTS

APPENDIX C

SOLID WASTE DISPOSAL AND RESIDENTIAL SOLID WASTE DIVERSION CHARACTERISTICS - SURVEY RESULTS

Community	Population*	Households*	Solid Waste Disposal Facility	Solid Waste Disposal Tipping Fee (Dollars**/Tonne)	Current Residential Bag/Can Limits Per Collection Day Pickup	Residential Solid Waste Collection Financed By	Residential Solid Waste Diversion Programs (R)
Albany, NY	105, 000	42,000	LF	$71 - $82	None	RPT	HHW, OR, PR, RCS
Augusta, ME	21, 000	9, 000	LF	$83	None	RPT	BCD, KWDO, PR, RCS, RDO, TR
Baltimore, MD	703, 000	276, 000	IN, LF	$94 IN, $106 LF	None	O (Q)	HHW, OR, PE, PR, RCS, RDO, TR
Barrie, ON	75, 000	27, 000	LF	$6 - $84	2 Bags/cans (D)	RPT	HHW, KWV, PR, RCS
Billings, MT	87, 000	33, 000	LF	$16	None	RPT	HHW, OR, RDO
Bismarck, ND	53, 000	19, 000	LF	$46	None	FRRUB	OR, RDO, TR
Boise, ID	146, 000	51, 000	LF	$5 m3	None	FRRUB	HHW, PE, RCS, RDO
Brantford, ON	85, 000	32, 000	LF	$70	5 Bags/cans	RPT, TF	HHW, OR, PR, RCS, RDO, TR
Brooks, AB	10, 000	4, 000	LF	NA	None	FRRUB	BCD, HHW, OR, PE, PR, RDO, TR
Buffalo, NY	313, 000	136, 000	LF	$37	10 - 114 L Containers	VRRUB	BCD, HHW, RCS
Burlington, ON	138, 000	49, 000	LF	$133	6 Bags/cans	RPT	HHW, PR, RCS, RDO, TR
Burlington, VT	38, 000	15, 000	LF	$115	None	PCBRD	BCD, HHW, OR, PE, PR, RCS, RDO, TR
Calgary, AB	819, 000	225, 000	LF	$30	5 Bags/cans (Fall only)	RPT	BCD, HHW, OR, PE, RDO, TR
Capital Regional District, BC	318, 000	136, 000	LF	$75	1 Bag/can (E)	FRRUB, RPT	BCD, HHW, OR, PE, PR, RCS, RDO, TR
Central Okanagan RM, BC	137, 000	54, 000	LF	$50	2 Bags/cans (F)	RPT, VRRUB	BCD, HHW, OR, PE, PR, RDO, TR
Charleston, WV	57, 000	25, 000	LF	$57	None	FFRUB	RCS, RDO
Charlottetown, PEI	33, 000	9, 000	LF, WTE	$36	Varies	RPT	BCD, HHW, KWCS, PR, RCS, RDO, TR
Cheyenne, WY	54, 000	20, 000	LF	$6 m3	None	FFRUB	HHW, OR, RDO, TR
Chicago, IL	2, 732, 000	1, 021, 000	LF	****	None	RPT	HHW, OR, RCS
Chico, CA	53, 000	16, 000	LF	$30	None	PCBRD	BCD, HHW, OR, PR, RCS, RDO
Cincinnati, OH	358, 000	154, 000	LF	$34	None	GF	PR, RCS, RDO, TR
Columbus, OH	636, 000	257, 000	LF	$28 - $45	1 - 90 L Container (G)	RPT	HHW, OR, RCS, RDO, TR
Davenport, IA	97, 000	32, 000	LF	$10 m3	3 - 125 L Bags/cans	RPT	BCD, HHW, OR, PE, PR, RCS, RDO, TR
Dayton, OH	179, 000	73, 000	LF	$56	1 - 340 L Container	O (Q)	HHW, KWCS, PE, PR, RCS
Decatur, IL	83, 000	34, 000	LF	$31	10 Bags/cans, 20 in Fall	PCBRD	OR, PE, RCS, RDO, TR

Edmonton, AB	628, 000	244, 000	LF	$25	None	FRRUB, RPT	BCD, HHW, OR, PE, PR, RCS, RDO, TR
El Paso County, CO	480, 000	180, 000	LF	$5 - $54 m3	None	PCBRD	HHW, OR, PE, RCS, RDO, TR
Eugene, OR	118, 000	47, 000	LF	$66	None	PCBRD	BCD, HHW, OR, PE, PR, RCS, RDO, TR
Fort Wayne, IN	183, 000	69, 000	LF	$28	None	FRRUB	HHW, OR, PE, PR, RCS, RDO, TR
Grand Rapids, MI	190, 000	69, 000	WTE	$42	None	RPT	RCS
Great Falls, MT	57, 000	24, 000	LF	$24	None	FRRUB	OR, PE, PR, RCS, RDO

KEY:

BCD = Beverage Container Depots
CD = Construction/Demolition
FRRUB = Flat Rate on Residential Utility Bill
GF = General Fund
HHW = Household Hazardous Waste
IN = Incineration
KWCS = Kitchen Waste (Curbside)
KWDO = Kitchen Waste (Drop-off)
KWV = Kitchen Waste (Vermicomposting)
LF = Landfill
MCBC = Municipality Charges Per Bag/Container
O = Other
OR = Oil Recycling
PCBRD = Private Collector Bills Residents Directly
PE = Paint Exchange
(PP) = Pilot Project
PR = Plastics Recycling
RCS = Recycling (Curbside)
RDO = Recycling (Drop-off)
RPT = Residential Property Tax
RRF = Resource Recovery Facility
TF = Tipping Fee
TR = Tire Recycling
VRRUB = Variable Rates on Residential Utility Bill
YW = Yard Waste
WTE = Waste to Energy

**** = Information Not Available
NA = Not Applicable

NOTES:

* Rounded to the nearest thousand.

** In Canadian dollars, rounded to the nearest dollar.

(A) $139 /household/year includes 3 waste stream pickup, processing and disposal (compostables, recyclables and mixed residuals).

(B) Flat rate: $6 - $15 (up to 500 kg) depending on vehicle size; over 500 kg, $0.49 /kg.

(C) Rate scale to be implemented in January 1999.

(D) Additional bags/cans $1 each.

(E) Additional bag/can tags can be purchased for $1.50-$3.50 each, depending on the municipality.

(F) Two additional tags can be purcahsed in advance, $1.50 each.

(G) All refuse in Columbus, OH must be containerized by code. A second container can be purchased by residents.

(H) Due to recent amalgamation various systems are in place:
- 50.5% no limit, 37.3% - 3 bag limit, 12.2% - 2 bag limit

(I) Additional bag tags $2 each.

(J) No direct bag/can limit, however, households suscribe to a volume based system and pay extra if extra volume is set out for disposal. This is an inscentive to reduce waste.

(K) Proposed 5 bag limit in 1999.

(L) Additional bags/cans $2 each.

(M) Toledo, OH is currently examining a bag limit as a way to encourage recycling.

(N) Example: 1-121 L can with weekly pickup is $18 /month, 2 can service is $36 /month, if there are extra bags/cans $7.25 /month each.

(O) Additional bag/can tags can be purchased for $2 each.

(P) Additional bag tags $1 each.

(Q) Other includes one of the following: revenue from sale of recyclables, service charge on city income tax bill or vehicle motor funds.

(R) Not including yard waste diversion programs.

(S) Springfield, MA solid waste diversion also includes PR, RCS and RDO.

APPENDIX C Continued

SOLID WASTE DISPOSAL AND RESIDENTIAL SOLID WASTE DIVERSION CHARACTERISTICS - SURVEY RESULTS

Community	Population*	Households*	Solid Waste Disposal Facility	Solid Waste Disposal Tipping Fee (Dollars**/Tonne)	Current Residential Bag/Can Limits Per Collection Day Pickup	Residential Solid Waste Collection Financed By	Residential Solid Waste Diversion Programs (R)
Guelph, ON	93, 000	32, 000	LF	$53	None	RPT	HHW, KWCS, KWDO, OR, PR, RCS, RDO, TR
Halifax RM, NS	354, 000	133, 000	LF	$100	None	O (Q), RPT	BCD, HHW, KWCS, RCS, TR
Hamilton-Wentworth RM, ON	460, 000	179, 000	LF, WTE	$71	None	RPT, TF	HHW, OR, PE, RCS, RDO
Huntington, WV	54, 000	23, 000	LF	$43	None	O (Q)	OR, PR, RCS, RDO
Indianapolis, IN	752, 000	320, 000	LF, WTE	$36 LF, $52 WTE	10 Bags/cans, 40 in Fall	RPT	HHW, OR, RCS, RDO
Kansas City, KS	143, 000	57, 000	LF	NA	None	FRRUB	HHW, OR, PE, RDO, TR
Kingston, ON	113, 000	44, 000	LF	$110	Varies (H)	RPT	HHW, OR, PE, PR, RCS, TR
Kitchener, ON	178, 000	68, 000	LF	$59	None	RPT	HHW, PE, RCS
Lansing, MI	120, 000	51, 000	LF	$13 m3	None	MCBC, PCBRD	BCD, HHW, OR, PR, RCS, RDO, TR
Lethbridge, AB	65, 000	25, 000	LF	$5 - $23	None	FRRUB	BCD, HHW, OR, PE, RDO
Lincoln, NE	203, 000	76, 000	LF	$23	None	PCBRD	HHW, RDO, TR
London, ON	326, 000	137, 000	LF, WTE	$72	None	RPT	HHW, PE, RCS, RDO, TR
Louisville, KY	270, 000	123, 000	LF	$35 - $37	None	RPT	HHW, PR, RCS, RDO
Madison, WI	195, 000	60, 000	LF	$46	None	RPT	HHW, OR, PE, PR, RCS, RDO, TR
Manchester, NH	100, 000	44, 000	LF	$72	None	RPT	HHW, OR, PR, RCS, RDO, TR
Markham, ON	173, 000	49, 000	LF	$26	3 Bags/cans	RPT	HHW, PR, RCS, RDO, TR
Milwaukee, WI	617, 000	250, 000	LF	$39	None	RPT	HHW, OR, PR, RCS, RDO, TR
Minneapolis, MN	355, 000	161, 000	WTE	$56	None	VRRUB	HHW, PE, PR, RCS, RDO, TR
Montreal, PQ	1, 032, 000	460, 000	LF	****	None	RPT	BCD, HHW, KWCS, KWV, RCS, RDO
North Vancouver, BC	42, 000	19, 000	IN, LF	$65	3 Bags/cans (I)	RPT	BCD, HHW, OR, RCS, RDO, TR
Oakville, ON	118, 000	38, 000	LF	$133	6 Bags/cans	RPT	HHW, PR, RCS, RDO, TR
Olds, AB	6, 000	3,000	LF	$30	None	FRRUB	BCD, KWCS, OR, PE, PR, RDO, TR
Omaha, NE	345, 000	134, 000	LF	$27	5 Bags/cans, no YW limit	RPT	RCS, RDO, TR
Oshawa, ON	134, 000	35, 000	LF	$86	8 Bags/cans	RPT	HHW, OR, PE, PR, RCS, RDO, TR
Ottawa-Carleton RM, ON	664, 000	281, 000	LF	$67	None	RPT	HHW, RCS
Peoria County, IL	183, 000	****	LF	$28 - $72	None	RPT	HHW, OR, PR, RCS, RDO, TR

Peterborough, ON	68, 000	29, 000	LF	$65	2 Bags/cans	RPT	HHW, OR, PE, PR, RCS, RDO, TR
Philadelphia, PA	1, 524, 000	661, 000	IN, LF	$78	None	GF, RPT	HHW, RCS, TR
Pittsburgh, PA	359, 000	154, 000	LF	$26	None	RPT	PR, RCS, RDO, TR
Portland, OR	451, 000	187, 000	LF	$90	Volume based system (J)	PCBRD	BCD, HHW, PR, RCS, RDO, TR
Provo, UT	87, 000	24, 000	LF	$38	None	MCBC	KWDO, OR, RDO
Quebec City, PQ	175, 000	****	IN	$82	None	RPT	BCD, OR, PE RCS, RDO, TR

KEY:

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(H) Due to recent amalgamation various systems are in place:
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(N) Example: 1-121 L can with weekly pickup is $18 /month, 2 can service is $36 /month, if there are extra bags/cans $7.25 /month each.

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(P) Additional bag tags $1 each.

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APPENDIX C Continued

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Community	Population*	Households*	Solid Waste Disposal Facility	Solid Waste Disposal Tipping Fee (Dollars**/Tonne)	Current Residential Bag/Can Limits Per Collection Day Pickup	Residential Solid Waste Collection Financed By	Residential Solid Waste Diversion Programs (R)
Ramsey County, MN	497, 000	198, 000	RRF, WTE	$54	None	PCBRD, RPT	HHW, OR, PE, PR, RCS, RDO
Rapid City, SD	55, 000	21, 000	LF	$67	None	FRRUB	KWCS, OR, PE, PR, RCS, RDO, TR
Red Deer, AB	60, 000	23, 000	LF	$30	None (K)	FFRUB	BCD, HHW, OR, PE, RCS, RDO
Regina, SK	185, 000	71, 000	LF	$20	8 Bags/cans	RPT	BCD, OR, PE, RCS, RDO, TR
Richmond, BC	148, 000	51, 000	IN, LF	$65	2 Bags/cans (L)	FRRUB, O (Q)	BCD, PR, RCS, RDO
Richmond Hill, ON	100, 000	33, 000	LF	$55	10 Bags/cans	RPT	HHW, OR, RCS
Rochester, NY	231, 000	94, 000	LF	$71	None	O (Q)	BCD, HHW, PR, RCS, TR
Sacramento, CA	374, 000	145, 000	LF	$28	None	VRRUB	BCD, HHW, OR, RCS, RDO
Salem, OR	108, 000	41, 000	WTE	****	None	PCBRD	BCD, OR, PR, RCS, RDO, TR
Salt Lake City, UT	172, 000	67, 000	LF	$31	None	FRRUB	HHW, OR, PE, RCS, RDO,TR
Saskatoon, SK	194, 000	77, 000	LF	$18	None	RPT	BCD, OR, PE, RDO, TR
Seattle, WA	521, 000	237, 000	LF	$133	****	****	HHW, OR, RCS, RDO, TR
Shawnee County, KS	165, 000	65, 000	LF	$33	None	FFRUB	HHW, KWV, PE, PR, OR, RDO, TR
Sioux Falls, SD	106, 000	45,000	LF	$20	Volume based system (J)	PCBRD	BCD, HHW, OR, PE, PR, RCS, RDO, TR
Spokane, WA	193, 000	75, 000	WTE	$138	None	VRRUB	HHW, PR, RCS, RDO
Springfield, MA	149, 000	45, 000	WTE	$88	1 - 340 L Cart (PP)	RPT	BCD, HHW, KWCS, KWDO, OR, PE (S)
St Cloud, MN	60, 000	22, 000	****	$85	None	MCBC	HHW, RCS
St Thomas, ON	32, 000	12, 000	LF	$139 /hhld (A)	2 Bags/cans	RPT	HHW, KWCS, PE, PR, RCS
Sudbury, ON	90, 000	41, 000	LF	$44 - $190	None	RPT	HHW, KWV, PR, RCS, RDO, TR
Surrey, BC	304, 000	101, 000	LF	$65	2 Bags/cans	FRRUB	HHW, KWCS, PE, RCS, RDO
Tacoma, WA	184, 000	70, 000	LF	$117	None	VRRUB	HHW, KWCS, OR, PR, RCS, RDO
Tillsonburg, ON	14, 000	5, 000	LF	$18	None	RPT	CD, KWCS, OR, PE, PR, RCS
Toledo, OH	323, 000	131, 000	LF	$38	None (M)	GF	PE, RCS, RDO, TR
Toronto, ON	655, 000	290, 000	LF	$50	None	RPT	HHW, KWV, PE, RCS, TR
Vancouver, BC	525, 000	200, 000	LF	$6 - $15 (B)	3 Bags/cans	FRRUB	BCD, HHW, KWV, OR, PE, RCS, RDO
Vancouver, WA	132, 000	60, 000	LF	$106	Linear rate structure (N)	PCBRD	BCD, HHW, PR, RCS, RDO, TR

Victoria, BC	71, 000	****	LF	$75	1 Bag/can (O)	RPT	BCD, RDO
Whitehorse, YK	24, 000	5, 000	LF	$0	4 Bags/cans (P)	FRRUB, RPT	BCD, HHW, KWDO, PE, PR, RDO
Willmar, MN	19, 000	7, 000	LF	****	****	****	****
Yellowknife, NWT	15, 000	6, 000	LF	$0 (C)	None	FRRUB	HHW, OR, PE, PR, RDO

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(O) Additional bag/can tags can be purchased for $2 each.

(P) Additional bag tags $1 each.

(Q) Other includes one of the following: revenue from sale of recyclables, service charge on city income tax bill or vehicle motor funds.

(R) Not including yard waste diversion programs.

(S) Springfield, MA solid waste diversion also includes PR, RCS and RDO.

APPENDIX D

YARD WASTE BANS, RESIDENTIAL DIVERSION PROGRAMS AND COLLECTION STRATEGY - SURVEY RESULTS

Community	Yard Waste in Total MSW (%*)	Yard Waste in Residential MSW (%*)	Yard Waste Ban/ Mandate	Yard Waste Diversion Programs	Yard Waste Collection Strategy	Yard Waste Materials Collected in Curbside/Drop-off Program(s)	Yard Waste Composting Method	Banned Materials and Size Limitations for Curbside/Drop-off Yard Waste Program(s)
Albany, NY	4%	13%	LFB	CO, CTR, M	CS, DO	B, CT, G, L, S, TS, WD	AW	None
Augusta, ME	1%	3%	LGC	BC, CO, CTR	CS, DO	CT, G, L, S, WD	W (G)	Large branches, vines
Baltimore, MD	****	****	O (B)	BC, CO, CTR, GC, M	CS, DO	B, CT, G, L, WD	W	Stumps
Barrie, ON	11%	****	LFB	BC, CO, CTR, GC	CS, DO	B, CT, G, L, WD	W	B > 10 cm diameter (CS)
Billings, MT	****	****	None	BC, CO, CTR	DO	B, CT, G, L	W	None
Bismarck, ND	****	6%	None	CO, CTR, GC, M	DO	CT, G, L	NA	Branches, sod, weeds
Boise, ID	40% (e)	40% (e)	None	BC, CO, CTR, GC, M, X	CS, DO	B, CT, L	NA	None
Brantford, ON	****	18%	None	BC, CO, CTR, GC	CS, DO	B, CT, G, L, S, WD	W	Brush
Brooks, AB	35% (e)	40% (e)	LFB	BC, CO, CTR, GC	CS, DO	CT, G, GW, L, S, WD	W	Tree trimmings
Buffalo, NY	****	****	None	BC, CO, CTR, GC	CS	B, CT, G, L, WD	W	Sod
Burlington, ON	9%	9%	LFB	BC, CO, CTR, GC, X	CS, DO	B, CT, G, L, WD	W	B > 7.5 cm dia., stumps
Burlington, VT	10%	6%	LFB	BC, CO, CTR, GC	CS, DO	B, CT, G, GW, L, S, TS, WD	W	Wood
Calgary, AB	****	30% (e)	None	CO, CTR	DO	CT, L	W	NA (CT & L programs)
Capital Regional District, BC	7% (e)	4% (e)	None (C)	BC, CO, X	DO	B, G, GW, L, WD	AW	B > 7 cm diameter, soil
Central Okanagan RM, BC	****	****	None	BC, CO, CTR, GC, M, X	CS, DO	B, CT, G, GW, L, S, WD	W	Branches > 1.5 cm diameter
Charleston, WV	10% (e)	10% (e)	LFB	CO, CTR	CS	B, CT, G, L, S, WD	SP (H)	None
Charlottetown, PEI	30% (e)	****	None	CO, CTR	CS	B, CT, G, L, S, WD	W (G)	None
Cheyenne, WY	****	****	None	CO, CTR, GC, M	DO	B, CT, G, L, S, WD, WW	W (I)	Stumps
Chicago, IL	14%	10%	LFB	BC, CO, CTR, GC	CS	B, CT, G, L, WD	NA	None
Chico, CA	10%	22%	None	BC, CO, CTR	CS, DO	B, CT, G, L, WD, WW	W	Palm frons, sod
Cincinnati, OH	****	****	SSBL	BC, CO, CTR, M	CS, DO	B, CT, G, L, S, WD	SP	None
Columbus, OH	****	5% (e)	SSBL	BC, CO, GC, M	CS	B, G, L, WD	W (J)	Logs, rocks, sod
Davenport, IA	14% (e)	18% (e)	LFB	BC, CO, CTR, GC, M	CS, DO	B, CT, G, GW, L, S, WD	ASP (K)	Branches > 15 cm diameter
Dayton, OH	****	****	SSBL	BC, CO, CTR	CS	B, CT, L, WD	SP, W	Grass
Decatur, IL	****	28%	LFB	BC, CO, CTR, M	CS, DO	B, CT, G, L, WD	SP, W	Branches > 10 cm diameter

Edmonton, AB	28% (e)	28% (e)	None	BC, CO, CTR, GC, X	CS	CT	NA (H)	NA (CT program)
El Paso County, CO	****	****	None	BC, CO, CTR, M	DO	B, CT, G, GW, L	W	Stumps
Eugene, OR	11%	****	None	BC, CO, GC	CS, DO	B, G, L, WD	W	B > 20 cm diameter (CS)
Fort Wayne, IN	****	18%	LFB	BC, CO, CTR, GC, M	CS, DO	B, CT, G, GW, L, WD	SP (K)	Fruit, sod, stumps
Grand Rapids, MI	****	17%	WTEB	CO, CTR	CS	B, CT, G, GW, L, S, WD	****	None
Great Falls, MT	25% (e)	25% (e)	None	CO, CTR	CS, DO	B, CT, G, L, S, WD	W	B > 15 cm dia., stumps
Guelph, ON	****	****	LFB	BC, CO, CTR, GC	CS, DO	B, CT, G, L	AW, C (L)	B > 5 cm dia. (CS), sod

KEY:

ASP = Aerated Static Pile
AW = Aerated Windrow
B = Branches
BC = Backyard Composting
C = Channel
CO = Collection (branches, grass, leaves)
CS = Curbside
CT = Christmas Tree
CTR = Christmas Tree Recycling
DO = Drop-off
G = Grass Clippings
GC = Grasscycling
GW = Garden Waste
INB = Incinerator Ban
IV = In-Vessel
L = Leaves
LFB = Landfill Ban
LGC = Leaves/Grass Must be Composted
M = Mulching
MSW = Municipal Solid Waste
O = Ordinance
S = Sod
SP = Static Pile
SSBL = Source Separtation Ban from Landfill
TS = Tree Stumps
W = Windrow
WD = Weeds
WTEB = Waste to Energy Ban
WW = Wood Waste
X = Yard Waste Minimization Principles (xeriscaping)

(e) = Estimate
**** = Information Not Available
NA = Not Applicable

NOTES:

* Rounded to the nearest percent.
(A) Food and yard waste combined.
(B) City of Baltimore ordinance - no yard waste to be dumped in landfill or incinerator.
(C) Yard waste landfill ban to be implemented in three southern Vancouver Island Regional Districts by January 2000. To be followed a year later by a kitchen waste landfill ban.
(D) Quebec provincial organic ban from landfills to be implemented in Spring 1999.
(E) City of Seattle ordinance - no yard waste in garbage.
(F) Kitchen waste pilot project.
(G) Yard waste is co-composted with kitchen waste.
(H) An in-vessel composting facility is under construction.
(I) Yard waste is co-composted with manure and lumber.
(J) Columbus, OH is currently testing a variety of European technologies.
(K) Yard waste is co-composted with biosolids.
(L) Yard waste is co-composted with wet waste (kitchen waste, sanitary products, kitty litter and pet waste, kleenex, paper towels, vaccum bags) manure and tobacco.
(M) Yard waste is co-composted with bark, coffee grinds, manure and vegetable waste.
(N) Yard waste is co-composted with manure and, pulp and paper residue.
(O) Yard waste is co-composted with vegetable and wood waste.
(P) Yard waste is co-composted with short paper fibre (papermill sludge).
(Q) Yard waste is co-composted with kitchen waste and industrial organic materials.
(R) Yard waste is co-composted with kitchen waste and non-recyclable products.

APPENDIX D Continued

YARD WASTE BANS, RESIDENTIAL DIVERSION PROGRAMS AND COLLECTION STRATEGY - SURVEY RESULTS

Community	Yard Waste in Total MSW (%*)	Yard Waste in Residential MSW (%*)	Yard Waste Ban/ Mandate	Yard Waste Diversion Programs	Yard Waste Collection Strategy	Yard Waste Materials Collected in Curbside/Drop-off Program(s)	Yard Waste Composting Method	Banned Materials and Size Limitations for Curbside/Drop-off Yard Waste Program(s)
Halifax RM, NS	1%	1%	LFB	BC, CO, CTR	CS, DO	B, CT, G, L, WD	ASP (G)	B > 1.0 m length, S, stumps
Hamilton-Wentworth RM, ON	****	****	None	BC, CO, CTR	CS, DO	B, CT, G, GW, L, S, WD	W	B > 7 cm dia., 1.0 m length
Huntington, WV	****	****	LFB	CO, CTR	CS, DO	B, CT, L	W	None
Indianapolis, IN	12%	20%	None	CO, CTR, GC	CS, DO	CT, L	W	NA (CT & L programs)
Kansas City, KS	13% (e)	****	None	NA	NA	NA	NA	NA
Kingston, ON	18% (e)	38% (e)	LFB	BC, CO, CTR, GC	CS, DO	CT, G, L (F)	W	Brush
Kitchener, ON	****	****	****	****	****	****	****	****
Lansing, MI	20%	****	LFB	BC, CO, CTR, GC, M, X	CS	B, CT, G, L, WD	ASP, W	None
Lethbridge, AB	****	****	None	BC, CO, CTR	DO	CT	NA	NA (CT program)
Lincoln, NE	****	23% (e)	LFB	BC, CO, CTR, M	CS, DO	B, CT, G, L	W	Branches > 2.5 cm diameter
London, ON	20%	20%	None	BC, CO, CTR, GC	CS, DO	B, CT, GW, L, WD	SP, W	Grass
Louisville, KY	18 % (e)	****	LFB	BC, CO, CTR, GC	CS	B, CT, G, GW, L, WD	SP, W	Branches > 5 cm diameter
Madison, WI	33% (e)	33% (e)	LFB	BC, CO, CTR, GC	CS, DO	B, CT, G, L, S, WD	SP	Roots, stumps
Manchester, NH	12% (e)	12% (e)	LFB, WTEB	CO, CTR	CS, DO	B, CT, G, GW, L, WD	W	Sod
Markham, ON	****	8%	LFB	BC, CO, CTR, GC, M, X	CS, DO	B, CT, G, L, S, WD	W	Grass (CS)
Milwaukee, WI	10%	12%	LFB	BC, CO, CTR, GC, M	CS, DO	B, CT, G, L	W	None
Minneapolis, MN	18%	****	LFB	BC, CO, M	CS, DO	B, G, GW, L, WD	SP	B > 7.5 cm dia., soil, stumps
Montreal, PQ	****	9%	None (D)	BC, CO	CS	B, CT, G, L, S, WD (F)	AW (G)	Branches > 8 cm dia.
North Vancouver, BC	****	****	None	BC, CO, CTR, GC, M, X	CS, DO	B, CT, G, L, WD	W (M)	B >7.5 cm diameter, sod
Oakville, ON	8%	****	LFB	BC, CO, CTR, GC, X	CS, DO	B, CT, L, WD	W	B > 7.5 cm dia., G, stumps
Olds, AB	7%	****	None	BC, CO, CTR, GC	CS, DO	B, CT, G, GW, L, WD	IV, W	None
Omaha, NE	****	35% (e)	LFB	CO, CTR, GC	CS	B, CT, G, L, WD	AW	B > 5 cm dia., 1.0 m length
Oshawa, ON	****	****	LFB	BC, CO, CTR, GC	CS, DO	B, CT, G, L	W	Large roots, stumps
Ottawa-Carleton RM, ON	****	7% (e)	None	BC, CO, CTR, GC	CS, DO	B, CT, G, L, WD	W	Sod, stumps
Peoria County, IL	7%	30%	LFB	BC, CO, CTR, GC, M	CS, DO	B, CT, G, L, S, WD	W	None
Peterborough, ON	****	20%	LFB	BC, CO, CTR, GC, M	CS, DO	B, G, L, S, WD	W	None

Philadelphia, PA	10% (e)	10% (e)	LFB	BC, CO, CTR, GC	CS	CT, L	W	NA (CT & L programs)
Pittsburgh, PA	25% (e)	25% (e)	LFB	CO, CTR, GC	CS, DO	B, CT, G, L, WD	AW	None
Portland, OR	****	4%	None	BC, CO, CTR, GC, M	CS	B, CT, G, L, S, WD	W	None
Provo, UT	20%	30%	None	CO, CTR, GC, M, X	CS, DO	B, CT, G, L, WD	W (K)	Stumps
Quebec City, PQ	2%	4%	INB	BC, CO, CTR, GC	CS, DO	CT, G, L	ASP, SP (N)	None
Ramsey County, MN	****	****	LFB	BC, CO	DO	G, L, S, WD	SP, W	Branches
Rapid City, SD	10%	23%	LFB	CO, CTR	CS, DO	B, CT, G, L, S, WD	W (K)	B >15 cm diameter, stumps

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APPENDIX D Continued

YARD WASTE BANS, RESIDENTIAL DIVERSION PROGRAMS AND COLLECTION STRATEGY - SURVEY RESULTS

Community	Yard Waste in Total MSW (%*)	Yard Waste in Residential MSW (%*)	Yard Waste Ban/ Mandate	Yard Waste Diversion Programs	Yard Waste Collection Strategy	Yard Waste Materials Collected in Curbside/Drop-off Program(s)	Yard Waste Composting Method	Banned Materials and Size Limitations for Curbside/Drop-off Yard Waste Program(s)
Red Deer, AB	23% (e) (A)	53% (e) (A)	None	BC, CO, CTR, GC, M	CS, DO	B, CT, G, GW, L	AW, SP, W	Spruce trees, weeds
Regina, SK	****	33% (e)	None	BC, CO, CTR, X	CS	CT	NA	NA (CT program)
Richmond, BC	33%	33%	None	BC, CO, CTR	CS, DO	B, CT, G, L, WD	W	B >15 cm dia., sod, stumps
Richmond Hill, ON	13%	13%	LFB	BC, CO, CTR, GC, M	CS, DO	B, CT, G, L, WD	W	None
Rochester, NY	****	18% (e)	LFB	BC, CO, CTR, GC	CS, DO	B, CT, G, L, WW	W	None
Sacramento, CA	26%	35%	None	BC, CO, CTR, GC, M, X	CS	B, CT, G, L, WD	W	None
Salem, OR	11%	18%	None	BC, CO, CTR, GC	CS, DO	B, CT, G, L, WD	SP	Sod
Salt Lake City, UT	****	****	None	NA	NA	NA	NA	NA
Saskatoon, SK	13%	36%	None	BC, CO, CTR	DO	CT, G, GW, L, S, WD	NA	Branches, twigs
Seattle, WA	****	17%	O (E)	BC, CO, CTR, GC, M, X	CS, DO	B, CT, G, L, WD	ASP (O)	B >10 cm diameter, sod
Shawnee County, KS	14% (e)	14% (e)	None	BC, CO, CTR, GC, M	DO	CT	NA	NA (CT program)
Sioux Falls, SD	20%	****	LFB	CO, CTR, M	CS, DO	CT, G, L, S, WD	W	Branches and brush
Spokane, WA	****	****	None	BC, CO	CS, DO	B, G, GW, L, S, WD	W	B >7.5 cm dia., 2.0 m length
Springfield, MA	****	****	INB, LFB	BC, CO, GC	CS, DO	B, G, L, WD	W (P)	Logs or stumps > 10 cm dia.
St Cloud, MN	****	****	****	CO, CTR	CS	B, CT, G, L, S, WD	****	None
St Thomas, ON	23% (A)	****	None	BC, CO, CTR, M	CS	B, CT, G, L	IV (Q)	None
Sudbury, ON	10% (e)	20% (e)	None	BC, CO, CTR	DO	CT, G, L, S, TS, WD, WW	W	None
Surrey, BC	15%	28%	None	BC, CO, CTR	CS, DO	B, CT, G, L, WD	W (M)	Sod, soil
Tacoma, WA	10% (e)	20% (e)	None	CO, CTR, GC, M	CS, DO	B, CT, G, GW, L, WD	SP	Manure, rocks, sod, soil
Tillsonburg, ON	****	****	None	BC, CO, CTR	CS, DO	B, CT, G, GW, L, S, WD	C	None
Toledo, OH	5% (e)	6% (e)	SSBL	CO, CTR	CS, DO	B, CT, G, L, WD	W	Logs > 25 cm dia, stumps
Toronto, ON	****	****	None	BC, CO, CTR, GC	CS, DO	B, CT, L	W	****
Vancouver, BC	11%	24%	None	BC, CO, CTR	CS, DO	B, CT, G, GW, L, WD	W	Sod, wood waste
Vancouver, WA	25% (e)	25% (e)	None	BC, CO, CTR, GC, M, X	CS, DO	B, CT, G, L, S, WD	W	B > 10 cm dia., sod, soil
Victoria, BC	****	****	None	CO, CTR	DO	CT	****	****
Whitehorse, YK	11% (e)	10% (e)	None	BC, CO, CTR	CS, DO	B, CT, G, L, WD	AW (R)	None

Willmar, MN	****	****	LFB	BC, CO, CTR, GC, M	DO	B, CT, G, GW, L	W	None
Yellowknife, NWT	****	****	None	CO, CTR	CS	CT	NA	NA (CT program)

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X = Yard Waste Minimization Principles (xeriscaping)

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(N) Yard waste is co-composted with manure and, pulp and paper residue.
(O) Yard waste is co-composted with vegetable and wood waste.
(P) Yard waste is co-composted with short paper fibre (papermill sludge).
(Q) Yard waste is co-composted with kitchen waste and industrial organic materials.
(R) Yard waste is co-composted with kitchen waste and non-recyclable products.

APPENDIX E

YARD WASTE CURBSIDE COLLECTION CHARACTERISTICS - SURVEY RESULTS

Community	Curbside Initiation Year	Households Served With Curbside Collection*	Curbside Collection	Collection Period	Pick-up Frequency	Same Day as Solid Waste Collection	Set Out Method for Yard Waste	Collection Equipment	Collection Financed by
Albany, NY	1986	30, 000 (e)	PCPC, PU	Y	WE	Yes	B, KPB, PS	DT, RSLC, SS	RPT
Augusta, ME	1992	7, 000	PU	S, Spring & Fall	WE	No	BPB, CPB, KPB, PGB	RBT, RSLC, SS	RPT
Baltimore, MD	1994	233, 000	PU	S, Oct-Nov	BW, M	No	PGB, PS	RSLC	O (C)
Barrie, ON	1994	27, 000	PCPC	Y	BW	Yes	B, KPB, OC	RSLC	TF
Billings, MT	NA	NA	NA	NA	NA	NA	NA	NA	NA
Bismarck, ND	NA	NA	NA	NA	NA	NA	NA	NA	NA
Boise, ID	1992	54, 000	PCPC	S, Nov-Jan	WE	Yes	B, KPB, OC	RSLC	FRRUB
Brantford, ON	1991	32, 000	PCPC	S, Apr-Jan	****	Yes	B, CPB, KPB	RSLC	RPT, TF
Brooks, AB	1997	1, 000	PU	S, Apr-Oct	WE	No	CC, PS	RSLC	FRRUB
Buffalo, NY	1995	70, 000 (e)	PU	S, Oct-Jan	WE	Yes	B, CPB, OC, PS	DT, FELC, RSLC	FRRUB
Burlington, ON	1996	50, 000 (e)	PCPC	S, Apr-Nov	BW	Yes	B, CPB	RSLC	RPT
Burlington, VT	1995	5, 000 (e)	PCPC	S, Oct-Nov	WE	No	KPB, OC	RSLC	O (C)
Calgary, AB	NA	NA	NA	NA	NA	NA	NA	NA	NA
Capital Regional District, BC	NA	NA	NA	NA	NA	NA	NA	NA	NA
Central Okanagan RM, BC	1998 (PP)	39, 000	PCPC	S, Spring & Fall	****	Yes	B, CPB, OC	RSLC	FRRUB, RPT
Charleston, WV	1996	****	PU	Y	WE	Yes	CPB, PCB	DT, RSLC	FRRUB
Charlottetown, PEI	1993, 1996	9, 000 (e)	PCPC, PU	S, Y (PP)	BW	Varies	PCB, PGB, ROC	DT, V	RPT
Cheyenne, WY	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chicago, IL	1991	740, 000	PU	Y	WE	Yes	CPB (blue)	RSLC	RPT
Chico, CA	1996	5, 600	RSPC	Y	BW, WE	Yes	PS, ROC	RSLC	PCBRD
Cincinnati, OH	1994	100, 000 (e)	PU	S, Apr-Jan	WE	Yes	B, KPB, OC	DT	GF
Columbus, OH	1996	284, 000	PCPC	Y	WE	Yes	B, KPB, OC	RSLC	RPT
Davenport, IA	1990	32, 000	PU	S, Mar-Dec	WE	Yes	B, KPB, ROC	RSLC	MCCRUB
Dayton, OH	1989	73, 000 (p)	PU	Y	WE	Yes	B, PGB, PS	RSLC	O (C)
Decatur, IL	1980's	28, 000 (e)	RSPC	Y	WE	Varies	B, KPB, OC	RSLC	PCBRD

Edmonton, AB	1990	****	PU	S, Jan	1 Pick-up	Yes	****	****	****
El Paso County, CO	NA	NA	NA	NA	NA	NA	NA	NA	NA
Eugene, OR	1997	36, 000 (p)	RSPC	S, May-Oct	WE	No	B, KPB, OC, ROC	RSLC	PCBRD
Fort Wayne, IN	1995	61, 000	PCPC, PU	S, Apr-Dec	BW, WE	Yes	B, KPB, OC, PCB	DT, RSLC, V	FRRUB, GG
Grand Rapids, MI	****	18, 000 (e)	PCPC	Y	WE	Yes	B, CPB	RSLC	O (C)
Great Falls, MT	1992	2, 000 (e)	PU	S, Fall	****	No	B, PCB	SS, V	O (C)
Guelph, ON	1994	35, 000 (e)	PCPC	S, Apr-May, Nov	2 Pick-ups	Yes	B, JB, KPB, OC	RSLC, V	RPT
Halifax RM, NS	1996	2, 000 (PP)	PCPC	Y	BW	No	ROC	HLA, RSLC	RPT, TF
Hamilton-Wentworth RM, ON	****	****	****	****	****	****	****	****	****
Huntington, WV	1996	18, 000 (p)	PU	S, Feb-Nov	CI	No	B, KPB, PCB, PGB	DT, FEL, V	O (C)
Indianapolis, IN	1991	300, 000 (e)	PU	S, Nov-Dec	WE	Yes	KPB, OC, PGB	RSLC	RPT

KEY:

B = Bundles
BPB = Biodegradable Plastic Bags
BW = Biweekly (every other week)
C = Claw
CC = Closed Container
CI = Call In
CPB = Clear Plastic Bags
DT = Dump Truck
FEL = Front End Loader
FELC = Front End Loader Compactor
FRRUB = Flat Rate on Residential Utility Bill
PCBRD = Private Collector Bills Residents Directly
GF = General Fund
GG = Government Grants
HLA = Hydraulic Lifting Arm
JB = Jute Bags
KPB = Kraft Paper Bags
M = Monthly
MCCRUB = Municipality Charges Per Container on Residential Utility Bill
O = Other
OC = Open Containers
PCB = Piled on Curb/Boulevard
PCPC = Public Contracts Private Collector
PGB = Plastic Garbage Bags
(PP) = Pilot Project
PS = Piled on Street
PU = Public
RBT = Rack Body Truck
ROC = Roll Out Cart
RPT = Residential Property Tax
RSLC = Rear/Side Loader Compactor
RSPC = Residents Suscribe to Private Collector
S = Seasonal
SS = Street Sweeper
TR = Tractors
TF = Tipping Fee
V = Vaccum
WE = Weekly
Y = Year Round

(e) = Estimate
**** = Information Not Available
NA = Not Applicable
(p) = Potential

NOTES:

* Rounded to the nearest thousand.

(A) Provo' s program is growing by 150-200 households per year.

(B) Pilot project for year round yard and kitchen waste program, set out methods include: biodegradable paper bags, roll out carts and closed containers.

(C) Other includes one of the following: city income tax, direct boulevard assessment, monthly solid waste collection fee, motor vehicle fund, special pick-up requests based on volume, or surcharges.

APPENDIX E Continued

YARD WASTE CURBSIDE COLLECTION CHARACTERISTICS - SURVEY RESULTS

Community	Curbside Initiation Year	Households Served With Curbside Collection*	Curbside Collection	Collection Period	Pick-up Frequency	Same Day as Solid Waste Collection	Set Out Method for Yard Waste	Collection Equipment	Collection Financed by
Kansas City, KS	NA	NA	NA	NA	NA	NA	NA	NA	NA
Kingston, ON	1995	****	PU	S, May-Nov	2 Pick-ups	No	B, OC, PGB	RSLC	RPT
Kitchener, ON	****	****	****	****	****	****	****	****	****
Lansing, MI	1991	40, 000	PU	S, Mar-Nov	WE	Yes	B, KPB, OC	RSLC	O (C)
Lethbridge, AB	NA	NA	NA	NA	NA	NA	NA	NA	NA
Lincoln, NE	1992	90, 000	RSPC	S, Apr-Nov	WE	No	KPB, ROC	RSLC	PCBRD
London, ON	1995	97, 000	PU	S, Mar-Dec	6 Pick-ups	No	B, CPB, OC	RSLC	RPT
Louisville, KY	1994	87, 000	PU	Y	WE	No	OC, PGB	RSLC	RPT
Madison, WI	1980	60, 000	PU	S, Apr-Nov	BW, M	No	PCB, PGB	RSLC, TR	RPT
Manchester, NH	1993	37, 000 (e)	PCPC	S, Apr-Nov, Jan	BW, WE	No	B, KPB, OC	DT	RPT
Markham, ON	1989	60, 000 (e)	PCPC	S, Apr-Nov	M, WE	Yes	B, CPB, OC	RSLC, V	RPT
Milwaukee, WI	1993	250, 000	PU	Y	CI	No	PCB, PS	RSLC	GG, RPT
Minneapolis, MN	1989	112, 000	PCPC, PU	S, Apr-Nov	WE	Yes	CPB, PGB	RSLC	O (C)
Montreal, PQ	1992	475, 000	PCPC, PU	S, Fall	****	No	CC, PGB (B)	RSLC, SS	RPT
North Vancouver, BC	1998	****	PU	S, Mar-Nov	WE	Yes	B, CPB	RSLC	RPT
Oakville, ON	1996	40, 000 (e)	PCPC	S	BW	Yes	B, CPB	RSLC	RPT
Olds, AB	1996	1, 000 (e)	PU	Y	BW	No	OC, ROC	HLA, RSLC	FFRUB
Omaha, NE	1991	114, 000 (p)	PCPC	S, Apr, Nov	WE	Yes	B, KPB, OC	RSLC	RPT
Oshawa, ON	1986	35, 000	PU	S, Spring & Fall	BW	Yes	B, CPB, PCB	RSLC	RPT
Ottawa-Carleton RM, ON	1996	205, 000	PCPC	S, Apr-Nov, Jan	BW, WE	Yes	B, KPB, OC, PCB	RSLC	RPT
Peoria County, IL	1988	35, 000	RSPC	S, Mar-Nov	WE	Yes	B, KPB, OC, ROC	RSLC	PCBRD, RPT
Peterborough, ON	1993	28, 000	PU	S, Apr-Nov, Jan	WE	Yes	B, KPB, OC	RSLC	RPT
Philadelphia, PA	1985	565, 000	PU	S, Oct-Dec	1 Pick-up	No	PCB	FELC, V	GF
Pittsburgh, PA	1993	120, 000	PU	S, Spring & Fall	1-3 Pick-ups	No	B, OC	RSLC, V	RPT
Portland, OR	1992	130, 000	RSPC	Y	BW	Varies	B, BPB, CC, KPB, ROC	RSLC	PCBRD

Provo, UT	1993	1, 000 (A)	PU	S, Mar-Nov	WE	Yes	ROC	RSLC	MCCRUB
Quebec City, PQ	1988	26, 000	PU	S, May-Nov	WE	Yes	CPB, PGB	RSLC	RPT
Ramsey County, MN	NA	NA	NA	NA	NA	NA	NA	NA	NA
Rapid City, SD	1992	15, 400 (e)	PU	Y	WE	Yes	B, KPB	RSLC	FRRUB
Red Deer, AB	1997	17, 000	PCPC	S, May-Oct	WE	Yes	B, OC	RSLC	FRRUB
Regina, SK	****	71, 000	PU	S, Jan	1 Pick-up	****	****	****	****
Richmond, BC	1996	28, 000	PCPC	Y	WE	Yes	B, CPB	RSLC	FRRUB
Richmond Hill, ON	****	33, 000	PCPC	S, Apr- Nov	WE	Yes	B, CPB, OC	RSLC	RPT
Rochester, NY	1992	68, 000	PU	Y	WE	Yes	B, PCB	C, DT, RSLC, SS, V	O (C)
Sacramento, CA	1953	107, 000	PU	Y	WE	No	PS	C, RSLC	FRRUB
Salem, OR	1997	80, 000 (e)	RSPC	Y	WE	Yes	ROC	RSLC	PCBRD

KEY:

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BPB = Biodegradable Plastic Bags
BW = Biweekly (every other week)
C = Claw
CC = Closed Container
CI = Call In
CPB = Clear Plastic Bags
DT = Dump Truck
FEL = Front End Loader
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APPENDIX E Continued

YARD WASTE CURBSIDE COLLECTION CHARACTERISTICS - SURVEY RESULTS

Community	Curbside Initiation Year	Households Served With Curbside Collection*	Curbside Collection	Collection Period	Pick-up Frequency	Same Day as Solid Waste Collection	Set Out Method for Yard Waste	Collection Equipment	Collection Financed by
Salt Lake City, UT	NA	NA	NA	NA	NA	NA	NA	NA	NA
Saskatoon, SK	NA	NA	NA	NA	NA	NA	NA	NA	NA
Seattle, WA	1989	147, 000	PCPC	Y	BW, M, WE	Varies	KPB, OC	RSLC	FRRUB
Shawnee County, KS	NA	NA	NA	NA	NA	NA	NA	NA	NA
Sioux Falls, SD	1991	****	RSPC	S, Apr-Nov	WE	Varies	KPB, OC, PGB, ROC	RSLC	PCBRD
Spokane, WA	1997	6, 000	PU	S, Mar-Nov	WE	Yes	ROC	RSLC	FRRUB
Springfield, MA	1990	48, 000	PU	S, Apr-Dec	BW	Yes	B, KPB, OC	RSLC	RPT
St Cloud, MN	1991	11, 000	PU	S, Apr-Nov	WE	No	CPB	RSLC	O (C)
St Thomas, ON	1994	10, 000 (e)	PCPC	Y	BW	Yes	ROC	RSLC	RPT
Sudbury, ON	NA	NA	NA	NA	NA	NA	NA	NA	NA
Surrey, BC	1998	78, 000	PCPC	Y	WE	Yes	BPB, KPB	RSLC	FRRUB
Tacoma, WA	1990	50, 000 (p)	PU	Y	BW	Yes	B, OC	FELC, RSLC	O (C)
Tillsonburg, ON	1995	5, 000	PCPC, PU	Y	WE	Yes	PCB, PGB	DT, FEL, RSLC, SS	RPT
Toledo, OH	1993	115, 000	PU	S, Oct-Jan	1-2 Pick-ups	No	PCB	DT, SS, V	RPT
Toronto, ON	1986	****	PCPC, PU	Y	BW, WE	Varies	CPB, KPB, ROC	RSLC, V	RPT
Vancouver, BC	1990	95, 000	PU	S, Oct-Jan	****	No	CPB, KPB	RSLC	FRRUB
Vancouver, WA	1992 (e)	9, 000	PCPC, RSPC	Y	BW	Yes	CC, KPB, ROC	FELC	PCBRD
Victoria, BC	NA	NA	NA	NA	NA	NA	NA	NA	NA
Whitehorse, YK	1997	400 (e)	PU	S, May-Oct	BW	No	BPB, KPB, ROC	DT	FRRUB, O (C)
Willmar, MN	NA	NA	NA	NA	NA	NA	NA	NA	NA
Yellowknife, NWT	1994	6, 000	PU	S, Jan	1 Pick-up	****	****	****	****

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APPENDIX F

YARD WASTE DROP-OFF COLLECTION CHARACTERISTICS - SURVEY RESULTS

Community	Drop-off Initiation Year	Collection Period	Number of Drop-off Depots	Drop-off Depot Supervised at All Times	Yard Waste Received at Drop-off Depot	Plastic Bags Accepted	Collection Equipment	Collection Financed by
Albany, NY	1986	S	1	Yes	Single pile	No	NA (D)	RPT, TF
Augusta, ME	1992	Y	2	No	Single pile	No (C)	O (E), RSLC	RPT
Baltimore, MD	1994	S, Oct-Nov	1	No	Multiple piles	Yes	RSLC, V	GF
Barrie, ON	1994	Y	1	Yes	Single pile	No	****	TF
Billings, MT	1996	Y	1	No	Mutiple piles	No	FELC	TF
Bismarck, ND	1992 (e)	S, Apr-Nov	25	No	Single/multiple pile(s)	Yes	RSLC	FRRUB, SWB
Boise, ID	1992 (e)	S, Nov-Jan	5 (A)	No	Single pile	No (C)	NA (D)	TF
Brantford, ON	1993	S, Apr-Dec	1	Yes	Single bin	No (C)	ROT	RPT, TF
Brooks, AB	1997	Y	1	No	Single pile	No	DT, FEL	FRRUB, RPT
Buffalo, NY	NA	NA	NA	NA	NA	NA	NA	NA
Burlington, ON	1996	Y	1	Yes	Single bin, multiple piles	No (C)	ROT	TF
Burlington, VT	1990	Y	1	Yes	Single pile	No	O (E)	EPS, SU
Calgary, AB	1990	S, Oct-Nov, Jan	27	No	Single bin	Yes	O (E), V	TF
Capital Regional District, BC	1992	Y	1	Yes	Single pile, multiple bins	No (C)	****	TF
Central Okanagan RM, BC	1998	Y	2	Yes	Multiple piles	Yes	FELC, GR	RPT, TF
Charleston, WV	NA	NA	NA	NA	NA	NA	NA	NA
Charlottetown, PEI	NA	NA	NA	NA	NA	NA	NA	NA
Cheyenne, WY	1991	Y	1	Yes	Multiple piles	No (C)	NA (D)	FRRUB, TF
Chicago, IL	NA	NA	NA	NA	NA	NA	NA	NA
Chico, CA	1996	Y	1	Yes	Single/multiple pile(s)	No	DT, RSLC	GAF
Cincinnati, OH	1994	S, Mar-Jan	4	Yes	Single bin	No (C)	ROT	SWB
Columbus, OH	NA	NA	NA	NA	NA	NA	NA	NA
Davenport, IA	1990	Y	1	Yes	Multiple piles	No (C)	O (E)	MCCRUB, TF
Dayton, OH	NA	NA	NA	NA	NA	NA	NA	NA
Decatur, IL	1980's	Y	2	Yes	Loose	No	FEL	TF
Edmonton, AB	NA	NA	NA	NA	NA	NA	NA	NA

El Paso County, CO	1994	Y	2	Yes	Multiple piles	No	FEL, GR	TF
Eugene, OR	1987	****	3	No	Single pile	No	NA (D)	TF
Fort Wayne, IN	1993	S, Apr-Nov	1	Yes	Multiple piles	No	FEL	TF
Grand Rapids, MI	NA	NA	NA	NA	NA	NA	NA	NA
Great Falls, MT	1992	Y	2	No	Single pile	No	****	MCCRUB
Guelph, ON	1994	Y	1	No	Single pile	No (C)	FEL	TF
Halifax RM, NS	1996	Y	2	Yes	Single pile	No	FEL	RPT
Hamilton-Wentworth RM, ON	1996	Y	3	Yes	Single bin	No	FEL, T	RPT
Huntington, WV	1996	Y	1	Yes	Multiple piles	No	FEL, GR	LCA, TF
Indianapolis, IN	1991	S, Dec-Jan	5-7	No	Single pile	No	NA (D)	RPT
Kansas City, KS	NA	NA	NA	NA	NA	NA	NA	NA
Kingston, ON	1991	Y	2	Yes	Multiple piles	No (C)	NA (D)	RPT
Kitchener, ON	****	****	****	****	****	****	****	****
Lansing, MI	NA	NA	NA	NA	NA	NA	NA	NA
Lethbridge, AB	****	S, Jan	3	****	****	****	****	****
Lincoln, NE	1992	Y	1	Yes	Single bin	No	ROB	GAF

KEY:

DT = Dump Truck
EPS = End Product Sales
FEL = Front End Loader
FELC = Front End Loader Compactor
FRRUB = Flat Rate on Residential Utility Bill
GAF = Gate Fee
GF = General Fund
GG = Government Grants
GR = Grinder
LCA = Landfill Closure Account
MCCRUB = Municipality Charges per Container on Residential Utility Bill
O = Other
(PP) = Pilot Project
RBT = Rack Body Truck
ROB = Roll-Off Box/Bin
ROT = Roll-Off Truck
RPT = Residential Property Tax
RSLC = Rear/Side Loader Compactor
S = Seasonal
SCTB = Service Charge on Tax Bill
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SWB = Solid Waste Budget
T = Trailer
TF = Tipping Fee
TFS = Tipping Fee Surcharge
V = Vaccum
Y = Year Round
(e) = Estimate
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NOTES:

(A) Boise, ID has 1 leaf and 4 Christmas tree drop-offs.
(B) Sioux Falls, SD has 1 year round drop-off at the landfill compost site, and 2 seasonal drop-off sites for leaves (Oct-Nov).
(C) Residents are requested to debag yard waste at the drop-off location.
(D) At the composting facility.
(E) Other includes one of the following: back hoe, bucket loader, end loader, rack body truck or a basic truck.

APPENDIX F Continued

YARD WASTE DROP-OFF COLLECTION CHARACTERISTICS - SURVEY RESULTS

Community	Drop-off Initiation Year	Collection Period	Number of Drop-off Depots	Drop-off Depot Supervised at All Times	Yard Waste Received at Drop-off Depot	Plastic Bags Accepted	Collection Equipment	Collection Financed by
London, ON	1995	S, Apr-Nov	2	Yes	Multiple bins/piles	No (C)	****	RPT
Louisville, KY	NA	NA	NA	NA	NA	NA	NA	NA
Madison, WI	1980	S, Apr-Nov	3	Yes	Directly into packer	Yes	RSLC	RPT
Manchester, NH	1993	Y	1	Yes	Directly into packer	No (C)	ROT	RPT
Markham, ON	1989	Y	1	Yes	Multiple piles	Yes	NA (D)	RPT
Milwaukee, WI	1993	Y	2	Yes	Single bin	No (C)	ROT	RPT, TF
Minneapolis, MN	1989	S, Apr-Nov	1	Yes	Single/multiple pile(s)	Yes	****	****
Montreal, PQ	NA	NA	NA	NA	NA	NA	NA	NA
North Vancouver, BC	mid 1980's	Y	1	Yes	Single pile	No	FELC	RPT, TF
Oakville, ON	1996	Y	1	Yes	Single bin, multiple piles	No (C)	ROT	TF
Olds, AB	1992 (e)	Y	1	Yes	Single pile	No	RSLC	RPT, TF
Omaha, NE	****	S, Dec-Jan	6-7	****	****	****	****	****
Oshawa, ON	1982 (e)	Y	1	Yes	Single bin	Yes	ROB	RPT
Ottawa-Carleton RM, ON	1996	Y	1	Yes	Multiple piles	No	FEL	RPT
Peoria County, IL	1988	****	1	Yes	Single pile	No	RSLC	TF
Peterborough, ON	1993	Y	1	No	Multiple bins	No	ROT	TF
Philadelphia, PA	NA	NA	NA	NA	NA	NA	NA	NA
Pittsburgh, PA	1993	Y	4	Yes	Single pile	No	DT, FEL	GG, RPT
Portland, OR	NA	NA	NA	NA	NA	NA	NA	NA
Provo, UT	1993	Y	1	Yes	Single pile	Yes	DT, RSLC	MCCRUB
Quebec City, PQ	NA	NA	NA	NA	NA	NA	NA	NA
Ramsey County, MN	1983	S, Apr-Nov	8	Yes	Single pile	No	FEL, T	GG, RPT
Rapid City, SD	1992	S, Mar-Jan	4	No	Multiple bins	No	ROT	FRRUB, TF
Red Deer, AB	1997	S, May-Oct	1	No	Multiple bins/piles	No	ROB	TF
Regina, SK	NA	NA	NA	NA	NA	NA	NA	NA
Richmond, BC	1992	Y	2	Yes	Single pile, multiple bins	No	DT, O (E)	FRRUB, TF

Richmond Hill, ON	****	Y	1	Yes	Single pile	No (C)	RSLC	TF
Rochester, NY	1992	S, Dec-Jan	5	No	Single bins	No	ROT	SCTB
Sacramento, CA	NA	NA	NA	NA	NA	NA	NA	NA
Salem, OR	1997	Y	1	Yes	Multiple bins	No	FEL	TF
Salt Lake City, UT	NA	NA	NA	NA	NA	NA	NA	NA
Saskatoon, SK	1997 (PP)	S	1	Yes	Single pile	No	DT	RPT
Seattle, WA	1989	Y	2	Yes	Single bin	No (C)	T	TF
Shawnee County, KS	****	S, Jan	****	****	****	****	****	****
Sioux Falls, SD	1991	Y	3 (B)	Yes	Single/multiple pile(s)	No (C)	FEL, ROT	TF
Spokane, WA	1997	Y	3	Yes	Multiple piles	No	RSLC	TF
Springfield, MA	1990	Y	1	Yes	Single pile	No	FELC, GR	GG, RPT
St Cloud, MN	NA	NA	NA	NA	NA	NA	NA	NA
St Thomas, ON	NA	NA	NA	NA	NA	NA	NA	NA
Sudbury, ON	1998	Y	5	Yes	Multiple piles	Yes (clear bags)	****	TF
Surrey, BC	1993	Y	1	Yes	Multiple bins	No (C)	NA (D)	NA
Tacoma, WA	1990	Y	1	Yes	Multiple piles/bins	No	T	FRRUB, TF

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Community	Drop-off Initiation Year	Collection Period	Number of Drop-off Depots	Drop-off Depot Supervised at All Times	Yard Waste Received at Drop-off Depot	Plastic Bags Accepted	Collection Equipment	Collection Financed by
Tillsonburg, ON	1995	Y	2	No	Single/multiple pile(s)	No	DT, FELC	RPT
Toledo, OH	1993	Y	3	Yes	Single pile	No	O (E)	RPT, SU
Toronto, ON	1988	Y	5	****	Single bin	Yes	T	RPT
Vancouver, BC	1995	Y	2	Yes	Single pile	No	FEL, T	FRRUB
Vancouver, WA	1992 (e)	Y	5	Yes	Single pile	No (C)	****	****
Victoria, BC	****	****	1	No	Single pile	No (C)	V	RPT
Whitehorse, YK	1997	Y	1	No	Single pile	No	FELC	RPT
Willmar, MN	****	S, Apr-Nov	1	Yes	Single pile	No	FEL	****
Yellowknife, NWT	NA	NA	NA	NA	NA	NA	NA	NA

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APPENDIX G

COMPOST FACILITY CHARACTERISTICS AND END MARKETS - SURVEY RESULTS

Community	Yard Waste End Product	Public/ Private Compost Facility	Composting Method	Yard Waste Tipping Fee (Dollars*/ Tonne) (N)	Design Capacity (Tonnes**/ Year)	1997 Quantity Processed (Tonnes**/Year) (P)	Facility Equipment	Compost Facility Financed By	End Market
Albany, NY	CO	PU	AW	$4	****	4, 700 t (1996)	FEL, GR, SC	RPT	GRE, MU, SGC, SL
Augusta, ME	CO	PU	W (B)	$0	1, 400 t	300 t	FEL, TP	O (Q)	GRE, MU
Baltimore, MD	CO	PU	W	****	6, 400-9, 100 t	****	SH	TF	MU
Barrie, ON	CO	PPP	W	$0	7, 000 t	5, 300 t	FEL, GR, SC, TP	TF	SL, SRE
Billings, MT	CO	PU	W	$0	****	****	CH, FEL, TP	TF	MU
Bismarck, ND	YW	NA	NA	NA	NA	NA	NA	NA	DLA
Boise, ID	YW	NA	NA	NA	NA	NA	NA	NA	DLA
Brantford, ON	CO	OPOP	W	$70	7, 500 t	2, 200 t	CH, FEL, GR, SC, TP	RPT, TF	GRE, SL
Brooks, AB	CO	PU	W	$0	2, 000 t	400 t	FEL, GR, MS, SC, TP	RPT, RUB	MU
Buffalo, NY	CO	OPOP	W	$31	****	****	CH, FEL, SC, SMWT	TF	****
Burlington, ON	CO	PU	W	$30	11, 000 t	9, 000 t	CH, FEL, GR, SC, SMWT, TP	RPT	GRE, SL
Burlington, VT	CO	PPNPFC	W	$0	9, 100 t	2, 000 t	DT, FEL, SC, SMWT, TP	EPS, TF	S, SRE
Calgary, AB	CO	PU	W	$0	3, 000 t	800 t	GR, SMWT	TF	MU
Capital Regional District, BC	CO	PU	AW	$30	****	15, 000 t	EX, GR, TP	RPT, TF	S
Central Okanagan RM, BC	CO	PU	W	$25	****	200 t	CH, FEL, GR, SC, SH, TP	RPT	MU
Charleston, WV	CO	PU	SP (C)	$0	Unlimited	4, 500 t	****	RUB	****
Charlottetown, PEI	CO	PU	W (B)	$36	20, 000 t	10, 000 t	SPWT	RPT	****
Cheyenne, WY	CO	OPOP	W (D)	$0	9, 100 t	1, 400 t (e), 1998	FEL, GR, SMWT, TP	EPS, TF	SL, SN, SRE
Chicago, IL	YW (A)	NA	NA	NA	NA	NA	NA	NA	DLA
Chico, CA	CO	OPOP	W	$12	30, 000 t	6, 500 t	FEL, GR, SC, SMWT, TP	TF	SL, SN, SRE
Cincinnati, OH	CO	PR	SP	$45 /truck	****	****	FEL, GR, SC	EPS, TF	SL
Columbus, OH	CO, M	OPOP	W (E)	$0	63, 500 t	81, 600 t	FEL, GR, SC, SPWT, TP	O (Q)	SGC, SL
Davenport, IA	CO	PU	ASP (F)	$3	29 t/day	23, 100 t	FEL, GR, SC, TP	GG, TF	MU, SL, SRE
Dayton, OH	YW	PR	SP, W	$2	****	****	FEL, GR, SC, TP	EPS, TF	L
Decatur, IL	CO	PR	SP, W	****	****	****	CH, FEL, GR, SC, SMWT	TF	L, MU, SL

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APPENDIX G Continued

COMPOST FACILITY CHARACTERISTICS AND END MARKETS - SURVEY RESULTS

Community	Yard Waste End Product	Public/ Private Compost Facility	Composting Method	Yard Waste Tipping Fee (Dollars*/ Tonne) (N)	Design Capacity (Tonnes**/ Year)	1997 Quantity Processed (Tonnes**/Year) (P)	Facility Equipment	Compost Facility Financed By	End Market
Edmonton, AB	NA	NA	NA (C)	NA	NA	NA	NA	NA	NA
El Paso County, CO	CO	OPOP	W	$0	Unlimited	****	FEL	TF	LR
Eugene, OR	CO	PR	W	$1	****	****	FEL, GR, SC, SH, TP	EPS, TF	SL, SRE
Fort Wayne, IN	CO	PU	SP (F)	$24	54, 900 t	18, 000 t	FEL, GR, SC	GG, TF	SL, SRE, SSB
Grand Rapids, MI	CO	PR	****	****	****	****	****	****	****
Great Falls, MT	CO	PU	W	$0	34, 000 t	10, 000 t	FEL, GR, SC	RUB	MU, SCO, SRE
Guelph, ON	CO, YW	PU	AW, C (G)	$0	30, 000 t	3, 000 t	D, FEL, TP	EPS, TF	MU, SSB
Halifax RM, NS	CO	PR	ASP (B)	$0	6, 000 t	****	CH, FEL, SH, TP	O (Q)	****
Hamilton-Wentworth RM, ON	CO	OPOP	W	$78	23, 000 t	5, 100 t	SC, SH, SPWT	RPT	SL
Huntington, WV	CO	CDMO	W	$0	9, 100 t	5, 400 t	CH, FEL, GR, SH, TP	O (Q)	MU
Indianapolis, IN	CO	PR	W	$16	****	5, 400 t	CH, D, FEL, GR, SC, SPWT, TP	TF	SRE
Kansas City, KS	NA	NA	NA	NA	NA	NA	NA	NA	NA
Kingston, ON	CO	PU	W	$50	4, 000 t	****	CH, FEL, GR, TP	RPT, TF	GRE, MU
Kitchener, ON	****	****	****	****	****	****	****	****	****
Lansing, MI	CO	PR	ASP, W	$3	5, 400 t	2, 900 t	CH, FEL, GR, SC, SMWT, TP	TF	****
Lethbridge, AB	NA	NA	NA	NA	NA	NA	NA	NA	NA
Lincoln, NE	CO	PU	W	$21	22, 700 t	****	FEL, GR, SC, SPWT, TP	TF	MU, SL, SRE
London, ON	CO, YW	PR	SP, W	$21 - $26	****	13, 300 t	CH, FEL, SC, SH, TP	RPT	DLA, MU
Louisville, KY	CO	PR	SP, W	$2 - $3	30, 000 t	24, 700 t	D, FEL, GR, SC, SPWT, TP	TF	****
Madison, WI	CO	PU	SP	$0	NA	NA	FEL, SC, TP	TF	GFA, GRE
Manchester, NH	CO	PR	W	$22	****	****	FEL, GR, SC, SPWT, TP	****	****
Markham, ON	CO	PR	W	$40	****	****	GR, SC, SPWT	TF	SGO, SL, SRE
Milwaukee, WI	CO	PR	W	****	45, 400 t	25, 900 t	CH, FEL	RPT	****
Minneapolis, MN	CO	PR	SP	$50	****	****	CH, D, FEL, GR, SC, SMWT, TP	EPS, TF	SL, SRE, SSB
Montreal, PQ	CO	PU	AW (B)	$5 - $33	12, 500 t	9, 000 t	D, FEL, SC	RPT	GRE, MU

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APPENDIX G Continued

COMPOST FACILITY CHARACTERISTICS AND END MARKETS - SURVEY RESULTS

Community	Yard Waste End Product	Public/ Private Compost Facility	Composting Method	Yard Waste Tipping Fee (Dollars*/ Tonne) (N)	Design Capacity (Tonnes**/ Year)	1997 Quantity Processed (Tonnes**/Year) (P)	Facility Equipment	Compost Facility Financed By	End Market
North Vancouver, BC	CO	PR	W (H)	$65	200, 000 t (e)	120, 000 t	CH, EX, FEL, GR, SC, SH	TF	S
Oakville, ON	CO	PU	W	$30	11, 000 t	10, 500 t	CH, FEL, GR, SC, SMWT, TP	RPT	GRE, SL
Olds, AB	CO	PR	IV, W	$20	****	400 t	SC, SPWT, TP	O (Q), TF	MU, S
Omaha, NE	CO	PU	AW	$0	31, 700 t	27, 000 t	FEL, SC, TP, WT	RPT	MU, SL, SN, SRE
Oshawa, ON	CO	PR	W	****	****	****	D, FEL, GR, SC, SH	TF	LR, SFA, SL
Ottawa-Carleton RM, ON	CO	PU	W	$0	****	17, 500 t	FEL, GR, SC, TP	TF	MU, S
Peoria County, IL	CO	OPOP	W	$21	****	****	FEL, GR	RPT, TF	GRE, MU
Peterborough, ON	CO	PU	W	$25	11, 000 t (e)	3, 700 t	FEL, TP	RPT	SL, SRE
Philadelphia, PA	CO	PU	W	$0	9, 100 t	3, 800 t	CH, SC, SPWT	O (Q)	GRE, MU
Pittsburgh, PA	CO	PR	AW	$41	****	****	FEL, GR, SC, SH, SPWT, TP	O (Q)	MU, SL, SRE
Portland, OR	CO	PR	W	$28	SPOF	SPOF	FEL, SC, SH, SPWT, TP	TF	SL, SRE
Provo, UT	CO	PU	W (F)	$0	****	****	FEL, GR, SC, TP	RUB, TF	S
Quebec City, PQ	CO	PR	ASP, SP (I)	$32	****	241,000 t	EX, SC	TF	MU, SRE
Ramsey County, MN	CO	PU	SP, W	$0	4, 500 t	4, 500 t	FEL, SC, SMWT, TP	GG, RPT	GRE
Rapid City, SD	CO	PU	W (F)	$0	22, 700 t	11, 800 t	FEL, GR, MP, SC, SPWT, TP	RUB, TF	LR, MU, SL, SRE
Red Deer, AB	CO	OPOP	AW, SP, W	$0	4, 000 t	1, 500 t	SC, SMWT, TP	RUB	MU
Regina, SK	NA	NA	NA	NA	NA	NA	NA	NA	NA
Richmond, BC	CO	PR	W	$3	Varies	10, 000 t	FEL, GR, SC, TP	EPS, TF	SL
Richmond Hill, ON	CO	PR	W	$60	17, 500 t (e)	16, 500 t	FEL, SH, SPWT	TF	SGO, SL, SRE
Rochester, NY	CO	PU	W	$0	6, 800 t	1, 200 t	FEL, SPWT	O (Q)	GRE
Sacramento, CA	CO, M	PU	W	$0	13, 600 t	9, 100-10, 900 t	FEL, GR, SC, SPWT, TP	RUB	SCO, SL, SRE
Salem, OR	CO	PR	SP	$1 - $2	****	13, 600 t	FEL, GR, SC, TP	TF	SL
Salt Lake City, UT	NA	NA	NA	NA	NA	NA	NA	NA	NA
Saskatoon, SK	YW	NA	NA	NA	NA	NA	NA	NA	DLA
Seattle, WA	CO	PR	ASP (J)	$26	149, 700 t	181, 400 t	FEL, GR, SC, SH, TP	EPS, TF	MU, SL, SRE

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Shawnee County, KS	NA	NA	NA	NA	NA	NA	NA	NA	NA
Sioux Falls, SD	CO	PU	W	$8	7, 300 t	****	FEL, GR, SC, SMWT, TP	TF	GRE, MU
Spokane, WA	CO	OPOP	W	$25	36, 300 t	22, 700 t	FEL, GR, SH	EPS, TF	MU, SL, SN, SSB
Springfield, MA	CO	OPOP	W (K)	$7	36, 300 t	33, 700 t	FEL, GR, SC, SH, SPWT, TP	GG, RPT	GRE, MU
St Cloud, MN	CO	PR	****	$40	****	****	****	****	****
St Thomas, ON	CO	PR	IV (L)	$139 / hhld (O)	10, 000 t	3,600 t	SC, SH, SPWT, TP	RPT, TF	SSB
Sudbury, ON	CO	OPOP	W	$0	5, 000 t (e)	4,500 t (e), 1998	FEL, GR, TP	TF	NYE
Surrey, BC	CO	PR	W (H)	****	200, 000 t (e)	120, 000 t	CH, EX, FEL, GR, SC, SH	TF	S
Tacoma, WA	CO	PR	SP	$41	45,400 t	****	FEL, SC, SH, TP	EPS, TF	S
Tillsonburg, ON	CO	PR	C	$35	200 t/day	****	D, FEL, SC, SH, SPWT, TP	TF	SL, SRE
Toledo, OH	CO	PR	W	****	27, 200 t	22, 000t	FEL, GR, SC, SPWT, TP	EPS, TF	SL, SGO, SRE
Toronto, ON	CO	PU	W	$0	70, 000 t	60, 000 t	CH, SC, SPWT, TP	RPT	GRE, S
Vancouver, BC	CO	PU	W	$0	22, 000 t	22, 700 t	FEL, GR, SC, SMWT, TP	RUB, TF	MU, SL
Vancouver, WA	CO, YW	PR	W	$78	****	****	****	TF	SL, SM, SRE (R)
Victoria, BC	CO	PU	****	$0	1, 800 t	1, 800 t	FEL, GR, SC	RPT	S
Whitehorse, YK	CO	OPOP	AW (M)	$0	****	1, 300 m3	FEL, SC, TP	RPT	SRE
Willmar, MN	CO	PU	W	$0	****	****	FEL	RPT	GRE, MU
Yellowknife, NWT	NA	NA	NA	NA	NA	NA	NA	NA	NA

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APPENDIX H

YARD WASTE DIVERSION PROGRAM PROMOTION AND PUBLIC EDUCATION - SURVEY RESULTS

Community	Billboards	Brochures	Composter Sale	Demo Garden	Direct Mailing	Flyer Drop	Kiosks	Newspaper	News Release	Phone Book	Posters	Public Seminars	Publication	Radio	School Programs	Special Events	Television	Telephone Hotline	Utility Bill	Website
Albany, NY		x				x		x				x								
Augusta, ME		x				x		x				x					x			
Baltimore, MD	x	x				x		x				x						x		
Barrie, ON		x		x				x				x			x					x
Billings, MT		x		x				x						x					x	
Bismarck, ND										x										
Boise, ID		x		x				x				x		x	x		x		x	
Brantford, ON		x	x			x		x						x					x	x
Brooks, AB		x						x						x					x	
Buffalo, NY		x				x		x				x			x		x	x		
Burlington, ON		x		x		x		x				x			x			x		x
Burlington, VT		x	x	x				x				x		x	x	x	x	x	x	x
Calgary, AB	x	x		x		x		x	x					x	x	x	x	x	x	x
Capital Regional District, BC		x		x				x				x			x			x		x
Central Okanagan RM, BC		x		x		x		x				x		x	x		x	x	x	
Charleston, WV								x											x	
Charlottetown, PEI					x			x												

Cheyenne, WY		x		x		x		x				x		x	x				x	
Chicago, IL		x		x		x		x						x			x			x
Chico, CA		x						x				x		x		x	x			x
Cincinnati, OH	x	x						x				x		x				x	x	
Columbus, OH		x				x		x				x		x	x				x	
Davenport, IA	x	x						x				x		x		x			x	
Dayton, OH		x										x		x			x			
Decatur, IL		x		x		x		x				x		x					x	
Edmonton, AB		x		x				x				x			x			x		x
El Paso County, CO		x						x	x				x	x			x			x
Eugene, OR		x		x				x				x								x
Fort Wayne, IN	x	x		x			x	x					x	x			x			x
Grand Rapids, MI		x				x		x				x					x	x		x
Great Falls, MT		x						x							x		x			
Guelph, ON		x						x					x	x		x		x		
Halifax RM, NS		x		x		x		x				x			x			x	x	x
Hamilton-Wentworth RM, ON		x						x					x					x		
Huntington, WV								x												
Indianapolis, IN		x						x						x	x		x			
Kansas City, KS	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Kingston, ON		x						x						x	x			x		x
Kitchener, ON	****	****	****	****	****	****	****	****	****	****	****	****	****	****	****	****	****	****	****	****
Lansing, MI		x		x				x				x		x	x		x	x		x
Lethbridge, AB		x		x				x				x					x	x	x	x
Lincoln, NE		x						x				x		x			x			
London, ON		x		x		x		x				x		x	x		x			x
Louisville, KY		x						x				x			x				x	
Madison, WI		x		x	x			x				x								x
Manchester, NH								x						x					x	
Markham, ON		x		x		x		x				x			x			x		x
Milwaukee, WI		x		x		x						x			x			x		x

**** = Information Not Available

NA = Not Applicable

APPENDIX H Continued

YARD WASTE DIVERSION PROGRAM PROMOTION AND PUBLIC EDUCATION - SURVEY RESULTS

Community	Billboards	Brochures	Compost Sale	Demo Garden	Direct Mailing	Flyer Drop	Kiosks	Newspaper	News Release	Phone Book	Posters	Public Seminars	Publication	Radio	School Programs	Special Events	Television	Telephone Hotline	Utility Bill	Website
Minneapolis, MN												x							x	x
Montreal, PQ		x		x				x				x		x			x	x		x
North Vancouver, BC		x		x		x		x				x			x			x		x
Oakville, ON		x		x		x		x				x			x			x		x
Olds, AB						x		x									x		x	
Omaha, NE		x		x		x									x					x
Oshawa, ON						x		x			x			x	x		x			x
Ottawa-Carleton RM, ON		x		x										x				x		
Peoria County, IL		x						x				x			x					
Peterborough, ON		x		x		x		x										x		
Philadelphia, PA								x												
Pittsburgh, PA		x						x				x					x			x
Portland, OR		x	x	x		x		x				x		x				x		
Provo, UT		x				x		x							x				x	
Quebec City, PQ		x										x			x			x		
Ramsey County, MN		x		x				x				x			x			x	x	x
Rapid City, SD		x						x				x		x					x	

Red Deer, AB		X						X						X	X		X	X	X	
Regina, SK		X				X		X				X		X			X	X		X
Richmond, BC		X		X		X		X				X						X		X
Richmond Hill, ON	X	X						X												X
Rochester, NY		X				X		X				X		X			X	X		
Sacramento, CA		X		X				X				X			X				X	
Salem, OR		X		X				X						X			X			X
Salt Lake City, UT	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Saskatoon, SK								X						X				X		X
Seattle, WA		X		X				X				X			X			X	X	X
Shawnee County, KS		X		X				X				X			X					
Sioux Falls, SD		X													X				X	
Spokane, WA		X				X		X				X		X	X		X	X	X	X
Springfield, MA	X	X				X		X				X		X	X		X	X		X
St Cloud, MN	****	****	****	****	****	****	****	****	****	****	****	****	****	****	****	****	****	****	****	****
St Thomas, ON		X		X		X		X				X			X					
Sudbury, ON		X				X		X				X			X			X		
Surrey, BC		X		X		X		X				X		X						
Tacoma, WA		X			X													X	X	
Tillsonburg, ON		X				X		X				X			X		X	X	X	
Toledo, OH	X							X						X	X		X			
Toronto, ON				X	X			X										X		X
Vancouver, BC	X	X		X				X	X		X			X				X	X	X
Vancouver, WA		X						X				X							X	
Victoria, BC	****	****	****	****	****	****	****	****	****	****	****	****	****	****	****	****	****	****	****	****
Whitehorse, YK		X						X				X							X	X
Willmar, MN								X						X						
Yellowknife, NWT								X						X					X	

**** = Information Not Available

NA = Not Applicable

APPENDIX I

POTENTIAL CASE STUDY COMMUNITIES FOR THE CITY OF CALGARY

Communities	Population	Yard Waste Diversion Programs	CS/DO Collection Start Year	Materials Collected	CS/DO Collection Period	Curbside Set-Out Method	Number of Drop-Off Depots	Public/ Private Compost Facility	Composting Method	End Use
Baltimore, MD	703, 000	BC,CS,CTR, DO,GC,M	1994/1994	B,CT,G,L,WD	S, Oct-Nov	PGB,PS	1	PU	W	MU
Bismarck, ND	53, 000	CTR, DO,GC, M	1992	CT,G,L	S, Apr-Nov	NA	25	NA	NA	DLA
Calgary,AB	819,000	CTR, DO	1990	CT,L	S,Oct-Nov, Jan	NA	27	PU	W	MU
Madison, WI	195, 000	BC,CS,CTR, DO,GC	1980/1980	B,CT,G,L, SD,WD	S, Apr-Nov, Jan	BU,KPB,OC	3	PU	SP	GFA,GRE
Minneapolis, MN	355, 000	BC,CS,DO,M	1989/1989	B,G,GW,L,WD	S, Apr-Nov	CPB,PGB	1	PR	SP	SL,SRE, SSB
Ottawa/Carlton, RM, ON	664, 000	BC,CS,CTR, DO,GC	1996/1996	B,CT,G,L,WD	S, Apr-Nov, Jan, Y	BU,KPB,OC PCB	1	PU	W	MU,SO
Ramsey County, MN	497, 000	BC,DO	1983	G,L,SD,WD	S, Apr-Nov	NA	6	PU	SP,W	GRE
Seattle, WA	521, 000	BC,CS,CTR, DO,GC,M,X	1989/1989	B,CT,G,L,WD	Y	KPB,OC	2	PR	ASP	MU,SL, SRE
Vancouver, BC	525, 000	BC,CS,CTR, DO,GC,M,X	1990/1995	B,CT,G,L, SD,WD	S, Oct-Jan Y	CPB,KPB	2	PU	W	MU,SL

KEY:

ASP = Aerated Static Pile
B = Branches
BC = Backyard Composting
BC = Backyard Composting (Master Composter)
BU = Bundles
DLA = Direct Land Application
DO = Drop-off
G = Grass
GC = Grasscycling
GFA = Given to Farmers
L = Leaves
M = Mulching
MU = Municipal Use
NA = Not Applicable
OC = Open Container
PCB = Piled on Curb
S = Seasonal
SD = Sod
SL = Sold to Landscapers
SO = Sold
SP = Static Pile
W = Windrow
WD = Weeds
X = Yard Waste Minimization Principles (Xeriscaping)

CPB = Clear Plastic Bags
CS = Curbside
CT = Christmas Tree
CTR = Christmas Tree Recycling

GRE = Given to Residents
GW = Garden Waste
KPB = Kraft Paper Bags

PGB = Plastic Garbage Bags
PR = Private
PS = Piled on Street
PU = Public

SRE = Sold to Residents
SSB = Sold to Soil Blenders

Y = Year Round

APPENDIX J

COMMUNITY CONTACT LIST - CANADA

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APPENDIX K

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