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REMOVING MAXIMUM KITCHEN ORGANICS FROM THE WASTE STREAM: A CASE STUDY

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ABSTRACT

Reducing the size of the household waste stream is increasingly dependent on the reduction of organics. Until recently, municipal diversion figures in Ontario, Canada have been based primarily on recycling. In an effort to divert organics and keep costs down, communities provide either pick up with processing at a central composting site and/or subsidies on backyard composters. This research, through the application of a pilot project, focuses on kitchen organics in a rural area in Ontario. The study looks at the feasibility of backyard digesting in conjunction with composting versus pickup. An inexpensive animal-proof digester is tested as a means of maximizing on-site composting and addressing resident concerns of cost and small and large animal visitations.

INTRODUCTION

In Canada, regular organics make up 37% of the residential waste stream, food accounting for 22%, and leaf and yard waste 15%. An additional 7% of the waste stream is made of low grade paper, for a total of 44% organics [1]. Canadians generate approximately 11 million tons of waste each year of which five million tons are organic waste. Only a fifth (one million tons) is currently diverted through exiting composting programs [2]. Canada exports 3.6 million tons of municipal solid waste (MSW) a year to the United States of which 2.35 million tons are shipped from Ontario to the state of Michigan. According to U.S. Senator

Debbie Stabenow of Michigan, "(t)his situation places a hidden tax and unfair infrastructure and public health burden on Michigan. At this rate, Michigan landfills will fill up years ahead of schedule." There is also a security concern being raised about the content of the garbage trucks after radioactive contaminated items and a ton of marijuana was found in various shipments crossing to Michigan [3]. In opposition a number of American politicians are arguing for a temporary ban on the importation of Canadian waste and the reinstating of a 1992 treaty that requires advanced notification of waste shipments giving states (or provinces) the chance to object to waste imports [4]. Notification could be used to cause long delays and trigger a crisis since not enough capacity exists in Ontario to dispose of the waste domestically for any length of time [5].

In the United States, 75 million tons (36%) of the 210 million tons in the municipal waste stream is compostable consisting of 28 million tons of yard trimmings, 22 million tons of food scraps, and 25 million tons of low grade paper. According to the United States Environmental Protection Agency [6] removing organics from the waste stream through central composting costs approximately $66/ton, $44.37/ton on average for collection and $21.65/ton on average for composting. In contrast, backyard composting costs on average $12.90/ton.

There are tradeoffs in selecting one form of composting over the other. Centralized composting provides all residents, with or without a backyard, a means to compost. It also can accept all forms of kitchen and backyard organics as well as low grade paper products. Alternatively, backyard composting is less expensive. The organics can be diverted without transportation and processing costs. Many backyard composting programs are based on diverting only a select list of organics, typically excluding processed foods, meats, cheese, and bread. The prejudice against these items is based on a concern of animals, ranging from raccoons and dogs to bears, which these organics can attract. There is also a dislike of the flies which are attracted to meats. As well, backyard composters are limited in space, discouraging the disposal of low grade paper.

This article will examine current organics diversion programs in Ontario, identifying the nature of the programs, the extent of diversion, and participation. Secondly, a compost pilot project in a rural community in Ontario, Canada will be described. The project applied the use of digesters, in addition to composters, to increase the range of organics that can be diverted on-site for residents in single-dwelling homes with backyards. Backyard digestion and composting was compared with pickup and centralized composting. The digesters were designed to be both inexpensive and animal-proof. The results are presented, followed by the implications for composting programs for other rural communities. Recommendations for minor improvements and further research and conclusions are provided.

MUNICIPAL ORGANICS DIVERSION PROGRAMS

Since 1994, Ontario regulations require municipalities with a population of 5,000 or more to have recycling and backyard composting programs and a community composting program for a municipality with 50,000 or more residents [7]. On average, waste diversion in Ontario communities has reached approximately 35% [8]. Success in reaching the 50% diversion target of the Ontario Ministry of the Environment for the household waste stream is dependent on a significant increase in the diversion of organics through composting or anaerobic digestion [1]. Virtually all urban single-family households in Ontario would have to have access to comprehensive organics programs to reach this target [1]. In 2001, centralized composting programs processed 325,000 tons of organic material. There are currently 190 municipalities in Ontario that offer this service to a total of 4,014,000 households. Backyard composting in 2001 diverted about 119,000 tons of organics. Three hundred and sixty-seven municipalities provide backyard composters for their residents, with over 74% of municipalities providing subsidies for the composters. A total of 1,190,000 households in Ontario have been provided with composters [9].

There is not enough space in this article to provide details on all variations and results of diversion programs in Ontario; however, a brief review of some of the MSW diversion programs is helpful to appreciate the impetus for the research presented in this article on using digesters for household backyard organics diversion. Before a program review, it is valuable to ask what would be a reasonable diversion rate for a family. How realistic is the Ontario Ministry of the Environment target of 50%? During the year 2001, Todd Pepper and his family separated and measured their household waste to determine what diversion rate they could achieve using the services (recycling, leaf collection, white goods pickup, centralized household hazardous waste, backyard composting, and centralized yard waste composting) offered in their community of Leamington, Ontario. Over the year, the Pepper family diverted 80% of their MSW with 11.7% of this being food waste and 34.4% yard waste. The family concluded they could come “extremely close to 100% diversion if (they) had access to a centralized composting facility and an enhanced recycling program” [10]. The diversion rate of 35% in Ontario could be a result of limited municipal facilities for diversion and/or lack of incentives for interest by residents. The following review will look at the diversion programs of Toronto, Guelph, Kingston, Centre and South Hastings, Halifax, and Edmonton.

In 2002, the Keele Valley landfill site that took the MSW of Toronto (the largest metropolitan area in Ontario) closed, being replaced with the Carleton Fanns landfill in the state of Michigan increasing disposal costs for the city by 300% [11]. As a result of the increased costs, border uncertainty and resistance by the state of Michigan to the importing of Toronto’s waste, Toronto has set very aggressive diversion targets to reduce waste disposal. Toronto aims to divert

60% of its MSW by 2006 and 100% by 2010 [12]. A green bin program has been developed in Toronto to divert the organics portion of their MSW. The program started in two areas of the city with plans to expand. Residents are required to separate organics for pickup. The organics included in this program are extensive including processed foods, dairy, meat, and animal waste [11].

The City of Guelph, a community of over 100,000, used a two-stream waste system which separates wet and dry items from 1995 to 2003, achieving a 56% diversion rate [13]. In 2003, Guelph introduced a Wet-Dry Plus program aimed at increasing the recycling component of the program and increasing annual savings by $1.7 million. The Wet-Dry Plus program receives an extensive range of organics and low grade paper. Guelph's landfill, Eastview, has become a short-term contingency disposal site for the City of Toronto waste in the event of a border closing increasing the pressure on both Toronto and Guelph to preserve landfill space by increasing diversion [15].

Some communities, looking to increase diversion and decrease costs, introduce a user-pay program. Between 1991 and 1996, 59 user-pay programs were introduced in Ontario. By 2003, the number of programs had risen to approximately 100 [16]. User-pay programs with a 2-bag limit help reduce waste 15-20%, while programs with a one-bag limit reduce residential waste by 25-35% [17]. For example, in 2003, the City of Kingston started a two-bag limit (with plans to reduce the bag limit to one) for weekly curbside waste disposal in an effort to reduce the quantity of residential waste produced and make residents more aware of the cost of waste. Each bag above the limit costs the resident $2 [18]. Kingston, a city of 113,000 people, achieved a diversion rate in 2002 of 41.6%, up marginally from 39.2% in 2001. A waste audit in 2001 revealed that 35% of the materials in a typical garbage bag could be backyard composted, 13% could be sent to the blue box, and 21% could have been diverted if a centralized composting facility was available [19]. The city offers centralized and backyard composting programs. The Kingston Web page on composting recommends excluding the following items from backyard composers: "meat, bones, or fatty foods like cheese, or salad dressing, as they may attract pests." These limits on backyard composting as found in the waste audit lead to organics in the waste stream [20].

Quinte Regional Recycling was a waste diversion program of the Centre and South Hastings Recycling Board, another community that uses backyard composting in combination with recycling and a user-pay program. Centre and South Hastings (C&SH) is a region formed of originally 15 municipalities with a population of over 95,000 residents. In 1991, C&SH set an objective of 71% diversion with 80% of single family householders backyard composting. All backyard composters were given to residents free of charge, costing the community $23 per composter for a total of $500,000, of which two-thirds was covered by the Ministry of the Environment and Energy. By 1996, diversion had reached 66%. Households composting had increased from 34% to 65% with a third of

participating households with two or more composters. Diversion reached roughly 170 kg/yr per composter with a total of 5,000 tons of organics per year being diverted [21] and annual savings of $350,000 [22]. While the diversion results are impressive relative to other communities, the backyard composting creates limits on what organics can be diverted through a backyard composting program. Items discouraged in this program include meat, fish, bones, dairy products, oils, or fats [23].

In December 2003, the Liberal government in Ontario committed to diverting 60% of recyclables by 2008 through the blue box system [24]. In April 2004, the Liberal government increased its emphasis on diversion by committing to 60% diversion of all Ontario waste by 2008 [25].

Two additional Canadian programs outside Ontario that are worthy of note are that of the province of Nova Scotia and the City of Edmonton in the province of Alberta. The province of Nova Scotia, with a population of approximately 1 million, has 18 composting facilities to handle 120,000 tons of organics per year [26]. Nova Scotia also has the distinction of being the only province in Canada to reach 50% diversion [27]. The Halifax Regional Municipality program of Nova Scotia, which serves 350,000 people in Halifax, Dartmouth, Bedford, and Halifax County, was developed out of a province-wide waste crisis. As part of a public consultation process, stemming from the province-wide crisis, organic waste from landfill and incineration was banned in Nova Scotia effective 1998 [28]. In its first year, 1999-2000, the Halifax Regional Municipality program achieved 43% diversion of waste [29] and had reached 54% by the fiscal year 2001-2002 [30]. Despite these admirable diversion figures, one of the leaders behind the diversion success in Nova Scotia, David Wimberly, noted "(e)ven the composting system uses a lot of energy in trucking and processing. Wouldn't it be better to do more low-tech stuff in our own backyard" [27]? A cost study of Cumberland County, a community of 9,500 in Nova Scotia, established annual operating costs, based on 2,500 tons of organic waste being processed, at $47.76 per ton, and debt retirement of an additional $48.00 per ton. This is the same cost as waste disposal in the province [26]. Organics are processed through an aerated windrow facility which takes all forms of organics. Compost is sold for $31 per ton. However, as the organics recovered increases to the composting plants' capacity of 5000 tons, the operating costs will drop 40-50% [28]. These costs show potential savings, especially in rural areas, if backyard digesters were used in conjunction with backyard composters.

As is evident from all the communities mentioned above, increased emphasis is being placed on providing residents with waste stream options other than landfill. The challenge is to find the means to reduce waste generation through composting while keeping costs manageable. This is particularly of concern for small rural communities who are often too small to make centralized composting financially viable. These communities usually have the option of backyard composting but due to animals are not able to obtain the diversion levels achieved

with centralized composting. Within this environment of waste reduction, Seguin Township in Ontario undertook a study to examine the feasibility and cost of backyard digesting in conjunction with composting and compared the cost to pickup for centralized composting. An inexpensive animal-proof digester was tested as a means of maximizing on-site composting and addressing resident concerns regarding small and large animal visitations. The remainder of this article will outline this project. The results indicate that bear and animal proof backyard digesters, used in conjunction with composters, provide a viable and effective alternative to pickup and centralized composting.

THE PROJECT

The goal of the Seguin Township pilot project (project) was to find a cost-affordable kitchen-organics diversion program acceptable to residents and capable of removing 100% of all household kitchen organic waste from the garbage bag and from eventual disposal. The project started June 6, 2000 and ended May 21, 2001. The site of the project was the Village of Rosseau in Seguin Township, Ontario, Canada. The village has a total of 136 households. Out of 53 households approached, 43 households agreed to participate in the project. These 43 households were designated as project households. Five project households were occupied only in the summer season, leaving 38 project households designated as generating waste year round. The remaining village households, the non-participating households, were included in the project as the control group. No businesses were included in the project.

THE PROJECT DESIGN

The project consisted of three four-week phases and an eight-month follow-up phase.

Phase 1 Benchmarking: June 6-July 4, 2000

For four weeks, project households' weekly waste, after recycling, was picked up at curbside and weighed four separate times. Project households did not change any of their prior waste practices. During the same four weeks, non-project households' weekly waste, after recycling, was picked up at curbside and weighed two separate times.

Phase 2 Curbside Pick-Up: July 5-July 31, 2000

For four weeks, project households' weekly waste, after recycling, was picked up at curbside and weighed four separate times. Project households were asked

to also put all weekly kitchen organic waste out at the curbside for pick-up. Project households' weekly kitchen organic waste was also weighed four separate times. During the same four weeks, non-project households' weekly waste, after recycling, was picked up at curbside and weighed once.

Phase 3 Backyard Digesting and Composting: August 15-September 11, 2000

For four weeks, project households' weekly waste, after recycling, was picked up at curbside and weighed four separate times. Project households were asked to backyard compost and/or digest on site all kitchen organic waste. During the same four weeks, non-project households' weekly waste, after recycling, was picked up at curbside and weighed one time.

Phase 4 Follow-Up: October 1, 2000-June 1, 2001

During the eight-month follow-up phase, project households were asked to continue to compost and/or digest all kitchen organic waste. On five separate occasions, one week's waste from all project and non-project households was weighed.

The kitchen organics collected and set out for pick-up or placed in backyard digesters and composters included: all vegetable and fruit products, all dairy and meat products, bread, coffee filters, coffee grounds and tea bags, cooked food scraps, egg shells, and pasta. Compostables not recommended for pick-up or placement in the digester were grass, leaves, and twigs. It was recommended that these items, known as yard waste, be composted separately on the project household property.

The final measurement of the project waste was completed on May 21, 2001 and the results of the final questionnaire were received by October 10, 2001. Information and feedback on the project was gathered through three questionnaires. The first was a household profile filled out when the household agreed to be a participant in the project. The second was an interim questionnaire completed at the end of phase 3. The final questionnaire was completed after phase 4.

The project was designed with two objectives. The first was to establish within Seguin Township a diversion rate for household kitchen organic waste that could be achieved through the implementation of a diversion program. The second purpose was to establish the net cost savings that could accrue to Seguin Township through such a program.

The concept of the project was unique as a curbside collection or backyard composting program because its intent was to take household kitchen organics diversion one step beyond the usual compost solution by providing a means to remove 100% of the household kitchen organics from the waste stream. The high participation rate that the project experienced—41 out of 43 households

participating—is an indication that there is a strong interest in waste reduction through composting and/or digesting in Seguin Township.

BACKGROUND

The project idea was developed in April 2000 by Karen Buck and Ruth McKay, members of the Seguin Township Waste Management Committee (STWMC). The 4-Phase Project was presented to the STWMC for its input and endorsement. On June 5, 2000, the Project was presented to Seguin Township Council where the project and its budget were approved.

The Waste Diversion Organization provided 75% of the funding for the pilot project. The funding was used for labor, administration, materials, and transportation. The Township of Seguin, which contributed the rest of the funding, assisted in the materials administration and equipment expenses.

On June 1, 2001, Seguin Township began the implementation of a new waste management collection system that would standardize waste and recyclables collection across the Township. All residents are now required to self-haul their recyclables and waste to collection and transfer sites. The new system precludes any consideration of a kitchen organics diversion program that would be based on curbside pick-up of kitchen organics that comprised phase 2 of the project. It does, however, offer the possibility of a new kitchen organics diversion program—Self-Haul of Kitchen Organics to Collection and Transfer Locations—for centralized processing or transport to a processing facility. To date, the findings of phase 3, the backyard composting and digesting of kitchen organics, have not been integrated into Seguin's waste management program.

DIVERSION OPPORTUNITIES AND PROGRAMS

In 1996, a waste composition study done in former Humphrey Township (now part of Seguin Township), which included the Village of Rosseau households' waste, revealed that the average waste composition, after recycling, included a range of 37% to 49% compostable material [31]. A 1999 snapshot survey of household waste undertaken by Karen Buck in Seguin Township confirmed that compostables and recyclables make up a significant part of Seguin Township waste. By weighing and photographing the contents of the bags of waste, it was concluded that 50% to 90% of the waste going to disposal was either compostable or recyclable.

Since 1989, recyclable materials from former Humphrey Township and the Village of Rosseau have been processed and marketed through the Materials Recycling Facility in Bracebridge, located in the District of Muskoka Lakes. This recycling facility affords the opportunity to residents to recycle a significantly wide and unique range of products and packaging made from aluminum, glass, paper, plastic, steel, and sometimes textiles. For example, Karen Buck

discovered through a two-week waste audit in 1996 that her family was able to divert 97% of their waste (by weight) away from disposal by using the Township waste management system for recycling and by employing backyard composting and digesting.

SELECTION OF HOUSEHOLDS

The Village of Rosseau was chosen as the site for the project because it includes two target populations—permanent and seasonal households—representative of Seguin Township. Seguin Township has approximately 4,500 households and a permanent population of approximately 3,400. Seguin Township is a Northern Ontario tourist and seasonal recreational destination. It has a permanent plus seasonal summer (mid May to mid October) population of approximately 12,000.

The Village of Rosseau also provided a compact residential area in which to run the project. The project only included occupied households that were located in the curbside pick-up serviced by the company JAC. This area presented controls that were necessary for the identification, separation, and isolation of household wastes at both the curbside and the Transfer Site. Karen Buck and Ruth McKay rode in the garbage truck cab on all project-related waste pick-up days to monitor the waste pick-up process. Without these controls and the convenience of an identified one-day—Monday—waste pick-up, the measurement of household wastes in the project area could not have been accomplished.

DIGESTER DESIGN

The project needed a digester that would be inexpensive, would have sufficient volume, and had the potential to be animal-proofed. A reusable large food barrel was sourced that met all three criteria. The food barrel selected was an ideal digester because it was large and because it had a one-piece screw-on lid that would make it virtually impossible for animals to remove. The round heavy-walled plastic construction of the barrels would also deter animals from successfully ripping or clawing them open to reach the kitchen organics inside. Ultimately, the selected food barrel was purchased directly from a food processor with the result that the price, including delivery to Seguin Township was reduced by 50%. See Figure 1 for a picture of an installed digester on a project household property.

ANIMAL PROOFING

At a cost of $10.00, the food barrels are one-third the cost of a composter but because they are food barrels they are not specifically designed for use as a digester. There are some minor modifications that would improve their performance. The handle area needs a cover or an insert so that an interested bear is

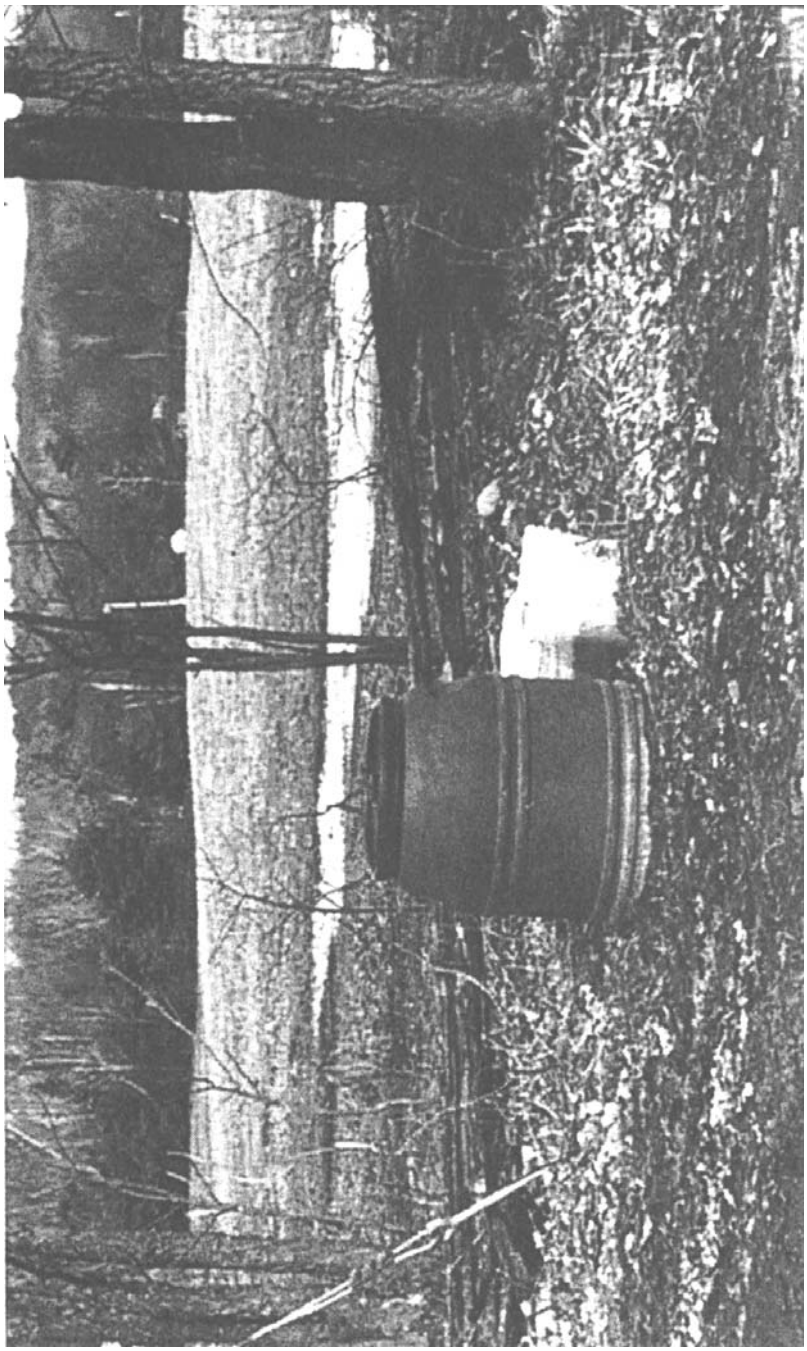

Figure 1. Installed digester on a project household property.

either deterred or, once it has chewed the handle area, does not expose the contents inside. The recessed area of the lid needs an insert to eliminate the pooling of water where mosquitoes could thrive. Barrels that cannot be buried to a depth of one-half (or at least one-third) the total height of the barrel, will need to be secured to a post to keep them in an upright and usable position so they are not dislodged and rolled around by bears.

The food barrels, from now on referred to as digesters, had to be tested to prove their ability to keep animals out. Phase 2 of the project allowed for the digesters to be used and tested. Prior to phase 2, four digesters were dug into the ground at the transfer site on Highway 141 in the former Township of Humphrey. This transfer site has an M.O.E. approved compost area that has been in use as a passive aeration windrow system since 1990. The compost area was not enclosed or fenced and, not surprisingly, it was visited regularly both day and night by bears. For this very reason the transfer site was a wonderful proving ground for the digesters.

The testing of the digesters was completed before their distribution to project households in phase 3 of the project. It was necessary to know that the installation and use of the digester would not be likely to put a household participating in the project at a high level of risk from bears. Although the Village of Rosseau, the project location, is not typical bear country, there are households in sparsely populated areas that are frequented or susceptible to bear visits.

The original plan for the digesters had been to remove the bottom to ensure good soil contact for the organic waste contents. The bottom of the hole where the digester would be installed was to be lined with half-inch-grid hardware cloth to deter animal access. However, two of the first four digesters installed as described and used in phase 2 at the transfer site were ripped out of the ground, presumably by bears, and the exposed open bottom gave the bears easy access to the kitchen organics contents. This was unacceptable.

Four replacement digesters, with their bottoms still intact, were prepared for use at the transfer site. To allow for drainage and some soil contact, 18 half-inch diameter holes were drilled into the bottom of each of the digesters. As part of the ongoing experiment involving the bears, these next four digesters were not dug into the ground but merely placed upright in the same compost area at the transfer site. It was obvious the next day that the bears had a great time rolling and moving the digesters in an attempt to get at the contents, but the digesters had been successful at keeping the bears out. However, an overturned, loose, and rolling digester is difficult for humans to use and, therefore, all four of the digesters plus four more were set into a trench dug to a depth of at least 18 or more inches. With the digesters half to two-thirds buried in the ground, not one was ripped out of the ground by the bears. The digesters, it was decided, were reliably animal-proof. They were distributed in phase 2 to households taking part in the project.

A BEAR VISITATION

Once installed for use on project households' properties in phase 3, the digesters were self-monitored by the project households. The project households were encouraged to report any attempts by animals to reach the kitchen organic waste contained inside the digester. One household reported a successful bear attempt.

The project household found the digester, lid off and on its side, in a recess of ground in the woods at the rear of their property. The bear had been successful at toppling the installed digester out of its hole, rolling it into the woods, removing the lid, and emptying the contents. It was concluded that for the bear to be so successful at removing the lid, the lid on the digester must have been screwed on incorrectly.

Working with the project household it was decided that the digester should be re-installed as a dummy. The digester would not be used. It was re-installed at the same location with the lid screwed on tightly. The bear did come back to investigate as was evidenced by muddy paw prints and teeth marks in the handle area of the digester. This time the bear was unsuccessful.

A second digester was installed in a different location that was highly visible and extremely exposed at the side of a road. The new location, however, afforded little soil to "dig" the composter into the ground. This proved to be a problem. The project household used the digester during the fall and the winter, but in the summer of 2001 the bear toppled the second digester and rolled it near the edge of the woods. Unable to remove the lid, the bear chewed a hole in the protruding handle area of the digester but was unable to access the food inside. See Figure 2 for picture of chewed handle. The project household, unable to use the toppled digester, went back to using the dummy in the original location. The dummy digester, now being used, aroused the bear's interest a second time but the bear was unable to reach the food inside or dislodge it from the ground.

Beyond this bear incident, there were no other notable animal incidents reported with the digesters. One resident reported that the digesters helped to keep the population of mice and raccoons usually attracted to composters away and, as a result, the larger predatory animals like foxes and fishers away. Residents with pets expressed appreciation of a system that permitted them to compost while keeping down unwanted predators that could harm or kill their pets. In phase 2 there were animal concerns at curbside with compost bags being torn apart by dogs, raccoons, or birds before they were picked up. Another problem in phase 2 was the week-long storage of compost within the household.

FINDINGS

In phase 1, with no change in their waste practices, project households generated 15% more waste than non-project households.

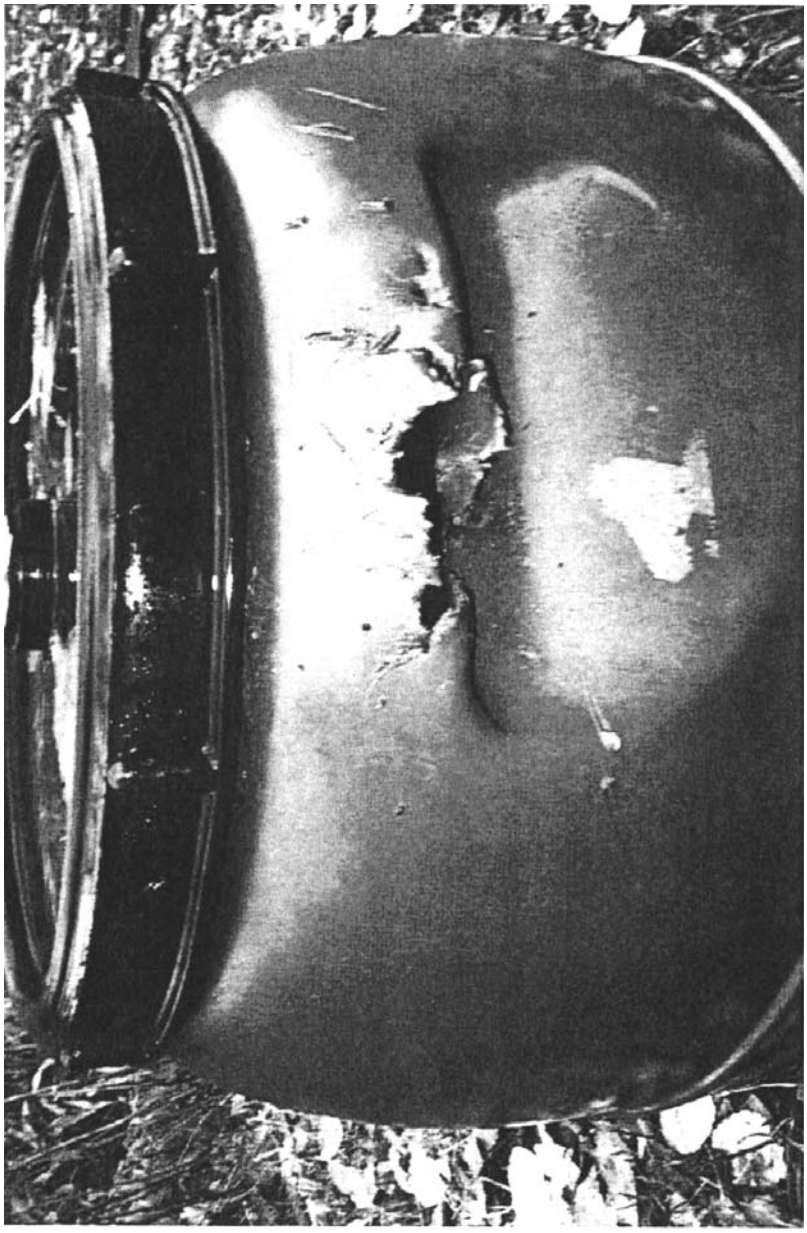

Figure 2. Chewed handle.

In phase 2, with curbside pick-up of kitchen organic, project households generated 52% less waste than non-project households.

In phase 3, with the backyard composting and/or digesting of kitchen organics, project households generated 48% less waste than non-project households.

In the follow-up phase, with continued backyard composting and/or digesting, project households generated 22% less waste than non-project households.

On average, over the project timeframe, project households achieved a 34% waste diversion of kitchen organics, after recycling.

PROGRAM RESULTS

This project has established that there are significant predictable savings that would accrue to Seguin Township through the implementation of a kitchen organics diversion program. A new lift and landfill fee, $85.00 per ton, was finalized by a contract signed by Seguin Township on October 15, 2001. The savings due to composting and digesting were calculated based on this rate.

At the time of the pilot project, the number of households that would have been considered for the program was 3375. A backyard digester diversion program that supplies 3375 Seguin Township households with a digester and 2531 households with a composter and is implemented in a one-year roll-out has the potential to save $290,746 over 10 years. These findings are based on a 34% diversion rate of organics after household recyclables are removed. Over a 20-year time frame, the potential net savings increase to $716,496. Over the long term, 34% was considered to be the most achievable diversion rate; however, the project reached a high of organics diversion of 52%. If sustained, 52% organics diversion would amount to $560,810 in net savings over 10 years, and $1,256,620 net saving over 20 years.

According to the Seguin Township Council, if there was implementation in Seguin Township it would now include 4500 households receiving digesters and 3375 receiving composters due to the recent closure of the only township landfill. With a one-year roll-out at 34% diversion rate after recyclables are removed, the net savings would be $387,662 over 10 years and $955,322 over 20 years. At 52% diversion rate after recyclables are removed, the savings over 10 years would be $747,747 and over 20 years $1,675,497.

The diversion program benefit–cost analysis does not consider any environmental costs and benefits. The environmental costs of landfilling kitchen organics versus backyard composting and digesting might include the increased pollution of waste transportation, depletion of landfill space, leachate treatment, and prevention, and the production and release of methane gas, a greenhouse contributor.

While both programs (curbside pick-up in phase 2 and backyard digesting/composting in phase 3) were equally effective in diverting organics from disposal the backyard digester and composter program was more popular than pick-up

among the project households. This preference was due to the convenience of disposal of organics on one's property eliminating weekly storage, the desired production of compost for gardening, and the perceived tax savings of a backyard program. There were two notable areas of concern expressed by the participants. Firstly, snow accumulation made digesting and composting difficult and less convenient. Secondly, the lids on the digesters were considered difficult by some residents to open and close, in particular when they froze shut on occasion during the winter.

The location of the digester and composter impacted the diversion rate. A convenient year-round location was more likely to encourage year-round composting and/or digesting.

The project backyard digesters and kitchen organic pickup programs were very successful in reducing organics in the waste stream, reducing the quantity of waste produced, and saving money. Seguin Township, despite supporting the project and exhibiting interest in its results, has to date not integrated an organics diversion program component into its waste management program.

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