



The City of Guelph Wet-Dry Recycling Center

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Executive Summary

Guelph, Ontario, (population:100,000), has acquired the reputation of being one of the most advanced communities in North America with regard to the management of Municipal Solid Wastes. This report presents the results of a study of the Guelph integrated waste management system, consisting of visits to the processing facilities, meetings with the Wet-Dry Marketing Officer presently responsible for the operation of the Guelph Materials Recovery Facility (MRF), Mr. Trevor Barton and review of published information on the Guelph MSW collection and processing facilities. The Guelph system consists of citizens separating MSW to "dry" and "wet" materials (consisting mainly of food, sanitary/hygienic and plant wastes). The two collections are transferred to a common MRF facility where the "dry" stream is subjected to manual and mechanical sorting techniques to recover paper, plastic, metal and glass. The "wet" stream is subjected to debagging followed by screening and subjecting the undersize to composting in a Longwood in-vessel bioreactor, followed by storage in static piles and final curing in windrows. The compost product is high quality material sold to top soil blenders and landscapers. The estimated rate of diversion of MSW from landfill is 58% of received material. The report presents operating and cost factors. Citizen participation in this advanced system of waste management is estimated at 98%. The Guelph "Wet-Dry" system is one of the first in North America and has received global recognition.

Basic Facts:

- **Current Capacity** (all numbers shown in this report are in metric tonnes): 48,500 tonnes (16,000 tonnes of wet compostables and 32,500 tonnes of dry recyclables).

The two wet and dry streams are co-collected using a single pass system and specially designed collection vehicles—one person operated 37 cubic yard compartmentalized vehicles, with a 75/25 split for dry and wet waste respectively (by volume). Collection is Monday to Friday, processing of Dry waste is also Monday to Friday in two shifts 7:00 a.m. – 3:00 p.m. and 3:30 p.m. – 11:30 p.m.

The MRF uses both manual and automated sorting to maximize efficiencies and product quality. There is no scheduled annual shutdown.

- **Projected annual capacity:** 135,000 tonnes (44,000 tonnes wet compostables and 91,000 tonnes dry recyclables.)

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- **Process:** Two streams: Wet and dry.
- **Recycled materials:** newspaper, cardboard, fine paper, boxboard, clear and coloured glass, PET, HDPE, mixed tubs & lids (SPI #4,5 resins) steel and aluminum from the dry stream; and hi-grade compost from the wet stream.
- **Organic Composter:** Longwood in-vessel bioreactor, capacity- 44,000 tonnes/year.(3,000 m² ,4,000ft²) The resulting compost has unlimited use rating.
- **Waste diversion:** 58% of material handled by the City of Guelph.
- **Participation rate:** 98% of all waste producers, excluding some private producers, (Apartment complexes, IC&I etc) who ship waste to external transfer stations for disposal and/or Michigan landfills.

Introduction

The City of Guelph (population 100,000) is located in Southern Ontario, approximately 50 miles west of Toronto. In 1983, the City of Guelph and the County of Wellington formed a joint Waste Management Master Plan to investigate and implement waste diversion options over the next 25 years. In 1989, Guelph began a Wet-Dry Recycling Pilot project that involved 900 households over a six-year period. It was decided that a two-stream option was the best, using green colored bags for principally food and plant wastes and blue bags for "dry" waste as the best collection method. In 1995, Guelph was converted to Wet- Dry Recycling and the Materials Recovery Facility (MRF) center was first opened to receive MSW. The dry stream came on line first, and the wet stream two months later. The center is managed by the Corporation of the City of Guelph. At the present time the rate of diversion of MSW from landfills is approximately 58% of all waste entering the facility. The MRF is also certified to receive waste from other municipalities and private enterprises all over Ontario.

MSW Process Overview:

The MSW is initially sorted into wet and dry streams by residents. Green bags are used for wet and blue bags are used for dry. This stage is critical and relies heavily on participation by the population. Guelph has achieved 98% compliance and the program has been well received. It has been in full operation for five years.

The IC&I sector waste is dealt with through a modified two-stream process to better suit the needs of the various clients. The MSW is then collected in two-compartment trucks and taken to the processing plant where the wet and dry begin their respective treatments.

Dry Stream of MSW (approx 20 tonnes/hour) –see Figures 1-5

Dry waste is brought to the Material Recovery Facility and is inspected for non-processable materials. Then it is sent through a pre-sort station where oversized items that might interfere with the mechanical operations that follow are removed. It is then sent to a ballistic separator that separates two and three-dimensional items. "Two-dimensional" materials such as waste (paper, cardboard, etc.) are mechanically shaken and in essence "floats" to the top of the ballistic separator where it travels onto a conveyor into a manual sort room for positive recovery of fiber materials and any incidental containers which are manually sorted, baled and stored for shipment to market. "Three-dimensional" waste falls to the bottom of the ballistic separator due to shaking and is conveyed past magnetic separators to remove steel and iron, then through air streams to remove heavy items from light, such as aluminum and plastic glass. An eddy current separator then removes aluminum from plastic. Heavy items are sorted on a ring sorter, which is a round metal conveyor where materials like glass, metal and/or plastics are sorted by hand. The clear flint and the coloured glass is hand sorted into roll-off containers for shipment to market. The plastics are sorted by hand by type for storage in bunkers before baling. Please note in the ceiling of the bunkers the PET bottles travel through a bottle perforator which helps in maximizing the density of the bales. All the recovered materials from the three-dimensional waste stream are stored for shipping; the remainder may be passed through a secondary sorting station for a final inspection. All material passing this stage is compacted and sent to landfill.

The process is rather labor intensive, (proper sorting results in a more pure and saleable product), but it results in a major reduction in the amount sent to landfill sites, a major consideration in regards to New York City. Also, by separating wet and dry, transfer stations would be less odorous because the wet materials in the stream to be sorted and recycled are greatly reduced.

Wet Stream of MSW (approx 25 tonnes/hour) –see Figures 1 & 6-10

Wet waste is brought to the Organic Waste Processing Facility and is inspected for non-processable materials as it is mechanically loaded onto the feed conveyor using a front-end loader. Then it is sent through a screw-thread auger to open the bags, there is some size-reduction before the material tumbles in a trommel screen which removes oversized material and plastic. There is no hand sorting on the wet side. Material removed at this stage is sent to the landfill. The remaining feedstock waste is passed under a magnet to remove ferrous, mixed with carbonaceous materials such as wood chips, shredded yard waste, animal bedding in the primary staging area. A front-end loader is again used to fill the composting bays.

The primary stage takes about 6 weeks of daily turning, a further 4 months where the material sits in static piles inside the compost building, followed by 2-4 weeks of windrow curing after screening through a ½ inch trommel.

The organic waste processing facility and composter incorporate a Longwood in-vessel channel composter and a curing area. It is fully enclosed with a turning machine to move material through the channels, an aeration system to maintain the correct temperature and a watering system to maintain proper moisture level. All air within the composter is passed through biofilters prior to venting to the atmosphere. These are large banks of finished compost and wood chips through which the air from the composting facility is forced to flow through. The wood chips/compost and the population of microorganisms present help to remove VOCs and reduce odours.

In 1998, the temperature was recorded daily in six of the eight channels (or bins), (two channels are empty and currently not in use), at 26 points in each channel corresponding to the location of 24 sprinkler nozzles, located approximately three meters (10 ft) apart. The other two temperature locations are the charging area and the header of the bin, which are located before the first sprinkler nozzle. Generally speaking, a temperature of 55 °C (131 °F) or greater was attained in each bin. In one month, a single bin can reach 55 °C as many as 100 – 160 times. In the winter months, both the feedstock and the bulking agent are frozen and the make-up air is cold, therefore it takes long to reach 55 °C in the front part of the bins. To aid in thawing out the frozen material, shredded yard waste, which continues to cook outdoors during the winter, is added. Wet waste reaches temperature easily in the last two thirds of the bin, but may not be completely composted by the end of the bin. Therefore, in the cold months of the year, the temperature of 55 °C is only seen in the secondary composter as the material finishes the composting process. In comparison, in the summer months, the highest rate of composting occurs in the primary composter, so the temperature of 55 °C is attained less often in the secondary composter (curing period).

The resulting compost is of high quality and is sold in bulk for "top dollar" prices of \$30- \$50/tonne. Recent tests give the compost an unrestricted rating, and it is being sold to topsoil blenders, landscapers and nursery operators, with demand far outweighing supply. The total quantity of compost sold in 1999 was 2,650 tonnes; estimated sales in 2000 are expected to exceed 3,000 tonnes.

Discussion and some thoughts re application to New York City

In general, Guelph has focused on producing quality recycled products in all categories and this has paid off in preferred supplier status for all produced commodities. Guelph has arrived at this position by implementing this operation in stages, with promotion and education of residents to obtain their acceptance and participation. Now that it is a proven success, such a system could be implemented in other locales, if resident participation and compliance can be obtained. Also, at the MRF end, if sorting is done properly, valuable products can be produced for sale. The key to success is the "positive sort".

Starting an initial operation on a pilot scale to work out the bugs and then increasing the scale by steps, as Guelph did, is a good way to proceed. Once an operation is running it can be improved over time. Any reduction in waste is a bonus and once all the benefits are factored in, it is cost effective also. This may be more so in NY, where MSW is transported to out of state landfill at the cost of US\$60/short ton and is bound to increase with time. In Guelph, the cost of this operation is slightly higher than the previous blue box/garbage system, however it diverts 158% more material from landfill, a factor that is of

major importance in New York City. Also, again the quality of life in areas with transfer stations would be greatly improved by the elimination of the wet organic component.

Residue to landfill

In 1996, staff began reprocessing every second or third organic residue compactor to recover oversized fruits and vegetables, which had not been recovered initially. In 1998, the residue from the organic waste processing facility totaled 3,009 tonnes, equivalent to 18% of the incoming wet waste. In addition, 1,461 tonnes of screened compost residue was also sent to landfill.

Dry residue totaled 10,348 tonnes sent to landfill but with modifications in production of the items that become waste, perhaps more could be reclaimed if it can become a saleable commodity. Crossover of items improperly bagged also leads to losses in recyclables, as well as making the job of the center more difficult as well.

At any one time, an inventory of waste received remains in the system, i.e. processing and handling is incomplete in that the material has not been transferred off-site. The amount of material that has not been processed and transferred off-site is the difference between the incoming weights and the outgoing weights. This quantity in inventory averages about 6,708 tonnes. Over 90% of this is windrows of leaves and shredded yard waste used as feed stock for the composter, curing piles of finished, screened compost stored on the compost pad and composting material inside the composter. The remaining 10% of inventory is recyclables in storage bunkers, baled or bulked awaiting transport to markets. A very small percentage, (1-2 days worth), of dry materials is unprocessed material on the tipping floor. The amount in inventory has decreased by 3,000 tonnes since 1997. This is a result of an improved marketing infrastructure which has buyers for compost moving the material off-site as soon as it is released.

Diversion Costs

The rate of diversion for the center is not based on quantities sold to market but rather on the difference between tonnages received and tonnages sent to landfill. This is because, for the wet process, only a portion of the diversion produces a product. Much of the diversion is due to the loss of tonnage through the composting process itself, also, evaporation of moisture from the organic waste typically results in 40-60% volume reduction. In summary, the diversion of wet waste from landfill in 1998 was 71%, whereas the dry waste diversion was 48%. Based on a weighted average, the over-all diversion from landfill for the center was 56% of all waste received.

The total cost for development of the center was \$36 million. This includes \$24 million for construction of the wet-dry facility itself and \$12 million for the approval process, legal fees, public consultation, the monitoring program (background levels), design and consulting fees.

In 1996, about 12,000 metric tonnes of wet waste were processed at the facility. An estimated 67 per cent of the wet waste stream and 51% of the dry waste stream was diverted, for an over-all diversion rate of 58 per cent. The residue was disposed at the local landfill for a tipping fee of \$53/tonne.

In 1997, over 16,000 tonnes of wet waste and 23,000 tonnes of dry waste were processed at the facility. Wet waste diversion from landfill was 75%, while dry waste diversion was 45%, for a total net diversion of 58%.

Collection costs are approximately \$49/tonne. This compares favourably with the average collection costs of \$60/tonne for the previous system (a semi-recycling system with limited diversion from landfill). Net waste processing costs are approximately \$50/tonne. Revenues for material recovered and

sold by the center average \$104/tonne. In 1998, a total of 3,204 tonnes of finished, screened compost was sold, which is nearly four times the amount sold in 1997. The majority of the produced compost was sold to several excavating companies who are the main customers for compost. They use the soil as a replacement for peat moss in triple mix soil blends produced for landscapers and nurseries. Other compost customers range from home owners to businesses and schools.

Shredded yard waste amounting to a total of 2,000 tonnes was sold to soil excavating companies, businesses and schools. Due to the low economic value of shredded yard waste, a public drop off area has been established where residents can help themselves of this material for free.

In the same year, the center sold 12,611 tonnes of recyclables of which newsprint and cardboard comprised over 75% of the total. Film plastic from industrial sources, textiles, poly-coat and mixed paper/foil had poor market prices or no market at all. The production of some of these items should be modified or discontinued in order to increase recyclability. A total of 422 tonnes of scrap metal and white goods were recycled, (Bumble Bee Recycling) while 50 tonnes of scrap tires were recycled (Recovery Technologies). Clean concrete (90 tonnes) and scrap wood reduced through tub-grinding (706 tonnes) were used in roadway construction at the landfill site, about 3 miles from the center. In addition, 2 tonnes of pallets were sold for re-use. The total revenue from the sale of recycling materials in 2000 is estimated to be about \$3,000,000 dollars CDN. The following tabulation examines the total costs and revenues of the Guelph system.

Table 1. Capital and operating costs of Guelph waste management system
(Annual basis; all figures in metric tonnes and CDN\$, 1999 figures)

	Tonnes	Unit cost	\$
MSW collected	48,404	49	2,372,000
Costs:			
"Dry" stream processed	32,789	50	1,639,000
"Dry" residue to landfill	16,281	53	863,000
"Wet" stream processed	15,619	50	781,000
"Wet" residue to landfill	4,325	53	229,000
Capital annual charge*		56	2,600,000
Total Costs			8,484,000
Revenues from sale of recovered materials		Total	2,000,000
Paper, metals, etc	16,126		
Compost product	3,726		
Costs-revenues:			6,484,000
Net cost per tonne of MSW collected:			133

* calculated on the basis of \$26 million investment at 10% and twenty year plant life

Summary and conclusions

The City of Guelph has achieved major reductions in the amount of MSW sent to landfill through the implementation of a two stream waste disposal system. The recycled products are of top quality and high

value. Also, as markets for recyclables increase, more of the dry component can be re-claimed. As the cost of landfilling increases, more of the non-municipal component that is currently being sent U.S. landfills will join the two-stream process. On the other hand, the cost of processing is dropping rapidly. For on-going information about Guelph's Wet-Dry operation, please visit the [Guelph municipal web-site](#). (The URL is available on the reference page.) It is expected that the operation will break even eventually. A trend toward major cost reductions has been evident from the initial start up.

Guelph has achieved this due in no small part to civic participation. Without the proper sorting at the producer level, an operation like this cannot succeed. Guelph initiated various public relations efforts and participation information releases ahead of full implementation of the system. Also, some produced materials (packaging, composites, etc), are totally useless and detrimental to recycling in general and their production should be discontinued or modified. This is beyond the power of any city to control, but worth mentioning in regards to recycling in general.

**PLEASE CLICK ON THE NUMBERS BELOW FOR FIGURES 1-10, TO VIEW ON FULL SCREEN,
PRESS F11 ON YOUR KEYBOARD**



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(or just print this, and the images in landscape format)

For more information about Guelph's Wet-Dry MSW operation, please contact [Trevor Barton](#) at (519) 767-0598, or e-mail at tbarton@city.guelph.on.ca
You can also visit the Wet-Dry website at <http://www.city.guelph.on.ca/document.cfm?category=180>
or click on the logo below.

References:

1. [Trevor Barton](#), Wet-Dry marketing Officer, Guelph WDRC
2. Nicole Heber, Community Relations Co-ordinator, WDRC
3. Maria Kelleher, Senior Consultant, Resources Integration Systems, Toronto
4. Arthur Andersen, Facility Benchmarking Study for the City of Guelph, WDRC
5. 1996-1998 Annual Reports, City of Guelph, WDRC
6. Summary of Preliminary Findings, 1991, City of Guelph, WDRC
7. All diagrams courtesy of the City of Guelph, WDRC

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