North Carolina Department of Environment and Natural Resources

DIVISION OF POLLUTION PREVENTION AND ENVIRONMENTAL ASSISTANCE

Frank Porter Graham Elementary School

Waste Assessment And Organic Recycling Report

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101 Smith Level Road,
Chapel Hill, NC 27516

Introduction:
Frank Porter Graham Environmental Science Teacher, Karen Daniel requested assistance to review the waste stream, primarily the organics being generated in the kitchen/cafeteria and help design a organic recycling program. On September 25, 2003 a meeting was held at the school to outline the project. In attendance were Karen Daniels, Teacher at Frank Porter Graham Elementary, Muriel Williman, Orange County Solid Waste Department, Rachel Eckert and Brian Rosa, both Environmental Specialist from NC DENR, Division of Pollution Prevention and Environmental Assistance. Karen Daniels outlined the current recycling activities, waste handling practices and we discussed possible composting opportunities. We also did a walk through to review the waste and recycling practices and to determine to best way to analyze the organic waste being generated in the kitchen/cafeteria.

Objectives:
This Project Has Three Objectives

1. Identify the Waste Stream in the Kitchen/Cafeteria
    a. What types of waste are being generated?
    b. How much waste is being generated?
    c. How much is it costing for disposal?
    d. What portion of the kitchen/cafeteria waste can be recycled or eliminated from disposal
    e. What portion of the kitchen/cafeteria (organic) waste can be collected and composted
2. Design a collection system in the kitchen/cafeteria to collect all organics with the minimal amount of disruption to staff and students and to be contamination free
3. Design and build a Vermi-composting (worm) system that has capacity to consume all the organics collected on a daily basis.

Steps:

1. Walk Through to observe current practices.
    Team (Karen Daniels, Muriel Williman, Rachel Eckert, Brian Rosa) walk-through through the school to observe how the recycling and waste is currently being handled
2. Waste Assessment
    Set up a three-day separation, collection and weighing of all waste being generated in the Kitchen/Cafeteria for breakfast and lunch.

3. Organize staff and students.
    Inform staff and students of the three-day procedure
    Get student volunteers to monitoring and assist the younger students to sort into designated containers.
    Brian Rosa and/or Muriel Williman to be on site at each meal to collect weigh and record all the weight data.

4. Tabulate all data and make recommendations.
   To graph all the weight data to determine what the actual weight of the all the waste and food waste being disposed of.
   Determine what portion of the food waste could be diverted into an organic recycling program (Vermi-composting)
   Determine and make recommendations to other waste reductions options
   Design a Vermi-composting system that has the capacity of consuming the food waste being generated (captured)

Current Waste Characterization

Current Waste Disposal

2- 8 cu yd Dumpsters being dumped per week = cu yd disposed of per year

Current Cost of Disposal

$. per 8 cu yd x per week = $. per year

Recycling

Paper Tons per year
Plastic Tons per year
Aluminum Tons per year
Diversion/Savings

Kitchen/Cafeteria Waste Assessment Data (based on collection of data for three (3) days)

Material Collected	Average Weight Collected (based on 3 days data, breakfast & lunch)
Food Waste	96 Pounds per day
Paper	31.5 Pounds per day
Milk	68.5 Pounds per day (@ 8 Lbs per gallon = approx 8.5 gallons)
Trash	28.8 Pounds per day
Styrofoam Trays	21.8 Pounds per day

Total Waste 246.6 Pound per day 1233 Pounds per week 24.6 Tons per year
Based on 1233 LBS/Week x 40weeks

Number of Meals Served (Average)

Breakfast	Lunches	Average
55	340	395 Meals/ Day

Average Waste Generated per Day per Meal
395 meals generates 246.6 Lbs = .62 Lbs per meal per day

Note: Styrofoam averages 22 Lbs per day by weight but take up 330 gallons or 1.633 cu.yd per day x 5 days per week = 8.15 cu.yd per week

Observations/Comments:

Paper (milk cartons, napkins & hand towels) (31.5 lbs. per day) To be collected, ground and mixed with food scraps to be recycled into worm food. Provide a 30-gallon container with plastic liners.

Milk (68.5 lb. or 8.5 gallons per day) Remind all students/diners to drink all of their milk and to take only if they are going to drink. Provide a 5–10 gallon pail to collect any residual milk to be dumped into a drain for disposal. The pail should be situated next to the paper collection container.

Trash (28.8 lbs per day, 24 % of total weight) Trash is made up of plastic containers, packaging and wrappers. Some of these containers that are made of # 1, # 2 & # 6 plastics (cereal bowls) could possibly be recycled? Consider alternatives to some of the pre-packaged foods to eliminate their packaging.

Food (96 lbs per day, 33 % of total weight) Some of the foods collected caused a significant amount of waste. Corn on the cob and baked potatoes both on the same day. Both food items were served, but much of it ended up in the waste. All food waste could be collected and recycled into worm food.

Styrofoam (22 Lbs. per day by weight) The Styrofoam averaged (11 – 30 gallon bags) 330 gallons or 1.633 cu.yd per day x 5 days per week = 8.15 cu.yd per week. That is equivalent to one 8 yd. dumpster per week being dumped to dispose of 2000 Styrofoam trays or 110 Lbs. at a cost of $ per week! By eliminating the Styrofoam trays from being disposed of at a cost savings of $ per week, the cost savings would offset the price difference for alternative trays. An alternative to Styrofoam trays would be biodegradable trays made from paper mache or other biodegradable materials. (See attached product information) The biodegradable trays could be collected, ground and recycled into worm food.

Recommendations

The intent of this project was to analyze the waste being generated, find out what is the character of that waste stream, and what portion of that waste is organic. With that information, design a Vermi-composting system with the capacity to consume all the organic waste being generated. If we design to the specifications that worms (Eisenia fetida) can consume half their weight per day. Eisenia fetida (red wiggler) worms require one (1) sq. ft of surface area per pound of feedstock per day. An organic waste collection program at FPG could capture approx. 125 Lbs. food and paper per day. If the school would switch to biodegradable trays, that would increase the organic material collected by about 25 Lbs. per day, or a total of 150 Lbs. per day.

I would recommend that FPG move forward with this project based on the 100 - 125 Lbs. of feedstock per day. When FPG changes to biodegradable trays the vermi system could easily expanded at that time.

At 125 Lbs. per day feedstock, the vermi system size should be about 100 - 125-sq. ft in surface area. Allowing for weekends for the worms to keep up, I believe we could build a system with 100 sq. ft surface area to be sufficient

Vermi-System Design

Worm Digester Specifications:

Require two (2) worm beds – (Dimensions) 2 'x 5' x 12', made of ¾" plywood and insulated with 1" foam. All internal surfaces covered with 1" foam and wrapped in plastic. External surfaces painted with white enamel paint. A substitute bed could be made from a recycled insulated garage door.

Shredder:

Worms require that their food be pre-digested or broken down by bacteria before they can consume. In order to facilitate this and speed up that process we need to grind or shred all the feedstock to provide a larger surface area for the bacteria to digest.

Budget:

Quantity	Item Description	Cost
2	Worm Beds – 2' x 5' x 10' insulated side, end and lid panels Lid to hinged for access (garage door) Or	$ 1200.00
2	Worm Beds – 2' x 5' x 12' insulated plywood side, end and Lid panels; Lid hinged for access (fabricated by volunteers)	$ 750.00
200'	Greenhouse heater cable (110 volt)	$ 75.00
25 '	¼" mesh hardware cloth (rodent proofing)	$ 25.00
50 Lbs.	Red Wiggler Worms (Eisenia fetida)($ 500.00 value)	N/C (donated)
1	Model # 10 CS Bell Hammer Mill (or equivalent) (240 volt)	$ 2500.00
2	30 Gallon collection containers	$ 30.00
2 Pair	Rubber Gloves	$ 10.00
1	Flat Shovel	$ 20.00
1	Garden Rake	$ 20.00
1 – 50 Lbs.	Bag – Agricultural Lime	$ 10.00
Total Cost		$ 3365.00 - $ 3815.00

Additional costs: have 240v single phase wired for the shredder.

Optional:

Greenhouse (20' x 20') to house the vermi-system, to help control the temperature and precipitation

Garden cart to haul the food waste to the vermi-system and to haul finished castings.

Small screener to screen out the finished castings. (To be designed and built by volunteer)

Other Materials Needed for Collection

Collection Containers

Trash	1 – Trash Container (30 gallon, existing) - Disposal
Milk	1 – 5 or 10 gallon pail – Disposal (drain)
Food, Paper, Biodegradable	2 – 30 gallon containers - Feedstock
Styrofoam	1 – 30 gallon container – Disposal

Vermi-System Operation

A few essential things to consider when considering a vermi-system (Worm composting).

- The Vermi-system is not a machine; it is a system that houses living organisms.
- The living organisms have certain needs or requirements to do their job (survive)
- As an operator, you are the caretaker of those living organisms.
- It's up to the operator, to know what those requirements are and provide them to the best of their ability.
- To realize that this is a long-term project. (100,000 worms lives area at stake)

Vermi-System Requirements

- Ideal Temperature Range 65 – 85 degree F, cooler temperatures slow the bacteria action, which slows decomposition and affects the worms eating ability, too warm and the worm will try to get away from the heated area. 100 degree F will kill a worm
- Moisture rate should be at 70% +, worms breath through their skin, the worms draw oxygen from the water (moisture) in the bedding/feedstock.
- The red wiggler requires high amount of nitrogen in its diet.(originally found in manure piles) food waste has about the same nitrogen content as manure (20-30:1 c:n ratio)
- Although the worms can survive extreme pH, a balanced 6.5 – 7.5 is preferred.
- Salt is a killer to worms, try to eliminate as much as possible (if the kitchen is serving a very salty dish, maybe you should discard it)
- The worms can be left alone for an extended period of time. Make sure that they will have enough moisture while you are gone. More moisture is much better than not enough.
- Harvesting of the castings (worm poop)can take place as often as you think it needs to be done. The worms can re-eat their own waste up seven times before it becomes toxic to their system.

Organic Recycling/Vermi-System Daily Operations

- Collect all food and paper (organics) waste from the kitchen/cafeteria contamination free.
- Grind/shred all organics through the shredder and mix well.
- Spread the ground and mixed organic feedstock onto the top of the worm beds. Try to spread a even layer covering the entire surface of the bed.
- Monitor the moisture, making sure the bedding/feedstock is maintaining enough moisture. (70%)
- Aerate the worm beds by pitch forking around the beds. (1 - 2 times a week)
- Monitor the health and population of the worms. (dig into the beds and looking at the worms, worm cocoons and other critters throughout the bed)
- Monitor the worm/food balance. Make sure the worms are keeping up with the demand. We can always add more worms.
- Broadcast several handfuls of agricultural lime throughout the bed 1 – 2 per month to help maintain the pH.