UBC Social Ecological Economic Development Studies (SEEDS) Student Report

Implementing a Composting System at UBC Okanagan: A Feasibility Study

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Executive Summary

UBC Okanagan is on a mission is to become the "greenest" campus in Canada. Organic waste composting would reduce the amount of solid waste that UBC Okanagan sends to the landfill, and would provide material for landscaping on campus. The purpose of this research project is to identify an appropriate composting system for UBC Okanagan. A suitable composting system must take into consideration the following: composter capacity, acceptable compostable materials, rates of decomposition, purchase and maintenance costs. I had informal conversations with people working at UBCO to determine the location, logistics, and system requirements for a composting system on campus. Kris Bruckmann, the Aramark Food Service Director, and Darren Bezanson, the Aramark Head Chef, provided information on waste production in the kitchen and cafeteria. I spoke with Al King, with Facilities Management, about composting generally, as well as potential locations for a composting system. Finally, I spoke with Roger Bizzotto, UBCO Facilities Manager, and discussed the details of operating and maintaining a composting system. A pilot study monitored the amount of compostable wastes generated in the kitchen and cafeteria for the period February 25 to 29, 2008. The kitchen generated approximately 1600 liters of compostable wastes consisting largely of vegetables, fruit and coffee grounds. Special bins were provided in the cafeteria into which people could choose to deposit their organic and compostable wastes; approximately 225 liters of wastes were collected, but this volume represents perhaps 10% of the compostable wastes generated in the cafeteria since few chose to separate their garbage. The cafeteria is shifting from Styrofoam take-out containers to biodegradable ones that could provide the necessary "brown matter" needed for the composting process. Based on these results, I recommend the University purchase and install

two Earth Tubs made by Green Mountain Technologies. Earth Tubs are a small in-vessel composting system that can break down 450 to 1700 liters of wastes per day, including up to 10% of the total volume of meat and dairy, which is approximately the amount collected in the cafeteria. The Earth Tubs take two and half weeks to fill to a total capacity of 4500 liters. Once the Earth Tub is full the final decomposition process takes an additional two weeks. I recommend that the Earth Tubs be installed in the Facilities Management compound where there is plenty of space for operation and expansion. UBCO will need to hire additional staff or train existing staff to operate and maintain the Earth Tubs. Green Mountain Technologies estimates that it will cost $11,500 to purchase and ship Earth Tubs to UBC Okanagan. As the UBC Okanagan campus continues to grow, additional Earth Tubs can be added to accommodate the increase in organic waste production.

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1.0 INTRODUCTION

UBC-Okanagan's mission is to become the "greenest" campus in Canada (Aidan Kieran 2007). To achieve this title we must implement certain changes that reduce our ecological footprint. UBCO's campus is on the right track with our geothermal energy, recycling, carpooling and various other projects. The purpose of this project is to identify an appropriate composting system for UBC Okanagan. The UBCO campus was established in 2005 with a population of 2,700 students. In 2007 the student enrollment increased by over a thousand to 4,864. The expected population for 2011 is 7,500 as well as an expected increase in the now 259 members of faculty (http://web.ubc.ca/okanagan/about.html 2007). With this increase in population there will also be an increase in waste production. Solid waste production is one of the growing causes of pollution and composting a portion of that waste seems to be such an easy way to "do our bit" and a task we can accomplish, yet it has not been implemented at our campus. Aramark, the company that provides food services as UBCO, is more than willing to work with the institution to establish a composting system. The campus requires a system to handle the organic and compostable wastes generated by the kitchen in our cafeteria. To identify a suitable composting system for UBCO, I will consider all composting systems from small to industrial-sized composters. A suitable composting system must take into consideration the following: composter capacity, compostable materials, rates of decomposition, purchase and maintenance costs, and the final use for the end compost. To aid my study I will examine different composting systems used by other schools and cities.

1.1 THE COMPOSTING PROCESS

Most dead organic materials go through a process where they naturally decompose over time, although this process occurs at different rates: grass clippings takes significantly less time to decompose than egg shells. Egg shells have a tough exterior which is harder to break down therefore the decomposition process takes longer. Composting systems are used to speed up the natural decomposition process. Compost has been used for millennia to enhance soil quality, thereby saving gardeners money on fertilizers, top dressings, water, pesticides and waste removal. Not only does composting offer an advantage to people financially, it also helps to reduce our reliance on landfills. Composting lowers the expense of garbage disposal and reduces the economic, social and environmental issues that come with dumping waste. It is important to know the different materials that each composting system processes and the materials that should be avoided. **Table 1.1** shows the different types of materials that generally compost well and materials that should be avoided.

Composting is the breakdown of organic material by a variety of organisms to produce nutrient-filled compost. Micro- and macro-organisms are both important components of the composting process. Micro-organisms, such as bacteria, fungi and actinomycetes, break down and digest organic material. The breakdown of organic materials requires appropriate levels of carbon, nitrogen, oxygen and moisture. Carbon in the organic matter provides energy for the micro-organism in the decomposition process. Compostable carbon materials are usually brown and include leaves, straw, woody matter and sawdust. Nitrogen is just as important as carbon because it provides the micro-organisms with proteins to grow and reproduce. Nitrogen-filled materials are usually green in the composting bin and include kitchen wastes and grass clippings. The ideal carbon:nitrogen ratio (C:N) must between 25:1 and 30:1, although levels as high as

Table 1.1 Compostable wastes

Composts well	Avoid composting
fruits and vegetables	dairy products
lawn wastes	meat products
dead plants (not diseased)	grease
potting soil	oil
coffee grounds and filters	fertilizers
paper towel	pesticides
nut shells	newspaper
flowers	waxed paper
eggshells	plastic
hay	metal
	diseased plants

40:1 will work but are less ideal (Campbell 1998). The C:N ratio is important: if there is not enough nitrogen available, the composting process slows down, but if there is too much nitrogen, ammonia gas is released producing unpleasant smells.

Once the correct C:N has been established in the composter, and sufficient oxygen is present, the aerobic decomposition process begins. To ensure an adequate supply of oxygen to the decomposer organisms, the compost pile must be turned or mixed. The decomposition process involves five stages: oxidation, reduction, degradation, conversion and maturation. The exposure to air and water induces the chemical oxidation process. This happens as psychrophilic bacteria digest carbon compounds and change the chemical state of the material. Psychrophilic bacteria are active in cooler temperatures between -17 ˚ C to 13 ˚ C (Anderson 1998). Reduction occurs in the first stages of decomposition when organisms such as earthworms and insects eat and digest the material, excreting small castings. At this stage, the compost pile begins to heat up due to the activities of mesophilic bacteria. These bacteria grow best in warmer conditions between 21 ˚ C to 32 ˚ C. When micro-organisms consume carbohydrates (carbon) and protein (nitrogen) from the waste they produce more heat, water, and carbon dioxide. At this stage, the macro-organisms escape the heat of the pile, and degradation (the third step) begins. Thermophilic bacteria now dominate because these are tolerant of temperatures greater than 38 ˚ C. The temperature in the compost pile gets so hot that anaerobic bacteria (bacteria that can survive without oxygen) can appear in the material and further aid the decomposition process. Conversion happens when the temperature starts to drop and the decomposition process slows down and other bacteria and fungi such as actinomycetes, molds and yeasts take over to complete the process. Maturation is the aging process of the freshly decomposed material. As the temperature has decreased, the conditions are again suitable for macro-organisms such as earth worms and sow bugs to return for the final stages of decomposition. The entire composting process can take weeks to years, depending on the material, the climate and the characteristics of the compost pile.

Modern composting systems aim to speed up the progression of natural decomposition. Below is a general overview of the different types of composting systems available that would be considered for the UBC-Okanagan campus.

2.0 COMPOSTING SYSTEMS

2.1 Soil incorporation:

Soil incorporation is the smallest-scale composting system possible. It involves digging a small hole 20cm or deeper, depositing organic material and covering the hole with soil. After being covered, this method has no maintenance and the organic material decomposes on its own. The larger the hole, the longer the matter takes to decompose. Each hole can be up to 0.5m deep by 0.5m wide, with the capacity of holding about 10 kg of organic material. Depending on the amount of organic wastes deposited, the decomposition process can take six months to three years. This system has few costs involved and requires only the purchase of a garden shovel and the energy to dig the holes.

2.2 Pile/ heap composting:

Pile composting is one of the most basic ways to compost. It consists of alternately layering organic material (kitchen and lawn wastes) with carbon sources such as soil, leaves or fertilizer to create the proper carbon: nitrogen ratio. The process of decomposition only begins once temperatures are high enough for the micro-organisms to start breaking down the organic material, which usually takes at least two weeks. The compost pile must be mixed a minimum of once a week to add oxygen to help the process. Depending on the size of the composting pile, turning can be done by smaller garden tools such as spades, or backhoes for larger piles. To mix the pile successfully, adequate space is required, which generally restricts this type of composting to an open system. As with any composting system, the correct amount of oxygen, water, nitrogen and carbon must be provided. Controlling oxygen and water levels may be difficult in Kelowna because the hot temperatures and dry summers provide poor conditions for rapid decomposition. Under ideal conditions this system takes at least three to four months to reduce the material to compost. Places with colder temperatures in the winter require two years to reduce the material to compost. An additional problem is that because it is an open system, the pile of rotting food may attract unwanted rodents. If the compost pile is larger than 1 m high by 1.5 m wide, the decomposition rates are significantly increased. The larger the compost pile, the longer it takes for the required temperatures to be reached, thereby extending the time it takes for materials take to be broken down by bacteria. Over time, and as more waste is added, the pile spreads out and may require a considerable amount of space. The cost of this system is dependent upon the type of machinery or tools used to mix the pile.

2.3 Windrows:

A variation on the compost pile that can handle larger volumes of organic wastes is the windrow. In this system organic wastes are piled into long rows. Windrows can have loose organic wastes with no restraints, see **Figure 2.1,** or the material can be retained by low walls made out of concrete or wood. At the start of the composting procedure windrows are generally 2 to 4 m wide and 2 to 3 m high. Windrows exceeding this size take longer to turn and lack adequate oxygen levels (Martin 2007). As seen in **Figure 2.2,** heavy machinery is usually required to construct and turn the organic waste to ensure adequate oxygen. With machinery turning the organic wastes every 1-2 days the material should successfully degrade in 2-3 weeks. Water may also need to be added during months in which conditions are hot and dry. If the wastes include proteins such as meat, the pile will need turning twice daily. Machinery to turn these piles cost anywhere from $50,000 - $ 100,000 U.S. (Popadynec 1992). If the windrows are not enclosed in a fenced area or covered, they often attract unwanted rodents. A final problem is that for this type of composting system, the smell is especially strong which does not allow this system to be close to public areas.

Figure 2.1: Windrow style composting (http://www.barnesnursery.com/bulk-soil.htm)

Figure 2.2 Turning waste using Wildcat windrow turner

(http://www.ecowaste.com/yardwst.htm)

2.4 Wire-mesh bins:

The wire mesh-bin system as seen in **Figure 2.3** constrains the compostable material in a smaller area than the pile system and is usually formed by using chicken wire. It is one of the least expensive composting systems typically costing less than $20, depending on the size. There are a number of problems that arise with using this system. The thin flexible wire is weak and can bend and be misshaped easily. As with the pile system, the wire-mesh bin system also requires proper oxygen and moisture levels. Like most places in Canada the Okanagan receives snow each winter that could potentially dismantle and destroy the wire mesh bin unless it is covered. The smaller the bin, the shorter the period of time needed for temperatures to rise and material to break down. This system is recommended to be no larger than 1.2 m wide by 0.6 m deep. The wire-mesh bin is not fully enclosed; therefore the larger the bin the longer it takes for temperatures to reach higher temperatures especially during colder weather. Like many of the smaller-scale systems, organic material takes over a year to break down.

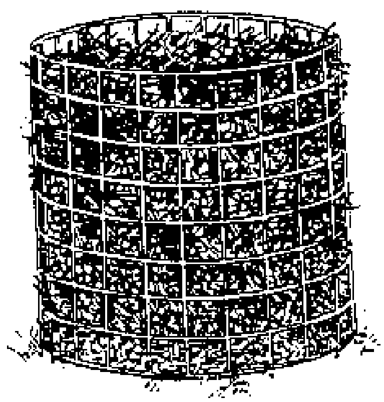

Figure 2.3 Wire-mesh composting bin

2.5 Wooden box/pallet composting:

Wooden-box or pallet composting, seen in **Figure 2.4,** consists of four wooden pallets that attach together with wire to form a square with an open top in to which the organic wastes are deposited. Wooden pallets can be obtained for free at many businesses .This composting system can easily accommodate an increase in wastes by attaching multiple boxes as needed. The wooden pallets do eventually rot and may need to be replaced. The average wooden pallet system has a capacity area of 2500 liters. Like the open pile and wire-mesh bin, materials in the wooden box composting system take over a year to break down.

Figure 2.4 Wooden box/ pallet composting

2.6 Plastic bins:

One of the most popular household composting systems is covered plastic bins. Unlike the compost systems described previously, this system is designed with a lid that seals in moisture as well as smell. **Figure 2.5** is a picture of a typical plastic bin; they are usually black to absorb sunlight and heat the contents to increase the rate of the decomposition process. As well, the lid prevents rodents and extra moisture from snow and rain from entering the container. This system comes in many different shapes and sizes. **Table 2.1** displays a number of different bins, their costs, and how many liters of organic waste they hold.

Figure 2.5 Plastic Bin

Table 2.1 Plastic bin pricing

Name	**Company**	**Cost**	**Capacity**
Wishing Well composter	Vermiculture	$120	250 liters
Recycled plastic compost bin	Clean Air Gardening	$160	360 liters
Home composter	Green House Mega Store	$70	140 liters
Euro composter	Green House Mega Store	$109	450 liters
Large Euro composter		$169	200 liters

2.7 Tumbler Bins:

Tumbler bins are designed to accelerate the decomposition process. They are large plastic barrels (**Figure 2.6)** that need to be turned manually to aerate the contents and increase the rate of decomposition. When the tumbler is full it can get quite heavy and difficult to turn. The tumbler bins do not have help of earth worms and other organisms to break down organic wastes, however the holes on the sides of the bins do allow oxygen to enter. This composting system decomposes faster than the plastic bin system and the time for organic material to break down varies on the size of the tumbler, the conditions, how often it is turned and the composition of wastes. **Table 2.2** lists a number of different tumblers, their costs and capacity.

Figure 2.6 Tumbler/ Rotating Barrel

Table 2.2 Tumbler pricing

Name	**Company**	**Cost**	**Capacity**
Tumbler composter bin	Clean Air Gardening	$165	240 liters
Tumbleweed compost tumbler	Clean Air Gardening	$190	250 liters
Urban compost tumbler UCT9	Urban Garden Center	$250	315 liters
Urban compost tumbler UCT7	Urban Garden Center	$200	245 liters

2.8 Vermicomposting:

Worms can be used to break down organic material. This process is called vermicomposting, as seen in **Figure 2.7**, and can be done indoors or outdoors. Red wiggler worms and manure worms can both be used in this process to break down organic material. The worms cost anywhere from $30 to $50 per pound. The worms consume compostable items (vegetable matter only), digest them and leave behind castings. The worms need to be placed in a rubber or plastic bin along with bedding such as shredded newspaper or soil. For this system to be successful the worms need to be placed in an area where the temperature is controlled between 50 ° to 80 ° (Appelhof 1997). Breaking down organic wastes into smaller pieces before placing them with the worms speeds up the decomposition process. One pound of worms can eat only one pound of food in a week, but the population of worms doubles every 3-4 months (Ebeling 2003). This composting system is clean, efficient and generally odour free. This process is ideal for small-scale composting, such as an individual household. At a larger scale there are many problems that can arise. It may be unrealistic to have someone manually chopping up the schools' weekly amount of organic waste into smaller pieces. With high quantities of worms and

organic material, the temperature may well exceed the recommended temperature and kill the worms. Overfeeding and underfeeding the worms can also cause problems. Feeding the worms too much will cause mold to develop on the organic wastes and create an unpleasant odor. Underfeeding the worms deprives them of nutrients that they need to survive and they will eventually die. On a large scale worms require a significant amount of space as they grow and reproduce. The worms require careful attention, and moisture, food levels and temperatures are harder to control when vermicomposting on a larger scale. If there is too much moisture present the bedding will turn sour making it unpleasant for the worms and also producing a foul smell. It is important to watch the types of foods that are being added to the worm bins. Too much salty or acidic food stresses the worms which can cause them to die. Temperature control is vital; if the temperatures are too high or are too cold the worms will die.

Johnson College in Scranton, PA, and The University of Waterloo in Ontario are two schools that successfully use vermicomposting. However this system is not used as their primary one and they have added multiple systems such as pile and bin composting to process the rest of the organic waste. The city of Point Edward in Cape Breton is doing a study of large scale worm composting established in a green house but it requires $83,000 to set up. Farmers in the area use the worm castings for fertilizer and often buy the product, which the city hopes will reduce some of the operating costs. Cape Breton has yet to determine whether this large scale vermicomposting system is feasible.

Figure 2.7 Vermicomposting

(http://vermiculturehttp://vermiculturedigest.blogspot.com/2007_03_01archive.html)

2.9 Small-scale in-vessel composting system:

Small-scale in-vessel composting systems offer a way to compost more material at a faster rate. There are many different styles of small-scale in-vessels made by different companies such as the containerized vessel, Gomixer, and CM-pro. A popular small-scale in-vessel system is the Earth Tub made by Green Mountain Technologies (**Figure 2.8**)**.** The Earth Tubs are closed bins and have a stainless steel auger that is powered by a 2HP gear motor**.** Earth Tubs have the processing capacity of 450 liters to 1700 liters of organic waste per day and can decompose up to 10% of total waste input of dairy, meat and cheese products. If 150 liters of wastes were added to the Earth Tub each day it would take four weeks to fill. The Earth Tub can be operated during cold temperatures as the system is insulated for cold weather operation. Once food scraps have been gathered they are added through the hatchway on the lid of the Earth Tub. Bulking materials are also added to the kitchen wastes to absorb the liquids produced by the organic wastes. Green Mountain Technologies suggests adding materials such as wood shavings, wood chips, sawdust, leaves, shredded paper products and hay. To aerate and mix the materials the auger motor is turned on and the lid rotated counter- clockwise at least four to five times per day. Spinning the lid triggers the motor to rotate and mix the organic material at a rate of one ton every ten to fifteen minutes. Optimum temperatures and aerobic conditions are maintained by an aeration system that draws air though the waste and removes odors by forcing air though the biofiltration air purification system. The spinning motion along with the trapped heat and aerobic system allows for favorable composting conditions inside the closed bin. The heat generated in the Earth Tub quickly breaks down the food scraps and the volume of wastes is reduced up to 70%. Excess liquids are generated and must be collected in a basin beneath the tub. This liquid can go back into the Earth Tub or it can be used as liquid fertilizer in a garden. With the correct maintenance, these containers keep the smell under control; however, it is still recommended that they are situated away from common areas. Composted material can be removed through the discharge door 2-4 weeks after the composting process started. If the Earth Tub is breaking down biodegradable containers the composting process may take longer than the projected time. The auger motor is used to push the finished material out of the Earth Tub. It is recommended that a tarp is placed below the door to collect material and provide an easy way of transporting the composted matter. Curing is the ‘cool down’ phase after the active phase, in which the compost is covered and left to stabilize for 20-40 days (Green Mountain Technologies 2006).

The City of Eugene in the U.S.A bought six Earth Tubs and placed them in local elementary and middle schools. Five of the six schools compost meat products, paper napkins, paper condiment cups, paper boats, fruits and vegetables. Five of the six schools have chosen to add small amounts of meat and dairy products to the Earth Tub. Each school has their own system to separate food wastes. Many have a sorting station in the cafeteria which is run by the older students. On average, each school produces 30 pounds a day of kitchen wastes that are added to the Earth Tub. Although the separation of food is monitored there is often contamination. Regardless of signs posted, plastic utensils often find their way into the Earth Tub; however, this contamination is kept to a minimum and does not affect the decomposition process in the Earth Tub. To acquire the correct C:N each school adds paper shredding, paper towel and saw dust, which also helps to eliminate any unpleasant odor that is caused by low levels of carbon. The finished product is used at the schools in their gardens; those schools that do not have a garden donate their compost to local community gardens. Earth Tubs have been both successful and popular in Eugene; however, this success did not come without a number of initial problems that restrained them from achieving great results. Originally, the bio filter drainage system was not draining properly because the drain was not situated low enough. They raised the earth tub several inches by placing bricks underneath it, which allowed liquid to drain into the bio filter successfully (City of Eugene Solid Waste and Recycling Program 2002).

There are various operating expenses that need to be covered with the cost of the Earth Tub. This system needs water, electrical and sewer hook ups as well as the expenses of constructing a site to install the earth tub. Green Technologies estimated the cost of one Earth Tub and the shipping to Kelowna British Columbia at $11,500.

Figure 2.8 Earth Tub System

(http://www.gmt-organic.com/images/et_tub.jpg)

2.10 Large-scale in-vessel composting systems:

These systems are closed-bin composting systems where organic wastes are composted in a short period of time. The enclosed system has moisture and temperature sensors that keep materials at the optimal conditions for the most rapid rates of decomposition. The *in-situ* mixing is done by large spinners that rotates and mixes the material. A computer-controlled system manages the decomposition process. Material can be broken down into compost as quickly as ten days. Because higher temperatures can be reached using this system, raw fish, chicken, meat and dairy can be added. Depending on the model, the system can hold up to 10 to 40 tons of wastes each day. However, most systems can process as little as 50 pounds a day. The large-scale in-vessel systems can cost up to $10 million and are purchased mainly for industrialized composting. They require a large amount of space and specific requirements for installation such as plumbing and electrical hooks up. Each machine differs in its requirements. To operate this large scale system requires at least two full-time and one part-time employees.

UBC-Vancouver uses the large in-vessel composter (**Figure 2.9**) purchased from Wright Environmental Management, one of the leading companies for in-vessel sales. The institution composts food waste, residual paper products, animal bedding, wood, yard waste and sawdust. A complete list of material that can and cannot be put into the in-vessel is provided in **Table 2.3.** These materials are gathered from 35 gallon bins from more than 400 buildings on campus. UBC Vancouver generates 4 to 5 tons of material each day that is added to and processed through their in-vessel system. The system takes approximately two weeks to generate compost, not including maturation time. The end compost is used in areas that were once covered by bark mulch. When the institution bought the system in 2001, the total cost for the system including installation and other materials was $800,000; however, this did not include the land they had to purchase at an additional cost of $400, 000, bringing the total cost to set up the in-vessel to $1,200,000 (Fitzgerald 2008). They have hired one part-time and two full-time employees who gather materials and operate the system. One of the biggest problems they still face is that materials like milk containers and juice boxes, which cannot be processed in the system, are placed in the green compost bins. Contamination is often an issue with any composting system; the university continues to educate the students and faculty by placing bigger signs and more of them, by the green bins displaying what can and cannot be composted. Within the first two years the school has diverted over 500 green bins (120 liters each) from going into the landfill (*University of British Columbia* 2007).

Figure 2.9 Large in-vessel system.

(http://www.recycle.ubc.ca/compostmain.htm)

Table 2.3 Acceptable wastes for large in-vessel system

Acceptable Wastes	**Unacceptable**
cooked food waste	juice boxes
meat and bones	plastic bags
dairy products	milk cartons
grains, bread, pasta	plastic cutlery
paper cups and plates	styrofoam
paper towels and napkins	glass
raw fruit and vegetable scraps	wooden chopsticks
coffee grounds and filters	wood
tea bags	sand
egg shells	metal
grass, leaves, plant clippings	biosolids
hay and straw	

(http://www.recycle.ubc.ca/compostmain.htm#vesselyesn)

As outlined above, there are many composting systems to choose from; however, few of the systems are suitable for UBC Okanagan. Soil incorporation, wire-mesh composting bins, wooden box/ pallet composting, plastic bins, pile composing and tumbler bins are all too small to accommodate the quantity of waste produced on campus. The campus does not have the space or the machinery to support the windrow style composting. UBC Vancouver uses their in-vessel system for over 400 buildings, the campus in Kelowna will never reach that size; therefore, the large in-vessel system is too expensive and not feasible. Therefore, I propose that UBC Okanagan installs the Earth Tub system. This system breaks down material at a rapid rate and multiple Earth Tubs can be added as needed. To determine the number of Earth Tubs required requires information on the quantity of organic compostable waste generated on campus.

3.0 METHODS

I had informal conversations with people working at UBCO to determine the location, logistics, and system requirements for an Earth Tub composting system on campus. Kris Bruckman the Aramark Food Service Director and Darren Bezanson the Aramark Head Chef, provided information on waste production in the kitchen and cafeteria. I spoke with Al King, with Facilities Management about composting as well as potential locations for the Earth Tub. Roger Bizzotto, UBCO Facilities Manager, discussed the details of operating and maintaining the Earth Tub. Finally, I spoke with Penny Bernard from Green Mountain Technologies regarding the purchase of Earth Tubs for UBC Okanagan.

3.1 How much waste does UBC Okanagan generate?

During the week of February 24 to 29, 2008, organic wastes were collected in the kitchen and cafeteria of UBC Okanagan. The purpose of this study was to measure the amount of compostable wastes that are generated in the kitchen on a daily basis. In the kitchen, where food preparation takes place, the Armark staff sorted all compostable wastes including vegetables, fruits and used coffee grounds into containers separate from the regular garbage. At 5 pm each day, the wastes were collected and the volume measured. These wastes did not include the compostable wastes generated elsewhere on campus, such as at the Wrap Zone, Tim Horton's, UBC Daycare and the residence buildings. A bin was provided in the cafeteria for three hours each day into which students and staff could deposit their compostable wastes. A poster board was set up that explained the composting project, as well as what could and could not be composted. Brochures with information about the project were distributed throughout the cafeteria to educate and encourage people to sort their wastes. The compost bin in the cafeteria was supervised to ensure that only compostable materials were deposited.

4.0 RESULTS

4.1 Compostable waste production in the kitchen and cafeteria

Table 4.1 summarizes the amount of compostable wastes collected over the five- day period in the kitchen and the cafeteria; in addition the kitchen staff estimate 170 liters is generated on a typical Saturday and 115 liters on Sunday. The estimated total amount of compostable wastes generated in the kitchen and cafeteria on an average week is 1711 liters. It was estimated that only 30% of the garbage generated during the school months is generated during summer months; therefore May through August monthly totals have been calculated at 70% less, giving the kitchen and cafeteria a yearly estimated compostable waste production of 63,000 liters.

Table 4.1 Amount of organic wastes generated in the kitchen and cafeteria , Feb 24 to 29, 2008, UBC Okanagan campus

	Kitchen		Cafeteria
Day	Quantity (L)	Time period	Quantity (L)
Monday	140	10:45 - 1:45	60
Tuesday	255	4:30 - 7:30	60
Wednesday	285	10:45 - 1:45	60
Thursday	176	4:30 - 7:30	15
Friday	340	10:45 - 1:45	15
Saturday	170	Estimate	10
Sunday	115	Estimate	10
Week Total (L)	1,481		230
Annual Total (L)	63000		

The results of the pilot study do not include compostable waste generated at other places on campus such as Tim Horton's, Wrap Zone, student residence, UBC daycare and the various classroom buildings. There is much opportunity for collection of compostable wastes throughout the campus.

5.0 DISCUSSION:

5.1 Compostable wastes generated in the kitchen

There are many factors that played a part in determining the amount of wastes that was generated by the kitchen. The majority of the food preparation in the kitchen is completed by 5 p.m.; however, the waste left over from the day including the salad bar, is disposed later and

These were not included in the measurements. The kitchen receives shipments of vegetables and fruits at different times during the week, and most of the fresh produce is prepared the day it arrives. For the week of the pilot study, the increase in wastes on Tuesday and Wednesday is due to the arrival of produce on Tuesday February 26th.

5.2 Compostable wastes generated in the cafeteria

Armark recently started using biodegradable containers that can be disposed of as compostable material; however, the shipment of biodegradable containers was late, and only Styrofoam containers were available. If the biodegradable containers had been available, the volume of compostable wastes would have been significantly higher. Throughout the study many students expressed their disapproval of Styrofoam containers and all were pleased to hear that the cafeteria is making the change to biodegradable containers.

On Friday February 29th, the sun room in the cafeteria was closed to prepare for a function that evening. As a result, most students got their meals to go and found other places to eat and dispose of their garbage. I did not receive a typical amount of compostable waste for the three hours over lunch on that Friday.

Many people bypassed the compost bin as well as the surrounding garbage bins, either because they did not understand the project or did not wish to participate and deposited their wastes elsewhere. All the garbage cans could not be placed beside the composting bins, which made it impossible to control where people disposed of their wastes. Although the compost bin was located directly beside the garbage bin there were many comments made about how it was too hard to separate the wastes. One student, when told that he could compost everything on his plate, replied, *I don't have time,* and then threw his wastes into the garbage can, directly beside the compost bin. Depositing compostable wastes into a separate bin is not difficult. Once the students and staff are properly educated about what can and cannot be composted, composting should become part of the routine, such as recycling. This education could be included as part of the first year- orientation.

Aramark Food Services have been making many environmentally-friendly changes to the cafeteria and are eager to help decrease waste production with the implementation of a composting system. Kris Bruckmann expressed the cafeteria's excitement for a composting system and outlined the extent of their ability to participation in operating the Earth Tub. The kitchen staff suggested placing the Earth Tub in close proximity to the cafeteria (**Figure 5.1**, **Site A**), so that they could easily dispose the organic wastes in the Earth Tub. Aramark offered to train the management staff and supervisors to run the day-to-day operations of the Earth Tub. Having the cafeteria staff in charge of disposing the organic wastes ensures that all wastes from the day is transported that night to the Earth Tub. Kris Bruckmann, Aramark manager, suggested that having the Earth Tub in public view would help to advertise composting on campus and increase and improve people's participation and knowledge about the process. However, once the wastes are fully decomposed, the Earth Tubs must be emptied and the final product stored somewhere else until ready to be used on campus, which will create a bit of a mess, and will also require assistance from Facilities Management on campus. I recommend an alternative location. **Site B** in **Figure 5.1** is located within the Facilities Management work area, and is fenced. This location has enough space to store the compost during the maturation stage. Placing the Earth Tub at this site will require a person with Facilities Management to transport the wastes from the cafeteria to the Earth Tub. In either site **A** or **B** someone needs to be in charge of maintenance, emptying and distributing the finished product. Roger Bizzotto has indicated that someone on their staff will be trained and take on this responsibility. Both areas have a water outlet; however both locations are in need of an electrical hook up.

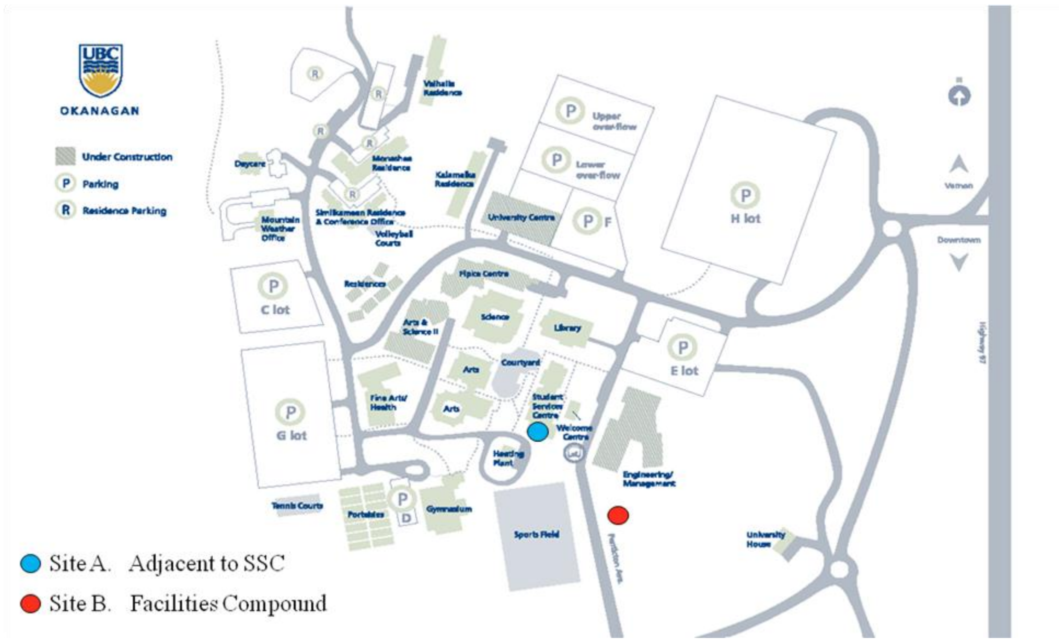

Figure 5.1 Possible Earth Tub locations on UBC Okanagan campus.

6.0 RECOMMENDATIONS:

There are many improvements UBC Okanagan needs to take to become the “greenest” campus in Canada. Although we are far ahead of many Universities with geothermal energy, we are far behind on the simpler things such as recycling and composting. The following are recommendations about composting organic wastes that I hope the University will implement to create a more sustainable campus.

6.1 Two Earth Tubs and staff

Based on the results of the cafeteria study, I recommend that the University purchase and install two Earth Tubs. The Earth Tubs can break down 450 to 1700 liters of wastes per day, including organic wastes, biodegradable containers and up to 10% of the total volume as meat and dairy, which is approximately the amount of waste generated in the cafeteria. The Earth Tubs should be located in the Facilities Management compound because it has enough space to store all material during the different composting stages as well as the required space to add more Earth Tubs as UBC Okanagan grows. Green Mountain Technologies, who produce the Earth Tubs, recommend that at least two staff members are trained to operate and maintain the Earth Tub composting system, including transporting wastes to the Earth Tub, daily temperature checks and turning, and removal of the compost. For a composting system to be successful it needs to receive proper attention. Currently there is insufficient staff to maintain a composting system. Facilities Management has not had a proper increase in the number of staff to withstand the increasing growth on campus let alone take on the extra responsibility of a composting system. For health and safety reasons I recommended that at least two staff be hired and trained in the operational maintenance of the Earth Tubs. These staff are not needed full time to run the Earth Tub, but the department needs the extra help as the university continues to grow.

6.2 Pile Composting

Installing the Earth Tubs could take months; in the interim it is possible for UBCO to collect and compost organic wastes. A closed-off holding area must be established to allow the compost from the Earth Tubs to mature. Until the Earth Tubs are installed, this area could be used for pile composting. UBC Okanagan already has the machinery on campus to rotate the wastes so there is no reason for any further delay in the collection of compostable wastes and the start of a pile-composting system.

6.3 Campus-wide composting

This study looked strictly at the organic wastes generated in the cafeteria; however, I recommend that the composting program expand throughout the campus. UBC Vancouver has composting bins throughout their campus for public usage as well as smaller bins for staff members and residences. UBC Okanagan should also collect organic wastes from all buildings on campus available in classrooms, offices and residences.

6.4 Involving the community

The growth of a composting system is endless; UBC Okanagan could involve Kelowna citizens in becoming a more sustainable community. The institution could charge residences to drop off their organic wastes. If the university cannot use all of the finished product on campus in the learning garden or landscaping, the material can be sold back to community farmers and gardeners.

6.5 Recycling

During my research for implementing a composting system I have become educated about the overall garbage disposal and recycling programs at UBC Okanagan. During the pilot study in the cafeteria many people expressed concern about the use of Styrofoam and plastic cutlery. Although the cafeteria is working towards getting Styrofoam eliminated, plastic cutlery can be and should be recycled. There needs to be separate marked bins for recycling plastic cutlery in the cafeteria.

6.6 Take-out containers

During the pilot study it was observed that the majority of students eating in the cafeteria used take-out containers. As well, a lot of students living in residence get their food to go and eat in their rooms. Even if the cafeteria switches to biodegradable take-out containers this is still an ongoing issue. When the students leave the cafeteria their wastes leave with them and will not be composted. I recommend that some sort of incentive be provided to students not to use take-out containers and to stay and eat in the cafeteria, such as a discount for students using dishes, or an extra charge for those using take-out containers.

If all of these recommendations are implemented they will benefit the environment and help UBC Okanagan with its goal of becoming a greener campus. With the proper education and training of the staff and students the campus can greatly improve waste management by developing our current recycling program and implementing a composting system.

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