

Bowen Island Organic Resource Recovery Report

Prepared for
**The Knick Knack Nook
Re-Use-It Store Society**

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Project Overview

The Knick Knack Nook, Bowen Island Re-use-it Store Society, (KKN) was founded out of a deep concern to save valuable materials from the landfill. From this impetus developed a mission statement to foster environmental responsibility. This philosophy led to the board of KKN's commitment to contribute to future Island initiatives in resource recovery. It recognizes that this is an area that is enormously complex and it needed comprehensive information before funding any specific direction. The Board engaged Morganne Keplar, ReSource-Full Habitats, to do a feasibility study. ReSource-Full Habitats was chosen because of Morganne's extensive knowledge of resource recovery systems, commitment to waste management on Bowen Island, and knowledge of community interactions. Some weeks later the scope of this report was expanded in response to a need for a more comprehensive overview as expressed by Bowen Island Municipality's (BIM), CAO, Brent Mahood. As the municipality at the present time does not have funds available for such a project, it was decided that KKN form a collaborative role with BIM by funding this report. This report will contain an examination of current resource management issues, the three organic¹ processes of composting, anaerobic digestion and biochar, stakeholders and strategies, and options for future resource recovery enterprises on Bowen.

¹The use of the word *organic(s)* in this report refers to various plant materials, woody or soft, that are used or generated and includes human and animal manures.

1) **Research Criteria**

ReSource-Full Habitat referenced four concepts and five premises throughout the project. This set of criteria determined appropriate options and solutions for on-Island processing of Bowen's organics¹ and revealed the basis of where to start this initiative considering the economic and philosophical aspects of responsibility. When presented they provide insight and rationale for the need to do things differently with regard to many of the Island's current practices.

a) **Concepts**

- i **“The Throw Away Society”**: In the 1900's urban waste management allowed and inadvertently encouraged a throw away, flush away society in North America. Convenient waste disposal without personal discomfort or true responsibility has afforded a cultural sense of entitlement for those services. It has fostered excess consumerism and waste with little regard to the finite quantities of raw materials or the care that should be taken with them throughout their life cycle.
- ii **“Zero Waste”**: “Zero Waste means designing and managing products and processes to systematically avoid and eliminate the volume and toxicity of waste and materials, conserve and recover all resources, and not burn or bury them. Implementing Zero Waste will eliminate all discharges to land, water or air that are a threat to planetary, human, animal or plant health.” (J. Anthony 2004)
- iii **“The Precautionary Principle”** advocates that regulations and safeguards need to be in place in advance of measurable scientific proof of environmental and social failure. For example, we must address air quality issues before the air is damaged and becomes a health hazard to all life forms and the environment.²
- iv **“The Proximity Principle”** “The Proximity Principle advocates that waste should be disposed of (or otherwise managed) close to the point at which it is generated, thus aiming to achieve responsible self-sufficiency at a sub regional level. Waste prevention and the household treatment of waste are at the top of the waste hierarchy. This engenders understanding and ownership of the waste problem and limits the growth of waste.” Studies estimate that household composting and bio-digestion practices are ½ the cost of a central processing facility per weight” (Knipe UK 2004). “The Proximity Principle works to minimize the environmental impact and cost of waste transport”.²

b) **Premises**

Based on the four concepts, five premises were established. These premises suggest that waste management practices be reviewed, that processes for resource recovery need to be employed locally and are mindful of the consequences of 1900's methods and the current environmental issues. Support and leadership by local governments in these initiatives is critical.

- i) **Landfill as an Avenue for Waste Stream Management will be Used Sparingly** as a last resort for inert materials.
 - (1) The methane produced in landfills from organic matter through the anaerobic decomposition (without oxygen) is 23 times more harmful than carbon dioxide, carbon dioxide and methane being two of the green house gases (GHG). Methane reclamation performed for environmental mitigation reasons and the used as a source of energy is an expensive process and is fallible.
 - (2) Available space for dumping waste is diminishing.

²: Environmental Management Principle (<http://coe.mse.ac.in/onerview/8.pdf>, Source: http://www.dsd.gov.hk/sewage_charges/polluter_pays_principle/index.htm. (1992)) (Polluter pay, User pay & Precautionary Principles) : Planning Policy Statement 11, Northern Ireland Planning and Waste Department of Environment: The Proximity Principle 1.23)

- (3) It is increasingly more expensive to use landfills due to tipping fees, distances to access them and the operational maintenance.
- ii) **Organics (and all materials) will be Processed, Used and Re-used** through safe and productive means with environmental and long term consideration throughout their life cycle. As the cost and availability of valuable resources diminish we can no longer afford to throw them away.
 - iii) **It is Essential to Re-think and Question Assumptions** about historical norms of waste management curbside service. Less frequent service and creating drop off facilities where logistically appropriate is a commitment to reduce garbage volumes, reduce a carbon foot print and reflects recycling trends, re-using what was once thought to be waste.
 - iv) **All Levels of Government Will Provide Rethink, Recycle, Re-use, Recover and Education Opportunities** in the area of resource recovery management, through by-laws, governance, staff time and financial support. These opportunities begin at the household and neighbourhood level, and then branch out to a community level (A.Knipe 2004). This allows communities the prospect to function at the highest level of waste management i.e.: When householders and businesses are responsible for the care of their excess materials they begin to think about their buying practices and reduce their overall consumption. On-going education through engaged participation and mentoring programs are essential to create effectual change of beliefs and habits. An example of this is a Metro Vancouver pilot project that provided composting bins to a group of people in the Glenbrook North Community, New Westminster, B.C., 2010 (Janice Armstrong resident coordinator). The average 10kg. per waste/week /family dropped to half their over-all general waste volumes.
 - v) **All Levels of Government Will Regulate the Responsibility for Product Life Cycles** to the producer and the consumer. Product content and process information is required. These regulations take into consideration current knowledge of environmental issues and finite resource supply i.e. Materials must be kept in a continual flow from production to use and back to use again without polluting, burning or burying them. This premise coincides with “polluter pays”³ which create the internalized incentives to produce reclaimable and safe products. The consumer makes choices depending on the product’s recyclable nature, toxic process, and cost to reclaim the products and ease of their own end-of-use management.

c) **Methodology**

The options and solutions for the use of organic materials for this research project involved personal interviews, internet explorations, follow-up conversations, attending conferences, and visits to facilities and businesses to obtain data and ideas. When asked by the Bowen Island Municipality (BIM) to research and address solutions for air quality assurance, the reduction of Bowen’s waste cost and a commitment to lowering the municipality’s carbon footprint, the scope of investigation and topics were expanded considerably. Discussions with the KKN Board, Mary Ellen deGrace, Jane Kellet, Diane Marshall, BIM’s CAO, Brent Mahood and staff members, Zero Waste Bowen (ZWB), Chair, Don Marshall and members, Bowen Island Recycling Depot (BIRD) Co-Chair, Don Marshall, Kim Kasasian & members, Bowen Waste Services (BWS), and others, have been integral to this research. Based on the research criteria and information gathered ReSource-Full Habitats developed a written review of Bowen Island’s Organic Resource Management, The Bowen Island Stakeholders and their Resource Recovery Relationships and the resulting Recommendations. This information is for use by the KKN, BIM and at the KKN’s discretion, other participants.

Refer to complete list of References and Contacts Appendix #1 Pg 29.

³ D6: Environmental Law, The Hon. Justice Brian J PRESTON, 2009, [http://www.lawlink.nsw.gov.au/lawlink/lec/ll_lec.nsf/vwFiles/Paper_07Apr09_PrestonCJ_Polluterpays.pdf/\\$file/Paper_07Apr09_PrestonCJ_Polluterpays.pdf](http://www.lawlink.nsw.gov.au/lawlink/lec/ll_lec.nsf/vwFiles/Paper_07Apr09_PrestonCJ_Polluterpays.pdf/$file/Paper_07Apr09_PrestonCJ_Polluterpays.pdf)

2) Organic Resource Management

This research, on behalf of the KKN's goal to support the use of organics on the Island, began with inquiries into relevant issues, current practices and methods of organic processing.

a) Relevant Issues

Several influencing factors came to light when examining feasibility and options for on-Island processing. These factors must be considered and in many cases resolved before viable initiatives can move forward.

i) Financial Considerations:

(1) **Any Resource Recovery Facility will be Costly.** It will take significant funds to create and maintain. Tipping fees and the sale of products are necessary for viability. "It is very difficult to make a profit" (D. Geesing, J. Paul, P. Arnold, pers. comm.).

(2) **Ferry, Fuel, and Labour Costs are Increasing.**

(3) **Bowen Island Municipality and Metro Vancouver District Factors:**

(a) **There is a Small Tax Base** due to Bowen Island's approximate (~) 3678 population and limited available funds, none of which have been set aside for on-Island organic recovery processing. Reference used: Population Statistics, Government of B.C., 2010.

The Bowen Island Municipality budget allowance for existing solid waste expense listed as ~\$520,000 and has mentioned intentions to reduce that cost through service reduction. Curbside waste and yard trimming pick up, for ~1500 households is supplemented by the purchase of the \$82/year decals. Some residences opt out of purchasing the decals. The decal fees offset the cost of solid waste removal expenses which include hauling recyclables and providing the large and banned item free drop off events. Refer to Appendix #3 BWS Services pg. 33.

Sewage Treatment at the Snug Cove Treatment Plant is a cost Recovery Service.

There are no excess funds to transfer to other processes considering the sewage lines that need upgrading and new lines that need to be built to supply the development in the Cove. This is critical so that the Municipality can sell their "Community Lands" property to pay off their purchase loan. Refer to Appendix #2:1, 2011 BIM budget, BIM Web site Pg. 32.

(b) **Tipping Fees at the North Shore Transfer Station are increasing** with garbage fees being considerably more than organics (A. Marr, pers. comm.).

http://www.metrovancouver.org/boards/bylaws/Bylaws/SDD_Bylaw_258.pdf.

(i) **Garbage to Landfill** or incineration is \$97/tonne and estimated to be at least \$187 by the end of 2015.

(ii) **Organics** that are received for composting and bio-digesting are \$63/tonne and estimated to be \$75 by the end of 2015.

(iii) **Onerous surcharges** will be levied to service providers when either food and yard trimmings or general garbage contains banned and prohibited items.
(<http://www.metrovancouver.org/services/solidwaste/disposal/Pages/bannedmaterials.aspx>)

ii) Regulations:

(1) **Food and Wood will be banned from the Regional Landfill.** This is mandated by Metro Vancouver Regional District (Metro Vancouver) and applies to all Bowen Island's waste.

(a) **Food Waste and Soiled Paper will be Banned by the end of 2012.** These, combined with the already banned yard trimmings will be accepted from Bowen Island upon completion of the "receiving facility" at the North Shore Transfer Station (NSTS) sometime in 2012 (A. Lynch, Andrew Marr, Brent Mahood pers comm.).

(b) **All wood will be banned from landfill as of 2015.**

- (2) **Air Quality Regulations:** The Ministry of Environment (MOE) governs these issues. Through both MOE and Metro Vancouver, Bowen Island residents and businesses must abide by any regulatory rules set out with regard to air quality.⁴
Refer to Official Community Plan Update Appendix #2:1, 2:2, 2:4, Pg.32.
- (3) **Bowen Island Fire Regulations Bylaw 270, 2009; Section 9:** Open-burning of organic material is only allowed by permit as seasonal and atmospheric conditions allow. These regulations combine with the regulations of MOE and Metro Vancouver. Burning of woody material and yard trimmings eliminates significant quantities of potential and necessary feedstock to make compost and other organic facilities viable⁴. Refer to Appendix #2:2, #2:3, pg. 32, [e-link 32](#)
- (4) **Organic Matter Recycling Regulations (OMRR):** Organic processes are regulated through the MOE. The regulation governs composting facilities, the production and the distribution of products. Refer to Appendix # 2:6, pg. 32,, and for composting facility requirements pg. 12.
- (5) **Energy Use and Green House Gas (GHG) Emissions:** The Municipality has committed to reduction in these two areas.
- (a) **Official Community Plan (OCP) Updates** cites objectives and policies for reducing energy by dealing with organics locally rather than transporting them off Island. Appendix #2:4, pg.32.
- (b) **A Carbon Neutral Contract** was signed by the BIM with the BC Provincial Government in 2008. The Municipal operations are to be compliant by the end of 2012. An additional commitment was made to reduce the Island's 2007 levels by 33% by 2020 and 50% by 2050. BC government software is being made available to determine level of compliancy. Refer to Appendix #2:5, pg.32.
- (c) **Zoning and Planning Logistics**, pg.12.
- (d) **Industrial Zoning** is required for land used for a commercial facility. Pertinent details are reviewed around zoning requirements including farm and Agricultural Land Reserve use for organic processing in AQMPR.⁴
- (e) **The Municipal Land that includes BWS, BIRD, and KKN** is the only land that is presently zoned for organic processing on the Island. The need for BC Hydro and Metro Vancouver Parks to re-locate there and the increasing requirements for solid waste and recycling management operations will likely exceed the existing space. (L. McIntosh pers. comm.) pg 24,
- (f) **Ten Acres of the Twenty Acre Municipal land**, at the end of Salal Road could be zoned to accommodate a facility. It is now zoned Rural Residential 3.⁴
- (g) **Five Acres of Parcel# 1, Municipally Owned Surplus Lands** (The Community Lands) could be rezoned from Rural Residential 1 to Industrial (past the Gas Station along Mt. Gardner Rd. towards Grafton Lake).
- (h) **The Official Community Plan (OCP) and Update**, (sections 5.3 and 5.4) commits Islanders to taking care of organic waste locally. The OCP Update does site particular parcels of land for industrial use but could include this reports suggestion of Parcel #1 (also referred to as Site #1of the Community Lands) and the Salal Rd site.
<http://www.bimbc.ca/files/embedded2010/OCP%20Update%20FINAL%20Jul%2030.pdf>

⁴The Sea to Sky Air Quality Management Plan (AQMP) was established in 2009. The Sea to Sky Air Management Planning for Bowen Island Municipality, Wood Waste Management Baseline and Options Report (AQMPR):(Scroggins Consulting, EABB Planning Services and Timmenga & Associates Inc. The June 16th 2010) report was presented to the Bowen Island Municipality., with recommendations for air quality precautionary measures. Reference to that report and suggested options are noted frequently and respectfully acknowledged, pg.32.

- iii) **Soil Needs are Met by Off-Island Sources:** High quality soil is scarce on Bowen Island due to its natural rocky regions. Consequently there is a continual importing of landscape and garden soil and mulches brought in by businesses and home owners from Fraser Richmond Soil and Fibers Ltd. located at the North Shore Transfer Station or from other outlets in the lower mainland.
- iv) **The Biosolids (human and animal bio-waste) are Useable in Organic Processing:** The de-watering capacity (liquid reduction) at the Snug Cove sewage treatment plant and the septage receiving pilot project allows the use of these concentrated biosolids in bio-digestion and composting processes.
 - (1) **The Two Million Dollar⁺** Upgrade will be on line in July 2011. The de-watering capacity is an advantage as it reduces the current hauling of sludge every 3 weeks to the Iona and Annasis Island treatment plants by approximately 80%, until such point that this can be used on-Island in one or more processes.
 - (2) **The Pilot Project** introduces septage from household septic tanks, in small amounts, into the upgraded system. This will also reduce the numbers of trips to the Iona or Annasis treatment plants, as is the current practice. However, as households bare this cost it won't reduce BIM's costs. It will, however reduce the Island's carbon foot print. (R.Leuter, EcoFluid, & J. Heart, KWL Engineering, 2011 pers comm.). Refer to pg. 8.
- v) **There are No Weigh Scales on Bowen** which makes it impossible to charge tipping fees by weight for an on-Island facility. (Purchase price ranges from ~ \$5000 to \$20,000 plus construction plus shipping: http://www.alibaba.com/product-gs/433678127/high_quality_weighbridge_scale.html).
- vi) **Increased Rat Population and Resident Bear(s):** This has a significant impact on household "backyard" composting. Denser residential areas such as Cates Hill are more susceptible to the rat infestation and the rats cause significant damage to cars and buildings. (A. Whitehead, pers comm.). The vermiculture in-home units do experience fruit fly infestations when not managed properly. With these factors, the arrival of the bears on the island and life style choices of some residents, composting is declining.
- vii) **Social Consciences and Will Power:** There is an earnest movement for increased food production and a general desire for a greater self-sufficiency on Bowen Island. This plays an important role in developing solutions for using organics productively instead of open air burning or shipping off-Island. Solutions that bring it back to proximity responsibility are possible when individuals, businesses and neighborhoods wholeheartedly focus on achieving these common goals.

b) **Current Practices**

In a comprehensive approach to seek viable solutions for processing organics on Bowen Island the current practices for all of the liquid and solid waste (resources) were investigated. This investigation included BIM's waste management contract with Bowen Waste Services (BWS) and a review of other service providers. It is acknowledged in this report that these businesses are intrinsically involved and will be a part of any viable solutions. This report pays respect and appreciation for their work and their contribution to the Island's economy and its social well being.

Keeping these business practices in mind along with the larger picture of environmental concerns and regional resource recovery programs allows for the presentations of realistic options and adjustments that can be made. The potential feedstock is tallied and the community groups that have a direct working relationship with Bowen's organics are mentioned as well.

Potential Feedstock Information

- i) **Food, Soiled Paper, Box and Paper Products:** Food includes raw and cooked process food and meats, dairy products, fruits, vegetables and grains. Soiled paper includes products such as

napkins, paper towels; take out food wrapping, pizza boxes & liners. Box and paper products include cardboard, newsprint, mixed paper and box paper. All are great potential for use in a compost or anaerobic digestion mix as feedstock.

- (1) **Handling:** The Municipality contracts BWS to pick up food scraps and soiled paper combined with general garbage in plastic bags on a weekly basis. Decals are purchase from the municipality by the householder for each bin that is set out at the curb. Locations such as the Cove and public docks are serviced as well. Food and soiled paper is estimated to be 20% of this general garbage. Food service businesses and multi family unit owners contract BWS privately. Their garbage generally contains higher volumes of food and soiled paper, estimated to be 40 % (BWS, pers comm.). Cardboard and paper products are dropped off at the Recycling depot. Refer to pg. 10 and Volunteer organizations Pg 9 for details of Bowen Island Recycling Depot Volunteers (BIRD). Refer to BWS full service Appendix #3 pg. 33.
 - (2) **Hauling:** BWS hauls general garbage to the North Shore Transfer Station (NSTS) in a one and half loads (47 cubic yard bin and one 20 cubic yard garbage truck) per week. It is transferred by other servers to the Vancouver Landfill in Delta, or Cache Creek, BC. 36% of garbage is transferred to the Burnaby Waste to Energy Incineration (A. Marr, pers comm.).
 - (3) **Processing: Composting:** An estimated 60% of households compost. 40% use the garbage pick up for all or some portion of their food scraps including food that they are reticent to compost such as meat scraps, bones and cooked food (D. Marshall, Zero Waste Bowen Survey 2010).
- ii) **Yard Trimmings:** include grass clipping, vegetable and garden material, shrubs and branches. This material is excellent for composting and anaerobic digestion.
- (1)**Handling:** The Municipality contracts BWS for the weekly yard trimming curbside pick-up, from April 15 to October 15. The trimmings are accepted loose in 70 liter bins or in kraft paper bags and bundled branches of no larger than a 3” diameter. In addition to curbside pick-up, BWS and Rent-a-Bin Waste Removal Ltd. and the various landscaping businesses collect this material from homeowners through seasonal and contract work.
 - (2)**Hauling:** Yard trimmings are either taken to local individuals who compost, feed them to their animals or are hauled off-Island in a 47 cubic yard container, to the NSTS where it is transferred to the Fraser Richmond Soil and Fiber Composting Facility. During peak seasons, spring and fall, BWS hauls three to four times a month and ~two trips a month through July and August when vegetation has slowed down due to drier conditions.
 - (3)**Processing: Composting and Burning:** Bowen Island, as a semi-rural community has a stronger commitment to composting than more urban counterparts. Of the 51% that don’t use curbside pick up for yard trimmings, 92% compost and 31% burn some of their materials (Zero Waste Bowen Survey 2010). Back yard open burning is an estimated 60 to100 + tonnes each year (D. McIntosh per com).
- iii) **Green Waste:** includes windfall, large branches and tree trimmings. This is valuable wood feedstock for composting and biochar production when chipped and can be used in anaerobic digestion as well.
- (1) **Handling:** Services are performed by a number of tree, landscaping & excavation operators on the Island and are generally hauled and processed by them as well. BC Hydro contracts emergency and regular under line maintenance and has pledged their quantities every four years (~486 tonnes) to a commercial facility if that was in place.
 - (2) **Hauling:** If these organics are hauled by BWS, J&E Backhoe, Rent a Bin or other wood service companies, they are hauled to the Weismiller Property on Buchanan Road Bowen, or the NSTS and other locations in the Vancouver area. Twin Island Excavation looks after their excess green waste and has an arrangement in the Lower Mainland to deliver feedstock to a

firm in exchange for soil and amendments which is brought back to Bowen to use with their business and various projects.

- (3) **Processing: Chipping or Bucked for Firewood:** Considerable tonnage is created but taken up for use in home heating, landscape mulching, horse paddocks and park trails. All of the handling and hauling business have an extensive and long history with existing customers and said they would not pay a tipping fee. Current practices therefore don't make these quantities readily available for organic processing.
- iv) **Land Clearing:** Includes roots, stumps, trees and debris from raw sites. If cleaned to a certain degree, this material is an excellent candidate for biochar.
- (1) **Handling:** Land developers and these businesses: J&E Backhoe Ltd, T-Rex Excavating Inc. and Twin Island Excavation Ltd. have been the main businesses dealing with land clearing material.
 - (2) **Hauling:** Most material is dealt with on site. In recent years the lumber industry has charged to take logs and only some get taken off Island.
 - (3) **Processing: Milling, Bucked for Firewood, Chipped or Stock Piled for Burning:** Currently, most land developers mill the logs with on site mills for siding, shingles and non structural needs. The balance is cut up for firewood or chipped for decomposition on existing sites. As a last resort, Bowen fire regulations allow for on site open burning through permits from the local fire department and the permission of higher level agencies for appropriate atmospheric conditions within seasonal parameters.⁴ Burning, although less expensive than any other method of dealing with this material is a frustrating process, having to wait for appropriate conditions or seasonal requirements. The residual stumps and woody debris is generally not fit for composting with its rocky content or large dimensions as it is hard to break into smaller pieces (time consuming and costly as it wears heavily on equipment) However, both Twin Island Excavation and Mr. Weismiller are in the process of applying for re-zoning to officially allow stockpiling and processing of organics to utilize woody material and other organics and would then, not be using the open-air burning method of disposal.
- v) **Construction and Demolition:**
- (1) **Handling:** Construction companies and the haulers are beginning to segregate construction material into separate bins or piles, "source separation" due to bans of various materials in general garbage. The industry has a high compliancy rate and diversion from land fill and yet will be required to recycle even more materials in the near future as all wood will be banned from landfill by the end of 2015 due to their implication in landfills and their possible and productive life cycle nature as organic material.
 - (2) **Hauling:** Services are provided by Bowen Waste Services, J&E Backhoe Ltd. and Rent a Bin Waste Removal Ltd. This material is not allowed in compost as it can be contaminated by paint and other toxic ingredients. This is being reviewed for the OMRR regulations to be able to use "clean lumber". Quantities are thought to be in the 400⁺ tonnes/yr. range.
 - (3) **Processing:** Urban Wood Waste Recyclers Ltd located in Vancouver and New Westminster handles construction and demolition wood. Mr. Weismiller does stock pile and salvaged wood, metal, construction dimensional pieces for resale and raw logs for milling and firewood purposes. He has included in his application for rezoning, a re-use-it construction outlet, as well as the organic processing and distributing facility. (E. Weismiller, pers comm.).
- vi) **Biosolids:** The use of biosolids constitutes a significant resource. It contains valuable nutrients for soil augmentation and will address the moral issue of sending it off-Island to other communities

to deal with it. These issues should not be ignored or dismissed. Refer to pg. 35 for more information, Return to Relevant Issues iv, pg.6.

- (1) **Handling:** The Snug Cove treatment plant is a tertiary level biological processing plant that discharges high quality treated waste water into the Howe Sound. 95 % of sewage on Bowen, however, is processed through household septic tanks and fields with many having specialized treatment plants where rocky conditions occur.
- (2) **Hauling:** Advantage Waste Specialties Inc., Bowen Biffies, Mainland Tank Services and McRae's Environmental Services Ltd haul all the biosolids to either Annasis Island (secondary treatment level) or Iona Treatment Plant (primary treatment level). It is noted that neither plant has as high a treatment level as Bowen Island's Snug Cove tertiary (three level) system.
- (3) **Processing:** The 2% solid sludge content from Cove system will be de watered to 15 to 18 % solid state in July 2011. As mentioned, not only does this reduce the off-Island hauling frequency but it allows the possibility of use of this organic material in a regulated commercial composting or use in an anaerobic system due to its less watery state. Septage (bio-solids from septic tanks) has high volatile carbon content and can not be put directly into compost. The pilot project when underway will accept the septage which will be gradually trickled into the upgraded Cove system to neutralize its potency.

Volunteer Organizations Managing Organic Feedstock

These groups will be listed within the Stakeholders and Collaborative Relationships Section and are mentioned here as groups that deal directly with Bowen's organic resources.

- (1) **BIHORA and Other Collectors of Animal Manures:** Those in animal husbandry are clear that all readily available manure is currently used for existing composting venues for gardens, landscaping and the excess is sold for their annual fundraisers. They have no desire or need to do any more than what they do now and it would take too much effort and extra expensive to reclaim beyond current practices (V. Pearce & President, K. Beaulieu, pers. comm.).
- (2) **B.I.R.D. Board and Members:** Twenty two volunteers manage the recycling depot building along with BWS. Together they research and source businesses that employ sound practices for recycled products. They provide education for the community and supervise recyclable placement and sorting in the collection bins at the depot with ~ 1500 volunteer hour per year. Paper, Newsprint and Cardboard collected at BIRD are of interest for feedstock in organic composting and bio-digestion because of their carbon content and the significant quantities collected. Cost analysis will determine the best use for these products during any given year.
- (3) **KKN:** Beyond the desire to fund organic processing they do recycle some organic clothing. These and other clothing material should be kept out of the landfill. The KKN currently take their excess to an outlet in Vancouver that either sells them or bales them up for rags and the re-creation of fabric items, (The Salvation Army).

Feedstock Availability

The statistics have been collected through personal communications with the tree, landscape, and excavation businesses and the liquid and solid waste service providers. Refer to Appendix #1 for businesses
 *All figures are strictly estimations except 112 tonnes of the yard trimming, 60 tonnes of green waste, the tonnes of paper and cardboard products and the cubic meters of sludge that have been hauled from the Snug Cove Treatment Plant and accurately recorded at their off Island destinations.

Approximate (~) Feedstock Volumes

Food waste:	~197 tonnes	Speculated to increase due to source separation
Yard trimmings:	~184 tonnes	Speculated to increase by 60 to 100 tonnes if an open burning ban is mandated
Green Waste	~232 tonnes	Speculated to increase by 100 ⁺ tonnes if an open burning ban is mandated
Land Clearing	~400 ⁺ tonnes	Speculated to increase by ~100 tonnes if ban is mandated
Cardboard	93 tonnes	
Mixed Paper	100 tonnes	
Newsprint	40 tonnes	
	~1246 tonnes	Plus speculated increases ~ 300 to 400 tonnes
		Plus BC Hydro 400 to 500 tonnes every four years
Sludge:	~ 190 m ³	2% solids, when de-watered to 30m ³ (15% solids)
Septage	~ 1700 m ³	before de-watering (widely ranging solid content and carbon volatility which depends on frequency of collection.

c) Three Organic Processing Options

Composting, Anaerobic Digestion and Biochar Production: Bowen's organics can be accommodated with these three techniques. For the purpose of this report the following information will explain the process of each of them, both natural and controlled, and give a brief overview of the requirements of a commercial facility.

i) Composting

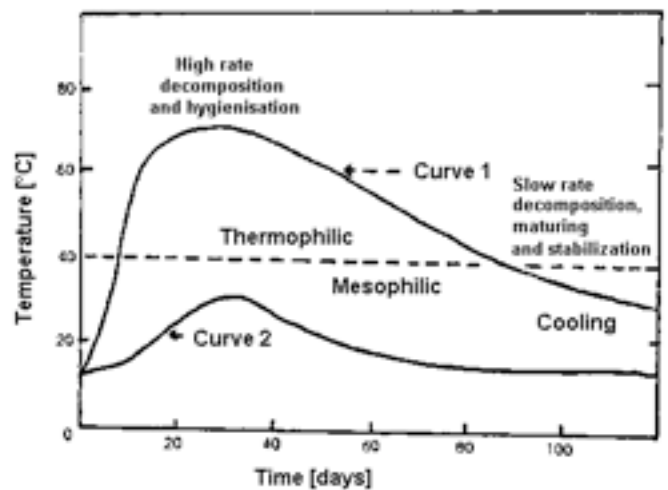
The Process: Composting is an organic process that happens naturally as plant material decomposes to simpler forms with the help of aerobic (oxygen based) bacteria, fungi, actinomycetes (part bacteria and part fungi) and small soil born invertebrates such as earthworms. Quantities of carbon, nitrogen, water and oxygen, are essential. Commercially, a carbon to nitrogen ratio of 30:1, with high carbon content (found in dry woody organics) and high nitrogen content (found in soft vegetative organics) must be mixed together to create a healthy environment for the composting microbes. Moisture content should be around 50% to 60 % and an adequate supply of oxygen must be available throughout the composting material for aerobic bacteria to flourish. Without oxygen an anaerobic process will occur with increased odors and putrefaction (rotting) which is an unwanted effect and will result in the formation of gases such as ammonia and methane. These are not easily taken care of in a compost facility and have many ramifications of environmental issues around GHG emissions, community discord and government regulations.

Although the stages of composting will occur naturally, a commercial facility must consciously manage the feedstock to bring about two temperature levels and a curing and cooling down stage. A temperature range of 40⁰C to 45⁰C (medium) must be maintained for at least 14 days and a high temperature range of 50⁰C to 55⁰C (high) must be maintained for three consecutive days. The medium temperature brings about most of the decomposition and the higher temperature

contributes to the decomposition as well as address pathogenic (disease producing) destruction. The final depletion and decomposition of complex raw materials is accomplished as the bacteria, fungi and actinomycetes use the balance of their food within the feedstocks. The temperature begins to drop and stabilizes. These stages are necessary to create a valuable, safe and stable product for use in food production, gardens and landscaping applications. If the compost is not fully cured, high temperatures may occur again and if used on plants in this state it may cause damage. Incomplete processed compost also has more inaccessible nutrients, will still attract vermin and vectors (disease carrying organisms) and may still contain high levels of pathogenic microbes (depending on the feedstock used).

The Benefits of Compost: It is used as a top dressing or mixed with soil and other amendments depending on the need. Using compost has become mainstream and widely known as a viable alternative to commercial fertilizers. It is also used as an erosion preventative, a water retention mechanism and an aeration vehicle. It has a natural insecticidal benefit and disease prevention factor. It is a commendable use of organics and one much desired over dumping to landfill or burning it. Importantly it is a valuable product for use in a community that intends to increase food production and especially for one that ships organics off the island and then has to haul soil back on.

ref.: "Merits of composting over landfill": <http://www.profu.se/pdf/reportCewep.pdf>.



Ref.: wordpress.com/2011/04/19/composting/ April 2011

Ref: <http://www.wifu.org/projs/project5/pres2.html>

Commercial Facility Requirements:

There are many factors that must be taken into consideration to create a composting facility on Bowen Island. A viable business venture with suitable land is a primary need. The scale that would be required depends on the available feedstock, the type of composting technique, and the scope of activity to deal with the end product to be sold on site or elsewhere.

- (1) **Land requirement of 3 to 5 acres, minimum**, is needed to accommodate a commercial composting facility but should not be limited to this size if more land is available.

Considerations are, but not limited to, having enough land for set backs from adjacent property lines, ease of vehicle access to the site, maneuverability and safety throughout, and equipment and vehicle storage. The spaces for tipping (dumping) organics, the stock piling of woody material, and the processing and curing of compost must all be adequate for the volumes anticipated. If the compost and other products are sold at the site, a separate area must be assigned with considerable distance kept between it and the direct operations. The space for a building for the operations staff and washroom facilities must also be assigned.

- (2) **Structures, Systems and Equipment** must be built or purchased depending on the type of composting technique, the types of feedstock and the system of dealing with odors and leachate (the liquid concentrate of composting, “tea”).

Considerations are, but not limited to, a weigh scale, tipping ramp, a covered receiving building for mixing (if food and bio-solids are used) on an asphalt or concrete (pavement) floor and pavement area for the composting and curing processes.

The Equipment required includes a grinder, a chipper, a hopper and auger system, one or two front-end loaders, a screening unit and conveyor system.

Water and Power are required.

If Aeration Systems are employed they will run in channels within the pavement or through pipes or hoses laid down on the pavement under the composting piles. In both cases fans and air pumps are hooked up to these pipes or channels to draw or push air through the compost to allow greater aerobic bacterial action. Air can be forced upward through the compost piles (positive aerations) or drawn down through the piles (negative aeration).

Odour Treatment is complimentary to this aeration system as the flow of odour laden air coming out of the compost is brought through to bio-filters. Bio-filters are often composed of moistened organics such as woodchips, yard trimmings, cured compost and may be mixed with shredded tires to neutralize and biologically treat the volatile chemicals (ammonia and others) with 60% to 85% elimination. One alternative and less expensive method is to cover the compost piles with eighteen inches to two feet of bio-filter organics when the cost of aeration isn't possible. (Tom Richard, Cornell Waste Management Institute ©1996 Cornell, University Ithaca, NY, USA, 607 255 1187, cwmi@cornell.edu, <http://compost.css.cornell.edu/odors/odortreat.html>)

Leachate Systems to deal with the liquid concentrate preventing ground contamination and providing storage and proper disposal must be in place before operations can begin. Leachate can be collected through drains in the pavement on the edges of the pavement or the area may be graded so that the leachate runs off into lined reservoirs, pits or into water treatment systems.

Strategies for Rats, Bears and Vectors (disease carriers) must be anticipated with appropriate containment of putrefied feedstock, coverings, fences and pest control techniques.

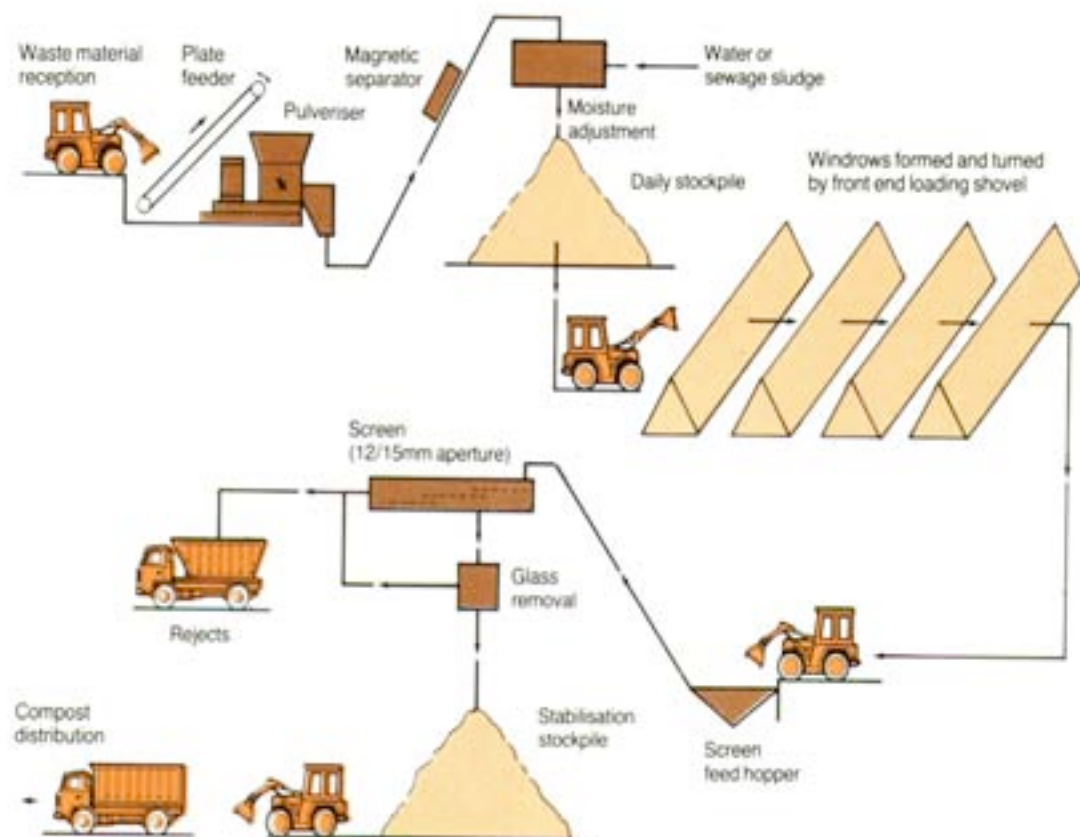
Possibilities exist to minimize building structures and extensive leachate and aeration systems with the use of the AgBag System, in-vessel systems or if only using yard trimmings and green waste, exposed windrow systems.

(3) **Regulation and Zoning Requirements:**

Provincial: Approval is required by the Ministry of Environment (MOE) and the Department of Agriculture (when animal manures and agriculture vegetation waste forms are used it is under the Waste Control Regulation BC Reg. 131/92). The Organic Matter Recycling Regulations (OMRR) is the industries set of rules and guidelines for processing compost on a commercial scale. The application for permitted operations must be applied for 90 days in advance of start up and need an environmental study if volumes are above certain limits (20,000 tonnes). As prescribed in the OMRR regulations a professional consultant is required to oversee the design, construction and initial operational training. The service operator must take a certified training course. Dr. John Paul of Abbotsford BC provides this certificate training in this region. The manner in which organics are processed, the temperatures achieved and the feedstock used dictates the end product to be a Class A or Class B Compost. Class A Compost is required for food producing soils.

Local: Land used for a commercial facility on Bowen Island needs to be zoned industrial. The OCP Update 2011 proposes two parcels, Radar Hill leased by Twin Island Excavation Ltd. 12

and the Weismiller property on Buchanan Rd. to be used for industrial purposes and both will need to go through the re-zoning process before any operations can begin. Re-zoning can be an onerous procedure involving public input and council's approval. The current directives in the OCP that strongly advocate the use of organics in productive processes on-island, that all organics will be banned from the landfill soon, and that Metro Vancouver did not permit the burning of the stockpile on the Weismiller property this year (2011), gives reason enough to secure these re-zonings in a timely manner with appropriate considerations. The usual permits will be applied for including road access, building, plumbing, electrical, and North Shore Health approval. It may take receive greater attention due to the MOE requirements and the unprecedented use of land on Bowen Island. As an added comment, neighbourhood community gardens would be an ideal companion activity for a group effort with a composting facility. These multi-use gardens also need local policy in place before anyone can begin, e.g. Cates Hill Neighbourhood Community Garden is on hold.



There are many configurations and systems that could be employed for a composting facilities on Bowen depending on available funds, the available feed stock, the topography, quantity of land, location, profit margins needed and the willingness to undertake an operation. This flow chart of turned windrow method could also be a static (not turned) windrow style with aeration system beneath the piles and it could be covered with 2ft natural bio fiber as a bio-filter or covered by synthetic covers. This is thought to be a feasible scenario for Bowen (P Arnold, D. Geering, T. Thomas, J. Paul pers. comm.).

Refer to Appendix #4 for more details on the natural process and dynamics of Composting, pg. 34.

Refer to Recommendations for On-Island Processing Steps, pg. 22, and Excel Spread Sheet for the various types and levels of composting Appendix #5, pg. 39.

ii) Anaerobic Digestion

The Process:

The anaerobic digestion (AD) i.e. fermentation processes occurs naturally. Within anaerobic conditions, (without oxygen) a complex biochemical process with the aid of anaerobic microorganisms break down organic matter to simpler constituents forming methane, carbon dioxide, and liquid and solid byproducts (digestate). When deliberately created, small in ground units, or above ground containers made of metal, fiberglass, concrete and brick are built within barns, in out-buildings or placed outdoors. Some have inflatable and floating bladders to accommodate the fluctuation in levels of materials that are produced and separated. These units receive crop and food residuals and numerous other organics such as cooking oils, yard trimmings, bio-solids, paper, wood chips, bark, sawdust, used mushroom medium, spent algae and human and animal manures (any that may be available on Bowen). Within in the airtight container, called a digester, they are stirred, (some are heated) and then allowed to set for a number of days, depending on the temperature. Biogases are captured and collected to be processed for fuel, automobiles, for electricity production, heating, cooking or heating.

Mesophilic digestion is the most commonly used process for anaerobic digestion (AD), in particular, for waste sludge treatment. Decomposition of the reactive suspended solids is around 40% over a process period of 15 to 40 days at a temperature of 30 to 40°C. Mesophilic digestion is usually more robust than the higher temperature, thermophilic digestion, but the biogas production tends to be less. Regulations may warrant a pasteurization stage in this process with a temperature requirement of 70°C for at least one hour to ensure a sufficient percentage of pathogens in the feedstock are destroyed.

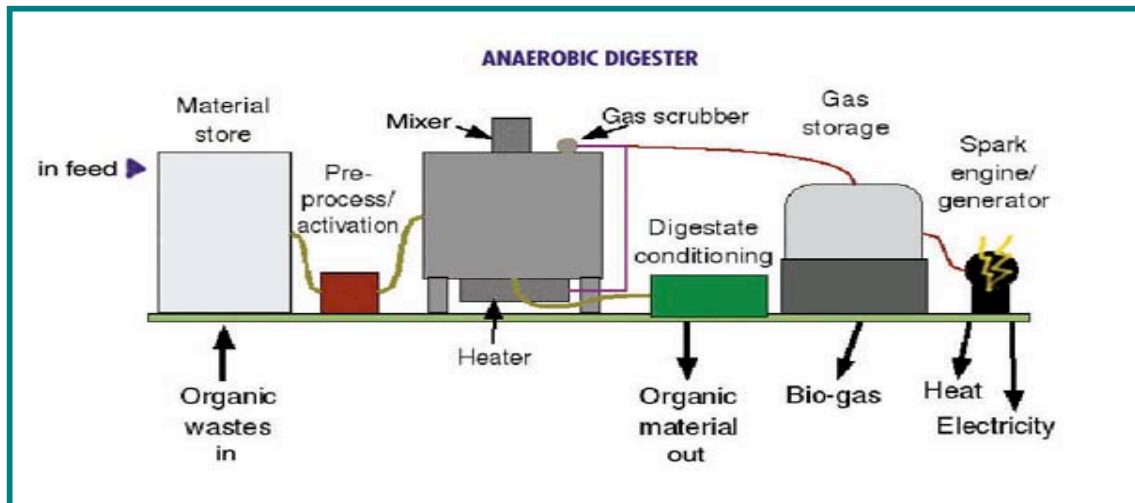
Thermophilic Digestion

Thermophilic digestion is less common than mesophilic digestion technology probably because it is more expensive as more energy is needed. There is also the necessity to have more sophisticated controls & instrumentation and the technical expertise. The digester is heated to 55°C and held for a period of 12 to 14 days. Thermophilic digestion systems provide higher biogas production (up to 95% pure methane), faster process time and an improved pathogen and virus destruction.

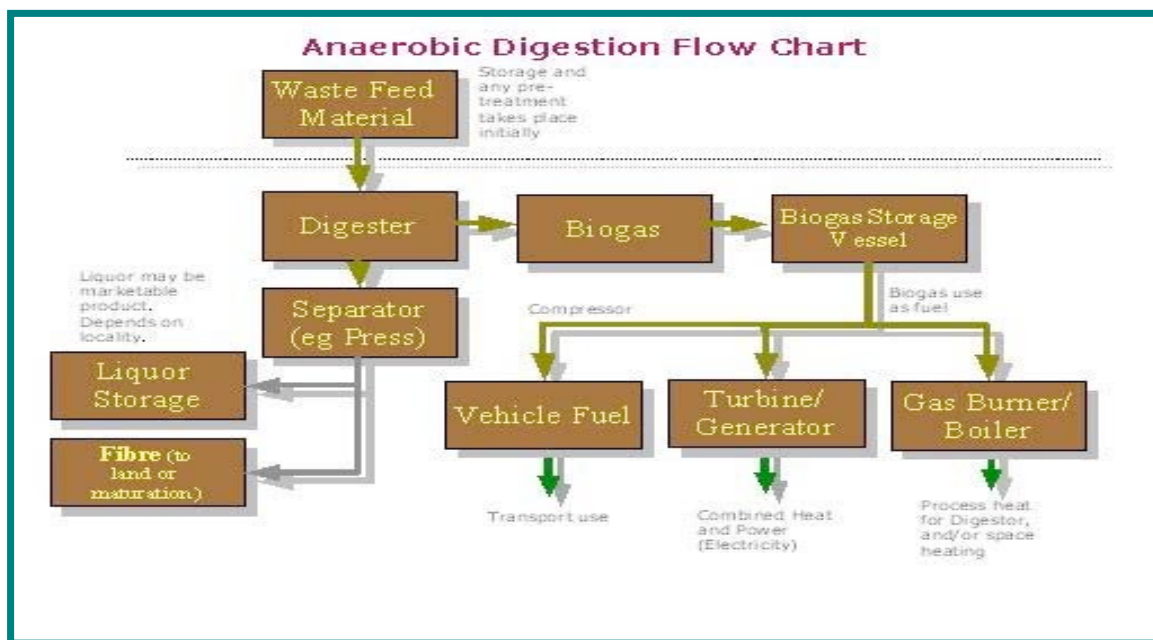
Ref.: http://www.esru.strath.ac.uk/EandE/Web_sites/03-04/biomass/background%20info8.html

Anaerobic Digestion has been used historically in numerous countries throughout the world but seldom before the 1950's in North America. The industrial sizes that are now being built as complex refineries, depending on the volumes and the technical requirement, can cost millions of dollars to build and thousands to maintain yearly. The Fraser Richmond Soil and Fiber digester being built will cost \$14 million and will be expected to process the excess organics that are coming from the Metro Vancouver region with their commitment to ban food from the landfills. The University of Calgary has a million dollar unit which cost \$500,000 to operate yearly. However, small designs are becoming available to meet the needs of smaller communities and neighbourhoods. They are robust, reliable, and safe. Interestingly, the do-it-yourself units continue to flourish all over the world including mobile units (GB Recycling UK, G. Bingham pers comm.) from the UK, China and Korea. AD facilities have been recognized by the United Nations Development Program as one of the most useful decentralized sources of energy supply as they are less capital intensive than large power plants and achievable on a family size scale.

These two flow charts depict the physical path of input to output and the useful by-products.



Ref.: http://www.zwes.ca/Section/Solutions/Anaerobic_Digestion



Ref. http://www.anaerobic-digestion.com/html/anaerobic_flow_diagram.html

The Benefits of Anaerobic Digestion include the reduction in putrefaction related odours of bio-solids, foods and manures and if well managed AD can decrease greenhouse gas (GHG) emissions. Due to its closed loop system the process requires low additional energy when using the biogas for operational uses for electricity and heat. The high temperature process destroys pathogens (harmful bacteria and viruses) and weed seeds. It creates more accessible essential nutrients for use as fertilizers than compost alone. If cellulose content is high it can be dried and used for animal bedding. The raw biogas is used to power motors and generators for vehicles, electricity and heating. On average, raw biogas contains 60% methane and 40% carbon dioxide and for commercial purposes would need higher methane percentages. On a community perspective, AD by-products can increase agricultural economics by providing local sources of soil additives and indirectly allow more potential for community owned and operated businesses in agriculture and energy production and sales.

Commercial Facility Requirements

(1) **Land requirement** of less than an acre is needed if located in an area of a sewage treatment plant or other organic processing facility, allowing for shared equipment and services. All aspects of the auxiliary functions of the compost facility apply to land use for an AD facility. Access, safety and vehicle movement, washroom, office and technical control rooms are needed. Space for stockpiling woody and shredded organics will need to be available. Food, bio-solids and liquid feedstock need to be placed directly in sealed storage or mixing chambers so there is no need of larger curing or mixing areas as there is with composting. The end solid product (digestate) is ideal to combine with the compost process and for future consideration space should be set aside for both, even on a neighbourhood scale. A newly developed process to reclaim phosphorus from waste water and bio-solids is also a candidate for a shared facility with anaerobic digestion at the sewage treatment plant area, land permitting. Refer to pg. 36.

(2) Various Structures, Systems and Equipment.

Considerations similar to that of a composting facility would be needed: a weigh scale, tipping ramp, water and power and the above mentioned facilities. Electricity however should be supplied through the production of the bio-gas.

The Equipment: Depending on the feedstock and the size, the facility may require a grinder or shredder to produce particles no larger than 12 mm and a front end loader. It is likely to require a generator and a compressor (convert to electricity), a press to reduce the liquid content, a boiler, and a heater. Refer to Flow Charts on pg.15, ref.: http://www.esru.strath.ac.uk/EandE/Web_sites/03-04/biomass/background%20info8.html.

(3) Regulation and Zoning Requirements:

Provincial: Anaerobic digestion is regulated under the Ministry of Environment which appears to give extensive guidance on acceptable feedstocks, nutrient management planning, waste discharges and best management practices. Businesses in BC, however, are having difficulty finding clear instructions and support from MOE in a timely manner.

Ref.: BC Ministry of Environment, On-farm Anaerobic Digestion Waste Discharge Authorization Guideline, May 14, 2010 <http://www.env.gov.bc.ca/epd/industrial/agriculture/pdf/anaerobic-digestion-guideline.pdf>

Local Regulations and Zoning: The potential exists for anaerobic digestion. The systems would have to be small scale units and if for community or multi-family use it will be subject to the same re-zoning regulations and land use requirements as that of a composting facility. With reference in the OCP update to resource recovery, energy production and food production this is a logical direction as well. Refer to pg.12. For photographs of anaerobic digesters suitable for Bowen refer to Appendix #4, pg. 36.

iii) Biochar Production

The Process:

Biochar is a high carbon, fine-grained charcoal. It is produced by the pyrolysis of organic feedstock (heated under pressure at elevated temperatures in absence of oxygen). Temperatures of between 430°C to 1000°C can be reached. The composition of biochar products depends upon the particular nature of the feedstock, particle size, achieved temperature, pressure, and elapsed time. The yield of products varies heavily with different temperatures. The lower the temperature is the more char that is created per unit of feedstock. The higher temperatures produce more gases. The two main methods of pyrolysis are “fast” and “slow”. Fast pyrolysis yields 20% biochar, and can be produced quickly whereas slow pyrolysis can be optimized to produce substantially more char (~50%), but takes on the order of hours to complete. Efficient facilities can be run entirely from the biogases that are produced in this process with 3–9 times more gas to spare for other uses.

Microwave technology is a third type being developed that generates heat from the friction in individual polar molecules within the organic material. A company in New Zealand, Carbonscape, is pioneering the use of low cost biomass (pine sawdust) and converting it into valuable finished products, fine carbons for filtering and purification, charcoal, biochar, bio-oil, fertilizers and bio-gas. This process gives promise to lessen the expensive processing of biochar. Refer to CarbonScape: <http://carbonscape.com/microwave-technology/input-stream/>.

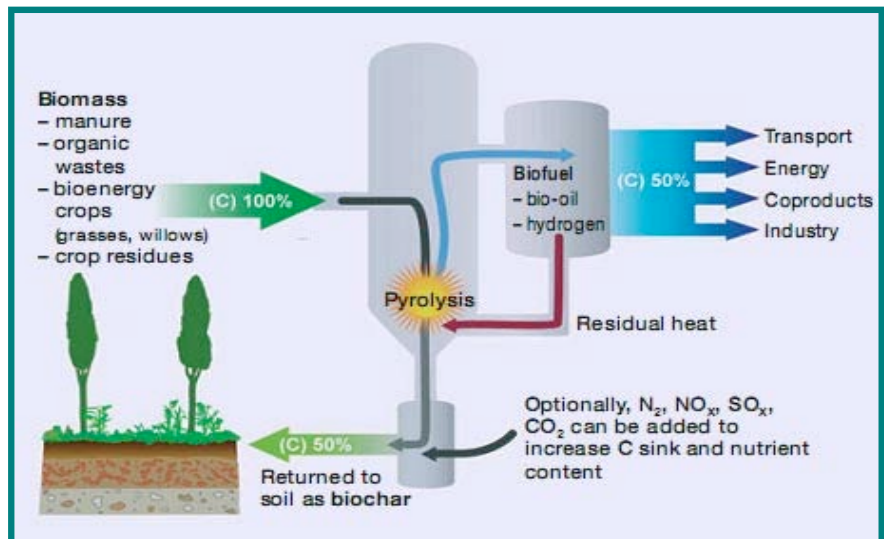
The Benefit of Biochar

The creation of biochar has been employed for centuries for cooking and heating and the improvement of food producing soils. It has been made with little sophistication and yet significant benefits. In recent times renewable oils and gases that are co-produced along with the biochar can be used as fuel for producing heat and electricity. Biochar's chemical makeup is largely resistant to decomposition and has the ability to sequester carbon from the air. It suppresses harmful methane and nitrous oxide emissions by ~50%. When placed in soil, carbon, as well as other nutrients, binds together with the bio-char to prevent them from being dissolved and washing away. Biochar has been found to significantly increase the efficiency of applied fertilizers and could eventually reduce the need for them with thorough application and the addition of compost. Crop yields increase by at least 10 % due to the beneficial growing environment with a higher pH level and higher inventory of nutrients. Owing to its tiny structural compartments and nature biochar creates oxygenated healthy soil with increased fungal and microbial populations that break down nutrients to accessible forms.

Biochar keeps its stable condition for hundreds of years as seen by examples in the Amazon rain forests. The distinction needs to be made that biochar may be a substance more suited to severely weathered and deprived soils (low pH, absent potassium, low or no humus). As it increases the pH it would not be an advantage to low pH (acid) loving plants. The effect of bio-char reduces the growth of the prolific weed and acid loving, Horsetail (*Equisetum arvense*) here on Bowen (J. Hoover, pers. comm. 2011). Biochar offers promise for its soil productivity, climate benefits and an added benefit from the use of its by-products for energy production. As history proves and more recent studies show, it remains in a stable condition and gives merit for its use on Bowen Island with its high rainfall, leaching conditions and low quality, shallow acidic soil.

This flow chart P17 depicts the physical path of input to output, with a few of the organics that can be used and the products produced with their uses.

Chart P16 Ref.: Hawaii Agriculture Notes: Biochar http://ahualoa.net/ahualoa.net/notes_biochar.htm



Pacific Pyrolysis Technology out of Australia has an extensive information section on biochar. <http://pacificpyrolysis.com/technology.html>, Refer to more information and diagrams to explain the process pg 37.

Commercial Facility Requirements

Land Requirement: Considerably less space than composting is needed as there is no need of curing stations but will depend on the size of the operation, volumes of feedstock available and whether the products will be sold on site. There must be allowance for all auxiliary considerations i.e. personnel and building space, storage of feedstock and end product containment. Refer to the Composting Section pg. 11.

(1) **Various Structures, Systems and Equipment:** Indoor, outdoor or portable units have been developed. The pros and cons of each with excess heat accumulation or loss of it are the trade offs along with the cost of enclosure. Keeping the material as dry as possible before burning decreases the burning cost. The biochar processing unit will have a bio-gas containment chamber with a closed loop system built to meet environmental controls. The fuels are returned back to itself to be used to heat the processing feedstock. The excess gases will be able to be directed for fuel for other uses with the need for generators, filters and compressors. A front end loader, a grinder and screening equipment are necessary to create and process the materials.

(2) **Regulation and Zoning Requirements:**

Provincial: BC legislation and other agency directives apply to biochar production including environmental factors such as air pollution, waste management, transportation, hazardous goods, and nutrient management. The Canadian Food Inspection Agency (CFIA) is involved due to the application of biochar to food producing soils.

Local: Re-zoning Procedure, Refer to pg 12.

Rezoning will be required for any property that creates biochar on a commercial basis but the Buchanan Rd. site has some traction as it is listed for industrial use in the OCP Draft Update 2011. It is also noted that many sections within the OCP Update, currently before council for approval, makes mention of the need to use organics on Island.. Refer to pg. 38, and <http://www.biochar.ca/> and <http://www.biochar-international.org/> and Local Opportunities pg 26.

Composting, Anaerobic Digesting and Bio-Char Units

A spreadsheet presenting various sizes and models of processing units was developed for this report. It shows a succession of options from in-home units to backyard and neighbourhood styles. A few commercial in-vessel units are thought to be viable. Research found that most commercial systems are custom made, large bunkers, tunnels, open air turned windrow or static pile aeration windrow systems and can not be referenced as designed units. Engineers or engineer firms are hired to design and oversee the creation of these systems. Refer to Beyond Bowen Recommendations pg. 26, and the spread sheet, Appendix #5 pg. 39.

3) **Bowen Island Stakeholders, Relationships and Related Factors**

a) **The Community, the Municipality, and Privately-Owned Businesses**

A resource recovery program that is environmentally and socially responsible as well as economically viable must include collaborative engagement of all affected stakeholders through the decision making process.

i) **Community Groups and Community Participation**

Motivated residents and community groups can take the resource recovery concepts to a practical level for themselves and others. Groups that are either currently active or interested in this topic are working on and meeting with other groups in the community to further food production, recycling, and organic resource recovery. Continuing to do so is a community building process and is an advantage that creates widespread positive results in these areas. The groups are, but not limited to this list:

Bowen Agricultural Alliance Society	Bowen Island Community School
Bowen's Preschools and Private Schools	Bowen in Transition
The Rotary Club of Bowen Island	The Bowen Island Garden Club
Bowen Island Horse Owners and Riders Assoc.	Bowen Island Recycling Depot
Knick Knack Nook Re-Use-It Store Society	Zero Waste Bowen

ii) **Municipal Services**

The Bowen Island Municipality manages or assists in essential services such as water, waste management, fire protection infrastructure, and roads for residents through yearly taxes and grant funds. It is critical that a municipality provide leadership and governance in resource recovery practices including timely approval for re-zoning and support of community and private initiatives. It is ideal to take the time to collaborate with all parties involved.

iii) **Privately-Operated Businesses**

Bowen Island looks to private business to share the financial risk and responsibility for some of the community's essential needs and requirements. They contribute to valuable services within the community, in liquid and solid waste removal, land clearing, tree and landscaping services, construction, land development and hydro operations. These businesses have an influencing factor with regard to resource recovery and will also be affected by any changes to current practices and regulations. Support and cooperation with these businesses is essential to accomplish the most sensible and viable solutions.

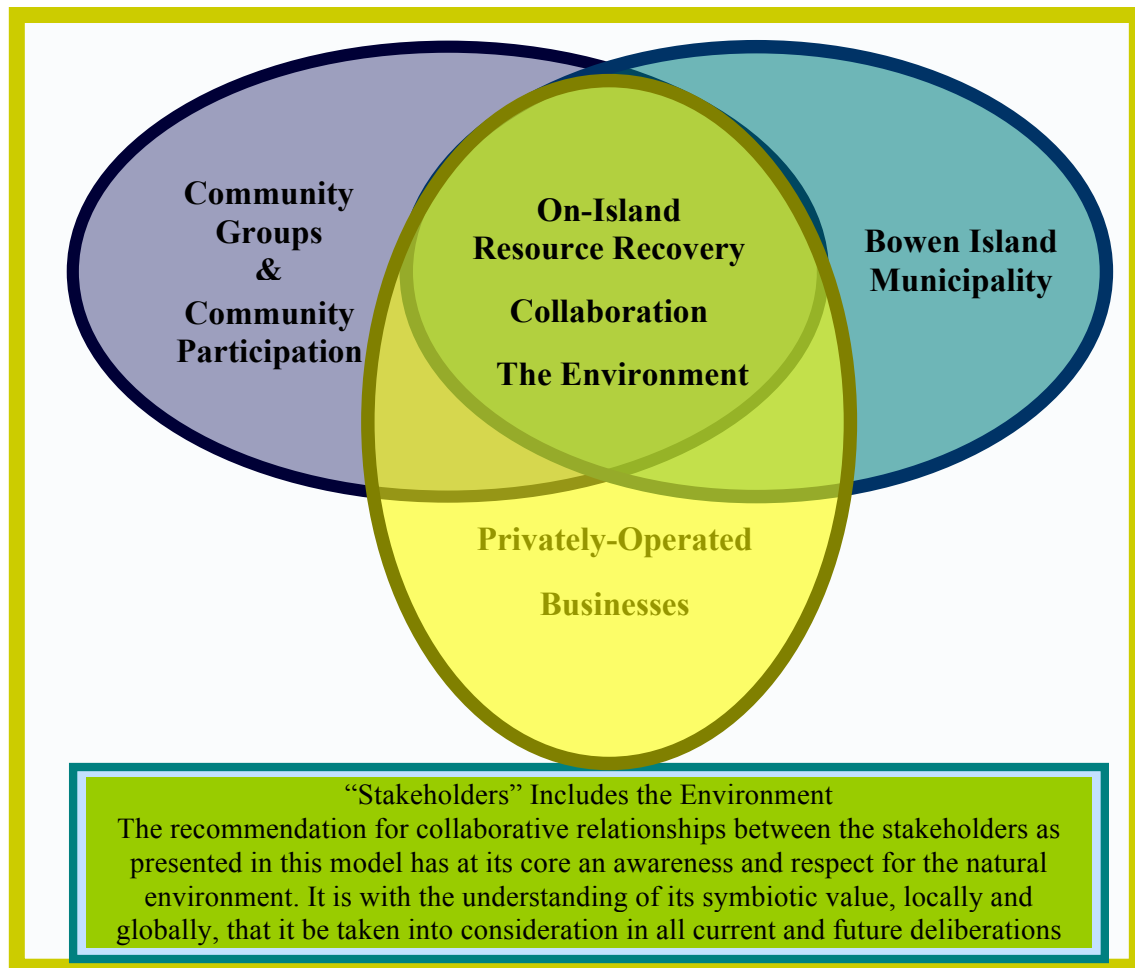
b) **Community Acceptance and Support**

Willingness to participate and comply with mandated changes in resource management relies on receiving clear accessible information, in a reasonable time frame. Local governments must allow and support community group initiatives where they are unable to do so themselves. On-going education and mentoring programs presented within the community, by community groups, will provide the desired impetus for commitment and acceptance. (Zero Waste Conference, Metro Vancouver, March 2011 and Zero Waste Conference, Recycling Council of BC, June 2011, Ruben Andersen, Metro Vancouver)

c) **Funding Opportunities**

Working together within the community amongst the various stakeholders may find it an advantage as it could lead to funding, grant and loan opportunities not otherwise accessible. Possibly opportunities for funding are through the Federal Union of Municipalities, National Resources Canada, The Union of BC Municipalities, BC Hydro, Department of Agriculture, local banks, credit unions and other funding agencies. Creative thinking and resourcefulness will be a key to finding economic solutions to the start up of resource recovery endeavors. Refer to full pg.30.

Bowen Island Resource Recovery Stakeholder Involvement



4) Recommendations

Based on the results of the research it was found that the options for processing organics along with the Island’s dynamics, present a complex situation. The recommendations therefore divide into four sections. Section One presents the social aspect, i.e. the relationships and planning initiatives that will be needed to accomplish and uphold the desired direction. Section Two presents the mechanics of organic processing. Specifically, it presents options for units or techniques and the order to accomplish the processes within the three possible levels of participation: household, neighbourhood and commercial undertakings. Section three presents insight and recommendations for the Municipality and Council’s review which sets out changes in waste management and related services as well as changes for land use and the open burning by-law. Section four presents a list of community businesses that are considering organic and energy related enterprises. It also contains a list of field related professionals and businesses that have expressed an interest in collaborative work with the Bowen community in this direction.

Section One: Bowen Island Resource Recovery Relationships and Strategic Planning Initiatives

- a) **That Collaboration be a Basic Code of Conduct between All Parties** that are either affected by or interested in the creation of resource recovery methods on Bowen Island. To be included: the CAO of BIM (or designated staff), a council member, affected and interested businesses and community members.

Action:

- i) **Establish Project Co-Coordinator (One from the Community, One from BIM)** to assist collaborative participation and action. This would be a one year commitment to liaise, coordinate initiatives and events, and support others in the direction of resource recovery and includes but not restricted to the following activities:
- (1) **To Liaise with BIM, CAO (Brent Mahood or designated staff) and Supportive Council Member.** This will include a review of the organic recovery direction and foster BIM's support for current and future initiatives presented by various groups and privately-owned businesses. It will be to confirm BIM's regulatory requirements and logistics for organic processing.
 - (2) **To Assist in the Establishment of a Resource Recovery Task Force** This group will instigate practical action directly related to organic processing. The task force will include a cross section of stakeholders and importantly a municipal staff member and representatives of the waste removal, tree, excavation, land development, construction and firefighting services. Instrumental to the success of this direction will be to address **current open burning by-laws along with securing land use for industrial use** for processing on appropriate levels needed. This could also include securing space for resource management and related storage: i.e.: baling of plastics, metals and paper products to reduce hauling time and costs and allow for organic stockpiling: ref. Lot 1 Community Lands as well as the other private and public land locations presented for this use. Refer to pg. 24.
 - (3) **To assist in the Development of Neighborhoods for the Purpose of Sharing Resources:** Expertise, time, equipment and land within a close proximity to their household environment. This indicates gardening, and organic processing on the neighbourhood scale and could also include:
 - (i) **The Establishment of an Inventory of Land Available for Food Production and Gardening Use:** Create a registrar of land owners who will allow land use for free or lease and a donor's category to an Island Land Account. Investigation should include previous inventory and locations which will have suitable sun exposure, whether productive soil conditions exist i.e. potential growing areas developed through creation of raised beds and soil amendments.
 - (ii) **Create "Building Neighbourhood" Strategies:** Developing the ability to work together within neighbourhoods to achieve common goals while respecting and understanding other peoples needs. Through collaborative methods this allows neighbourhoods and communities to address and adjust to current and future needs. Examples of workshops are: "Permaculture", "inCOMMON Community Development", "The Listening Project", "From Knowing to doing"
 - (iii) **Encourage Representatives of Community Groups to Gather on a Regular Basis** to foster synergies around activities and strategies. BIM is to be included. Suggested groups could include but not limited to the stakeholders list on pg.19.

Rationale:

- i) Designated collaborative leadership committed specifically to resource recovery is crucial to the success of this direction. It will not go forward or stay on track without it.
- ii) Fosters continuity and the reduction of duplication.
- iii) Increases the chance for innovative, realistic solutions required for change.
- iv) Creates lasting commitments, stable relationships, and resilient neighbourhoods.

b) **That Education Programs be Developed to address Resource Recovery.**

Action:

- i) **Develop and Distribute Informative Literature** regarding and in advance of needed changes using mail-outs and other communication methods.
- ii) **Integrate Education within Local Established Groups, Activities and Events** while encouraging trans-generational involvement. This could incorporate and include church, community, school, cultural, sustainable and environmental group events.
- iii) **Develop Public Survey(s) and Pilot Projects which may include Universities and/or Research Firms** to establish patterns and quantities, and explore innovative technique for the uses of organics. The surveys and pilot projects must include commercial enterprises as well as households.
 - (1) **Develop Surveys that Request Willingness To:** record quantities of organics generated per week; participate in a bulk order of compost units; take a leadership role in creating community and/or neighbourhood participation; donate organics to a designated neighbourhood location or to a commercial facility, drop off garbage and organics at the recycling depot or other designated drop off location.
 - (2) **Develop Pilot Projects** that enhance the use of organics on Island, partnering with suppliers of products, systems, and education and financial institutes. E.g. UBC, SFU. Puxin. Refer to pg. 26.
- iv) **That a Centre be Created for Demonstrations of Organic Processing and other Innovative Ideas** for re-use of organic and re-useable materials in existing or new physical locations for education and demonstration, perhaps combine with BICS's Outdoor Learning Centre (S Haxby, BICS Coordinator pers. comm.) and other sites. Refer to Section Four (e) pg. 25.

Rationale:

- i) Initial and on-going education is necessary to develop awareness and compliancy in resource separation and recovery practices
- ii) Resource separation compliancy and recovered quantities decrease without continued mentoring and education programs.
- iii) Education programs and demonstration centers enhances resiliency, self-sufficiency, and social well-being.

Section Two: Top Recommended Options for Organic Processing

This second section reviews specific processing units and techniques. Deliberately, household then neighbourhood units are presented ahead of commercial applications. This order coincides with the recommended order of addressing the responsibility of processing organics on-island. Taking responsibility at or close to home is the essence of the *Proximity Principle* and promotes overall waste reduction. Once home and neighbourhood composting and digestion is promoted and developed it can more accurately be assessed whether the balance of available organics warrant a commercial facility. If it is the case that households do not compost their own food and yard trimmings and there are no other solutions in place on Bowen, food and yard trimmings will be hauled off-island to be composted or digested at the Fraser Richmond Soil and Fiber Facility. The method of containment is important to the householders, the transporters and the processing facility when dealing with food to limit the on-set of odors and putrifaction. The recommended items or techniques are in alphabetical order, not in an order of preference. Each has advantages and disadvantages and the choice would have to be made in consideration of personal, neighbourhood and community conditions, needs and economics.

a) **Composting Options:** Refer to Appendix #4, pg.35, and Appendix #5, pg 39, closest.

i) **Household Processing:**

- (1) **Indoor Units:** Envirocycle, 360 Worm Factory

- (2) **Indoor Electrical Units:** NatureMill ProXE, Greengood Red Dragon (electrical units break down food scraps much faster than manual systems).
 - (3) **Outdoor Units:** Envirocycle, Jora, Lee Valley, 3-Stage Continuous, Sun-Mar Drum
 - (4) **Outdoor Techniques:** Trench and cover with naturally occurring or enhanced aerobic microbes and earthworm application, rat proof constructed bins (wood and stone)
- ii) **Neighbourhood Processing**
 - (1) **Units:** Earth Tub, GreenGood, Jora, Sun-Mar
 - (2) **Techniques:** Trench, rat proof constructed bins
 - iii) **Commercial Processing:** Can address all organic feedstock
 - (1) **Units:** Agbag, Earthflow, HotRot
 - (2) **Techniques:** Aeration and static concrete bunker and windrow styles when built and maintained, carefully addressing leachate, odour and vermin, (if using all types of feed stock).
- b) **Anaerobic Digesting Options:** Refer to pg. 36.
 - i) **Household Processing**
 - (1) **Indoor Household Units:** Ecoliving Bokashi
 - (2) **Outdoor Household Units:** Puxin AD units ,custom made, home constructed
 - ii) **Neighbourhood Processing:** Puxin AD anaerobic digesters, custom made to scale in-ground home and portable styles
 - iii) **Commercial Processing:** Puxin AD units & others, custom made units to accommodate total quantities and stock. Refer to outdoor and commercial units, and pg 36 of examples, Appendix #5 spread sheet pg 38.
 - c) **Biochar Production:** Refer to Appendix #4 pg. 38.
 - i) **Household Processing:** Small units, local people using steel drums, (J Hoover, A. Whitehead, Bowen Island), on-line designs and units for purchase. Refer to Appendix #4
 - ii) **Commercial Processing:** Custom or commercially made: <http://pacificpyrolysis.com/technology>.
 - d) **Containment for Food and Yard Trimmings for Composting**
 - i) **Home, Neighbourhood or Commercial Use**
 - (1) **Food:** Kitchen counter-size, 7 liter containers, with lids or specialty buckets designed for collection and preferably with aeration. If the food is placed in bags that are going to be composted they must be certified compostable bags and approved. Another alternative is newsprint lined and layered within household containers and then placed directly into newsprint lined garbage bins. This works well for home composting.
 - (2) **Yard Trimmings:** Loose in bins or kraft paper bags for yard trimmings. In 2012 yard trimmings and food will be combined in the same container, loose, or in tested and approved compostable bags by the Fraser Richmond Soil and Fiber Composting Facility. The technique of lining the curbside bins with newsprint is the first choice being requested by the facility. However, they will accept the approved compostable bags, the brand, Bag to Earth paper kraft bags with cellulose liners have been approved. Newsprint and paper bags add to the carbon content and soak up the liquids. The packages “breath”, which helps keep the material in the aerobic, non methane producing state.

Section Three: Municipality Waste Management Recommendations & Considerations

Due to the request by CAO, Brent Mahood, of BIM, additional scrutiny of Bowen’s waste management stream was employed to be able to inform and suggest alternative practices. These recommendations are in keeping with the resource recovery criteria and premises substantiated in this report.

- 1) **Ban Open Burning of Land Clearing and Windfall Organic Material** when alternative methods for the re-use of wood based materials is in place. Proposed date recommended is on or before Metro Vancouver’s deadline of wood banned from landfill, at the end of 2015: This could include

upwards to 600 tonnes or more per year which would provide significant quantities of high carbon content that is needed in organic processing.: QMPR⁴ Strategy #1 and #4 pgs 12 and 13. The major developments such as Cape Roger Curtis, King Edward Bay, Evergreen and Cowan Point mill some of their land cleared logs on site and buck wood for heating homes. Chipping in place is also employed to create areas for future or current homeowner's gardens and landscape areas. Stumps can be stock piled for future use in biochar production or used in berm development. This report recognizes chipping, bucking, and milling as a valuable use beyond burning even if composting, bio-char or bio-digestion is not employed on a community level

- 2) **Ban Burning of Yard Trimmings** with a proposed ban date of January 2012, (not aimed at barbecues, beach bonfires or woodstove use, QMPR⁴.
This encourages home or neighbourhood organic processing or curbside pickup practices which will funnel these materials into extended productive uses. It follows the concept of local composting and home and neighbourhood garden development for increased food production.
- 3) **OCP Update: Set out more Industrial Land Use Options:**
The OCP update recommends organic processing and use of resources on Island in many sections of the document. Upon staff and council's decision there could be one or two more proposed pieces of land set out before it is finalized. The Orchard property was zoned industrial and is now used as institutional. As a result there is even less available land designated than before. At the time of rezoning, the process will be the safety net if the community is not willing and the use is not deemed appropriate.
 - a) Lot 1, Community Lands (west, past the gas station on Grafton Rd.), 3 to 5 acres, allotted for organic and waste management use. There is a current and future need for more space.
 - b) Salal Rd, Radar Hill and Buchanan Rd. sites to be used for organic processing and handling uses.
- 4) **Negotiate with Metro Vancouver to have the use of the Crippen Park lands** around BIRD, specifically the "Crippen Parks Meadows". This could be assigned to the Bowen community as a multiple-use parcel. It could allow for anaerobic digestion, composting, community gardens, and intensive farming. The synergies are obvious even on a small scale. Don Marshall has also mentioned extending the envelope of BIRD for a construction re-use centre. The National Park issue will not be decided for some time but it is critical not to lose sight of the prospects of this land for community farm and garden projects, an original farm and contained within in the ALR. (Bowen Island Rotary Club Community Garden Conversation Event pers. comm. Feb. 2011).
- 5) **Waste Management Transitioning to Resource Recovery:**
 - a) **Mandate Clear Garbage Bags by October 2011 or Earlier for General Garbage:**
Using a clear bag or none at all to contain general garbage is an obvious step in creating full responsible compliance for recyclable and banned items. It is a progression to reduce curbside service costs. Service providers will place non-compliant containment back to curb which results in a quick learning curve.
It is reasonable to conclude that general garbage, being light and clean (after organics are banned), can be taken at homeowner's discretion to the recycling depot at the same time as their recyclables. This should not be a great burden unless people haven't been recycling, in which case, it is time they are. Some may need help or may have to pay privately as they do in Whistler.
Clear bags are only a few cents more than dark ones and can easily be brought in to sell at our local stores. If people chose the no bag at all method, they are probably compliant and it allows them to reduce their costs for garbage and save the need for plastics. (Wholesale costs, \$32 for 200). It is also logical that volumes of recyclables will increase due to the clear bag mandate, however if baling is initiated there will be less hauling of those items (refer to 5b).
 - b) **Consider Baling Recyclables** by paid operator to reduce frequency of trips (when services are reduced to every other week, refer to c.) e.g. Plastic milk jugs would be reduced from 7 trips off-Island per year to 1 load per year. Metals and paper baled would receive higher dollar value. These funds could be redirected, along with any other support, to pay for a baler. Cooperation with BIRD and an economic

analysis is needed. Baling will require a fork lift use. Due to the space and safety requirements it is an added reason for the industrial space needed. Refer to Community Lands Lot #1, in 3a of this section.

- c) **Change Frequency and Nature of Curbside Pick-Up from Weekly to Every Other Week**, starting on or before December 31 2011 through to April 2012. There is less volume during this cooler season so it is the best time to work out the “kinks”. As the home compost programs gets under way and when food is separated out, (early 2012) general garbage should decrease by 30 to 40%. Weekly service would resume April to the end of October 2012 due to higher volumes. Service then should only be for food and yard trimmings. Residents, at this time should be taking their general garbage to BIRD. General garbage drop-off at Bird can either be tossed in loose or be in clear plastic bags into a bin but will have to be monitored for compliancy throughout all hours of operations. As is the case now, it must be closed, in off hours.
- d) **Commit to Education and the Necessary Steps to Move Resource Recovery Forward** through funds and staff time however limited. Designate one staff member and one willing council member to liaise with a community coordinator around initiatives for change of services, new practices and other programs. Commit to collaborative relationships with the community. Refer to recommendations pg. 21.
- e) **Garbage Pick up Services Paid through Taxes**. It has been observed that some people don't pay for decals and yet dump their garbage in the Cove. When general garbage diminishes the need for hauling recyclables increases. It is an evolving change in direction of expenditures. A cost analysis should reveal how much taxes would be added and that it could save staff time at decal time as well. This sentiment is view similarly to school taxes, where everyone bears the cost.

Section Four: Community Solutions, Organic Process Initiative and Professional Contacts

Local

- a) **Permaculture** is philosophical and practical sense of growing food and living within a closed loop environment, Kim Howden, kimberbee@shaw.ca and Conrad Jiraschka, edibleavenue.com., both teach this practice and live on Bowen Island and work at community building through Permaculture hands on workshops and community collaboration.
- b) **Community Development:** reference to “inCOMMON Community Development” and “The Listening Program”: and workshops in *The Work of Byron Katie*, Kim Howden, Bowen Island
- c) **Shared Gardens:** Ruddy Garden, Contact 604-947-6991, kimberbee@shaw.ca and Kami Kanetsuka's garden, 604 947 9713.
- d) **Vermiculture:** Sale of red wiggler worms for Bowen Island.: Grandpa John's Worms can be purchased and discounts are available for bulk quantities. Abbotsford, BC, Canada, V4X 2N1 Phone 604.628.0357, © 2010 Transform Compost Products
- e) **Demonstration Centre Possibilities:** BICS Outdoor Learning Centre, BIRD, The Davies Orchard Demonstration Garden, The Ruddy Garden and Café, The Building Center, and Metro Vancouver's Crippen Park, “Meadows”. Inquiries have been made in conversations with BICS, BIRD, ZWB, BIT and KKN. Don Marshall and Bill Carr have spoken of having BIRD be an area for ongoing composting demonstration and other resource recovery practices such as a Construction Re-use-it division. Mary Ellen deGrace, Pres. of KKN has taken pictures of an attractive center, such as this in Eugene, Oregon, July 2011.
- f) **Following the Approval of 2011 OCP Update, Twin Island Excavation Ltd.** will submit a re-zoning application for Industrial use to have a compost facility on their 35 year leased Crown Lands, Radar Hill, where the company now operates a rock crushing operation. Twin Island is willing to take composting to a commercial level and needs a supportive community. Randy Arnott said “Some one needs to work on this to get it going.” (R Arnott co-owner of Twin Island Excavation Ltd. pers. comm. June 2011).
- g) **Following the Approval of 2011 OCP Update Mr. E Weismiller of J& E Backhoe** will be applying for re-zoning of his property on Buchanan road. It is a comprehensive plan to include a variety of functions that address organic recovery, good use of re-useable resources such as construction materials, and reducing a former carbon foot print by replacing the open burning of stockpiled

debris and land clearing material with the production of biochar. There will be a pilot /small prototype biochar unit manufactured first. He has put a team together to advise him, including environmental consultant, Alan Whitehead, and team organizer Bill Newport. There is interest and an option to combine efforts with a community member Brett Dowler

- h) **Brett Dowler** of Bowen Island has immersed himself thoroughly for past two years in the study of various resource recovery processes. He has studied food and fish production, greenhouse production, aquatics, green energy technology and other self sustaining practices. He is currently developing pilot projects in the three processes that have been discussed in this report and he is willing to join forces with others who share his holistic vision. His knowledge base and enthusiasm is impressive.
- i) **Dominique Kluyskens** of Bowen intends to install a fuel cell in 2011 at his house to generate electricity in a silent and pollution free manner. The fuel used will be hydrogen or methanol. Methanol can either be purchased or in the long run be produced locally from wood waste.
- j) **David Paulus** of Bowen is in the initial stages of building a bio-reactor/digester using wood chips to heat his home. He is planning on marketing this product. He also has completed a hydro-electric generator which supplies electricity to some of his lights and refrigeration. When he converts his lighting to LED fixtures he will be able to power all of them.

Beyond Bowen

- a) **ABL Environment, Compost Consultants Ltd.:** Tom Austin MSc, P.Eng, is a connection through Don Marshall of a firm that takes you through the compost facility process. 902-466-0050 ext. 101
- b) **Dr. Paul Arnold**, Bio-Logic Environmental Systems, Dartmouth, Nova Scotia, very practical and very knowledgeable consultant. When he has other consulting contracts in the area he is willing to come to Bowen for a reduced daily rate (\$500/ day) plus the cost of travel to Bowen. I believe him to be a logical source and he has experience with HotRot in-vessel Compost systems as well which is a unit that Twin Island is interested in. , 902 449 6910, email: bio-logic@ns.sympatico.ca
- c) **Jenna Eisel**, HEMMERA, B.A.Sc, Environmental Engineering Specialists, Vancouver. Jenna is interested in helping with composting, bio-digestion and phosphorus reclamation. <http://www.hemmera.com/services>, 604.669.0424 ext. (236), jeisel@hemmera.com
- d) **Patrick Mulholland**, Carney's Waste System: He has offered to talk about the use of biosolids to the Bowen Community if any doubts about its use in composting. Compost operations Manager, Squamish, Whistler Compost Facility.patrick@carneyswaste.com, C: 604 848 4750 For interest sake a link to the schematic layout for the Whistler compost facility is provided http://www.carneyswaste.com/facilities/whistler_compost.html
- e) **Dr. John Paul**, Transform Compost Systems Ltd: Dr. Paul is a well known professional in the field. He is the owner of Transform and gives lectures, designs custom made composting facilities; consults and guides the process from permits through start-up and technical support for operations. He provides the training classes for operators. Abbotsford, BC, Canada V4X 2N1, Phone: 604-856-2722.
- f) **Bob Paul**, Ministry of Agriculture: If Bowen can present a proposal that links both food and energy production he could support funding for it. In particular, he has an idea for algae production and energy. Innovation and Governance Branch, Bio Economy Analyst: 250 387 5121, (pers. comm. and Whistler Zero Waste Conference).
- g) **Sauder School of business UBC:** Partnerships with post graduate students in the engineering department is a possibility. Andrea Lloyd, Community Service Learning Coordinator says she is willing to find links with next year 2011/12 classes and projects on Bowen "At the UBC Community Learning Initiative we have projects in different faculties that may work well with your project and plans - Land and Food Systems, Applied Science (engineering and landscape architecture), as well as within the business school". She needs a summary of ideas of what is being entertained, such as the custom made bio-char processing, or anaerobic digestion or perhaps a small scale community composting facility. This is worthy of investigation and could be combined with a Local Food Production Grant or other funding, 604-831-5203, andrea.lloyd@ubc.ca, <http://csl.ubc.ca/>

- h) **Surrey Anaerobic Digestion Pilot Project.** Dr. Dieter Geering of Fraser Richmond Soil and Fiber research department will keep us informed of a small scale pilot project in Surrey for an anaerobic digester, 604 837 5617 dgeeing@fraserrichmond.ca.
- i) **SymbiAudit Sustainability Consultants Inc.:** Julian Radlein, president of his Vancouver based company, presented on Bowen in April to a group of interested community organizations and businesses. He has a strong community collaborative approach to resource recovery and he and his team has experience in the three processes (Office) 604.694.2463, (Direct) 778.996.0710, julianr@symbiaudit.com, www.symbiaudit.com. Refer to pg. 37,
- j) **Tamara Thomas** is an organic process consultant from Washington State. She was recommended by Dieter Geering. She has a reasonable rate and significant experience. She listed her service roster as: “Compost and organics recycling assistance, regulatory compliance, permitting, organization, operation plans, product quality improvement, trouble shooting, sampling, OMR certification assistance”. When needing to hire an advisor and technical professional she should be in the considerations. tnthomas@terre-source.com. (425) 844-6068.
- k) **Esther Wei**, of Eco-biogas has a pilot project in mind for the Bowen community with their small anaerobic digesters and suggests a collaborative effort to secure funding from the BC Bio-Energy Network. She is the co-inventor (Puxin) of these small affordable functional systems that use mixed organics including septage, manures to produce fuel, heat and fertilizers. (604)983-2254, North Vancouver, ewei@eco-biogas.com, www.eco-biogas.com. These units are shown on pg.37.
- l) **Reference Book:** Lehmann, J., Joseph, S. (2009) Biochar for Environmental Management – Science and Technology, Earthscan, London. ISBN 978-1-84407-658-1.

Conclusion

In researching the possible options for resource recovery methods for Bowen Island's organics, many aspects of complexity were encountered. In conclusion, the gains to be made and the importance of the re-use of these valuable resources on-Island correspond to the need to reduce Bowen's carbon footprint; the need for increased food and soil production; and the desire to reduce transportation costs.

The strategies and the synergy presented involving the various groups and businesses, along with the enthusiasm held out for organic use by householders and neighborhoods present a compelling story of possibilities. As there is a limited population and small tax base, the close to home solutions are the logical first steps in working towards the use of all organic materials on the Island. It is also believed that all three processes, composting, anaerobic digestion and biochar are entirely possible on an appropriate and moderate scale. The viability of establishing large scale community processing, however, will require a thorough financial analysis. Whether moderate or large scale, it will take cooperation, support and focused leadership. It will also take careful management and cooperation with the use of the available feedstock. With a reduction in open burning of yard trimmings and woody material, improved air quality will be ensured. The renewed availability of this material also, importantly, coincides with the volume of carbon feedstock needed for the three processes.

Convinced of the merits of this direction, having first established the needs/wants of the community and the various methods, the Bowen Island Municipality is encouraged to be pro-active in the approval process to support the individuals and businesses that are striving to make things happen. It is advised that the recommendations be acted upon with commitment, determination and urgency. There is no reason not to begin now.

Looking to the near and distant future, the solutions for organic uses will bring about an increasing social capacity for self-reliance and environmental stewardship.

ReSource-Full Habitats would like to take this opportunity to say that it has been an honour to be of service to the Knick Knack Nook. I am heartened by their enthusiasm to support this direction and anticipate the envisioned success in these areas for this community.

I want to thank all the participants who contributed time and energy to help with the details and options presented. It has been greatly appreciated. I would also like to acknowledge and express gratitude to Mary Ellen deGrace, Diane Marshall, Bruce McPhee and Tim Rhodes for their editing and formatting assistance.

Sincerely
Morganne Keplar

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Villages, Homes and Gardens
Inclusive Eco Practices
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Cell: 778 228 1361,
Email: mkeplar@gmail.com

Appendix # 1 References and Contacts: Feb. 18, 2011 to June 21, 2011. Return link pg. 3.

- 1) **Tree and Landscaping Services:**
Artist in the Garden Designs, BC Hydro Vegetation Department, Carefree Greenery Ltd., Christine Roocroft Landscaping, Dave Paulus Tree Services, Dave's Tree Services & Firewood Sales, Home Farm Gardens Ltd., First Choice Tree, Tree West.
- 2) **Excavation Services:**
FreeWheeling Enterprise, J&E Backhoe Ltd, T-Rex Excavating Inc, Twin Island Excavating Ltd,
- 3) **Other Waste Removal Services** as well as BWS:
Advantage Waste Specialties Inc., Bowen Biffies, Mainland Tank Services and McRae Environmental Services Ltd., Need a Bin Waste Removal Ltd.
- 4) **Community Groups:**
B.I.H.O.R.A, The Bowen Garden Club, The Rotary Club of Bowen, Bowen Agricultural Alliance
- 5) **Land Owners and Developers:**
Roger McGillivray, Stephanie Legg: Belterra Co-Housing, Wolfgang Duntz: Bowen Island Properties, Eanson Ho: Project Manager, Cape Roger Curtis, John Reid Evergreen, Debra Fortesque via Mike Carachelo a mid Island Property, David Sorensen: King Edward Bay.
- 6) **Restaurants:**
Blue-eyed Mary's, Cocoa West, Miksa Restaurant, The Ruddy Potato/The Ruddy Cafe and Garden, The Snug, The Village Baker, Tuscany and Artisan Eats
- 7) **Mayor and Councilors:**
Peter Frinton, Doug Hooper, Allison Morse, Bob Turner, David Wrinch
- 8) **Individuals and Community organizations:**
 - a) Bowen Island Community School, Community Coordinator, Sarah Haxby
 - b) BIRD board and members: Chair, Don Marshall, and Bill Carr, Kim Kasasian
 - c) BIHORA: Kat Balieu, Vivian Pearce
 - d) KKN: Jane Kellet, Mary Ellen deGrace, Diane Marshall, Jocelyn Willis,
 - e) Bowen in Transition: Don Marshall, Shasta Martinuk, Doug Nash, Maureen Witney,
 - f) Zero Waste Bowen: Chair: Don Marshall, Bill Carr, Brett Dowler, Paul Fast, Morganne Keplar, Shasta Martinuk, Doug Nash, Christine Roocroft, Maureen Witney
 - g) Murray Atherton, Deborah Bramm, Eva Churcher, Darcie Buzzelle, Bill Carr, James Glave, John Hoover, Bruce Howlett, Alan and Stacy Leigh, Dan Parke, Tim Rhodes, Matthew Smith, Faye White, Maureen Witney, Alan Whitehead
- 9) **Professionals, Managers, Department Heads and Consultants:**
 - a) Dr. Paul Arnold, PEng, MBA, PhD, Bio-Logic Environmental Systems, Ivan Curry School of Engineering, Acadia University, Wolfville, Nova Scotia
 - b) Jim Atwater, PEng, Autothermal Thermophilic Aerobic Digestion, UBC
 - c) Greg Ball, Plant Manager, ICC Group, Compost Facility Nanaimo BC
 - d) Brian Biddlecombe, Bowen Island Fire Chief
 - e) Blue Mountain Composting Consultants and Systems for Eco-Tub and Earth Flow Systems
 - f) Dr. Sally Brown, University of Washington, biosolid specialist
 - g) Andre Chollat, composting trench style for Ruddy Potato and others on Bowen
 - h) Guy Dauncey, Author, lecturer, environmental consultant, Vancouver Island
 - i) Ann Eastman, Ph D, Senior Manager, Innovations, Ministry of Agriculture
 - j) Bill Granger, M Env. Studies, Parks & Env. North York, Port Moody
 - k) David Hocking, Metro Vancouver Sustainability Communications
 - l) Dr. Dieter Geesing, PhD. PAg. RPBio, Fraser Richmond Soil & Fiber, Quality Manager Western Canada, Richmond, BC
 - m) Miquel Guerrero, UBC Sauder School of Business, Vancouver, BC

- n) Green Mountain Composting , Morgan and Vance, Bainbridge Island, Washington, USA
- o) Josh? , Courtney/ Comox Composting Facility, Vancouver Island, BC
- p) Halan Kelly, P.E, P.Eng, Dayton & Knight Engineering, Vancouver, BC
- q) Dave Knox, P.E, P.Eng, Chief Operating Officer of ICC Group Composting Systems, Vancouver Island, BC, (Victoria Office)
- r) Rudolf Leuter, EcoFluid and John Heart, KWL Engineering, Design and Maintenance of Cove Treatment Plant. Vancouver, BC
- s) Dr. Donald Manivic, PCivic Eng. UBC, Reclamation of Phosphorus
- t) Patrick Mulholland. R.P.Bio., Compost Operations Manager for Whistler/Squamish Composting Facility, Whistler, BC
- u) Brian Leung, Director, GreenGood Compost, Vancouver Office
- v) Andrea Lloyd, UBC-Community Learning Initiative, Vice President
- w) Shelly O'Brian. U. of Calgary, Director of Operations and Maintenance, Facilities Management including composting and bio-digestion, Calgary, Alberta
- x) Michael @ City Farmer, Kitsilano Demonstration Gardens
- y) Dr. John Paul, PhD. P.Ag , Transform Compost, Abbotsford, BC
- z) Dr. Leonard Perry, University of Vermont, department of Plant and Soil Sciences
- aa) Julian Radlein, SymbiAudit Sustainability Consultants, Vancouver
- bb) Liz Scroggins Consulting, Air Quality Management Planning Report, Pemberton, BC
- cc) Tamara Thomas, P. Engineer, Terre-Source LLC, Washington
- dd) Gerald Tibbo, HotRot Composting Systems, Halifax, Nova Scotia
- ee) Alan Whitehead, M.Sc., R.PBio. Environmental Consultant, Bowen Island

10) **Metro Vancouver Waste Management Staff and Committee Contacts:**

- a) Al Lynch, North Shore Recycling Program, Manager North Vancouver, BC
- b) Greg Moore, Director of the Metro Vancouver Waste Management Committee Chair and Mayor of Port Coquitlam,.
- c) Andrew Marr, Metro Vancouver, Senior Engineer, Integrated Planning

11) **Documents Reviewed:** (others were referenced throughout the report)

- a) R.V. Anthony, Zero Waste International Association. 2004.
- b) A.D. Knipe, Management of Household Food Waste, UK. 2004.
- c) L. Perry, , University of Vermont, Department of Plant and Soil Sciences 2006:
- d) Sea to Sky Air Quality Management Planning for Bowen Island Municipality m, Wood Waste Management Baseline and Options Report prepared by: Scroggins Consulting with EABB Planning Services (Andy Beard, Bowen) and Timmenga & Associates Inc. June 19, 2010 draft.

12) **Funding Opportunities:**

- a) **The Federal Community Fund, Green Municipal Fund Brownfield Remediation Projects** Provided by Federation of Canadian Municipalities
- b) **The Union of B.C Municipalities.** (UBCM) , Local Government Program Services, (250) 356-5134 lgps@ubcm.ca, **The Community Health Promotion Fund, The Healthy Food & Beverage Sales (HFBS) program, Community Development Program,** Green infrastructure Canada
- c) **Civic Info BC Grants and Funding:** <http://civicinfo.bc.ca/18.asp?ancla=5> Grants and Funding Partnerships: **Knowledge Building and Workshops,** Provided by Canadian Rural Secretariat, Deadline, 2012, **BC Hydro Power Smart Sustainable Communities Program,** by: BC Hydro, Deadline: None, **Community Energy and Emissions Planning-QuickStart Provided** by BC Hydro, Deadline: None, **EcoENERGY for Renewable Power,** Provided by: Natural Resources Deadline: None, **Local Government Agricultural Planning Program,** Provided by: **Investment Agriculture Foundation** of British Columbia, Deadline: None, **Out reach Communities,** Provided by: Human Resources and Skills Development Canada, Deadline: None, **Smart Development Partnership, Program Provider:** Province of BC Ministry of Community and Rural Development, **The Climate Trust** (based in

Portland, Oregon) has produced a fact sheet on their report for the **West Coast Regional Carbon Sequestration Partnership** assessing carbon market investment criteria for biochar projects.

- d) **David Suzuki Foundation**
 - e) **The First Credit Union**, Bowen Island community Partnership Branch, **Vancity Credit Union**, (David Berge Senior Vice President, Community Investment, Vancity), **TD Bank Canada**
 - f) **Green Community Funding**: <http://www.bcfarmbiogas.ca/opportunities/funding>, Enviro-Loan: Farm Credit Canada's Enviro-Loan, AAFC AgriFlexibility Fund: FarmCreditCanadaal 1-888-332-3301. <http://www.bcfarmbiogas.ca/files/pdf/FCC%20Energy%20Loan.pdf> Farm Credit Canada. loans for energy such as biofuels.
 - g) **ARDCORP** (B.C. Agricultural Research & Development Corporation) #230 – 32160 South Fraser Way Abbotsford, B.C. V2T 1W5 604-854-4483 Toll Free 1-866-522-3447 Fax 604-854-4485
 - h) **The BC Bio Energy Network**: The BC Bio Energy Network supports the demonstration and deployment of products and systems that produce heat, power or combined heat & power; process biomass into solid fuel; refine biomass into liquid fuel; or collect or concentrate biogas to be used as fuel. “These products and systems take advantage of BC’s Bio Energy Opportunities in the agriculture, forest and municipal sectors”. <http://www.bcbioenergy.com>, Michael Weedon, Executive Director, Tel: 604-891-1257 or 604-805-2115, michaelweedon@bcbioenergy.ca.
 - i) **Joan Hayes of the Snug Cafe** spoke of a financial program CSPT or CSBT or CSFP, “The Federal guarantee on Loans to Startup” Canadian small business loan, up to \$500,000 for energy or environmental practices. Cross reference back to pg 19.
- 13) **Distributors**: These are viable solutions for Bowen’s use and as well as a source of information.
- a) **Bag to Earth Food Containment Bags**, Charlotte McLaughlin, Municipal Relations, B.C, 604-360-2831, cmclaughlin@bagtoearth.com
 - b) **Ecoliving Organic Solutions**, Digester Unit Bokashi Unit, Jora Compost Unit and Sun-Mar Compost Unit distributor Salt Spring BC: Eric Beamish, Home, 250 537 8424, Eco Living" ecolivingos@shaw.ca.
 - c) **Ecotainer, Sales Inc. Recycling Equipment and Container Systems** Norseman Environmental Products:, http://www.norsemanplastics.com/html/norseman_environmental_products.html, Tom Button, ,2253 Harbour Greene Drive, Surrey, BC V4A 5J3, (604) 535-7293; tom@ecotainer.ca
 - d) **Envirocycle Systems Inc.** Composting Units, (sml. indoor, lg. outdoor), Magog, Quebec, David @ 819 769 1423
 - e) **Green Mountain Technologies**, Earth Tub, Earth Flow Commercial System, consulting firm as well. Morgan and Vance, Bainbridge Island, Washington
 - f) **NatureMill Indoor Composting Units: distributor** Pacific Rim College, Victoria, BC. Bonnie, 250 483 2119 or San Francisco Kevin 415 233 4946, indoor electrical compost o
 - g) **HotRot Composting Systems**, In-vessel Compost units :Gerald Tibbo, Rep for HotRot and Engineering firm Hatch Engineering Canada, Nova Scotia, HotRot would consider lease agreement, includes consultation and training, Gerald Tibbo GTibbo@hatch.ca 1 902 442 2020, Cell1 902 452 9411.
 - h) **Sure Close food collection Containers**, Ontario, Rod Muir, 416 535 9918, Sure-close.ca.
 - i) **PUXIN Science and Technology CO LTD.** info4@puxinbiogas.com, Victor Shi Wang and EcobioGas: Esther Wei, (604)983-2254 ewei@eco-biogas.comwww.eco-biogas.com. Esther has an idea to work with the Bowen community to do a pilot project with the anaerobic digesters with funding from the BC Bio-Energy Network.
 - j) Refer to others in Appendix #5. pgs. 39 and 40.

Appendix # 2: Bowen Island Municipality Financial and Other Policy Document References

- 1) BIM Budget: Summary 2011 General operating Fund five year financial Plan, <http://bimbc.ca/files/embedded2010/110426SpC6-1b>. Return to pg. 4.
- 2) The Sea to Sky Air Management Planning for Bowen Island Municipality, Wood Waste Management Baseline and Options Report, Scroggins Consulting, EABB Planning Services and Timmenga & Associates Inc. The options within this report include phasing out all open air burning and the need to compost organics rather than burn them. These recommendations have not been addressed by the Bowen Municipality, as yet, although in part are included in the draft OCP Update 2011 The June 16th 2010 , <http://bimbc.ca/files/embedded2010/100517COWR2-1a5>
- 3) Fire Regulations Bylaw 270, 2009: Section 9 Outdoor Burning provides regulations for land clearing fires, backyard clean up fires, campfires and controlled fires. The general provision for all open burning of land clearing and yard waste is the allowance of these to occur between Oct 15 and Apr 15. . <http://bimbc.ca/files/embedded/091207COW3-2a>, Return to pg. 5.
- 4) OCP Section Bylaw 139, 1999: light industrial uses and OCP Section 4.3, on island organic use, source separation composting, education, composting, 4.33 expansion of recycling and composting facilities http://www.civicinfo.bc.ca/Library/Bylaws_From_Local_Governments/Official%20Community%20Plan/OCP_Bylaw_139--BowenIsland--2002.pdf and <http://www.bimbc.ca/files/embedded2010/OCP%20Update%20FINAL%20Jul%2030.pdf>
- 5) OCP Up date Section 2 | Towards a Sustainable Future: Natural Environment Sections 2.5 and 2.6, Climate Change Mitigation Policies: 15, 18 through 20, 25 and 32 through 34 “Governments achieve carbon neutrality by reducing emissions where possible, by purchasing carbon offsets to compensate for its greenhouse gas emissions or by developing projects to offset emissions. Such projects may include converting to energy efficient buildings and replacing old fleet vehicles and buses with hybrids.” Bowen signs on Climate Action Charter Nov2007. <http://www.bimbc.ca/files/embedded2010/OCP%20Update%20FINAL%20Jul%2030.pdf>
- 6) OMRR Regulations for the Production of Compost Web site: <http://www.env.gov.bc.ca/epd/codes/omr/pdf/compost.pdf>

Appendix #3: Bowen Waste Services is a pivotal stakeholder in the resource recovery relationship

The Bowen based company has been in operation for 17 years. It is a family owned and operated business with several employees. It is currently providing increased services with rates based on a two year old agreement. A recent extension to their contract ends November 1, 2011. Volumes and costs have been increasingly incurred as new items are added to the list of recyclables i.e. managing and hauling some types of electronics and now all plug-in equipment, as of July 2011. Food and soiled paper separated from general garbage to be placed with yard trimmings is scheduled to come into effect in early 2012. This and other issues need attention in advance of deadlines. The Bowen Municipality therefore has a need to review and decide the most effective and efficient Bowen's waste management services and the contract with BWS is under consideration by the BIM.

BWS Contract Includes:

- 1) **Vehicle & Transfer Bin/Container Purchases,**
- 2) **Fuel, Labour, Maintenance, WCB Payments, and Insurance**
- 3) **Ferry Fees and Tipping Fees**
- 4) **Residential curbside pick up and delivery of Garbage**
 - a) It is on a weekly basis year round
 - b) It takes two days to collect from all the households.
 - i) Garbage is contained in bags in curbside 70 liter bins or placed loose in the bins
 - ii) Recyclables, other banned items, as well as the food co-exists with in the garbage bags. e.g.: asphalt shingles, batteries, plastics, glass, gypsum are found. BWS have been fined and pay for that out of pocket, i.e. \$200 for gypsum (BWS pers. comm.).
 - c) As each garbage truck is full, it is transferred at BIRD into a 47 cubic yard (c.yd.) container. Once a week, along with one smaller 20c.yd truck it is transported to the NSTS. Garbage volumes increase during the summer months with two or three 47c. yd bins/ week. Trucks and bins larger than the 47c.yd. are not accepted at the NSTS and would require hauling to the Cache Creek, BC landfill.
 - d) Materials from NSTS are transferred to the Vancouver land fill in Delta, or Cache Creek and 36% to the Burnaby Waste to Energy Incineration (A. Marr per comm.).
- 5) **The Cove and Dock Garage** pick up is constant and often overflowing. Some residents who do not subscribe to curbside pick-up use these.
- 6) **Residential Curbside Pick up and delivery of Yard Trimmings**
 - a) It is on a weekly basis from April 15th to Oct 15th on Wednesdays
 - b) Grass clipping, leaves, brush, branches, vegetable and garden plant materials are picked up loose in bins or in Kraft paper bags and up to three inch diameter woody material bundles. Hauling to the NSTS is more frequent in the spring and fall with 3 to four trips a month rather than two trips a month through July and Aug. for a total of 115 tonnes in 2010. Back yard open burning allows at least 60 to 100 tonnes of yard trimmings to be burned each year (D. McIntosh per com).
- 7) **Recyclables Hauled from B.I.R.D.** and delivered to receiving outlets, (glass, to Abbotsford):
 - a) 110 trips, totaling 310 tonnes, not including electronic waste, in 2010
 - b) 93 trips, ½ ton truck loads specifically for electronic waste in 2010
 - c) There continues to be more recyclables mandated to be source separated as recycling evolves. These additions can not be foreseen from one year to the next and it is difficult to be reflected that in a five year contract.
- 8) **Free Drop off Service:** Delivery of paints/toxic materials and large household items, “Spring and Fall Clean up Days” and “Hazardous Waste Days” are included within the contract. *One extra in the summer and the Christmas tree drop off is courtesy of Bowen Waste. A \$20 fee for each mattress has been incurred and must be charged to the residents.
- 9) **Surcharges (Fines):** Transfer stations inspected loads of garbage and any that contain prohibited materials are assessed a \$50 minimum surcharge, plus the cost of removal and clean-up or remediation. Loads containing banned materials are assessed at 50% tipping fee.

Appendix #4 More on the Basics of Composting, Anaerobic Digestion, Biochar Units

The Basics of Composting

1) Essential Oxygen, Aerobic Bacteria (requires oxygen), Fungi and Actinomycetes

- a) In the production of compost, oxygen introduced by forced aeration or by manually turning it frequently is necessary to allow the aerobic bacteria and the other micro organism to flourish. High levels of aerobic bacteria are an advantage to aid the de-composition of feedstock in a fast and productive manner. This reduces the risk of producing offensive odors (rotten eggs or cabbage) and importantly reduces the production of methane, ammonia and other noxious compounds produced by anaerobic bacteria. These are not captured in this process method as they are deliberately with anaerobic digestion systems.
- b) There are three types of aerobic bacteria that are involved in composting, activated in the three temperature ranges. They are naturally occurring in soils and the air. Portions of existing compost batches or soils are often introduced and mixed with new material to ensure fast growth of these bacteria. The Psychrophiles are slow performing cooler temperature bacteria best at 13C. Mesophiles, the middle temperature range, grow best at 25C and perform most of the work. The high temperature Thermophiles bacteria are allowed to maintain working at 50C for 3 consecutive days to assure death destruction of pathogens and neutralizing pharmaceutical content with in various food and bio-solid feedstock. It is regulated as such for safety and use on food producing soils, (as mentioned Class A level compost).
- c) Fungi are primitive plants that take over the compost pile in the final stages and prefer moderate temperatures 21-24C. Actinomycetes are active at the end of the process during the curing stage and give compost a pleasing earthy smell. They appear as the grayish, "cobweb" fluff through out the compost and are a natural productive part of the process allowing the final use of raw material to be converted to simpler forms. (<http://www.compostheaven.com/compost.html>)

2) Carbon and Nitrogen

- a) All organic matter has a ratio of carbon to nitrogen (C:N). The composting micro-organisms require available proportions of carbon for energy and nitrogen for protein production. Regulations for commercial processing, sets out a range of (C:N) content that can be achieved by various mixes of feedstock with 30:1 commonly used as optimal. Higher aeration maintenance has been shown to allow for more equal ratios (HotRot, Gerald Tibbo pers comm.). Woody material such as wood chips, sawdust, paper, straw and dried leaves provides the carbon factor. The more moist and dense materials such as food, biosolids, animal manures, and grass clippings contain the higher nitrogen factor. The more carbon feedstock that is in a compost mix, the longer it takes to decompose. If too much nitrogen is in a mix, the hotter the mix and it exhibits a very strong ammonia smell. (L. Perry, 2008, <http://perrysperennials.info/pubs/oh88compost.pdf>). Whistler's Facility, feedstock consists of biosolids, woodchips and food scrapes uses a range of C:N13:1 to 20:1 in a in-vessel system (P. Mulholland pers. comm.).
- b) High Carbon Feedstock, (C:N): Wood chips 400:1, Sawdust 325:1, Cardboard, shredded 350, Newspaper, shredded 175:1, Straw 75:1, Leaves 60:1, Fruit waste 35:1
- c) High Nitrogen Feedstock, (C:N): Garden waste 30:1, Weeds 30:1, Vegetable scraps 25 to 15:1 Coffee grounds 20:1 Food waste 20:1 Grass clippings 20:1, Seaweed 19:1, Manures 15:1 (<http://en.wikipedia.org/wiki/Compost>) (<http://www.composting101.com/c-n-ratio.html>)

3) Water, and it's relationship to Leachate and Odor

- a) Moisture is essential to carry out all biological processes. 50% to 60% moisture content is the optimal range for composting. Not enough water sets the process into a dormant state. More water may be needed if composting is open to the outdoors in dry hot weather (Josh, Comox, Courtney Facility pers comm.). A manual squeeze test, which releasing one or two drops of water, is a simple indication of the correct range.
- b) Depending on the type and mix of feedstock the compost process gives up more or less moisture. The moisture that results is a liquid called leachate commonly called compost tea. It contains dissolved

chemicals. It is so strong that it must be diluted at 1 to 500 part tea to water if collected and used as a fertilizer or insecticide. In the commercial setting this leachate must be contained to prevent it from seeping into the ground as it would damage ground water systems and plant life.

- c) Too much moisture will “smother” the aerobic bacteria and allow the anaerobic bacteria a chance to grow with the resulting production of the unwanted methane. Leachate and low aerobic levels are the sources of odors and one of the main reasons that composting facilities can be closed down and one of the main reasons they are not usually placed in populated areas. The care from the attending operators is critical to this and if managed well does not need to be a problem (T. Thomas pers. comm.).

4) **Feedstock Dimension and Density**

The composting process works best when the materials are 3 to 13 mm in diameter. The smaller the item and greater the surface area exposed to the microbes, the faster the decomposition. Too small, however, increases compaction and limits air flow. Woody material and dry material must be chipped or shredded. Whistler’s facility uses 2 to 10 mm in length and uniformity (P. Mulholland, pers. comm.).

- 5) **Decomposition Period:** Without controlled intervention these materials take the following lengths of time to decompose: Vegetables: 5days-1 month, Paper: 2-5 months, Cotton T-shirts: 6 months, Orange Peels: 6 months, Trees Leaves:1 year, Wool Socks: 1-5 years, Plastic Coated Milk Carton: 5 years, Leather Shoes: 24-40 years, Nylon Fabric: 30-40 years, Tin Cans: 50-100 years, Aluminum Cans: 80-100 years, Glass Bottles: 1 million years, Styrofoam Cups: 500 years- forever, Plastic Bags: 500 years- forever.
<http://en.wikipedia.org/wiki/Biodegradation>. When considering the various types of composting systems the length of process time is from 21 days to 12 weeks in the active stages and 28 days to 24 weeks in the curing or cooling down stage.

6) **The Placement of Bowen’s Processed Biosolids on Food producing Soils:**

The standard of a soil amendment, (compost or other organic process products) is under strict regulations. Class A compost is the designated class of compost that can be used on food producing soil. It can contain biosolids when processed under high temperatures. The guidelines of Class A also indicates that it must be void of material such as plastic, metal, rocks and pathogens levels beyond a certain level.

Keep things in perspective when considering the use of biosolids. Address the fears that are often brought up around this topic by looking to the science and the technical support that is available.

- a) Bowen has very limited industrial or toxic processes
 - b) The tertiary (three) treatment level, at the Cove Bay Treatment plant surpasses the standard regulation, with the use aerobic microbial action, decomposing the biosolids. EcoFluid supervises the plant operations and has had honorable mention for its design. The Iona treatment plant has a primary level. This is to say that the sludge on Bowen Island has already undergone treatment that addressed concerns of pathogens and pharmaceuticals.
 - c) Before any biosolids are used in any process they will be tested thoroughly to establish the quantities of pathogenic microbes, metals and other toxic elements. The mitigating steps will be taken accordingly. Test show that with the 50C that is maintained for three consecutive days in composting and the 1 to 2 hrs at 70C in anaerobic digestions there is at least a 75% decrease in the already limited amounts of non acceptable ingredients.
 - d) Commit to a local Education Campaign: “The Safe Use of Medications and Return Program”, combined with the knowledge that pharmaceuticals are neutralizes and broken down through microbial action negates the often implied consequences. (Dr. S. Brown, J. Radlein, Dr. D. Geering, P. Mulholland, T. Thomas pers. comm.) Refer to this topic on the virtues of the use of Biosolids: University of Washington, S Brown, North American authority on use of Biosolid in food production. Sally L. Brown: slb@u.washington.edu.
- 7) **Reclaiming Phosphorus:** Look to the future when the newly developed phosphorus retrieval process from septic and sludge by UBC Professor Dr. Don Manivic can be done on Bowen. All phosphorus, an essential plant growth requirement, will be depleted in 30 years world wide. This process reclaims phosphorus from human and animal biosolids. "There will be a small scale processor in the future" (D Manivic, pers. comm.).

Composting Units and Techniques



Indoor, 360 Worm Factory



Indoor, Envirocycle Mini Compost



Indoor NatureMill ProXE



Jora 270 or Jora 400



Sun-Mar 200 or 400



Stone Bin, Bear proof



Household to Small Scale Community Composting

(Left to Right Systems: AgBag, Earthflow, HotRot, and Bunker Aeration) Although not shown in this document, a highly used small scale automated restaurant/business or neighbourhood system called the Earth Tub has had successful installations across Canada and the US. The GreenGood and Jora units have potential through with their larger automated sizes. Interest and initiatives are taking hold on Bowen Island to have these various scales of composting methods. Organizations such as, BAA, BIRD, BIT, BIHPA and KKN are following through with efforts to support home and neighbourhood levels. A number of businesses are considering branching into this area as well.

Anaerobic Digestion:

In-Home Application: Ecoliving Bokashi, 18L unit uses a shredded wood or coconut base inoculated with digestive microbes (EM) to ferment the food scraps. It takes about three week to fill up and one more week of treatment occasionally adding the EM mixture. A seal must be kept on the surface as the food is added, plastic or well fitted plate will do. A second unit is an advantage but placing the food in the freezer until the first batch can be dug into a soil trench is an alternative. This material which smells like pickled food must be place in the soil for 10 days before planting in the area



Watch <http://www.youtube.com/watch?v=NZFrPZZIFTs&feature=related> and <http://www.youtube.com/user/BioEnergySustTechUF> for a good explanation of the anaerobic process by university students: University of Florida with Dr. Ann Wilkie supervising projects.



Home and Neighbourhood Applications:

The 1.6m³ Portable solar Digester (left) and the 2.5m³ Family Food & Sewage treatment plant (right):

Both these examples are Puxin Science & Technology systems. They take organics including sludge or septage and food into the fermentation tank, a pump regulates the gas flows into the storage bags and filters on

to their uses within the home. The small portable system can work off of a solar charge. Both sets come with lighting fixture and a two burner stove. Very interesting prospect!

<http://www.puxinbiogas.com>. Refer to Appendix #5 for pricing pg. 39. Esther Wei, www.eco-biogas.com, the co-inventor is coming to Bowen to show case this technology on August 6th 2011, as part of Sustainability Day and the Compost and Soil Building Event in Davies Orchard.

Watch, (sub titles in English) Build biogas plant: <http://www.youtube.com/watch?v=nFiKCaIFd0g&feature=related> for a neighbourhood application made in the ground with bricks



Small Commercial Size Operations:

Consultant Julian Radlein of SymbiAudit came to Bowen in April 2011 to talk with a group of interested folks. His firm specializes in collaborative community work in the area of sustainable practices in managing organics and recyclables. He and his firm have worked with bio-digestion development and other methods. His strong suite is to get people engaged and on board with one accord while presenting systems that are to scale for the needs and the local economics.



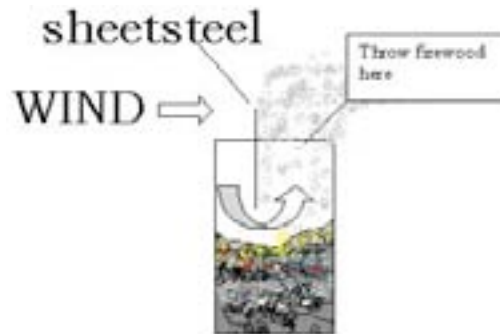
Anaerobic digestion creates greater amounts of accessible phosphorus of the biosolids than composting and remains one of the important reasons for looking into AD processing.

a) Biochar Production

Simple Home Built Biochar without Capturing Bio-Gas

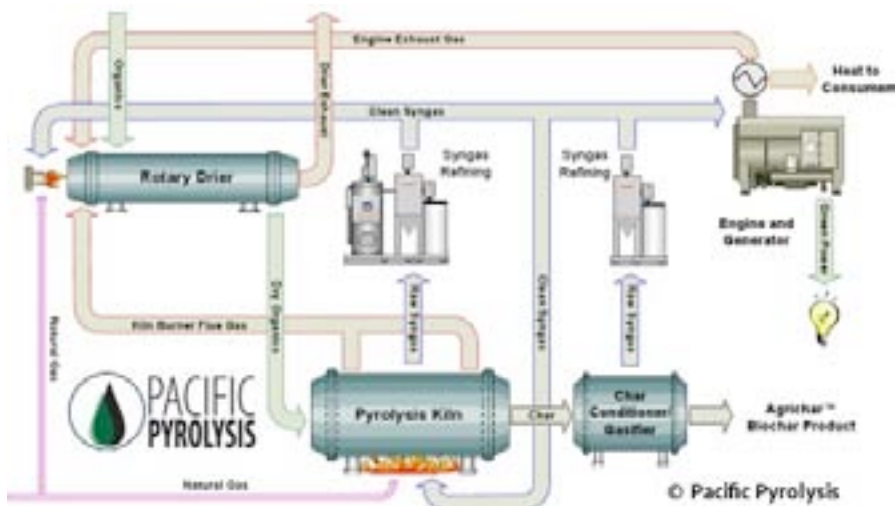
To make charcoal you can make a fire in an upright steel barrel with the high carbon stock you have placed there. It is open on the top end and when it is almost full, as it is burning, you put the lid on (airtight except for a small vent) and let it be for 2-3 days.

John Hoover, Alan Whitehead, and Brett Dowler, from Bowen have been experimenting. John built the fire around the barrel and Alan put the paint can with three holes in it, in the wood stove over night.



Commercial Pyrolysis Units

These show a technical application with a built-in system to capture and use the resulting bio-gases for the process itself. They produce “green” energy that is distributed to boilers, for heating homes or buildings, or placed in engines and generators to produce electricity. Biochar is a home, neighbourhood and commercial option on Bowen as more people discover the attributes of bio-char that enhance soil quality and improve plant production, along with being able to capture fuel for energy use.



Notice the difference between the two set of soil colors and the growth difference with abundance of biochar in the soil or lack of it. The richness and results are unmistakable



<http://pacifppacificpyrolysis.com/technology.html>

Containing the gases and particulate is of concern but systems developed would take that into consideration for air quality reasons and the benefit of using the gases for fuel for heating and creating electricity. Return to pg.16.

PROCESS UNITS, CONTAINMENT METHODS compiled for Bowen Island Organic Resource Recovery JULY 21 2011										
Company	Located	Contact Info	Unit Name	System Type	Process Time in Unit	Accessories / Feedstock	Unit Operation	Base Cost	References	Comments & Information
Home										
LeeValley	1180 S.E. Marine Drive Vancouver	(604) 261-2262	3stage continuous Compost unit, 120gal..	Outdoor aerobic composting, family	4 wk for each level, 12 wks first use, get 10 gal. of compost/m	see pictures: http://www.leevalley.com/en/shopping/AddVIEWS.aspx?p=67260 / Kitchen and garden feedstock.	Add daily	\$199 plus tx. Retail order	Diane & Don Marshall, on Bowen	Lee Valley discontinued a former to bring in this one made in New Zealand. (also out of # Exaco Trading# Model: EARTH)
Eco Living,	Salt Spring Island,, BC	Eric Beamish, 250 537 8424, ecolivingos@shaw.ca	Indoor Bokashi unit ,8 liter (.0185 cu.m)	Indoor Microbe assisted anaerobic digester	3wks, leave 4 days w/o adding food then bury in soil for 10 days curing	Bokashi Starter Microbes, 100 lb. quantities \$450.006 or 1lb bag \$10./1mth.supply / Kitchen scraps	Add daily, keep plastic on food to keep air out	2 units incl. 1.36 kg. of microbe bokashi \$125	KKNook, Mary Ellen DeGrace, on Bowen	Could try to keep some of the original batch to set up each consecutive batch. Otherwise, the bocashi mix expensive, seems high. Need to ask Mary Ellen
Vermiculture Canada	Toefield Alberta	Paul Worbey 780 662 3309	360 Worm Factory	Indoor vermiculture 4 tray unit includes drain tray and spout, new design,	12wks harvest first tray	Price incl. red wriggler & a few could be donated through Wynn Nielson / Kitchen scaps but no citrus, pasta, oils, raw meats	Add every other day with shredded paper	\$200 incl. worms & del.	30 people on Bowen,,Maureen Witney	70F. Temp Good workers unless too much volume or not enough shredded paper to absorb moisture & keep fruit fly away. Compost tea good for diluted fertilizer. 1cup to 1gal water
Nature Mill	Dist: Pacific Rim College, Victoria or Nature Mill California	Bonnie @ 250 483 2119 www.pacificrimcollage.ca or Kevin, Cal. 1800613 6629 ext 2804	NatureMill PRO XE Edition Compost	Indoor automated , aerobic electric, heated , \$0.50/day hydro	Three weeks in total but composted in 2, curred for 1	Filter that last 5 years,electricity @\$0.50 /day and wood pellets or equiv of .061b/day / Kitchen scraps, no bones, citurs or fruit pits	Add daily, automatic heat and turning, empty bottom tray when light goes on	\$399 plus tax & \$25 for Del. Bulk order above 5, \$349. ea plus tx & del	Pacific Rim College uses them , Bonnie @ 250 483 2119	Good reviews comes recommended, does a family of five/ 5lbs /day
Envirocycle Systems inc.	Magog Quebec	David 819 769 1423 david.b@envirocyclesystems.com	Mini Envirocycle (indoor 17gal) & Original Envirocycle (Outdoor 52 gal)	Indoor & outdoor aerobic continuous food & yard trimmings	4wks	Kitchen scraps for indoor and kitchen and yard trimming for outdoor units.	Add daily,Easy turning, turn more for faster composting	Mini: ~ 88 incl. ship+ tax Original outdoor ~116 incl. shpg +tax	No reference but in talking with them directly they say they have o them and they have good results	I do recommend this unit because of price and fast compost timing ease of turning on little wheel and compost collection tray.
Sun Mar Garden Composter	Eric frm Eco living might get good deal.	1 888 341 0782	50 gal. or 0.45 cu.ft. 200 SunMar	Outdoor continuous composter	12 wks 4wks summer	Kitchen and shredded yard trimmings	Daily use, turn and may need water	\$329	Maureen Witney, loves hers and part of the reason for seeking them as one of first choices	Sturdy and inner chamber that funnels composted material to access hatch, bulk order could get better prices
Sun Mar Garden Composter	same as above	1 888 341 0782	100gal. Or 0.68 cu.m 400 SunMar	Outdoor 2 chamber continuous composter	12 wks 4wks summer	Kitchen and shredded yard trimmings	Daily use, turn frequently	\$479.00		Same as above.
Home Depot Garden Composters	Vancouver		60gal. Dynamic composter	Outdoor continuous composter	12 wks 4wks summer	Kitchen and shredded yard trimmings	Daily use, turn frequently	\$169.	Brett Dowler has one	Hard to put together and flimbsy handle. Mixed reviews for sure
Home Depot Garden Composters	West Vancouver		48gal. Suncast Spinning Composter	Outdoor continuous composter	4wks summer	Kitchen and shredded yard trimmings	Daily use, turn frequently	\$119.99		Has bar with Tines inside, looks good
Home Hardware	Simpson Home Hardware, W. Van.	604 922 - 4138	50gal. Nartura Tumbler	Outdoor continuous composter	4wks summer	Kitchen and shredded yard trimmings	Daily use, turn frequently	119.99		no Comment
Exaco USA Ltd.	Austin Texas	on line	Aerobin Insulated Composting Bin 113gal, nsulated	Outdoor	12 wks harvest	Kitchen and shredded yard trimmings		\$380. + tx + ship.		Not investigated but looks good
Laurie Chamber custom built Stone composter	Lund BC http://www.cityfarmer.info/2009/10/08/bear-proof-compost-bin	Laurie Chambers ,	Bear-proof Stone compost	Out door	12 wks	Kitchen and shredded yard trimmings	Daily use		City Farmer in Vancouver	Showing this as an example in main report for the situation on Bowen. Would have to phone City Farmet to see if there are plans.
Jora Compost Canada Ltd	direct: Jora,Mt.St Hiliare, Que. 514 710 5672	distrib:Eric Beamish 250 537 8424, Salt Spring	Outdoor insulated 2 chamber Jk 125 & JK270	Outdoor Insulated, 2 chamber , continuous composter	6 to 8 wks	High Temp up to 75C allow for all food scraps & stredded yard trimming	Daily use, all foods except large bones and twigs but needs shredded carbon's	Prices indicates Minimum order of 5 JK125: \$345 per unit, JK 270:\$508 per unit,plus tx includes del, JK400:\$750 per unit	KKNook & Zero Waste Bowen combining sharing the cost of a demo unit JK270	JK125:2liter/day (4-6 person use,10-15l/wk), JK270:4 l/day (10-12 person use, 20-30 l/wk), JK400: 7-11 l/day (20-25 person use, 50- 80 l/wk)
PUXIN Science and Technology CO LTD. info4@puxinbiogas.com and EcobioGas	Guangdong Province P.R. China , Tel 13168055771	Esther Wei (604)983-2254 ewei@eco-biogas.comwww.eco-biogas.com	Puxin 2.5m ³ fiberglass portable biogas digester	Portable solar digester anaerobic digester	Takes 1 year to fill tank to use digestate but use methane as process allows	all necessary accessories come with the unit and will take food, shredded yard trimmings and manures, any type of organics as long as sml. Particles	daily use but little maintenance	\$1300, plus \$800shipping fee, includes, gas storage container,filter, pump, lamp, two burner stove		20 ft contanier: US \$2050, 35 sets 2.5m ³ portable solar digester,& fittings : US \$2950, 80 sets of Portable digester and fitting. 40 ft HQ contanier: US \$3250, 100 sets of Portable digester and fitting.
Same as above	Guangdong Province P.R. China , Tel 13168055771	same as above	2.5m ³ PUXIN Family Size Sewage Treatment System	anaerobic digester	?	Same as above but is hooked up to sewage from house or barns	automated	USD 3,323	t Esther is happy to talk with anyone.	Esther Wei will be coming to Bowen to inform community about her units and how they work

Company	Located	Contact Info	Unit Name	System Type	Process Time in Unit	Accessories / Feedstock	Unit Operation	Base Cost	References	Comments & Information
Jora Compost Canada Ltd	Salt Spring, BC	514-710-JORA info@joracanada.ca	Indoor 2 chamber 1.4cu. m Jk5100	Automated, regulated,	2 to 4 wks	wall-mounted control panel, Kitchen and yard trimmings chipped and shredded woody organics	clean auger daily and thoroughly	\$40,000. + \$5000 ship + tx		100 l/day 700lt /wk or 5 Tonnes/yr (250 people)
Green Mountain Technologies	Bainbridge Island, US	Morgan Davis, 802-368-7291	Insulated Outdoor 2.3 cu. m Earth Tub	Automated, tub with Auger	4 weeks	Bio-filter (95 gallon cart) with ventilation blower, kitchen scrapes and yard trimming & wood chips	1/4 hr not including shredding material	2 units: 20,000	U of C, Shelly O'Brien 403 270 9706	40 to 150lb./d or 18 to 68kg/d or 6 to 24 tonne/y
GreenGood Composter	568 Beatty St. Vancouver	Brian Leung Director, 604 568 7875	GG2	Indoor, aerobic Automated,	24 hrs but 4 wks curing	AC 3-Phase 240 V/60 Hz, 1,200 - 1,825 kWh/month, all kitchen scraps except bones but can take shellfish , needs initial boost of Effective Aerobic	1/2 or less	\$629		Not including tax, installation or servicing
GreenGood Composter	568 Beatty St. Vancouver	Brian Leung Director, 604 568 7875	GG10	Indoor or enclosed Automated,	24 hrs, 4 wks curing	AC 3-Phase 240 V/60 Hz, 1,200 - 1,825 kWh/month same as above	1/2 hr, or less ng	\$5095		Not including tax, installation or servicing
GreenGood Composter	568 Beatty St. Vancouver	Brian Leung Director, 604 568 7875	GG30	Housed, aerobic Automated,	The more raw food the longer it will tak	AC 3-Phase 240 V/60 Hz, 1,200 - 1,825 kWh/month, all kitchen scraps except bones but can take shellfish	1 hr, http://www.greengoodcomposter.com/owner-manuals-3/	\$14,597		GG50 is \$20,319, GG100 is \$29,250, Not including tax, installation or servicing

Community/ Commercial

Ag-Bag Environmental	2320 SE Ag-Bag Lane, Warrenton, OR 97146	1-800-334-7432 www.ag-bag.com	Community and farm system.ted		8 - 12 wks up to three sets a year	110volt for aeration system/ takes all if shredded including biosolids	Curing time open 4-8wks	\$135,000		Refer to AQMP Pg.18 & 19 for AgBag, receiving Bldg, Loewen Mixer, ground clearing, 23,000 tonne/yr.
Green Mountain Technologies	5350 McDonald Ave. Bainbridge, Wash. US	Vance Calvez c: (206) 518-7214 o: (206) 319-7102	23cu.m Earth Flow :EF-30		4 wks	30A 220V single or 208V 3 phase	1/2 hr, not including shredding	106,725		.75 to 1tonne/day
Transfor Compost	33119, S Fraser Way Abbotsford	Dr John Paul	customed engineered						Olds College, District of Kent and many more.	Dr. John Paul; custom made bunker style for less than \$100., 000. just ball park.
HotRot Composting Systems	New Zealand/ Halifax Nova Scotia	Gerald Tibbo GTibbo@hatch.ca	Hot Rot 1206	utomated system, uses all organics,	21 days with curring time of 4 wks	Engineered system using less space than windrow or other systems. nd works with operators, look to on line require	2hrs /day, Need technical training, and computer feedstock work additional	\$150,000. +-\$10,000 shpg, traing & hopr	Halifax and several locations in the world,	Direct notes fromGerald Tibbo, Rep for HotRot and Engineering firm Hatch Engineering Canada, could consider lease agreement. Takes .5 tonnes/day, 4 to 6wks. curring
HotRot Composting Systems	New Zealand/ Halifax Nova Scotia		Hot Rot 1509	Same	21 days with curring time of 4 wks	same only larger unit.	Same as above.	\$285.00+ - shpg , trng, & hopper	Been in contact since 2007	Expensivse upfront but less infrastructure, for leachate, odor control, aearation, vermin control and dainly maintenance or turning mechanically, Takes .8 to 1.5 t/day 4 to 6 wks curring .
PUXIN Science and Technology CO LTD. info4@puxinbiogas.com and EcobioGas	Long Gang Shenzhen, Guangdong Province P.R. China , Tel 13168055771	Esther Wei (604)983-2254 ewei@eco-biogas.comwww.eco-biogas.com	10m ³ biogas digester , made of concrete with steel mold.	Anerobic Digestion	on going	Concrete walls form by assembly of steel forms, accessories are bought according to need,s see literature for details	daily use, don't know how much per day.	\$5260 on steel mould and gasholders, plus shipping, and the material and labour for the concrete body.	Morganne is contact 0676 on Bowen.But Esther is happy to talk with anyone.	Part of the \$5050 steel mould cost is recoverable if it can be resold or used multiple times, also 100m ³ unit or larger

Avg. 1.5kg, of Food Scraps / person /wk on Bowen X 2.2 persons/ household on Bowen X 1700 household =291t to 301 tonnes/per year with 3862 householders on Bowens and approximately over 40 tonnes from Restaurants (BWS pers comm) given that % of kitchen scraps are composted the figure of 197 tones are available for commercial composting or other processes or to be hauled off the Island.

60% to 65% compost up to so 40% ~120 available tonnes and BWS say with an estimated 40 tonnes from restaurants = 140 tons in the garbage each year = .38 tonnes /day.

Note that one liter of kitchen scap weighs .5kg. So interesting to note that each person produces at least 3 lt. per/wk., 78kg/yr or156 lt./yr/perso of kitchen waste..

Kitchen Collection Containers & Bags

Lee Valley , www.leevalley.com/ Stainless steel, 6 L , \$23.50 plus tx., Plastic Kitchen Catcher with charcoal filter 7 L., \$19.90 plus tx.

Sure-Close Food Collection Container, 7.1 L, Rod Muir, 416 535 9918, Sure-close.ca, rodmuir@sympatico.ca, \$14.95 CAD + \$11.95 CAD shipping has venting and very good handling capabilities

Norseman Kitchen Collectors, NPL 29, 7.1 L., \$13.5 incl. del. & tx. Tom Button 1-800-561-6525. Local: 604-535-7293, enviro@norsemanplastics.com not venting

Certified Compostble Bags : Only tested and approved bags will be allowed by Fraser Richmond Soil and Fiber Composting Facility

Earth to Bag, Kraft bags with cellulose liners: Charlotte McLaughlin, cmclaughlin@bagtoearth.com, 604-360-2831

Grott Sack is being tested m Angel Heart, UK, Georgina Bingham, finish testing at Fraser Richmond Compost Facility at end of Aug. 2011 and at ICC Nanaimo Facility in July.2011

Norseman NPL280 w/casters Source Separation Organics (SSO) Curbside BIN contain, 54 L , \$34.00 incl tx & del. Tom Button 1-800-561-6525. Local: 604-535-7293, enviro@norsemanplastics.com