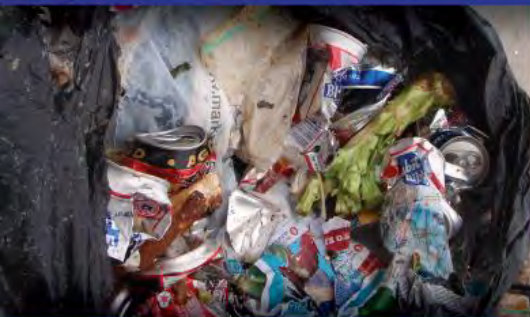
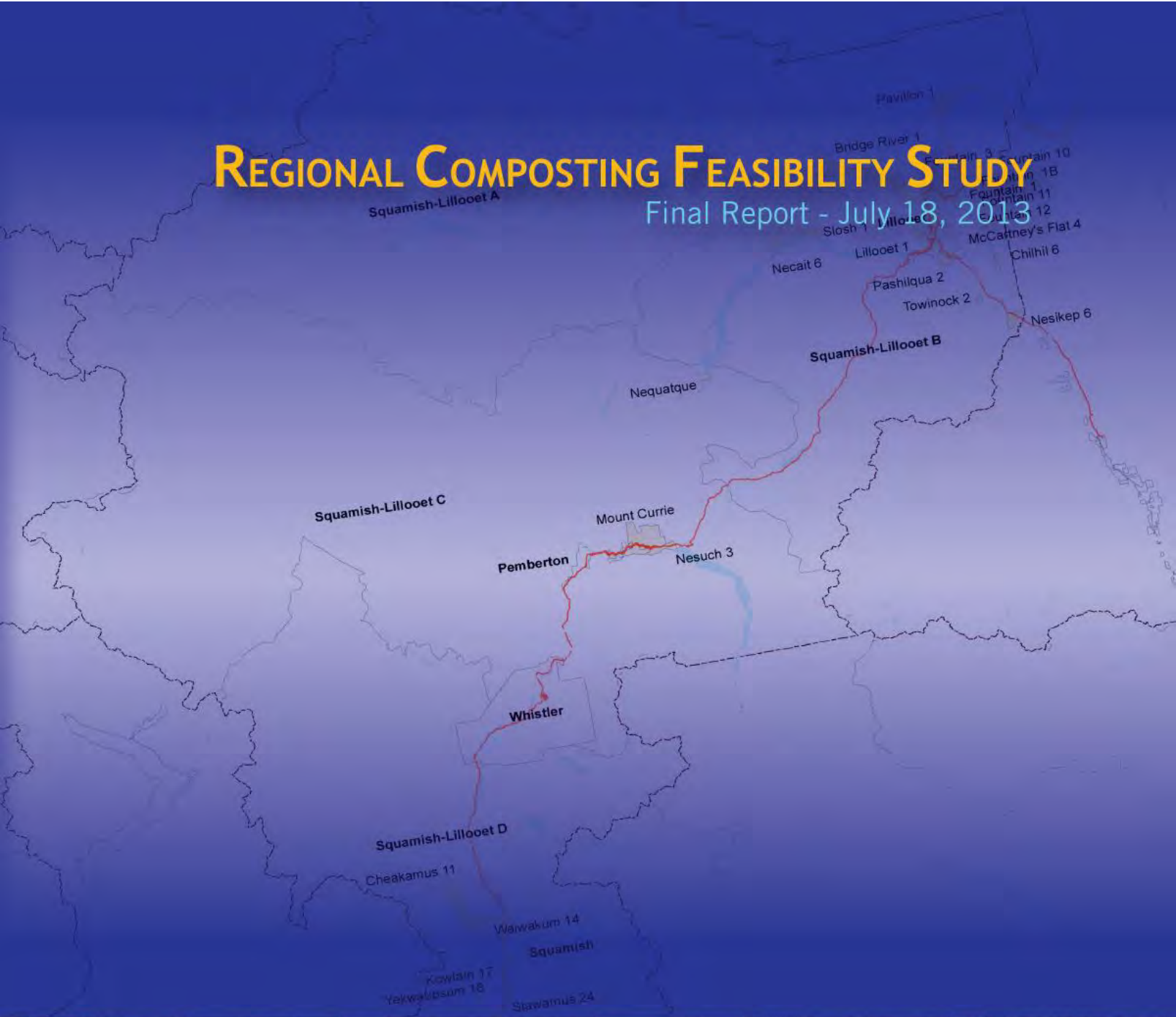


REGIONAL COMPOSTING FEASIBILITY STUDY

Final Report - July 18, 2013



Submitted to: Squamish-Lillooet Regional District
Attention: Brooke Carere





July 18th, 2013

Squamish-Lillooet Regional District
PO Box 219
1350 Aster Street
Pemberton, BC
V0N 2L0

Attention: Brooke Carere, Utilities and Environmental Services Technician

Re: *Regional Composting Feasibility Study – Final*

Dear Ms. Brooke Carere,

Dillon Consulting Limited is pleased to submit this regional composting feasibility study prepared on behalf of the Squamish-Lillooet Regional District. The purpose of this study was to characterize the amount of organic waste in the public waste stream, suggest potential composting scenarios, and identify organics collection and processing opportunities throughout the region.

Should you have any questions regarding this report please do not hesitate to contact Neil Crellin at 604-278-7847. Thank you for the opportunity to be of assistance.

Yours sincerely,

DILLON CONSULTING LIMITED

A handwritten signature in blue ink, appearing to read "N. Crellin", is written over a horizontal line.

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Limited**

Executive Summary

On behalf of the Squamish-Lillooet Regional District (SLRD) Dillon Consulting Limited (Dillon) has undertaken a feasibility study for the purpose of identifying municipal organics collection and processing opportunities within the region. The scope of work included the following:

- Execution of waste audits to identify the proportion and volumes of organic waste in the waste stream for the various regions of the SLRD;
- Research to consider a range of organics collection and processing options for the region; and
- Formulation of organics collection and processing options suitable for the SLRD, considering factors such as cost, transportation distances, treatment options, treatment locations, and economic and environmental benefits and barriers.

The region already has the Whistler Compost Facility (WCF), owned by the RMOW and operated by Carney's Waste Systems. The focus of that facility is the treatment of sewage biosolids. The WCF is supported by a "compost curing" facility located at the Squamish Landfill via operating contract with Carney's. In considering potential options for organics management, Dillon has anticipated the continued operation of the WCF as it might be amended by potential operational changes outlined in the recent report prepared on behalf of RMOW, see reference: Conestoga Rovers & Associates (2012). The region also has recently seen the initiation of the privately operated Sea to Sky Soils composting facility located at Pemberton.

The SLRD region incorporates several industries involved in the management of bulk organic materials which might also be amenable to composting. Such industries include forestry and the forest products industries. Given the commercial nature of the management of such materials, and the absence of public information to describe potential quantities or economic availability, they have not been considered as part of this study. However in practice they represent a potential resource to support any further composting efforts by the community, and consideration of their availability should be included in the commercial evaluation of potential compost facility development.

Compost processing can be achieved by a variety of technological approaches subject to the character of the organic source streams. However the principal factor in determining appropriate technology is often a consideration of economics, and in particular the application of the principle of "economies of scale". In broad terms, the capital cost of increasingly complex "in-vessel" processing technologies can be off-set by the ability to process larger quantities of materials in a shorter time frame on a cost per tonne basis. The population of the SLRD (and its associated capacity to generate organic materials) is relatively small when compared with other jurisdictions which have developed composting programs. This study has therefore focused on less mechanised composting processes with lower capital cost, which may be more amenable to the population and geography of the SLRD. The essence of the study is therefore the consideration of whether the scale of organics generation in the region (not already processed at the WCF) is consistent with the economic composting of those materials via organised programs, given the collection/transportation costs associated with selected potential program arrangements and centralised compost processing facilities.

The study is presented in two parts. The first part is a discussion of the quantities of organic materials that may be available in the region, over and above those already composted at the WCF. This includes projections of potential organic materials currently disposed to landfill via the garbage waste stream. Those projections are based on waste audits conducted as part of this study and publicly available information to describe total waste volumes disposed. The subsequent analytical part of the study is presented in terms of three potential options for the development/expansion of compost processing locations (Lillooet, Whistler and Squamish) with consideration of two potential source generation scenarios as follows:

- Scenario 1 – WCF Optimization – considers the implementation of recommended options for optimization of the WCF as described in Conestoga Rovers & Associates (2012) including food waste diversion and relocation of the curing facility from Squamish to the WCF; and
- Scenario 2 – Equivalent to Scenario 1, plus consideration of a “maximum potential” organics capture scenario, intended to reflect an optimistic view as to the largest quantities of potentially compostable materials that might be segregated from the garbage stream, and so provide an indication of the most positive economic opportunity relative to the “economies of scale” principle.

In 2011, the WCF processed 13008 tonnes of organic material (biosolids-3658 tonnes, food waste-1082 tonnes, leaf and yard/wood waste-8268 tonnes). The facility is operating at or near capacity. Further opportunities for the region must be considered in terms of additional options to that established facility. It should also be recognized that RMOW is seeking to optimize the operation of the WCF and may adopt two key actions:

1. Relocation of the curing facility from Squamish to the WCF (reduced interim handling/transportation).
2. The transfer of food waste to an alternative composting facility (when available) for approximately 4 months of the year, to allow the maximum quantity of biosolids to be processed when the quantity of biosolids brought to the facility exceeds the capacity of the composting system.

These two measures will create an opportunity for alternative processing of food waste, currently collected and managed from the RMOW area, and provide opportunities in terms of available space at the Squamish Landfill, Lot 22.

In addition to uncollected organic waste from residential and commercial producers, the other publicly available organic materials already collected in the SLRD region which are not currently processed for compost include:

- Approximately 350 tonnes of leaf and yard waste collected from the northern part of the SLRD region that is annually burned at the Lillooet Landfill; and
- Sewage biosolids generated at the Lillooet wastewater treatment plant (approximately 200 tonnes/year), which are the only biosolids in the region not directed to the WCF.

If, as described in Scenario 1, the “food waste diversion” recommendation for WCF operations (CRA, 2012) is implemented, and “over-capacity” material were not disposed to landfill at Rabanco (US), it would make available an additional 1410 tonnes/year for composting (840 tonnes of food waste & 570 tonnes of biosolids) based, on 2011 data.

If, as described in Scenario 2 the municipalities in the region implemented aggressive policy and by-law implementation and enforcement to segregate organics from the garbage waste stream in both the residential and ICI sectors, then an optimistic assessment of the additional “recoverable” quantities of organics in the Squamish Area might be of the order of 3655 tonnes/year and 3590 tonnes/year in the Whistler Area. As of yet, no source-separated organics (SSO) program has been considered for Lillooet and northern communities due to the low density and relatively small quantities of material that might be recoverable (480 tonnes).

Based on 2011 data, the total projected recoverable quantity of organic materials, over and above those materials already processed at WCF is estimated at 7725 tonnes/year (Whistler Area – 3590 tonnes, Squamish Area – 3655 tonnes, Lillooet Area - 480 tonnes). A breakdown of data by community in each area is provided in **Appendix D**, for example, within the Whistler Area, the projected recoverable quantity of organic materials arising from Pemberton/Pemberton Transfer Station is 425 tonnes/year.

Considering the Options and Scenarios presented in this study, a review of cost projections for: collection, transportation and processing indicates that on a \$/tonne basis, transportation is the least significant component

via which options might be selected. The cost of compost processing on a \$/tonne basis is the most significant, and in line with the general principle of “economies of scale”, the larger the processing facility the lower the potential unit rate cost.

Review of Scenario 1 indicates that with potentially minimal additional collection or transportation costs, an additional 1140 tonnes/year of material could be composted at a processing facility located in the Whistler Area. For assessment purposes, the study has assumed a “low-tech”/low capital cost approach to further composting in the region, however the facility operating such a system might be an extension of the WCF facility or a new facility such as that initiated by Sea to Sky Soils.

Under Scenario 2, review of estimated costs for collection, transportation and processing indicates that the most favourable option from a processing cost basis is a regional facility in either the Whistler or the Squamish area. In order to achieve the projected diversion and recovery of organics that might support such an option, municipalities would need to adopt aggressive policy development and by-law implementation and enforcement. There would also be additional cost in separate collection and transportation of organic materials to a regional facility, and those costs are of a similar scale to processing (estimated \$80/tonne for curbside SSO collection in Squamish, and \$130/tonne for segregated depot collection in the RMOW).

Other key opportunities/constraints identified by the study include the following:

- The two residential RMOW drop-off depots provide an opportunity to control and maximize organics diversion through inspection. With supporting infrastructure and fully manned facilities, the depots could seek to implement a highly effective means to maximize organics diversion through citizens delivering source-separated organics to drop-off sites in which the waste is inspected;
- The availability of “brown” wood waste is a key constraint to further compost processing in the region. The existing WCF facility has been successful in attracting much of the available municipal and land development wood waste streams, but also must supplement those streams with purchased wood chips. Any further compost processing must anticipate that additional “brown” material sources would need to be developed, likely from the commercial sector; and
- A small municipal compost operation in the Lillooet or Pemberton region would only be feasible if the operations were covered through existing labour and a substantial amount of required infrastructure (operating pad, covered space) were available, or alternatively if a community level facility could be supported with volunteer assistance.

In conclusion, the key findings of the report are that further compost processing is possible for segregated organic materials already available in the community, and also that additional volumes of organic materials could be recovered from existing waste streams at a scale consistent with “Low Tech” composting approaches, however because of regional geography, the relatively small scale of the communities present and the consequently small quantities of organic material generated, the economics of composting do not appear attractive when compared directly with existing waste disposal alternatives. The effort to adopt sustainability objectives such as increased composting will therefore need to come from the community who might place value on the success of achieving other non-financial goals. Given those limitations of scale, and the potential absence of a driving financial motivation to implement further measures, it would therefore be essential for all municipalities to work collectively in order to minimize overall waste collection and disposal costs, and come to a regional solution that meets the aspirations of all the communities.

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1 Introduction

1.1 Scope of Study

On behalf of the Squamish-Lillooet Regional District (SLRD), Dillon Consulting Limited (Dillon) has undertaken a feasibility study for the purpose of identifying organics collection and processing opportunities within the region. The scope of work included the following:

- Execution of waste audits to identify the proportion and volumes of organic waste in the waste stream for the various regions of the SLRD;
- Research to consider a range of organics collection and processing options for the region;
- Formulation of organics collection and processing options suitable for the SLRD, considering factors such as cost, transportation distances, treatment options, treatment locations, and economic and environmental benefits and barriers; and
- Suggestion of potential organics management scenarios to the SLRD.

In preparing this study, Dillon has adopted the following considerations:

- The region studied includes the SLRD, the District of Squamish (DOS), the Resort Municipality of Whistler (RMOW), the Village of Pemberton (VOP), and the District of Lillooet (DOL). For the purposes of the study, the region has been considered as a whole, without regard to the potential requirements for working agreements between jurisdictions to achieve any potential option;
- The region already has a compost facility (the Whistler Compost Facility (WCF)) owned by the RMOW and operated by Carney's Waste Systems, of Whistler BC (Carney's). The focus of that facility is the treatment of sewage biosolids. The WCF is supported by a "compost curing" facility located at the Squamish Landfill via operating contract with Carney's. In considering potential options for organics management, Dillon has anticipated the continued operation of the WCF, rather than adopting a "blank page" approach. Dillon has also considered potential changes to the WCF operations, as outlined in the recent report prepared on behalf of the RMOW, see Conestoga Rovers & Associates (2012), attached;
- Currently, the Whistler Centre for Sustainability is creating a comprehensive Integrated Sustainability Plan (ISP) for the SLRD. It is anticipated that the ISP will include organics collection and processing as part of the vision, based on apparent emission reductions and environmental opportunities;
- The generation of SSO from residential sources requires either a segregated curbside collection program or the operation of segregated collection at a waste receiving facility or transfer station. At present there are no segregated food waste/organics curbside collection programs within the region. Dillon understands that the DOS may implement a curbside collection program in the future. Dillon also understands that the RMOW will not consider any curbside collection program for Whistler, but could adopt programs to promote organics segregation and collection via its two transfer stations. For the purposes of the study, Dillon has developed scenarios which consider each of these potential programs as a means of realising the maximum availability of organic materials currently disposed to landfill;
- Compost processing can be achieved by a variety of technological approaches subject to the character of the organic source streams. However the principal factor in determining appropriate technology is often a consideration of economics, and in particular the application of the principle of "economies of scale". In broad terms, the capital cost of increasingly complex "in-vessel" processing technologies can be off-set by the ability to process larger quantities of materials in a shorter time frame on a cost per tonne basis.

The population of the SLRD (and its associated capacity to generate organic materials) is relatively small when compared with other jurisdictions which have well-developed composting programs. The study has therefore focused on less mechanised composting processes with lower capital cost, which may be more amenable to the population and geography of the SLRD. The essence of the study is therefore the consideration of whether the scale of organics generation in the region (not already processed at the WCF) is consistent with the economics of composting those materials via organised programs, given the transportation costs associated with selected potential program arrangements and centralised compost processing facilities; and

- The study assumes that no additional organic waste is imported to the region.

The study is presented in two parts. The first part is a discussion of the quantities of organic materials that may be available in the region, over and above those already composted at the WCF. This includes projections of potential organic materials currently disposed to landfill via the garbage waste stream. Those projections are based on waste audits conducted as part of this study and publicly available information to describe total waste volumes disposed. The subsequent analytical part of the study is presented in terms of three potential options for the development/expansion of compost processing locations (Lillooet, Whistler and Squamish) with consideration of two potential source generation scenarios as follows:

- Scenario 1 – WCF Optimisation – considers the implementation of recommended options for optimization of the WCF as described in Conestoga Rovers & Associates (2012); and
- Scenario 2 – Equivalent to Scenario 1, plus consideration of a “maximum potential” organics capture scenario, intended to reflect an optimistic view as to the largest quantities of potentially compostable materials that might be collectable, and so provide an indication of the most positive economic opportunity relative to the “economies of scale” principle.

1.2 Previous Studies

The SLRD has provided access to other relevant studies as follows:

- Southern Region Centralized Composting Program Feasibility Study, prepared by Gartner Lee Limited in May 2002 on behalf of the SLRD;

The purpose of this project was to determine appropriate composting technologies for the available feedstocks in the southern portion of the SLRD and to evaluate collection options, siting options, costs, and administrative requirements to execute a composting program. This is similar to the current study; however, the previous study only considered the area containing the municipalities of Squamish, Whistler, and Pemberton with an equivalent population of 45,000;

- Solid Waste Composition Study – Whistler Recycling and Transfer Station, prepared by Meghan Saunders in August 2010, on behalf of Resort Municipality of Whistler;

The purpose of this study was to achieve a representation of the composition of residential garbage within the community of the Resort Municipality of Whistler (RMOW). Waste audits were conducted from residential garbage containers from Nester’s Road Depot and Function Junction Depot, RMOW’s two drop-off sites for garbage and recycling; and

- Cost-Benefit Study – Whistler Composting Operations (Draft), prepared by Conestoga-Rovers & Associates (CRA) in June 2012, on behalf of RMOW.

The purpose of this cost-benefit analysis was to assess potential changes to operations at the Whistler Composting Facility. The information will be used to assess potential for modifications or additions to the composting infrastructure, to identify options for increasing capacity for biosolids (and so reduce seasonal export of the material), and to ensure optimal operation of the compost facility through a constant and consistent supply of required feedstocks.

The documents mentioned above are provided in Appendix A, in chronological order.

1.3 Solid Waste Management Planning and Sustainability Commitments

In 2006, the SLRD achieved a recycling rate of 33% and had reduced the per capita disposal rate by 53%, relative to their disposal rate in 1990. The SLRD's Solid Waste Management Plan (SWMP) was updated in December 2007, and serves as a guiding document for waste management throughout the region (Gartner Lee, 2007). This updated plan aims to reduce the amount of waste disposed by an additional 30%. The SWMP is driven by a Zero Waste approach that increases the scope of waste planning by considering the flow of materials from initial stages and process design, through resource extraction, manufacturing, consumption, and disposal (SLRD RFP, 2012). There is a substantial amount of focus on organic and compostable material, as organic material accounts for approximately 40% of the residential waste stream. In addition, organic waste adds substantial mass to landfilled material and creates significant amounts of methane.

The SLRD is also in the process of developing an Integrated Community Sustainability Plan (ISP) that will provide direction for the region to realize sustainability objectives it has for the environmental, cultural, social, and economic dimensions of its identity. The final ISP is expected in June 2013.

Lastly, all member municipalities of the SLRD have committed to the provincial government's Climate Action Charter (CAC). This commitment includes measuring and reporting on community greenhouse gas (GHG) emissions, while working to create compact, energy efficient communities. Establishing regional composting programs will dramatically reduce GHG emissions by diverting organic waste from landfills where it significantly contributes to methane production (SLRD RFP, 2012).

1.4 Scope, Electoral Areas, Demographics, and Population Growth

The scope of this study included the entire regional district, which covers 16,353.68 km² stretching from Porteau Cove in the south to Pavilion in the north (SLRD RFP, 2012). The regional district is organized into electoral areas A and B in the north and C and D in the south. A map showing the extent of the electoral areas is provided in Appendix B - Figure 1-1.

The following member municipalities are included within the SLRD's boundaries:

- The District of Squamish;
- The Resort Municipality of Whistler;
- The Village of Pemberton; and
- The District of Lillooet.

Based on the 2011 census estimate, incorporating the 2011 non-permanent Whistler visitor population, the estimated total population is 54,488. Of that, a population of 3,165 resides on First Nation reserves in over 20 First Nation bands.

The rate of population growth in the region has been consistently higher than the provincial average (SLRD, 2008). However, there has been a province-wide slowing trend over time. The population of the SLRD more than doubled from 16,232 residents in 1976 to 35,225 residents in 2006 (30 year period). During this time period, the

population in the region increased at an annual rate of approximately 3.9%, whereas the provincial population increased by 2.3% over the same period. Some of the primary factors driving growth include lifestyle selection, increased demand for recreational services, economic and employment opportunities, natural beauty & environmental qualities, and proximity to the Lower Mainland. Strong, sustained growth is predicted for the region in the next 30 years (SLRD, Regional Growth Strategy, June 2010). Between 2003 and 2031, the population of the region is projected to almost double again from 35,141 to 68,153 residents.

2 Solid Waste Management in the SLRD

2.1 Compostable Waste Streams

The study considers three principal organic streams potentially suitable for composting. They are:

- Food waste (including: non-food compostables such as soiled paper) derived from residents and commercial operations;
- Biosolids (sewage treatment plant solids) derived from wastewater treatment plants operated by the municipalities; and
- Leaf and yard waste including vegetation clearance/management debris derived from municipal and other activities and residential yard trimmings.

For the purposes of compost processing, a fourth stream, wood fibre or “brown” material is also often required (typically dry wood waste, shavings etc.). This material is considered as an “amendment” and is used:

- As bulking material to provide aeration during the composting process;
- To balance carbon composition to the heavy nitrogen load from food waste; and
- To control the moisture content.

Wood fibre is usually generated from commercial activities and must be acquired to support composting of the other three streams if there is insufficient (dry) leaf and yard waste. The availability of “brown” material in the region and the opportunity to supplement via use of wood waste is an important theme of this report, and may represent a practical and economic constraint to further composting in the region.

2.2 Existing Organics Waste Management in the Region

The current focus of composting in the region is the processing of sewage biosolids. With the exception of biosolids generated by the Lillooet wastewater treatment plant (approximately 230 tonnes/year), all biosolids derived from municipal wastewater treatment plants in the south of the region are transferred to the Whistler Compost Facility (WCF) for composting. Food scrap composting opportunities for residents include collection bins at the Squamish Recycling Centre (Carney’s office) and the Squamish landfill. Bins are also available at the both the Whistler depots (Function junction and Nester’s).

In the District of Squamish opportunities for residential yard waste composting are planned to include full curbside yard waste collection from spring to fall (May 13 – Nov 15). The Squamish Landfill also accepts yard waste. For Whistler residents the RMOW offers yard waste drop off events at the Nestor’s Depot in the Spring and in the Fall. The events typically are held during long weekends and usually run for four days. The Whistler transfer station also accepts yard waste. Furry Creek (FC) and Britannia Beach (BB) now have yard waste bins in each of their communities from May – Nov. In 2011, 3 tonnes was collected in FC and 6.1 tonnes was collected in BB for a

total of 9.11 tonnes for Area D. The SLRD is exploring specific options for Pemberton and Area with the Zero Waste Strategy.

Leaf and yard waste generated by SLRD operations in the Northern third of the region is transferred to the Lillooet Landfill where it is stockpiled and burned once a sufficient amount has accumulated. This equated to approximately 350 tonnes in 2011 (equivalent to 1000 m³). Leaf and Yard waste generated by the DOS was 882 tonnes in 2011 (equivalent to 2500 m³) and a similar quantity by the RMOW, both of which are composted at the WCF.

Commercial food scrap collection is in place for several large hotels and restaurants located in the RMOW with private collection provided by Carney's Waste Services (Carney's). No similar service is available elsewhere in the region. Organic material deposited at the Whistler and Squamish drop-off locations or collected by Carney's from Whistler is transferred to the WCF for composting, see Section 2.3 below.

2.3 Composting Facilities

The only municipal composting facility in the region is the RMOW's closed in-vessel composting facility (the WCF). The facility is operated by Carney's via contract to the RMOW. Carney's is responsible for management, routine operation of the facility, and all hauling of material. The facility accepts processed biosolids, food scraps, and wood fibre.

A private composting facility is in the process of being established at a site near Pemberton. The proponent is Sea to Sky Soils, of Mount Currie, BC. Sea to Sky Soils may incorporate food waste treatment as part of their operations and the SLRD is considering the presence of the facility within an amendment to the regional Solid Waste Management Plan.

2.3.1 Disposal Facilities and Transfer Stations

Table 2-1 provides a summary of the waste receiving facilities in the SLRD including the Electoral Areas serviced, approximate waste flow, materials accepted and site specifications. A summary of disposal costs at each facility is provided in **Table 2-2**.

Table 2-1 Summary of Waste Receiving Facilities in the SLRD

Facility	Services Electoral Area(s)	2012 Waste Audit Performed	Approx. Waste Flow To Landfill (tonnes/year)	Materials Accepted	Location, Description, and Specifications
Squamish Landfill	C, D	Yes	13,721	Household garbage, commercial and construction waste, tires, gypsum board, appliances, clean wood waste	<ul style="list-style-type: none"> • Located on Landfill Road in the Brackendale neighbourhood, west of Highway 99, opposite Alice Lake turnoff • Owned by the District of Squamish • Operates 364 days per year
Lillooet Landfill	A, B	Yes	322	Household garbage, commercial and construction waste, cardboard, mixed paper, plastics, used oil, paint, metal & appliances, clean wood waste, "Free store" items	<ul style="list-style-type: none"> • Located on the west side of the Fraser Canyon, 3 km north of Lillooet • Owned by the SLRD • Collect and process recycling on site • Drop off of E-waste, paint and household hazardous waste as accepted under Product Care and Encorp Stewardship program.
Whistler Transfer Station & Depots at Nester's & Function Junction	C, D	Yes	12,213 (of which 2443 tonnes (2011) came from depots)	Garbage and mixed waste, gypsum board, large household appliances, tires, recyclable materials (glass, tin, paper), clean wood and yard waste, clean sawdust/woodchips/shavings/hog fuel, invasive and noxious plant matter, organics.	<ul style="list-style-type: none"> • Located on Callaghan Valley Road 15 km south of Whistler off Highway 99 • Owned by the Resort Municipality of Whistler • Operate 364 days per year
Pemberton Industrial Park Transfer Station	C		1,802	Household garbage, tires and rims, appliances and metal, furniture, mattresses, batteries, clean fill	<ul style="list-style-type: none"> • Located at 1947 Carpenter Road in the Pemberton Industrial Park • Owned by SLRD • Tipping fees apply • Operates 312 days per year • Drop off available for paint and household hazardous wastes • Wood waste not accepted • Household recycling accepted • Large loads refused

Facility	Services Electoral Area(s)	2012 Waste Audit Performed	Approx. Waste Flow To Landfill (tones/year)	Materials Accepted	Location, Description, and Specifications
Devine Transfer Station	C		81	Only household waste	<ul style="list-style-type: none"> ● Located on Hwy 99 5 km South of D'Arcy ● Owned by the SLRD ● Household recycling accepted ● Large loads refused ● No tipping fees ● Only operates 3 days per week during the summer and 2 days per week during the winter
Gold Bridge Transfer Station	A	Yes	68	Household and commercial waste, construction waste, appliances and furniture, tires, cardboard, "free store" items	<ul style="list-style-type: none"> ● Located on Saddle Road ● Tipping fees apply ● Household recycling accepted ● Fire Smart program collects residential yard waste

Table 2-2 Summary of Disposal Costs

Waste Stream	Goldbridge (\$)	Lillooet (\$/tonne)	RMOW (\$/tonne)	Squamish (\$/tonne)	Pemberton (\$/tonne)	Metro Vancouver (\$/tonne)
Biosolids	N/A	7.5/m ³	110	N/A	N/A	Unknown
Organics	N/A	N/A	75	*Free drop off for residents	N/A	71
Yard Waste	N/A	0	30	40	N/A	63
Wood Chips	N/A	0	0	40	N/A	63
Clean Wood Waste (compost suitable)	N/A	0	30	40	N/A	63
Contaminated Wood (not compost suitable)	\$13 per pickup truck	65.50	120	80	N/A	107
Mixed C&D – Non - Recyclable	\$20 per pickup truck	65.50	120	108	N/A	107
Garbage	\$13 per pickup truck, \$2 per bag	65.50	120	108	\$9 per pickup truck, \$0.75 per bag	107

3 Regulatory Background

3.1 Federal Regulation

The *Canadian Fertilizers Act* (R.S.C. 1985) provides the opportunity for Agriculture and Agri-Food Canada to regulate compost offered for sale in Canada. The Fertilizers Act and Regulations prescribe the kinds of materials that are acceptable in compost (including biosolids) providing that all materials meet the prescribed safety, efficacy and labeling standards. The federal government continues to review the situation via groups such as the Bureau de Normalization du Quebec (BNQ) through the Canadian Council of Ministers of the Environment (CCME) and the Biosolids Task Group. Every five years, the BNQ is mandated to review their policies; funds are currently being sought for a re-evaluation in 2013.

In addition, the Canadian General Standards Board has created a Permitted Substances List for organic production systems through the Standards Council of Canada. This comprehensive list includes the permitted substances for crop production as part of an organic production system. Of note are conditions associated with substances entitled “Compost obtained from off-farm sources” and “Composting feedstocks” as shown in **Table 3-1** below indicating: Acceptable Feedstocks for Organic Farming Certification (Canadian General Standards Board).

Table 3-1 Acceptable Feedstocks for Organic Farming Certification

Substance Name	Origin and Usage
Compost obtained from off-farm sources	<p>Compost obtained from off-farm sources:</p> <ul style="list-style-type: none"> a. shall not exceed the maximum acceptable levels of trace contaminants (mg/kg) and foreign matter outlined for unrestricted use (Category A) compost as specified in the Canadian Council of Ministers of the Environment (CCME) publication <i>Guidelines for Compost Quality</i>, b. shall not cause a buildup of heavy metals in soil over repeated applications, c. shall meet criteria for acceptable levels (MPN/g total solids) of human pathogens as specified in the CCME publication <i>Guidelines for Compost Quality</i>.
Composting feedstocks	<p>Acceptable feedstocks include:</p> <ul style="list-style-type: none"> a. animal manures conforming to par. 5.5.1 of CAN/CGSB-32.310, Organic Production Systems — General Principles and Management Standards; b. animal, animal products and by-products (including fishery); c. plants and plant by-products (including forestry and source-separated yard debris, such as grass clippings and leaves). <p>The following are prohibited as composting feedstocks: sewage sludge; leather by-products; glossy paper; waxed cardboard; paper containing coloured ink; and animal, animal products and animal by-products that are not guaranteed free of the risk materials specified in bone meal. Except for animal manures, feedstocks that may be contaminated with substances not included in this standard or prohibited by par. 1.4.1 of CAN/CGSB-32.310, shall require documentation to confirm the absence of these substances OR documentation substantiating the common degradation of such contaminants during the composting process.</p>
Bone meal	<p>Permitted only if guaranteed free of specified risk materials including the skull, brain, trigeminal ganglia (nerves attached to the brain), eyes, tonsils, spinal cord and dorsal root ganglia (nerves attached to the spinal cord) of cattle aged 30 months or older; and the distal ileum (portion of the small intestine) of cattle of all ages.</p>

3.2 Provincial Regulation

The principal regulation governing the performance of compost producing facilities with production greater than 20,000 tonnes per annum in BC is the Organic Material Recycling Regulation (OMRR): <http://www.env.gov.bc.ca/epd/mun-waste/regs/omrr/index.htm>. In British Columbia (as in most other provinces), compost products are quantified in terms of two classes which are differentiated by: pathogen content, compost maturity, and metals content (respectively referred to in OMRR as pathogen reduction processes, vector attraction reduction and quality criteria).

Unlike some other provinces which have adopted, or are considering the adoption of the CCME Guidelines for Compost Quality (2005), the criteria regarding vector attraction reduction in particular, differ in British Columbia in that they are not as stringent as in other provinces. The criteria for the three quality constituents in addition to sampling frequency, record keeping and freedom of distribution as shown in **Table 3-2**.

Of note are conditions for composting yard waste and clean wood alone and the need for a land application plan if Class B compost is produced. The OMRR also has a similar (but more complicated) set of criteria that differentiate Class A and Class B biosolid products. Of particular note is that Class A compost (which has unrestricted application) can be produced containing biosolids provided the biosolids meet at least a Class B standard.

In support of proponent “dischargers” wishing to comply with the OMRR, BC has issued the *Compost Facility Requirements Guideline*: <http://www.env.gov.bc.ca/epd/codes/omr/pdf/compost.pdf> which provides guidance in regard to the requirements for professional support in the preparation of Environmental Impact Studies, Odour and Leachate Management Plans, and Environmental Impact Assessments, relative to facility siting and design, as described under the Regulation. In addition BC provides the *Land Application Guidelines for the Organic Matter Recycling Regulation and the Soil Amendment Code of Practice*: <http://www.env.gov.bc.ca/epd/mun-waste/regs/omrr/pdf/land-app-guidelines.pdf> which provides best Management Practices to support compliance with OMRR and also provides guidance on applicability of related BC regulations including: *BC Contaminated Sites Regulation*, *Agricultural Waste Control Regulation/Code of Agricultural Practice for Waste Management*, and the *Agricultural Land Commission Act*. The OMRR are currently under review for potential changes, particularly associated with vector control.

Certification of Organic produce is provided by independent agencies such as the Pacific Agricultural Certification Society (PACS) and the Canadian Organic Growers (COG). Discussions with PACS has indicated that, in principle the use of compost derived from food waste may be acceptable in the production of Certified Organic products provided there is an adequately robust program of raw material assessment (prior to receipt at the composting facility) and a program of sampling and analysis (for exclusion of prohibited parameters) in the final compost product. As yet there is no precedent for which PACS has accepted such a procedure in BC.

3.3 Municipal Regulation

While potential composting facility locations are identified in this study, such developments are only considered on a conceptual basis. The relevant municipal regulation which might apply to any particular site or proposed facility design is therefore beyond the scope of this study. Nonetheless, the siting and operation of any composting facility is subject to municipal planning and zoning requirements, and any relevant bylaws.

Table 3-2 Compost Quality Criteria as per OMRR (2007)

	Pathogens	Vector Attraction Reduction (Maturity)	Quality Criteria (Metals) ≤ in mg/kg or µg/g	Sample Frequency	Record Keeping	Distribution
Yard Waste/ Clean Wood	Turn pile periodically	One of: -aerobic for >14 days @ >40°C with average >45°C and 15:1<C:N<35:1 OR -cured for >21 days and 15:1<C:N<35:1 and ΔT<20°C 60 cm inside pile of 3 m diameter and 2 m high after 3 days with moisture 35-60% and ambient temp 5-30°C	Arsenic 13 Cadmium 3 Chromium 100 Cobalt 34 Copper 400 Lead 150 Mercury 2 Molybdenum 5 Nickel 62 Selenium 2 Zinc 500	Every 1000 tonnes dry solids or once/year, whichever occurs first	Operating records (temperatures and retention times) recorded every working day, held for 36 months Test results held for 36 months	Unlimited
Class A compost from SSO (including food waste)	Before vector attraction tests: One of: -windrow at 55°C ≥15 days (with 5 turnings) OR -static aerated pile, in-vessel at 55°C ≥3 days Before or during vector attraction tests: 7 samples with fecal coliform <1000 MPN/g total solids	Either one of: -reduction in volatile solids >38% OR -specific oxygen uptake rate (SOUR) for biosolids treated in an aerobic process shall be less than or equal to 1.5 milligrams of oxygen per hour per gram of total solids (dry weight basis) at a temperature of 20°C OR -if incorporated by tillage, then no significant amount of Class B compost must remain on the soil surface 6 hours after application.	Arsenic 75 Cadmium 20 Chromium 1060 Cobalt 150 Copper 2200 Lead 500 Mercury 15 Molybdenum 20 Nickel 180 Selenium 14 Zinc 1850	Every 1000 tonnes dry solids or once/year, whichever occurs first	Operating records (temperatures and retention times) recorded every working day, held for 36 months	Requires land application plan with numerous restrictions

4 Estimation of Organic Materials Quantities

4.1 Introduction

The following sections provide a discussion on the study findings to indicate the regional quantities of compostable materials that might be available in the three organics streams: food waste, biosolids and leaf & yard waste, over and above the material already processed at the WCF.

The approach for evaluation of each was as follows:

- Food waste quantities (including non-food compostables) were estimated in the garbage stream by conducting waste audits to describe representative waste compositions in each area, and then applying those composition analyses to data describing the total weight of garbage disposed of by relevant area, as provided by the SLRD for 2011;
- Biosolids quantities were taken from estimates published in regard to operation of the WCF. Quantities of biosolids produced at the Lillooet WWTP were provided by the District of Lillooet; and
- Leaf and yard waste quantities were estimated from waste audit findings and information provided by the SLRD.

The quality of information to describe existing and projected material quantities is variable and is discussed in later sections of this report.

4.2 Waste Audit Methodology

In order to estimate the quantities of potentially compostable organic materials in the garbage stream, the study implemented waste audits to provide a snapshot of waste composition for the various regions and facilities (*i.e.*, percentages of each type of waste). In each audit, waste was broken down into six categories and included:

- Food – BCKYD (backyard compostable);
- Food – Non BCKYD (non-backyard compostable);
- Yard waste;
- Non-food organics;
- Recyclables; and
- Residual waste.

The aim of the waste audits was to determine the percentage of food scraps and other compostable materials coming from the following sources from each regional area:

- Curbside garbage collection programs;
- Collections from commercial sources in Whistler;
- Yard waste and food scraps collection bins at Whistler/Squamish depot sites; and
- Transfer stations.

Dillon utilized the principles of three key reference methodologies to develop a sorting approach that was relevant to the context of this assignment, namely:

1. PWGSC RPS National 5 Phase Solid Waste Management Protocol (June 2002).
2. CCME Recommended Waste Characterization Methodology for Direct Waste Analysis Studies in Canada (April 1999).
3. ASTM Standard Test Method for Determination of the Composition of Unprocessed Municipal Solid Waste (ASTM D5231 – 92).

In the case of characterization programs completed in British Columbia, the Province's 1991 document *Procedural Manual for Municipal Solid Waste Composition Analysis* is routinely referenced. Dillon targeted the three primary sort categories: organics, recyclables, and residual waste. Organics were sorted into four subcategories: food scraps (backyard compostable and non-backyard compostable), yard waste, and non-food organics such as compostable paper. As the identification of other materials within the waste stream can assist in future diversion plans, recyclables were sorted into one category based on materials that are acceptable for drop-off at the SLRD's recycling depots which includes mixed paper, cardboard, metals, glass, and plastics 1, 2, 3, 4, & 5. Dillon prepared notes and took photographs during the waste sort and documented wastes in the respective "residual" category.

Sorting procedures were based on a standard field procedure using suggested minimum individual samples sizes from ASTM 1992 and CCME 1999. The field procedure included the use of dedicated, labelled sorting containers and scales. Food scraps were sorted into two types: the scraps that are suitable for backyard composting (*e.g.*, vegetable peels), and those that are not (*e.g.*, meat). Recyclables were sorted into one single category to calculate the amount of recyclables that are being disposed. These data may assist SLRD in future diversion initiatives. Field staff also recorded a list of "common contaminants" that could be used to target future educational programs.

Five days were dedicated to sorting of waste, for a "snapshot" of the composition throughout the SLRD. This was planned to include a dedicated day at the following locations:

- Lillooet Landfill (Electoral Area A residential and commercial waste);
- Lillooet Landfill (Electoral Area B residential and commercial waste);
- Squamish Landfill (Electoral Area D residential and commercial waste), including a look into the food scraps collection at the drop-off depot;
- Whistler Transfer Station, including a look into the food scraps collection at the drop off depot; and
- Pemberton Industrial Park Transfer Station (Electoral Area C residential and commercial waste), Audits of Pemberton loads were scheduled to occur in conjunction with the Squamish landfill audits, however, issues prevented waste from being delivered for sorting. In the absence of that information Dillon has relied on estimates drawn from the other audits which are anticipated to reflect the same general waste compositions given the similarities of the development type and populations across the SLRD region.

The garbage flows from each area and their respective ultimate disposal locations is shown in **Figure 4-1**.

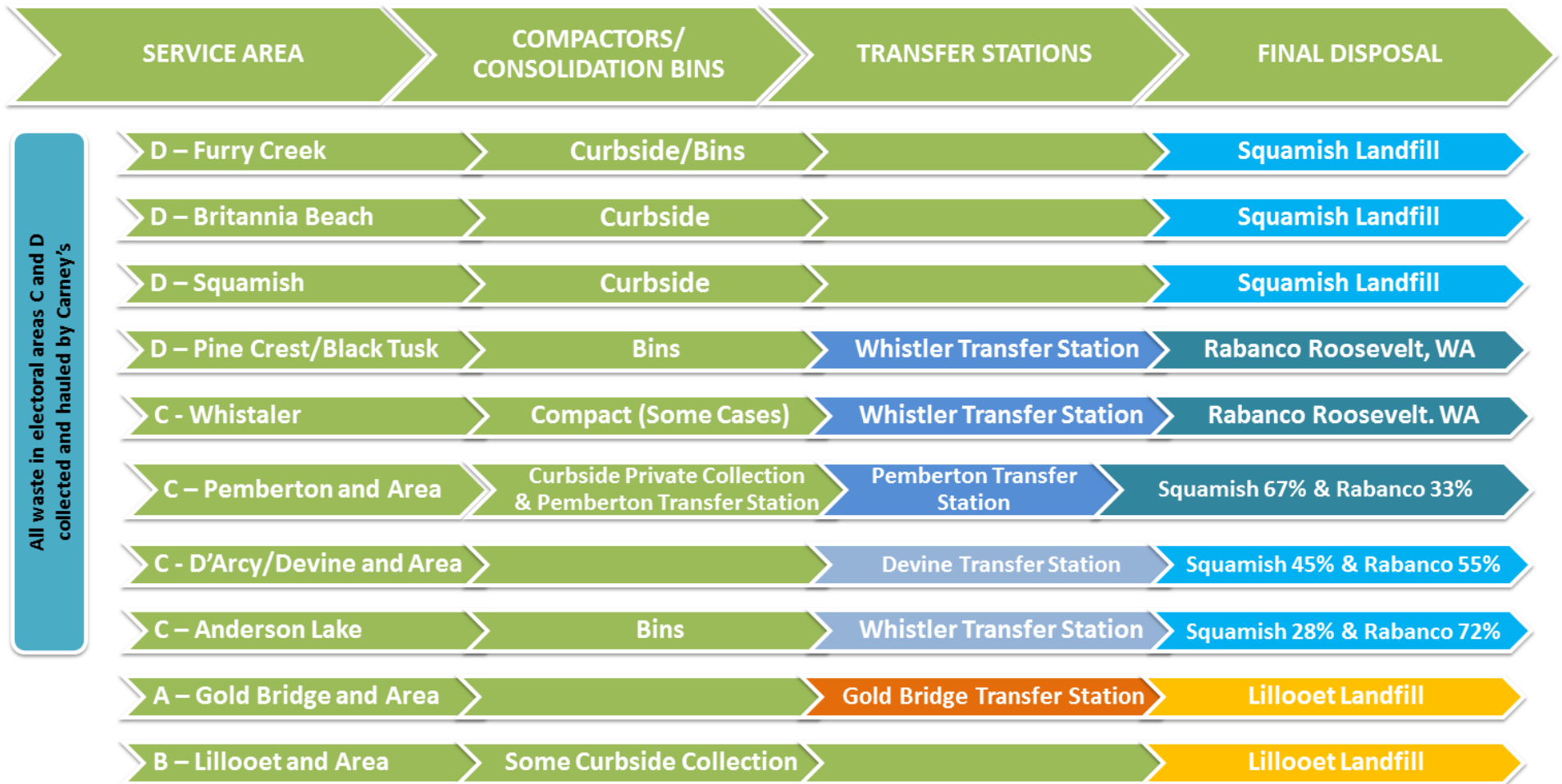
Dillon targeted randomly selected loads of garbage and recycling generated from both residential and commercial sectors across the geographic areas. This included waste from single family and multi-family residences, and the IC&I sector. It should be noted that a one-week sort cannot be considered to fully represent all variations in a waste stream. Nonetheless, the sort was completed in a manner consistent with other previous sorts in the SLRD and the

wider province, and provides information consistent with the overall scope of the project and the intended use of the data.

4.3 Calculation of Food Waste Quantities

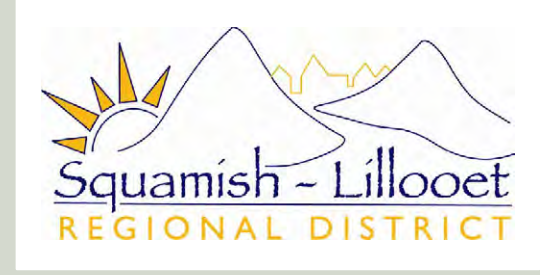
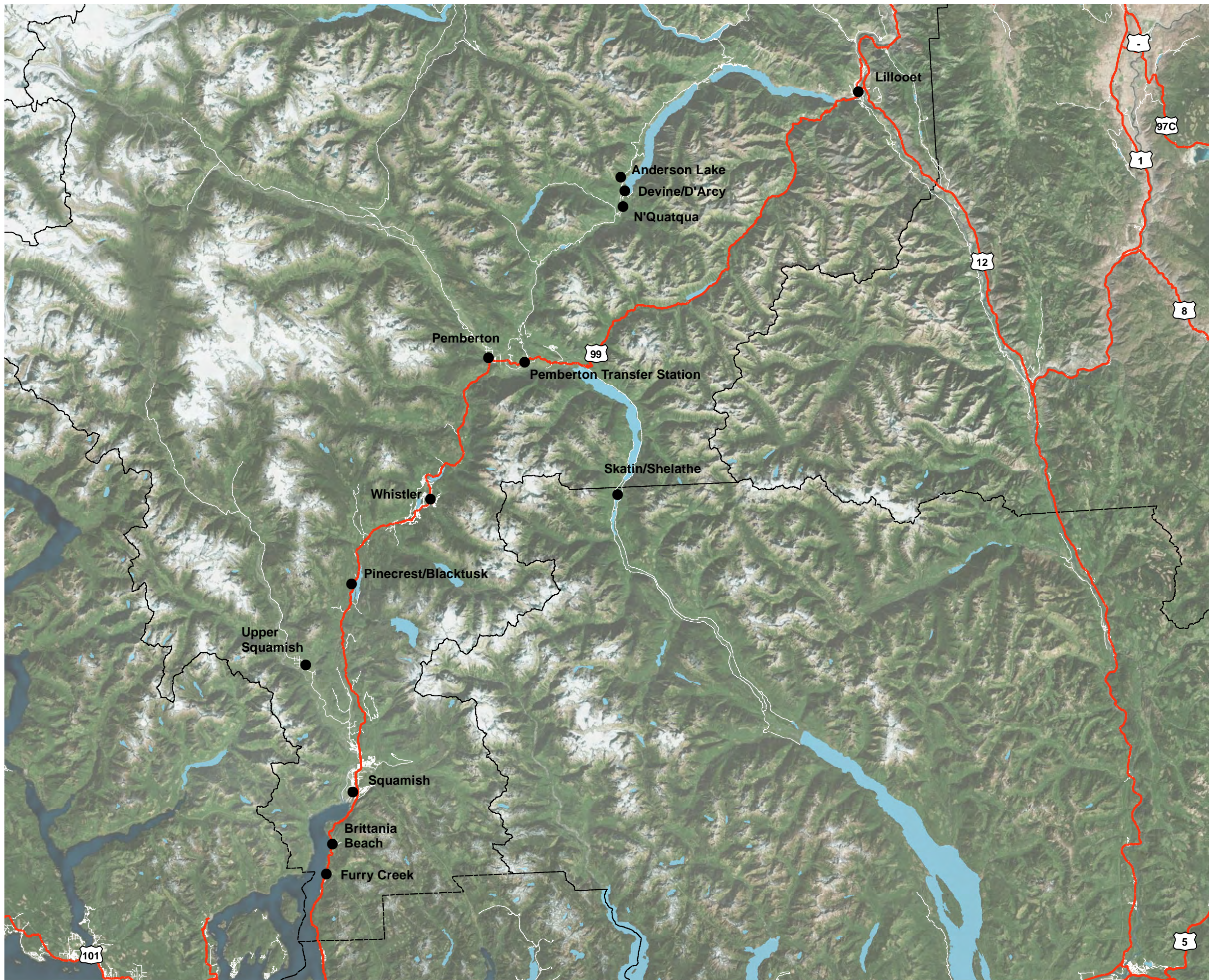
Figure 4-2 shows the locations of the waste receiving facilities. **Appendix C** provides the original data collected during the waste audits and site photos. Based on the waste composition data, the volumes of organic waste generated (tonnes) by each community are presented in **Appendix D** as Tables 1 through 6 and summarized in Figures 1 through 4 (shown in relation to collection area). Note that these numbers are assumed to be representative of the 2011 calendar year and only reflect volumes of waste intended for landfill.

Figure 4-1 Summary of Garbage Flow by Collection Area and Disposal Location



Notes:

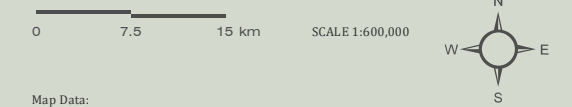
- The Squamish Landfill and Whistler Transfer Station are both operated by Carney's
- The Whistler Compost Facility (WCF) is located on site at the Whistler Transfer Station
- Based on Carney's Waste Tracking Report 2008-2011



Squamish - Lillooet Regional District
Regional Composting Feasibility Study Waste Audit

Location of Waste Receiving Facilities
Figure 4-2

- Waste Sources
- Highways
- Roads
- ▭ Regional District Boundaries
- Lakes



Map Data:
Aerial based on Bing Maps Hybrid.
Waste Data created by Dillon Consulting

Map Created By: Eric Hertzman
Map Checked By: Clement Lam
Map Projection: BCAlbers



Project: 12-6216
DATE: 7/17/2013

The estimated total quantities of food waste that could be re-directed from waste currently disposed to landfill, as shown in **Appendix D**, is summarized in **Table 4-1**. If recommendations for optimization of WCF operations are implemented, it is anticipated that the WCF would be operated to maximize processing of biosolids. During the four winter months when biosolids production is at its peak, food waste composting capacity would be reduced at the Whistler Compost facility. As a result, an additional 841 tonnes of food waste per year would become available in the four winter months for potential processing via an alternative facility, such as Sea to Sky Soils.

By totalling the estimated annual quantities of organic waste in all of the municipalities in the SLRD, there is the theoretical potential to divert an additional 11800 tonnes of organic waste from disposal per year. However, it should be recognized that such levels of diversion would require a significant level of effort in public education and stringent enforcement (including materials bans and active ticketing for infringement) to quickly approach diversion beyond 50% of the potentially compostable materials (*i.e.*, approximately 25% of the total waste stream). See Section 4.6 which includes a projection of material recoverability.

The options are described by considering centralized management of organics in three areas. Available quantities in each area are aggregated based on the community total calculated in **Appendix D**. For the purposes of these calculations, the “areas” and projected quantities of organics currently disposed with garbage shown in **Table 4-1** below; see **Appendix D** for detailed breakdown.

Table 4-1 Estimate of Total Organics Disposed to Garbage in 2011

Whistler Area		Squamish Area		North Area	
Whistler	4637.95	Squamish	5863.63	Lillooet	104.17
Pemberton	580.34	Upper Squamish	13.37	Goldbridge	35.3
Pemberton Transfer Station	258.4	Pinecrest/Blacktusk	39.2	N'Quatqua	20.1
		Skatin/Shelath	14.16	Devine/Darcy	56.27
		Britannia Beach	121.11	Anderson Lake	5.7
		Furry Creek	66.87		
Totals	5476.74		6118.46		221.54
Approximate Total/Area	5500		6100		200

The two identified scenarios for organics quantities under each option are summarized in **Table 4-2**.

Table 4-2 Estimated Total Organics Quantities in 2011 Over and Above that Processed at WCF

Scenario	Whistler Area (tonnes/year)	Squamish Area (tonnes/year)	North Area (tonnes/year)
Scenario 1 – WCF Optimization	840	0	0
Scenario 2 – “Maximum Potential”	840+5500	6100	200

4.4 Calculation of Biosolids Quantities

The only municipal wastewater treatment plant not directing biosolids to the WCF is the plant in Lillooet, which is understood to generate approximately 200 tonnes per year.

For the purposes of this study, it has been assumed that the RMOW will continue to operate the WCF and that it will continue to process biosolids from the SLRD and Whistler. For significant periods of the year the WCF operates at capacity. In 2011 the WCF received 5069 tonnes of biosolids and processed 3658 tonnes. A quantity of the unprocessed material (approximately 1410 tonnes) was transported to the Rabanco (US) landfill for disposal. If the proposed optimization measures for WCF operations are implemented, that quantity of biosolids will be partially replaced by an unprocessed quantity of food waste (840 tonnes). A quantity of unprocessed biosolids (1410-840 = 570 tonnes) will still potentially be directed to landfill.

For the two identified scenarios, biosolids quantities are summarized in **Table 4-3**.

Table 4-3 Estimated Total Biosolids Quantities in 2011 Over and Above that Processed at WCF

Scenario	District of Lillooet (tonnes/year)	All Other SLRD Municipalities (tonnes/year)
Scenario 1 – WCF Optimization	0	570
Scenario 2 – “Maximum Potential”	200	570

4.5 Calculation of Leaf and Yard Quantities

For the purposes of this study, estimates of leaf and yard waste have been made based on annual tonnage disposal information provided by the SLRD, DOS & RMOW. In 2011, the WCF used 7993 tonnes of “brown” materials, of which 1020 tonnes derived from RMOW (combination of municipal departments and commercial landscapers) and 882 tonnes were derived from the Squamish area. In addition, the WCF accepted 1732 tonnes of “Land Clearing Waste” from private sources, and purchased an additional 4460 tonnes of wood chips and “dimensional lumber” (to be chipped).

The SLRD annually accepts approximately 1000 m³ of vegetation at the Lillooet landfill (equivalent to an estimated 350 tonnes/year) which is currently burned.

Review of **Appendix D** also indicates that small percentages of “yard waste” are being disposed via the garbage waste stream, but were segregated via the audit. These quantities of leaf and yard waste within the garbage stream amount to a further estimated 771 tonnes/year disposed to landfill via Squamish (12%), 94 tonne/year via the Whistler Depots (5%) and approximately 30 tonnes/year via Lillooet (2-9%) and Goldbridge (4%).

For the two identified scenarios, total collected leaf & yard waste quantities over and above the quantities currently used at WCF are therefore summarized in **Table 4-4**.

Table 4-4 Estimated Total Leaf & Yard Waste Quantities in 2011 Over and Above that Processed at the WCF

Scenario	Whistler Area (tonnes/year)	Squamish Area (tonnes/year)	Lillooet & Goldbridge (tonnes/year)
Scenario 1 – WCF Optimization	0	0	0
Scenario 2 – “Maximum Potential”	90	770	350+30

4.6 Estimation of Recoverable Quantities of Organic Materials

With the exception of materials deposited at Lillooet (350 tonnes/year) and those materials currently being disposed with garbage (770+90+30 tonnes/year) it is inferred that a significant proportion of the region’s municipally generated “brown” waste is already being transferred to the WCF and is actively composted. The availability of alternative sources of “brown” waste to support additional composting operations in the SLRD has not been reviewed. However it is noted that sources such as materials derived from land clearing may diminish as the RMOW approaches OCP build-out, and planned near-term developments in Squamish tend to focus on brownfield redevelopment. If the SLRD moves forward with additional composting initiatives it may consider reviewing alternative sources of brown materials potential available via the forestry industry such as wastes from dry land sorts. Estimation of Recoverable Quantities of Organic Materials

It is not reasonable to expect that the total estimated quantities of organic materials identified via the waste audits can be collected and diverted for composting, particularly in the early stages of waste segregation program development. **Table 4-5** provides a suggested estimate of recoverable organics based on the circumstances of generation of each waste stream in each general area, and Dillon’s experience of the success of organics diversion programs elsewhere.

In particular these estimates assume the following:

- That programs in the ICI and residential sectors (*e.g.* source-separated curbside organics collection) are implemented in DOS and achieve diversion of 50% of the 50% total organics content of waste currently disposed to landfill, as estimated in **Appendix D**, and that RMOW residential collection via the Whistler Depots adopts segregated organics collection and achieves diversion of 50% of the 39% total organics content of waste currently disposed to landfill, as estimated in **Appendix D**;
- That the organic (food waste) collection operated by Carney’s in RMOW continues to generate the equivalent quantity of materials which is already 100% recovered. If the number of commercial organisations using Carney’s service increases then quantities may increase; and
- That “biosolids” are considered to be 100% recoverable and are equivalently amenable to being composted.

It should be recognized that the capacity of any public program to divert 50% of the organic content of the existing garbage stream will require an aggressive program of public engagement and support by the municipalities. To illustrate, the District of North Vancouver introduced a program of source-separated curbside organics collection in 2008 with the ongoing support of the North Shore Recycling Program. In 2011, the program was still only

considered to have consistent involvement of less than 20% of the single family homes serviced. It is the required combination of achieving high participation and high quality of participation that makes achieving the 50% target a significant undertaking.

Table 4-5 Estimate of Recoverable Material Quantities

	Squamish Area			Whistler Area			North Area		
	Estimated Total	Estimated Recoverable		Estimated Total	Estimated Recoverable		Estimated Total	Estimated Recoverable	
	tonnes	%	tonnes	tonnes	%	tonnes	tonnes	%	tonnes
Leaf & Yard	770	70	540	90	70	65	380	100	380
Food & Non-Food	6100	50	3050***	6340*	50	3590*	200	50	100
Biosolids	285**	100	285	285**	100	285	200	100	200
Total	7156		3875	6715		3940	770		680

*Assumes 840 tonnes of food waste would be 100% available if Whistler Optimization options are implemented (5500+840)

**Assumes a 50/50 split of 570 tonnes total biosolids between Squamish Area and Whistler Area

***Approximately 425 tonnes is the estimated recoverable for Pemberton (50% of 838 tonnes), see Appendix C "Total Organics" Pemberton and Pemberton Transfer Station

For compost processing purposes, it is necessary to balance the food waste available with a requisite amount of brown, woody waste in the form of either leaf & yard waste or shredded wood in order to control moisture and create a carbon:nitrogen balance conducive to effective composting. This implies that some of the leaf and yard waste from the north area is not required in the north and the lack of leaf & yard waste in the south requires additional woody waste in the Squamish and Whistler areas. To avoid the processing of excessive leaf & yard/wood waste in the north, it has been assumed for estimation purposes that only 100 tonnes/year would be utilized with the remainder available for the compost facilities to the south. In addition, all biosolids are assumed to be processed through the existing compost facility in Whistler, or disposed to landfill at Rabanco WA. **Table 4-6** outlines the projected feedstock quantities that might potentially be available for composting purposes. These quantity projections are then applied in the subsequent economic evaluations.

Table 4-6 Estimate of Recoverable Material Quantities Not Including Biosolids (tonnes)

Scenario	Squamish Area	Whistler Area	North Area
Leaf & Yard/ Wood Waste	540	65	380*
Food & Non-Food	3050	3590	100
Total	3590	3655	480

*Note: Because of the complexities of collection/treatment in the "North Area", the following economic evaluation only considers treatment of 150 tonnes, with balance potentially available for the Squamish and Whistler areas.

5 Collection & Transportation of Organic Waste

The following subsections describe the methodology to the calculations for collection costs of additional organics recovery and transportation costs for identified scenarios.

5.1 Estimates of Collection Costs for Additional Organics Recovery

Curbside Collection in the Squamish Area

Presently, collection of SSO in the region consists of backyard composting and the general public hauling their yard trimmings or organics to one of the facilities in the Whistler, Squamish or Lillooet areas. As the Squamish area generates potentially the largest volumes of organic material, the curbside collection of SSO may be the first opportunity to be considered. This would provide a year-round supply of organic material that could be diverted from the landfills, producing a product that could be—depending on its quality—a resource for the public or for commercial ventures.

In a typical curbside collection program, households are provided with a “kitchen-catcher” in the home and a “green-bin” to place at the curb for bi-weekly or weekly collection. The collection vehicle then, depending on the distance, will transfer the SSO to an organic transfer station or directly to the compost facility. As the capture rate in SSO programs is typically less than 100%, organic material would still be present in the remaining waste stream. Thus, regular waste collection would still be required and would have to be disposed of in a permitted municipal solid waste landfill.

The initial expenses for the collection include the purchase of the home collection bins, a public education program and a new collection contract. Ongoing expenses include replacement of bins, public education program, and administration.

An opinion of the budget to collect curbside SSO is based on the following:

- In 2009, Squamish Council investigated the cost to collect mixed food and yard waste year-round for an initial budget of approximately \$440,000;
- As outlined in **Table 4-5** there is an estimated recoverable of 3590 tonnes of leaf & yard and food waste available in the Squamish Area;
- Assuming an annual inflation rate of 2.1% as determined by the B.C. Ministry of Finance, the future value of the \$440,000 would be approximately \$468,000 by 2012; and
- With an opinion of the budget for curbside collection of SSO being (\$468,000/3590) for \$130.29/tonne. Additional costs would include bin purchase, public education and administration.

Collection in the Whistler and Lillooet Areas

The Lillooet area, given the population density, the available organic tonnages, and the physical expanse of the area would not be a candidate for curbside collection of SSO. Similarly Dillon understands that RMOW would not consider curbside collection for reasons specific to the demographic and land-use characteristics of the community, and also the potential to promote wildlife concerns. While curbside collection of SSO may not be practical in the Whistler and Lillooet areas, composting options currently exist for public drop-off at the transfer stations at Whistler (Nesters and Function Junction) and the Lillooet Landfill,

In order to estimate potential collection and transportation costs associated with segregated organic waste, Dillon has made some assumptions about potential working methods and costs. These assumptions are not necessarily the optimum approach, but have been applied consistently as a means of calculating comparative estimates.

For example, establishing a wood waste transfer station at the Lillooet Landfill could utilize existing staff to monitor and handle the facility. Such a facility would require an additional estimated six 5-tonne bins per month. The bins could be placed on a concrete pad sized to accommodate two bins (one operational, one delivered). A private haulage company could be engaged to transfer the organic material to the proposed compost facility. Assuming a rental budget of \$150 per bin and a transfer budget of \$150/hour travel time (approximately 3 hours one way to Squamish) the estimated budget to provide collection and to transfer a tonne of organics would be approximately \$180/tonne. Several similar calculations have been undertaken as an estimate of potential collection, travel and transfer costs associated with each of the scenarios evaluated.

The projected annual generation rate of recoverable organic material in the Whistler area is approximately 3655 tonnes. This tonnage would require a dedicated staff member and approximately ten 1-tonne bins to handle the project organic material. The bins could be placed on a concrete pad sized to accommodate three bins (two operational, one delivered). A private haulage company could be engaged to transfer the organic material to the proposed compost facility in Squamish. Assuming an annual staff budget of \$50,000 (including disbursements), a rental budget of \$225 per bin and a transfer budget of \$150/hour travel time (approximately 1.0 hours one way to Squamish) the estimated budget to provide collection and to transfer a tonne of organics would be approximately \$66.18/tonne.

5.2 Estimates of Transportation Costs for Identified Scenarios

For the purpose of this study, the transfer of the organic material was based on the following assumptions:

- The center of generation for each of the municipal units in the study was approximated from populated places central point placing;
- Locations of the existing transfer stations and landfills are based on approximations from sources including geocoding, aerial surveying, and populated places central point placing;
- Travel times were approximated based on road network length, travel speeds, road classes, and one-way restrictions;
- Travel times do not reflect seasonal variations in accessibility due to snow fall, wet weather, or other weather events;
- Travel times do not reflect changes in elevation;
- Travel times assume vehicles are travelling at the speed limit in all situations;
- Travel distances were determined by using ArcGIS and the Network Analyst extension;
- Road data from ArcGIS base layers, and GeoBC road network datasets modified based on missing data; and
- Trucking costs were obtained on a tonne/km basis from Section 4.7 of the Cost-Benefit Study – Whistler Composting Operations (Draft), prepared by Conestoga-Rovers & Associates (CRA) in December 2012.

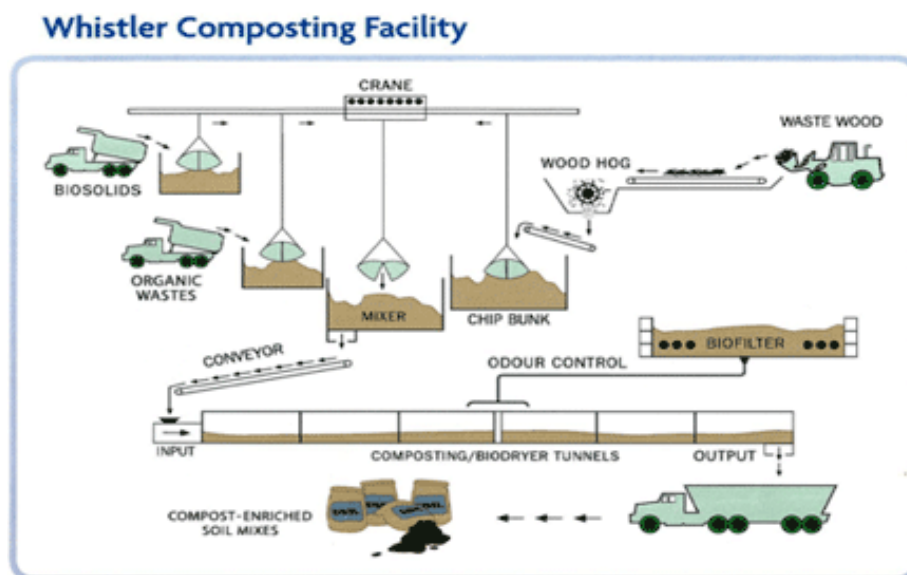
The estimated trucking cost for a municipal unit was then determined by multiplying their annual organic tonnage by the tonne/km cost and by the distance from their center of generation to the proposed compost facility. See **Appendix D** for an illustration of “short access” corridors applied.

6 Composting Organic Waste

6.1 Understanding WCF Compost Operations & Potential Future Amendments

The WCF is located at the Whistler Transfer Station in the Callaghan Valley, approximately 15 km south of Whistler and currently processes food waste and biosolids received from the RMOW, DOS, VOP and the SLRD. Compost production occurs in three stages. In the first stage, organic materials are processed via two fully enclosed flow-through tunnels to transform organic wastes into a fine soil-like material over a 14-day period. In the second stage, the compost produced from the WCF is trucked approximately 38 km to Squamish for curing at “Lot 22” leased by Carney’s. In the third stage, large over-sized residual wood pieces are screened from the curing process (overs) and are trucked back to the WCF for reprocessing (Conestoga-Rovers & Associates, 2012). The screened product is then blended with the resulting soil mixes trucked to Squamish and the Whistler Transfer Station for sale. Purchasers use the soil for gardening and landscaping purposes. Carney’s currently manages all operations. **Figure 6-1** summarizes the flow of organics through the WCF.

Figure 6-1 Whistler Composting Facility Flow of Organics



Currently, Carney’s is responsible for the composting of commercial and residential organic wastes at the WCF, and the sale of the resulting organic soil products to residential and commercial customers (Carney’s, 2012). Clean wood waste is accepted and occasionally purchased (kiln dried sawdust) at the WCF for use as a composting amendment to optimize the process (Conestoga-Rovers & Associates, 2012).

Historically, WCF biosolids processing capacity has been exceeded during the winter tourist season (October to March), when biosolids production is at its peak while the supply of dry wood fibre is at its lowest. When capacity is reached, excess biosolids are exported for disposal at the Rabanco Landfill in southern Washington State (Conestoga-Rovers & Associates, 2012). **Table 6-1** summarizes quantities processed at the WCF (SLRD RFP, 2012).

Table 6-1 Overview of Quantities Processed at the WCF

Feedstock	2009 Tonnage	2010 Tonnage	2011 Tonnage (CRA, 2012)
Processed Food Waste	1252	1371	1082
Processed Biosolids	3746	3521	3658
Wood Fibre Used	5385	7553	8268
Total Processed	10383	12445	13008

Note: For approximately 5 months of the year the WCF operates at capacity and must divert some material for disposal. In 2011, the WCF received 5069 tonnes of biosolids and processed 3658 tonnes. A quantity of the unprocessed material (1411 tonnes) was transported to the Rabanco (US) landfill for disposal.

As part of this study, Dillon attended a site visit to the WCF operations on June 6, 2012. Hosted by Patrick Mulholland of Carney’s Waste Systems, the visit included the compost facility at Whistler and the curing site at Lot 22. The visit to the compost operations in Whistler and Squamish provided a first-hand account of the manner in which three organic waste feedstocks—biosolids (15–25% solids), food waste, and shredded wood waste—are managed. The three feedstocks are compartmentalized in concrete bunkers from which an overhead grapple collects desired quantities of the three constituents as per the operator’s intended recipe.

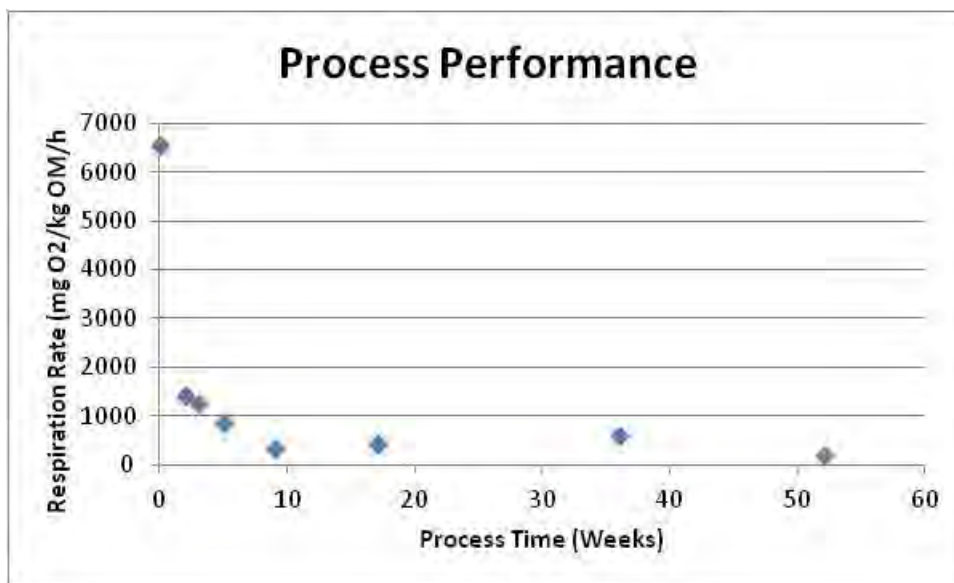
Maintaining the organic wastes in separate cells and metering the three constituents prior to mixing provides for complete control of the feedstock, a feature which is unavailable in most facilities. The three constituents are then blended in a hopper (2200 lb biosolids:800 lb food waste:4000–5000 lb wood waste) and fed to one of two proprietary tunnels designed by Wright Environmental Management Inc. The organic waste sits in trays on screened frames that are advanced through the length of the tunnel hydraulically. Air is introduced through the screens with the material agitated one-half on the way through the tunnel with three rotating shafts positioned vertically across the width of the tunnel.

After 14 days, the material has been advanced through the tunnel and is discharged with the assistance of three more rotating shafts positioned vertically across the width of the back-end of the tunnel. Once the material has been discharged, it is stored adjacent to the tunnels for approximately one week until sufficient material has been produced to move it to Lot 22 near Squamish. Once at Squamish, the material is maintained in un-aerated windrows for a number of months until it is screened at which time it is stored in large piles for up to one year before its release and subsequent sale as a topsoil blend.

Compost samples at various stages of the existing process at Whistler and Squamish were obtained to assess their relative state of decomposition (maturity) and assess process performance. Dillon recommends that such assessment is made in terms of respiration rate which is a measurement of the rate of oxygen consumption by the microbes in any given sample throughout the process—the higher the rate of respiration, the more easily consumable the remaining organics, and hence the less mature the sample. Fresh feedstock typically has a high respiration rate that declines over time as the food is consumed; the better the process, the faster the decline in respiration rate. National guidelines recommend a respiration rate below 400 mg oxygen/kg organic matter/h in order to be deemed mature. Current maturity requirements in British Columbia (originally introduced in Table 3-2 and categorized as “Vector Attraction Reduction” within the OMRR), do not include respiration as a criteria for maturity.

Respiration rates from the WCF process are summarized in **Figure 6-2** and indicate a rapid reduction in respiration rate over the 2-week period within the Wright tunnel and an eventual respiration rate below the recommended threshold of 400 mg oxygen/kg organic matter/h. Dillon infers that the effective reduction in respiration rate (implying rapid stabilization) may be due to the fine grained nature of the biosolids which are more amenable to quicker decomposition because of their high relative surface area to mass. In addition, the predominant feedstock (biosolids) is mixed with an uncommonly high (but appropriate) amount of wood waste which provides superior structure (porosity and permeability) for air circulation. If the facility was to consider processing a greater amount of food waste it is unlikely that it would enjoy the same process performance, as food waste would have a higher demand for oxygen that would be distributed over a longer period of time due to the system's lack of substantial agitation. In Dillon's assessment the WCF works effectively in processing biosolids to produce a mature product. That assessment is consistent with the RMOW's consideration that the existing system continues to process biosolids and, as opportunities arise, consider the diversion of food waste to an alternative process which would free up more capacity for biosolids.

Figure 6-2 Process Performance: Respiration Rates from Samples Collected at Various Process Stages of the WCF



The tunnel system is equipped with six temperature probes which registered a range between 60 and 80°C, which is higher than the typical operational temperatures of most systems. The high temperatures are again due in part to the presence of the biosolids which, because of their fine constituency, are more volatile than typical food waste and immediately respond when introduced into the tunnel. It may be that performance could be optimized further by adjusting the tunnel operating temperature to cool the composting mass below the 65°C threshold which would further accelerate the rate of decomposition and reduce the time required to produce a mature product in Squamish. In an attempt to determine if the higher temperatures had an inhibitory impact, the microbial population was measured in samples collected from the feedstock, from the Wright product pile awaiting relocation to Squamish, and from a windrow at Lot 22 after 17 weeks of processing.

The results of **Table 6-2** indicate low microbial counts in most samples, particularly those out of the Wright tunnel; feedstocks will typically be low as the microbial population is yet to be established, however the microbial count in the composted product at various stages of decomposition (particularly during the active stage of decomposition) would typically be higher than those recorded. It may be that due to the relatively high operating temperatures

within the Wright tunnels; there may be some opportunity to further optimize microbial activity by reducing the operating temperature to 55°C, the temperature required for pathogen control.

Table 6-2 Microbial Populations (Colony Forming Units/mL) in Compost Samples

	Replicate #1	Replicate #2
Feedstock	<10 ⁷	<10 ⁷
Wright Product in Pile (3 weeks)	13 x 10 ⁷	16 x 10 ⁸
Squamish Windrow #3 (17 weeks)	5 x 10 ⁷	3 x 10 ⁹

Dillon also took spot measurements of temperatures and oxygen content in the piles and windrows after the material had been processed through the Wright tunnels. Based upon these preliminary spot-test sample results, the existing operations at Whistler and Squamish appear capable of managing the feedstocks delivered to them and produce a quality, matured product within a year. Biosolids (particularly stabilized biosolids), the predominant active constituent in the feedstock, by their nature can decompose very quickly given sufficient oxygen and therefore possess a capacity to reach maturity in a short period of time. A higher food waste component would probably be more challenging due to the greater degree of reactivity and its less refined consistency. Dillon infers that the key to the process's success is the quantity of wood waste added to provide the structure and oxygen access demanded by the biosolids. The presence of the wood waste in the static curing windrows in Squamish is also significant as it hastens the curing process through the provision of air through the relatively porous mass and should not be removed until the product is fully mature.

An operations Cost-Benefit study of the facility has recently been reviewed by RMOW (Conestoga Rovers & Associates, 2012). The recommendations of that study include:

- Amendment of tipping fees to reflect cost estimates as presented;
- Consideration of a Covered Wood Storage Area to manage moisture in wood fibre amendment;
- Construction of a Windrow Curing Area at the WCF site, *i.e.*, remove the requirement for transporting material back and forth to Lot 22 at Squamish; and
- Food Waste Diversion, *i.e.*, use the WCF capacity to focus on biosolids processing by directing food waste to a potential private composting facility (Sea to Sky Soils) at Pemberton. The principal benefit of this measure would be to reduce costs for transport and disposal of excess biosolids to Rabanco (US), during periods of peak generation when the WCF capacity is exceeded.

The potential implementation of these measures provides future circumstances that Dillon has considered as "Scenario 1" in its options evaluation below. The key opportunities which these circumstances present include:

- Potential for available space to undertake an additional composting opportunity at Lot 22, Squamish; and/or
- Potential for diversion of collected commercial sector food waste to a compost facility, which might then attract more materials for composting.

6.2 Composting Technologies Appropriate for SLRD Opportunities

Compost processes range from low-tech options (such as simple uncovered windrows), to high-tech in-vessel systems (with rotating drums and shafts). The matrix shown in **Figure 6-3** below illustrates the relationship between the types of compost technologies and the respective criteria.

Because low-tech operations have very little process control, their environmental liability is higher (greater potential for unacceptable leachate and odour generation) and consequently the feedstocks are limited to less dense, porous, drier, woody materials such as leaves and woody waste. The greater the constituency of wet, nitrogen-rich feedstocks such as food waste and biosolids, the greater the need for process control.

Although the capital cost of more sophisticated technologies increases with the degree of sophistication, the associated operating costs can vary widely and depend upon the degree of automation, how tightly the operating parameters are controlled, and how long the process is expected to take in order to produce a mature product. The choice of a composting process to suit a municipality's needs is based on a number of criteria including:

- Space & time available to produce a mature product;
- Feedstock tonnage and composition;
- Proximity to residents (odour control);
- The amount of natural rainfall;
- Security (animals, vectors);
- Product quality (weed seeds, nutritional content, organic content); and
- Regulatory constraints.

Once it is determined that food waste and/or biosolids are a significant constituent of the feedstock, some degree of moisture control becomes necessary, particularly in regions such as the SLRD where the natural rainfall is greater than 500 mm/year. The sophistication of the facility is then driven by the quantities of material to be processed and the regulations within OMRR. **Figures 6-4** and **6-5** describe generic compost facilities designed to illustrate typical requirements for development of a compost processing facility. The capital and operating costs of these facilities can be used as a basis to compare proprietary/commercial technologies once the region has determined an acceptable organic waste management strategy.

Figure 6-3 Relationship Between Compost Technology and Various Criteria

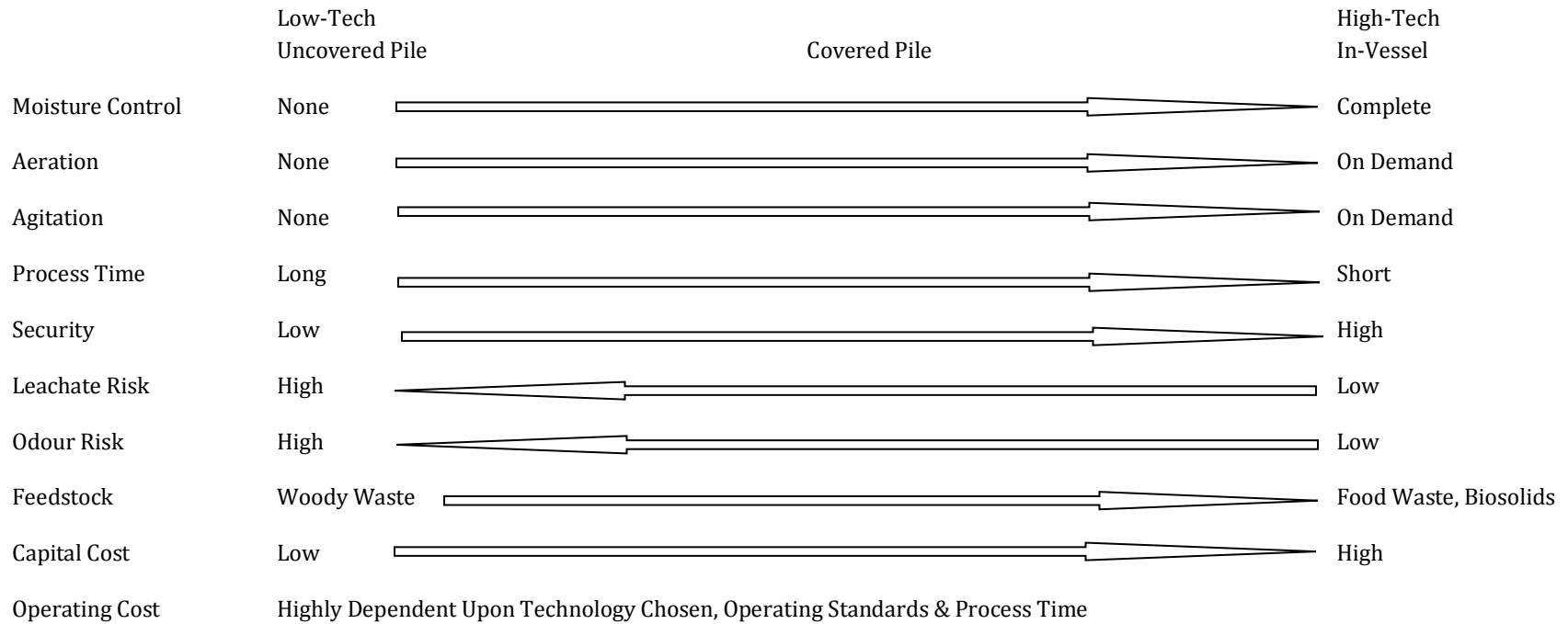


Figure 6-4 Advanced Basic Compost Facility Layout with Forced Aeration, Leachate Control and Biofilter Odour Management

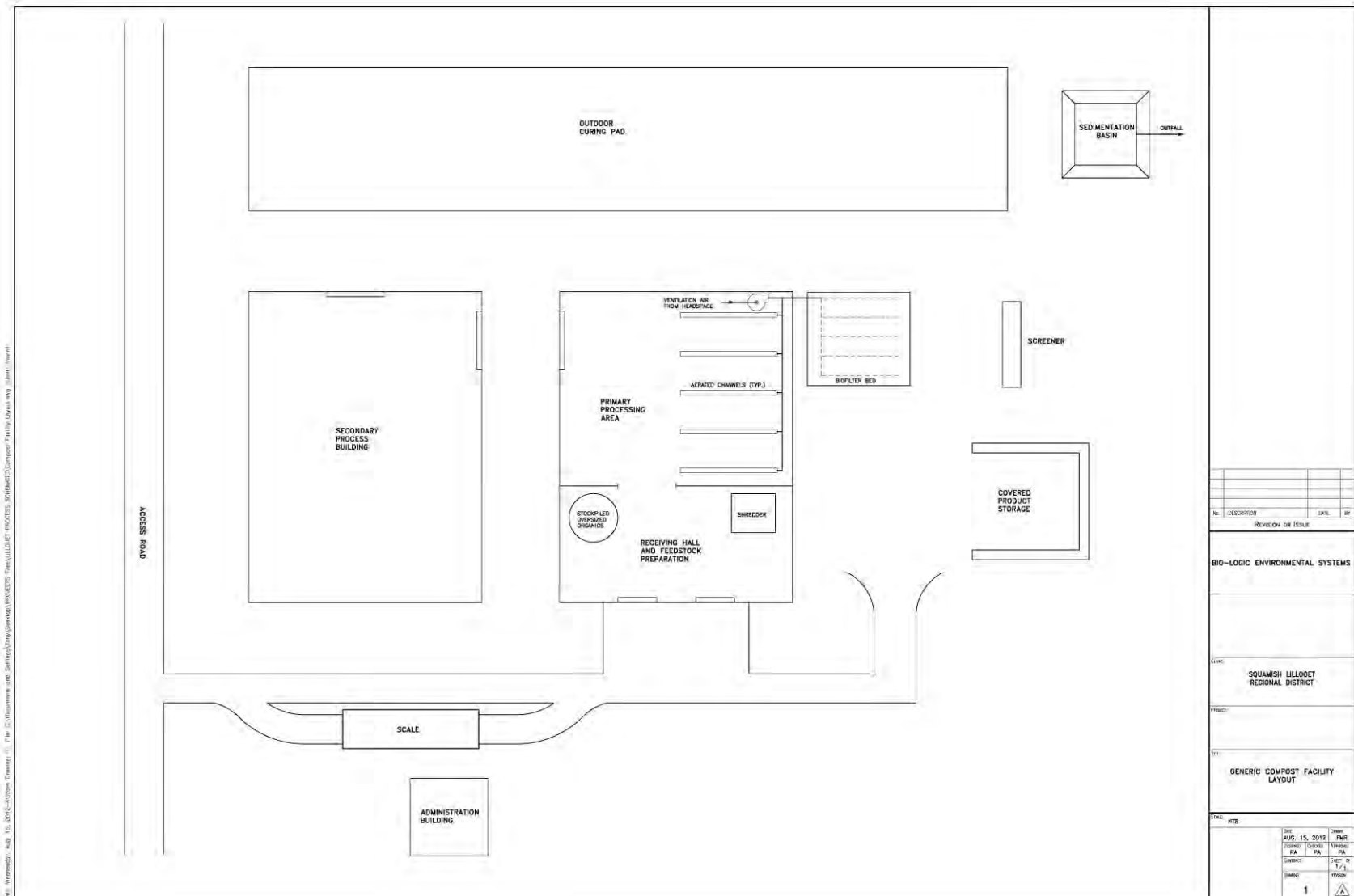
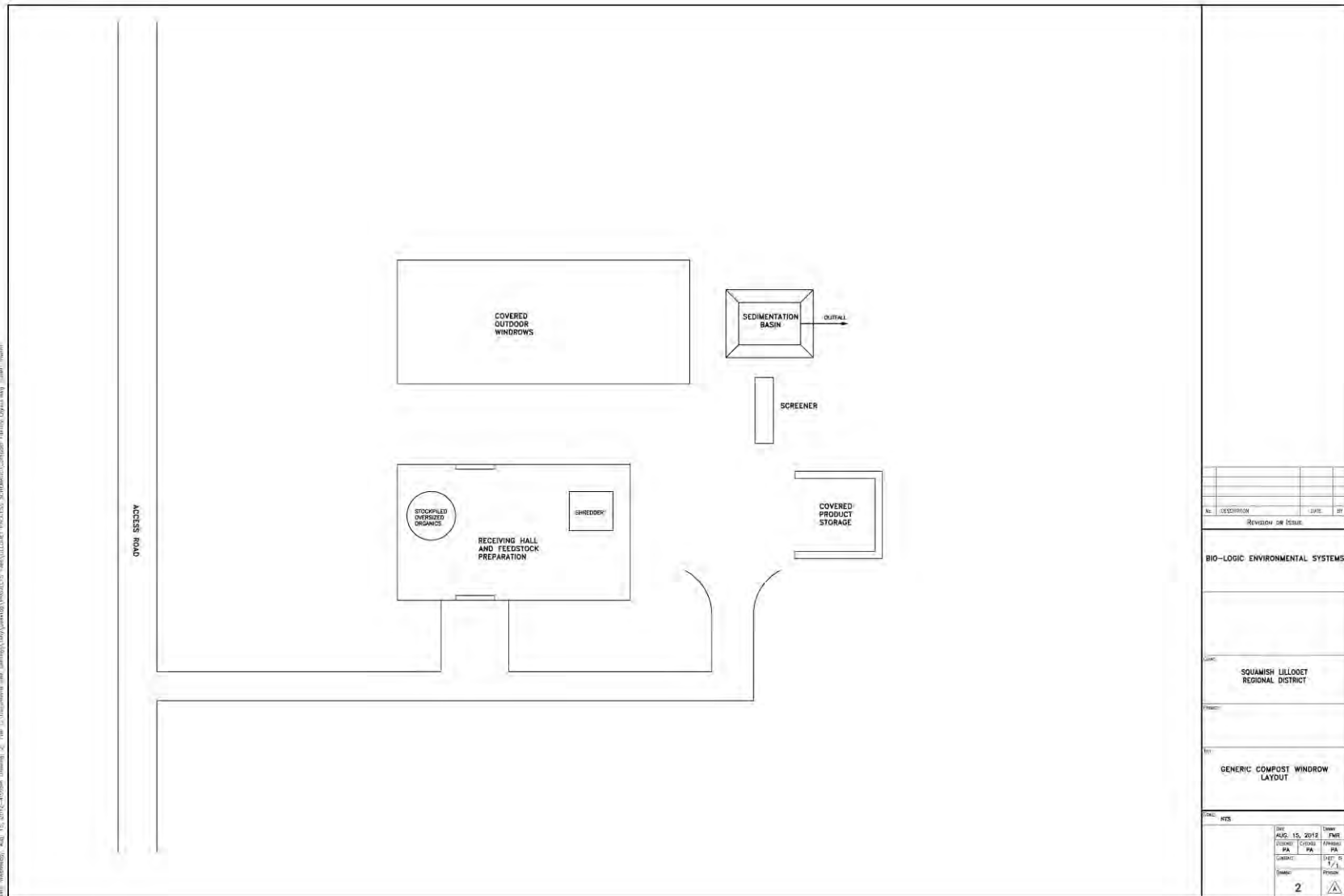


Figure 6-5 Basic Facility Layout for a Windrow Facility



Dillon has adopted the generic layouts presented as a basis for illustrating capital and operating costs for potential facilities outlined in the following optional strategies. These strategy options all consider that the WCF remains in operation and the potential facilities are considered as additional capacity:

- Option 1 – Local Compost Facilities serving local areas with facilities sited at the Squamish Area (Lot 22), Whistler/Pemberton Area (WCF and/or Sea to Sky Soils), and/or Lillooet Area (Lillooet Landfill). This option reflects the lowest transportation costs/GHG Emissions;
- Option 2 – Regional Facility Whistler - serving the whole of the region with facilities sited in the Whistler/Pemberton Area (WCF and/or Sea to Sky Soils); and
- Option 3 – Regional Facility Squamish - serving the whole of the region with a single facility sited in the Squamish Area (Lot 22).

The following section provides a “bottom up” evaluation of capital and operational processing costs associated with facilities such as those shown in **Figures 6-4** and **6-5**, located as per the Strategy Options described earlier. In developing this financial evaluation, it should be noted that there is a range of potential unit costs associated with each line item. The “bottom up” costing approach should therefore not be seen as a precise predictor of costs, but instead be used as a measure:

- To compare commercial options against;
- To provide the municipality with a base model that can be fine-tuned; and
- To compare the scale of relative differences between options costed under equivalent assumptions.

The assumptions adopted for each potential facility follow.

Administrative Building Details:

- Squamish & Whistler: 100 m²;
- Centralized facility: 150 m²; and
- Lillooet: none.

Receiving Hall Details:

- Squamish, Whistler and Centralized facility: capable of storing 1 weeks’ worth of feedstock, 2.25 m deep with actual size 50% greater than storage capacity; and
- Lillooet: 100 m².

Primary Processing Details:

- 15% reduction by volume and mass;
- 1 month retention time;
- Aerated bunker dimensions (4 m wide x 2 m deep x 15 m long);
- Primary process area 25% more than bunker area; and
- Not included for Lillooet.

Secondary Processing Details:

- 10% reduction by volume and mass;
- 3-month retention time;
- Non-aerated bunker dimensions (4 m wide x 2 m deep x 15 m long);
- Secondary process area 25% more than bunker area; and
- Not included for Lillooet.

Fan/Electrical Building Details:

- Whistler & Squamish: 100 m²; and
- Central facility: 150 m².

Asphalt Pad Details (excepting Lillooet):

- 11.5% reduction by volume and mass;
- 8-month retention time; and
- Trapezoidal windrows (4 m wide at bottom, 2 m wide at top, 3 m high, 25 m long).

Asphalt Pad Details (Lillooet):

- 33% reduction by volume and mass;
- 16-month retention time;
- Trapezoidal windrows (4 m wide at bottom, 2 m wide at top, 2.5 m high, 25 m long); and
- One extra windrow space added at each end for access.

Biofilter Details:

- Whistler & Squamish: 20,000 CFM delivered to aeration process, 70,000 CFM removed as ventilation, 50,000 CFM to biofilter;
- Central facility: 40,000 CFM delivered to aeration process, 140,000 CFM removed as ventilation, 100,000 CFM to biofilter;
- 45 second retention time;
- 3 feet deep; and
- No aeration for Lillooet.

Capital Amortization:

- Capital amortized over 12 years @ 4% compounded monthly.

Personnel Costs:

- \$50,000/year per facility (including staff salary benefits: health, insurance, pension).

The results of **Tables 6-3** and **6-4** indicate that the costs of managing organic waste can be prohibitively high, particularly on a small-scale, and a significant amount of the facility's costs are associated with managing the oversized materials that are returned to the front-end of the operation which are essential to maintain the composting mass in an unsaturated state. The evaluations are comprehensive and conservative in nature and include costs that could be avoided depending upon specific conditions. In using the evaluations as a comparative against private alternatives, it is crucial that the private alternatives be held to the same high standards as those embedded in the evaluations presented, including a realistic time-to-maturity, maintaining the composting mass in an unsaturated state during the primary and secondary stages, and eliminating environmental impacts. Such a comparison must include a thorough performance evaluation of any alternative since municipal units are always at least indirectly accountable for the manner in which its organic wastes are managed. Review of the cost breakdown tables below (**Tables 6-3** and **6-4**) provide an indication of the potential cost per tonne total feedstock that might be associated with development of potential municipally operated facilities at Lillooet, Squamish, Whistler or a centralized facility at either Squamish or Whistler. At an estimated cost of \$396/tonne for the smallest scale facility (Lillooet) it may be more appropriate to consider a community level system.

Subdividing the northern region into smaller stations that handle amounts below the OMRR trigger would require 20 stations similar in nature to the 4-bunker system shown in **Figure 6-6**, below. A full-time person tending to the bins and other issues such as animals, contamination, and sharing equipment would arise, but if sufficient community support were available it may be an alternative to a municipal scale operation. The three key requirements would be: the availability of "brown waste" (3:1 ratio relative to food waste), the ability to closely manage moisture (using some form of fabric or building cover); and, the opportunity to benefit from materials, equipment and staff that may already be present at existing sites such as the Lillooet Landfill.

Figure 6-6 Typical Community Compost Depot



The four bunker system includes: one bunker to store wood (chipped, clean), one to store yard waste and two to as the compost piles. Additional storage would also be required for curing, subject to performance and residence time achieved in the compost piles.

The SLRD would need to consider facilitating policy and by-law provisions including the following measures:

- Facilitate transportation of compost materials to the facility;
- Coordination of timing, receiving facilities and locations for food scrap drop-off;
- Communication and public education campaigns;
- Bylaw amendment to promote source separated food scraps;
- Market development for compost produced (*e.g.* local residents pick up); and
- Product management and control via facility gate/scale software systems.

In developing its Zero Waste Strategy, the SLRD may identify specific groups who might wish to support such an approach at an existing facility. The specific details of scale and basis of operation might then be considered in more detail.

Table 6-3 Estimations to Evaluate Capital and Operational Processing Costs for Municipal Compost Facilities

Parameter	Lillooet	Whistler	Squamish	Centralized Facility
Raw feedstock (tonnes/year)	150	3655	3590	7727
Additional bulking material required (tonnes/year)		1133	479	1265
Over-sized by-product returned to front end (tonnes/year)	75	2390	2033	4490
Total feedstock (tonnes/year)	225	7178	6104	13,482
Total feedstock (m ³ /year)	586	18,113	15,320	34,021
Product (tonnes/year)	75	2390	2033	4490
Product (m ³ /year)	125	3984	3388	7483
Primary process bunkers	N/A	12	10	22
Secondary process bunkers	N/A	31	26	58
Asphalt pad windrows	4	39	33	73
Site area (m ²)	1050	12,777	11,936	25,437

Table 6-4 Evaluation of Capital and Operational Processing Costs for Municipal Compost Facilities

Parameter	Rate	Lillooet	Whistler	Squamish	Centralized Facility
Capital Costs					
Engineering Services (10% of non-equipment capital)		38,000	317,845	283,905	585,267
Clear & Grub	\$2.50/m ²	2625	31,943	29,840	63,593
Gravel (18") & Roll Site	\$35/m ³	16,806	204,510	191,049	407,147
Administration Bldg	\$540/m ²	-	54,000	54,000	81,000
Receiving Hall	\$540/m ²	54,000	125,398	106,062	235,530
Primary Process Bldg	\$540/m ²	-	486,000	405,000	891,000
Secondary Process Bldg	\$500/m ²	-	1,162,500	975,000	2,175,000
Fan/Electrical Bldg	\$576/m ²	-	57,600	57,600	86,400
Asphalt Pad	\$60/m ²	36,000	234,000	198,000	438,000
Road, Yard Servicing, Drainage		25,000	100,000	100,000	200,000
Stormwater/Sedimentation Basin & Pond		15,000	25,000	25,000	40,000
Biofilter	\$2.75/CFM	-	137,500	137,500	275,000
Covered Product Storage Area	\$100/m ²	10,000	40,000	40,000	60,000
Mechanical-Air (stainless steel ducting, fans, controls)		-	300,000	300,000	500,000

Parameter	Rate	Lillooet	Whistler	Squamish	Centralized Facility
Mechanical-Liquids (pumps, piping, leachate collection, water supply, fuel storage)		20,000	80,000	80,000	150,000
Electrical (wiring, service, controls)		20,000	140,000	140,000	250,000
Shredder/Mixer		50,000	150,000	150,000	200,000
Loader		75,000	400,000	400,000	600,000
Screener		20,000	60,000	60,000	100,000
Scale		-	65,000	65,000	85,000
Subtotal Capital		416,431	4,171,296	3,797,956	6,437,937
Tax (5%)		20,822	208,564	189,898	321,897
Total Capital		437,253	4,379,861	3,987,854	6,759,834
Annualized Capital Cost		45,939	460,163	418,978	710,211
Operating Costs					
Personnel		25,000	150,000	150,000	250,000
Electricity		2000	120,000	120,000	200,000
Fuel		5000	80,000	80,000	140,000
Disbursements		10,000	60,000	60,000	100,000
Repairs & Replacement Account		5000	60,000	60,000	120,000
Bulker Purchases	\$25/tonne		28,325	11,975	31,625
Total Operating Costs		47,000	498,325	481,975	841,625
Compost Sales	\$50/tonne	3750	119,500	101,650	224,475
Annual Net Operating Costs Including Amortized Capital		89,189	838,988	799,303	1,327,361
\$/tonne raw feedstock		595	230	223	172
\$/tonne total feedstock (incl. overs & extra bulker)		396	113	131	98

Additional bulking material added to bring total of bulking material+recirculated over-sized material+leaf & yard/wood waste in raw feed equal to food waste in raw feed

% of what is composted is produced as over-sized by-product (by mass)	33%
% of over-sized by-product returned to front end for re-processing (by mass)	100
% of total feedstock process loss (by mass)	33%
% of total feedstock process loss (by volume)	33%
Density leaf & yard/wood waste (tonne/m ³)	0.35
Density food waste (tonne/m ³)	0.7
Density recycled over-sized by-product (tonne/m ³)	0.25
Density finished product (tonne/m ³)	0.60

Site area 50% greater than sum of administrative building, receiving hall, primary & secondary process buildings, asphalt pad, fan/electrical building, storage area and biofilter.

6.3 Backyard Composting (BYC) & Community Composting

While it is currently unknown how many households in the SLRD are backyard composting, a recent study by the North Shore Recycling Program reveals that households can divert 360 to 450 kg/year (range depends on program support or training from municipality). The NSRP promote backyard composting in the three North Shore municipalities as the most cost-effective and environmentally responsible way to manage the non-meat and dairy portion of SSO. Since 2007 the NSRP has sold compost bins at a subsidized price for North Shore residents, offered free compost coaching sessions and “how-to” videos on their website via a staff of 4 permanent employees. NSRP sells the Garden Gourmet bins that are made from 100% recycled HDPE and 60 cm x 60 cm x 28 cm (\$45). NSRP estimates that 50% of SF households have a backyard composter based on the number of backyard composters sold in the District of North Vancouver since 1991. A report by NSRP (May, 2011) indicated that between 8,398 and 10,514 tonnes of single family waste may be diverted through the use of backyard composting in the District of North Vancouver, City of North Vancouver and District of West Vancouver), equivalent to: 425kg/hh/yr (for those participating households) and a reported involvement of 35% of SF households composting (self-reported via phone survey). A significant concern in the NSRP area is the attraction of bears to food scrap waste. It should be noted that restrictions in RMOW prevent households from backyard composting due to wildlife concerns, however, it is also clear that managing organic wastes through on-site management is the most cost-effective means to deal with most organic wastes. The NSRP program has worked progressively to achieve its reported 35% rate of involvement. If the SLRD wishes to consider an equivalent focus in backyard composting, it is clear that it will have to be supported with a strong educational program. With suitable availability of wood waste there would be the opportunity to consider a number of localized community compost sites which would entail an enclosure sitting on a concrete pad.

7 Organics Collection and Processing Design/Model Options

7.1 Social, Economic, Environmental Considerations

The socio-economic impact of the options have been considered in terms of the number of full-time equivalent jobs created via each potential facility, based on the potential facilities and operational scenarios described in Section 6.2 above. **Table 7-1** (below) provides a summary of potential full-time equivalent jobs at each facility under each scenario.

Siting of new compost processing facilities has potential environmental consequences and must be managed consistent with regulatory requirements and the planning objectives of the approving authority. In general terms, permitting the expansion of an existing facility is typically more feasible than permitting the development of a new facility because: firstly the facility is likely sited in a location at which conditions have previously already been adopted as being acceptable for such operations. Secondly, existing environmental controls (*e.g.* fencing, drainage management, access and operational infrastructure) are likely already in place may serve dual purpose in supporting any expanded development. With additional available space at existing waste management facilities including: Lillooet Landfill, Area 22 at Squamish Landfill (anticipating that “curing” moves to the WCF), and the WCF itself, it is not anticipated that the scale of additional composting operations considered in Section 7.2 below would be significantly constrained by permitting limitations.

High level estimates of GHG reductions generated from diversion of organic waste from landfill were developed to allow comparative assessment between identified options. The principal GHG benefit of diverting organic waste from landfill arises due to the reduced emission of methane gas relative to carbon dioxide achieved by the aerobic composting technologies considered in this report. The estimation process drew upon the Government of Alberta's Quantification Protocol for Aerobic Composting Projects (Dec, 2008) and the Intergovernmental Panel on Climate Change (IPCC) 2006 Guidelines for National GHG Inventories - Volume 5. In developing these estimates, it was

assumed that transportation GHG emissions were similar between the baseline scenario (collection and transportation to landfill) and the project scenarios (collection and transportation to composting site(s)). Additionally, it was assumed that the GHG emissions related to material handling at composting facilities would be negligible due to the low technology processes being proposed (*i.e.*, low consumption of electricity and fuel at composting sites) and their relative similarity to the handling of materials at landfills. The estimates are provided as an order of magnitude indicator of the potential for GHG reductions from the proposed composting activities. These estimates should not be relied on for project related financing planning. If such estimates are required, the SLRD should consider undertaking a detailed scenario specific assessment of GHG reduction potential once a preferred scenario has been selected by the SLRD.

7.2 Review of Regional Composting Feasibility Options

The three identified options have each been reviewed in light of the two potential future scenarios. **Table 7-1** provides a summary assessment of each scenario relative to criteria specified by the SLRD.

Table 7-1 Summary Assessment of Scenarios 1 and 2

	SCENARIO 1 - WCF - OPTIONS ADOPTION						SCENARIO 2 - MAXIMUM POTENTIAL SOURCE UTILIZATION					
	1. WCF treats only biosolids. 2. Compost curing moves to WCF. 3. 'Community' scale composting commences at Lillooet. 4. ICI SSO collection from Whistler.						1. WCF continues to treat biosolids & food waste. 2. Residential SSO collection for all Squamish Area with effective SSO segregation at Whistler (depots x 2). 3. ICI collection from Whistler and Squamish.					
	Criteria						Criteria					
	Estimate of Recoverable Quantities (2011)	Estimate of Collection Cost	Estimate of Transportation Cost	Estimate of Processing Cost (Capex/Opex/Revenues)	Jobs Created (FTE)	Environmental (GHG)	Estimate of Recoverable Quantities (2011)	Estimate of Collection Cost	Estimate of Transportation Cost	Estimate of Processing Cost (Capex/Opex/Revenues)	Jobs Created (FTE)	Environmental (GHG)
	tonnes	\$/tonne	\$/tonne	\$/tonne		tonnes CO2/year		\$/tonne	\$/tonne	\$/tonne		tonnes CO2/year
OPTION 1: Local Facilities Serving Local Areas												
Lillooet Landfill - SLRD	150	See Notes	Drop Off	\$396	1	100-300	150	See Notes	Drop Off	\$396	1	100-300
Squamish Landfill - Lot 22	NA	NA	NA	NA	NA	NA	3590	\$80	\$7	\$131	3	3500-6000
Whistler WCF or Sea to Sky	841	Carney Service	\$6	\$150	2	800-1000	3655	\$56	\$6	\$113	3	3500-6000
OPTION 2: Regional Facility in Whistler												
	NA	NA	NA	NA	NA	NA	7725	\$56/\$80	\$19	\$98	4	7000-12000
OPTION 3: Regional Facility in Squamish												
Public												
Squamish Landfill - Lot 22	NA	NA	NA	NA	NA	NA	7725	\$56/\$80	\$20	\$98	4	7000-11000

Notes:

"Estimate for Collection Cost" for Squamish based on residential SSO program cost estimate, expressed as "per tonne residential SSO collected", i.e., for the estimated 3050 tonnes (2011) = \$80/tonne

"Estimate for Collection Cost" for Whistler based on manned depots (3 FTE equivalents @\$150 plus capital \$50k), expressed as "per tonne residential SSO segregated", i.e for the estimated 3589 tonnes (2011) = \$56/tonne.

"Estimate of Collection Cost" for Lillooet based on manned TS - Costs included in Capex/Opex for processing (1 staff member undertakes both roles)

NA - "Not Applicable" typically because not applicable under Scenario 1

8 Conclusions

8.1 Opportunities to Compost Segregated Organic Materials Already Generated in the Region

The SLRD already has an operational compost management capability operating at the Whistler Compost Facility with compost curing at the Squamish Landfill. In 2011, the WCF processed 13008 tonnes of organic material (biosolids-3658 tonnes, food waste-1082 tonnes, leaf and yard/wood waste-8268 tonnes). The facility is operating at or near capacity for close to 6 months of the year (CRA report 2012). Further opportunities for the region must be considered in terms of additional options to that established facility. It should also be recognized that RMOW is seeking to optimize the operation of the WCF and may adopt two key actions:

- The relocation of the curing facility from Squamish to the WCF (reduced interim handling/transportation); and
- The transfer of source materials from biosolids/partial food waste to sole focus on biosolids.

These two measures will create an untreated volume of food waste, currently collected and managed from the RMOW area, and provide opportunities in terms of available space at Squamish Landfill, Lot 22.

The other organic materials generated in the SLRD region which are not currently processed for compost are:

- The approximately 350 tonnes of leaf and yard waste which was collected from the north of the SLRD region and is annually burned at the Lillooet Landfill; and
- Sewage biosolids generated at the Lillooet wastewater treatment plant (approximately 200 tonnes/year), which are the only biosolids in the region not directed to the WCF.

If, as described in Scenario 1, the “food waste diversion” recommendation for WCF operations (CRA, 2012) is implemented, and “over capacity” material were not disposed to landfill at Rabanco (US), it would make an additional 1410 tonnes/year available for composting (840 tonnes of Food Waste & 570 tonnes of Biosolids), based on 2011 data.

8.2 Opportunities to Segregate Additional Organic Materials in the Region

If, as described in Scenario 2, the municipalities in the region implemented aggressive policy and by-law implementation and enforcement to segregate organics from the garbage waste stream in both the residential and ICI sectors, then an optimistic assessment of the additional “recoverable” quantities of organics in the Squamish Area might be of the order of 3655 tonnes/year and 3590 tonnes/year in the Whistler Area. As of yet, no source separated organics (SSO) program has been considered for Lillooet and northern communities due to the low density and relatively small quantities of material that might be recoverable (480 tonnes).

Based on 2011 data, the total projected recoverable quantity of organic materials, over and above those materials already processed at WCF is estimated at 7725 tonnes/year (Whistler Area – 3590 tonnes, Squamish Area – 3655 tonnes, Lillooet Area – 480 tonnes).

8.3 Review of Regional Composting Feasibility Options

Considering the Options and Scenarios presented, a review of cost projections for: collection, transportation and processing indicates that on a \$/tonne basis, transportation is the least significant component.

The cost of processing on a \$/tonne basis is the most significant, and in line with the general principle of “economies of scale”, the larger the processing facility the lower the potential unit rate cost.

As noted above, the unit costs identified in **Table 7-1** above should not be considered as a reliable projection of actual cost. Instead they are an indicator of relative significance of costs when comparing option costs estimated in the equivalent manner. Review of Scenario 1 indicates that with potentially minimal additional collection or transportation costs, an additional 1141 tonnes/year of material could be composted at a processing facility located in the Whistler Area. The estimate of process cost provided in **Table 7-1** assumes a “low-tech” approach as described in Section 6; however, the facility operating such a system might be an extension of the WCF facility or a new facility such as that proposed by Sea to Sky Soils. Given the relatively high unit rate cost that might be incurred for processing at a facility in Lillooet, any consideration of additional processing capacity in the Whistler Area should consider transportation of existing organic materials collected in Lillooet to that facility (an additional 480 tonnes/year).

Under Scenario 2, review of estimated costs for collection, transportation and processing indicates that the most favourable option from a processing cost basis is a regional facility in either the Whistler or the Squamish area. In order to achieve the projected diversion and recovery of organics that might support such an option, municipalities in the region would need to adopt aggressive policy development and by-law implementation and enforcement. There would also be additional cost in separate collection and transportation of organic materials to a regional facility, and those costs are of a similar scale to processing (estimated \$80/tonne for curbside SSO collection in Squamish, and \$130/tonne for segregated Depot collection in RMOW).

8.4 Conclusion

In conclusion, the key findings of the report are that further compost processing is possible for segregated organic materials already available in the community, and also that additional volumes of organic materials could be recovered from existing waste streams at a scale consistent with “Low Tech” composting approaches, however because of regional geography, the relatively small scale of the communities present and the consequently small quantities of organic material generated, the economics of composting do not appear attractive when compared directly with existing waste disposal alternatives. The effort to adopt sustainability objectives such as increased composting will therefore need to come from the community who might place value on the success of achieving other non-financial goals. Given those limitations of scale, and the potential absence of a driving financial motivation to implement further measures it would therefore be essential for all municipal units to work collectively in order to minimize overall waste collection and disposal costs, and come to a regional solution that meets the aspirations of all the communities.

9 Closing

This report was prepared exclusively for the purposes, project, and location outlined in the report. The report is based on information provided to or obtained by Dillon as indicated in the report, and applies solely to conditions existing at the time of the investigation.

Should you have any questions about the information contained in this report, please contact Neil Crellin at 604-278-7847. Thank you for the opportunity to be of assistance.

Appendix A
Reference Documents

Reference Documents

Squamish-Lillooet Regional District (SLRD) (2012). Regional Composting Feasibility Study – Request for Proposals.

Gartner Lee Limited (May 2002). Southern Region Centralized Composting Program Feasibility Study.

Conestoga-Rovers & Associates (June 2012). Cost-Benefit Study, Whistler Composting Operations.

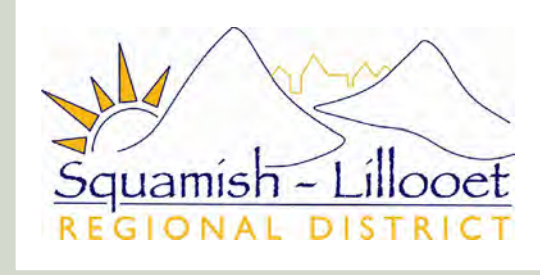
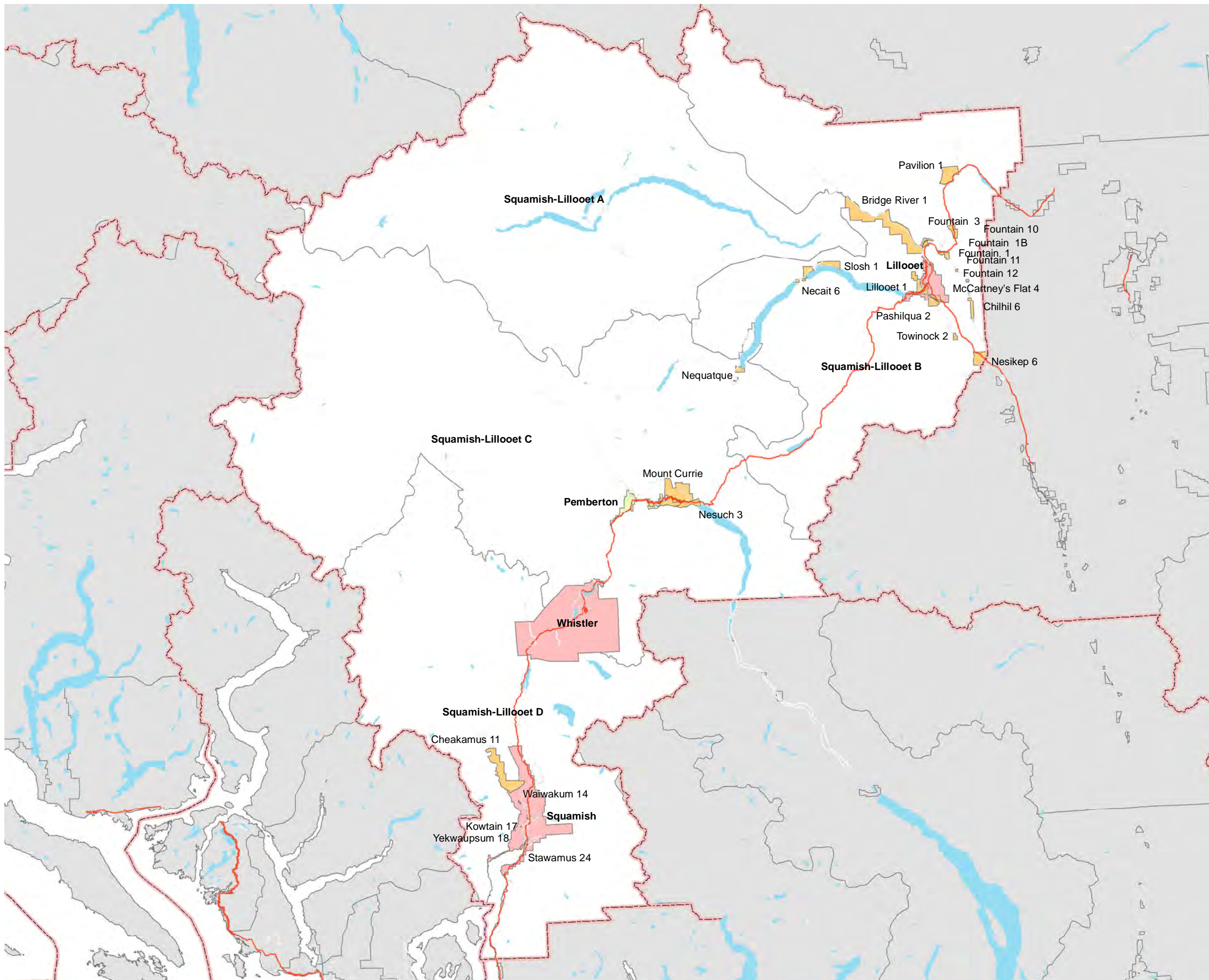
Squamish-Lillooet Regional District (SLRD) (2008). Regional Growth Strategy.

Saunders, Meghan (August 2010). Solid Waste Composition Study – Whistler Recycling and Transfer Station.

Gartner Lee Limited (December 2007). Solid Waste Management Plan Update.

Carney's Waste Systems (Carney's) – Whistler Compost Facility (2012). Viewed on July 5, 2012 at:
http://www.carneywaste.com/facilities/whistler_compost.html.

Appendix B
Map Showing Extent of Electoral Areas



Squamish - Lillooet Regional District
Regional Composting Feasibility Study Waste Audit

Squamish - Lillooet Regional District and Electoral Area Boundaries

Figure 1 - 1

- Municipality
- Reserve
- Regional District Electoral Area
- Village
- Non - SLRD
- Lakes
- Regional District Boundaries
- highway
- collector



Map Data:
Aerial based on Bing Maps Hybrid.
Waste Data created by Dillon Consulting

Map Created By: Eric Hertzman
Map Checked By: Clement Lam
Map Projection: BCAlbers



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Appendix C
Original Waste Audit Data and Photos

SLRD Regional Composting Feasibility Study
Appendix C - Raw Data

Area	Location	Type		TOTAL	Food - BCKYD	Food - Non BCKYD	Yard	Non Food Organic	Total Organics	Recyclables	Residual		
D	Squamish	Residential	KGs Sorted	349.9	75.3	57.2	42.6	19.2	194.3	45.3	110.3		
			% of Total Waste		22%	16%	12%	5%	56%	13%	32%		
		Commercial - Mixed Load	KGs Sorted	325.4	35.5	83.1	0	24.5	143.1	76.8	105.5		
			% of Total Waste		11%	26%	0%	8%	44%	24%	32%		
C	Whistler	Residential	KGs Sorted	491	76.5	69.1	26.8	18.5	190.9	111.3	188.8		
			% of Total Waste		16%	14%	5%	4%	39%	23%	38%		
		Commercial - Ski Resort Housing	KGs Sorted	396.7	53	50.2	4.6	15.2	123	155.2	118.5		
			% of Total Waste		13%	13%	1%	4%	31%	39%	30%		
		Commercial - Grocery Store	KGs Sorted	219.6	16.3	102.2	0	4.8	123.3	45.1	51.2		
			% of Total Waste		7%	47%	0%	2%	56%	21%	23%		
B	Lillooet	Residential	KGs Sorted	273.6	27.8	31	24.5	8.4	91.7	56.2	125.7		
			% of Total Waste		10%	11%	9%	3%	34%	21%	46%		
		First Nations	KGs Sorted	118.8	19.2	29.4	2.9	7.3	58.8	29.9	30.1		
			% of Total Waste		16%	25%	2%	6%	49%	25%	25%		
		Commercial - Mixed Load	KGs Sorted	436.1	46	44.3	4.1	23.3	117.7	253.7	64.7		
			% of Total Waste		11%	10%	1%	5%	27%	58%	15%		
A	Goldbridge	Residential / Commercial - Mixed	KGs Sorted	300.5	47.8	79.2	7.4	22.4	156.8	62.2	81.5		
			% of Total Waste		16%	26%	2%	7%	52%	21%	27%		
		DLC Load	KGs Sorted	** Refer to photos. Did not sample as materials were too large. One object would have thrown results off.									
			% of Total Waste										

Waste Audit Samples



Photo 1 – Food – Backyard Compostable Sample

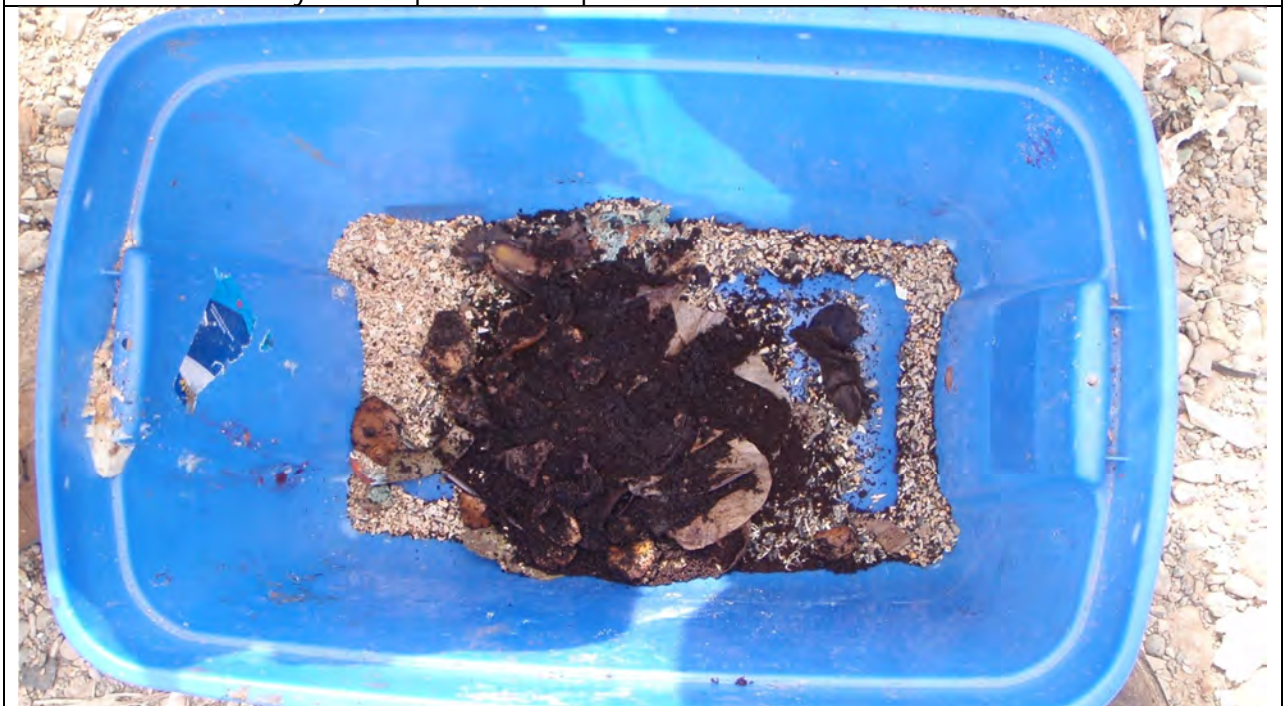


Photo 2 – Food – Backyard Compostable Sample



Photo 3 – Food – Not Backyard Compostable Sample



Photo 4 – Food – Not Backyard Compostable Sample



Photo 5 – Food – Not Backyard Compostable Sample



Photo 6 – Yard Waste Sample



Photo 7 – Non-Food Organic Sample



Photo 8 – Non-Food Organic Sample



Photo 9 – Non-Food Organic Sample



Photo 10 – Recyclables Sample



Photo 11 – Recyclables Sample



Photo 12 – Recyclables Sample



Photo 13 – Garbage Sample



Photo 14 – Garbage Sample

Lillooet Landfill Site Photos – Area **A** (Goldbridge) and Area **B** (Lillooet) Waste Audit Samples



Photo 1 – Lillooet Landfill Tipping Face



Photo 2 – Leaf and Yard Waste Pile



Photo 3 – Area where Leaf and Yard waste was burned



Photo 4 – Creosote Logs on Site



Photo 5 – Goldbridge DLC Sample Load



Photo 6 – Goldbridge DLC Sample Load



Photo 7 – Goldbridge DLC Sample Load



Photo 8 – Goldbridge DLC Sample Load



Photo 9 – Goldbridge Residential/Commercial Sample Load



Photo 10 – Goldbridge Residential/Commercial Sample Load



Photo 11 – Lillooet Residential Sample Load



Photo 12 – Lillooet Residential Sample Load



Photo 13 – Lillooet Commercial Sample Load

Whistler Transfer Station Site Photos – Area C (Whistler) Waste Audit Samples



Photo 1 – Whistler Transfer Station



Photo 2 – Leaf and Yard Waste Pile



Photo 3 – Drywall and Wood Waste Pile



Photo 4 and 5 – Wood Bins

Squamish Landfill Site Photos – Area D (Squamish) Waste Audit Samples



Photo 1 – Leaf and Yard Waste, Wood Waste and Wood Chip Area



Photo 2 – Yard Waste Pile



Photo 3 – Wood Chip Pile



Photo 4 – Wood Pile

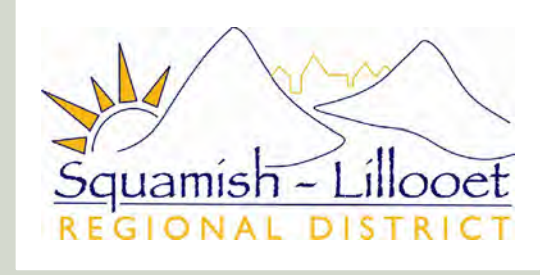
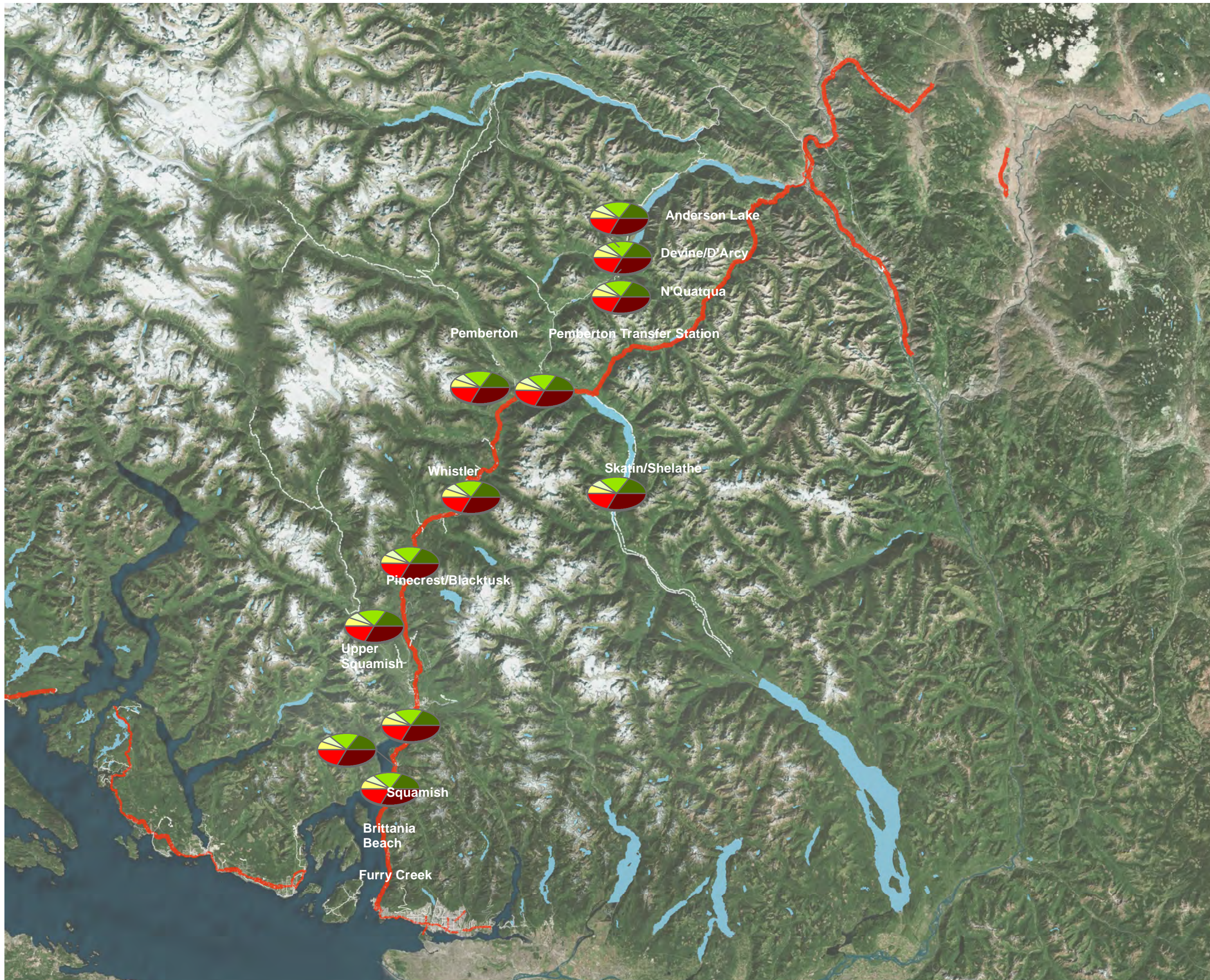


Photo 5 – Waste Sorting Area



Photo 6 and 7 – Waste Sorters

Appendix D
Volumes of Organic Waste
Generated by Each SLRD Community



Squamish - Lillooet Regional District
Regional Composting Feasibility Study Waste Audit

Squamish Landfill Waste Sources
Figure 1

Waste Sources

- Food - BCKYD
- Food - Non BCKYD
- Yard
- Non Food Organics
- Recyclables
- Residual

Road Type

- highway
- arterial
- collector
- local
- recreation
- resource
- service

Lakes

Regional District Boundaries

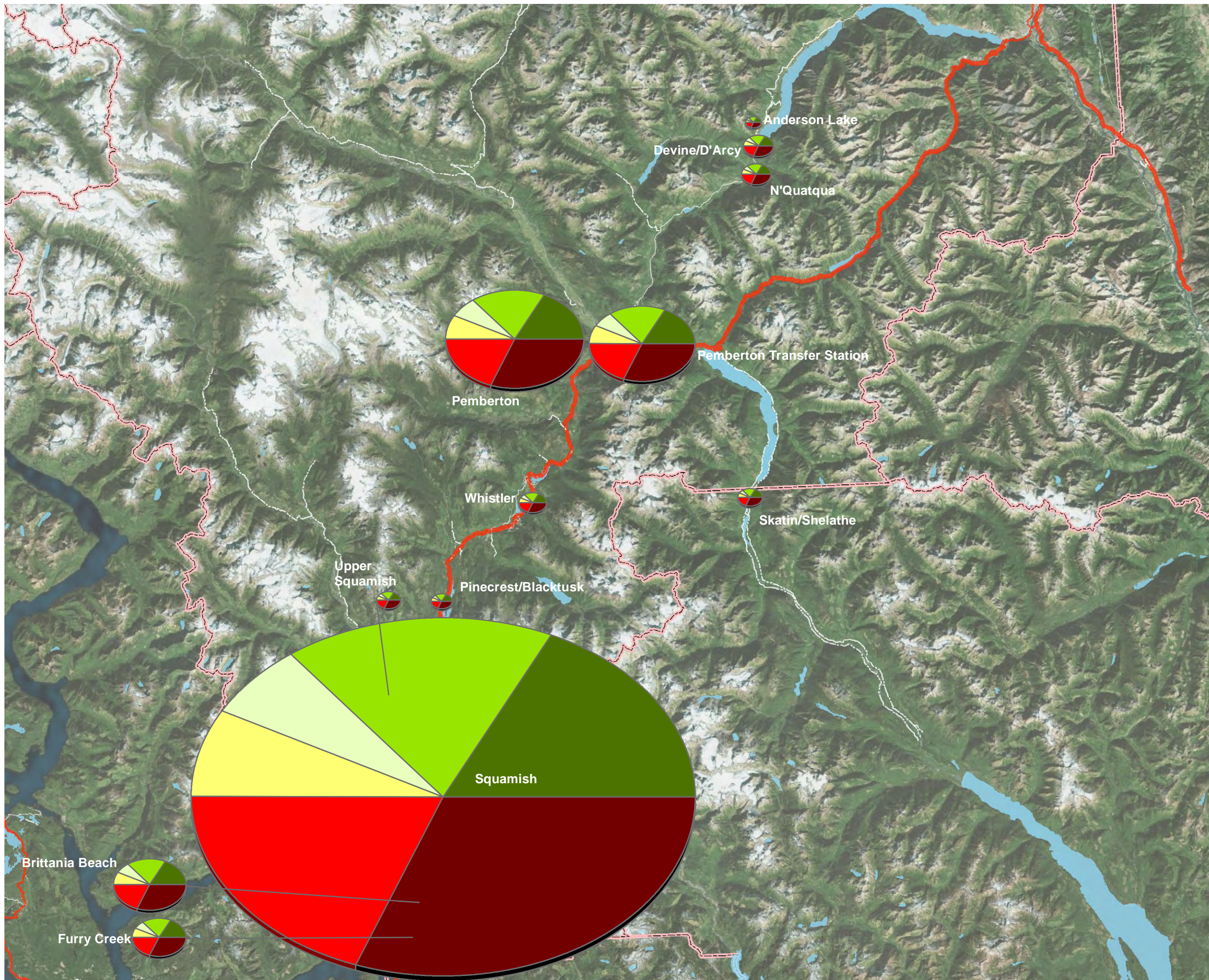


Map Data:
Aerial based on Bing Maps Hybrid.
Waste Data created by Dillon Consulting

Map Created By: Eric Hertzman
Map Checked By: Clement Lam
Map Projection: BCAlbers



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Squamish - Lillooet Regional District
Regional Composting Feasibility Study Waste Audit

Squamish Landfill Waste Sources Proportional Pie Charts

Figure 2

Waste Sources

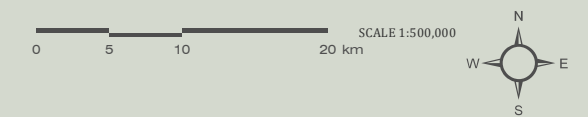
Pie Chart Proportional to Total Waste

- Food - BCKYD
- Food - Non BCKYD
- Yard
- Non Food Organics
- Recyclables
- Residual

Road Type

- highway
- arterial
- collector
- local
- recreation
- resource
- service

- Lakes
- Regional District Boundaries



Map Data:
Aerial based on Bing Maps Hybrid.
Waste Data created by Dillon Consulting

Map Created By: Eric Hertzman
Map Checked By: Clement Lam
Map Projection: BCAlbers



Project: 12-6216
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Squamish - Lillooet Regional District
Regional Composting Feasibility Study Waste Audit

Whistler Transfer Station Waste Sources Proportional Pie Charts


Figure 3

Waste Sources

 Pie Chart Proportional to Total Waste

-  Food - BCKYD
-  Food - Non BCKYD
-  Yard
-  Non Food Organics
-  Recyclables
-  Residual

Road Type

-  highway
-  arterial
-  collector
-  local
-  recreation
-  resource
-  service
-  Lakes
-  Regional District Boundaries

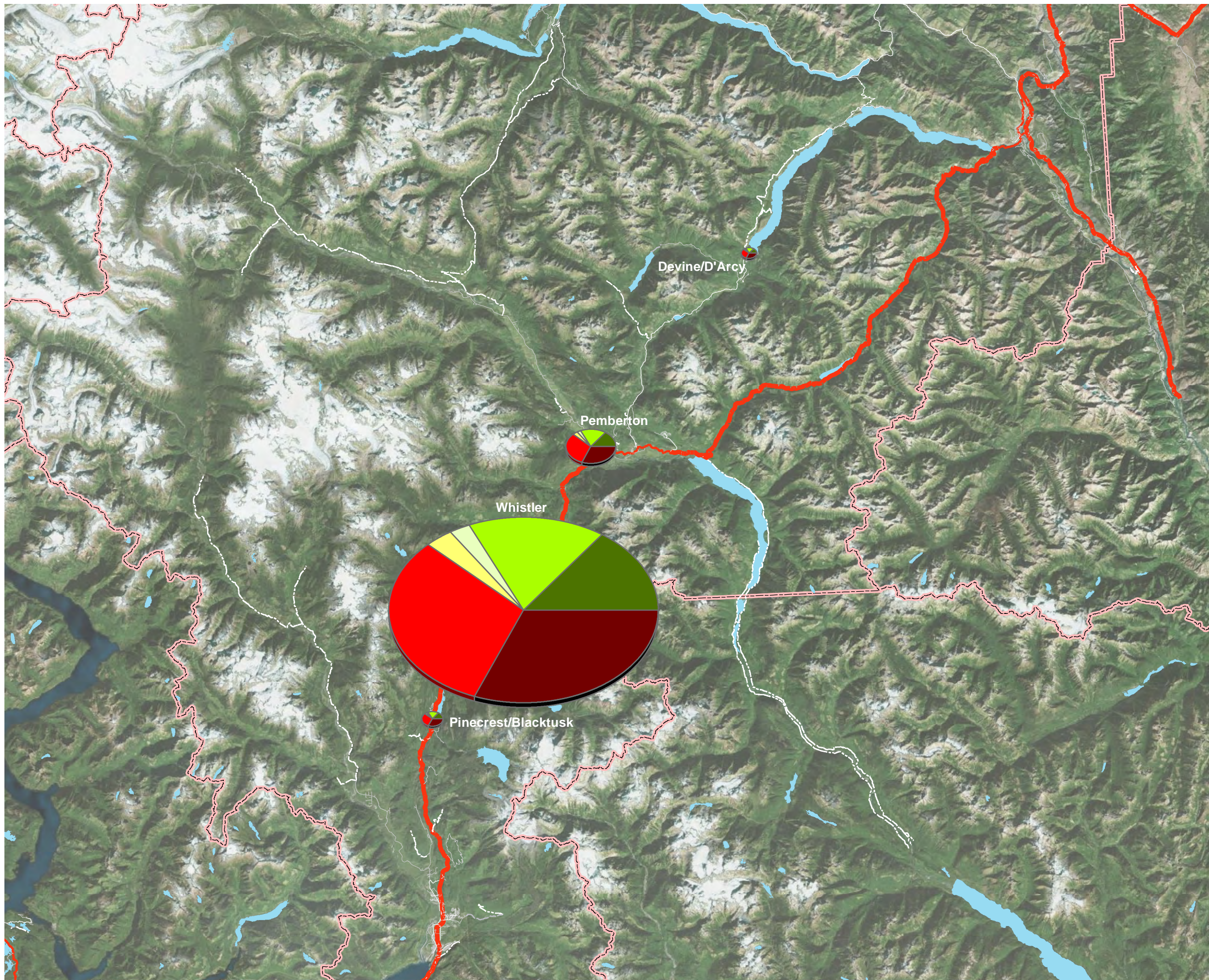


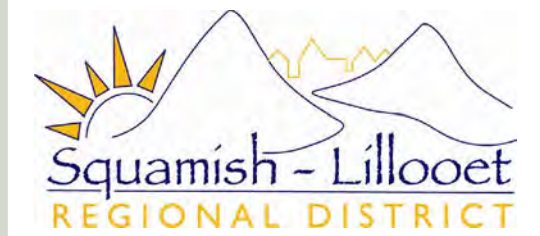
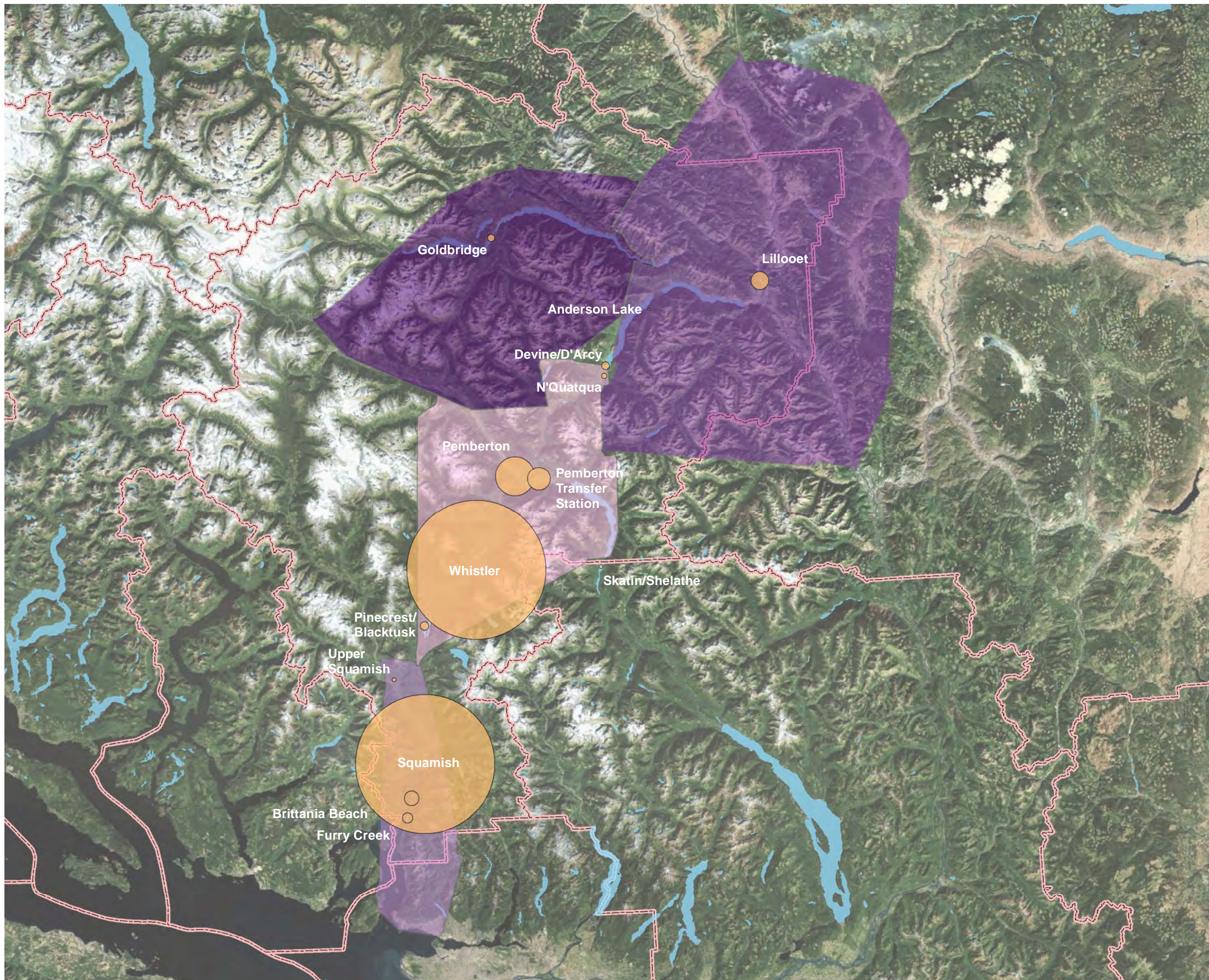
Map Data:
Aerial based on Bing Maps Hybrid.
Waste Data created by Dillon Consulting

Map Created By: Eric Hertzman
Map Checked By: Clement Lam
Map Projection: BCAlbers



Project: 12-6216
STATUS: DRAFT
DATE: 7/17/2013

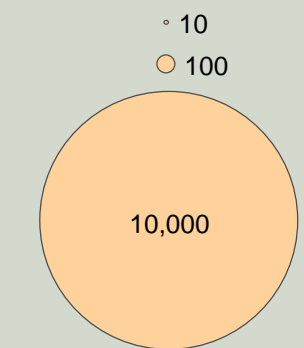




Squamish - Lillooet Regional District
Regional Composting Feasibility Study Waste Audit

Shortest Access Corridors and Total Waste
Figure 4

Circles Proportional to Total Waste in Tonnes



Shortest Access Corridors

- Goldbridge
- Lillooet
- Squamish
- Whistler
- Regional District Boundaries



SCALE 1:900,000



Map Data:
Aerial based on Bing Maps Hybrid.
Waste Data created by Dillon Consulting

Map Created By: Eric Hertzman
Map Checked By: Clement Lam
Map Projection: BCAlbers



Project: 12-6216
STATUS: DRAFT
DATE: 8/27/2012

Table 1 - Summary of Waste Composition Percentages

Area	Location	Type	Food - BCKYD	Food - Non BCKYD	Yard	Non Food Organic	Total Organics	Recyclables	Residual
D	Squamish	Total	16%	21%	6%	7%	50%	18%	32%
		Residential	22%	16%	12%	5%	56%	13%	32%
		Commercial - Mixed Load	11%	26%	0%	8%	44%	24%	32%
C	Whistler	Total	13%	20%	3%	4%	40%	28%	32%
		Residential	16%	14%	5%	4%	39%	23%	38%
		Commercial - Ski Resort Housing	13%	13%	1%	4%	31%	39%	30%
		Commercial - Grocery Store	7%	47%	0%	2%	56%	21%	23%
B	Lillooet	Total	11%	13%	40%	50%	32%	41%	27%
		Residential	10%	11%	9%	3%	34%	21%	46%
		First Nations	16%	25%	2%	6%	49%	25%	25%
		Commercial - Mixed Load	11%	10%	1%	5%	27%	58%	15%
A	Goldbridge	Total	16%	27%	30%	80%	52%	21%	27%
		Residential / Commercial - Mixed	16%	26%	2%	7%	52%	21%	27%
		DLC Load	** Refer to photos. Did not sample as materials were too large. One object would have thrown results off.						

Total Amount of Waste Generated by Each Source - 2011 Tonnes - All Waste Sources

SOURCE	TOTAL	Food - BCKYD	Food - Non BCKYD	Yard	Non Food Organic	Total Organics	Recyclables	Residual
Anderson Lake	11.40	1.87	2.37	0.72	0.74	5.70	2.06	3.64
Britannia Beach	242.40	39.77	50.36	15.29	15.69	121.11	43.83	77.46
N'Quatqua	40.06	6.57	8.32	2.53	2.59	20.01	7.24	12.80
Devine/D'Arcy	120.94	18.56	24.82	6.25	6.64	56.27	25.86	38.81
Furry Creek	133.84	21.96	27.81	8.44	8.66	66.87	24.20	42.77
Pemberton	1,245.22	191.38	255.62	64.70	68.64	580.34	265.28	399.60
Pemberton Transfer Station	517.28	84.87	107.47	32.63	33.47	258.45	93.53	165.30
Pinecrest/Blacktusk	94.07	13.06	18.98	3.39	3.89	39.32	24.38	30.37
Upper Squamish	26.75	4.39	5.56	1.69	1.73	13.37	4.84	8.55
Skatin/Shelathe	28.34	4.65	5.89	1.79	1.83	14.16	5.12	9.06
Squamish	11,735.94	1,925.58	2,438.25	740.34	759.46	5,863.63	2,121.96	3,750.36
Whistler	11,736.92	1,546.60	2,348.09	334.09	409.17	4,637.95	3,299.17	3,799.80
Subtotal - Solid Waste	25933.15	3859.26	5293.54	1211.85	1312.51	11677.16	5917.47	8338.52

Total Amount of Waste Generated by Each Source - 2011 Tonnes - Residential Services

SOURCE	TOTAL	Food - BCKYD	Food - Non BCKYD	Yard	Non Food Organic	Total Organics	Recyclables	Residual
Anderson Lake	-							
Britannia Beach	67.70	14.57	11.07	8.24	3.72	37.60	8.77	21.34
N'Quatqua	40.06	8.62	6.55	4.88	2.20	22.24	5.19	12.63
Devine/D'Arcy	81.26	15.13	12.38	7.23	3.78	38.52	14.38	28.37
Furry Creek	119.02	25.61	19.46	14.49	6.53	66.09	15.41	37.52
Pemberton	118.47	25.50	19.37	14.42	6.50	65.79	15.34	37.35
Pemberton Transfer Station	517.28	111.32	84.56	62.98	28.38	287.25	66.97	163.06
Pinecrest/Blacktusk	51.98	8.10	7.32	2.84	1.96	20.21	11.78	19.99
Upper Squamish	-							
Skatin/Shelathe	-							
Squamish	2,725.21	586.48	445.50	331.79	149.54	1,513.31	352.82	859.08
Whistler	2,443.90	380.77	343.94	133.39	92.08	950.18	553.98	939.73
Subtotal - Solid Waste	6164.88	1176.10	950.14	580.26	294.69	3001.19	1044.63	2119.06

Squamish Landfill - 2011 Tonnes Landfilled From Each Source - All Waste Sources

SOURCE	TOTAL	Food - BCKYD	Food - Non BCKYD	Yard	Non Food Organic	Total Organics	Recyclables	Residual
		16.4%	20.8%	6.3%	6.5%	50.0%	18.1%	32.0%
Anderson Lake	11.40	1.87	2.37	0.72	0.74	5.70	2.06	3.64
Britannia Beach	242.40	39.77	50.36	15.29	15.69	121.11	43.83	77.46
N'Quatqua	40.06	6.57	8.32	2.53	2.59	20.01	7.24	12.80
Devine/D'Arcy	81.26	13.33	16.88	5.13	5.26	40.60	14.69	25.97
Furry Creek	133.84	21.96	27.81	8.44	8.66	66.87	24.20	42.77
Pemberton	846.29	138.86	175.82	53.39	54.77	422.83	153.02	270.44
Pemberton Transfer Station	517.28	84.87	107.47	32.63	33.47	258.45	93.53	165.30
Pinecrest/Blacktusk	20.76	3.41	4.31	1.31	1.34	10.37	3.75	6.63
Upper Squamish	26.75	4.39	5.56	1.69	1.73	13.37	4.84	8.55
Skatin/Shelathe	28.34	4.65	5.89	1.79	1.83	14.16	5.12	9.06
Squamish	11,735.94	1,925.58	2,438.25	740.34	759.46	5,863.63	2,121.96	3,750.36
Whistler	36.34	5.96	7.55	2.29	2.35	18.16	6.57	11.61
Subtotal - Solid Waste	13720.65							

Whistler Transfer Station - 2011 Tonnes Received From Each Source - All Waste Sources

SOURCE	TOTAL	Food - BCKYD	Food - Non BCKYD	Yard	Non Food Organic	Total Organics	Recyclables	Residual
		13.2%	20.0%	2.8%	3.5%	39.5%	28.1%	32.4%
Anderson Lake	-							
Britannia Beach	-							
N'Quatqua	-							
Devine/D'Arcy	39.68	5.22	7.94	1.13	1.38	15.67	11.17	12.85
Furry Creek	-							
Pemberton	398.93	52.53	79.80	11.31	13.87	157.51	112.26	129.16
Pemberton Transfer Station	-							
Pinecrest/Blacktusk	73.31	9.65	14.66	2.08	2.55	28.94	20.63	23.73
Upper Squamish	-							
Skatin/Shelathe	-							
Squamish	-							
Whistler	11,700.58	1,540.63	2,340.54	331.80	406.82	4,619.79	3,292.60	3,788.19
Subtotal - Solid Waste	12212.50							

Lillooet Landfill (Southern SLRD) - 2011 Tonnes Landfilled - All Waste Sources

SOURCE	TOTAL	Food - BCKYD 11.2%	Food - Non BCKYD 12.6%	Yard 3.8%	Non Food Organic 4.7%	Total Organics 32.4%	Recyclables 41.0%	Residual 26.6%
Lillooet and Area	321.80	36.12	40.67	12.23	15.15	104.17	131.98	85.64

Lillooet Landfill (Southern SLRD) - 2011 Tonnes Landfilled - Residential Services

SOURCE	TOTAL	Food - BCKYD 10.2%	Food - Non BCKYD 11.3%	Yard 9.0%	Non Food Organic 3.1%	Total Organics 33.5%	Recyclables 20.5%	Residual 45.9%
District of Lillooet Garbage Trucks - Residential Services	218.12	22.16	24.71	19.53	6.70	73.11	44.80	100.21

Gold Bridge Transfer Station (Southern SLRD) - 2011 Tonnes Received - All Waste Sources

SOURCE	TOTAL	Food - BCKYD 15.9%	Food - Non BCKYD 26.4%	Yard 2.5%	Non Food Organic 7.5%	Total Organics 52.2%	Recyclables 20.7%	Residual 27.1%
Gold Bridge and Area	67.66	10.76	17.83	1.67	5.04	35.30	14.00	18.35

Squamish Landfill - 2011 Tonnes Landfilled From Each Source - Residential Services

SOURCE	TOTAL	Food - BCKYD	Food - Non BCKYD	Yard	Non Food Organic	Total Organics	Recyclables	Residual
		21.5%	16.3%	12.2%	5.5%	55.5%	12.9%	31.5%
Anderson Lake	-							
Britannia Beach	67.70	14.57	11.07	8.24	3.72	37.60	8.77	21.34
N'Quatqua	40.06	8.62	6.55	4.88	2.20	22.24	5.19	12.63
Devine/D'Arcy	41.58	8.95	6.80	5.06	2.28	23.09	5.38	13.11
Furry Creek	119.02	25.61	19.46	14.49	6.53	66.09	15.41	37.52
Pemberton	118.47	25.50	19.37	14.42	6.50	65.79	15.34	37.35
Pemberton Transfer Station	517.28	111.32	84.56	62.98	28.38	287.25	66.97	163.06
Pinecrest/Blacktusk	-							
Upper Squamish	-							
Skatin/Shelathe	-							
Squamish	2,725.21	586.48	445.50	331.79	149.54	1,513.31	352.82	859.08
Whistler	-							
Subtotal - Solid Waste	3629.32							

Whistler Transfer Station - 2011 Tonnes Received From Each Source - Residential Services

SOURCE	TOTAL	Food - BCKYD	Food - Non BCKYD	Yard	Non Food Organic	Total Organics	Recyclables	Residual
		15.6%	14.1%	5.5%	3.8%	38.9%	22.7%	38.5%
Anderson Lake	-							
Britannia Beach	-							
N'Quatqua	-							
Devine/D'Arcy	39.68	6.18	5.58	2.17	1.50	15.43	8.99	15.26
Furry Creek	-							
Pemberton	-							
Pemberton Transfer Station	-							
Pinecrest/Blacktusk	51.98	8.10	7.32	2.84	1.96	20.21	11.78	19.99
Upper Squamish	-							
Skatin/Shelathe	-							
Squamish	-							
Whistler	2,443.90	380.77	343.94	133.39	92.08	950.18	553.98	939.73
Subtotal - Solid Waste	2535.56							

Appendix E
Estimates of Collection,
Travel, and Transfer Costs

SLRD Regional Composting Feasibility Study
Appendix E - Estimates of Collection, Travel and Transfer Costs

To Squamish Landfill 22) (Lot	Opinion of Travel Time	Opinion of One Way Travel Distance	Average Speed	2011		
				Estimate of Annual Organic Material	Estimated Annual Transportation Budget	Estimated Transportation Cost per Tonne
				minutes	km	km/hour
Lillooet	152	181	71.3	150	\$10,304.18	\$69
Squamish	11	17	94.8	3592	\$23,676.97	\$7
Whistler	43	50	70.3	3655	\$69,386.78	\$19

To Whistler/Pemberton Area Sea to Sky) (WCF or	Opinion of Travel Time	Opinion of One Way Travel Distance	Average Speed	2011		
				Estimate of Annual Organic Material	Assumed Annual Transportation Budget	Estimated Transportation Cost per Tonne
				minutes	km	km/hour
Lillooet	122	145	71.4	150	\$8,287.46	\$55
Squamish	38	53	83.5	3592	\$71,981.45	\$20
Whistler	13	15	69.3	3655	\$20,246.18	\$6