XCG
Environmental Engineers & Scientists

XCG CONSULTING LIMITED
T 780 432 5770 | edmonton@xcg.com
#200, 6768 75th Street, Edmonton, Alberta, Canada T6E 6T9

XCG 30 Since 1990

XCG File No. 4-2111-01-76
January 8, 2021

BIOCOVER EVALUATION – PHASE ONE
SECHELT LANDFILL
SECHELT, BRITISH COLUMBIA

Prepared for:

SUNSHINE COAST REGIONAL DISTRICT (SCRD)
1975 Field Road
Sechelt, British Columbia
V0N 3A1

Attention: Mr. Raphael Shay
Water and Energy Projects Coordinator

Trevor Mahoney, B.S.E.
Project Manager

Jessie Darichuk
Project Manager

TABLE OF CONTENTS

FIGURES

TABLES

APPENDIX

1. INTRODUCTION

1.1 Purpose and Use

XCG Consulting Limited (XCG) was retained by the Sunshine Coast Regional District (SCRD) to prepare a Biocover Evaluation (Evaluation) for the Sechelt Landfill (Site). The objective of this report is to provide a high-level evaluation of a biocover system for the Site to support the SCRD in the process of considering a biocover system. Phase One includes a feasibility study to investigate technical, financial, and regulatory uncertainties surrounding the biocover application and a cost benefits analysis to assess greenhouse (GHG) savings and GHG emissions avoided. At the conclusion of this phase of the Evaluation, the SCRD will use this report to determine if they wish to proceed to Phase Two. Phase Two will involve a field work program including a test biocover section on the landfill, periodic landfill gas monitoring, geotechnical evaluation of selected biocover materials, and an update to this Phase One report based on the field program.

The scope of this report is limited to the matters expressly covered. This report has been prepared for the sole benefit of Sunshine Coast Regional District and may not be relied upon by any other person or entity without the written authorization of XCG Consulting Limited. Any use or reuse of this document (or the findings and conclusions represented herein), by parties other than those listed above, is at the sole risk of those parties.

1.2 Background

In May of 2010, the SCRD adopted the *Our Coast, Our Climate – Sunshine Coast Community Energy and Emissions Plan* with the goal of reducing GHG emissions by 7% by 2031 and a target of 332,000 tonnes per year. This plan supports the goals outlined in the Intergovernmental Panel on Climate Change (IPCC) 2018 report on limiting climate change to 1.5ºC and a 45% reduction over 2010 levels by 2030 and net zero emissions by 2050. Based on the SCRD's 2010 inventory, solid waste accounted for 11% of the community's emissions which supported the need to tackle solid waste emissions.

The Environment and Climate Change Canada (the ECCC) requires annual calculation and reporting of carbon dioxide, methane, and nitrous oxide emissions produced at landfills if they exceed the threshold of 10,000 tonnes of CO2-e per year. In 2019, XCG conducted a GHG Emissions Assessment for the Site to report on these emissions which included emissions from stationary fuel combustion, on-site transportation, and waste. XCG determined that 797.878 tonnes of GHG emissions or 20,070 tonnes of CO2-e were produced at the Site which exceeded the ECCC threshold for GHG reporting of 10,000 tonnes of CO2-e per year. Most of the emissions came from methane produced by the organic material breaking down in the landfill. Only 0.002304 tonnes of emissions was produced from the on-site propane use (stationary fuel combustion) and construction equipment and vehicles (on-site transportation).

In 2012, XCG also conducted a Landfill Gas Utilization Feasibility Analysis to evaluate the installation of LFG collection system to capture and utilize LFG. The design and construction of the Sechelt Landfill including the lack of impermeable liners under it has resulted in a large amount of the gas migrating sideways or underground out of the Sechelt Landfill and not out of the top. The LFG pumping test of 2015 determined that only approximately 15% of the landfill gas could be captured. XCG determined it would not be feasible to install a LFG collection system due to the extremely high installation costs and the low amount of LFG that could be captured. The Site also generated less than 1,000 tonnes of methane per year which was not enough to install a flare or scrub and sell to Fortis British Columbia (BC).

In 2015, the District of Sechelt piloted a food and green waste curbside collection program for 500 homes. Over the past five years, the program is diverting, on average, approximately 205 tonnes of material per year. In 2021, The District of Sechelt plans to expand the program District-wide.

In 2018, the Town of Gibsons implemented a food waste curbside collection program and in 2019, the first full year, the Town of Gibsons diverted 185 tonnes of food waste.

In October 2020, the SCRD implemented a food waste curbside program in Electoral Areas B, D, E, and F which will divert approximately 650 tonnes of food waste per year.

If the SCRD were to implement a food waste drop-off at Pender Harbour Transfer Station and implement a food waste ban for both the residential and commercial sector, the SCRD would divert 2,300 tonnes of organics from landfill annually which is equivalent to a 2,300 CO2-e reduction. To further reduce GHG emissions, the SCRD has requested an evaluation of implementing a biocover system at the Site in hopes to further tackle GHG emissions from waste and reach their goal of 7% GHG emission reductions by 2031 (Infrastructure Services Committee Agenda Package, October 2019).

2. SITE DESCRIPTION

The Site is located at 4901 Dusty Road in Sechelt, BC approximately 6.5 kilometres northeast of the District of Sechelt. The Site is located on Crown Land under License of Occupation No. 237204. The legal description of the Site is Block C, District Lot 7613, Group 1, New Westminster District.

The Site property is bounded to the north, east, and west by Crown Land (DL 7613), and to the south by Northcote Properties (DL 2464). The landfill encompasses an area of approximately 7 hectares, within an overall Site area of approximately 9.5 hectares. A site location map is shown on Figure 1.

Lehigh Hanson Materials Limited owns the mineral rights and currently operates its Sechelt Mine on the land south and west of the Site, with future expansion options for the Crown Land east and north of the Site.

The Site operates under Operational Certificate No. 106060 and comprises a non-hazardous solid waste landfill that accepts municipal solid waste from the District of Sechelt, Town of Gibsons, Sechelt Indian Government District, and all of the electoral areas in the SCRD. In addition, as of July 20, 2015, waste received at the Pender Harbour Transfer Station is landfilled at the Site.

In 2013, the SCRD constructed approximately 13,500 square metres of closure as part of Stage B closure outlined in the September 2012 Interim Design, Operations and Closure Plan (IDOCP). The remaining two thirds of the Site has approximately six years remaining until full closure and includes Stage H (18,500 m^2) which will close in 2021 and the Final Closure (31,000 m^2) which will close in 2026.

3. REGULATORY SETTING

The following section provides an overview of the regulatory environment which governs final cover at the Site.

3.1 Provincial Regulations

The 2016 Landfill Criteria for Municipal Solid Waste (Landfill Criteria) published by the British Columbia Ministry of Environment and Climate Change Strategy (MOECC) regulates final cover at landfills. The Landfill Criteria applies to all landfills on public and private land in British Columbia that receive municipal solid waste and include all new landfills, lateral and/or vertical expansions of existing landfills, new landfill phases, and existing landfills. Key elements of the criteria which are applicable to this Evaluation include:

- The minimum final cover shall consist of a barrier layer (soil or geomembrane), providing a maximum hydraulic conductivity of 1×10^{-5} cm/sec for landfill sites located in arid and semi-arid regions and 1×10^{-7} cm/sec for landfill sites located in non-arid regions.
- The final cover soil barrier layer shall have a minimum compacted thickness of 0.6 metres measured perpendicular to the slope with a minimum 0.15 metre topsoil layer capable of establishment and sustained growth of the vegetative cover.
- The final cover system is to be designed to ensure the maximum allowable leachate generation rate is not exceeded but will allow for waste stabilization during the post-closure period. The final cover using geomembrane as the barrier layer shall have a geomembrane or geocomposite equivalent to 1×10^{-7} cm/sec, with a geotextile (or sand) protection layer, with a minimum 0.45 metre common fill layer and minimum 0.15 metre topsoil layer capable of establishment and sustained growth of the vegetative cover. The depth of the topsoil layer should be related to the type of vegetation proposed to accommodate to necessary rooting depth. Soils of higher permeability may be approved based on leachate generation potential at the landfill site.
- A completed final cover shall be seeded or hydroseeded at the first opportunity that will result in successful germination and sustainable growth. Trees and shrubs can be also used to establish a vegetative cover. The vegetal species should be selected to ensure that their root systems will not impact the performance of the low permeability layer.
- Alternative final cover design, such as an evapotranspiration cover, can be approved if it can be demonstrated that the alternative provides equivalent or better performance with respect to reduction in infiltration and other objectives, such as erosion resistance and LFG control.
- Each area of the landfill footprint that has achieved final contours shall be closed within 365 days to provide for progressive closure of the landfill site.
- Final contours of the landfill shall be constructed at grades not steeper than 3H:1V (33%). The recommended design criteria for the top plateau of the landfill is a

slope not less than 10H:1V (10%) for cover systems using a soil barrier layer. The grade for the top plateau can be reduced up to 25H:1V (4%) for cover systems using a durable geomembrane or composite barrier layer with an overlying drainage layer above the final landfill side slope.

The Organic Matter Recycling Regulation Reg. 18/2002 of BC (OMRRR of BC) governs the construction and operation of compost facilities, and the production, distribution, storage, sale and use of biosolids and compost. It provides guidance for local governments and compost and biosolids producers, on how to use organic material while protecting soil quality and drinking water sources. Key elements of the regulation which are applicable to this Evaluation include:

Part 4 – Storage and Land Application Requirements

Division 1 – Storage at a Land Application Site

Storage facility

18 A storage facility must

a) be of sufficient capacity to store all the managed organic matter to be used on the land application site for the period of time needed for its application as a fertilizer or soil conditioner,

b) be located at least 15 metres from any watercourse and 30 metres from any source of water for domestic purposes, and

c) be maintained in such a manner as to prevent the escape of managed organic matter.

Storage site

19 (1) Managed organic matter may only be stored at a storage site as follows:

a) for not more than 2 weeks if it is

(i) used within 2 weeks, and

(ii) stored in a manner that prevents the escape of managed organic matter;

b) for more than 2 weeks if it is

(iii) stored for no longer than 9 months,

(iv) located at least 30 metres from any watercourse or any source of water used for domestic purposes, and

(v) stored in a manner that prevents the escape of managed organic matter.

(2) Berms or other works must be constructed around the storage site if necessary, to prevent the escape of managed organic matter.

Rainy season storage using a storage site

20 (1) This section applies to

a) Vancouver Island,

b) the Fraser Valley, and

c) any other area of British Columbia that receives a total average precipitation greater than 600 mm (24 inches) during the months of October to March inclusive.

(2) Managed organic matter that

a) is to be applied to land under a land application plan,

b) is stored at the land application site,

c) is not stored in a storage facility, and

d) must be covered from October 1 to March 31 of the next year to prevent the escape of managed organic matter.

As stated in the 2017 XCG Design, Operations, and Closure Plan (DOCP), there is no planned major future use of the Site. The Site may continue to receive waste as a transfer station; however, the Site will likely need to be expanded to accommodate the additional bins and stockpiles needed for a waste transfer station. The northwest corner of the Site could be transitioned into a transfer station, while the remainder of the Site would be restricted to passive use, such as wildlife habitat area, community trails, or green space. The SCRD may also consider building a transfer station closer to Sechelt and limit use of the Site to passive use. The application of a biocover system composed of organic materials such as biosolids or sludge would not impact the proposed future use of the Site.

3.2 Landfill Operational Certificate

The landfill is currently approved to operate under Operational Certificate No. 106060 issued by the MOECC on July 8, 2014. Key elements of this approval with respect to final cover include the following:

- Soil meeting the commercial land use standard as set forth in the Contaminated Sites Regulation, may be utilized for berm construction, daily, intermediate, and final cover, top dressing and landscaping. Soil with any substance with a concentration exceeding the lowest applicable numerical soil standard commercial land may only be used for internal berms, or daily or intermediate cover.
- The operational certificate holder must, to the satisfaction of the Director, take measures to minimize leachate generation, including by not limits to, providing effective covering and surface water runoff.
- The operational certificate holder must apply final cover to any area of the landfill which will not receive any further waste. Final cover must be applied in accordance with the design and operating plan required and at a minimum must consist of a at least 1.0 metre of low permeability ($<1 \times 10^{-5}$ cm/s) compacted soil (or equivalent) cap plus a minimum of 0.15 metre of topsoil and suitable vegetative cover, or as approved by the Director.

A copy of the Operational Certificate is included as Appendix A

Should the SCRD decide to proceed with applying a biocover system, an amendment to the Sites DOCP would be required. The current DOCP is approved by the MOECC and does not allow for this form of final cover system.

3.3 Technologies & BMPs for Reducing GHG Emissions from Landfills

The MOECC's 2011 Technologies and Best Management Practices for Reducing GHG Emissions from Landfills Guidelines is a guiding document for the selection of technologies and best management practices (BMPs) for reducing GHG emissions specifically from municipal solid waste landfills in BC. The document contains a BMP Decision tool to help determine which BMPs and technologies are most suitable and feasible for reducing LFG emissions based on landfill site condition criteria such as landfill stage, LFG generation, and LFG collection system as described below.

- Landfill stage – active: refers to sites that are currently accepting waste and have yet to undergo full closure, as well as sites that are transitioning towards closure.
- Estimated LFG Generation – no: Site is currently estimated to generate less than 1,000 tonnes of methane per year, based on the initial LFG Generation Assessment.
- LFG Collection System – no: a LFG collection system is not currently installed at the Site.

Based on the site condition criteria, one of the recommended BMPs is a biocover because the Site is active, produces less than 1,000 tonnes of CO2e, and does not have a landfill gas collection system.

4. BIOCOVER

4.1 Oxidation of Methane

According to the ECCC, emissions from Canadian landfills account for 20% of national methane emissions. Estimates have shown that approximately 27 million tonnes of CO2-e are generated annually from all Canadian landfills. Over the past couple of decades, the mitigation of LFG from landfill sites via LFG management systems has gained popularity. Typical approaches include the application of an active LFG collection system or improved landfill cover technologies and in some instances the integration of both.

One example of an improved landfill cover technology is a biocover system which has shown to increase the methanotrophic microorganism content in the intermediate or final cover materials and is typically implemented on top of a traditional cover layer to provide additional GHG emissions control. To do so, there needs to be an increase in the proportion of organic materials (e.g. biosolids, compost, compost screenings, and wood), which will result in increased methane oxidation and reduced GHG emissions.

Methane oxidation in landfill cover soil reduces GHG emissions from landfills and there are a number of published and peer reviewed scientific research papers that have reported methane oxidation rates of 22% to 55% through operational soil cover (Whalen et al., 1990; Chanton et al., 2009; Chanton et al., 2011). Methane oxidation can be further enhanced by using biocover systems composed of biosolids and other organic materials. In several different experiments and studies that optimize biocover properties, methane removal rates as high as 100% were achieved with an average rate of 80% to 100% (Kettunen et al., 2006, Berger et al. 2005, Humer and Lechner, 1999). Although oxidation rates ranging from 80% to 100% have been achieved the methane oxidation potential of a biocover is controlled by several factors, including soil temperature, moisture content, pH, and nutrient content. Material composition is also an important factor, as texture and grain size affect oxygen diffusion into the landfill cover. The thickness and moisture-holding capacity of the biocover affects the retention time of the transported methane within the cover and controls the amount of oxidation that occurs (Stern et al., 2007).

4.2 Materials

A biocover typically consists of a methane degradation layer (e.g. organic materials) on top of a gas distribution layer (e.g. gravel) of varying type, engineered properties, and depth. The methane degradation layer contains a higher proportion of methanotrophic microorganisms than conventional cover materials (e.g. clay soils), enabling it to oxidize larger volumes of methane, converting it to carbon dioxide gas, which is considered to have 21 times less global warming potential than methane gas. The gas distribution layer provides a mechanism for the gas to be evenly distributed throughout the biocover to provide optimal conditions for methane oxidation (MOECC Technologies and Best Management Practices for Reducing GHG Emissions from Landfills Guidelines, 2011).

Typical materials used for the methane layer include a mixture of biosolids, compost, compost screenings, and wood. For the gas distribution layer, the most common and best suited material is a porous gravel to allow for gas to be evenly distributed throughout the biocover. All the materials required for a biocover system are available in the surrounding areas of the Site. The ideal biocover elements include (Huber-Humer et al., 2009):

- Bulk density 0.8-1.1 kg/L
- Moisture content 30-50%w/w
- Water holding capacity 50-130% DM
- Air filled pore volume >25% v/v
- Particle size distribution 0.063-2mm:20-30;2-6.3mm:ca.40; 6.3-20mm:20-40; >20mm:ca 10
- Conductivity <4 mS/cm
- pH value 6.5-8.5
- SO_4^{2-} >500 ppm DM
- NH_4^+-N <400 ppm DM
- NO_2^--N <0.1 ppm DM
- NO_3^--N No limit value
- P_{total} >0.3% DM
- N_{total} >0.5 % DM
- Organic content >15% DM
- TOC >7 % DM

The thickness of methane degradation layer used in this Evaluation is 0.65 metres and the gas distribution layer is 0.3 metres. Several studies recommend 1.2 metres and 0.5 metres for the methane degradation layer and gas distribution layer respectively but for the purpose of this Evaluation and to compare costs of permitted final cover to biocover, the lesser thicknesses were used (Kaur-Mikk Pehme et al., August 2020). If the SCRD decides to proceed with implementing a biocover system on the Final Closure area and for the purpose of obtaining maximum GHG reductions, the recommended thickness of 1.2 metres would instead be used.

The current final cover used at the Site is a composite final cover composed of the following elements:

- Mixed vegetation;
- 0.15 metres organic soil;
- 0.50 metres native soil;
- Lateral drainage layer, consisting of DRAINTUBETM (a collection system consisting of small collection tubes surrounded by geotextile);

- Low-density polyethylene (LDPE) geomembrane; and
- 0.30 metres sand (LFG collection layer).

The recommended biocover is composed of the following elements:

- Mixed vegetation;
- 0.65 metres Biosoil and compost screenings or 0.195 metres septage solids/dried sludge and 0.455 metres compost screenings; and
- 0.30 metres drain rock.

For this Evaluation, the following materials for a biocover were investigated:

- Chapman Creek Water Treatment Plant – sludge (after dewatering for one year);
- Dusty Road Facility (DRF) – septage solids or biosolids; and
- Salish Soils – Biosoils, compost screenings, wood chips, and drain rock.

It should be noted that the above materials are all locally available and in close proximity to the Sechelt Landfill.

The evaluation of the materials included phone conversations and/or emails with staff from each of the three material supply options. Staff confirmed material content, mixtures, and quantities which have been described in detail below.

The septage solids from the DRF have 50% volatiles, have more sand content, and are not overly strong in organic content which is more ideal for methane oxidation. More mature material oxidizes methane better than fresh material which can do the opposite.

The District of Sechelt currently has 1,700 tonnes of septage solids dewatering in Geotubes at the DRF. This amount of material is produced every two years which is more than adequate material for the application of a biocover on the Final Stage at the Site.

Chapman Creek Water Treatment Plant produces a sludge comprised of dewatered solids (2%) and backwash water (<0.1%) that will be sent for drying. This material could also be used in the biocover mixture.

Salish Soils is a composting facility on a 10-acre site located 4 kilometres from the Site. Approximately 9,175 cubic metres per year of compost material is produced at this facility. This amount of compost is on the lower end of what would be required to cover the Final Stage but the facility has the capability to stockpile and store compost material on-site until needed if they are given ample time to do so. The composting facility also currently has 1,529 to 2,294 cubic metres of compost screenings and wood that are ready for use. Salish Soils produce several different kinds of compost one of which contains biosolids from Sechelt District called Biosoil. The Biosoil product can be mixed at various concentrations ranging from 25% to 40% biosolids mixed normally with 60% to 75% sand but for the biocover it would instead be mixed with compost screenings and wood for better methane oxidation. For this Evaluation, 30% biosolids and 70% compost screenings and wood were chosen because it best meets the properties listed in Section 4.2, which allow for moisture concentrations up to 50%.

The second reason for the 30% mix choice is due to the increase in cost as the organic content increases.

If the SCRD decides to proceed with implementing a biocover on the Final Stage, a procurement process would have to be completed for sourcing the materials. The material supply options listed above are only potential material sources and may not be the ultimate sources of materials.

5. TECHNICAL FEASIBILITY

5.1 Material Supply Scenarios

For this Evaluation two different scenarios are presented, keeping in mind that if the SCRD were to proceed with either scenario, a procurement process would need to be completed. The first scenario has all materials delivered to and mixed at a third-party location and the second scenario has all materials delivered to and mixed at the Site.

5.2 Material Supply Scenario One (Third-Party)

Scenario One evaluates the mixture of Biosoils (30%) and compost screenings and wood (70%) for the methane degradation layer and drain rock for the gas distribution layer. All these materials would be mixed, where applicable, on-site at a third-party location and then delivered to the Site.

5.3 Material Supply Scenario Two (the Site)

Scenario Two will have the septage solids and/or the dried sludge, and compost screenings, wood, and drain rock delivered directly to the Site. The material would then be stored and mixed at the Site and used as needed. If material is stored at the Site, berms or other works and a shelter to cover the material would need to be constructed for the Site to comply with the OMRRR of BC.

5.4 Other Resources

The only additional resources that would be required are trucks to transport the material and equipment to mix, spread, and maintain the material. All these costs have been incorporated into the cost per metre squared which is provide in more detail in Section 6.

5.5 Pilot Scale Biocover System

If the SCRD were to proceed with Phase Two, feasibility of the biocover system would be investigated for implementation on the Final Closure area and include implementing a pilot scale biocover system on a portion of the tarped off area which currently does not have final cover. As per Section 4.2, the materials required to construct a pilot scale biocover on a portion of the tarped off area and to implement a biocover on the Final Stage of the Site are local and readily available. The 2017 DOCP outlines that Stage H will be closed in the spring of 2021 which will not align with the timeline for Phase Two of the Evaluation and as such will be excluded from this Evaluation. Additionally, an amendment to the existing DOCP would be required if the SCRD decides to proceed with implementing a biocover system on the Final Closure area as a permanent cover for the Sechelt Landfill. The DOCP would need to be submitted to the MOECC for approval prior to implementing the biocover system. An amendment would not be required for the pilot scale biocover if it is removed after the program is complete.

5.6 Operational Concerns

In discussions with the SCRD, concerns were raised about the negative impacts on the Site that could result from the implementation of a biocover system. The SCRD had specific concerns regarding leachate quantity and quality as well as slope stability and how a biocover would integrate/intersect with the geomembrane liner.

5.6.1 Leachate Quantity

The biocover can be designed in a manner to allow for moisture retention and evaporation, such as an evapotranspiration cover. The SCRD is in an area of moderate potential evapotranspiration. The existing final cover design for the landfill promotes runoff and reduces water retention in the cover materials. A biocover and evapotranspiration cover would still encourage runoff, however the materials would be chosen to retain water and allow it to evaporate.

Using the Hydraulic Evaluation of Landfill Performance Model (HELP Model), the original cover design estimated approximately 50% of the annual precipitation for the Site would be runoff to the surface water conveyance system. Of the remaining 50% of the precipitation approximately 3% (25 mm) would infiltrate through the final cover and be considered leachate. The remaining 47% would evaporate.

The biocover design would drastically decrease the amount of precipitation runoff. The HELP Model estimates approximately 5% of the annual precipitation would be runoff to the surface water conveyance system and approximately 75% of the annual precipitation would evaporate, leaving 20% (225 mm) of the annual precipitation to infiltrate the final cover and be considered leachate.

5.6.2 Leachate Quality

During Phase Two of the Evaluation XCG would collect samples of the proposed biocover materials and have them tested for Toxicity Characteristic Leaching Procedure (TCLP). The TCLP analysis provides an indication of the impacts a material that is being proposed for use in the final cover would have on the quality of the leachate in the landfill. In the past (February 2013) TCLP testing was conducted on biosolids being disposed of at the Site and the same process would be used for the proposed biocover materials. This testing would confirm if the implementation of a biocover will impact leachate quality.

5.6.3 Slope Stability

During Phase Two of the Evaluation XCG would conduct a geotechnical assessment of the proposed biocover materials. Currently, biocovers are being used across BC and North America with no known slope stability issues. As such, XCG does not anticipate any slope stability issues with the implementation of a biocover.

As part of the geotechnical assessment, XCG will evaluate the interface between the current final cover and the proposed biocover for stability issues. As stated above there are numerous sites across BC and North America with a similar interface between geomembrane covers and biocovers. As such, XCG does not anticipate and slope stability issues at the interface of the two cover systems.

6. FINANCIAL FEASIBILITY

6.1 Stage B Closure - 2013

The slope and impermeability of the current Stage B final cover system will likely limit the applicability of a biocover on this section. The SCRD has already invested a significant amount of money into the placement of the approved final cover and it would not be economically feasible to remove and replace the final cover with a biocover. For the purposes of this Evaluation, a biocover is only considered for the Final Stage of the Site (31,000 m^2) which will close at the end of 2026. For both scenarios presented below, labour and contractor costs have been included but neither one includes contract administration, engineering, mobilization, and demobilization.

6.2 Material Supply Scenario One (Third-Party) Costs

A detailed breakdown of the costs associated with Scenario One implementation for the Final Stage Closure is presented in Table 2. The cost associated with Scenario One for the Final Stage Closure $1,102,980. The total costs for implementing the Scenario One biocover is $1,093,370 less than the currently permitted final cover. These costs include all materials, transportation, placement, grading, and compaction.

6.3 Material Supply Scenario Two (the Site) Costs

A detailed breakdown of the costs associated with Scenario Two implementation for the Final Stage Closure is presented in Table 2. The cost associated with Scenario Two for the Final Closure $758,260. The total costs for implementing the Scenario Two biocover is $1,438,090 less than the currently permitted final cover. These costs include all materials, transportation, placement, grading, and compaction. The only additional costs, if the SCRD were to proceed with Scenario Two, would be for a 3.0 by 3.65 metre shelter and berms around the material to protect the material from the weather, prevent it from escaping the Site. The approximate cost to complete the Site improvements to comply with the OMRRR of BC is $15,000 to $20,000.

7. COST BENEFITS ANALYSIS

The cost benefits analysis assesses GHG savings and emissions avoided, as well as the cost to purchase carbon offsets.

7.1 Methane and CO2-e Production

As per the 2013 XCG Landfill Gas Management Summary, peak methane emission rates for 2009 through 2014 were less than 1,000 tonnes per year. As such, the Site was not regulated to install a LFG collection system.

The 2019 XCG GHG Emissions Assessment for the Site and determined that 804 tonnes of methane or 20,101 tonnes of CO2-e were produced at the Site which exceeded the ECCC threshold for GHG reporting of 10,000 tonnes of CO2-e per year. Based on this report, methane and CO2-e projections for 2027, after the landfill is closed, without a curbside organics diversion program or a food waste ban, will be 901 tonnes or 22,521 tonnes per year respectively.

According to the 2017 DOCP, the Final Stage will be able to accept 12,804 tonnes of waste. A food waste ban implemented at the beginning of 2022 could divert up to 2,300 tonnes of organics from this stage of the Sechelt Landfill. The food waste ban would reduce the methane produced annually by 24 tonnes annually beginning in 2023 from 854 tonnes (21,348 tonnes CO2-e) to 830 tonnes (20,753 tonnes CO2-e) and by 99 tonnes in 2027 (the first year after the Site is closed), from 901 tonnes (22,521 tonnes CO2-e) to 802 tonnes (20,049 tonnes CO2-e). By 2035, the CO2-e would be below the 10,000 tonne of CO2-e per year limit at 9,764 tonnes.

If a food waste ban were implemented along with a biocover on the Final Stage at 80% oxidation, the methane could be reduced by 642 tonnes in 2027 from 802 tonnes (20,049 tonnes CO2-e) to 160 tonnes (4,000 tones CO2-e) when the Sechelt Landfill is filled to capacity. Emissions would be below the 10,000 tonnes of CO2-e per year limit for reporting the year the biocover is constructed if 80% oxidation occurred on all the methane emitted.

A large amount of the LFG migrates sideways or underground out of the Sechelt Landfill and not out of the top. For methane to be oxidized it needs to filter out of the top of the Sechelt Landfill and pass through the gas distribution layer and finally the methane oxidation layer. Other mechanisms that help move LFG vertically out of landfills to maximize methane oxidation would be investigated in Phase Two.

The Site is exceeding the ECCC threshold for GHG reporting of 10,000 tonnes of CO2e per year and as such, the SCRD will need to continue with annual monitoring and reporting. The threshold is in place to ensure exceedances are monitored and reported and is not an indication of non-compliance. The Site will naturally produce less LFG over the years beginning in 2026 when no material is accepted. If no curbside organics diversion program or food waste ban and biocover system were implemented, methane emissions and CO2-e would be below regulatory thresholds beginning in 2036 at 395 tonnes and 9,872 tonnes respectively, which means annual monitoring and reporting would not longer be required.

7.2 Carbon Offsets

Implementing a food waste ban and biocover on the Final Stage of the Sechelt Landfill can significantly reduce the amount of methane produced by the Site if 80% of the methane produced is oxidized. Most of the methane produced is from the organics already landfilled at the Site which means that a biocover would be more effective in reducing methane emissions when compared to implementing a food waste ban. A detailed breakdown of the GHG's can be found in Table 3 Waste and Emissions Summary.

According to the 2019 Environment and Climate Change Canada Carbon Pollution Pricing: Options for a Federal Greenhouse Gas Offset System the cost to offset the excess emissions in 2019 was $20 per tonne with costs increasing annually by $10 per tonne. In 2023, 20,753 CO2-e tonnes will be produced with a food waste ban, and at $60 per tonne the total cost to purchase carbon offsets for the excess emissions would be $645,180.

8. SUMMARY

The proposed biocover design has potential for reducing methane emissions at the Site using elements of circular economy - instead of wasting natural soils and using expensive synthetic liners for the construction of an impermeable final cover layer, functional waste-derived materials can be used instead. There are several other benefits to implementing a biocover on the Final Stage of the Sechelt Landfill.

1. Potential GHG reductions of methane from 830 tonnes (20,753 tonnes CO2-e) to 166 tonnes (4,515 tonnes CO2-e) annually in 2023 with a food waste ban.
2. Potential GHG reductions of methane from 802 tonnes (20,049 tonnes CO2-e) to 160 tonnes (4,000 tonnes CO2-e) annually in 2027 with a food waste ban and biocover on the Final Stage with 80% oxidation of all the methane emitted.
3. A significant reduction in cost of final cover by using local materials that may otherwise landfilled. Cost differences range from $1,093,370 with material being mixed at a third-party location to $1,438,090 with material mixed at the Site. Although the savings are less with having the material mixed at a third-party location this option may be preferred due to the limited space at the Site for mixing and storing biocover material.
4. Using material from the DRF and/or Chapman Water Treatment Plant, that is currently being stockpiled and will eventually be landfilled, as a final cover instead. In turn, this frees up annual tonnage capacity at the Site to accept more waste from other sources.
5. A reduction in desiccation cracking of the cover, higher soil moisture retention, reduced runoff, and improved vegetation growth (MOECC Technologies and Best Management Practices for Reducing GHG Emissions from Landfills Guidelines, 2011).

A large amount of the LFG migrates laterally or underground out of the Sechelt Landfill and not out of the top. This means that the amount of methane that could be oxidized is unknown. As part of Phase Two, a biocover system would need to be piloted and methane testing conducted before and after implementation to confirm oxidation rates. Additional and future costs such as biocover material testing and methane monitoring would be assessed in Phase Two of the Evaluation which includes a field work program described in more detail in the next section.

9. PHASE TWO EVALUATION

The actual amount of LFG that will move vertically out of the Sechelt Landfill and through the biocover system and the amount of methane that will be oxidized are unknown. These unknowns will be investigated in Phase Two which will involve the following tasks:

Task One (March/April 2021) – Slope Stability Analysis

XCG will conduct a Geotechnical Analysis of the proposed biocover materials. Along with the Geotechnical Analysis, XCG will complete the chemical analysis (including TCLP, organics content, and general chemistry) on the proposed biocover materials. If the biocover materials are found not stable XCG will not proceed to Task Two and will instead provide a summary letter explaining the results and reasons for not proceeding to Task Two. The approximate cost for Task One is $20,000.

Task Two (June/July 2021 to June/July 2022) - Biocover Pilot Program

XCG will test the effectiveness of oxidizing methane on a portion of the tarped off area over a one-year period to cover all seasons. Monthly methane gas readings will be taken along with soil moisture levels. At the time of the visit, weather conditions will be noted and the report will include the weather data from Environment Canada for the entire month. The approximate cost for Task Two, not including materials, is $69,000.

Task Three (September/October 2022) – Phase Two Biocover Evaluation Report

Based on the field program findings, a Phase Two Biocover Evaluation Report will be developed and include a summary of recommendations. There are other types of methane oxidation systems including, biofilters (passive and active), bio-windows, and bio-tarps which may be, depending on the biocover pilot program results, determined to be a better fit in place of the traditional biocover system. The approximate cost for Task Four is $12,000.

Task Four (October 2022) – Sechelt Landfill Operational Certificate Amendment

If the SCRD decides to proceed with implementing a biocover or another type of methane oxidation system on the Final Closure a detailed timeline with firmed up tasks and costs will be provided. XCG will update the DOCP to include the final cover material and thickness changes and submit it to the MOECC. Once the MOECC approves the DOCP, XCG will fill out the application to have the Sechelt Landfill Operational Certificate amended. An approximate response time of four to six months can be anticipated and will align with the next required DOCP submission in 2022. The approximate cost for Task Three is $4,000.

The total cost for Phase Two is approximately $105,000.

It should be noted that at any point during the Phase Two Evaluation if the XCG and the SCRD determines that a biocover will negatively impact the Sechelt Landfill, XCG will discontinue work on the Evaluation and a summary letter will be prepared in lieu of a full report.

10. REFERENCES

1. Berger, J., L.V. Fornés, C. Ott, J. Jager, B. Wawra, and U. Zanke, "Methane Oxidation in a Landfill Cover with Capillary Barrier. Waste Management 25:369–373," 2005.
2. British Columbia Ministry of Environment and Climate Change Strategy, "Landfill Criteria for Municipal Solid Waste," June 2016.
3. British Columbia Ministry of Environment and Climate Change Strategy, "Technologies and Best Management Practices for Reducing GHG Emissions from Landfill Guidelines," June 2011.
4. Chanton, J. P., D. K. Powelson, et al., "Methane Oxidation in Landfill Cover Soils, is a 10% Default Value Reasonable?" J. Environ. Qual. 38(2): 654-663," 2009.
5. Chanton, J., T. Abichou, et al., "Observations on the methane oxidation capacity of landfill soils." Waste Management 31(5): 914-925," 2011.
6. Huber-Humer, M., Roder, S., and Lechner, P, "Approaches to assess biocover performance on landfills. Waste Management 29: 2092-2104," 2009.
7. Humer, M.; and P. Lechner, "Alternative approach to the elimination of greenhouse gases from old landfills. Waste Management Research. (17), 443-452," 1999.
8. Infrastructure Services Committee, "Sunshine Coast Regional District Infrastructure Services Committee Agenda Package, SCRD Boardroom, 1975 Field Road, Sechelt British Columbia," October 2019.
9. Kaur-Mikk Pehme et al., "Field Study on the Efficiency of a Methane Degradation Layer Composed of Fine Fraction Soil from Landfill Mining," August 2020.
10. Kettunen, R., J. M. Einola, and J. A. Rintala, "Landfill methane oxidation in engineered soil columns at low temperature. Water, Air and Soil Pollution. 177: 313-334," 2006.
11. Majdinasab, Alireza, and Qiuyan Yuan, "Performance of the Biotic Systems for Reducing Methane Emissions from Landfill Sites: A Review." Ecological Engineering 104:116–30," 2017.
12. Stern, J. C., J. Chanton, et al., "Use of a biologically active cover to reduce landfill methane emissions and enhance methane oxidation. Waste Management 27(9): 1248-1258," 2007.
13. Whalen, S. C., W. S. Reeburgh, et al., "Rapid Methane Oxidation in a Landfill Cover Soil. Applied and Environmental Microbiology 56(11): 3405-3411," 1990.
14. XCG Consulting Limited, "Design, Operations, and Closure Plan, Sechelt Landfill, Sechelt, British Columbia," December 2017.
15. XCG Consulting Limited, "2018 Greenhouse Gas Emissions Assessment, Sechelt Landfill, Sechelt, British Columbia," April 2019.

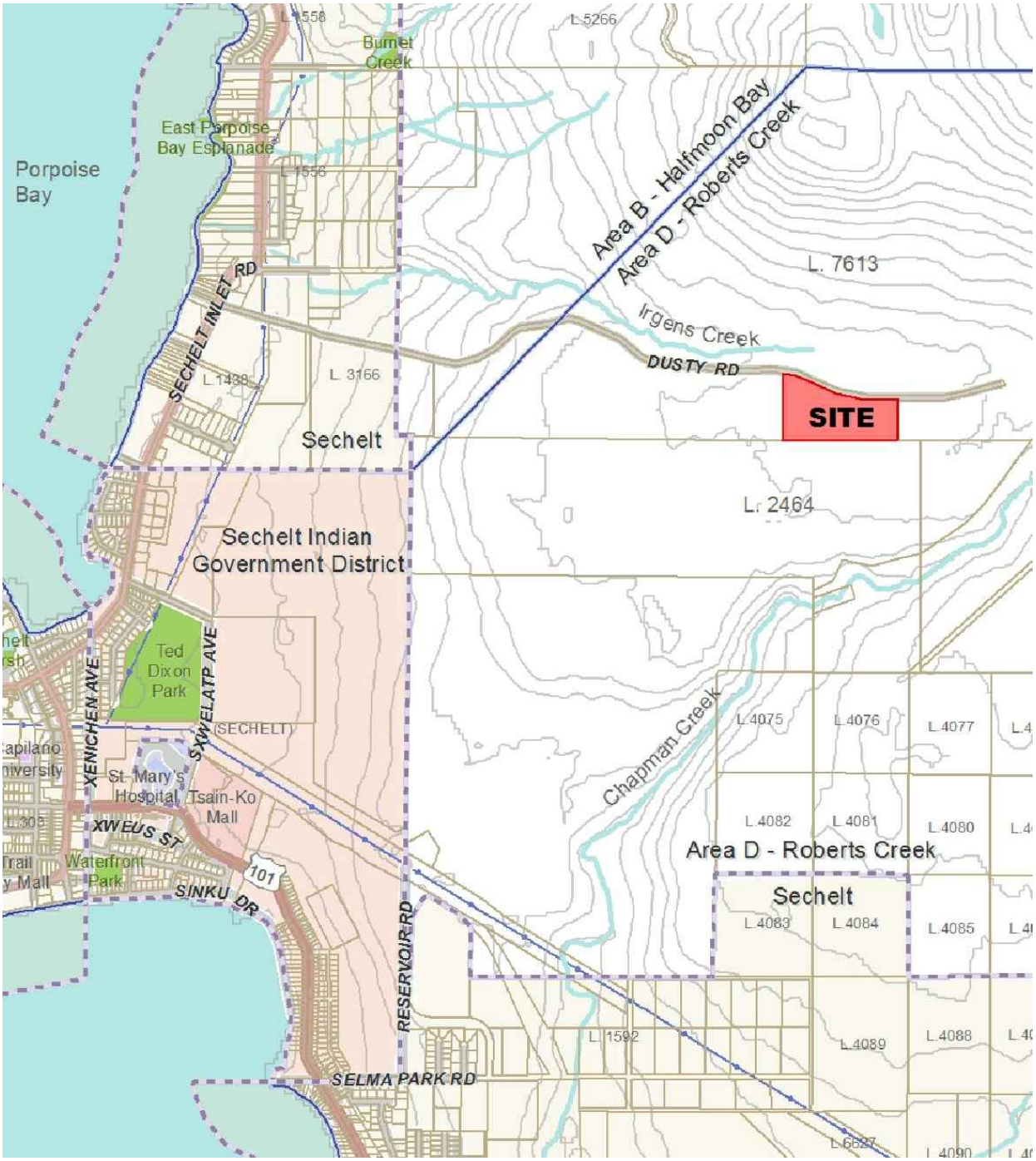
16. XCG Consultants Ltd., "Interim Design, Operations, and Closure Plan, Sechelt Landfill, Sechelt, British Columbia," September 2012.

17. XCG Consultants Ltd., "Landfill Gas Management Summary, Sechelt Landfill, Sechelt, British Columbia," January 2013.

18. XCG Consultants Ltd., "2015 Landfill Gas Pumping Test, Sechelt Landfill, Sechelt, British Columbia," January 2015.

19. XCG Consultants Ltd., "Landfill Gas Utilization Feasibility Analysis, Sechelt Landfill, Sechelt, British Columbia," September 2012.

FIGURES



0 500 1000 m

1 : 25000

SITE LOCATION MAP

BIOCOVER EVALUATION - PHASE ONE
SECHELT LANDFILL
SUNSHINE COAST REGIONAL DISTRICT

XCG
Environmental Engineers & Scientists

DATE	JOB NO.	FIGURE NO.
DEC 2020	4-2111-01-76	1

(file: R421110176001FIG01.dwg)

DUSTY ROAD

SHARE SHED

GATE/PUBLIC ENTRANCE

OFFICE TRAILER

POWER SHED

SCALE HOUSE

SPECIAL WASTE STORAGE

MAINTENANCE SHED

CONVEYANCE DITCH FROM SECHELT SPRING (LOCATED BY SCRD)

PUBLIC TIPPING AREA

CONTACT WATER POND

FOREBAY

GATE

0 20 40 m

1 : 1500

LEGEND

- PROPERTY BOUNDARY
- APPROXIMATE LIMIT OF WASTE
- APPROXIMATE FENCE LINE
- EXISTING CONTOURS
- EXISTING ASPHALT ROAD
- EXISTING GRAVEL ROAD
- EXISTING BUILDING
- EXISTING CULVERT
- EXISTING SURFACE WATERCOURSE
- EXISTING STORMWATER GRAVITY MAIN

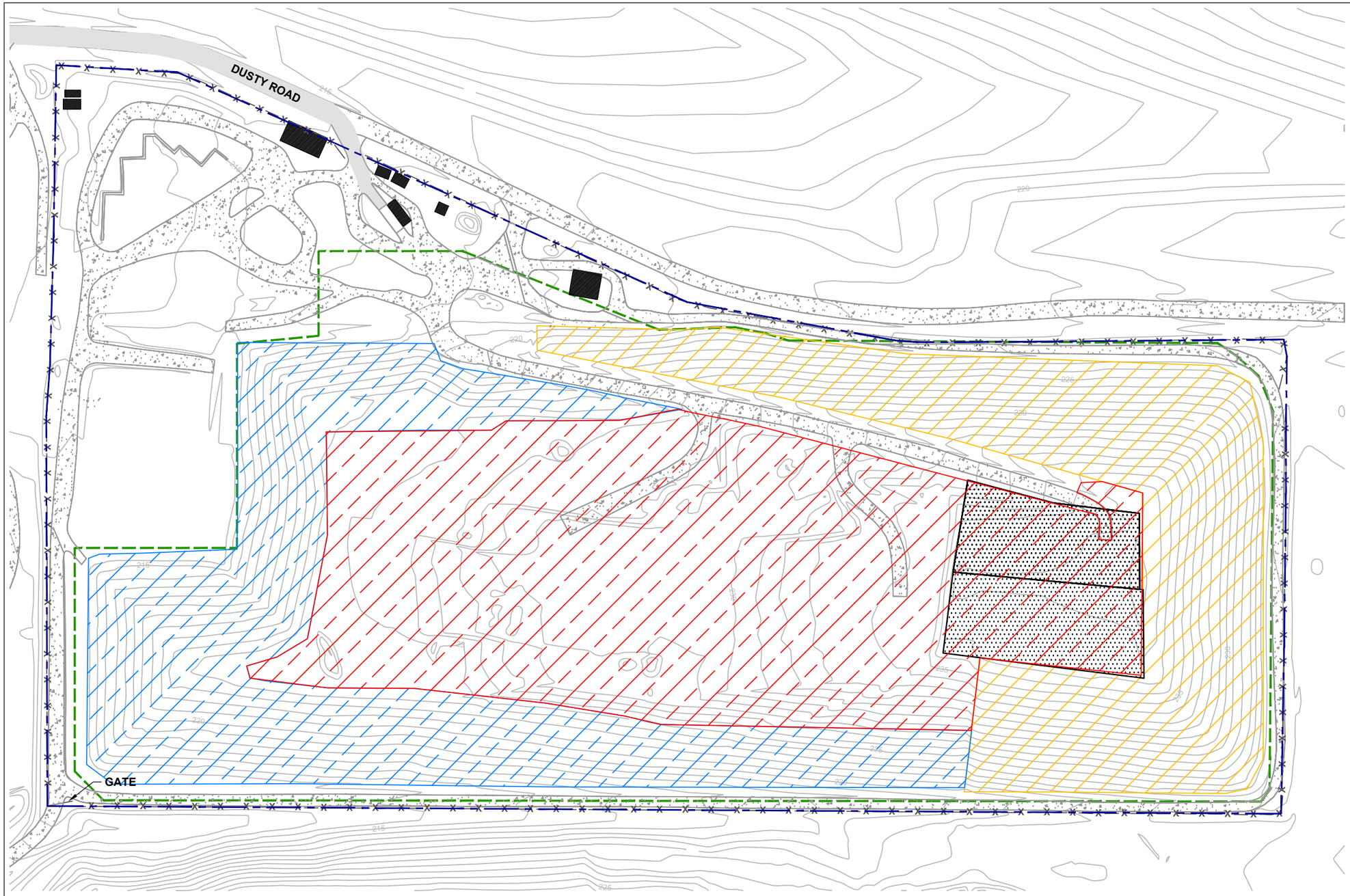
NOTES: EXISTING CONDITIONS AS OF NOVEMBER 29, 2019 (file: R421110176001FIG2.dwg)

EXISTING SITE FACILITIES

BIOCOVER EVALUATION - PHASE ONE
SECHELT LANDFILL
SUNSHINE COAST REGIONAL DISTRICT

XCG CONSULTING LTD.

DATE	JOB NO.	FIGURE NO.
DEC 2020	4-2111-01-76	2



0 20 40 m

1 : 1500

LEGEND

- PROPERTY BOUNDARY
- APPROXIMATE LIMIT OF WASTE
- APPROXIMATE FENCE LINE
- EXISTING CONTOURS
- EXISTING ASPHALT ROAD
- EXISTING GRAVEL ROAD
- EXISTING BUILDING
- EXISTING STAGE B CLOSURE (2013)
- EXISTING TARPED AREA
- PROPOSED STAGE H CLOSURE (2021)
- PROPOSED FINAL CLOSURE (2026)

NOTES: EXISTING CONDITIONS AS OF NOVEMBER 29, 2019 (file: R421110176001FIG2.dwg)

STAGES OF LANDFILL CLOSURE

BIOCOVER EVALUATION - PHASE ONE
SECHELT LANDFILL
SUNSHINE COAST REGIONAL DISTRICT

XCG CONSULTING LTD.

DATE	JOB NO.	FIGURE NO.
DEC 2020	4-2111-01-76	3

TABLES

Table 1 Existing Final Cover Design Costs

Final Closure	Thickness (m)	$/m^2 in 2026 Funds	31,000 m^2
Organic Soil	0.15	$11.90	$368,900.00
Native Soil	0.50	$12.25	$379,750.00
LDPE	0.001	$18.20	$564,200.00
Draintube	0.001	$20.30	$629,300.00
Sand	0.30	$8.20	$254,200.00
TOTAL	**0.95**	**$70.85**	**$2,196,350.00**

Table 2 Biocover Costs for Final Closure

Mixed at a Third Party Location	Thickness (m)	Area (m2)	$/m2 in 2026 Funds	Cost
Methane Oxidation Layer (Biosoil @ 30% & Compost screenings/wood @ 70%)	0.65	31,000	$17.97	$557,070.00
Gas Distribution Layer (drain rock)	0.30	31,000	$9.12	$282,720.00
Material Placement, Grading and Compaction (If Required)	1.00	31,000	$8.49	$263,190.00
TOTAL	**1.95**	**93,000**	**$35.58**	**$1,102,980.00**

Mixed at Site	Thickness (m)	Area (m2)	$/m2 in 2026 Funds	Cost
Methane Oxidation Layer (Septage Solids @ 30%)	0.195	31,000	$0.00	$0.00
Methane Oxidation Layer (compost screenings/wood @ 70%)	0.455	31,000	$2.32	$71,920.00
Gas Distribution Layer (drain rock)	0.30	31,000	$9.12	$282,720.00
Material Mixing	1.00	31,000	$4.53	$140,430.00
Material Placement, Grading and Compaction (If Required)	1.00	31,000	$8.49	$263,190.00
TOTAL	**2.95**	**155,000**	**$24.46**	**$758,260.00**

Table 3 Waste and Emissions Summary

Year	MSW (tonnes)	Relatively Inert (tonnes)	Mod. Decomp. (tonnes)	Decomposable (tonnes)	Decomposable (tonnes) with Organics Ban	Total MSW Landfilled	C02e Emissions (tonnes/year)	C02e Emissions (tonnes/year) with Organics Ban
1989	12,000	2,160	3,600	6,240	6,240	24,000		
1990	12,000	2,160	3,600	6,240	6,240	36,000		
1991	12,000	2,160	3,600	6,240	6,240	48,000		
1992	12,000	2,160	3,600	6,240	6,240	60,000		
1993	17,062	3,071	5,119	8,872	8,872	77,062		
1994	11,684	2,103	3,505	6,076	6,076	88,746		
1995	11,574	2,083	3,472	6,018	6,018	100,320		
1996	11,532	2,076	3,460	5,997	5,997	111,852		
1997	11,884	2,139	3,565	6,180	6,180	123,736		
1998	10,658	1,918	3,197	5,542	5,542	134,394		
1999	11,054	1,990	3,316	5,748	5,748	145,448		
2000	10,514	1,893	3,154	5,467	5,467	155,962		
2001	11,036	1,986	3,311	5,739	5,739	166,998		
2002	10,992	1,979	3,298	5,716	5,716	177,990		
2003	11,647	2,096	3,494	6,056	6,056	189,637		
2004	13,375	2,408	4,013	6,955	6,955	203,012		
2005	13,741	2,473	4,122	7,145	7,145	216,753		
2006	13,436	2,418	4,031	6,987	6,987	230,189		
2007	12,630	2,273	3,789	6,568	6,568	242,819		
2008	11,639	2,095	3,492	6,052	6,052	254,458		
2009	11,784	2,121	3,535	6,128	6,128	266,242		
2010	11,510	2,072	3,453	5,985	5,985	277,752		
2011	11,108	1,999	3,332	5,776	5,776	288,860		
2012	10,524	1,894	3,157	5,472	5,472	299,384		
2013	9,071	1,633	2,721	4,717	4,717	308,455		
2014	10,446	2,507	2,820	5,119	5,119	318,901		
2015	11,067	2,656	2,988	5,423	5,423	329,968		
2016	12,667	3,040	3,420	6,207	6,207	342,635		
2017	12,976	3,114	3,504	6,358	6,358	355,611		
2018	13,191	3,166	3,562	6,464	6,464	368,802		
2019	13,500	3,240	3,645	6,615	6,615	382,302		
2020	13,635	3,272	3,681	6,681	6,681	395,937		
2021	13,771	3,305	3,718	6,748	6,748	409,708	20,737	20,737
2022	13,909	3,338	3,755	6,815	4,512	423,618	21,045	21,045
2023	14,048	3,372	3,793	6,884	4,557	437,666	21,348	20,753
2024	14,189	3,405	3,831	6,952	4,603	451,854	21,646	20,512
2025	14,331	3,439	3,869	7,022	4,649	466,185	21,941	20,317
2026	14,474	3,474	3,908	7,092	4,695	480,659	22,232	20,164
2027	0	0	0	0	0	480,659	22,521	20,049
2028	0	0	0	0	0	480,659	20,495	18,280
2029	0	0	0	0	0	480,659	18,662	16,678
2030	0	0	0	0	0	480,659	17,005	15,227
2031	0	0	0	0	0	480,659	15,504	13,912
2032	0	0	0	0	0	480,659	14,146	12,720
2033	0	0	0	0	0	480,659	12,915	11,638
2034	0	0	0	0	0	480,659	11,800	10,656
2035	0	0	0	0	0	480,659	10,789	9,764
2036	0	0	0	0	0	480,659	9,872	8,953

APPENDIX A
OPERATIONAL CERTIFICATE NO. 106060

BRITISH COLUMBIA

July 8, 2014

Tracking Number: 243546
Authorization Number: 106060

REGISTERED MAIL

SUNSHINE COAST REGIONAL DISTRICT
1975 FIELD ROAD
SECHELT, BC
V0N 3A1

Dear Operational Certificate Holder:

Enclosed is Operational Certificate 106060 issued under the provisions of the *Environmental Management Act*. Your attention is respectfully directed to the terms and conditions outlined in the operational certificate. An annual fee will be determined according to the Permit Fees Regulation.

Please be aware that the following documents are required for submission by the specified dates set forth in the operational certificate:

- A hydrogeologic characterization and impact assessment of the landfill by August 31, 2015;
- An updated design and operating plan by December 31, 2017;
- An geotechnical and seismic assessment by April 30, 2018
- An environmental monitoring plan by April 30, 2018
- A leachate management plan for the landfill, acceptable to the Director, by December 31, 2015; and
- An annual report for the preceding 12 month period from January 1 to December 31 must be submitted to the Regional Director, Environmental Protection, by March 31 of each year.

This operational certificate does not authorize entry upon, crossing over, or use for any purpose of private or Crown lands or works, unless and except as authorized by the owner of such lands or works. The responsibility for obtaining such authority rests with the operational certificate holder. It is also the responsibility of the operational certificate holder to ensure that all activities conducted under this authorization are carried out with regard to the rights of third parties, and comply with other applicable legislation that may be in force.

.../2

This decision may be appealed to the Environmental Appeal Board in accordance with Part 8 of the *Environmental Management Act*. An appeal must be delivered within 30 days from the date that notice of this decision is given. For further information, please contact the Environmental Appeal Board at (250) 387-3464.

Administration of this operational certificate will be carried out by staff from the Coast Region. Plans, data and reports pertinent to the operational certificate are to be submitted to the Regional Director, Environmental Protection, at Ministry of Environment, Regional Operations, Coast Region, 2nd Floor, 10470 - 152 Street, Surrey, BC V3R 0Y3.

Yours truly,

Avtar S. Sundher BSc.
for Director, *Environmental Management Act*
Coast Region

Enclosure

cc: Environment Canada

BRITISH COLUMBIA

MINISTRY OF ENVIRONMENT

OPERATIONAL CERTIFICATE

106060

Under the Provisions of the Environmental Management Act and

in accordance with the Sunshine Coast Regional District's

Solid Waste Management Plan

SUNSHINE COAST REGIONAL DISTRICT
1975 FIELD ROAD
SECHELT, BC
V0N 3A1

is authorized to manage municipal solid waste / recyclable material and discharge residual solid waste to the ground at the Sechelt Landfill located at 4901 Dusty Road, Sechelt, British Columbia, subject to the conditions listed herein. Contravention of any of these conditions is a violation of the *Environmental Management Act* and may result in prosecution.

This Operational Certificate supersedes and cancels all previous versions of the permit PR-02547 issued under the authority of the *Environmental Management Act*.

1. AUTHORIZED DISCHARGES

1.1 This section applies to the discharge of municipal solid waste and contaminated soil to the Sechelt Landfill. The discharge of municipal solid waste must be restricted to sources within the Sunshine Coast Regional District. The site reference number for this discharge is E208123.

Date issued: July 8, 2014

Avtar S. Sundher BSc.
for Director, *Environmental Management Act*
South Coast Region

1.1.1 The discharge is authorized by the Sunshine Coast Regional District's approved solid waste management plan. The maximum rate of discharge is 15,000 metric tonnes per year.

1.1.2 The characteristics of the discharge must be municipal solid waste as defined in the *Environmental Management Act* and include other material as specifically authorized by the Director. Waste asbestos may be discharged in accordance to Section 40 of the Hazardous Waste Regulation and in accordance with the Sunshine Coast Regional District's bylaws.

Materials prohibited from discharge include hazardous waste (excluding asbestos), liquids, semi-solid waste, biomedical waste and the following:

- Recyclable Materials including:
  a. used white goods,
  b. auto hulks and other large metallic waste,
  c. used tires,
  d. used lead acid batteries,
  e. gypsum wallboard, and
  f. corrugated cardboard.

- any other waste and/or recyclable material regulated under the Ministry's Recycling Regulation when alternate disposal options become available;

- other materials banned by the regional district in implementing the Sunshine Coast Regional District's solid waste management plan or bylaws; and

- other materials which may be designated by the Director when alternative disposal becomes available.

1.1.3 Waste must not be discharged into water or within a buffer zone as identified in Section 2.9, 2.10 and 2.11. The burning of waste is prohibited.

1.1.4 The authorized works common to this section and Section 1.2 and 1.3 are a sanitary landfill, locking gate to control access by the public, weigh scale and related appurtenances, approximately located as shown on Site Plan A.

Date issued: July 8, 2014

Avtar S. Sundher BSc.
for Director, *Environmental Management Act*
South Coast Region

1.1.5 The authorized works specific to this section are those associated with a landfill operation and include berms, covering material, electrified bear fence, surface water diversionary works and environmental monitoring systems, approximately located as shown on attached Site Plan A and Site Plan B.

1.1.6 The authorized works must be complete and in operation while discharging.

1.1.7 The legal description of the location of the area of discharge is:

Block C, District Lot 7613, Group 1, New Westminster District.

1.1.8 The civic address of the Sechelt Landfill is 4901 Dusty Road, Sechelt, BC.

1.2 This section applies to a public drop off and recycling area for the management of municipal solid waste and recyclable material from sources within the Sunshine Coast Regional District.

1.2.1 The types of materials which may be managed in this area include waste as set out in Section 1.1.2, and typical recyclable materials.

1.2.2 The quantity of recyclable material that may be stored is limited to the capacity that can be reasonably handled on the site.

1.2.3 The authorized works are those associated with a public drop of and recycling area and include an access area, roll-off bins and related appurtenances approximately located as shown on Site Plan A.

1.2.4 The facility is located on a portion of Block C, District Lot 7613, Group 1, New Westminster District.

1.3 This section applies to a return collection facility for the management of household hazardous waste from sources within the Sunshine Coast Regional District.

1.3.1 The operational certificate holder must obtain the necessary approvals prior to commencement of operation of the return collection facility and ensure compliance with all applicable legislation. The operational certificate holder must notify the Director at least 30 days prior to commencement of operations.

Date issued: July 8, 2014

Avtar S. Sundher BSc.
for Director, *Environmental Management Act*
South Coast Region

1.3.2 The types of material which may be managed at this facility are typical household hazardous wastes.

1.3.3 The quantity of household hazardous waste that may be stored must be in accordance with the Hazardous Waste Regulation and is limited to the registration quantity as a return collection facility.

1.3.4 The authorized works are those associated with a return collection facility and include an access area, a secured storage area for household hazardous waste and related appurtenances approximately located as shown on Site Plan A.

1.3.5 The facility location is proposed to be on a portion of Block C, District Lot 7613, Group 1, New Westminster District.

1.3.6 The operational certificate holder must submit an updated Site Plan A at least 30 days prior to commencement of operations.

2. DESIGN AND PERFORMANCE REQUIREMENTS

2.1 Design and Operating Plan

The operational certificate holder must operate the facilities authorized in Section 1 in accordance with a design and operating plan certified by a qualified professional. The operational certificate holder must submit an updated design and operating plan of the existing landfill authorized in Section 1, acceptable to the Director. The plan must address each of the subsections in the Landfill Criteria for Municipal Solid Waste (June 1993, or the most recent version) including performance, siting, design, operational, closure and post-closure criteria and the Guideline for Environmental Monitoring at Municipal Solid Waste Landfills (January 1996 or the most recent version).

The plan must include, but is not limited to, information regarding:

- A fill strategy for the design capacity of the landfill. The plan must incorporate the concept of progressive closure and take into consideration environmental protection measures and the proposed end use of the site.

Date issued: July 8, 2014

Avtar S. Sundher BSc.
for Director, *Environmental Management Act*
South Coast Region

- A contingency plan (including funding) to close the landfill is to be developed prior to the design capacity being achieved should the landfill not be supported by future Sunshine Coast Regional District solid waste management plans or is closed for any other reason;
- Estimated elevations;
- Cell size, compaction details, daily, intermediate and final cover including types of materials used;
- Actions taken to ensure slope stability;
- Anticipated schedule for progressive closure activities;
- Measures to minimize leachate generation, including surface water diversion measures;
- A groundwater monitoring program in accordance with the requirements of Section 2.5;
- Recommended action plan to be undertaken as a result of the existing and subsequent leachate management assessment required in Section 3.13;
- A landfill gas management plan if required by Section 2.4 and updated in accordance with anticipated legislation changes;
- Recommended actions as a result of the existing and subsequent geotechnical, hydrogeological, landfill gas and any other assessments;
- Contingencies to address environmental protection issues, including leachate, landfill gas management and slope stability, in the event of an earthquake or any other emergency;
- Fire prevention measures;
- Operational requirements for the return collection facility for household hazardous waste, if applicable;
- List of recyclable materials accepted and how they are managed at the site;
- Incoming waste inspection, removal of unauthorized waste and staff supervision on the active face;
- Estimated closure/post closure-costs and details of how the closure/post-closure funds will be accrued;
- Measures to minimize hazards to public safety; and
- Measures to control vectors, odours, dust, wind-blown litter and scavenging.

The facilities must be developed, operated and closed in accordance with the design and operating plan. Should there be any inconsistency between this Operational Certificate and the design and operating plan, this Operational Certificate must take precedence unless otherwise agreed in writing by the Director.

Date issued: July 8, 2014

Avtar S. Sundher BSc.
for Director, *Environmental Management Act*
South Coast Region

The Interim Design and Operating Plan was submitted in December 2012. The operational certificate holder must review the design and operating plan on an annual basis to determine if changes are required. Any revisions to the design and operating plan must be certified by a qualified professional and acceptable to the Director as part of the annual report required in Section 4.6.

The operational certificate holder must also submit an updated design and operating plan every five (5) years which includes, at a minimum, any revisions submitted as part of the previous five years of annual reporting. The next design and operating plan is required by December 31, 2017

2.2 Geotechnical and Seismic Assessment

The operational certificate holder must submit a geotechnical and seismic assessment for the landfill, acceptable to the Director, which meets the Landfill Criteria for Municipal Solid Waste (June 1993, or the most recent version). The assessment must address, at a minimum, slope stability during construction, operation, and post-closure is required. The geotechnical and seismic assessment must be reviewed and updated every five (5) years hereafter. The next assessment is required by **April 30, 2018** Actions recommended in the assessment and subsequent reviews must be incorporated into the design and operating plan as required in Section 2.1. A qualified professional must conduct the assessment and subsequent reviews.

2.3 Hydrogeological Assessment

The operational certificate holder must review the hydrogeology of the landfill authorized in Section 1.1 annually and submit the results with the annual report required in Section 4.6. Actions recommended in the annual reviews must be incorporated into the design and operating plan as required in Section 2.1 and form the basis of a recommended groundwater monitoring program as required in Section 2.5. A qualified professional must conduct the annual reviews.

The operational certificate holder must submit an updated hydrogeologic characterization and impact assessment of the landfill authorized in Section 1.1 acceptable to the Director, by **August 31, 2015.** The assessment must meet the Landfill Criteria for Municipal Solid Waste (June 1993, or the most recent version) and be reviewed and updated every five (5) years hereafter. A qualified professional must conduct the assessment and subsequent reviews.

Date issued: July 8, 2014

Avtar S. Sundher BSc.
for Director, *Environmental Management Act*
South Coast Region

2.4 Landfill Gas Assessment

The operational certificate holder must submit to the Director supplemental landfill gas assessments and generation reports every five years as required under the Landfill Gas Management Regulation. Annual monitoring and reporting of landfill gas must be done in accordance with the Landfill Gas Management Regulation and the criteria set out in the Environmental Monitoring Program (EMP) in Section 2.5.

The landfill gas assessment must address, but is not limited to, each relevant subsection in the Landfill Criteria for Municipal Solid Waste (June 1993, or the most recent version) and the Guideline for Environmental Monitoring at Municipal Solid Waste Landfills (January 1996 or the most recent version). Should the assessment indicate that the nonmethane organic compounds (NMOCs) will exceed 150 tonnes/year, then the operational certificate holder must submit a landfill gas management plan, acceptable to the Director.

At any time, based on the assessment or any other information, the Director may require the installation and operation of gas recovery and pollution prevention works, including landfill gas monitoring wells. It should be noted that the Ministry of Environment has developed the Landfill Gas Management Regulation under the Greenhouse Gas Reduction (Emissions Standards) Statutes Amendment Act, 2008. The requirements of the Regulation and its guideline documents must be incorporated by the operational certificate holder into the landfill gas management plan and design and operating plan as they come into effect.

2.5 Environmental Monitoring Plan

The Operational Certificate holder must submit an Environmental Monitoring Plan acceptable to the Director by April 30, 2018. The plan must be prepared by a qualified professional and meet the requirements set forth in the Landfill Criteria for Municipal Solid Waste (June 1993, or the most recent version) and the Guideline for Environmental Monitoring at Municipal Solid Waste Landfills (January 1996 or the most recent version).

Date issued: July 8, 2014

Avtar S. Sundher BSc.
for Director, *Environmental Management Act*
South Coast Region

The operational certificate holder must review the environmental monitoring plan on an annual basis to determine if changes are required. Any revisions to the plan must be prepared and certified by a qualified professional acceptable to the Director. The operational certificate holder must also submit an updated environmental monitoring plan every five (5) years, which includes, at a minimum, any revisions submitted as part of the previous five years of annual reporting required in Section 4.6.

2.6 Qualified Professionals

All facilities and information, including works, plans, assessments, investigations, surveys, programs and reports, must be certified by qualified professionals. Refer to Section 3.1 of the operational certificate for the definition of a qualified professional.

2.7 Additional Facilities or Works

The Director may require investigations, surveys, and the construction of additional facilities or works including, but not limited to, leachate and bear-proofing measures. The Director may also amend the requirements of any of the information required by this operational certificate including plans, programs, assessments and reports.

2.8 Public Health, Safety and Nuisance

The landfill must be operated in a manner such that it will not create a public nuisance or become a significant threat to public health or safety with respect to landfill gas, unauthorized access, roads, traffic, airport activity, noise, dust, litter, vectors, or wildlife attraction.

2.9 Surface Water Diversion

Discharge of municipal solid waste into water is prohibited. The Operational Certificate holder must construct adequate surface water and groundwater diversion works to minimize surface water run-off and groundwater seepage from entering the landfill.

Date issued: July 8, 2014

Avtar S. Sundher BSc.
for Director, *Environmental Management Act*
South Coast Region

2.10 **Ground and Surface Water Quality Impairment**

The landfill must be operated in a manner such that ground or surface water quality does not decrease beyond that specified by the British Columbia Water Quality Guidelines, or other appropriate criteria as may be specified by the Director, at or beyond the landfill property boundary.

If exceedances to the specified water quality criteria occur as a result of landfill operations, the Director may require that control measures or works be undertaken in addition to those outlined in Section 3.13.

2.11 **Buffer Zones**

The operational certificate holder must maintain the existing buffer zone relative to the property boundary of: 2 to 4.5 metres to the south, 10 to 98 metres to the west, 4.42 metres to the north and 4 to 18 metres to the east as shown in Site Plan A and Site Plan B.

The buffer zone must include an adequate firebreak. The firebreak must be maintained free of combustibles.

2.12 **Survey of the Landfill**

The Operational Certificate holder must conduct a legal survey which identifies the metes and bounds for both the limits of the landfill footprint and the boundaries of the landfill site. Copies of the land surveys are to be kept on file for review if requested by the Director. The corners and breakpoints of landfill footprint limits and landfill site boundaries are to be established and maintained in the field.

The operational certificate holder must also conduct an annual survey of the height, contour, surface area and settlement of the landfill and submit as part of the annual report required in Section 4.6.

3. OPERATIONAL REQUIREMENTS

3.1 **Definitions**

"**director**" means the Director or a person delegated to act on behalf of the Director, as defined in the *Environmental Management Act*;

Date issued: July 8, 2014

Avtar S. Sundher BSc.
for Director, *Environmental Management Act*
South Coast Region

"**commercial quality soil**" means soil which does not contain any substance with a concentration exceeding the lowest applicable numerical soil standard for commercial land as set forth in the Contaminated Sites Regulation.

"**hazardous wastes**" as defined by the Hazardous Waste Regulation pursuant to the *Environmental Management Act* are prohibited from disposal unless expressly authorised by the Hazardous Waste Regulation, approved by the Director or as specified in the Operational Certificate;

"**regional director**" means Regional Director, Environmental Protection;

"**qualified professional**" means an applied scientist or technologist specializing in a particular applied science including, but not necessarily limited to, agrology, biology, chemistry, engineering, geology, or hydrogeology and

- who is registered in British Columbia with their appropriate professional organization, acting under that association's Code of Ethics and subject to disciplinary action by that association, and

- who, through suitable education, experience, accreditation and knowledge, may be reasonably relied on to provide advice within their area of expertise;

"**return collection facility**" means a household hazardous waste collection facility or a mobile household hazardous waste collection facility;

"**suitable cover**" means soils utilized in accordance with Section 3.5 of this operational certificate or other material acceptable to the Director:

"**commercial quality soil**" means soil which does not contain any substance with a concentration exceeding the lowest applicable numerical soil standard for commercial land (CL) use as set forth in the Contaminated Sites Regulation.

3.2 Bypasses

The discharge of effluent which has bypassed site control works as listed in Section 1.1.5 is prohibited unless the prior approval of the Director is obtained and confirmed in writing. In the event of an emergency, Section 3.3 must be followed.

Date issued: July 8, 2014

Avtar S. Sundher BSc.
for Director, *Environmental Management Act*
South Coast Region

3.3 Emergency Procedures

The authorized works must be inspected regularly and maintained in good working order. In the event of an emergency or condition beyond the control of the operational certificate holder including, but not limited to, unauthorized fires ~~arising from spontaneous combustion or other causes, or detection of leachate~~ on the property, the operational certificate holder must take appropriate remedial action and notify the Director immediately. The Director may reduce or suspend operations to protect the environment until the authorized works has been restored, and/or corrective steps taken to prevent unauthorized discharges.

3.4 Inspections

The operational certificate holder must inspect the authorized works regularly and maintain them in good working order. The Director must be immediately notified of any malfunction of these works.

The operational certificate holder must inspect the property boundaries regularly and notify the Director of any visual evidence of environmental impacts on adjacent properties.

3.5 Soil Management

Soil meeting the commercial land use standard, as set forth in the Contaminated Sites Regulation, may be utilized for berm construction, daily, intermediate and final cover, top dressing and landscaping. Soil with any substance with a concentration exceeding the lowest applicable numerical soil standard for commercial land may only be used for internal berms or daily or intermediate cover. The utilization or discharge exceeding the industrial quality soil and hazardous waste soil is prohibited.

Soils utilized for berm construction, intermediate and final cover, top dressing and landscaping must not be included in determining the rate of discharge specified in Section 1.1.1.

Date issued: July 8, 2014

Avtar S. Sundher BSc.
for Director, *Environmental Management Act*
South Coast Region

3.6 Waste Compaction and Covering

All waste must be placed in cells of a size determined by a qualified professional, and in accordance with the design and operating plan and must address each of the subsections in the Landfill Criteria for Municipal Solid Waste (June 1993, or the most recent version). The working face must be confined to the smallest practical area. The waste must be compacted and covered as per the design and operating plan.

Daily cover consisting of a minimum of 0.15 metres of suitable cover material or a functionally alternate cover material, as authorized by the Director, must be applied to the working face at the end of each operating day. If alternate cover is utilized, then the working face must be covered with a minimum of 0.15 meters of suitable cover at least once every week or as approved by the Director. Intermediate cover, consisting of a minimum 0.30 metre of suitable cover material must be applied within thirty (30) days to any area of the landfill which will not receive any further waste for thirty (30) days. The Director may vary the frequency of covering when freezing conditions adversely affect normal operation.

3.7 Completed Areas of the Landfill

The operational certificate holder must apply final cover to any area of the landfill which will not receive any further waste. Final cover must be applied in accordance with the design and operating plan required in Section 2.1 and, at a minimum, must consist of a minimum of 1.0 metre of low permeability ($<1 \times 10^{-5}$ cm/s) compacted soil (or equivalent) cap plus a minimum of 0.15 metre of topsoil and suitable vegetative cover, or as approved the Director.

With the written approval of the Director, the topsoil used for the final covering may be mixed with conditioning agents such as sludge (biosolids), compost and the like to add organics and improve the moisture holding capacity and nutrient value of the soil. Soil must be utilized in accordance with Section 3.5. Final cover must be constructed and maintained with adequate drainage and erosion controls and seeded with suitable grasses. Surface water runoff must be directed away from the landfill footprint. Soils must be in accordance with the Organic Matter Recycling Regulation (OMRR) and the Contaminated Sites Regulation (CSR).

Date issued: July 8, 2014

Avtar S. Sundher BSc.
for Director, *Environmental Management Act*
South Coast Region

3.8 Wildlife and Vector Management

Vectors (carriers capable of transmitting a pathogen from one organism to another including, but not limited to flies and other insects, rodents, and birds) must be controlled by the application of cover material at the required frequency per Section 3.6 or by such additional methods as specified by the design and operating plan and the Director. This landfill must be operated so as to minimize the attraction of wildlife such as bears and birds by applying cover at required frequencies and instituting a good housekeeping program.

Additional works may be required or other operating instructions may be issued by the Director should a wildlife nuisance or hazard arise.

3.9 Litter Control

Litter must be controlled by compacting the waste, minimizing the work face area, applying cover at the required frequencies, providing litter control fences and instituting a regular litter pickup and general good housekeeping program or as specified by the Director.

3.10 Electric Fencing

The operational certificate holder must maintain an electrified bear fence, at a minimum, around the landfill footprint, or implement alternative bear-proofing measures, acceptable to the Director, that will deter bears from entering that part of the site. The electric fence must be energized at all times, unless otherwise approved prior by the Director in writing. The fence must be maintained to the standards set out by the manufacturer until implementation of the landfill closure plan required in Section 5.2. Any penetrations through the electric fencing by bears must be immediately reported to the Ministry's Conservation Officer Service.

3.11 Fire Prevention and Control

The operational certificate holder must take all reasonable measures necessary to prevent fires from occurring at the site and is responsible for complying with all local fire safety requirements. The operational certificate holder must provide adequate fire breaks that are free of combustibles around the perimeter of the landfill footprint.

Date issued: July 8, 2014

Avtar S. Sundher BSc.
for Director, *Environmental Management Act*
South Coast Region

The operational certificate holder must maintain firefighting equipment and materials as required. In the event of a landfill fire, immediately notify the local fire department, the Provincial Emergency Program and the Director.

3.12 Posting of Signs

The operational certificate holder must post signage, to the satisfaction of the Director, at the entrance of the landfill site with the following current information including:

- Site name;
- Owner and operator;
- Contact telephone number and address for the owner and operator;
- 24 hour telephone number in case of emergency;
- Hours of operation;
- Materials and wastes accepted for recycling and land filling;
- Prohibited materials and wastes; and
- Tipping fees.

3.13 Leachate Management

The operational certificate holder must, to the satisfaction of the Director, take measures to minimize leachate generation, including but not limited to, providing effective covering and surface water runoff. Actions taken and their effectiveness must be detailed in the annual report as required in Section 4.6.

The operational certificate holder must submit a leachate management plan for the landfill authorized in Section 1.1, acceptable to the Director, by **August 31, 2015**. The plan must meet the Landfill Criteria for Municipal Solid Waste (June 1993, or the most recent version) and the Guideline for Environmental Monitoring at Municipal Solid Waste Landfills (January 1996 or the most recent version) and must be reviewed and updated every five (5) years hereafter. The leachate management plan, prepared by a qualified professional, must review the adequacy of the existing works to protect the receiving environment and identify any necessary upgrades and include a schedule for their implementation. Once implemented, the upgraded works must form part of the authorized works identified in Section 1.1.5.

Date issued: July 8, 2014

Avtar S. Sundher BSc.
for Director, *Environmental Management Act*
South Coast Region

3.14 Landfill Gas Management

The Landfill must not cause combustible gas concentrations to exceed the lower explosive limit in soils at the property boundary or 25% of the lower explosive limit at or in on-site or off-site structures.

3.15 Management of Recyclable Materials

The operational certificate holder must take all practical measures to segregate for recycling and reuse of waste destined for disposal at this site.

Recyclable materials must be managed in a manner to not cause pollution and in accordance with the *Environmental Management Act* and its regulations.

3.16 Management of Household Hazardous Waste

The amount of household hazardous waste accumulated at the facility authorized in Section 1.4 must be stored in accordance with the Hazardous Waste Regulation and is limited to the registration quantity as a return collection facility.

4. MONITORING AND REPORTING REQUIREMENTS

4.1 Monitoring

The Operational Certificate holder must implement an environmental monitoring program as required in Section 2.5. The Operational Certificate holder must maintain records of all monitoring program data and analyses available for inspection. Based on the information submitted in the annual report, or any other information relevant to the site, the Director may vary the frequency, location and analyses of environmental monitoring as warranted.

4.1.1 Slope Stability Monitoring

The operational certificate holder must regularly monitor for evidence of slope instability as part of regular operations for evidence of tension cracking, veneer instability or failure.

Date issued: July 8, 2014

Avtar S. Sundher BSc.
for Director, *Environmental Management Act*
South Coast Region

4.2 Sampling Procedures

Sampling is to be carried out in accordance with the procedures described in the "British Columbia Field Sampling Manual for Continuous Monitoring and the Collection of Air, Air-Emission, Water, Wastewater, Soil, Sediment, and Biological Samples, 2003 Edition (Permittee)", or most recent edition, or by suitable alternative procedures as authorized by the Director.

A copy of the above manual is available on the Ministry web page at http://www.env.gov.bc.ca/wsd/data_searches/field_sampling_manual/field_man_03.html

4.3 Analytical Procedures

Analyses are to be carried out in accordance with procedures described in the "British Columbia Laboratory Manual (2009 Permittee Edition)", or the most recent edition, or by suitable alternative procedures as authorized by the Director.

A copy of the above manual is available on the Ministry web page at www.env.gov.bc.ca/epe/wamr/labsys/lab_meth_manual.html.

4.4 Waste and Recyclable Materials Recording

The operational certificate holder must record the quantity, in tonnes, of waste, recycling, and return collection received at the landfill. Also, the quantity of recyclable materials and household hazardous waste removed from these facilities must be recorded.

4.5 Records Management

The operational certificate holder must maintain the following information and records, current and suitably tabulated, at the landfill office or Regional District office for inspection:

- A copy of Operational Certificate 106060;
- Training procedures and personnel training records;
- Contingency plans and notification procedures;
- The current design and operating plan;
- Inspection records from staff and regulatory agencies;
- Most recent hydrogeological, geotechnical and landfill gas assessments;

Date issued: July 8, 2014

Avtar S. Sundher BSc.
for Director, *Environmental Management Act*
South Coast Region

- Incoming waste and soil records;
- Records of recyclable material and household hazardous wastes shipped offsite including the name of company and location the recyclable material and household hazardous waste is sent;
- Environmental monitoring results and interpretations;
- Records of commercial quality soil used as cover material identified in Section 3.5 along with records of soil shipped offsite; and
- Annual operating and monitoring reports for the previous 5 years.

4.6 Reporting

The operational certificate holder must prepare an annual report which must include, but is not limited to, the following:

- A review and interpretation of the analytical data from receiving environment monitoring for the calendar year;
- Summaries of waste and recyclable material records, with the amount of waste landfilled reported as a volume and tonnage;
- Summary of recyclable material and household hazardous wastes shipped offsite including the name of company and location the recyclable material and household hazardous waste is sent;
- Summary of amount of commercial quality soil brought onsite;
- Updated estimates for the remaining capacity, closure date for the current phase and closure date for the current landfill footprint;
- Results of the annual survey required under Section 2.12;
- An evaluation of leachate generation control measures;
- Results of the landfill gas monitoring;
- Revised closure/post closure costs, confirmation of sufficient funds available, and a statement of the current dollar value of the Closure Fund and the amount earmarked for the Sechelt Landfill site;
- Revised design and operating plan and planned improvements if applicable for minor revisions;
- Revised environmental monitoring program;
- Identification of operating problems and corrective actions taken;
- An evaluation of the recycling programs including waste diversion;
- Summary of public complaint/resolutions for the landfill;
- In the event of any non-compliance with the conditions of this operational certificate, an action plan and schedule to achieve compliance; and

Date issued: July 8, 2014

Avtar S. Sundher BSc.
for Director, *Environmental Management Act*
South Coast Region

- The results of all monitoring programs as specified in this Operational Certificate. Data interpretation and comparison to the performance criteria in the Landfill Criteria for Municipal Solid Waste, the Guidelines for Environmental Monitoring and Municipal Solid Waste Landfills. Trend analyses, as well as an evaluation of the impacts of the discharges on the receiving environment in the previous year must be carried out by a qualified professional.
- Monitoring data must be entered into EMS – Environmental Monitoring System electronically and submitted in electronic and printed format satisfactory to the Regional Director.

The annual report for the preceding 12 month period from January 1 to December 31 must be submitted to the Regional Director, Environmental Protection, by **March 31** of each year.

5. CLOSURE AND POST-CLOSURE REQUIREMENTS

5.1 Closure Plan / Funding

The operational certificate holder must accrue, during the life of the landfill, a dedicated reserve fund in a form acceptable to the Director, sufficient to finance closure and environmental contingencies related to the landfill. The estimated cost of carrying out closure and how the fund will be accrued must be included in the design and operating plan required in Section 2.1. The estimated costs of closure and post-closure activities must be updated annually and submitted to the Director as part of the annual report required in Section 4.6. Should the estimated costs of closure and post-closure increase then the operational certificate holder must increase the rate of accrual as

5.2 Progressive Closure

The operational certificate holder must submit a closure plan as part of a Design and Operating Plan for the facilities authorized in Section 1 by **December 31, 2015** acceptable to the Director. The plan must be reviewed and updated every 5 years as part of the Design and Operating Plan or until the site is decommissioned and a closure-plan under Section 5.3 is approved. The plan must be prepared by an independent qualified professional and include information regarding:

- Phasing plan showing areas to be progressively closed.
- Estimated total waste volumes and tonnage and the closure date;

Date issued: July 8, 2014

Avtar S. Sundher BSc.
for Director, *Environmental Management Act*
South Coast Region

- A topographical plan showing the final elevation contours of the landfill and surface water diversion and drainage controls;
- Design of the final cover including the thickness and permeability of barrier layers and drainage layers and information on topsoil, vegetative cover and erosion prevention controls;
- Rodent and nuisance wildlife control procedures;
- Proposed end use of the property after closure;
- A post-closure monitoring program for groundwater, surface water, landfill gas, erosion and settlement for a minimum period of 25 years;
- Post-closure operation of pollution abatement engineering works such as leachate and landfill gas collection/treatment systems for a minimum period of 25 years; and
- Contingencies to address environmental impact concerns which may arise during the minimum post-closure period of 25 years.

5.3 Post-Closure Operation and Maintenance

A post-closure plan must be submitted not less than 2 years prior to decommissioning of the landfill. The closure plan must be reviewed every 5 years following closure and updated to encompass the next 10 years of post-closure activities. The post-closure plan and subsequent updates must be prepared by an independent qualified professional licensed to practice in the province of British Columbia and knowledgeable in such matters. The post-closure plan and subsequent updates must be submitted to the Director for approval and must include at least the following:

- a complete review and assessment report of the overall integrity of the landfill,
- Procedures for notifying the public about the closure and alternative waste disposal facilities;
- a detailed timetable for post-closure procedures and correction of any deficiency identified in the review and assessment report,
- a detailed schedule of inspection, monitoring and maintenance to be carried out for a minimum post-closure period of 25 years, and
- a process for the administration of the post-closure security fund required under Section 5.1 of this operational certificate.

Date issued: July 8, 2014

Avtar S. Sundher BSc.
for Director, *Environmental Management Act*
South Coast Region

5.4 Declaration of Landfill

Landfills sited on titled land must register a covenant that the property was used for the purpose of waste disposal as a charge against the title to the property as provided for under Section 219 (1) of the *Land Title Act*. Landfills located on crown land are to have a "notation on file" registered that the property was used for the purpose of waste disposal. The registration of the charge or legal notification is to be submitted to the Regional Director.

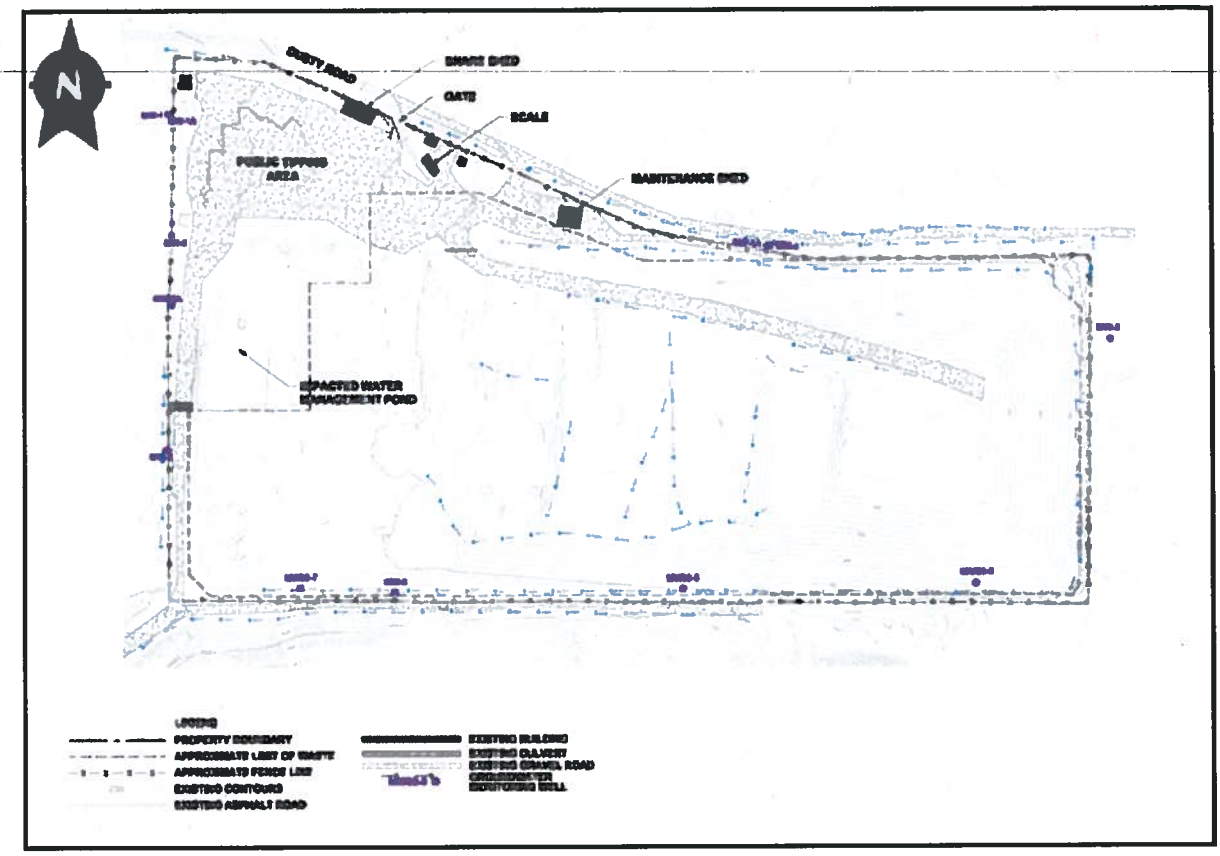
5.5 Site Decommissioning

In accordance with Section 40 of the *Environmental Management Act* and Part 2 of the Contaminated Sites Regulation, the operational certificate holder must submit a site profile to the Director not less than 10 days prior to decommissioning the facilities authorized in Section 1.

Date issued: July 8, 2014

Avtar S. Sundher BSc.
for Director, *Environmental Management Act*
South Coast Region

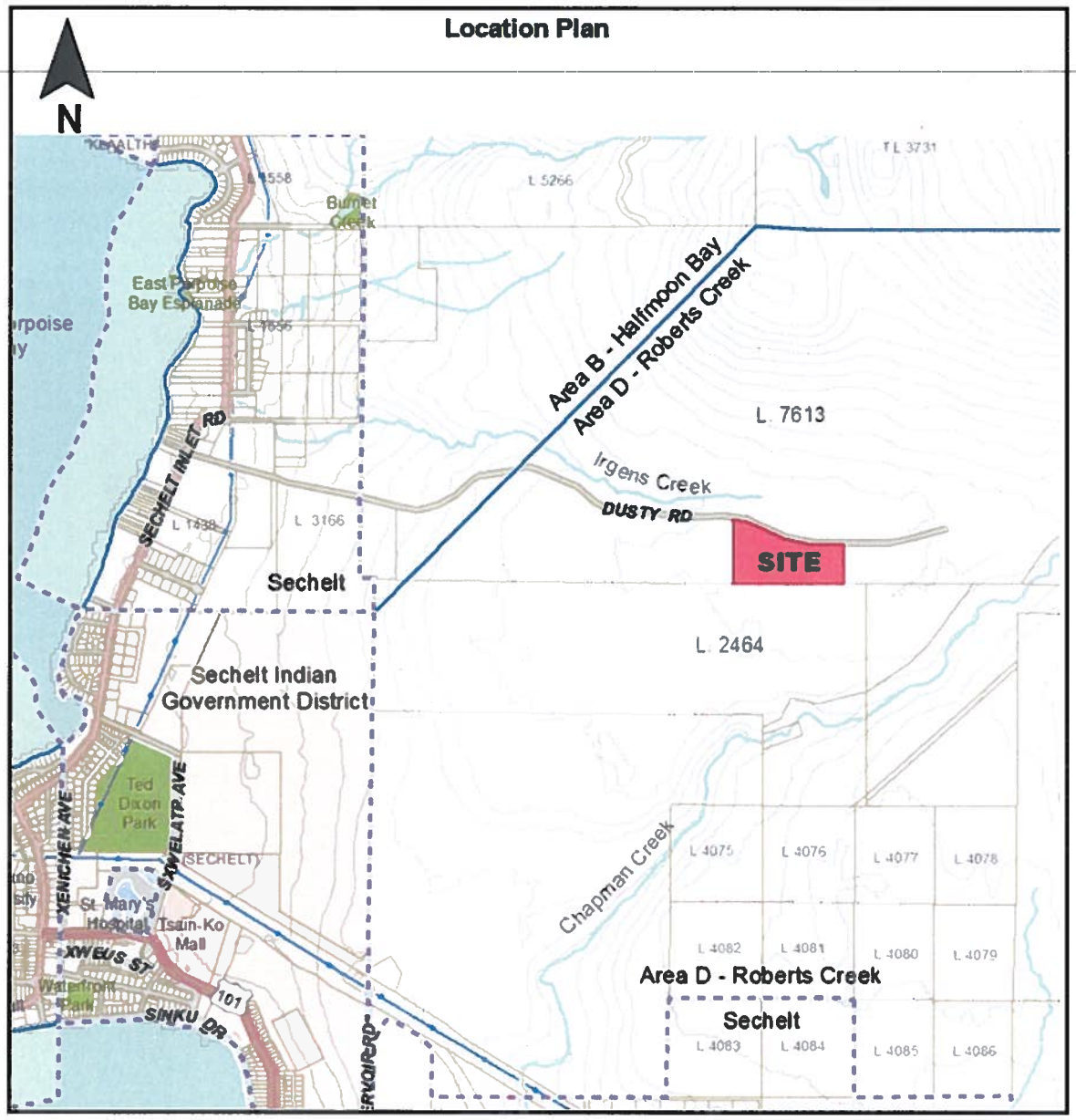
SITE PLAN A



Date issued: July 8, 2014

Avtar S. Sundher BSc.
for Director, *Environmental Management Act*
South Coast Region

SITE PLAN B



Date issued: July 8, 2014

Avtar S. Sundher BSc.
for Director, *Environmental Management Act*
South Coast Region

Operational Certificate Number: 106060