ALBERNI VALLEY LANDFILL

DESIGN, OPERATIONS AND CLOSURE REPORT

Submitted To: British Columbia Ministry of Environment

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On behalf of the Alberni-Clayoquot Regional District

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Executive Summary

The Alberni-Clayoquot Regional District (ACRD) operates the Alberni Valley Landfill (AVL) under Operational Certificate Number MR-524, issued June 29, 2004. The AVL is a municipal solid waste landfill that accepts waste from the City of Port Alberni, ACRD Electoral Areas within the Alberni Valley and Bamfield and First Nations Communities Tseshaht, Hupacasath, Huu-ay-aht and Uchucklesaht.

This report was developed to meet the operations, closure and post-closure plans required by Section 2.4 of the Operational Certificate and the *Landfill Criteria for Municipal Solid Waste*, published by the British Columbia Ministry of Environment (MoE) in 1993.

The AVL is currently operated by Berry & Vale Contracting Ltd., who have been under contract with the ACRD since 1980. The AVL is open seven days per week and regulates tipping fees under Bylaw R1006-4. The weigh scale and building are located at the only public entrance to the landfill. Recycling materials and white goods are accepted and stored near the entrance for subsequent removal. Recycling materials and compost are removed by private companies.

The weigh scale was installed at the AVL in 1994. Records have been maintained since 1995 and annual weights have ranged from about 13,500 tonnes to 22,900 tonnes. It has been estimated that 50% of the solid waste is from residential sources and the additional 50% originates from industrial, commercial and institutional sources.

Landfilling activities at the AVL began in the 1970's. It was constructed on a natural bedrock basin, lined with a clay layer. Investigations have described the base as massive basaltic rock with very low primary porosity and few fractures and the average hydraulic conductivity of the rock mass is interpreted to be 10^{-8} m/s. Surficial sediments of varying depth are located above the bedrock basin, comprised of low permeability clayey silt and glacial till and high permeability sand and gravels. There are no apparent signs of historical slope instability, and a seismic assessment was conducted to evaluate landfill stability.

A leachate collection system has been constructed of impermeable berms, drain pipes, pumps and ditches. The potentially leachate contaminated water is directed to a flow equalization pond at the east boundary, where it is then piped to the City of Port Alberni municipal sewage lagoon for treatment. In the past 5 years, the volume of leachate generated and treated ranges from 362,880 m^3 to 627,320 m^3.

The AVL is in the process of acquiring ownership or long term tenure of the AVL property. The property line buffers are 30 m on the north, 15 m on the east and south and 50 m on the west. Surrounding land use on the north, west and east is forested, while the property to the south is a logging road adjacent to additional forested land. The nearest residence is approximately 500 m northeast of the AVL while the Tseshaht First Nation reserve is located approximately 700 m north of the AVL.

Two creeks are located within 100 m of the landfill boundary. Various engineered controls have been constructed to change the flow patterns to direct runoff and groundwater towards a flow equalization pond.

A quarterly water quality monitoring program collects samples for surface water, bedrock and groundwater wells, and leachate to monitor contaminant levels at and surrounding the landfill. The landfill is currently containing all leachate as monitoring wells at the boundaries are showing concentrations less than the associated standards.

The landfill is located at an elevation of approximately 80m and well beyond the limits of the 200 year floodplain. It is also above the tsunami flood risk area.

Landfill gas generation assessments were conducted by Cameron Advisory Services Ltd. in 2003 and 2008. Both reports indicated that less than 150 tonnes of non-methane organic compounds was being generated at the AVL, therefore no landfill gas collection system has been designed and installed. In order to meet the new landfill gas regulation effective January 1, 2009, a landfill gas generation report was prepared by McGill & Associates Engineering Ltd. The results indicated that approximately 932 tonnes of methane was generated in 2009 and that approximately 955 tonnes were generated in 2010. It was estimated that the landfill will produce greater than 1,000 tonnes of methane in 2012, thereby initiating the design and installation of a landfill gas collection system.

The filling plan utilizes a series of cells that are to be filled sequentially. The first layer of cells (A through D) will cover the entire landfill footprint of about 21.8 hectares and will be raised to an elevation of 88m. Filling will continue at a slope of 3 horizontal to 1 vertical, to maximize the filled volume and maintain structural stability. A second layer of cells (E through H) will be constructed on top of the first level, thereby bringing the final landfill to an elevation of 106 m. Using the proposed design criteria, there is an estimated 2,995,000 m^3 of remaining capacity at the AVL.

Historic filling densities have varied, with the last density found to be 0.66 tonnes/m^3. The average annual solid waste tonnage from the last five years is 21,000 tonnes. Using the average tonnage and filling density, it is estimated that the AVL will reach full capacity 94 years from now, in the year 2104.

At closure the landfill will be capped with several layers including an impermeable liner to prevent rainfall infiltration into the landfill. A surface water drainage plan will be developed to re-direct runoff into a separate equalization pond.

After landfill closure, water quality monitoring, landfill gas monitoring and regular inspection and maintenance will continue at the AVL. The post-closure monitoring will likely continue for a minimum of 25 years.

Annual contributions to a closure and post-closure fund has begun. Preliminary cost estimates indicate that over $11,500,000 will be needed in the closure and post-closure fund to pay for closure activities. In order to provide financial security for the AVL, it is recommended that the ACRD contribute approximately $115,000 annually to this fund.

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1. INTRODUCTION

The Alberni-Clayoquot Regional District (ACRD) operates the Alberni Valley Landfill (AVL) to dispose municipal solid waste from the Alberni Valley area. The landfill is located approximately 5 km west of the City of Port Alberni and operates under Operational Certificate Number MR-524, issued by the Ministry of Environment on June 29, 2004. While the landfill is under the jurisdiction of the ACRD, daily landfill operations are conducted by Berry & Vale Contracting Ltd., under contract with the ACRD.

1.1 Objective

The objective of this report is to provide site development, operating, leachate management, closure and post-closure plans required to meet section 2.4 of Operational Certificate MR-524. A copy of the operational certificate is attached as Appendix A. This report was developed based on the criteria specified by the *Landfill Criteria for Municipal Solid Waste*, published by the Ministry of Environment (MoE) in June 1993, to address:

- Performance Criteria;
- Siting Criteria;
- Design Criteria;
- Operational Criteria; and,
- Closure and Post-Closure Criteria.

1.2 List of Reports

Since the start of landfilling activities in the 1970's, numerous reports have been prepared documenting activities and work conducted at the landfill. A list of reports prepared for the AVL is provided in Appendix B.

1.3 Background

The first operational certificate was issued for the AVL in 1971. The intent of the landfill was to service the Alberni Valley. The known areas disposing of waste at the AVL include:

- The City of Port Alberni
- ACRD Electoral Areas:
    - Area A – Bamfield
    - Area B – Beaufort
    - Area D – Sproat Lake
    - Area E – Beaver Creek
    - Area F – Cherry Creek

- First Nations Communities:
    - Tseshaht
    - Hupacasath
    - Huu-ay-aht
    - Uchucklesaht

According to a solid waste management report prepared in 2007, it is estimated that the AVL services a population of approximately 29,000 residents. It was also estimated that approximately 50% of the waste is from residential sources, and the other 50% is from commercial, industrial and institutional sources.

The AVL is located in a natural bedrock basin. It was reported that the bedrock basin was lined with a natural clay layer that formed a natural swamp. Impermeable berms, drain pipes and other engineered controls were constructed to prevent drainage into natural surface water drainage courses. Since operation, several reports and studies have been conducted to evaluate leachate containment at the landfill.

Daily AVL operations are conducted by Berry and Vale Contracting under contract to ACRD. Berry and Vale Contracting were originally awarded the contract in 1980, and have been re-issued the contract since then.

1.4 Report Structure

The report has been divided into the following seven major sections:

- Existing Site and Infrastructure (Section 2);
- Landfill Design (Section 3);
- Current Landfill Operations (Section 4);
- Waste Characterization and Quantification (Section 5);
- Performance Criteria (Section 6);
- Closure Plans (Section 7);
- Post Closure Plans (Section 8); and,
- Financial Security (Section 9).

2 EXISTING SITE & INFRASTRUCTURE

The AVL is located approximately 5 km west of Port Alberni, BC. It is situated on wide ridge that separates the Alberni Inlet from Sproat Lake, at an elevation of approximately 80 m above sea level. The AVL property includes an area of approximately 49 hectares and is described as Block D, Lot 268, Alberni Land District. A site location plan is attached as Figure 1.

2.1 General Site Layout

A plan showing the general site layout is attached as Figure 2.

The landfill entrance is located at the northwestern limit of the property. Entrance facilities include weigh scales, scale shack, transfer bin unloading area, recycling drop off area, aboveground storage tank for waste oil collection and a paved storage area for white goods and other large items.

The entrance road continues east past a caretakers residence and shop. The north fill area, as shown on the site plan, has been filled to an intermediate height of approximately 89.5 m and is temporarily capped. Current land filling operations are occurring in the area shown on Figure 2.

The southern expansion area has undergone investigation to evaluate the composition of the subsurface materials, prior to any landfilling. Geological investigation continued throughout 2009. Filling in this area will begin when the current fill area reaches capacity.

A leachate collection system has been constructed throughout the landfill to direct leachate flows to the eastern property boundary where they are collected in a flow equalization lagoon, and are subsequently piped to the City of Port Alberni municipal sewage lagoon for treatment. Further detail on the leachate collection system is provided in Section 3.2.

2.2 Property Boundary

The landfill property covers an area of approximately 49 hectares. The legal property boundary is shown on Figure 3. The property is not currently owned by the ACRD, but is held under a series of licences. A list of each licence, and its status is provided in

Table 1 with the locations shown on Figure 3.

Table 1: List of Licences for AVL

File Number	Licence Number	Area (hectares)	Expiry	Purpose
0303607	104416	19.2	Feb. 8, 2002	Former licence of occupation given for garbage disposal purposes. Includes entrance facilities and north fill area.
0320451	105840	-	As long as required	Statutory right of way for waterline and powerline.
0347167	104424	2.5	Oct. 8, 2002	Former licence of occupation for disposing garbage and all kinds of noxious, offensive or unwholesome substances.
1400774	103856	7.6	Jun. 15, 2001	Former licence of occupation for extraction of cover material.
1403985	104628	2.4	Feb. 8, 2002	Former licence of occupation for quarrying, digging or removal of gravel for landfill cover, topsoil removal and garbage disposal.
1407308	104770	-	Jan. 31, 2014	Access road from McCoy Lake Road
1408153	112324	6.8	July 31, 2016	Licence of occupation for sand and gravel removal.
1408609	106458	6.6	Nov. 30, 2009	Licence of occupation for disposing refuse.

As seen in Table 1, most of these licences have expired and the ACRD no longer holds tenure over the land. The ACRD is in the process of trying to secure long term tenure or ownership over the AVL occupied land.

A vegetated buffer surrounds most of the landfill property. The required 50 m buffer is maintained on the western limit of the property. The buffer along the northern property line has been reduced to 30 m to accommodate the previously constructed base of the northern landfill area. The east and south buffers have been reduced to 15 m to provide the maximum landfill footprint area, and therefore the maximum capacity and life span. The *Alberni Valley Landfill 2003 Report*, prepared by McGill & Associates Engineering Ltd., estimated that the reduction in buffer width would increase the life of the landfill by about 19 years. The assigned buffer areas are shown on Figure 3.

A former tire recycling plant was located on Block B of DL 307. Negotiations have been under way between the Province and the ACRD over a number of years regarding the now defunct Tire Recycling Plant. No agreements or conclusions have yet been made as to the future of the tire recycling plant.

2.3 Surrounding Land Use

The property surrounding the AVL is comprised of undeveloped privately held forested land on the north (District Lot 105), to the east privately held (District Lot 124) and crown owned on the west (District Lot 268). Directly south of the landfill property is a logging road followed by more forested land. Across the logging road to the south is an area used as a small sawmill. The property containing the sawmill does not have any water or sewer services on site. Power to the property is provided by the ACRD.

The nearest development is an eight lot residential subdivision located approximately 500 m northeast of the landfill. It is reported that there is one bedrock well drilled at the subdivision (DL 105) however it is not generally used as a supply source due to high dissolved solids concentrations. The BC Water Resources Atlas was used to identify registered water wells near the AVL. The nearest registered well was located greater than 1100 m northwest of the AVL property.

The Tseshaht First Nation Reserve is located approximately 700 m north of the AVL. Landfill users access the AVL via McCoy Lake Road, which relies on access through Tseshaht First Nation Reserve land.

With no development located within 300 m of the AVL, there are no adjacent land uses that are expected to be adversely impacted by either leachate or gas generated at the AVL property. A figure showing surrounding land use is attached as Figure 3.

The Alberni Valley Regional Airport is located approximately 8 km northwest of the AVL. Based on the distance between the airport and the AVL and the fact that daily cover is applied to control scavenging birds, the potential for birds causing hazard to aircraft is considered low.

2.4 Geology & Unstable Areas

Numerous investigations have been conducted to evaluate the subsurface conditions at the AVL. Geotechnical investigations indicate that the site is underlain by a clay layer that is located in a natural bedrock basin. Various depths of surficial material have been observed around the landfill, with deeper deposits located in troughs between bedrock outcrops. The bedrock is described as massive basaltic rock with very low primary porosity and few fractures.

Drilling investigations identified the bedrock troughs between outcrops as being a potential leachate seepage pathway, however inclined drilling was conducted to evaluate the bedrock condition below two bedrock surface troughs; one in the south expansion area and one in the east expansion area. In the south expansion area, the bedrock was characterized as very competent with a hydraulic conductivity between 10^{-7} and 10^{-9} m/s and a mean hydraulic conductivity of 5×10^{-9} m/s. The east expansion area was slightly more permeable with hydraulic conductivities ranging from 6×10^{-8} to 2×10^{-6} m/s, with a mean hydraulic conductivity of 1×10^{-7} m/s. Bedrock quality was expected to increase with depth in this area.

Based on the investigation, it was determined that the average hydraulic conductivity of the rock mass that underlies the landfill site is interpreted to be 10^{-8} m/s.

Surficial sediments of varying depths are located above the bedrock basin. Surficial sediments consist of sand and gravel, fine sand with silt, clayey silt or glacial till. The clayey silt and glacial till layers are expected to be relatively impermeable while the sand and gravel layers would allow groundwater flow.

The preliminary geotechnical assessment conducted by Piteau Associates in 1993 indicated that there were no apparent signs of historical slope instability. A seismic assessment was completed for the AVL in 2011.

Seismic Assessment

In February 2011, Piteau Associates Engineering Ltd. submitted a *Seismic Assessment* for the Alberni Valley Landfill. The objective of the report was to assess the seismic risk at the site and the potential effects of a seismic event on the landfill by addressing:

- Potential for liquefaction of foundation;
- Landfill stability during a seismic event; and,
- Possible fault movement in actual landfill area.

As a result of the assessment, the following conclusions were made regarding the stability of the AVL:

- The AVL is primarily underlain by shallow bedrock and relatively dense cohesive sediments that do not present a liquefaction risk during an earthquake. The south and east expansion areas are on granular sediments deposited in bedrock troughs. The granular sediments are generally dense enough not to liquefy during an earthquake, however there may be some localized layers within the foundation that may liquefy during a major earthquake.
- Central Vancouver Island is a seismically active area with many small tremors recorded since 1900. The two largest earthquakes on record are an M5.8 near Ucluelet and an M7.3 northwest of Comox. The interpolated seismic hazard for the site is a peak ground acceleration of 0.343 g with a 2% probability of occurring in a 50 year period.
- There are no active faults within the landfill site that could cause damage. The closest mapped fault is about 7 km northeast from the landfill.
- Limit equilibrium analysis demonstrate that landfill slopes will maintain adequate stability during a seismic event with the possible exception of sections through the eastern toes of the landfill in the east and south expansion areas. Partial liquefaction of

the foundation in these areas could lead to some slight lateral movement of the landfill. Any movement would be limited by the stable sections adjacent to these areas.

- Potential effects of a major earthquake include liquefaction within some layers or lenses of granular sediments in the landfill foundation, which would result in some small settlements and possibly some slight lateral movement of the landfill toe. The effects should not affect the landfill operation or covers system. As the facility is not lined, there would be no loss of containment due to a liner failure. The only adverse effects would be possible damage to existing and any future leachate interception wells located at the toe of the landfill, to the proposed seepage cutoff wall, or to the french drain that will collect leachate beneath the south expansion area. The risk could be addressed with more detailed investigations/analyses to more accurately quantify liquefaction potential and stability, or by contingency/mitigation measures in the landfill design.

- The contingency to address the loss of interception wells would be to construct replacement wells. The wells could be installed in a short period of time and could be commissioned quickly as the services are already in place.

- The contingency measure to address possible damage to the cutoff wall would be a plan to complete interim repairs with a large backhoe, and to direct any seepage through the failed cutoff section with ditches to the leachate surge lagoon. Complete repairs could be completed within about a six month time frame.

- One mitigation measure to address possible failure of the french drain would be to sub-excavate the toe area around the drain and backfill it with coarse crushed rock. This would strengthen the foundation of the toe, and provide a rock drain to convey discharge from a break in the french drain to the landfill toe. A second mitigation measure would be to design the final landfill configuration to be stable. This could involve flattening the final slope of the landfill in areas of concern by incorporating one or two wide benches at intermediate elevations.

Additional detail on the background, analysis and results are found in the Piteau Seismic Assessment report.

2.5 Surface Water

There are two identified surface water receptors located within 100 m of the landfill boundary. Stevens Creek begins on the northern boundary of the site and drains north, towards the Alberni Inlet. Christie Creek runs along the east boundary from the south east corner of the property and flows east to the Alberni Inlet. The nearby surface water bodies are identified on Figure 2.

Based on the natural geology prior to land filling, the site formed a natural swamp. Most of the site was reported to drain north into Stevens Creek with some flow east towards Christie Creek. Since then, various engineered controls have been constructed to change the flow patterns through the surficial sediments in order to direct runoff and groundwater towards the flow equalization lagoon. To eliminate the groundwater and surface water pathway from the landfill to Stevens Creek, a clay berm was constructed along the northern boundary of the site. The clay berm in conjunction with a deep groundwater pump prevents groundwater and surface water flow towards the creek and redirects it into the leachate collection system. Thereby, minimizing, if not eliminating, groundwater flow from the site to Stevens Creek.

Christie Creek is located directly east of the flow equalization lagoon and aeration lagoon. The leachate collection system is designed to collect runoff and groundwater from the landfill boundaries and direct it into the flow equalization lagoon. The flow equalization lagoon has been constructed with clay to provide containment and eliminate seepage into the underlying soils. Therefore, no leachate is expected to leave the landfill property and migrate to Christie Creek. Details of the leachate collection system is included in section 3.2 below. There are leachate monitoring wells on the east side of the flow equalization pond to confirm water quality to the east.

A third surface water location, Heath Creek, nears the western property line and flows west. This creek is located greater than 300 m from the nearest filled area and is considered to have low risk of leachate impacts since it is located in the opposite direction of local groundwater flow. A bedrock and groundwater well monitors water quality in this direction.

Groundwater flow in bedrock is primarily towards the north and east. A lesser flow is to the southeast while the extreme western edge of the southern expansion area shows a potential gradient to the west.

Groundwater flow in surficial sediments has been altered to force groundwater within the landfill to enter the leachate collection system. The *Water Quality Monitoring Report to December 2010,* submitted by Piteau Associates, produced a figure indicating the interpreted groundwater flow directions for both surface sediments and bedrock. A copy of the figure is included in Appendix C.

To confirm that leachate is not negatively impacting the surrounding surface water receptors, the water quality monitoring program includes collecting surface water samples from each of the three creeks, with both an upstream and downstream sample collected from Christie Creek. The samples are collected quarterly and the results reported annually with comparison to the British Columbia Approved and Working Water Quality Guidelines. Additional detail on the water quality sampling program is found in Section 4.5 and a summary of the monitoring results is found in Section 6.1.

2.6 Floodplain

According to the *Floodplain Mapping of Somass River and Tributaries at Port Alberni* (produced by British Columbia Water Management Division, Hydrology Branch, Flood Identification Section on September 30, 1997), the AVL is well beyond the limits of the 200 year floodplain. The plan also indicates that areas with an elevation of 10.0 m or less may be at risk of tsunami flood damage. As the AVL is located at an elevation of approximately 80 m, it is well above the tsunami flood risk area.

3 LANDFILL DESIGN

The AVL has been designed to operate as a combination of a natural control landfill and an engineered landfill.

3.1 Design Approach

The *Landfill Criteria for Municipal Solid Waste* indicates that a natural control landfill must have at least a 2 m thick liner of low permeability soil with a hydraulic conductivity of 10^{-8} m/s and an engineered landfill must have at least a 1 m thick compacted soil liner with a hydraulic conductivity of 10^{-9} m/s or less. The AVL has been designed using a natural bedrock liner with engineered controls to provide additional containment where needed. Therefore, the AVL is considered a combination of natural control and engineered landfill.

The base of the landfill uses the low hydraulic conductivity of the underlying bedrock to contain any leachate generated. The mean of hydraulic conductivity test results in bedrock is 5 x 10^{-9} m/s with some higher hydraulic conductivities of 10^{-7} in two identified sub-vertical fault zones. Several bedrock troughs have been identified between the bedrock outcrops. While the troughs have the potential to provide preferential pathways for leachate leaving the landfill, engineered controls such as clay berms have been implemented to eliminate these pathways.

Future expansion areas will be designed to keep the water table at least 1.2 m below the bottom of the solid waste.

3.2 Leachate Collection System

A leachate collection system has been constructed to capture leachate generated by the landfill. The leachate collection system directs flow to the eastern edge of the landfill property where it enters a flow equalization pond. The leachate flows through a gravity fed pipeline to the City of Port Alberni municipal sewage lagoon for treatment. The leachate collection system is shown on Figure 4. The current leachate control infrastructure includes:

- A berm constructed at the north west edge of the landfill prevents surface flow from entering Stevens Creek;

- A 400 mm diameter drain pipe carries leachate from below the north landfill area to the westerly pump station adjacent to the north boundary;
- A pump lifts leachate accumulating below the landfill from the drain pipe at the base of the landfill to the concrete channel on the north boundary.
- A concrete lined leachate interception and conveyance channel along the north and eastern perimeters of the landfill directs flows to the flow equalization lagoon;
- A 58,600 m^3 flow equalization pond stores leachate flows that exceed the flows which are above a predetermined rate to the City Lagoon. An overflow is provided for excessive storm events;
- A 2.7 km pipeline transports flows from the flow equalization pond to the City of Port Alberni municipal sewage lagoon for treatment;
- An interception trench and sump on the northern property boundary controls leachate migration on the north property boundary with pumps to maintain a capture leachate and pump it into the concrete lined interception trench;
- A sump and pump to collect leachate from the transfer area and pump it into the leachate collection system for treatment;
- A clay and HDPE lined berm along the western landfill boundary to prevents migration of groundwater through a bedrock trough towards Heath Creek;
- A 300 mm diameter perforated drain near the south side of the south expansion area directs flow to the east and subsequently the flow equalization lagoon.

3.3 Leachate Generation

A preliminary water balance was conducted in 1995 by Piteau Associates Ltd. to estimate the quantity of leachate generated from an expanded landfill. The winter flow that would have to be conveyed for treatment was estimated at 17.6 L/s. Details of the actual leachate volumes generated are discussed below in Section 6.2.

After closure, the landfill will be capped and a separate surface runoff collection system will be designed. It is anticipated that the surface water runoff will be of sufficient quality to enter the local surface water system, once water quality is confirmed by monitoring. The capped landfill will be relatively impermeable and reduce the amount of rainfall entering the landfill, and thus the amount of leachate generated. It is expected that flows entering the leachate collection system will be less than the current flows.

3.4 Contingency Measures

As part of the landfill design, several contingency measures have been identified as solutions, should the performance criteria indicate that there are leachate impacts beyond the boundary of the landfill. Contingency measures include:

- Drilling interception wells and installing pumps to intercept leachate flows and direct them into the leachate collection system;
- Excavating a deep sump to intercept flows destined for surface water bodies; and,
- Constructing a permanent clay berm to block groundwater flow.

Leachate impacts are further avoided by locating monitoring wells to allow early identification of potential problems. The above contingency measures apply in the event of failure of the existing leachate control system.

A clay source is available locally and the landfill operators have the machinery available onsite for any construction needed.

3.5 Landfill Gas Management System

To meet the current operational certificate and the *Landfill Criteria for Municipal Solid Waste*, a landfill gas generation assessment must be conducted:

- After 100,000 tonnes of waste have been discharged at the landfill; and,
- Re-assessed within five years.

The AVL reached 100,000 tonnes of waste prior to 2002. Therefore, landfill gas generation assessments were conducted in 2003 and 2008 by Cameron Advisory Services Ltd. As reported in 2003, the estimated volume of the AVL was 477,000 tonnes and the estimated non-methane organic compounds (NMOCs) production rate was estimated at 96 tonnes per year. The report prepared in 2008 indicated that the landfill contained approximately 571,000 tonnes and estimated NMOC emissions are approximately 120 tonnes per year. As both reports indicate that the estimated landfill NMOCs were below 150 tonnes/year, a landfill gas management system was not required.

Effective January 1, 2009, the MoE released the *Landfill Gas Management Regulation*. This regulation supersedes the previous regulation and is focused on reducing greenhouse gas emissions from landfills and identifying potential landfill gas recovery opportunities. The new regulation is now in effect and indicates that for landfills with volumes greater than 100,000 tonnes, a landfill gas generation assessment report must be submitted by January 1, 2011. The new regulation utilizes a different assessment methodology and evaluates the need for a landfill gas collection system based on the amount of methane generated each year. Should the annual

amount of methane generated exceed 1,000 tonnes, a landfill gas management design plan must be developed.

A *Landfill Gas Generation Assessment Report for the Alberni Valley Landfill*, prepared by McGill & Associates Engineering Ltd. in December 2010 and updated in March 2011, was completed to meet the new regulations. Discussion of the report and its results are provided in Section 6.3.

3.6 Filling Plan

The landfill is being constructed in a series of cells. The first layer of cells are being raised to an elevation of approximately 88 m and are then temporarily capped, until the surrounding cells are brought up to the same elevation. By raising the cells in a series of steps, it will allow for maximum usage of the landfill while maintaining reasonable access to the site. Figure 6 shows the first layer of cells, designated A through D. Cells A and B are considered the east expansion area while Cells C and D are considered the south expansion area. Landfilling is currently occurring in Cell A. After Cell A, filling will progress to Cell B. Prior to filling Cell B some clearing will be required, together with a detailed survey defining the landfill base in that area and to confirm drainage control. While Cell B is being filled, some construction waste, comprised of materials considered relatively inert, will begin to be placed in the western limit of Cell C. These types of materials are expected to generate very little leachate, if any. This allows the filling of municipal solid waste within Cell B to be maximized, and utilize the existing leachate collection system in Cell B. Once Cell B becomes filled, all landfilling activities will be moved to Cell C and subsequently D. The first layer of cells will expand the landfill footprint to its maximum area, of approximately 21.8 hectares.

The second layer of cells are designated Cell E through H. These cells are located above the first layer of cells and will be filled sequentially to an elevation of approximately 106 m. The estimated footprint area of the finished surface of the landfill will be approximately 6.6 hectares. Figure 7 shows the location of the upper level of cells.

The slope of the landfill face is designed to be 3 horizontal to 1 vertical. This slope is large enough to maximize the filled volume while maintaining structural stability of the slope.

In 2008, the volume of each cell was estimated using the design criteria and the results are provided in the table below.

Table 2: Estimated Volume of Landfill Cells

Cell	Estimated Volume (m^3)
A	200,000
B	250,000
C	570,000
D	390,000
E	590,000
F	460,000
G	270,000
H	340,000

Based on a topographic survey completed on June 4, 2010, there is an estimated 125,000 m^3 remaining in Cell A.

The construction of access roads within the landfill will be designed to service multiple cells, thereby minimizing road construction costs and reducing the amount of usable volume allocated to roads. Roads will be designed to have a maximum grade of 7%, in order to facilitate larger commercial trucks.

A permanent access road along the north and east boundary has been proposed to provide access to the equalization lagoon. A permanent access route along the electric fence will enable inspection and maintenance of the electric fence.

4 CURRENT LANDFILL OPERATIONS

The following sections outline the routine operations and activities at the AVL.

4.1 General

The landfill is operated by staff from Berry and Vale Contracting Ltd. and is open to the public seven days a week. Signage is located at the entrance to inform users of the owner, operator, contact numbers, landfill hours, tipping fees, accepted waste and banned materials. The designated landfill operating hours are:

- Summer Hours (April 16 to October 15):

  Monday to Friday 8:00 am to 5:30 pm
  Saturday & Sunday 9:00 am to 4:30 pm

- Winter Hours (October 16 to April 15):

  Monday to Friday 8:00 am to 4:30 pm
  Saturday & Sunday 9:00 am to 4:00 pm

The landfill is closed on Statutory Holidays. During working hours, landfill staff are present in the scale shack at all times. After hours, the entrance gate is locked. A full-time caretaker resides on the landfill property and is available for emergencies after hours.

The scale shack is located inside the landfill entrance to meet all incoming traffic. For large quantities, the vehicle is weighed before and after tipping and then charged according to the type and weight of waste disposed. Tipping fees at the AVL are regulated by Bylaw R1006-4. Current tipping fees are:

- Domestic Waste (84 kg or greater) - $95.00/tonne ($8.00 minimum)
- Domestic Waste (84 kg or less):
    - $2.00 each garbage bag or can ($8.00 maximum)
    - $2.00 for each tire or $170 per tonne, whichever is greater
    - $100.00 for each wrecked auto
    - $200.00 for each wrecked truck or bus
    - Fridges and freezers - $20.00 each
- Construction/Demolition Waste - $120.00/tonne
- Stumps, land clearing debris - $120.00/tonne

Fees for additional controlled waste items are included on Bylaw R1006-4 included in Appendix D.

The AVL does not charge for disposal of recyclable materials. Recycling bins are provided on an asphalted area near the landfill entrance. A temporary disposal area for white goods, bulky metallic objects, tires and batteries is provided near the landfill entrance. Compostable material is dropped off at a designated location within the landfill. The paved area has a drainage system to control spills and possible rainfall generated leachate from the uncovered containers. Drainage collected in this area is pumped to the concrete trench on the north boundary

Certain materials are not accepted at the AVL, examples include reactive and/or radioactive wastes, hazardous waste, special waste as defined in the Waste Management Act and solid waste that is on fire or smouldering.

When users have only small quantities of waste, the waste is emptied into the tipping bins located near the landfill entrance. Large commercial vehicles are sent to the active landfill face for waste disposal. When the bins at the tipping area become full, they are trucked to the landfill face and emptied by AVL staff. As only commercial users are allowed onto the working face, the opportunity for scavenging is not available.

4.2 Fill Area

The active filling area is currently located in the eastern expansion area. At the end of each day, large metal covers are placed over the active face. The use of the metal covers reduces the need for cover material therefore making the landfill operations more economic and also maximizes the volume solid waste being placed in the land fill. As the areas become filled, the waste is compacted and a granular fill material is placed over the waste. Both the large metal covers and the fill material acts as temporary cover to prevent attraction of vectors and other wildlife and to prevent wind from blowing refuse and spreading litter. The electric bear control fence was constructed to prevent bears and other wildlife from entering the landfill.

During dry summer months, a water truck is readily available to help with providing dust control as needed. As there are no residential or commercial activities directly surrounding the landfill, dust control is not a major concern at the AVL. The water truck also provides a first response level of fire protection.

4.3 Fire Protection

The ACRD has recently expanded the Sproat Lake Volunteer Fire Department service area to offer fire fighting services to buildings and structures located at the AVL. These services will also include first responder services for accidents or injuries.

Fire fighting is currently the responsibility of the operations contractor, currently Berry and Vale Contracting. They have water tanks located around the site to provide initial protection, should a fire breakout. The tanks are backed up by a larger water storage reservoir (495 cubic metre capacity). It is reported that some small fires have broken out at the AVL in the past and they were successfully extinguished by the operations contractor.

To avoid the spread of fire within the landfill area, filling is completed in a series of cells, with fire breaks located between cells. The maximum dimension of the fire cells are 27.4 m by 27.4 m by 3 m deep. Each cell is surrounded by a minimum of 150 mm of fire resistant material, usually a granular material.

4.4 Cover Material

Cover material is currently extracted from the surficial soils located in the southern area of the site. It is expected that the source of the onsite cover material will be depleted within the next year. On June 26, 1989, License #102799 was issued to the ACRD to allow the extraction of gravel for ballast and landfill cover purposes from part of Lot 307. The agreement was valid for a period of 10 years, therefore expiring on June 26, 1999. A new Licence of Occupation (Licence No. 112324) for this property was given on July 31st, 2006 for a term of 10 years. The quantity of cover material at this property is unknown. The ACRD has used this as a source in the past, however, they have not extracted any gravel from it over the last 15 years .While the ACRD is not currently using this as a source of cover material, it is investigating the possibility of gravel

extraction from this site. A permit has been issued by the Ministry of Forests to allow removal of the trees in preparation for extraction of the gravel. Once logging is done clearing will be required to uncover the gravel. As the Tseshaht First Nation has shown an interest in the land. The ACRD is currently in discussion with TFN regarding the land clearing and extraction activities

As the current onsite cover material source is being depleted, the ACRD will be investigating other cover material options. The cover material options include acquiring additional land offsite for gravel extraction, blasting and crushing onsite bedrock, purchasing and trucking in cover material and using existing ACRD land as a gravel source. Alternative cover materials such as foams or liners are not considered appropriate at this time.

In order to conserve the amount of cover material needed, the landfill operators have begun using sloped tarps that can be utilized on the daily finished side slopes to reduce the need for daily cover. Based on the first couple of months of use at the AVL, the operator estimates that the use of the sloped tarps has resulted in a 20% reduction in the amount of cover material needed.

The long term plan for the ACRD is to always have five years worth of cover material secured for ACRD use.

4.5 Environmental Monitoring

Water Quality

A quarterly water quality monitoring program is conducted to evaluate water quality at and surrounding the landfill property. The program is contracted to Piteau Associates Engineering Ltd. while the field sampling program is conducted by trained ACRD staff.

The monitoring program has been in place since 1994 and includes the collection of water level data, leachate samples, surface water samples, surficial groundwater samples and bedrock groundwater samples. The results of the monitoring program are reported yearly.

The 2010 monitoring year involved sampling the leachate drain, 12 monitoring well sites, two pump stations and four surface water monitoring sites. The objective of the water quality monitoring program is to meet the *Guidelines for Environmental Monitoring at Municipal Solid Waste Landfills*, prepared by the Ministry of Environment, last reviewed January 1996.

Wells are located within the landfill, as well as on the north, east, south and west limits of the AVL. While the water quality analysis varies from each of the sample locations, the common analyses include:

- Field measurements:
    - Conductance
    - Temperature

  - pH
  - Odour
  - Colour
- Lab Analyses:
  - Conductance
  - pH
  - Total Dissolved Solids (TDS)
  - Chloride
  - Sulphate
  - Ammonia
  - Nitrate
  - Chemical Oxygen Demand (COD)
  - Total or Dissolved Metals.

One well is also analyzed for Total Organic Carbon (TOC) and the leachate sample from the aeration lagoon is sampled annually for Volatile Organic Carbons (VOCs) and acid extractables. A summary of the water quality results is found in Section 6.1.

Additional detail on the quarterly sampling program can be found in *Water Quality Monitoring Report to December 2010,* submitted by Piteau Associates.

Landfill Gas

According to landfill gas assessments conducted in 2003, 2008 and 2011, landfill gas is not yet a concern at the AVL. The estimated amount of gas generated does not cause any risk to anyone at the site or the surrounding properties.

4.6 Annual Reporting

The *Landfill Criteria for Municipal Solid Waste* indicates that an annual report must be prepared and submitted to MoE. As specified in Operational Certificate MR-524, the annual report will be submitted by May 1st of the following year.

5 WASTE CHARACTERIZATION & QUANTIFICATION

5.1 Waste Characteristics

When measuring weights at the scales, AVL staff also characterize the incoming solid waste into several categories. The waste is either placed into the landfill or removed by an outside recycling company. The general solid waste categories and their destinations are shown in the table below.

Table 3: Destination of Incoming Landfill Material

Waste Category	Destination
Mixed Solid Waste	Landfilled
Tires	Stockpiled for future recycling
Recycle Can	Removed by outside company for recycling
Glass	Removed by outside company for recycling
Newspaper	Removed by outside company for recycling
Cardboard	Removed by outside company for recycling
Plastic	Removed by outside company for recycling
Compost	Stockpiled then removed by outside company for composting
Outgoing Steel	Removed by outside company for recycling
Asbestos	Landfilled
Special Waste	Landfilled
Roofing	Landfilled
Gyproc	Landfilled
Stumps + Demo	Landfilled

Tires are currently stockpiled on site. While a recycling program is anticipated to begin in the future, this program has not yet been implemented. Asbestos is occasionally accepted at the landfill, however only under permit. Asbestos is buried in a separate section near the east expansion area. Special waste includes those materials which are atypical and require a permit for disposal. Compost is stockpiled onsite and then removed by a private composting company.

The ACRD is in the process of reviewing the types of solid waste accepted at the AVL.

The characterization of garbage with the Alberni Valley has not been formally measured, however the SWMP prepared by Gartner Lee Limited in 2007, estimates the solid waste composition for the Alberni Valley. The values are based on a study for the Regional District of Nanaimo, with some alterations to reflect the conditions in the Alberni Valley. Their estimated waste composition is shown in the following table.

Table 4: Estimated Waste Composition

Category	Estimated Percentage of Total Waste
Compostables	37%
Miscellaneous	16%
Paper	15%
Construction/Demo	13%
Plastic	12%
Metal	4%
Electronics	1%
Glass	1%
Household Hazardous	1%

When reviewing waste diversion activities, the amount of recyclable materials entering the landfill changed significantly since the implementation of the ACRD curbside recycling program in 2008.

5.2 Waste Quantification

Since the weigh scales were installed in 1995, they have been calibrated annually. The annual tonnage of waste entering the landfill has been recorded and quantities from 2003 to 2010 are provided in the following table.

The table reflects the reduction in recyclable materials that corresponds with increased recycling and the implementation of the curbside recycling program.

Table 5: Annual Weights from 2003 to 2010

	Annual Weight (tonnes)							
Category	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**
Garbage	12,423	13,670	14,832	15,395	17,134	14,382	19,150	18,340
Tires (# of tires)	362	270	963	593	585	511	487	458
Recycle Can	38	42	55	96	0	0	0	0
Glass	17	20	23	22	0	3	0	0
Newspaper	40	42	34	1	0	0	0	0
Cardboard	43	54	50	0	0	0	0	0
Plastic	24	28	32	47	32	0	0	0
Compost	318	321	352	272	277	302	307	290
Outgoing Steel	579	662	692	716	733	568	435	373
Asbestos	34	20	15	31	51	26	23	53
Waste	173	64	163	116	369	74	2,982	0
Roofing	732	888	1,277	1,517	1,861	1,624	1,154	775
Gyproc	52	59	120	152	192	209	174	188
Stumps + Demo	1,285	1,771	2,789	2,208	2,482	2,784	2,376	2,572

The amount of waste actually landfilled is provided in the table below. These weights have been used to estimate the quantity of solid waste entering the landfill.

Table 6: Annual Landfill Weights from 2003 to 2010

	2003	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**
Weight of Landfilled Material in tonnes	14,672	16,479	19,198	19,422	22,019	19,026	22,878	21,931

Landfill weights prior to 1995 were estimated by Cameron Advisory Services Ltd. in the *Alberni Valley Landfill Report on Landfill Gas* prepared in 2003. Using these historic estimates prior to 1995, there is an estimated 650,000 tonnes of solid waste at the AVL as of the end of 2010. A copy of the estimated landfill weights since inception are provided in Appendix E.

5.3 Existing Landfill Volumes

Landfilling activities at the AVL began in the early 1970's. The elevation of the original base is estimated to be approximately 70 m. The northern area of the landfill has been closed and capped at an elevation of approximately 88 m. The estimated volume of waste within the northern landfill area is 800,000 m^3.

Current operations involve filling within the east expansion area. A topographic survey (June 4, 2010) of the landfill face indicated that there was approximately 247,700 m^3 of waste within the east expansion area. Therefore, as of June 4, 2010, there is an estimated 1,047,700 m^3 of solid waste in the AVL.

The annual survey data is compared to the weigh scale records to estimate what rate of filling is being achieved at the AVL. The survey data from May 26, 2009 and June 4, 2010 indicate that approximately 37,170 m^3 was added to the landfill. Approximately 24,477 tonnes of solid waste was added to the landfill during this time, indicating a filling density of approximately 0.66 tonnes/m^3. This density does not represent the actual density of the landfill, as cover material has not been included in the calculation. While densities have varied over the past years, a value of 0.66 tonnes/m^3 is used for predicting future filling rates.

6 PERFORMANCE CRITERIA

Gartner Lee Limited was retained to prepare a Solid Waste Management Plan (SWMP) for the ACRD. Based on an evaluation of current public and political direction, the following plan objectives were developed:

- Reduce the amount of waste requiring disposal;
- Increase the level of recycling activity throughout the regional district; and,
- Ensure that any residual waste is disposed of in a manner that protects environmental and social well-being.

The objectives are in line with those of the *Landfill Criteria for Municipal Solid Waste* in that they promote the reduction of solid waste and thus the reduction in the production of leachate and landfill gas. The ACRD has begun implementation of the recommendations developed in the SWMP. The following sections provide discussion on the performance criteria used to meet the objectives above.

6.1 Groundwater and Surface Water Quality

The water quality monitoring program was established in 1994 and has been conducted quarterly since 1998. Surface water samples are collected from Heath Creek, Stevens Creek, Christie Creek (both upstream and downstream of the AVL) and from the leachate lagoon. In addition, several monitoring wells have been installed around the landfill to evaluate both

water quality in surficial sediments and bedrock. The wells are located both within and surrounding the landfill property. Attached Figure 5 shows each of the water quality monitoring locations.

The analytical results from each location are compared to the *British Columbia Approved Water Quality Guidelines* and a *Compendium of Working Water Quality Guidelines for British Columbia* for the protection of freshwater aquatic life. In addition, the results have been compared to the *Guidelines for Canadian Drinking Water Quality* to evaluate water quality should a future drinking water source be considered.

In order to manage leachate generated by the landfill, a leachate collection system has been constructed. Details of the leachate collection system is described in Section 3.2. The water quality sampling locations surrounding the landfill are used to determine if any leachate excursions are occurring. To date, leachate excursions have been identified at the north, east and west boundary and remediated by the construction of impermeable berms and altered groundwater flow conditions.

A leachate sample is collected from the aeration lagoon each sampling period. The historic results indicate that the strength of the leachate appears to be relatively constant, with some seasonal variations. When compared to samples collected from directly below the landfill area, the concentration of leachate at the aeration lagoon appears to be diluted by 2:1. The leachate chemistry typically has neutral pH, high electrical conductivity and alkalinity and high concentrations of chloride, calcium, potassium, sodium, iron, manganese and ammonia. Various concentrations have exceeded the guidelines in the past. In 2010, the leachate sample had concentrations above the guidelines for total dissolved solids, total iron, total manganese and ammonia nitrogen. The leachate concentrations are considered typical for a landfill of this size and age and are not considered a concern as leachate is transported to the municipal sewage lagoon for treatment.

Within the landfill, some of the wells had parameters that exceeded the water quality guidelines. In 2010, contaminants exceeding the guidelines include pH, total dissolved solids, dissolved arsenic, dissolved copper and ammonia nitrogen.

One well located west of the landfill and two surficial wells located south of the landfill (south of the south expansion area) have not shown any leachate impacts. While a few parameters have exceeded the applicable guidelines, they have been attributed to background conditions. One surficial well installed along the east property boundary, in the berm adjacent to the leachate storage lagoon, has not shown indications of leachate impact and did not exceed the guidelines in 2010. Surficial wells located at the north edge of the landfill, north of a leachate interception trench, have not shown leachate impacts, except for in 2001 as a result of a leachate pump failure and met the water quality guidelines in 2010.

According to the *Water Quality Monitoring Report to December 2010* by Piteau Associates, the monitoring data for bedrock wells indicate that water quality is well within the drinking water criteria, with the exception of a few parameter that are naturally occurring.

Samples from Heath Creek and Stevens Creek have met the applicable guidelines in recent years, with the exception of manganese concentrations in Stevens Creek that exceeded the aesthetic objective for drinking water, but met the freshwater aquatic life criteria. The report also indicated that the Christie Creek water quality complied with the receiving water quality criteria for which analyses were performed in 2010, with the exception of naturally occurring parameters.

A detailed discussion of each of the sample locations and their results can be found in the *Water Quality Monitoring Report to December 2010,* submitted by Piteau Associates, dated September 2011.

6.2 Leachate Generation

Leachate generated within the landfill is collected and directed to a flow equalization lagoon near the eastern boundary of the property. The leachate then travels through an underground pipeline to the City of Port Alberni sewage lagoon for treatment.

The volume of leachate entering the sewage treatment plant is measured by the City of Port Alberni through an electronic data collection system. A chart showing the monthly volume of leachate entering the sewage lagoon from 2006 to 2010 is shown below.

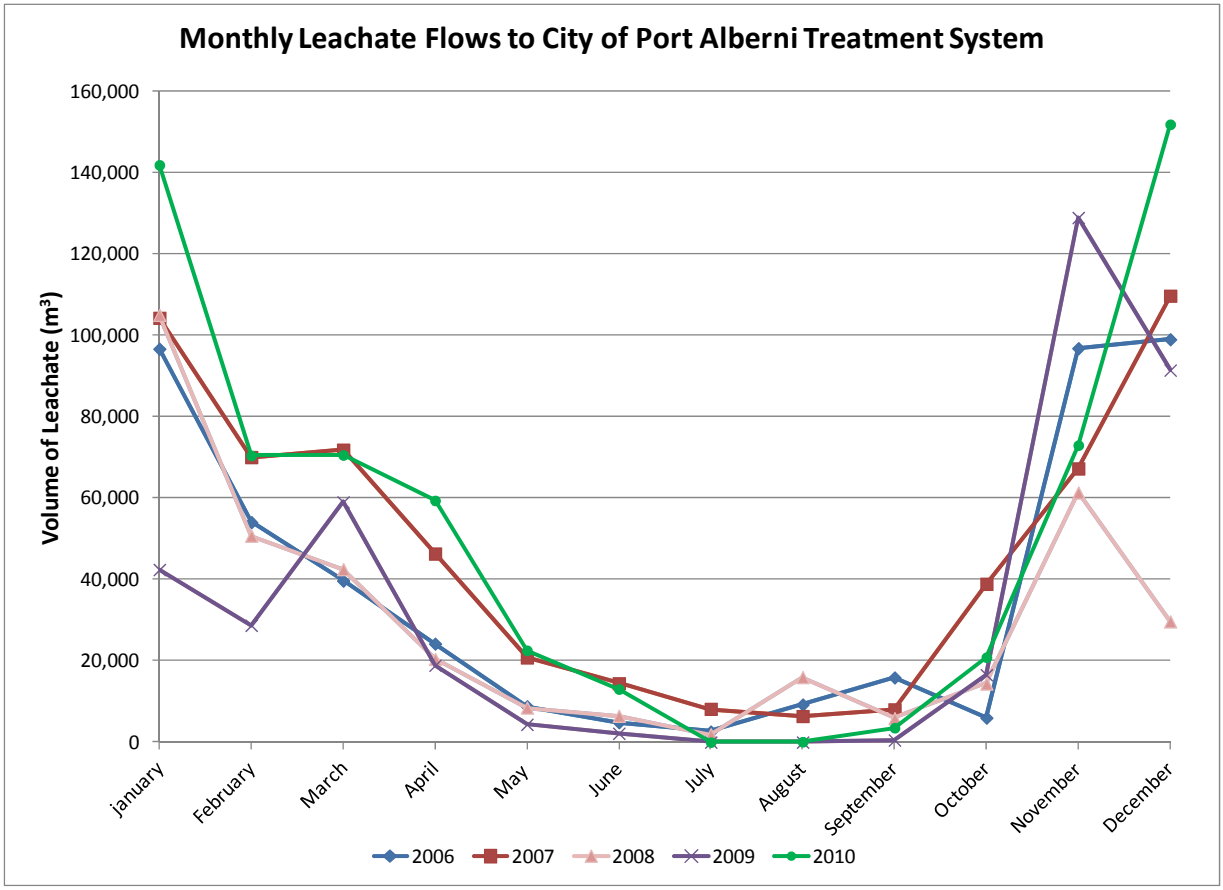


Chart 1: Monthly Leachate Flows 2006 to 2010

As observed in the figure, the volume of leachate generated correlates with the seasonal rainfall trends. During dry summer months (June to September), minimal leachate is generated, while more significant volumes are generated during the wet winter months (November to March). The total estimated leachate flows from 2006 to 2010 are provided in the table below.

Table 7: Approximate Annual Leachate Flow

Year	Approximate Total Leachate Flow (m^3)
2006	457,970
2007	566,440
2008	362,880
2009	393,070
2010	627,320

In the past 5 years, the volume of leachate generated and treated ranges from 362,880 m^3 to 627,320 m^3.

6.3 Landfill Gas Management

A *Landfill Gas Generation Assessment Report for the Alberni Valley Landfill* was prepared by McGill & Associates Engineering Ltd. in December 2010 and updated in March 2011. The estimated and measured solid waste quantities entering the landfill for the past 30 years were compiled and it was determined that approximately 549,884 tonnes of waste had been landfilled. Solid waste deposited prior to the past 30 years was not considered to contribute to landfill gas generation. Where available, scale records were used to categorize incoming waste into several general categories. As a solid waste composition study has not been completed, the solid waste characterization was taken from *British Columbia's Solid Waste Flow, 2006 Summary Report* to provide an estimated breakdown of the residential, commercial and construction demolition categories. Using site specific model parameters and an annual solid waste increase in 0.3%, the quantity of methane generated at the AVL each year was estimated. There was an estimated 932 tonnes generated in 2009, and 955 tonnes generated in 2010. It was predicted that the 2012 year will be the first year the AVL will reach greater than 1,000 tonnes of methane generated.

As a landfill gas management system is not yet required, a landfill gas collection system has not yet been designed. Annual landfill gas updates will be submitted as part of the annual operations and monitoring report. The system will be designed when implementation is required, thus utilizing the most recent design philosophy.

6.4 Public Health, Safety and Nuisance

The landfill is located in a rural area, surrounded by an electric bear fence with public access through one entrance gate. Landfill staff are present in the scale shed at the entrance of the landfill and are aware of users entering the landfill property. After landfill hours, all gates are closed and locked detering public entry on to the site.

Due to the mixed composition of waste at municipal solid waste landfills, odour concerns are often an issue. The rural location of the landfill and the surrounding vacant forest land have eliminated odour complaints from neighbouring properties. Intermediate cover and daily cover activities also help to prevent odour concerns.

7 CLOSURE PLANS

Once the landfill reaches its maximum capacity, it will be decommissioned according to the closure plan. The closure plan dictates the procedures and activities that must be implemented to close the landfill according to the MoE *Landfill Criteria for Municipal Solid Waste*.

7.1 Closure Design

Future operations are anticipated to follow the current operations plan with construction of slopes at 3:1 to an elevation of 106 m. At closure, a landfill cap will be constructed. The objective of the cap will be to:

- Minimize water infiltration into the landfill, therefore reducing the amount of leachate generated;
- Minimize gas migration out of the landfill and towards gas collection facilities, if required;
- Control odours generated by the landfill; and,
- Prevent access to the solid waste from vectors and other wildlife.

The cap will cover the entire landfill face and re-direct surface water away from the landfill. In addition to the landfill cap, a surface water drainage plan must also be addressed. The surface water drainage plan will be separate from the leachate collection system to reduce the volume of contaminated water being treated. At closure the surface ditches will be direct water to the equalization pond, in the southeast corner of the landfill, to provide flow equalization during storm events, prior to discharge to Christie Creek. The proposed landfill at closure, including surface water drainage, is shown in attached Figure 8.

In order to divert surface water, the landfill cap must be impermeable to reduce infiltration. The proposed landfill cap is as follows:

- Topsoil layer – approximately 0.3 m thick topsoil layer to promote vegetation growth;
- Protective Layer – approximately 0.6 m thick layer of low permeability soil to act as a protective layer against both erosion and desiccation cracks;
- Drainage Layer – approximately 0.15 m thick coarse sand and gravel layer to promote drainage towards the landfill boundaries;
- Barrier Layer – impermeable synthetic geomembrane liner to prevent water infiltration into the landfill; and,
- Grading Layer – approximately 0.6 to 0.9 m thick coarse layer to grade landfill surface and provide stability.

A section through the proposed cap is shown in Figure 9. While the landfill cap is to be placed over the entire landfill surface, it is likely that openings will be required to facilitate a landfill gas extraction system. While a landfill gas extraction system is not yet required for the landfill,

it is assumed that a system will be required in the future. The future assessment, design and construction of a landfill gas extraction system will follow the MoE *Landfill Gas Management Regulation*, effective January 1, 2009.

7.2 Volume and Estimated Date of Closure

Based on the design criteria presented above, the remaining landfill capacity is estimated to be 2,995,000 m^3. As the landfill currently contains about 1,047,700 m^3 of waste, there will be an estimated 4,000,000 m^3 of solid waste at the AVL at closure.

A density of 0.66 tonnes/m^3 is used to predict future filling densities. Using the past 5 years of data, the average annual solid waste tonnage is about 21,000 tonnes. Therefore, based on this information, there is an estimated 94 years of life remaining at the landfill, indicating that the AVL is estimated to reach full capacity in 2104.

The remaining landfill capacity and estimated date of closure are based on the ACRD obtaining ownership or long term tenure over the AVL property. Should the long term plans change, the estimated date of closure will be affected and should be updated.

7.3 Closure Notification

Approximately one year prior to closure, appropriate signage will be placed at the landfill entrance to warn users of the upcoming closure and to notify them of new disposal locations. Approximately 3 months prior to closure, an advertising program will be initiated to notify local residents and businesses of the upcoming closure and alternative locations. Forms of advertising will include ads in the local paper and on local municipal websites.

7.4 Legal Obligations

Upon landfill closure, a covenant will be registered on the property indicating that the property was used as a municipal solid waste landfill, thereby meeting the requirements of the *Land Title Act*.

8 POST-CLOSURE PLAN

Once the AVL has been formally closed, additional monitoring activities will be necessary to assess water quality around the landfill, monitor the landfill gas collection system and inspect the landfill for signs of disrepair.

8.1 Water Quality Monitoring

As required by the *Landfill Criteria for Municipal Solid Waste*, a water quality monitoring program will continue once the AVL has been closed. The water quality monitoring program is expected to be similar to the current program and will continue for at least 10 years following closure. The program will involve quarterly monitoring of surface water, groundwater and leachate at

and surrounding the landfill. The water quality results will be compared to the *Approved and Working Criteria for Water Quality*, published by the BC MoE. The results will be reviewed and reported yearly. The report will evaluate the effectiveness of the landfill cap and surface water drainage system and address any identified water quality issues.

After ten years, it is anticipated that the water quality at the landfill will stabilize and the water quality monitoring frequency will be reduced to semi-annually. After 25 years, the results will be reviewed and if there is sufficient evidence that shows that the landfill has not had significant impact on the surrounding environment, the water quality monitoring program will be ended.

8.2 Landfill Gas Management

It is anticipated that a landfill gas management system will be constructed prior to closure. As a collection system is not yet required and therefore not yet designed, the details of required operation, maintenance and monitoring is unknown. Preliminary plans anticipate that an ongoing collection and treatment system will be installed. After closure, a remote SCADA system will be utilized and maintenance staff will be contacted for emergencies. A quarterly inspection and monitoring program, will likely have to be established to evaluate landfill gas generation for a minimum of 25 years.

8.3 Inspection and Maintenance

After closure, a regular inspection and maintenance program must be initiated to maintain the integrity of the landfill. Inspections must include evaluation of the:

- landfill cap by noting any significant erosion, cracking, settlement or seepage;
- electric fence for structural integrity and performance;
- landfill cap for evidence of wildlife or rodent impacts; and,
- leachate collection system components for containment.

The inspection reports should identify if maintenance activities are required. Inspections are anticipated to be monthly for the first year, and quarterly for the years following.

8.4 Buildings/Structures

No structures will be constructed on the finished landfill surface as there is high potential for differential settlement. It is understood that a small structure or shed may be required to facilitate the landfill gas collection system, and if required, will be designed and constructed with MoE approval. Past the 25 year post-closure date, it is unlikely that any structures will be constructed on the property.

9 FINANCIAL SECURITY

The ACRD is responsible for establishing a closure fund to cover costs associated with landfill closure and post-closure activities. Closure activities include properly capping the finished landfill face and post-closure activities include continued monitoring and maintenance. The estimated costs are tabulated in the table below.

Table 8: Estimated Closure & Post-Closure Costs

Item	Estimated Cost
Closure:	
• Landfill Cap & Associated Closure Construction	
Grading Layer – 0.6m sand and gravel	$2,079,000
Barrier Layer – geosynthetic membrane liner	$1,848,000
Drainage Layer – 0.15m sand and gravel	$693,000
Protective Layer – 0.6m low permeability soil	$3,465,000
Topsoil Layer – 0.3m topsoil	$1,386,000
Vegetation	$57,750
• Legal Fees	$30,000
Subtotal Closure Costs=	$9,558,750
Contingency (10%) =	$955,875
Total Closure Costs =	**$9,558,750**
Post-Closure:	
• Water (surface water, groundwater and leachate) Quality Monitoring:	
Quarterly Monitoring for 15 years ($15,000/year)	$225,000
Semi-Annual Monitoring for following 10 years ($10,000/year)	$100,000
• Landfill Gas Operations and Monitoring for 25 years ($15,000 per year)	$375,000
• Roads Maintenance ($400/year)	$10,000
• Surface Water Control System Inspection & Maintenance ($1,600/year)	$40,000
• Leachate Collection System Inspection & Maintenance ($400/year)	$10,000
• Landfill Cap Inspection & Maintenance ($400/year)	$10,000
• Utilities (hydro for electric fence & gas collection system, $5000/year)	$125,000
• Miscellaneous Rehabilitation Costs ($1,000/year)	$25,000
Subtotal Post-Closure Costs =	$920,000
Contingency (10%) =	$92,000
Total Post-Closure Costs =	**$1,012,000**
Total Closure & Post-Closure Costs =	**$11,526,625**

A more detailed breakdown of quantities and unit costs for the landfill cap construction has been included in Appendix F. All costs are based on current dollars and do not include escalation. In the preparation of this estimate, several assumptions have been made. The above cost estimate assumes that:

- The unit costs are based on current construction values
- All construction materials are expected to be from offsite sources and estimated costs include transportation and placement
- Costs do not include the purchase of a new landfill site or the construction of an onsite transfer station
- No remediation work will be required at closure
- A landfill gas collection system will be implemented and will only require minor operations, maintenance and monitoring post-closure
- All monitoring wells will be installed prior to closure
- All post-closure inspections and maintenance will be provided by the ACRD
- Access roads will be constructed prior to closure as part of regular operation
- Major drainage paths and surface water controls will be implemented prior to closure
- Engineering design fees will be included in the operations budget in the years prior to closure

All of the above costs should be considered preliminary as it is difficult to predict costs for greater than 90 years into the future. It should be expected that actual costs will vary significantly and they should be updated regularly to reflect current construction practices and prices.

In order to allow the ACRD to save an appropriate financial security to cover closure and post-closure costs, annual contributions should be made to the AVL Closure Fund. The following table summarizes the estimated costs, current closure fund and recommended annual closure fund allocation.

Table 9: Summary of Closure Fund Status

Item	Estimated Cost
Total Closure & Post Closure Costs	$11,526,625
Current Closure & Post-Closure Fund	$1,059,013
Required for Financial Security	$10,467,612
Annual Allocation (based on 95 years)	$115,000

It is recommended that $115,000 be added to the AVL closure fund each year. This should be evaluated at regular intervals to evaluate if it is sufficient.

The estimated costs are based on the ACRD obtaining ownership or long term tenure over the AVL property. Should this not proceed as planned, the closure plan, closure fund and annual closure fund allocation must be reviewed and updated to reflect the change.

10 LIMITATIONS

This document was prepared by McGill & Associates Engineering Ltd. for the Ministry of Environment, on behalf of the Alberni-Clayoquot Regional District. Its material, recommendations and conclusions represent the best material available to McGill & Associates Engineering Ltd. at the time of the report preparation. Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties. McGill & Associates Engineering Ltd. accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

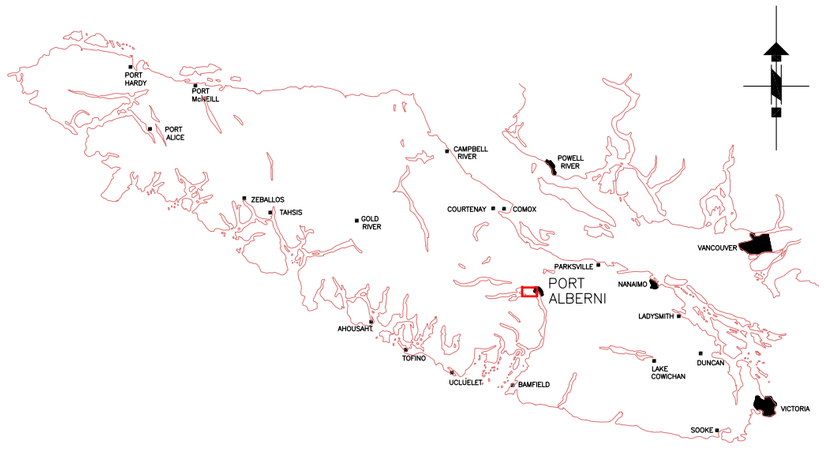
Yours truly,

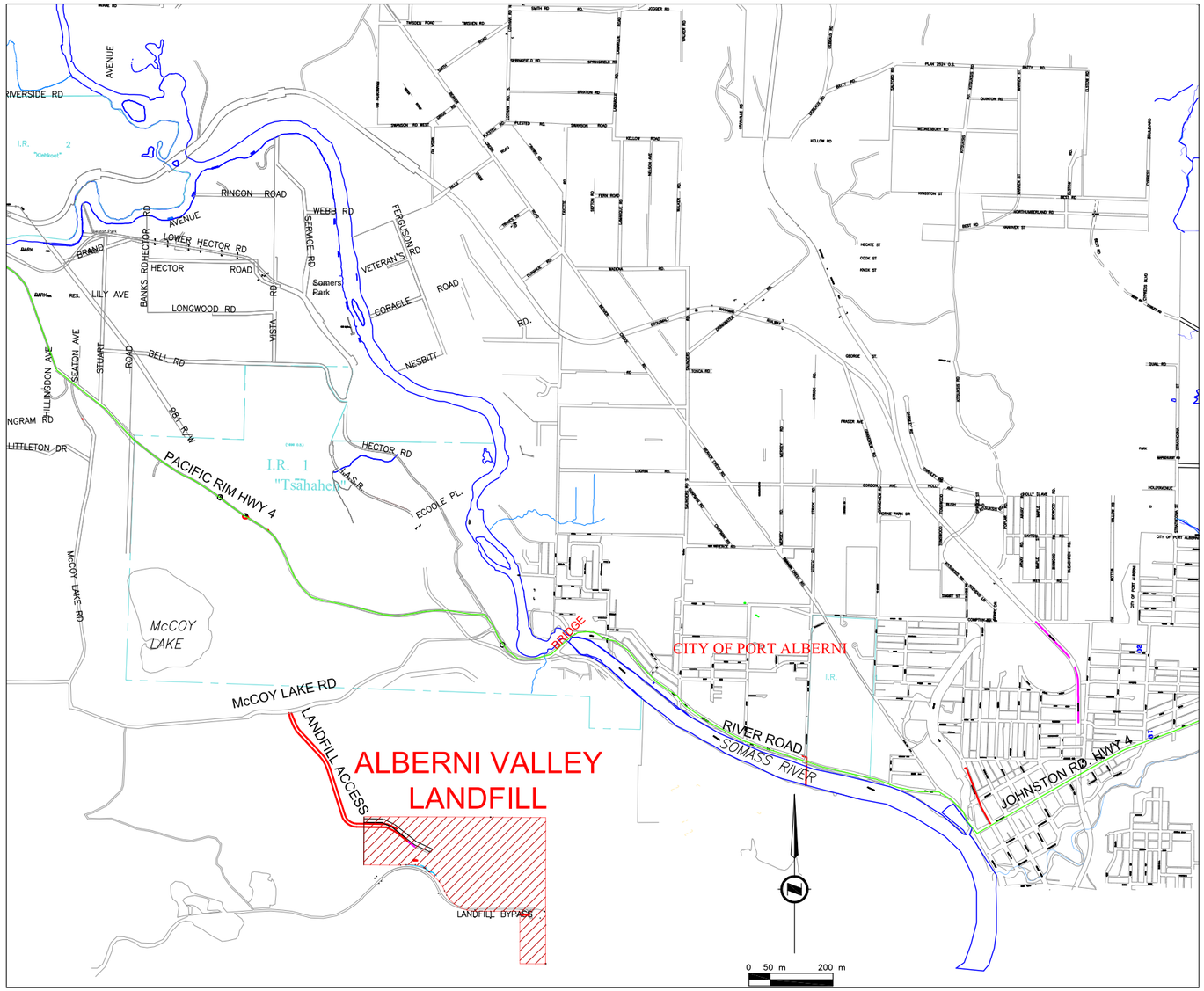
for **McGill & Associates Engineering Ltd.**

Sarah Waldriff, P.Eng.

Alan McGill, P. Eng.
Principal

FIGURES





S:\1756 ACRD AVLLandfil Operations Plan\2010\Report Figures\FIGURE 1 Site Location Plan.dwg Oct 31, 2011 9:06:44am

NOVEMBER 2011

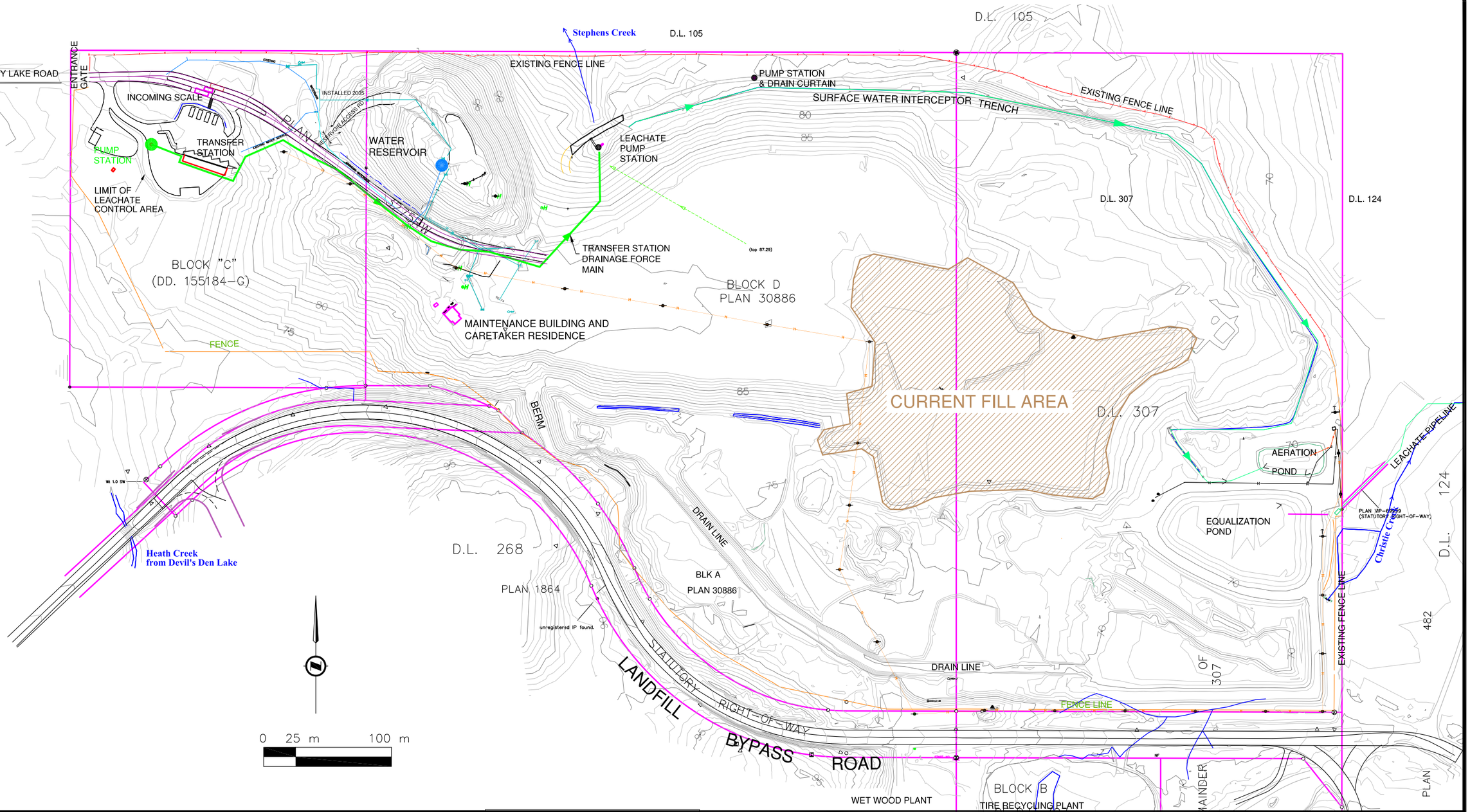
ALBERNI CLAYOQUOT REGIONAL DISTRICT

ALBERNI VALLEY LANDFILL - DESIGN, OPERATIONS & CLOSURE REPORT

SITE LOCATION PLAN

FIGURE 1

S:\1756 ACRD AVLLandfil Operations Plan\2010\Report Figures\FIGURE 2- General Site Plan.dwg Oct 31, 2011 9:08:29am



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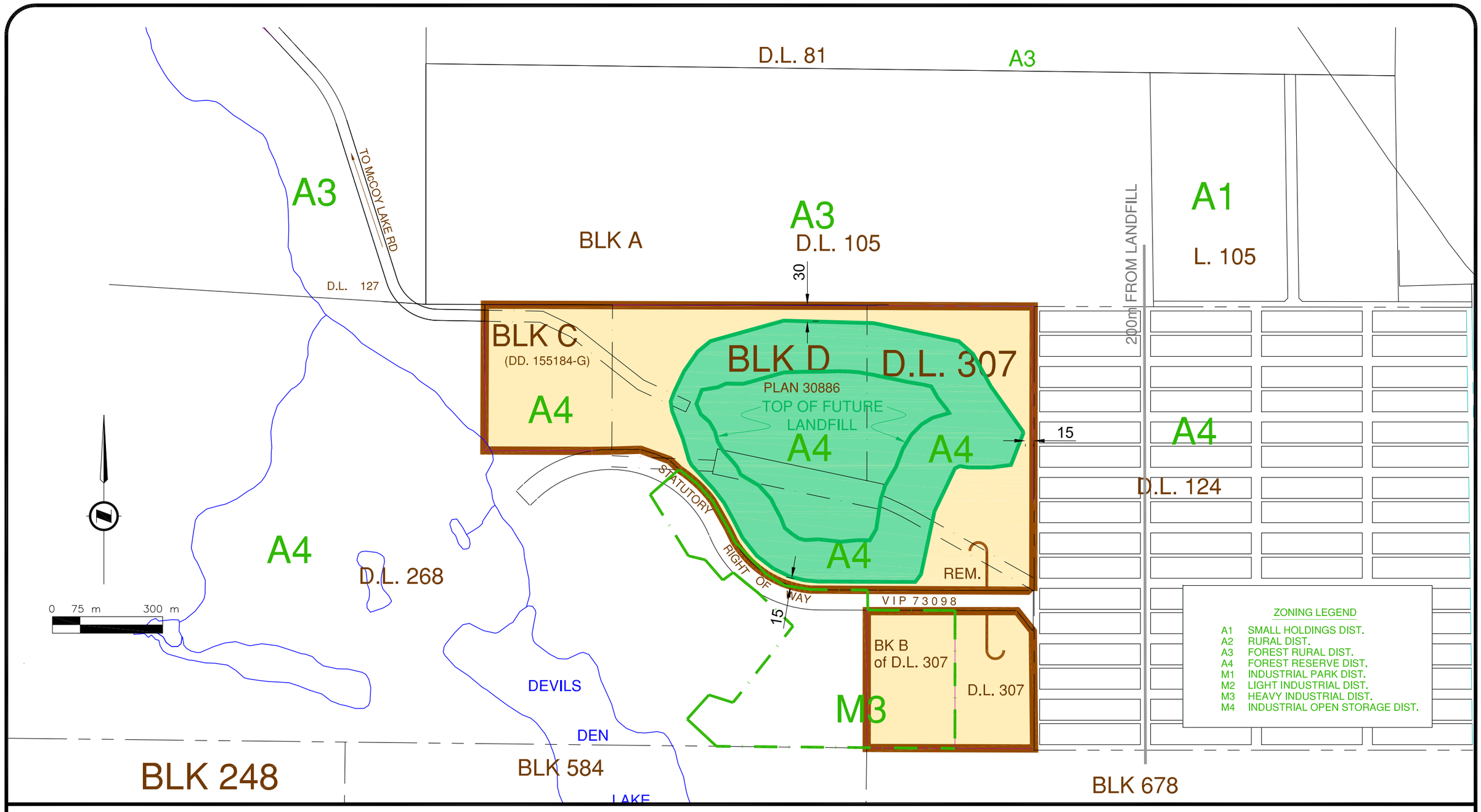
ALBERNI CLAYOQUOT REGIONAL DISTRICT

ALBERNI VALLEY LANDFILL - DESIGN, OPERATIONS & CLOSURE REPORT

GENERAL SITE PLAN

FIGURE 2



S:\1756 ACRD AVLLandfill Operations Plan\2010\Report Figures\FIGURE 3 - Landfill Buffers & Surrounding Land.dwg Oct 31, 2011 9:09:57am

NOVEMBER 2011

ALBERNI CLAYOQUOT REGIONAL DISTRICT

ALBERNI VALLEY LANDFILL - DESIGN, OPERATIONS & CLOSURE REPORT

LANDFILL BUFFERS & SURROUNDING LAND USE PLAN

FIGURE 3

S:\1756 ACRD AV\Landfill Operations Plan\2010\Report Figures\FIGURE 4– Leachate Collection System.dwg Oct 31, 2011 9:11:28am

Stephens Creek

D.L. 105

EXISTING FENCE LINE

PUMP STATION & DRAIN CURTAIN

SURFACE WATER INTERCEPTOR TRENCH

EXISTING FENCE LINE

GATE

INCOMING SCALE

INSTALLED 2005

TRANSFER STATION

WATER RESERVOIR

LEACHATE PUMP STATION

PUMP STATION

LIMIT OF LEACHATE CONTROL AREA

(top 87.29)

D.L. 307

D.L. 124

MAINTENANCE BUILDING & CARETAKER RESIDENCE

FENCE

DRAIN LINE

AERATORS

LEACHATE PIPELINE TO CITY OF PORT ALBERNI MUNICIPAL SEWAGE LAGOON

BERM

CURRENT FILL AREA

AERATION POND

EQUALIZATION POND

Christie Creek

DRAIN LINE

BLK A

PLAN 30886

OVERFLOW CONTROL STRUCTURE

EXISTING FENCE LINE

Heath Creek from Devil's Den Lake

DRAIN LINE

LANDFILL BYPASS ROAD

FENCE LINE

WET WOOD PLANT

TIRE RECYCLING PLANT

ROAD TO DRYLAND SORT

0 25 m 100 m

NOVEMBER 2011

ALBERNI CLAYOQUOT REGIONAL DISTRICT

ALBERNI VALLEY LANDFILL - DESIGN, OPERATIONS & CLOSURE REPORT

LEACHATE COLLECTION SYSTEM

FIGURE 4

S:\1756 ACRD AVLLandfil Operations Plan\2010\Report Figures\FIGURE 5- Water Quality Monitoring Locations.dwg Oct 31, 2011 9:13:13am

ENTRANCE GATE
INCOMING SCALE
TRANSFER STATION
WATER RESERVOIR
EXISTING FENCE LINE
Creek
MW98-9
MW98-10
PUMP STATION & DRAIN CURTAIN
MW94-6
MW94-5
SURFACE WATER INTERCEPTOR TRENCH
EXISTING FENCE LINE
LEACHATE PUMP STATION
D.L. 307
D.L. 124
(top 87.29)
BH00-2C 75.03m
BH00-1C 72.27m
LIMITS OF EXISTING FILLED AREA
MAINTENANCE BUILDING AND CARETAKER RESIDENCE
FENCE
MW94-4
MW09-1
MW09-2
MW09-3
MW09-4
BERM
MW09-5
BH00-3A 67.73m
BH00-6B 59.2m
BH00-7B 59.3m
BH00-4B 65.6m
BH00-12A 69.7m
BH00-5B 67.25m
BH00-3B 66.5m
BH00-2B 61.9m
AERATION POND
AERATOR ANCHOR BLOCK
LEACHATE FORCE LINE
BH00-1A 64.10m
DRAIN LINE
BH00-1B 66.5m
EQUALIZATION POND
BH07-14 5.5m
BH00-7A 65.71m
MW09-6
BH00-8A 71.10m
BLK A PLAN 30886
MW09-7
BH00-5A 74.95m
BH00-10A 66.5m
BH07-13 5.2m
MW02-3 72.83m
Christie Creek
BH00-6A 62.69m
MW09-9
MW09-8
MW09-10
BH07-12 2.8m
BH07-11 6.6m
MW 94-2
EXISTING FENCE LINE
BH00-2A 63.10m
MW09-12
DRAIN LINE
MW09-11
MW09-13
BH07-01 5.20m
BH07-02 14.9m
BH07-03 16.2m
BH07-04 13.4m
BH07-05 12.4m
BH07-06 12.5m
BH07-07 10.0m
BH07-08 9.4m
BH07-09 10.4m
BH07-10 7.6m
BH00-4A 60.61m
BH00-9A 63.00m
BH00-11A 59.02m
LANDFILL BYPASS ROAD
MW02-1
MW02-2
WET WOOD PLANT
TIRE RECYCLING PLANT
ROAD TO
Heath Creek from Devil's Den Lake
0 25 m 100 m

BH BOREHOLE
MW GROUND WATER MONITORING WELL
BH BEDROCK MONITORING

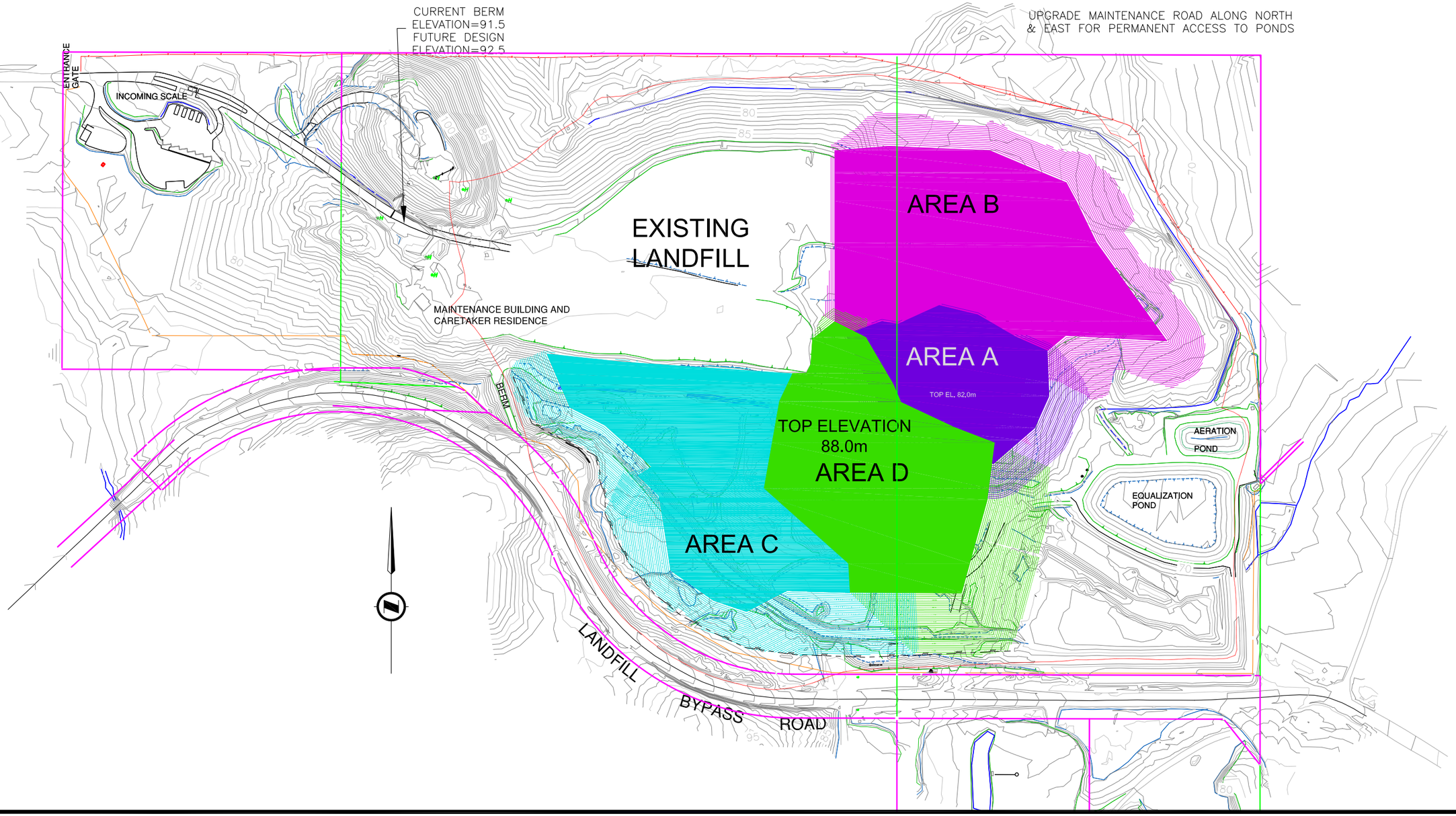
ALBERNI CLAYOQUOT REGIONAL DISTRICT

FIGURE 5

NOVEMBER 2011

ALBERNI VALLEY LANDFILL - DESIGN, OPERATIONS & CLOSURE REPORT

WATER QUALITY MONITORING LOCATIONS



S:\1756 ACRD AVLLandfill Operations Plan\2010\Report Figures\FIGURE 6– Landfill Cells A to E.dwg Oct 31, 2011 9:15:00am

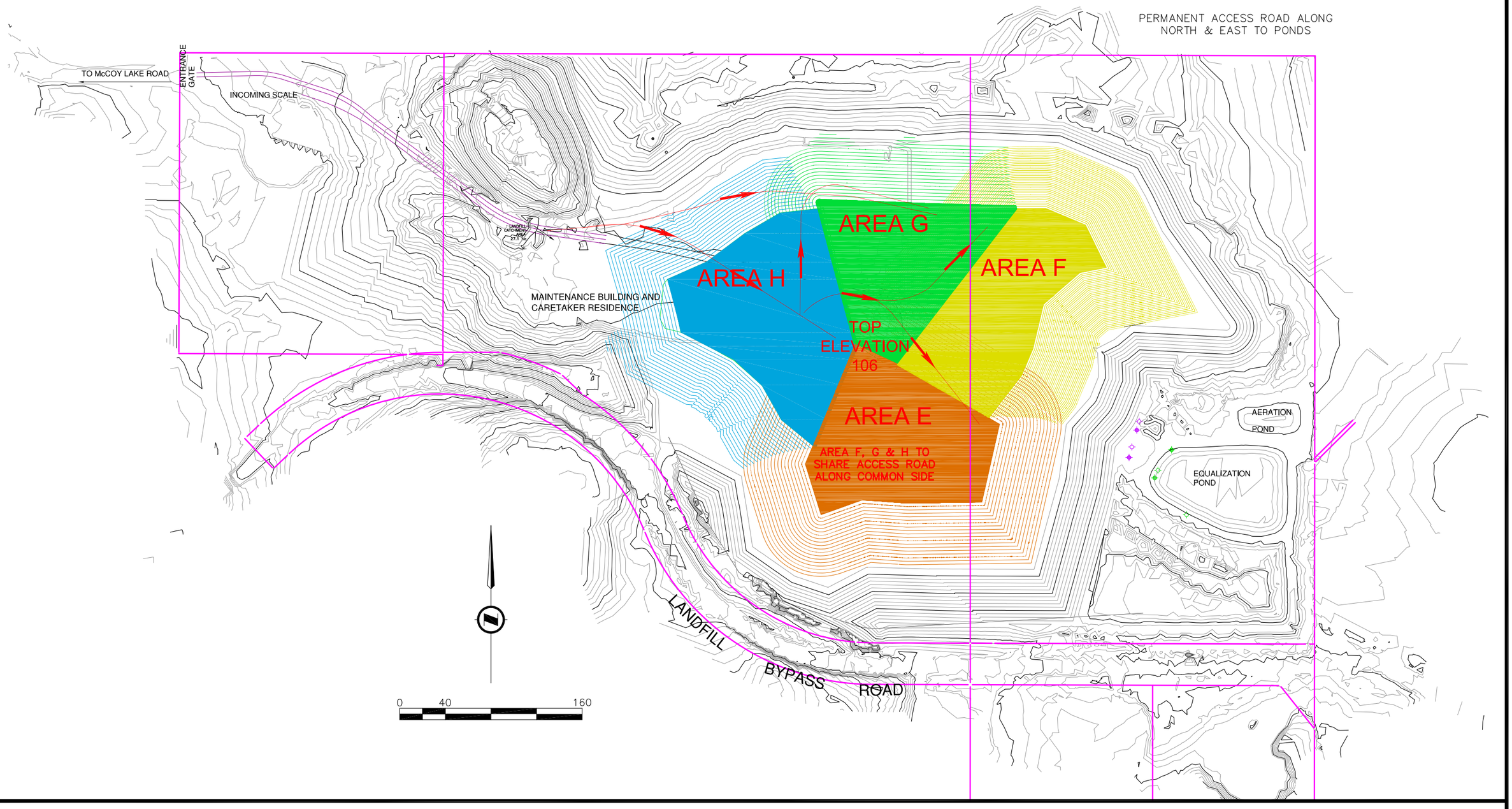
NOVEMBER 2011

ALBERNI CLAYOQUOT REGIONAL DISTRICT

ALBERNI VALLEY LANDFILL - DESIGN, OPERATIONS AND CLOSURE REPORT

LANDFILLING PLAN CELLS A TO D

FIGURE 6



NOVEMBER 2011

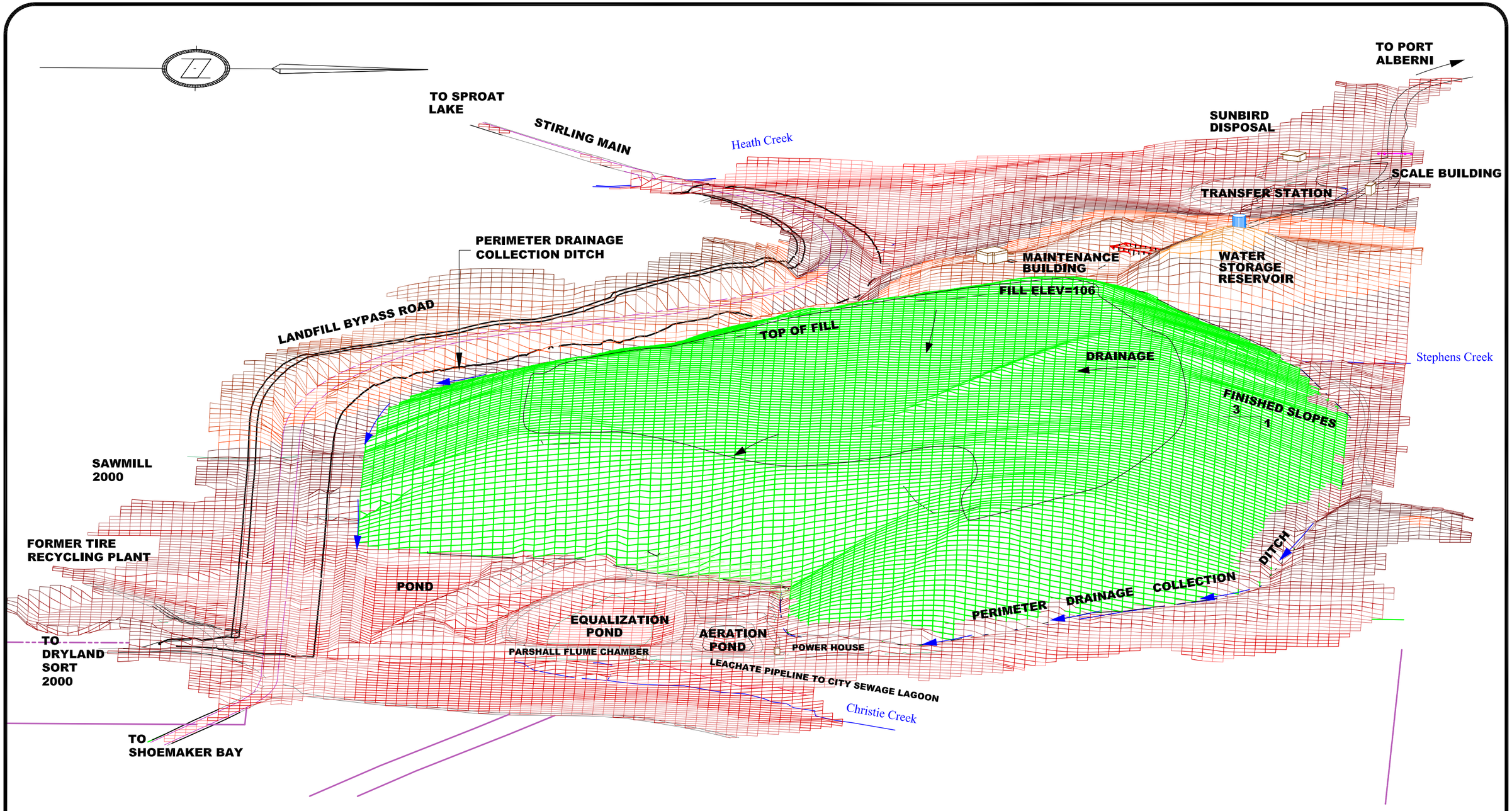
ALBERNI CLAYOQUOT REGIONAL DISTRICT

ALBERNI VALLEY LANDFILL - DESIGN, OPERATIONS & CLOSURE REPORT

LANDFILLING PLAN CELLS E TO H

FIGURE 7

S:\1756 ACRD AVLLandfil Operations Plan\2010\Report Figures\FIGURE 7- Cells E to I.dwg Oct 31, 2011 9:20:23am



NOVEMBER 2011

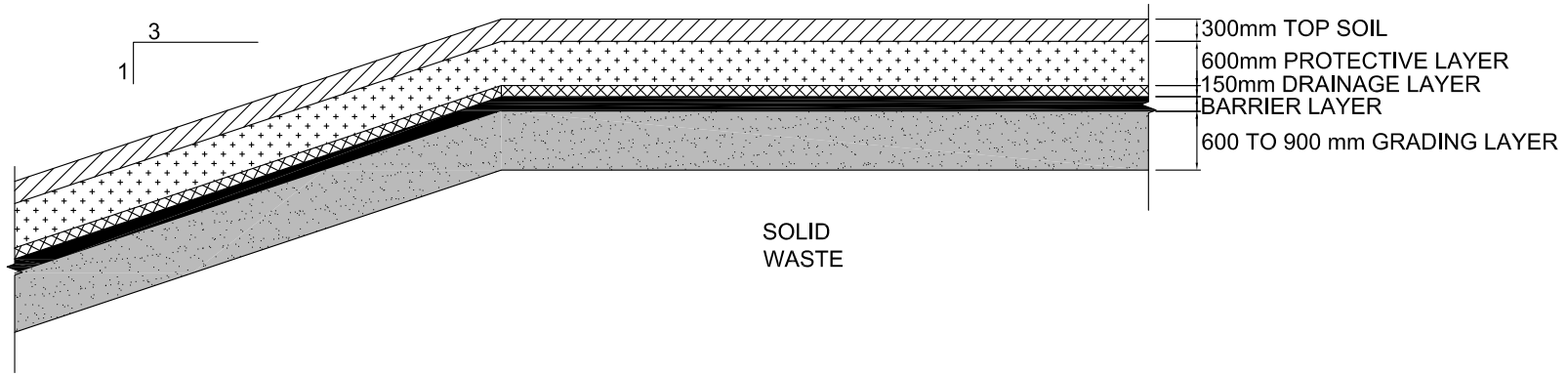
ALBERNI CLAYOQUOT REGIONAL DISTRICT

ALBERNI VALLEY LANDFILL - DESIGN, OPERATIONS & CLOSURE REPORT

LANDFILL CLOSURE PLAN

FIGURE 8

S:\1756 ACRD AVLLandfill Operations Plan\2010\Report Figures\FIGURE 8- LandFill Closure Plan.dwg Oct 31, 2011 9:22:16am



NOVEMBER 2011

ALBERNI CLAYOQUOT REGIONAL DISTRICT

FIGURE 9

ALBERNI VALLEY LANDFILL - DESIGN, OPERATIONS & CLOSURE REPORT

LANDFILL COVER DETAIL

APPENDIX A

OPERATIONAL CERTIFICATE MR-524

BRITISH COLUMBIA

2010 VANCOUVER

File: MR-00524

Date: JUN 29 2004

REGISTERED MAIL

Alberni-Clayoquot Regional District
3008 Fifth Ave
Port Alberni BC V9Y 2E3

Dear Operational Certificate Holder:

Enclosed is Operational Certificate MR-00524 issued under the provisions of the *Waste Management Act*. Your attention is respectfully directed to the terms and conditions outlined in the Operational Certificate.

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.

This decision may be appealed to the Environmental Appeal Board in accordance with Part 7 of the *Waste Management Act*. An appeal must be delivered within 30 days from the date that notice of this decision is given, in accordance with the practices, procedures and forms prescribed by regulation under the *Environment Management Act*. For further information, please contact the Environmental Appeal Board at 250 387 3464.

.../2

Orig - agreements file
cc - Sean

Ministry of Water, Land and Air Protection
Regional Operations
Vancouver Island Region
Mailing/Location Address:
2080 Labieux Rd
Nanaimo BC V9T 6J9
Telephone: (250) 751-3100
Facsimile: (250) 751-3103
http://www.gov.bc.ca/
http://www.gov.bc.ca/wlap/

Administration of this Operational Certificate will be carried out by staff from the Vancouver Island Region office. Plans, data and reports pertinent to the Operational Certificate are to be submitted to the Regional Waste Manager at Ministry of Water, Land and Air Protection, Regional Operations, Vancouver Island Region, 2080 Labieux Road, Nanaimo, British Columbia, V9T 6J9.

Yours truly,

R. Alexander
Regional Waste Manager
Vancouver Island Region

Enclosure (Copy of signed legal Operational Certificate)

cc: Environment Canada

BRITISH COLUMBIA

MINISTRY OF WATER, LAND AND AIR PROTECTION

Vancouver Island Region
Environmental Protection
2080-A Labieux Road
Nanaimo, British Columbia
V9T 6J9
Telephone: (250) 751-3100
Fax: (250) 751-3103

OPERATIONAL CERTIFICATE

MR-00524

Under the Provisions of the Waste Management Act

Regional District of Alberni-Clayoquot

3008 Fifth Avenue

Port Alberni, British Columbia

V9Y 2E3

is authorised to manage recyclable material and waste from the Regional District of Alberni-Clayoquot and environs at the Alberni Valley landfill located near Port Alberni , British Columbia, subject to the conditions listed below. Contravention of any of these conditions is a violation of the *Waste Management Act* and may result in prosecution.

1. MANAGEMENT OF WASTE AND RECYCLABLE MATERIAL

1.1. Sanitary Landfill

1.1.1. This subsection applies to the discharge of waste to a sanitary landfill.

1.1.2. Waste may be discharged to the sanitary landfill shown on attached Site Plan A.

1.1.3. The characteristics of the discharge must be municipal solid waste as defined under the *Waste Management Act* and other wastes as approved in writing by the Regional Waste Manager.

1.1.4. The authorised works are a sanitary landfill, and related appurtenances approximately located as shown on attached Site Plan A.

1.1.5. The authorised works must be complete and in operation on and from the date of this operational certificate.

1.2. Leachate

1.2.1. This subsection applies to the management of leachate from the landfill.

1.2.2. The characteristics of the surface water and groundwater at the property boundary must not exceed concentrations set in the *British Columbia Approved Water*

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Date Amended:
(most recent)

R. Alexander
Regional Waste Manager

Quality Guidelines (Criteria) and *A Compendium of Working Water Quality Guidelines for British Columbia*. Where natural background water quality concentrations exceed the aforementioned guidelines, characteristics of the surface water and groundwater must not exceed background concentrations.

1.2.3. The authorized works are a leachate collection and conveyance system, leachate treatment works, lift station and related appurtenances approximately located as shown on Site Plan A.

1.2.4. Leachate must be collected, treated and conveyed to the City of Port Alberni sewage treatment system.

1.2.5. The authorized works must be complete and in operation on and from the date of this operational certificate.

1.3. Location of authorised facilities

The location of the facilities for the management of recyclable material and waste to which this operational certificate is applicable is Block D of Lot 268, Alberni Land District, approximately located as shown on attached Site Plan A. The location of the leachate treatment facility is Lot 307, Alberni Land District approximately located as shown on attached Site Plan A.

2. GENERAL REQUIREMENTS

2.1. Entrance facilities

2.1.1. The authorised facilities are signs, weigh scales, recyclable material and waste drop-off and storage facilities and related appurtenances approximately located as shown on attached Site Plan A.

2.1.2. The authorised facilities must be complete and in operation on and from the date of this operational certificate.

2.2. Bear-Proof Facilities

2.2.1. Bears must not access putrescible waste at the landfill facility. All putrescible waste that arrives at the landfill facility must be immediately contained within a bear-proof bin or an area enclosed by a bear-proof electric fence. Grass, leaves, weeds, branches and woodwaste are exempt from bear-proofing requirements.

2.2.2. A bear-proof electric fence must be installed around the landfill.

2.2.3. The bear-proof electric fence must be designed, constructed, operated and maintained to prevent bears from penetrating the fence.

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(most recent)

R. Alexander.
Regional Waste Manager

2.2.4. The bear-proof electric fence must be complete and in operation on and from the date of this operational certificate.

2.3. Qualified Professionals

All facilities and information, including works, plans, assessments, investigations, surveys, programs and reports, must be certified by qualified professionals.

2.4. Plans

2.4.1. Site development, operating, leachate management, closure and post closure plans must be submitted to the Regional Waste Manager by October 31, 2004.

2.4.2. The plans must address, but not be limited to, each of the subsections in the *Landfill Criteria for Municipal Solid Waste* including performance, siting, design, operational and closure and post-closure criteria.

2.4.3. The facilities must be developed, operated and closed in accordance with the plans.

2.5. Landfill Gas

2.5.1. When 100,000 tonnes of waste have been discharged at the landfill, an assessment of the potential for landfill gas generation must be submitted to the Regional Waste Manager.

2.5.2. The landfill gas assessment must address, but is not limited to, subsections 4.2 and 6.4 of the *Landfill Criteria for Municipal Solid Waste* and section 6 of the *Guidelines for Environmental Monitoring at Municipal Solid Waste Landfills*.

2.5.3. The potential for landfill gas generation is to be re-assessed at least once every 5 years after the initial assessment.

2.6. Seismic and Fault Activity

A report that assesses the risk from seismic and fault activity must be submitted to the Regional Waste Manager by October 31, 2004.

2.7. Additional Facilities or Works

The Regional Waste Manager may require investigations, surveys, and the construction of additional facilities or works including, but not limited to, additional leachate and landfill gas management facilities. The Regional Waste Manager may also amend the requirements of any of the information required by this operational certificate including plans, programs, assessments and reports.

Date Issued: JUN 29 2004
Date Amended:
(most recent)

R. Alexander
Regional Waste Manager

3. MONITORING AND REPORTING

3.1. Monitoring Program

3.1.1. A monitoring program must be developed to identify any impacts to the environment and public health from the landfill.

3.1.2. The monitoring program must address, but not be limited to, subsections 4.1, 4.2 and 7.15 of the *Landfill Criteria for Municipal Solid Waste* and the *Guidelines for Environmental Monitoring at Municipal Solid Waste Landfills*.

3.1.3. Monitoring must be conducted in accordance with the monitoring program.

3.2. Annual Operating and Monitoring Report

3.2.1. An annual operating and monitoring report for the preceding 12 month period from January 1 to December 31 must be submitted to the Regional Waste Manager by May 1 of each year.

3.2.2. The report must include:

- An executive summary;
- Tonnage of each type of waste discharged to the landfill for the year;
- Remaining site life and capacity;
- Review of the preceding year of operation, plans for the next year and any new information or proposed changes relating to the facilities and plans;
- Comparison of the monitoring data with the performance criteria in section 4 of the *Landfill Criteria for Municipal Solid Waste* and the *Guidelines for Environmental Monitoring at Municipal Solid Waste Landfills*, interpretation of the monitoring data, identification and interpretation of irregularities and trends, recommendations, and any proposed changes to the monitoring program.

4. SITE CLOSURE

4.1. Closure and Post-Closure Fund

A closure and post-closure financial security trust fund must be built up over time. The closure and post-closure fund must ultimately meet or exceed the estimated closure and post-closure costs plus a reasonable contingency for any remediation that may be required.

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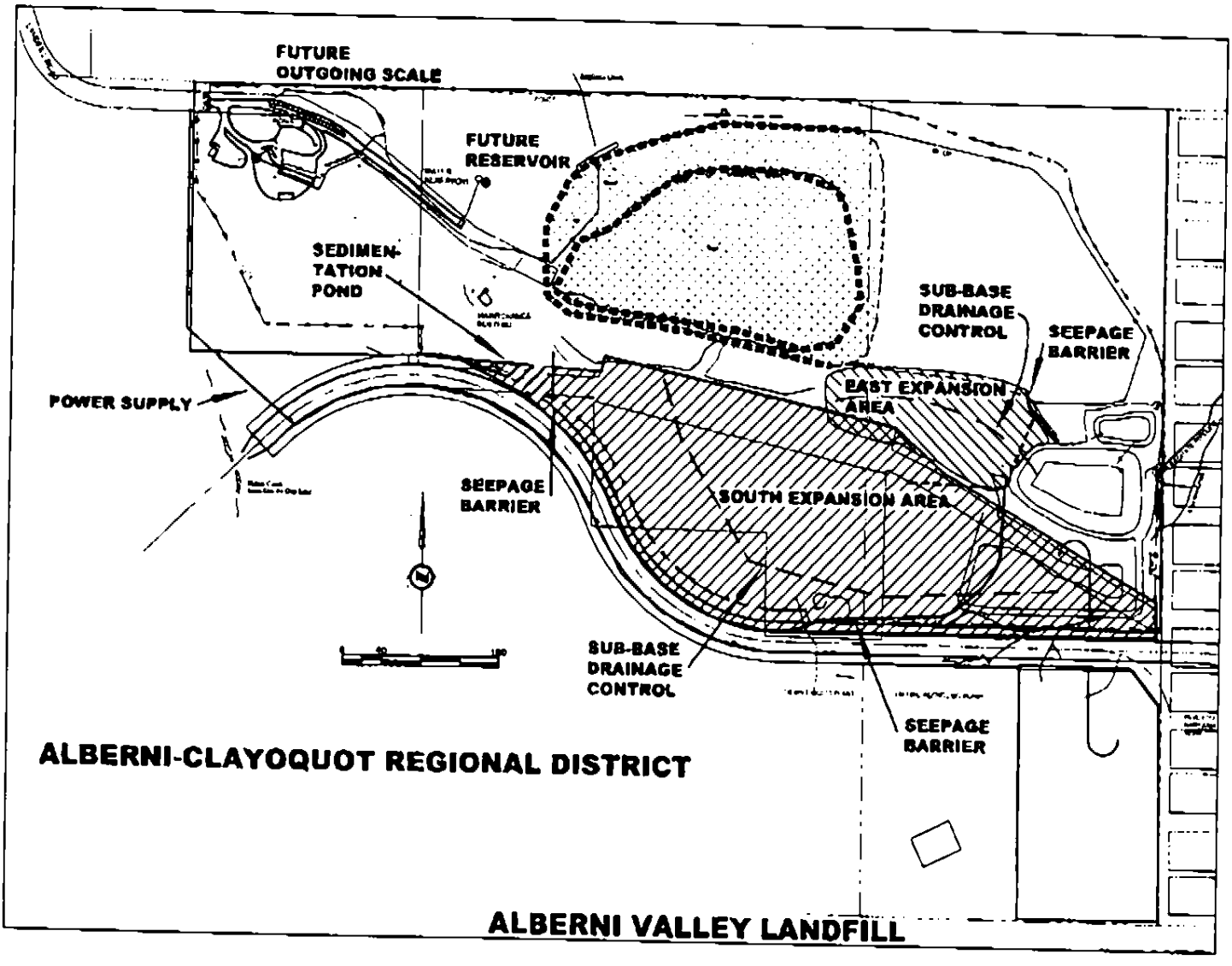
Date Amended:
(most recent)

R. Alexander.
Regional Waste Manager

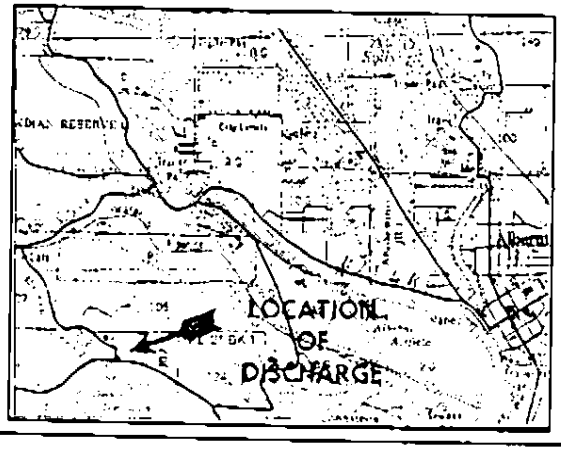
PROVINCE OF
BRITISH COLUMBIA

Environmental Protection

SITE PLAN A



Location Map



Scale: 1:2400

OPERATIONAL CERTIFICATE: MR-00524

Date: JUN 29 2004

R.Alexander
Regional Waste Manager
Vancouver Island Region

APPENDIX B

LIST OF REPORTS

Historical Reports for Alberni Valley Landfill

- Associated Engineering Services Ltd., 1973. Design Drawings for the Regional District of Alberni-Clayoquot Sanitary Landfill. 10 drawings.

- McGill & Associates Engineering Ltd., 1995. "*Surface Water Control-North Boundary-Alberni Valley Landfill, Port Alberni, B.C.*" Report prepared for the Alberni Clayoquot Regional District., June.

- Piteau Associates Engineering Ltd., 1995. "*Stage 2 Solid Waste Management Plan, Phase I Hydrogeological and Geotechnical Assessment - Alberni Valley Landfill*." Report prepared for the Alberni Clayoquot Regional District, March 1995. (Piteau Project #1005)

- Cameron Advisory Services Ltd., 1995. "*Solid Waste Management Plan - Stage 2 Final Report*" Report prepared for the Alberni Clayoquot Regional District." November 1995.

- Piteau Associates Engineering Ltd., 1996. Letter to Mr. John Hornquist of the Regional District of Alberni-Clayoquot, regarding *a Review of Domestic Well Water Quality - Alberni Valley Landfill, Port Alberni, B.C.* July 12, 3p.

- McGill & Associates Engineering Ltd., 1996. "*Leachate Disposal - Alberni Valley Landfill-Alberni Clayoquot Regional District, Port Alberni, B.C.*" Report prepared for the Alberni Clayoquot Regional District, February.

- Seacor Environmental Engineering Inc., 1997. "*Remedial Program of Biocell Soils Stored and Disposed of at McCoy Lake Landfill, Port Alberni, B.C.*" Letter report prepared for Ministry of Environment, Lands and Parks, July 10, 1997. (Seacor Project #N0238-005)

- Piteau Associates Engineering Ltd., 1998. "*Assessment of Possible Leachate Excursion across North Property Boundary, Alberni Valley Landfill, Port Alberni, B.C.*" Letter report prepared for McGill & Associates Engineering Ltd., September 9, 2008. (Piteau Project #1005)

- Piteau Associates Engineering Ltd., 1998. "*Water Quality Monitoring Program to Spring 1998 - Alberni Valley Landfill, Port Alberni, B.C.*" Report prepared for the Alberni-Clayoquot Regional District, July, 25p.

- Piteau Associates Engineering Ltd., 1999. "*Water Quality Monitoring Program to Summer 1999, Alberni Valley Landfill, Port Alberni, B.C.*" Report prepared for the Alberni Clayoquot Regional District, November 1999. (Piteau Project #1005)

- Frontier Geosciences Inc., 2000. "*Report on Seismic Regraction Investigation, Alberni Valley Landfill Expansion, Port Alberni, B.C.*" Report prepared for Piteau Associates Engineering Ltd., May 2000. (Frontier Project #FGI-513)

- Piteau Associates Engineering Ltd., 2000. "*Preliminary Report for Geotechnical Investigation and Assessment of Expansion Areas.*" Report prepared for the Alberni-Clayoquot Regional District and McGill & Associates Engineering Ltd., October 2000. (Piteau Project #2076)

- McGill & Associates Engineering Ltd., 2001. "*Alberni-Clayoquot Regional District, Alberni Valley Landfill East Expansion.*" Letter to Ministry of Water, Land and Air Protection, July 11, 2001. (McGill Project #1869-2001)

- Piteau Associates Engineering Ltd., 2001. "*Water Quality Monitoring Program to December 2000 - Alberni Valley Landfill, Port Alberni, B.C.*" Report prepared for the Alberni-Clayoquot Regional District, January, 32p.

- McGill & Associates Engineering Ltd., 2001. "*Alberni Valley Landfill, East Expansion*" Letter prepared for Ministry of Water, Land and Air Protection, July 11, 2001. (McGill Project #1869-2001)

- Piteau Associates Engineering Ltd., 2002. "*Water Quality Monitoring Program to December 2001, Alberni Valley Landfill, Port Alberni, B.C.*" Report prepared for the Alberni-Clayoquot Regional District, January 2002.

- Piteau Associates Engineering Ltd., 2002. "*Geotechnical Investigation and Assessment of Expansion Areas, Alberni Valley Landfill, Port Alberni, B.C.*" Report prepared for the Alberni-Clayoquot Regional District and McGill & Associates Engineering Ltd., December 2002. (Piteau Project #2076)

- Piteau Associates Engineering Ltd., 2003. "*Water Quality Monitoring Program to December 2003, Alberni Valley Landfill, Port Alberni, B.C.*" Report prepared for the Alberni-Clayoquot Regional District, January 2003. (Piteau Project #1005)

- Piteau Associates Engineering Ltd., 2003. "*Geotechnical Investigation and Assessment of Expansion Area, Alberni Valley Landfill, B.C.*" Report prepared for the Alberni-Clayoquot Regional District and McGill & Associates Engineering Ltd., April 2003. (Piteau Project #2076)

- Cameron Advisory Services Ltd., 2003. "*Alberni Valley Landfill, Report on Landfill Gas.*" Report prepared for McGill & Associates Engineering Ltd., May 2003.

- McGill & Associates Engineering Ltd., 2003. "*Alberni Valley Landfill, 2003 Report.*" Report Prepared for the Ministry of Water, Land & Air Protection, July 2003. (McGill Project #2024)

- Piteau Associates Engineering Ltd., 2005. "*Water Quality Monitoring Program to December 2004, Alberni Valley Landfill, Port Alberni, BC.*" Report prepared for the Alberni-Clayoquot Regional District and McGill & Associates Engineering Ltd., April 2005. (Piteau Project #1005)

- Piteau Associates Engineering Ltd., 2007. "*Water Quality Monitoring Program to December 2006, Alberni Valley Landfill, Port Alberni, B.C.*" Report prepared for the Alberni Clayoquot Regional District., October 2007. (Piteau Project #1005)

- Gartner Lee Limited, 2007. "*Solid Waste Management Plan*" Report prepared for the Alberni Clayoquot Regional District, November 2007. (Gartner Project # GLL 60717)

- Piteau Associates Engineering Ltd., 2008. "*Water Quality Monitoring Program to December 2007, Alberni Valley Landfill, Port Alberni, B.C.*". Report prepared for the Alberni-Clayoquot Regional District, September 2008. (Piteau Project #1005)

- Robert D. Cameron, 2008. "*Alberni Valley Landfill, 2008 Report on Landfill Gas*". Report prepared for Alberni-Clayoquot Regional District., August 2008.

- Piteau Associates Engineering Ltd., 2009. "*Water Quality Monitoring Program to December 2008, Alberni Valley Landfill, Port Alberni, B.C.*" Report prepared for the Alberni-Clayoquot Regional District, September 2009. (Piteau Project #1005)

- McGill & Associates Engineering Ltd., 2010. "*Alberni Valley Landfill, 2008 Operations and Monitoring Report*". Report prepared for British Columbia Ministry of Environment., January 2010. (McGill Project #1756-2010)

- Piteau Associates Engineering Ltd., 2010. "*Water Quality Monitoring Program to December 2009, Alberni Valley Landfill, Port Alberni, B.*C." Report prepared for the Alberni-Clayoquot Regional District, November 2010. (Piteau Project #1005)

- McGill & Associates Engineering Ltd., 2010. "Alberni Valley Landfill, 2009 Operations & Monitoring Report". Report prepared for British Columbia Ministry of Environment, December 2010. (McGill Project #1559-2010)

- Piteau Associates Engineering Ltd., 2011. "Seismic Assessment, Alberni Valley Landfill, Port Alberni, B.C." Report prepared for the Alberni-Clayoquot Regional District, February 2011. (Piteau Project #2076)

- McGill & Associates Engineering Ltd., 2011. "Landfill Gas Generation Assessment Report for the Alberni Valley Landfill" Report prepared for the British Columbia Ministry of Environment, December 2010, Updated March 2011. (McGill Project #2756-2010)

- Piteau Associates Engineering Ltd., 2011. "*Water Quality Monitoring Program to December 2010, Alberni Valley Landfill, Port Alberni, B.*C." Report prepared for the Alberni-Clayoquot Regional District, September 2011. (Piteau Project #1005)

APPENDIX C

GROUNDWATER FLOW FIGURES

DWG. NUMBER: K:\1005\Cadd\1005-071.dwg (Fig 6)

HEATH CREEK AT McCOY LAKE ROAD

MW02-4 64.86

MW98-9 71.94

MW94-6 71.69 56.29

MW98-10 73.73

FORCEMAIN PUMP STATION

MW94-5 74.59 N/A

CLAY BERM

NORTH LEACHATE INTERCEPTION/CONVEYANCE DITCH

MW94-1 66.22 82.06

MW94-4 ARTESIAN >72.5 59.84

LOT 'D'

EAST EXPANSION AREA

BH00-5B N/A

MW94-7 N/A N/A

BH00-3A N/A

BH00-1A N/A

MW94-3 N/A N/A

PW-2 65.02*

PW-1 69.39* 55.44+

AERATION LAGOON

SOUTH EXPANSION AREA

FLOW EQUALIZATION POND

SEEPAGE CUTOFF TRENCH / BERM

FRENCH DRAIN

BH00-8A 71.18

BH00-7A N/A

BH00-6A 69.45

BH00-5A 71.12 70.26

MW05-1 67.84* 69.59* 66.88+

MW02-3 69.32 69.46

MW94-2 BURIED BURIED

MW94-8 N/A N/A

BH00-2A 69.77

BH00-4A 54.61

BH00-11A N/A

MW02-1 69.91 69.92

MW02-2 69.16

NORRIS

DW-1 DW-2 DW-3 DW-4 DW-5 DW-6

1500 N 1400 N 1300 N 1200 N 1100 N 1000 N 900 N 800 N 700 N 600 N

2600 E 2700 E 2800 E 2900 E 3000 E 3100 E 3200 E 3300 E 3400 E 3500 E 3600 E 3700 E 3800 E 3900 E 4000 E 4100 E 4200 E 4300 E

LEGEND

MW94-7 GROUNDWATER MONITORING WELL INSTALLED BY PITEAU ASSOCIATES ENG. LTD.

BH00-6A BOREHOLE

GROUNDWATER ELEVATIONS IN SHALLOW AND DEEP PIEZOMETER (m-geod.) – DECEMBER 6, 2010
* WATER LEVEL MEASURED NOVEMBER 2010
+ WATER LEVEL MEASURED JULY 20, 2010, WHEN PW-1 OPERATING PROPERLY
UNDERLINED VALUES ARE INTERPRETED TO BE SIGNIFICANTLY BELOW TRUE STATIC LEVEL. ITALICIZED VALUE INDICATES LEVEL THAT HAS NOT EQUILIBRATED OR IS OTHERWISE ERRONEOUS.
BLUE DENOTES PIEZOMETRIC LEVEL IN SURFICIAL SEDIMENTS.
RED DENOTES PIEZOMETRIC LEVEL IN BEDROCK.

69.05 (BLUE)
69.05 (RED)

APPROXIMATE EXTENT OF LANDFILL EXPANSION AREAS

BEDROCK OUTCROPPING OR CLOSE TO SURFACE

INTERPRETED GROUNDWATER FLOW DIVIDE IN SURFICIAL SEDIMENTS (DASHED LINE INDICATES VERY APPROXIMATE)

INTERPRETED GROUNDWATER FLOW DIRECTION IN SURFICIAL SEDIMENTS

INTERPRETED GROUNDWATER FLOW DIVIDE IN BEDROCK (DASHED LINE INDICATES VERY APPROXIMATE)

INTERPRETED GROUNDWATER FLOW DIRECTION IN BEDROCK

HYDROGEOLOGICAL SECTIONS (FIGS 4 AND 5)

NOTE:
GRID IS RELATIVE TO McGILL & ASSOCIATES ENGINEERING LTD. DATUM

0 50 100 150 200 250m
SCALE 1:5000

ALBERNI-CLAYOQUOT REGIONAL DISTRICT

PITEAU ASSOCIATES
GEOTECHNICAL AND HYDROGEOLOGICAL CONSULTANTS

WATER QUALITY MONITORING PROGRAM
ALBERNI VALLEY LANDFILL
PORT ALBERNI, B.C.

POSTED GROUNDWATER ELEVATIONS AND INTERPRETED GROUNDWATER FLOW DIRECTIONS

BY:	DATE:
MLS/sl	SEP 11
APPROVED:	FIG:
ATH	6

APPENDIX D

ALBERNI-CLAYOQUOT REGIONAL DISTRICT, BYLAW R1006-4

REGIONAL DISTRICT OF ALBERNI-CLAYOQUOT

BYLAW NO. R1006-4

A Bylaw to Amend Tipping Fees for
the Alberni Valley Landfill

WHEREAS by Supplementary Letters Patent, dated August 10th, 1973 as amended, the Regional District of Alberni-Clayoquot was granted the function of Garbage Disposal under Division XIV of its Letters Patent;

AND WHEREAS the Regional District of Alberni-Clayoquot is empowered to establish a scale of charges payable for depositing refuse at a disposal site;

AND WHEREAS the Regional Board of the Regional District of Alberni-Clayoquot has established regulations and a scale of charges for the Alberni Valley Landfill;

AND WHEREAS the Regional Board of the Regional District of Alberni-Clayoquot wishes to amend the tipping fees for the Alberni Valley Landfill;

NOW THEREFORE, the Board of the Regional District of Alberni-Clayoquot in open meeting assembled enacts as follows:

1. Bylaw R1006, cited as “Alberni Valley Landfill Tipping Fee and Regulation Bylaw No. R1006, 1999”, as amended, is hereby amended by replacing Schedule “A” with Schedule “A” attached to and forming part of this bylaw.
2. This bylaw comes into effect on September 1, 2010.
3. This bylaw may be cited as the “Alberni Valley Landfill Tipping Fee Amendment Bylaw No. R1006-4, 2010"

Read a first time this	day of
Read a second time this	day of
Read a third time this	day of
ADOPTED this	day of

Secretary-Treasurer

Chairperson

REGIONAL DISTRICT OF ALBERNI-CLAYOQUOT

SCHEDULE "A" to BYLAW NO. R1006-4

CHARGES

1. The charge for depositing covered solid waste at the disposal ground is:
   a. Loads 84 kg or greater $95.00/tonne ($8.00 minimum)
   b. Loads under 84 kg - $2.00 each garbage bag or can ($8.00 maximum)
   c. $2.00 for each tire or $170 per tonne, whichever is greater
   d. $100.00 for each wrecked auto
   e. $200.00 for each wrecked truck, bus or recreational vehicle
2. In the event that the scales provided are not operational, weight shall be estimated by the scale clerk at the landfill.
3. The fee to be charged for all loads of solid waste which arrives at the landfill site uncovered shall be double the normal fee for loads of covered solid waste.
4. There shall be no charge for recyclable materials, including but not limited to paper, metal, boxboard, Corrugated Cardboard, compostable materials and other materials as determined by the Regional District but excludes any material contaminated by food or oil and any material that is a Controlled Waste.
5. All charges payable under this Bylaw shall be paid prior to the deposit of the solid waste for which the charge is made unless it is necessary to weigh the vehicle depositing solid waste loaded and empty to determine the weight of solid waste, in which case the charge shall be paid immediately after weighing the vehicle empty.
6. The person paying a charge shall obtain a receipt for such payment and shall produce such receipt for inspection on request of a person employed for that purpose at a disposal site as a condition of depositing solid waste at a disposal site.
7. Not withstanding anything to the contrary in this Bylaw, persons depositing solid waste at a disposal site on a regular basis may apply to the Regional District for credit and if credit is granted to that person, then payment of the charge imposed under Section 1 shall be made and the credit extended on condition that:
   a. Payment in full shall be received by the Regional District within thirty days of the last day of the month for which an invoice has been submitted. The Regional District will invoice monthly for material delivered during the proceeding month. The invoice amount will be based on the total quantity of the refuse delivered during the month, and the posted disposal rates in effect at the time of delivery.
   b. Late payments will be subject to an interest charge of 2% per month (effective annual interest of 24%)

c. The Regional District reserves the right to cancel, upon five days' notice, the credit offered herein for late payment, non-payment or other justified cause.

8. Controlled Waste

The charges, as measured by weight on the scales, for the depositing of Controlled Waste at the disposal site are:

a. Construction/Demolition Waste - $120.00 per tonne; if the Demolition Waste is crushed to pieces 7 cubic centimetres or smaller the charge is $95.00 per tonne;

b. Stumps, land clearing debris - $120.00 per tonne;

c. Waste oil (commercial) - $0.50 per litre;

d. Material containing traces of contaminated soils:

i. $10.00 per tonne provided that the Ministry of Environment has approved of disposal of the contaminated soil, without treatment, at the Alberni Valley Landfill or;

ii. $70.00 per tonne plus the Regional District’s estimated out-of-pocket treatment costs, provided that the Ministry of Environment has approved of the treatment and disposal of the contaminated soil at the Alberni Valley Landfill.

e. Material containing pumpings from domestic septic tanks - $120.00 per tonne;

f. Material containing catch basin and manhole material - $120.00 per tonne;

g. Waste asbestos - $250.00 per tonne ($120.00 minimum);

h. Fish, shrimp shells, animal carcasses - $170.00 per tonne ($95.00 minimum), provided that there will be no charge for animal carcasses removed from public roadways by a public body or their contractor;

i. Fridges and freezers - $20.00 each;

j. Batteries - no charge if separated and placed in hazardous waste container;

k. Steel Cable - $500.00 per tonne;

l. Biomedical waste - $132.00 per tonne;

m. Loads containing Gypsum - $120.00 per tonne;

n. Loads containing Corrugated Cardboard - $130.00 per tonne;

o. Loads containing fish feed totes - $400.00 per tonne ($120.00 minimum).

APPENDIX E

ESTIMATED LANDFILL WEIGHTS

Historic Quantities at Alberni Valley Landfill

Year[1]	Annual Weight (tonnes)	Cumulative Weight (tonnes)
1975	18,903	18,903
1976	19,228	38,131
1977	19,460	57,591
1978	19,912	77,503
1979	19,677	97,180
1980	21,199	118,379
1981	18,713	137,092
1982	18,573	155,665
1983	18,433	174,098
1984	18,292	192,390
1985	17,869	210,259
1986	17,730	227,989
1987	17,593	245,582
1988	17,455	263,037
1989	17,317	280,354
1990	17,179	297,533
1991	17,042	314,575
1992	16,917	331,492
1993	17,062	348,554
1994	17,115	365,669
1995	19,653	385,322
1996	15,335	400,657
1997	16,694	417,351
1998	16,201	433,552
1999	15,959	449,511
2000	14,966	464,477
2001	13,462	477,939
2002	13,500	491,439
2003	14,672	506,111
2004	16,479	522,590
2005	19,198	541,788
2006	19,422	561,210
2007	22,019	583,229
2008	19,026	602,255
2009	22,878	625,133
2010	21,931	647,064

Notes:

1. Anuual weights from 1995 to 2010 are based on scale records. Annual weights prior to 1995 are based on estimates from the *Alberni Valley Landfill Report on Landfill Gas* , prepared by Cameron Advisory Services, May 2003.

APPENDIX F

CLOSURE & POST-CLOSURE COST ESTIMATE

AVL Estimated Closure & Post Closure Costs

Item	Unit	Quantity	Unit Cost	Total
Landfill Cap & Associated Closure Construction				
Grading Layer - 0.6m sand and gravel	m^3	138,600	$15	$2,079,000
Barrier Layer - geosymthetic membrane liner	m^2	231,000	$8	$1,848,000
Drainage Layer - 0.15m sand and gravel	m^3	34,650	$20	$693,000
Protective Layer - 0.6m low permeability soil	m^3	138,600	$25	$3,465,000
Topsoil layer - 0.3m topsoil	m^3	69,300	$20	$1,386,000
Vegetation	m^2	231,000	$0.25	$57,750
Legal Fees	L.S.	1	$30,000	$30,000

Subtotal =	$9,558,750
Contingency (10%) =	$955,875
Total =	**$10,514,625**

Annual Post-Closure Costs

Water Quality Monitoring and Reporting	# Years	Cost/year	Total
Quarterly Monitoring	15	$15,000	$225,000
Semi-Annual Monitoring	10	$10,000	$100,000
Landfill Gas Collection System Monitoring and Reporting	25	$15,000	$375,000
Roads Maintenance	25	$400	$10,000
Surface Water Control System Inspection & Maintenance	25	$1,600	$40,000
Leachate Collection System Inspection & Maintenance	25	$400	$10,000
Landfill Cap Inspection & Maintenance	25	$400	$10,000
Utilities (hydro power for electric fence & gas collection system)	25	$5,000	$125,000
Miscellaneous Rehabilitation Costs	25	$1,000	$25,000

Subtotal =	$920,000
Contingency (10%) =	$92,000
Total =	**$1,012,000**
Total Closure & Post-Closure =	**$11,526,625**
Existing Closure & Post Closure Fund (2010) =	$1,059,013
Amount Needed for Financial Security =	$10,467,612
Annual Allocation for 92 Years =	$113,778