Cleanup Action Plan

Intalco Landfill Closure Program
Ferndale, Washington

Prepared by

Washington Department of Ecology
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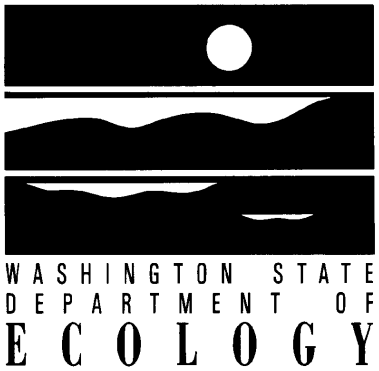

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Intalco Aluminum Corporation
4050 Mountain View Road
Ferndale, Washington 98248

June 15, 2006

1.0 INTRODUCTION

1.1 Purpose

This document is the Cleanup Action Plan (CAP) for the closure of five landfills on the Intalco Aluminum Corporation Ferndale plant site. The CAP outlines the steps and procedures for conducting an environmental cleanup of three historic landfills at the plant and the closure of both the plant's solid waste landfill and the Resource Conservation and Recovery Act (RCRA) dangerous waste landfill. The purpose of the Cleanup Action Plan is to:

- Describe the proposed final cleanup action and monitoring plans including the rationale used to make this determination for the closure of three of the five Intalco landfills;
- Summarize the closure plans for the solid waste landfill and the RCRA dangerous waste landfill;
- Identify site specific cleanup standards, remediation levels, points of compliance, and points of measurement for each hazardous substance and media of concern;
- Summarize other alternative cleanup actions evaluated in the Feasibility Study;
- Identify and describe the remedial action alternative selected for the Site;
- Present the schedule for implementing the Ecology Cleanup Action Plan; and
- Provide an opportunity for the public to comment on the proposed final cleanup action and the landfill closure plans.

1.2 Facility Description

The Intalco Aluminum Corporation (Intalco) primary aluminum reduction plant (the Site) is located at 4050 Mountain View Road in Ferndale, Washington, on approximately 320

acres of a 1,200 acre upland tract that overlooks the Strait of Georgia in Whatcom County. The plant has operated fairly continuously at the Ferndale site from May 8, 1966 to date. The plant was temporarily curtailed from June-December 2001. The plant is comprised of three potlines to produce aluminum. Each potline occupies two buildings with each building divided into two pot rooms, for a total of 6 potline buildings and 12 pot rooms. Each potline contains 240 electrolytic reduction cells or pots connected electrically in series. The pots are fabricated steel shells 25 feet long, 15 feet wide and 4 feet deep, lined with insulating and refractory brick and carbon materials that form a cathode structure. Each pot produces more than a ton of aluminum per day. A landfill vicinity map is shown in Figure 1 and an aerial photo of the site is presented in Figure 2. During the early operation of the plant, waste was disposed on site in three different historic landfills. Waste is currently disposed of in two permitted, on-site landfills.

The three historic and two active landfills are located on the western portion of the site. A brick storage pile is located northeast of the landfill complex. A steep 180-foot bluff adjacent to the Strait of Georgia forms the western boundary of the smelter property. The three historic landfills, referred to as the Beach I Landfill, Beach II Landfill, and the Closed Construction Debris Landfill were created by filling or partially filling three natural ravines that cut and drain into the bluff and Strait. All of the historic landfills were started during the construction of the plant in 1966. The solid waste and RCRA dangerous waste landfills that are currently active are permitted and located in the northern portion of the property, away from the bluff on the upland plain. The solid waste landfill is a double-lined facility permitted by the Whatcom County Health Department. The RCRA dangerous waste landfill is a triple-lined facility regulated by the Department of Ecology. The brick storage pile is regulated by the Whatcom County Health Department.

The Beach I landfill was created by filling a ravine in the northwest corner of the plant. The filling of the Beach I Landfill was begun soon after construction of the plant in 1966. Review of aerial photographs and historic plant records suggest that the landfill was used intermittently until 1973 and discontinued in 1976. Intalco's records indicate that in 1984 the landfill was closed.

The Closed Construction Debris Landfill is located in a ravine directly west of the western plant access road. It is located between the Beach I and Beach II Landfills and was opened in 1966 for disposal of debris from the construction of the Intalco plant. Aerial photographs indicate that the landfill attained its current shape by 1973. This suggests that the landfill received little to no waste after 1973. According to Intalco records, the Closed Construction Debris Landfill was closed to dumping in 1980.

The Beach II landfill is the southernmost of the historic landfills. The disposal at this site was begun in 1971. Although aerial photographs suggest that disposal operations ceased in 1976, the landfill was used on rare occasions for several years after 1976.

The Solid Waste Double-Lined Landfill and the Dangerous Waste Triple-Lined Landfill were constructed in 1987, the same year that their operation began. The Solid Waste

Double-Lined Landfill serves as the plant's solid waste disposal facility. The Dangerous Waste Triple-Lined Landfill serves as the plant's dangerous waste disposal facility as designated by the Resource Conservation and Recovery Act (RCRA). The unit is operating under a RCRA Interim Status Permit based on a Dangerous Waste Part B Permit Application submitted in 1986. The Interim Status Permit allows Intalco to accept spent potliner, a RCRA designated dangerous waste (K088) and spent potliner treatment plant sludge (K088) in the landfill. In May of 2004, the RCRA Landfill was approved to receive PCB remediation waste.

An on-site brick storage pile located near the Solid Waste Double-Lined and the Dangerous Waste Triple-Lined Landfills has been used intermittently for storage of used bake oven brick. The area has been used since the mid-1970s for brick storage.

1.3 Applicability

This Cleanup Action Plan is applicable only to the cleanup and closure of the Beach I, Beach II, and Construction Debris Landfills and the permitted Solid Waste Double-Lined Landfill and Dangerous Waste Triple-Lined Landfill. The cleanup standards and cleanup actions presented in this document have been developed as a result of a remediation process conducted with Department of Ecology (Ecology) oversight. The cleanup levels and actions are site specific and should not be considered as setting precedent for other similar sites.

Ecology is lead agency for this action. A threshold determination has been made to issue a Determination of Non-Significance (DNS) for this cleanup project. The DNS will be publicly noticed concurrently with the Cleanup Action Plan. A public hearing will be held concerning the action. Alcoa has received a Hydraulic Project permit from the Department of Fish and Wildlife. Alcoa has also received a local grading permit and shoreline permit from Whatcom County. The Whatcom County Health Department will oversee the closure of the Solid Waste Double-Lined Landfill. Pursuant to WAC 173-340-710(9)(e), Alcoa has the continuing obligation to determine whether additional permits, approvals, or other substantive requirements are required to implement the remedy. In the event that Ecology or Alcoa become aware of additional permits, approvals, or substantive requirements that apply to the remedial action, each party shall promptly notify the other party of this knowledge. Ecology shall make the final determination on the application of any additional substantive requirements at the site.

The cleanup action for the site was selected based on the information developed for the cleanup action alternatives identified in the draft Remedial Investigation/Feasibility Studies (RI/FSs). In accordance with the requirements of WAC 173-340-360, the cleanup action meets the following threshold criteria:

- Protect Human Health and the Environment
- Comply with Cleanup Standards

- Comply with Applicable State and Federal Laws, including legally applicable requirements and All Relevant and Appropriate Requirements (ARARs)
- Provide for Compliance Monitoring

Specifically Ecology has determined that Chapter 173-303 WAC (Dangerous Waste Regulations, Chapter 173-350 WAC Solid Waste Handling Standards, Chapter, RCW 90.48 (Water Pollution Control), and RCW 43.21C (State Environmental Policy) are applicable at this site. Chapter 173-160 (Minimum Standards for Construction and Maintenance of Wells) is a relevant and appropriate regulation if new wells are required at any of the landfills.

Potentially Liable Persons (PLPs) cleaning up sites independently, without Ecology oversight, may not cite numerical values of cleanup levels specified in this document as justification for cleanup levels in other unrelated sites. PLPs that are cleaning up other sites under Ecology oversight must base cleanup levels and cleanup standards on site-specific regulatory considerations and not on numerical values contained in this CAP.

1.4 Declaration

The selected remedies - removal of Beach I and II landfills and capping with closure of the CCDL landfill - are protective of human health and the environment once they have been implemented. Ecology gives preference to permanent solutions to the maximum extent where practicable. The selected remedies comply with cleanup standards for cyanide, fluoride, PAHs, and polychlorinated biphenyls, provide for adequate compliance monitoring, and comply with current state and federal laws governing cleanup activities. For this remediation project, off-site disposal technologies were evaluated and not used. Waste recycle and on-site disposal technologies using existing landfills were examined and used. Off-site landfill disposal was disproportionate to the incremental degree of protection provided when compared to on-site landfill disposal and closure.

2.0 SITE DESCRIPTION AND HISTORY

2.1 Site Location and Background Information

Alcoa's Intalco Aluminum Ferndale Plant, located at 4050 Mountain View Road, Ferndale, Washington 98248 is a primary aluminum reduction facility located 13 miles south of the United States-Canada border. Primary aluminum is a product that is cast into billets and ingots, which are shipped to fabrication plants for the production of many end products made of aluminum.

The plant shown in Figure 2 occupies 320 acres of a 1,200 acre tract on the Strait of Georgia in Whatcom County The Alumax Corporation constructed the Intalco Works during the mid-1960s. With the exception of an 11-month temporary curtailment in 2001, the plant has operated continuously at Ferndale since May 8, 1966. Alcoa, Inc. purchased Alumax in July 1998. Intalco's property and the neighboring property to the north and south are zoned by Whatcom County as Heavy Impact Industrial. The property to the east is zoned for residential and agricultural use. The Strait of Georgia is located to the west of the Site. The Site is located within Sections 20, 21, 27, 28, and 29 of Township 39 North, Range 1 East.

The climate in the general area of the Intalco Works is Pacific maritime, dominated by onshore flow that keeps the temperatures relatively mild. Climate data was obtained from the Bellingham Airport for the period December 1949 to May 1996. The average maximum temperatures range from 43.1 degrees in January to 71.4 degrees in July and August. The average yearly precipitation for the period of record was 35.55 inches with approximately 70% of that occurring in the months of October through March.

The plant uses the Pechiney process technology to produce aluminum. The Ferndale plant is comprised of three existing potlines to produce aluminum. Each potline occupies two buildings, with each building divided into two pot rooms, for a total of 6 potline buildings and 12 potrooms. Each potline contains 240 electrolytic reduction cells or pots. The pots are electrically connected in series. Each pot produces more than a ton of aluminum per day. The plant can produce 307,000 tons of aluminum annually.

Primary aluminum production involves the electrolytic reduction of aluminum oxide (Al_2O_3) to elemental aluminum in molten cryolite (Na_3AlF_6) called "bath". The process takes place in a reduction cell, or "pot", which consists of a rectangular reinforced steel shell generally lined with a carbon cathode surrounded by an insulating material. High temperatures are generated from electrical resistance heating, which keeps the aluminum and cryolite bath in a molten state. This molten material is the electrolyte. The carbon cathode contains steel collector bars for conducting electric current through the cell or pot. These collector bars extend through the side of the pot to the negative pole of the power supply.

The positive pole of the power supply is connected to the anode. The anodes are made of carbon and are attached to the cell by a superstructure that suspends them using a copper rod in the molten cryolite bath.

Reduction occurs when aluminum oxide is fed into the molten electrolyte and current is passed from the cathode to the anode though the bath. Electrolysis breaks down the aluminum oxide into aluminum metal and oxygen that combines with the carbon in the anode to form carbon dioxide and carbon monoxide. The carbon anode is consumed in the aluminum smelting process but the cathode is not.

The molten elemental aluminum sinks to the bottom of the pot and is removed periodically for casting. A typical pot may operate for two to five years before it needs to be removed for replacement. A pot fails when iron from its shell or collector bars is detected in the elemental aluminum, or when the insulation and carbon layer fractures and the shell leaks molten aluminum. When a cell fails the insulation and carbon block layers are removed and the steel shell is relined. The removed lining is called "spent potlining" and is contaminated with cyanide and fluoride. Spent potliner is a listed dangerous waste (K088). The cyanide is created when atmospheric nitrogen combines and reacts with the carbon cathode blocks under the high temperatures of aluminum production. The fluoride originates from the cryolite in the bath material. The spent potlining is disposed in the Intalco on-site triple-lined dangerous waste landfill. The removed refractory brick that does not contain carbon residual is disposed of in the on-site double-lined solid waste landfill.

In 1986 Intalco constructed both a triple-lined dangerous waste landfill and a double-lined solid waste landfill. Spent potliner was listed as a hazardous waste by the EPA effective on September 13, 1988, and as a dangerous waste by the State of Washington listed on March 7, 1991. From 1986 until 1998, spent potliner (K088) was landfilled in the existing triple-lined landfill located at the north end of the plant. In 1998 Intalco stopped disposing spent potliner in the triple-lined facility and began shipping the material to an off-site facility.

The triple-lined cell was designed to conform to federal regulations for hazardous waste landfills under the Resource Conservation and Recovery Act (RCRA) as specified by Ecology in WAC 173-303.

The triple-lined landfill was constructed in phases over two different time periods: the original cell construction (completed in 1986) and construction of an extension referred to as Lateral Extension A (completed 1990). A second extension application was submitted to the Department of Ecology and will increase the active triple-lined facility to over 6 acres. In 2006, Intalco will dispose of all solid waste and spent potliner generated at the smelter in the dangerous waste landfill until it reaches capacity.
The double-lined solid waste landfill was also constructed in 1986. The landfill was constructed to dispose of non-dangerous wastes generated at the plant. These wastes typically include: insulating brick, refractory brick from pots and induction furnaces, salt

cake from the cast house, primary water treatment sludge, baghouse bags, waste dust, and scrap paste.

Three historic landfills, referred to as the Beach I, Beach II, and the Closed Construction Debris Landfills were created during the construction of the plant in 1966.

The on-site brick storage pile has been used from 1974/75 to the present. Approximately 15,500 cubic yards of bake oven brick currently exist in the pile. Prior to and after the closure of the original waste storage area and the construction of the double- and triple-lined landfills, the brick storage area was intermittently used to store bake oven brick for reuse in construction laydown areas and roads. The reuse of the material was stopped. The material will be used in the construction of the CCDL buttress.

2.2 Current Status

The site is located on the active Intalco smelter. The Solid Waste and Dangerous Waste Landfills are located north of the plant potrooms and transformer/rectifier switching yard. The Beach I, Beach II, and Closed Construction Debris Landfills are located on the west side of the plant on or near the Strait of Georgia bluff. The closest neighbors are located off of the plant property to the east.

2.3 Future Use

The Intalco site has been used for industrial purposes since 1966 and it is currently zoned for heavy industry. Two other large industrial tracts containing large oil refineries and liquid natural gas storage are located to the north and south of the plant. There are no plans for the site use to change in the near future. Future development plans depend on the market conditions of the price of aluminum and regional power rates. Two closed landfills (Solid Waste Landfill and the Construction Debris Landfill) and one active landfill (Dangerous Waste Landfill) will remain after the cleanup action. It is anticipated that the remaining Dangerous Waste Landfill on the facility will reach capacity in 5 to 8 years and be closed.

3.0 RESULTS OF ENVIRONMENTAL STUDIES

3.1 Site Characterization

3.1.1 Physical Characteristics and Geology

The Intalco Landfill Sites are located in the Puget Sound Lowland, a north-south trending structural and topographic depression that is bordered by the Olympia Mountains to the west and the Cascade Mountains to the east. The Strait of Georgia lies to the west of the Site and, for the purposes of water quality and sediment quality, is considered part of Puget Sound.

Lake Terrell is the closest fresh surface water body to the site. It lies approximately 1.4 miles northeast of the site. Terrell Creek flows north from Lake Terrell and enters the Puget Sound in Birch Bay, approximately 5.25 miles north of the site. The Lummi River branches off the Nooksack River south of Ferndale, Washington and enters Lummi Bay approximately 3.5 miles south of the site. The Nooksack River enters Bellingham Bay at Bellingham, Washington.

3.1.2 Hydrogeologic System

In the project area, Pleistocene glaciomarine deposits overlie Tertiary volcanic, sandstone and shale bedrock of Tertiary age. The glaciomarine deposits are exposed at the surface, and the underlying bedrock is buried as much as 300 feet below the surface. The Pleistocene deposits are of variable thickness, extent and character, and represent the numerous glacial advances and retreats over the last 10,000 years. Four formations have been identified at the Site: Cherry Point Formation, Esperence Sand, the Kulshan Glaciomarine Drift, and the Bellingham Glaciomarine Drift. The Chuckanut Formation is thought to underlie the Cherry Point Formation but has not been identified at the Site. The Site is covered with topsoil, fill material, surficial sand and gravel above the glaciomarine sediments.

Three potential water-bearing units have been identified at Intalco: the regional sea level aquifer (middle member of the Cherry Point Formation), the shallow aquifer (basal portion of the Esperance Sand), and the surficial aquifer (perched zones of limited extent in the drift deposits). No aquifers containing potable water are known to exist below the regional sea-level aquifer. Saline water is expected to occur near the base of the Cherry Point Formation due to the proximity to the Strait of Georgia at the Beach I, Beach II, and Closed Construction Debris Landfill locations.

The land surface at the Site is covered with topsoil and surficial sand and gravel derived from the Pleistocene glaciomarine drift deposits immediately beneath them. These drift deposits are identified as the Bellingham and Kulshan Glaciomarine Drifts. Both the Bellingham and Kulshan are interglacial drift deposits that represent sediments deposited in marine waters below a floating ice sheet, and together are estimated to be about 15 to 35 feet thick at the sites. In general, the Bellingham Drift is a gray-brown silt with poorly sorted sand and gravel, with numerous cobbles. The Kulshan, which occurs below the Bellingham and may not be present in some areas, is a blue-gray silt with some clay and

sparse rounded pebbles, and a generally low sand content. Because the Bellingham and Kulshan Drift Deposits are similar in composition and were not differentiated during logging, they are referred to together in this report as the Bellingham-Kulshan Glaciomarine Drift deposits (Bellingham-Kulshan deposits or B-K deposits). The Bellingham-Kulshan Glaciomarine Drift deposits logged during geotechnical drilling were described as a till-like mixture of silt, clay, sand, and gravel, with occasional shell fragments and organics.

Directly beneath these Bellingham-Kulshan drift deposits lies the Esperance Sand. The Esperance Sand is comprised of Quaternary alluvial sediments deposited during the Vashon stage of the Fraser glacial period. In general, the Esperance Sand is a brownish-gray silty sand with numerous thin gravelly channels, and varies greatly in thickness. During geotechnical drilling, this deposit was described as poor- to well-graded sand with layers of poorly graded gravel with sand.

The contact between the Esperance Sand and the top of the underlying Cherry Point Formation is an erosional unconformity with high relief. Like the Bellingham-Kulshan deposits, the Cherry Point consists of glaciomarine drift sediments, deposited during an interglacial period. The Cherry Point has been divided into three members; the upper clay and silt member, the middle interbedded clay and sandy gravel member, and the lower sand and silt member. The formation is at least 300 feet thick in the vicinity of the Intalco site (Intalco, 1992).

The upper member of the Cherry Point Formation consists of clay and silt with layers of well-sorted fine sand in the upper 10 feet at some locations beneath the site. The top elevation of the Cherry Point ranges from about 80 feet at the eastern edge of the active landfills to 130 to 160 feet near the western bluff. The thickness of this upper member varies considerably and thins to the south as the Esperance Sand thickens (Shannon & Wilson, 1980). South of Intalco at the Conoco-Phillips refinery, the top of the Cherry Point is at an elevation of about 60 feet NGVD.

The middle member of the Cherry Point Formation consists of interbedded sand, gravel, and clay with a thickness of about 40 feet in the vicinity of the Intalco plant. The middle member is present within the interval from about sea level to 40 to 50 feet above sea level (Shannon & Wilson, 1980). The lower member of the Cherry Point Formation is composed primarily of silt and clay. The thickness of this stratigraphic unit beneath the site is estimated to be 100 to 150 feet (Shannon &.Wilson, 1980).

The interbedded sequence of sand and gravel within the middle member of the Cherry Point Formation is the primary aquifer supplying domestic and industrial water supplies in the vicinity of the Site. The middle member of the Cherry Point can be found within the elevation interval of about sea level to 50 feet above sea level at the Intalco facility (Shannon & Wilson, 1980). The groundwater flow direction is expected to be westerly. South of Intalco at the Conoco-Phillips refinery, potentiometric mapping for the sea level aquifer indicates a west-northwest flow direction at a gradient of about 24 feet per mile. The groundwater elevation ranges from 20 to 40 feet above sea level, which is

comparable to that observed in wells near Intalco, and indicates a westerly groundwater flow direction (Shannon & Wilson, 1980). The aquifer likely discharges into the Strait of Georgia, where it outcrops below sea level.

Another zone of saturation, referred to as the shallow aquifer, occurs at the erosional contact between the Cherry Point and the Esperance Sand. This zone is fairly consistent in the highlands area and has been characterized as a regional aquifer within the upland area (Lindsay et al, 1995). In the area of the Intalco facility, however, subsurface investigations indicate that this unit is generally thin, and its usability for water supply is limited. The erosional unconformity (scouring) at the top of the Cherry Point controls the occurrence and flow direction of the shallow aquifer. Due to the variable nature of the erosional surface, the depth to water, groundwater flow direction, and hydraulic gradient vary significantly. This zone crops out in the steep bluffs that extend from the beach to the highlands. These outcrops may represent areas of groundwater discharge.

Above the Esperance, the Bellingham-Kulshan drift deposits are considered an aquitard. However, small perched zones of limited aerial extent and seasonal water-yield potential have been identified in the upper sandy portion of the Bellingham in the vicinity of the active landfills (Intalco, 1992). These perched zones may be present in the highlands at depths of 10 to 15 feet below ground surface.

Data from reports of previous regional geologic investigations by Newcomb (1949) and Easterbrook (1963 and 1976) indicate that the Chuckanut Formation lies stratigraphically below the Cherry Point Formation. The Chuckanut is considered the bedrock beneath the site and is thought to be approximately 100 to 150 feet below sea level at the Site. The Chuckanut Formation has an undetermined thickness at this site, and consists of interbedded shale and sandstone.

3.2 Site Investigations and Chemicals of Concern

The Investigations of the three landfills, the Closed Construction Debris Landfill, Beach I, and Beach II began in January of 2000. Ecology met with representatives of Intalco Works in January to review the history of the Beach I and Beach II landfills and to explore options for remediation. During that meeting it was agreed that the landfills would be addressed under the Model Toxics Control Act (MTCA). During the summer of 2001 Ecology issued Agreed Order DE 01 TCPIS 2949 which directed Intalco to conduct a remedial investigation of each of the three landfills and prepare a feasibility study that presented a detailed evaluation and focused list of cleanup action alternatives.

In accordance with the Agreed Order, Intalco conducted field investigations of the different landfills in May, August, and December of 2000. Two reports describe the results of the field investigations: MFG 2000b and MFG 2001a. The field work in 2000 was completed to answer the following questions concerning the Site:

- Assess the aerial extent, volume, and character of the waste materials present;
- Sample and analyze waste materials;

- Locate, sample and analyze seeps/springs emanating from or adjacent to the landfills; and
- Sample and analyze near shore sediments

Analysis of the field data required further field work in September and October of 2001, May 2002, and April 2004. The later field work was designed to accomplish the following objectives:

- Evaluate geotechnical conditions;
- Further characterize the nature and extent of constituents in wastes; and
- Characterize underlying native soils and groundwater

The results of the last set of investigations were presented in two reports (MFG 2001b and Anchor 2004).

Intalco has conducted dangerous waste testing of the on-site brick pile. Soils and ground water beneath the brick pile have not been analyzed.

In 1999, Intalco conducted sediment sampling in both the intertidal zone along the beach front that borders the plant at the Beach I, Beach II, and the Closed Construction Debris Landfills and near the plant outfalls. The sediment sampling event was part of the requirements of the Intalco NPDES permit. Sediment from that sampling event was analyzed for PAHs, PCBs, and various semi-volatile organic compounds.

Polychlorinated biphenyls (PCBs) and polycyclic aromatic hydrocarbons (PAHs) were found above the sediment sampling criteria. After a review of the chemistry and bioassay data collected during the 1999 study, Ecology agreed that remedial cleanup action of the sediments adjacent to Intalco was not necessary at that time, although, contaminated sediments adjacent to the three landfills remained a concern. In 2001, sediment samples were collected along the shoreline of the Beach I, Beach II, and the Closed Construction Debris Landfills and tested for PCBs and PAHs. When compared with the Washington State Department of Ecology Sediment Management Standards (SMS), no results from the sample event exceeded the SMS standards. The current proposed NPDES permit renewal document defers any additional sediment characterization to the cleanup Consent Decree after the removal of the Beach I and Beach II Landfills and the capping of the Closed Construction Debris Landfill.

3.2.1 Beach I Landfill

Field investigations were conducted at the Beach I landfill in May 2000, December 2000, September/October 2001, and May 2002. The Beach I Landfill is the northern most landfill at Intalco and occupies a steep ravine located along the Strait of Georgia cliffs (Figure 2). A total of 11 borings, 19 test pits, and 8 hand excavated test pits were advanced at the landfill. Soil samples, waste samples, and overland seep samples were collected and analyzed for a wide range of chemical constituents and geotechnical

properties. Samples were taken on the top of the bluff and at the toe of the landfill along the Strait. Figure G3 shows the location of test pits and water samples. The waste which was found in the landfill consisted of bricks, concrete, metal fragments, aluminum metal, wood fragments, sand and gravel mixed with black organic material sometimes with creosote or hydrocarbon odor. Soils with high concentrations of fluoride, PAHs and total cyanide indicate that the landfill potentially contains pot room bath, minor potliner debris, construction debris from the construction of the plant, and waste from the paste plant. The waste stream is typical of an aluminum smelter.

Soil samples were analyzed for total metals, fluoride, total cyanide, semi-volatile organics, PCBs, ignitability, corrositvity, reactivity, and toxicity. Analytical results of waste samples indicate the presence of the following range of concentrations of constituents of potential concern (COPCs):

Fluoride	185 to 593 milligrams per kilogram (mg/Kg)
Total PCBs	0.096 to 1.79 mg/Kg
Total cyanide	<0.56 to 85.5 mg/Kg
Total PAHs	4.9 to 26.4 mg/Kg
TCLP barium	0.14 to 0.326 mg/Kg
Fish bioassay	Non-hazardous

Samples taken below the waste in native soils which underlay the landfill indicate the presence of the following COPCs:

Fluoride	18.3 to 31 mg/Kg
Total PAHs	<0.029 to 0.059 mg/Kg

Analytical results of mixed soil and waste collected from the toe of the landfill along the beach indicate the presence of the following range of concentrations of COPCs:

Total cyanide	<0.62 to 0.68 mg/Kg
Fluoride	61.6 to 111 mg/Kg
Total PCBs	<0.044 to 19 mg/Kg
Total PAHs	4.9 to 26.4 mg/Kg
TCLP barium	0.14 to 0.326 milligrams per liter (mg/L)

Near the toe of the landfill along the beach, seeps are found that intermittently flow into the Strait of Georgia. A temporary weir was installed at the toe of the Beach I landfill to measure water flow rate. A flow rate of 2.5 gallons per minute was noted. Analytical

results of water quality samples collected from the seeps indicate the presence of the following range of concentrations of COPCs:

Total cyanide	<0.010 to 0.087 (mg/L)
Amenable cyanide	<0.010 to 0.087 mg/L
Fluoride	0.91 to 73.7 mg/L
Total PCBs (unfiltered)	<1.0 to 9.9 mg/L
Total PCBs (filtered)	<1.0 mg/L

Ground water was sampled below the landfill at a depth of approximately 60 feet, just above the Esperance Sand and Cherry Point Formation. The samples showed very low amounts of hydrocarbons.

Geotechnical drilling through and near the Beach I landfill indicates approximately 16,000 cubic yards (22,700 tons) of waste and soil is present in the landfill. Actual volumes may vary. This estimate includes the overlying cover soil and approximately two feet of underlying soil.

3.2.2 Beach II Landfill

Field investigations were conducted at the Beach II Landfill in May 2000, December 2000, September and October 2001 and May 2002. The Beach II Landfill is the southern most landfill located along the Strait of Georgia cliffs (Figure 2). A total of 24 borings, 14 test pits, and 12 hand excavated test pits were advanced at the Beach II Landfill. Soil samples, waste samples, and overland seep samples were collected and analyzed for a wide range of chemical constituents and geotechnical properties. Figure G4 shows the location of the test pits and water samples. Samples were taken on the top of the bluff and at the toe of the landfill along the Strait. The waste which was found in the landfill consisted of bricks, concrete, metal fragments, aluminum metal, wood fragments, sand and gravel mixed with black organic material sometimes with creosote or hydrocarbon odor. The Beach I and Beach II Landfills have similar waste characteristics. The Beach II Landfill has much higher amounts of PCB waste in the soils. Analytical results of samples indicate the presence of the following range of constituents of potential concern (COPCs):

Total cyanide	<0.57 to 1.0 mg/Kg
Fluoride	25.5 to 682 mg/Kg
Total PCBs	0.0521 to 1850 mg/Kg
Total PAHs	0.0805 to 4759 mg/Kg
TCLP barium	0.38 to 0.58 mg/L
Fish bioassay	Non-hazardous

The analytical results of soils found underlying the landfill indicate the presence of the following range of COPCs:

Fluoride	8.0 to 25.5 mg/Kg
Total PCBs	0.178 to 0.248 mg/Kg
Total PAHs	<0.304 to 0.838 mg/Kg

Samples of mixed soil and waste were collected at the toe of the landfill. The samples contained the following COPCs:

Fluoride	105 to 164 mg/Kg
Total PCBs	<0.143 to 3.72 mg/Kg
Total PAHs	<1.8 to 95.2 mg/Kg
TCLP barium	0.39 to 0.47 mg/L

The Beach II Landfill has several small seeps which flow overland to the Strait of Georgia. The flow rates of the two seeps are too low to measure. Analytical results of water quality samples collected from the overland seeps indicate the presence of the following range of concentrations of COPCs:

Amenable cyanide	<0.010 to 0.015 mg/L
Fluoride	60.7 to 72.3 mg/L

Geotechnical drilling through and near the Beach II landfill indicates approximately 76,300 cubic yards (114,300 tons) of waste and soil is present in the landfill. This estimate includes the overlying cover soil and approximately two feet of underlying soil. Approximately 14,000 cubic yards (21,000 tons) of landfill soil contains PCB-containing waste at a concentration greater than 50 mg/kg. Actual volumes may vary.

3.2.3 Closed Construction Debris Landfill

Field investigations were conducted at the Closed Construction Debris Landfill (CCDL) in December 2000, September/October 2001, May 2002, and May 2004. A total of nine borings and 11 test pits were advanced at the CCDL. The May 2004 field effort was conducted to characterize the local hydrogeologic conditions upgradient of the landfill. The CCDL occupies the northern half of a broad ravine extending from the bluff toward the Strait of Georgia. The western limit of the landfill is over 200 feet from the beach at an elevation 60 feet higher than the beach. The bottom of the ravine forms the southern boundary of the landfill. The landfill slopes gently to the southwest. On the western face of the landfill the slope becomes very steep and is densely vegetated with trees and blackberries. Soil samples, waste samples, and seep samples were analyzed for a wide range of chemical parameters. The results of the waste samples indicate the presence of the following range of constituents of potential concern (COPCs):

Total cyanide	<0.57 to 6.0 mg/Kg

Fluoride	395 to 515 mg/Kg
Total PCBs	11.5 to 94.9 mg/Kg
Total PAHs	130 to 3334 mg/Kg
TCLP barium	0.20 to 0.81 mg/L

Soils found below the wastes indicate the following constituents of potential concern (COPCs):

Fluoride	2.7 to 119 mg/Kg
Total PCBs	0.722 to 0.608 mg/Kg
Total PAHs	0.13 to 1.60 mg/Kg

The Closed Construction Debris Landfill has a small stream that flows past the toe of the waste. The stream is fed by discharges from the south side of the ravine and an upstream source. The stream is primarily fed from landfill seepage and drainage from the constructed benches on the south slope of the ravine. The stream becomes dispersed and disappears lower down the ravine at an elevation of 35 feet. The stream never directly discharges into the Strait of Georgia. Analysis of the stream chemistry indicates the following range of concentrations of COPCs:

Fluoride	30.6 to 49.3 mg/L

The horizontal and vertical extent of waste and volume calculations were performed using historic records and maps, as well as data obtained from the results of field investigations. The CCDL is estimated to contain approximately 61,000 (91,400 tons) in-place cubic yards of soil cover, waste, and approximately two feet of underlying soil.

3.2.4 Solid Waste Double-Lined Landfill

The Solid Waste Double-Lined Landfill was constructed in 1986 and serves as the plant's solid waste facility. This landfill operates under a Solid Waste Permit issued by the Whatcom County Health Department. The remaining capacity of the Solid Waste Double-Lined Landfill is approximately 56,000 cubic yards (79,000 tons).

A ground water monitoring program was started in 1986 and has monitored ground water downgradient of the facility for 20 years.

3.2.5 Dangerous Waste Triple-Lined Landfill

The Dangerous Waste Triple-Lined Landfill was constructed in 1986 and serves as the plant's dangerous waste landfill. This landfill is currently operating under a RCRA Interim Status Permit based on a Dangerous Waste Part B Permit Application submitted

to the Department of Ecology in 1986. The Dangerous Waste Triple-Lined Landfill was originally permitted to receive K088 spent potliner and spent potliner sludge waste. In May 2004, the U.S. Environmental Protection Agency approved disposal of polychlorinated biphenyl impacted soils and waste regulated under the Toxics Substances Control Act in the landfill. The remaining capacity of the landfill is approximately 70,000 cubic yards (104,000 tons).

A ground water monitoring program was started in 1986 and has monitored ground water downgradient of the facility for 20 years.

3.2.6 Near Shore Sediment Samples

Intalco conducted sediment sampling in 1993, 1999, and 2001 in the vicinity of the plant's NPDES outfalls and the historic landfills. The 2001 sampling event focused on the historic landfills (Beach I, Beach II, and the Closed Construction Debris Landfills) and adjacent intertidal sediments. Low levels of PCBs were detected in near shore sediments but were below Sediment Quality Standards (SQS).

4.0 MEDIA CLEANUP LEVELS

4.1 Selection of Method for Establishing Cleanup Levels

The Model Toxics Control Act Cleanup (MTCA) regulations provide three methods for determining cleanup standards for a contaminated site. The standards provide a uniform, statewide approach to cleanup that can be applied on a site-by-site basis. The two primary components of the standards, cleanup levels and points of compliance, must be established for each site. Cleanup levels are established at the level a particular hazardous substance does not threaten human health or the environment. Points of compliance designate the location on the site where the cleanup levels must be met. The types of cleanup levels are known as Method A, Method B, and Method C.

Method A applies to relatively straightforward sites that involve only a few hazardous substances. The method defines cleanup levels for 25 to 30 of the most common hazardous substances. The method also requires that the cleanups meet promulgated federal and state regulations such as the maximum contaminant levels established by the Clean Water Act. Method B is a standard method that can be used at all sites. The cleanup levels are established using a site risk assessment that focuses on site characteristics or concentrations of individual hazardous substances established under applicable state and federal laws. In addition to accounting for human health impacts, Method B cleanup levels must account for any potential terrestrial or aquatic ecological impacts.

Method C is similar to Method B. The main difference in the two methods is that the lifetime cancer risk is set at a lower number. The method can be used only when Method A or Method B is technically impossible, the site is defined as an industrial site, or attainment of Method A or Method B cleanup levels has the potential for creating a significantly greater overall threat to human health and the environment. As under Method B, potential terrestrial and aquatic ecological impacts must be accounted for in addition to human health impacts when establishing Method C cleanup levels. Unlike Method B, though, only the impacts on wildlife must be considered when conducting a terrestrial ecological evaluation. In addition, Method C also requires that the person undertaking the action comply with all applicable state and federal laws.

4.2 Media Cleanup Standards

All five landfills at the Intalco smelter complex are located within a large area zoned Heavy Impact Industrial by Whatcom County and meets the definition of an industrial property under WAC 173-340-200. The cleanup standards, remediation levels, points of compliance, and points of measurement are discussed in the following sections.

At the Intalco landfill sites, two pathways exist for constituents of potential concern to enter the environment. These pathways are through direct contact with contaminated soil and consumption of groundwater or surface water. MTCA requires that cleanup levels be based on reasonable maximum exposure. This is the highest exposure that can be

reasonably expected to occur for a human or other living organism at a site under current and potential future use.

The maximum exposure for soil at an industrial site such as the Intalco landfills is based on dermal contact and incidental ingestion of soil during a 9.5 hour work shift. The point of compliance for cleanup levels based on direct contact with soil, without institutional controls, is the upper fifteen feet of accessible soil. The Beach I, Beach II, and Closed Construction Debris Landfills are located outside of operational areas of the plant and access is limited due to safety concerns posed by steep slopes. Access to the two permitted landfills, the Solid Waste and Dangerous Waste Landfills is also limited. Three closed Landfills will remain after the cleanup action: the Solid Waste Double-Lined, Dangerous Waste Triple-Lined, and Closed Construction Debris Landfills.

Investigation of the hydrogeologic conditions along the bluff indicates that the occurrence of ground water is limited. The ground water discharges via seasonal seeps which are either evapotranspirated or incorporated into surface water runoff. Ground water and surface water flows occur at the Closed Construction Debris Landfill.

After removal of Beach I and Beach II Landfills and the final capping of the Closed Construction Debris Landfill, seeps from the landfills will be minimized or eliminated. The cleanup action should improve the water quality of the samples collected from the bluff landfills. It is believed that the cleanup action will remove the sources of contamination at the Beach I and Beach II landfills, and divert ground water from flowing through contamination at the Closed Construction Debris Landfill.

The following constituents of potential concern are found in soils at the two landfill sites: Beach I – PAHs, PCBs, total cyanide, and fluoride and Beach II - fluoride, PAHs, and PCBs. The following three constituents of potential concern are found in surface water and ground water seeps: fluoride, weak acid dissociable (WAD) cyanide, and total PCBs. The Closed Construction Debris Landfill contains the following constituents of potential concern in soils: fluoride, total PCBs, and PAHs. The surface water stream which partially discharges from the landfill contains only fluoride as a constituent of potential concern.

4.2.1 Marine Surface Water

Marine surface water cleanup standards at the site are based on marine acute water quality standards for Metal Cyanide Complex Method (ASTM D 6994-04) and PCBs and British Columbia ambient water quality recommended criteria for fluoride. They are 10 ug/L for total PCBs (WAC 173-201A), 9.1 ug/L for Metal Cyanide Complex (WAC 173-201A), and 1.5 mg/L fluoride (British Columbia). There currently are no state or federal marine surface water standards for fluoride. The conceptual site model for the historic landfill shows that water infiltrates during rain events through the glacial marine drift to the boundary between the Esperance Sand and the Cherry Point Formation. Seeps emanate from the contact between the alluvial sediments and the indurated older sediments found below the alluvium at each landfill.

During the RI, combined seep waters were observed at flow rates of up to 2.5 gallons per minute during the wet season at Beach I. Pre-remedy flows observed at both the Beach II and the Closed Construction Debris Landfills were less than the flow observed at the Beach I Landfill. The seeps converge at the base of the excavated Beach I landfill prior to entering the Strait of Georgia. At Beach I and Beach II the zone of potential impact from the seeps is defined by the width of the landfill and the horizontal distance from the landfill to the intertidal area. After remediation all seep flow ceased from the Beach II Landfill.

The measured background concentration of fluoride in seawater at the site was approximately 1.3 mg/L. Besides the common cations and anions that are present in seawater, site-specific testing also indicated that approximately 0.80 mg/L of phosphate, as orthophosphate was available for reaction. This observation is important because fluoride and phosphate ions are known to commonly form the mineral fluorapatite in natural environments. Based on site-specific chemistry of the receiving water and the seep chemistry, the USGS-developed model, PHREEQC, was used to evaluate if fluorapatite precipitation could buffer the concentration of fluoride in seawater at the ocean water/seep interface. The model showed that the concentration of fluoride in seawater at equilibrium with fluorapatite is approximately 1.3 mg/L, which is equal to the site observed background concentration in seawater. The model also showed that there is an excess amount of phosphate available in the site seawater that would be used to buffer fluoride associated with incoming seep water through the precipitation of fluorapatite.

Additional modeling was performed to determine a threshold fluoride load from the seeps that would coincide with the consumption of excess phosphate in the seawater, thus producing concentrations of fluoride above the observed equilibrium concentration of 1.3 mg/L as loading continued. Based on seep flow conditions and local tidal currents, the model indicates that the seep fluoride concentration would need to be approximately 400 mg/L before an imbalance in the equilibrium between fluoride and phosphate in the receiving water in reached, which would then start to increase the amount of fluoride in the receiving water to 1.36 mg/L. Therefore, under worst case seep flow conditions fluoride concentrations below 400 mg/L will not cause an increase in the receiving water concentrations of fluoride above the Marine Surface Water Cleanup Standard of 1.5 mg/L. The Surface Water Remediation Level for fluoride at the Beach I and the Closed Construction Debris Landfills will be set at 100 mg/L, four times lower than the buffering capacity of the sea water.

As stated above, the Marine Surface Water Cleanup Standard for fluoride is 1.5 mg/L. The point of compliance for marine surface water at the Beach I, Beach II, and Closed Construction Debris Landfills is the Strait of Georgia below the MLLW datum adjacent to each individual historic landfill. The site-specific equilibrium geochemistry assessment showed that a Surface Water Remediation Level for fluoride of 100 mg/L at the point of measurement for each historic landfill will achieve the Marine Surface Water Cleanup Standard at the point of compliance in the Strait of Georgia.

The point of measurement to achieve compliance with the Surface Water Remediation Level at the Beach I and II Landfills is the confluence of the intermittent surface seeps in the exposed banks directly below the Beach I Landfill. There is no surface water flow at the Beach II Landfill and the soil conditions, contaminants of concern levels, and groundwater conditions at Beach I are the same as Beach II. Therefore, the data from the Beach I Landfill will be used to demonstrate compliance with the Surface Water Remediation Level for the Beach II Landfill in accordance with WAC 173-340-747(f). The point of measurement to achieve compliance with the Surface Water Remediation Level at the Closed Construction Debris Landfill is the intermittent stream at the base of the landfill.

4.2.2 Ground water

Groundwater within the vicinity of the historic landfills was determined to be non-potable. The groundwater does not serve as a current source of drinking water. The groundwater is not a potential future source of drinking water because: 1) the groundwater is located beneath steep slopes making groundwater recovery technically impossible, and 2) the groundwater yield at the site is on the order of 0.1 gallons per minute and is insufficient to sustain a normal domestic water well.

Because the groundwater in the vicinity of the historic landfills was determined to be non-potable, the Groundwater Cleanup Standard for fluoride was established using a site-specific risk assessment in accordance with WAC 173-340-720(6). The 'incidental surface water ingestion by a child' scenario was determined to be the reasonable maximum exposure scenario for the purpose of establishing the standard. Specifically the following cases were evaluated:

- Acute: a child ingests a liter of seep water every day for one month
- Chronic: a child ingests a quarter-liter of seep water once a month for six years

Several human health and toxicology research resources and databases (ASTDR, IRIS, FDA, NIH, NCEA, and HEAST) regarding fluoride effects were reviewed to determine an applicable reference dose for the site. The literature review found that an acute, safe exposure concentration (reference dose) for fluoride ingestion would range from 5 mg/kg-day to 16 mg/kg-day for a 3-year-old child. However, because a groundwater cleanup level must be calculated for chronic and acute effects using MTCA Equation 720-1, the IRIS published chronic reference dose of 0.06 mg/kg-day was used. With this approach, the resulting groundwater cleanup level was found to be 117 mg/L for the chronic case and 415 mg/L for the acute case.

Under MTCA, a groundwater cleanup standard shall not exceed a surface water cleanup level; therefore, the more restrictive Surface Water Remediation Level of 100 mg/L was chosen for the Groundwater Cleanup Standard. This value meets the full requirements of WAC 173-340-720(6) and, as required, demonstrates that:

- Applicable state and federal laws (other than drinking water standards) have been complied with;
- No significant acute of chronic toxic effects on human health will result;
- A carcinogenic risk does not exist since fluoride is not a carcinogen;

- Limitations for organic contaminants do not apply to groundwater at this site since fluoride is not an organic;
- The chosen Groundwater Cleanup Standard does not exceed the Surface Water Remediation Level; and
- Groundwater flows directly into surface water; therefore, concerns of alternate groundwater to surface water pathways are not applicable

The site-specific risk assessment will be publicly noticed concurrently with the Cleanup Action Plan.

The point of compliance for groundwater at the Beach I and Beach II Landfills is the seep at the Beach I Landfill. The point of compliance for groundwater at the Closed Construction Debris Landfill is the intermittent stream at the base of the landfill.

4.2.3 Soils

The Soil Cleanup Standards for PAHs and PCBs were calculated both on the basis of an industrial zoning ecological evaluation and MTCA Method A industrial land use standards. MTCA Method A industrial cleanup levels were found to be lower than the levels determined in the industrial zoning ecological evaluation; therefore, MTCA Method A industrial standards will be used at the site for PAHs and PCBs. Because a MTCA Method A industrial standard does not exist for fluoride, Method B was used. The soil cleanup standard for ingestion exposure under MTCA Method B industrial is 210,000 mg/kg. To assess the most restrictive condition, the Method B Soil Cleanup Standard for fluoride was calculated using the three-phase partitioning model under WAC 173-340-747(4) using the 100 mg/L Groundwater Cleanup Standard and site-specific data.

The Soil Cleanup Standard for PAHs is 2.0 mg/kg based on benzo(a)pyrene soil ingestion. The Soil Cleanup Standard for total PCB mixtures is 10.0 mg/kg based on soil ingestion. The Soil Cleanup Standard for fluoride is 5,950 mg/kg and was calculated using the three-phase partitioning model under WAC 173-340-747(4).

To determine a site specific partitioning coefficient and dilution factor, fluoride data was collected at the Beach I landfill. One seawater, three soil, nine pore water, and four surface water seep samples were collected and analyzed. All samples were measured from seep water and pore water from Beach I. A series of three lysimeters were installed to obtain pore water samples at a depth of 12 inches below the existing ground surface. Three sample events collected pore waters. Soils samples were collected at 6-inch intervals during the lysimeter placement. It was observed that fluoride decreases with depth in each lysimeter. The data was analyzed and a Kd of 26.5 was calculated.

Dilution occurs as water percolates through the soil column and combines with off-site groundwater prior to exiting the landfill as a seep. The dilution factor is a ratio of the pore water fluoride concentration to that of the measured seep. That dilution is 2.23. Both the dilution factor and the Kd along with the 100 mg/L Groundwater Cleanup

Standard were used to determine a soil cleanup standard for protection of marine surface water.

The point of compliance for soils at the Beach I and Beach II Landfills is the native soil/waste boundary.

5.0 ALTERNATIVE CLEANUP ACTIONS

5.1 Summary of Cleanup Alternatives

This section of the Cleanup Action Plan summarizes the cleanup actions that Alcoa and Ecology considered in the Remedial Investigation/Feasibility Study for the Site. The Feasibility Study outlined specific alternatives for the cleanup or closure of the Closed Construction Debris Landfill, Beach I, Beach II, Solid Waste Double-Lined Landfill, and the Dangerous Waste Triple-Lined Landfill. Intalco examined two alternatives for cleanup of the Beach I and Beach II Landfills and six alternatives for the Closed Construction Debris Landfill.

In 2001 Intalco prepared an RI/FS to identify and evaluate the remedial actions for cleanup of the Beach I and Beach II Landfills. Alternatives included the following solutions:

- Removal and Disposal of Waste in an Off-Property Landfill

  This alternative included excavation of waste materials from Beach I and Beach II and hauling the waste to a permitted, off-property landfill. The underlying slopes would be graded and revegetated.

- Removal and Disposal of Waste in an On-Property Landfill

  This alternative included excavation of waste materials from Beach I and Beach II and hauling the waste to the Solid Waste and Dangerous Waste Landfills. The underlying slopes would be graded and vegetated. This is the selected alternative.

The no action solution was not considered. Both alternatives will meet the MTCA threshold described in WAC 173-340-360. Treatment or capping remedial actions were not considered as viable cleanup alternatives for the Beach I and Beach II Landfills. On-site disposal was considered to have less difficulty in managing short term risks and is less costly than removal and disposal of waste in an off-property landfill. Removal and disposal of waste in an on-site landfill was chosen as the preferred cleanup option for the Beach I and Beach II Landfills.

In 2002 Intalco prepared an RI/FS to identify and evaluate the optimum remedial action for the Closed Construction Debris Landfill. The different alternatives are listed below:

- No Action and Institutional Controls

  This alternative includes monitoring of the landfill and surface water seeps with deed restrictions to prevent future development.

- Landfill Maintenance and Institutional Controls

  This alternative included monitoring of the landfill, collection and disposal of released waste material, collection of surface water seeps, fencing, signage, and deed restrictions to prevent future development on the landfill.

- In-Place Capping with a Multi-Layer Cap and Institutional Controls

This alternative included extending the landfill footprint, capping the landfill with a synthetic membrane cap over the flatter portions of the landfill, and a soil cap over the steeper portions of the landfill. Fencing, signage, and deed restrictions would be implemented. Seeps would be monitored.

- In-Place Capping with a Multi-Component Cap, Buttress, and Institutional Controls

This alternative included capping the landfill with a multi-component cap and installation of a stabilizing soil or rock buttress. Fencing, signage, and deed restrictions would be implemented. Seeps would be monitored. This is the selected alternative.

- Removal and Disposal of Waste in an On-Property Landfill

This alternative included removal of waste and disposal in the Solid Waste Double-Lined and Dangerous Waste Triple-Lined Landfills. The underlying slopes would be graded and vegetated.

- Removal and Disposal of Waste in an Off-Property Landfill

This alternative included removal of waste and disposal in a permitted off-property landfill. The underlying slopes would be graded and vegetated.

No Action and Landfill Maintenance and Institutional Controls alternatives do not meet the cleanup standards and does not remove the exposure pathway. The four remaining alternatives meet the MTCA threshold criteria and are similar in terms of protectiveness, overall permanence, and long term effectiveness. The In-Place Capping with a Multi-Component Cap, Buttress, and Institutional Controls is considered the most cost effective and implementable.

5.2 Description of the Proposed Cleanup Action

In January of 2002, Intalco submitted Feasibility Studies for the closure and cleanup of the Beach I, Beach II, and Closed Construction Debris Landfills. During the summer of 2002, Ecology and Intalco discussed cleanup and closure options for the three closed and two active landfills located at the Intalco Works in Ferndale. Intalco proposed and Ecology agreed that removal of waste from Beach I and Beach II Landfills was the only cleanup scenario which would meet the protection standard required by the Model Toxics Control Act. The waste from Beach I and Beach II will be disposed in an on-site landfill. Due to cost considerations and the overall volume of waste, it was decided that the Closed Construction Debris Landfill will be closed in place with an engineered drainage and landfill cover. The Solid Waste Double-Lined and Dangerous Waste Triple-Lined landfills will be closed following the permit closure plans after each respective landfill reaches capacity.

During 2003, Intalco performed a site-specific human health risk assessment for the placement of Toxic Substance Control Act (TSCA) waste from the Beach II Landfill into the Dangerous Waste Triple-Lined Landfill. Based on the acceptable risk results, disposal of Beach II Landfill PCB-containing waste into Dangerous Waste Triple-Lined Landfill meets the 40CFR Section 761.61(c) Risk-Based Disposal Option under the current PCB disposal rules. EPA, in their letter dated May 17, 2004, has approved the placement of the TSCA-regulated waste into the Dangerous Waste Triple-Lined Landfill.

Intalco then proceeded with completing engineering plans for closure and in September of 2004 prepared formal technical specifications for the landfill closure program. The specifications were submitted as 90 % design specifications with detailed drawings that could be used to direct the construction. After Ecology review, the document was updated to the 100% effort level and used to bid the project. The 90 Percent Intalco Landfill Closure Program – Technical Specifications, Engineering Design Report, and CQA/CQC Plan contain mandatory cleanup requirements and is incorporated by reference into the Consent Decree and this Cleanup Action Plan. The Final Technical Specifications (Revision 3, dated April 2006) are included as Exhibit C of the Consent Decree. Refinements to the retaining structure for the CCDL were made throughout 2005 and early 2006. These refinements were approved by Ecology and incorporated into the final design prior to construction.

The proposed cleanup action for the site consists of the following items:

- **Beach I Landfill.** The cleanup action for the Beach I Landfill includes removal of approximately 16,000 cubic yards (22,700 tons) of waste material. Waste from the landfill will be excavated, then hauled to, and disposed in, the double-lined solid waste landfill. Materials, such as concrete, brick, and clean soil that meet MTCA industrial cleanup standards and can be re-used, will be tested and stockpiled for later use. Logs that can be re-used will also be stockpiled for later use. Upon completion of waste removal, the slope underlying the Beach I Landfill area will be graded and vegetated, erosion control and drainage control measures installed, and slope surface treatments applied, in an effort to return the natural ravine to an approximation of its pre-landfilling conditions. Recycled logs may be re-used as part of the slope treatment. With the approval of Ecology, Intalco began to implement the Beach I remedy in June 2005.

  Signage will be placed on the property at the confluence of seeps at the base of the Beach I Landfill with the following warning, “Former landfill. Do not drink water.” The signage is subject to Ecology review and approval.

- **Beach II Landfill.** The cleanup action for the Beach II Landfill includes removal of approximately 76,300 cubic yards (114,300 tons) of waste material, including a portion of the waste that is regulated under

TSCA. Materials, such as concrete, brick, and clean soil that meet MTCA industrial cleanup standards and can be re-used, will be tested and stockpiled for later use. Logs that can be re-used will also be stockpiled for later use. Waste removed from the Beach II Landfill will be placed in the Solid Waste Double-Lined and Dangerous Waste Triple-Lined Landfills until those landfills reach capacity. The Beach II Landfill will be graded and vegetated, erosion control and drainage control measures installed, and slope surface treatments applied, in an effort to return the natural ravine to an approximation of its pre-landfilling conditions. Recycled logs may be re-used as part of the slope treatment. With the approval of Ecology, Intalco began to implement the Beach II remedy in June 2005.

If seeps resurface at the Beach II Landfill, signage will be placed on the property at the confluence of these seeps at the base of the Beach II Landfill with the following warning, "Former landfill. Do not drink water." The signage is subject to Ecology review and approval.

- **Closed Construction Debris Landfill.** The cleanup action for the Closed Construction Debris Landfill includes stabilization of existing slopes through grading and installation of a buttress on the exposed face of the landfill. A trench will be excavated at the toe of the landfill and rock and selected fill will be placed in the trench next to the landfill to form a stabilizing buttress. Excavated material may be placed in low areas at the top of the landfill or hauled to, and disposed in, the Solid Waste Double-Lined landfill or the Dangerous Waste Triple-Lined landfill. A portion of the recycled material from the Beach I Landfill and Beach II Landfill, such as concrete, brick and rock, may be sorted and beneficially reused to stabilize the slope. Existing brick that is stockpiled on site may also be beneficially reused in the buttress fill or in low areas under the closure cap. TCLP analysis indicates the presence of fluoride in brick samples ranging from 16 to 92 mg/L.

  An engineered, multi-component, low permeability cap will be installed over the landfill footprint to minimize infiltration of surface water through the in-place waste materials, thereby minimizing the production of leachate.

  Erosion control and drainage control measures will be installed to further enhance the stability of the closure cap and buttress.

  Signage will be placed on the property along the intermittent stream at the base of the Closed Construction Debris Landfill with the following warning, "Former landfill. Do not drink water." Ecology will approve the signage and the final access plan for the area once capping of the Closed Construction Debris Landfill is complete.

Closure will occur during the 2006/7 construction seasons.

- **Closure of the Solid Waste Double-Lined Landfill.** The cleanup action for the Solid Waste Double-Lined Landfill includes filling the landfill to final grades and installing an engineered, multi-component, low permeability cap over the landfill footprint to minimize infiltration of surface water through the in-place waste materials, thereby minimizing the production of leachate. Erosion control and drainage control measures will be installed to further enhance the stability of the closure cap. Closure activities will be regulated under the Solid Waste Regulation Chapter 173-350 WAC. Closure will occur during the 2006/7 construction seasons.

- **Closure of the Dangerous Waste Triple-Lined Landfill.** The cleanup action for the Dangerous Waste Triple-Lined Landfill includes modification of the Part B Interim Status Permit to accommodate waste from the Beach I and Beach II Landfills, filling the landfill to final grades and installing an engineered, multi-component, low permeability cap over the landfill footprint to minimize infiltration of surface water through the in place waste materials, thereby minimizing the production of leachate. Erosion control and drainage control measures will be installed to further enhance the stability of the closure cap. Closure activities will be regulated under both RCRA Interim Status Standards and MTCA. The Closure Plan found in the Interim Status Part B Permit application will be followed. Closure is expected to occur in approximately 5 to 8 years when the landfill reaches capacity.

5.3 Maintenance and Monitoring Plans

Since contaminated soils, contaminated sediments, and potliner dangerous waste will be contained on-site, a maintenance and monitoring plan will be implemented as part of the cleanup remedy. Monitoring for the Beach I, Beach II, and Closed Construction Debris Landfills is described below. Monitoring for the Solid Waste and Dangerous Waste Landfills is described in each of the individual landfill closure plans.

Beach I and Beach II Maintenance Monitoring. For the first and second years following the completion of the removal of the Beach I and Beach II Landfills, Intalco will monitor erosion and vegetation quarterly and submit an annual report describing any maintenance activities. Intalco will insure that repairs of slope failures and revegetation are reported in each annual report.

After cleanup, surface seeps at the Beach I Landfill (and Beach II Landfill, if flowing) will be monitored semi-annually: once during the rainy season and once during the dry season in years 2007, 2009, and 2011. Intalco will submit an annual report that summarizes monitoring results.

After cleanup, the intermittent stream at the base of the Closed Construction Debris Landfill will be monitored semiannually: once during the rainy season and once during the dry season in years 2007, 2009, and 2011. Intalco will submit an annual report that summarizes monitoring results. The Closed Construction Debris Landfill maintenance and monitoring plans are subject to a MTCA five year review (WAC173-340-420). The monitoring plans will be re-evaluated at year five in the monitoring period and either continue as directed in the Consent Decree or be changed to reflect the current conditions. Monitoring plans will continue to be reviewed every five years.

Surface Water Monitoring
Post Remediation

Beach I	Beach II	Closed Construction
Fluoride	Fluoride	Fluoride
PCBs	PCBs	-
Metal Cyanide Complex	Metal Cyanide Complex	-

5.4 Institutional Controls

Intalco shall record a restrictive covenant (WAC 173-340-440) for the Site covered by this Consent Decree within ninety (90) days after completing remediation of the Closed Construction Debris Landfill, or no later than December 31, 2006, whichever occurs first.. The covenant shall address both the restriction on use of portions of the site and restrictions on groundwater withdrawal. The institutional controls consist of the filing of a restrictive covenant describing the condition of the property, that a cleanup was completed at the site, and that groundwater withdrawal from the site is restricted. The specific restrictions for certain landfills are described in more detail below. Intalco is required to submit an estimate of cost associated with the landfill closures and a method of maintaining sufficient and adequate financial assurance to cover the costs.

5.4.1 Solid Waste Double-Lined Landfill

The Solid Waste Double-Lined Landfill will be closed following the current landfill closure plan. The closure shall follow WAC 173-350-400(6) which requires the owner or operator to record with the local zoning authority a map and statement of fact concerning the location of the disposal facility in the property deed. This description shall be in an instrument that is normally examined during title search and that will in perpetuity notify any potential purchaser that the property is a closed disposal facility. This shall be completed 90 days after closure.

5.4.2 Dangerous Waste Triple-Lined Landfill

The Dangerous Waste Triple-Lined Landfill will be closed following the Code of Federal Regulations Part 265, Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities, specifically, 40 CFR 265 Subpart G,

Closure and Post Closure. Intalco shall submit to a local zoning authority a survey plot indicating the location and dimensions of landfill cells with respect to permanently surveyed benchmarks. The plot must be prepared by a professional land surveyor. The notice must contain a note, prominently displayed, which states the owner's or operator's obligation to restrict disturbance of the hazardous waste disposal unit in accordance with the applicable Subpart G regulations. The notice shall be placed in the deed to the facility property or in some other instrument that is normally examined during title search. The notice shall run in perpetuity and notify any potential purchaser that the property has been used to manage hazardous waste. This shall be done 60 days after final closure.

5.4.3 Closed Construction Debris Landfill

The remediation plan for the Closed Construction Debris Landfill calls for a cover and continued monitoring. Contaminated soils will be left in place at the facility. Following closure of the landfill, Intalco shall place a description of the waste and record a restrictive land use covenant within 90 days of completing remediation of this landfill, or December 30, 2006, whichever occurs first.. This description shall be in an instrument that is normally examined during title search and that will in perpetuity notify any potential purchaser that the property was closed as a result of a MTCA cleanup The covenant will prevent Intalco from taking actions that interfere with the integrity of the cap and control exposure of future site workers to the contaminants. It will mandate that ground water may not be withdrawn from the landfill footprint. The site may be used for industrial purposes consistent with the cleanup action and the covenant.

5.5 Restoration Timeframe

The cleanup action at the Beach I, Beach II and Closed Construction Debris Landfills calls for the removal of historic waste at Beach I and Beach II Landfills and the covering of waste at the Closed Construction Debris Landfill with an impermeable cap. Surface water seeps at Beach I and Beach II are contaminated with PCBs, cyanide, and fluoride. The intermittent stream are the Closed Construction Debris Landfill is contaminated with fluoride.

The point of compliance at the Beach I and Beach II Landfills for soil restoration is the native soil/waste boundary. The point of compliance for groundwater at the Beach I and Closed Construction Debris Landfills are the surface water seeps in the exposed bluff soils adjacent to the Georgia Strait. Groundwater flows to the west beneath each landfill into the seeps. The surface water seeps flow intermittently from the site. Flows range from zero to 2.5 gallons/ minute at Beach I. Estimated surface water flows at Beach II are less than one gallon per minute. No estimated surface water flow estimates have been made for the Closed Construction Debris Landfill.

At the Beach II and the Closed Construction Debris Landfills, no ground water was found in any of the exploratory drilling which was completed in the local aquifer in the Cherry Point Formation. The steam flows from Beach I and Beach II go underground prior to emptying into the Strait of Georgia. The surface water flows past the Closed

Construction Debris Landfill in a small intermittent stream from an area upgradient of the Landfill. This surface water also enters the Strait of Georgia as subsurface flow.

The cleanup action will remove contaminated soil at the Beach I and Beach II Landfills resulting in a soil restoration timeframe at project completion (estimated to be December 2007).

The restoration time frame for ground water entering surface water has been calculated using flow data from the Beach I Landfill and flow estimates for the Closed Construction Debris Landfill and Beach II Landfill. Flow at the Beach I Landfill is 2.5 gal/minute. Saturated thickness of the soil column was approximately 7.5 feet as determined by exploratory well logs. Flow was estimated between 25 and 100 feet per year through the landfill waste. Porosity was estimated to be 20% in the silts and waste found at Beach I. The Beach I Landfill covers approximately 16,000 square feet of bluff and slope surface. Using the above data, the time to pass one pore volume through the soil column was calculated to be approximately 50 days or two months. Six pore volumes will pass through the soil column in one year. In five years, approximately 30 pore volumes will have passed through the sedimentary column. With removal of the source and natural attenuation due to the movement of 30 pore volumes of aquifer water through the sedimentary column, the ground water/surface water interface will reach cleanup standards within the five year monitoring period assuming a conservative linear rate of decrease in the dissolved contaminates.

At Beach II and the Closed Construction Debris Landfills, flow rates could not be measured due to low water volumes. No water was encountered in the exploratory drilling at either landfill. Seeps that are present are intermittent and do not flow year round. For Beach II, using 1 gal/minute flow rate, estimated 5 foot saturated thickness, 84,523 square feet of bluff and slope, and 20% porosity, approximately one pore volume will pass through the soil column in 1.2 years. With removal of the source waste and natural attenuation due to the movement of five pore volumes of aquifer water through the sedimentary column the ground water/surface water interface will reach cleanup standards in the five year monitoring period assuming a linear rate of decrease in the dissolved contaminates.

The Closed Construction Debris Landfill conditions are similar to the Beach II Landfill conditions. The Closed Construction Debris Landfill has 93,474 square feet of bluff and slope. Using the same estimated parameters as was used in the Beach II landfill (1 gallon/minute, 5 foot saturated thickness, 20% porosity) approximately one pore volume will pass through the soil column in 1.3 years. Remediation of the landfill with an engineered cover will result in a significant decrease in water inflow into the unit. With the construction of the cover and natural attenuation due to the movement of 1.3 pore volumes of water per year through the sedimentary column, the ground water/surface water interface will reach cleanup standards within six years assuming a linear rate of decrease in the dissolved contaminants.

6.0 SCHEDULE

6.1 Work Schedule

The project has been started with the approval of Ecology. An outline of the actual and tentative schedule for implementation of the remedial action activities is given below:

- Engineering Design Report Finished (Actual) — December 2004
- Engineering Drawing and Specifications (Actual) — December 2004
- Intalco Selects Contractor (Actual) — February 2005
- RCRA Part B Permit Changes Public Notice (Actual) — June 2005
- Cleanup of Beach I & Beach II (Completed) — Fall 2005
- Draft Cleanup Action Plan — April 2006
- Draft Consent Decree — April 2006
- Public Comment Period — July 2006
- Begin Mobilization of Materials — May 2006 (Actual)
- Start Cleanup (CCDL) and move Brick Pile — Spring 2006
- Begin Closure (Solid Waste Landfill) — Summer 2007
- Cleanup/Closure Complete — December 2007
- Cleanup Report Due — April 2008
- Begin Closure (DW Landfill) — Estimated 2011-2014

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Figures

Figure One Vicinity Map

Figure Two Site Overview Map

Figure G3 Beach I

Figure G4 Beach II