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September 6, 2011

Jeff Rodin, On-Scene Coordinator
United States Environmental Protection Agency, Region 10
1200 Sixth Avenue, Mail Stop ECL-116
Seattle, Washington 98101

RE: Contract No. EP-S7-06-02; Technical Direction Document No. 10-06-0003
Final Focused Sampling Assessment and Removal Action Report
RAMCO Aluminum Waste Disposal Site, Dallesport, Washington

Dear Mr. Rodin:

Enclosed please find the final report of the focused sampling assessment and removal action performed at the RAMCO Aluminum Waste Disposal Site. If you have any questions or require further assistance, please contact Tim Adair at (503) 248-5600 or me at (206) 920-1739.

Sincerely,

ECOLOGY AND ENVIRONMENT, INC.

Steven G. Hall
START-3 Project Leader

Enclosure

cc: Tim Adair, E & E, START Project Manager, Portland, Oregon

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Focused Sampling Assessment and Removal Action Report

RAMCO Aluminum Waste Disposal Site
Dallesport, Washington
TDD: 10-06-0003

REGION 10
START-3
SUPERFUND TECHNICAL ASSESSMENT & RESPONSE TEAM

Prepared for:

U.S. Environmental Protection Agency, Region 10
1200 Sixth Avenue
Seattle, Washington 98101

Prepared by:

Ecology and Environment, Inc.
720 Third Avenue, Suite 1700
Seattle, Washington 98104

September 2011

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Executive Summary

The United States Environmental Protection Agency (EPA) completed a focused sampling assessment, a removal action, and post-removal action surface water and groundwater sampling at the Recycled Aluminum Metals Company (RAMCO) Aluminum Waste Disposal Site in Dallesport, Washington.

RAMCO, a now defunct company, occupied a building located within the Dallesport Industrial Park near Dallesport, Washington, where it extracted aluminum from dross received from primary aluminum smelters in the Northwest. From approximately 1982 to 1989, RAMCO placed the resulting salt cake plus a smaller amount of baghouse dust in an unlined landfill on the east end of the Dallesport Industrial Park. The waste material in the landfill produced ammonia gas when wet, causing concern that hazardous constituents from the waste material in the unlined landfill would eventually leach to groundwater and impact nearby surface water bodies

The Washington Department of Ecology (Ecology) conducted an interim cleanup action in 2007, 2008, and 2009, in which approximately 69,000 tons of waste was removed. Due to funding restraints, Ecology was unable to complete the cleanup and requested that the removal be completed by the EPA.

On May 6, 2009, the EPA, along with Ecology and the United States Army Corps of Engineers, conducted a site visit to the waste disposal site. Participants observed waste aluminum and spent pot lining, a waste product of the electrolytic process of smelting aluminum. The spent pot lining is a K088 Resource Conservation and Recovery Act hazardous waste (spent aluminum pot liner from primary aluminum reduction), and its hazardous constituents include cyanide and fluoride. Because of the cleanup work performed by Ecology, it appeared that about two-thirds of the landfill had been excavated to date. The remaining one-third of the landfill appeared to contain about 250 tons of material that needed to be excavated, aerated, crushed, and prepared for shipment to an appropriately licensed landfill.

The EPA completed a focused sampling assessment in the fall of 2009 that showed continued leaching of landfill contaminants to the local groundwater aquifer surrounding the landfill. On May 14, 2010, the EPA approved an Action Memorandum for a time-critical removal action because of the threat that the remainder of the landfill contents posed to human health and the environment. With continued leaching to groundwater, contaminants could threaten ecological receptors or enter downgradient surface water bodies and threaten human populations and wildlife. Downgradient receptors include Lake Celilo (the Columbia River impoundment behind The Dalles Dam) downstream.

The EPA's removal action began the week of July 19, 2010, and was performed by the EPA’s Emergency Response and Removal Services (ERRS) contractor, with support from the Superfund Technical Assessment and Response Team (START) and the U.S. Coast Guard Pacific Strike Team. The removal action was completed in September 2010.

The EPA generated three waste streams from the site: non-regulated aluminum salt cake, aluminum slag, and K088-regulated hazardous waste. A total of 18,969 tons of the aluminum salt cake was transferred to the Wasco County Landfill, approximately 48,000 pounds of aluminum slag was recycled off site, and 16 tons of K088-listed hazardous waste was transferred to the Chemical Waste Management of the Northwest landfill in Arlington, Oregon. The ERRS crew completed the removal action by installing a permanent access gate and barrier of large boulders to prevent access to the former disposal area.

Following the completion of the removal action, START performed two surface water and groundwater sampling events at the site. One was completed in September 2011 immediately following the conclusion of the removal action. The next sampling event was performed approximately seven months later, in

April 2011. A temporary accumulation of water that formed over the excavated area during the 2010–2011 winter was included in the April 2011 sampling event. Including the 2009 focused sampling assessment, the EPA/START completed three groundwater and surface water sampling events at the RAMCO site.

Groundwater analytical results from sampling of the monitoring wells surrounding the former RAMCO disposal area before and after the removal action show that the local aquifer has been affected by the leaching of contaminants associated with the waste in the unlined landfill. Elevated levels of chloride, nitrates, nitrite, cyanide (as hydrogen cyanide), and ammonia were consistently detected in monitoring wells MW-2 through -5 from 2009 through 2011.

Based on the results of the sampling events performed before and six months after the removal action, it appears that the contaminants of concern from the RAMCO disposal area have not migrated to the surrounding surface water bodies. However, the new temporary accumulation of water in the former Ramco landfill is impacted by contaminants associated with the former unlined landfill. The temporary accumulated water is elevated with respect to ammonia, chloride, total dissolved solids, cyanide, and metals, including barium, cobalt, copper, iron, magnesium, manganese, potassium, selenium, sodium, vanadium, and zinc.

This report presents the results of the EPA's time-critical removal action performed in 2010 and the three separate rounds of groundwater and surface water sampling performed in 2009, 2010, and 2011. Ecology will continue to conduct long-term groundwater monitoring to ensure the effectiveness of the Removal Action.

1. SITE DETAILS

The Recycled Aluminum Metals Company (RAMCO) disposal site is located in the Dallesport Industrial Park, which is owned and operated by the Port of Klickitat. The industrial park is a mixed light and heavy facility located approximately two miles east of the small community of Dallesport, Washington (Figure 1). The 2007 population of Dallesport was 1,239.

The unlined disposal site is located about 400 feet southwest of Spearfish Lake, about 500 feet north of a pond known as Joe's Lake, and about 1000 feet north of the Columbia River (Figure 2).

RAMCO Aluminum Waste Disposal Site, Dallesport, Washington

Latitude:	45.6253834	**Longitude:**	-121.1312199
Site Number	10HF	**Contract Number:**	ER-R7-07-02
D.O. Number:	0029	**Action Memo Date:**	5/13/2010
Response Authority:	CERCLA	**Response Type:**	Time-Critical
Response Lead:	EPA	**Incident Category:**	Removal Action
NPL Status:	Non NPL	**Operable Unit:**	Not Applicable
CERCLIS ID:	WAN001002793	**RCRA ID:**	WAD988508586

2. PURPOSE

The United States Environmental Protection Agency (EPA) tasked Ecology and Environment, Inc., under Superfund Technical Assessment and Response Team (START)-3 contract number EP-S7-06-02, Technical Direction Documents numbers 09-04-0015 and 10-06-0003, to assist with a focused sampling assessment and removal action at the RAMCO disposal site.

START performed the focused sampling assessment for the EPA in August 2009 to characterize the waste materials and potential impacts to surface water and groundwater. The removal action was performed by the EPA's ERRS contractor from July to September 2010, with support from START and the United States Coast Guard Pacific Strike Team. Following the removal action, START performed two rounds of surface water and groundwater sampling (September 2010 and April 2011) to evaluate water quality after the waste material had been removed.

Throughout the focused sampling assessment, removal action, and sampling activities, START was tasked with documenting site conditions through logbook entries and photographs, collecting environmental samples for analytical testing, and providing technical assistance to the EPA. Selected photographs taken throughout the project are included in Attachment A.

3. PERSONS INVOLVED

Agency/Company	Contact Persons/ Position	Phone Number
EPA	Jeff Rodin, On-Scene Coordinator	(206) 553-6709
Emergency and Rapid Response Services /Environmental Quality Management, Inc.	Joe Ficek, Response Manager	(425) 673-2900
START/Ecology & Environment	Tim Adair, Project Manager/Responder	(503) 248-5600
	Eric Lindeman, Site Manager/Responder	(206) 624-9537
	Steve Hall, Site Manager/Responder	(206) 920-1739
U.S. Coast Guard Pacific Strike Team	Jeremy Thomas, Responder	(415) 798-4533
	Troy Utley, Responder	(415) 798-4533

4. BACKGROUND

RAMCO, a now defunct company, occupied a building located within the Dallesport Industrial Park near Dallesport, Washington, where it extracted aluminum from dross received from primary aluminum smelters in the northwest. Dross is a by-product of the primary smelting process, and the major constituents of dross are aluminum, aluminum oxides, mixtures of nitrides, mixtures of chlorides, and traces of other impurities.

The aluminum extraction process consisted of heating the dross in a gas-fired furnace and adding sodium chloride to the furnace as a fluxing agent. At the end of a four-hour run, molten aluminum was tapped out of the furnace into ingots. The molten salt remaining in the furnace was then skimmed out of the furnace either into metal molds or onto a bed of sand on a concrete floor, where it cooled and hardened. The salt cake, composed primarily of sodium chloride, aluminum oxide, and aluminum metal, was then a waste that required management and disposal.

Another waste material generated during the electrolytic process of aluminum smelting is spent pot lining. The spent pot lining is a K088 Resource Conservation and Recovery Act hazardous waste (spent aluminum pot liner from primary aluminum reduction) and can contain cyanide and fluoride as well as other hazardous substances.

From approximately 1982 to 1989, RAMCO placed this salt cake plus a smaller amount of baghouse dust in an unlined disposal site at a location approximately one-half mile away from the RAMCO buildings. RAMCO ceased placing the waste materials in the unlined landfill in approximately 1989, and RAMCO ceased operations in the Dallesport Industrial Park in approximately 1993.

The waste material placed in the landfill produced ammonia gas when wet. The odor of ammonia had been detected in the past during both direct-push sampling and groundwater monitoring (Ecology 2006). Nitrates, sodium, chloride, and total dissolved solids in groundwater were measured at levels exceeding primary or secondary water quality standards. Because major salt-forming chemical elements (sodium, calcium, potassium) measured during groundwater sampling exceeded levels of these elements found in seawater, there was a strong indication that salts from the unlined landfill were leaching to groundwater (Ecology 2006).

The potential human health and environmental impacts from the disposal of the salt cake in the unlined disposal site include public health and ecological risks and potential increased total dissolved solids and metal concentrations in groundwater and surface water.

The contaminants of concern (COCs) (cyanide, polycyclic aromatic hydrocarbons [PAHs], ammonia, and metals, including aluminum, cobalt, copper, iron, manganese, and vanadium) are hazardous substances or pollutants or contaminants as defined by sections 101(14) and 101(33) of the Comprehensive Environmental Response, Compensation, and Liability Act, as amended, 42 U.S.C. section 9601(14) and (33).

5. PREVIOUS INVESTIGATIONS/CLEANUP ACTIONS

In 1993, Hart Crowser, on behalf of the former owner of RAMCO, sampled and tested salt cake wastes generated during the recovery of aluminum from aluminum dross from three of the facility's aluminum smelters. Based on the results of the tests, newly generated salt cake was designated as a Washington State dangerous waste because it was an aquatic toxin. The test results also demonstrated that salt cake waste that is crushed and allowed to aerate can experience a significant reduction in aquatic toxicity (Hart Crowser 1993).

In June and July of 2005, Ecology oversaw an investigation in which the waste material was characterized and five groundwater monitoring wells were installed adjacent to the unlined disposal site to determine the depth to groundwater and the potential impacts of the site on the groundwater in the area. In April 2006, Ecology oversaw additional sampling of the aluminum waste in the disposal site using a direct-push soil probing machine. A key finding from one boring was a zone at the bottom of the aluminum waste (27 to 29 feet below the surface of the landfill cover) with perched water, an elevated temperature, and a strong odor of ammonia gas when exposed to air. In addition, the direct-push soil probe was not able to penetrate a dense layer approximately 8 feet below the surface in the center of the landfill. Ecology conducted a Site Hazard Assessment pursuant to the Ecology Model Toxics Control Act (MTCA) on the unlined waste disposal site. The site was added to the State Hazardous Sites List and is among the upper 40 percent of sites according to the risk it presents. The results of the investigations are summarized below (Ecology 2006).

- The waste in the landfill contained up to 28 percent aluminum, up to 8 percent sodium, up to 2.8 percent magnesium, up to 2.1 percent calcium, and up to 1.5 percent potassium, plus lesser amounts of chromium, manganese, iron, copper, nickel, and zinc.
- The waste material placed in the landfill produced ammonia gas when wet. The odor of ammonia had been detected in the past during both direct push soil sampling and groundwater monitoring.
- Nitrates, sodium, chloride, and total dissolved solids in groundwater were measured at levels exceeding primary or secondary water quality standards. Because major salt-forming chemical elements (sodium, calcium, potassium) measured during groundwater sampling exceeded levels of these elements found in seawater, there is a strong indication that salts from the landfill are leaching into groundwater.
- Leaching tests performed to determine whether the waste is a dangerous indicated that metals also could leach from the aluminum waste. However, groundwater monitoring

through July 2005 had not shown elevated levels of metals attributable to leaching from the landfill.

Ecology conducted an interim cleanup action of the site in 2007, 2008, and 2009. Approximately 69,000 tons of aluminum waste and associated material was excavated, treated on site, and transported to the Wasco County Landfill for disposal. Treatment prior to hauling off site consisted of screening or crushing the material, followed by aeration (storage in piles open to the air) for periods of time ranging from less than one hour to more than seven days. Ecology was unable to completely remove all aluminum waste and associated material due to funding constraints and requested the assistance of the EPA.

On May 6, 2009, the EPA, along with Ecology and the United States Army Corps of Engineers, conducted a site visit to the waste disposal site. Participants observed waste aluminum and spent pot lining, a waste product of the electrolytic process of smelting aluminum. The spent pot lining is a K088 Resource Conservation and Recovery Act hazardous waste (spent aluminum pot liner from primary aluminum reduction) and can contain cyanide and fluoride as well as other hazardous substances.

6. FOCUSED SAMPLING ASSESSMENT

In August 2009, the EPA conducted a focused sampling assessment of the aluminum waste disposal site. Environmental samples were collected from aluminum waste stockpiles, buried aluminum waste, and groundwater and nearby surface water. The results of the investigation are summarized below.

- The following analytes exceeded the EPA's Regional Screening Levels (RSLs) for Chemical Contaminants at Superfund Sites in industrial soils: the PAHs benzo[a]anthracene, benzo[a]pyrene, benzo[b]fluoranthene, dibenz[a,h]anthracene, and indeno[1,2,3-cd]pyrene; and the metals aluminum, cobalt, copper, iron, manganese, and vanadium (EPA 2010a).
- Groundwater samples were collected from three monitoring wells. Chloride, fluoride, nitrate, nitrite, and cyanide as hydrogen cyanide were detected above EPA drinking water standards or RSLs.
- Surface water samples collected from the surrounding water bodies Joe's Pond, Little Spearfish Lake, and Spearfish Lake were free of all COCs, and no analytes were reported above their respective screening criteria.

Based on the results of the focused sampling assessment (E & E 2009a), the EPA decided to perform a time-critical removal action to complete the excavation and off-site disposal of the aluminum waste at the waste disposal site (EPA 2010b).

7. REMOVAL ACTIVITIES

The removal action began during the week of July 19, 2010, when the EPA's ERRS contractor began to mobilize equipment and office trailers to the site and coordinated with the Port of Klickitat (property owner) for use of staging areas and fill material. The EPA, START, and the United States Coast Guard Pacific Strike Team also mobilized to the site. The EPA contacted the United States Army Corps of Engineers Dalles Dam visitor center and the Dallesport fire and ambulance service to inform them of the intended work, and a fact sheet for the removal activities was provided to interested parties and was also posted at the nearby Spearfish Lake Recreation Area.

On July 26, 2010, ERRS began excavation- and construction-related tasks, which continued until September 14, 2010. During the first week, the screened stockpile accumulated by a previous Ecology contractor was transported off site to the Wasco County Landfill. The removal of this stockpile allowed room for a screening plant and the associated screening stockpile. The screening plant was used for the duration of the removal action to screen the dross waste before it was transported to the Wasco County Landfill. The screening process also continued the aeration process so that the waste's ammonia odor was minimized before the material was shipped off site.

ERRS started excavation on the southeast edge of the site by removing the uncontaminated top soil in preparation to excavate the aluminum dross waste placed in the landfill. Following excavation, the waste was placed into stockpiles so that the dross could be aerated, which allowed ammonia to off-gas. The dross waste was pushed from the downgradient areas of the landfill to an upgradient location nearer the landfill entrance and into stockpiles. This activity helped to break up and aerate the waste and allowed the material to be visually inspected for large pieces of aluminum slag, K088-listed waste, or any larger waste materials that could not go through a screening plant. Finally, the waste material that was small enough was fed into a screening plant and separated. Aluminum dross, K088 waste, and other waste materials were manually separated and placed in separate waste stream stockpiles.

Throughout the removal process, START monitored the site for concentrations of dust particulates, explosive atmosphere, and ammonia. Data Ram 4s were used to monitor particulates, and stationary, remotely monitored AreaRAEs were used to monitor for explosive atmosphere and ammonia. The stationary monitoring equipment was strategically placed each day downwind of the site activities based upon weather conditions. Individual MultiRAE Plus and ammonia monitors were used by START to monitor specific site activities. While none of the site activities produced any eight-hour time weighted averages that required respiratory protection, air-purifying respiratory protection was used at times to protect from short-duration ammonia peaks, eliminate ammonia nuisance odors, or provide dust protection for workers. The ERRS contractor also used a water truck for the roadways and water hoses directed onto specific excavation areas to minimize dust.

As the waste screening proceeded, separating the gravel-sized dross from larger waste, more waste material was excavated from the landfill to supply the screening plant. The screening process efficiently removed oversized pieces of waste and large rocks from the gravel-sized dross. The profile of the screened material (i.e., gravel-sized dross) was determined to be acceptable for disposal at the Wasco County Landfill, and this screened material was intermittently transported to the Wasco County Landfill throughout the duration of removal activities.

The Wasco County Landfill accepts only gravel-sized non-hazardous material for disposal. To meet this requirement, the larger material from the RAMCO site was separated from the gravel-sized dross by the screening plant, then crushed to a smaller size. ERRS mobilized a crusher to the site on August 13, 2010, to crush the larger pieces of dross material. Before crushing, the larger pieces of excavated dross waste were hand-sorted, and materials incompatible with the crusher were removed (i.e., aluminum slag, carbon rods of KO88 waste, pieces of steel, or other foreign objects). The material crushed by the crusher was then transported to the Wasco County Landfill as non-hazardous waste with no further screening. Once the crusher was on site, the dross material was screened and crushed as needed to produce a constant supply of gravel-sized material for non-hazardous disposal at the Wasco County Landfill. Aluminum slag, carbon rods of KO88 waste, pieces of steel, and other foreign objects that could not be crushed were placed in separate piles to be shipped off site at the end of the removal action.

Once all the screened/crushed material was shipped off site to the Wasco County Landfill, the hazardous K088 waste and the aluminum slag were also shipped off site. On September 11, 2010, ERRS loaded approximately 48,000 pounds (24 tons) of aluminum slag and shipped it to a recycling facility. On

September 14 and 15, 2010, two containers of K088 hazardous waste were shipped off site to the Chemical Waste Management of the Northwest hazardous waste landfill in Arlington, Oregon. The cumulative disposal/recycling quantities for the removal action are summarized below. Shipping manifests and waste disposal documents are located in Attachment B.

Waste Stream	Disposal	Quantity
Non-Hazardous Dross Material	Wasco County Landfill, Wasco County, Washington	576 truck loads (approximately 18,969 tons)
Hazardous K088 Waste	Chemical Waste Management Inc., Arlington, Oregon	32,050 pounds (16 tons)
Aluminum Slag	Recycler	24 tons

The final preparation of the site included the rebuilding of the perimeter barbed wire fence on the east, constructing an access road to the three monitoring wells on the east side of the site, and placing large rocks and a gate at the west entrance to restrict access. To complete the removal action, ERRS completed restoration activities, re-graded the site to alleviate dangerous slopes and hanging rock, and demobilized equipment and temporary office trailers.

8.0 POST-REMOVAL WATER SAMPLING RESULTS

The first round of groundwater and surface water body sampling occurred during the fall of 2009, and the results are summarized in Section 6.0 of this report. Contaminants of concern that were positively identified were examined for trends and are summarized in the following sections.

On September 8, 2010, immediately at the conclusion of the removal action, START collected water samples from three site monitoring wells, the Dallesport Industrial Park's industrial water supply well, and three surrounding surface water bodies. On April 12, 2011, START returned to the site and collected additional groundwater and surface water from these locations and the temporary accumulation of water over the former RAMCO landfill excavation area.

During both sampling events, START collected and analyzed the samples in accordance with the site-specific sampling plan (E & E 2009b) and sampling plan alteration form (E & E 2011). The surface water and groundwater samples were analyzed for PAHs (EPA method 8270-SIM), toxic analyte list metals (EPA 6000 and 7000 series methods), total and amenable cyanide (EPA method 9010), total dissolved solids (EPA Method 160.1), chloride (EPA method 325), nitrates (EPA Method 300), and ammonia (EPA method 350.1) by a subcontract laboratory.

Figure 2 shows the surface water body and monitoring well sampling locations. Tables 1 and 2 list the results of the three START water sampling events: pre-removal during August 2009 and post removal during September 2010 and April 2011. Analytical testing results and START data validation memoranda are included in Attachment C.

Surface water body sampling results were compared against MTCA cleanup levels for groundwater, EPA RSLs for tap water, and EPA maximum contaminant levels (MCLs). Analytes exceeding threshold screening values and obvious trends are discussed below.

8.1 Surface Water Results Detected Above Screening Values

Dissolved Metals

The fall 2010 sampling event revealed concentrations of arsenic in the three surface water body sampling locations. Arsenic was detected in Joe's Pond (7.64 micrograms per liter [μg/L]), Spearfish Lake (5.48

μg/L), and Little Spearfish Lake (9.52 μg/L) at concentrations exceeding the MTCA cleanup level for arsenic in groundwater of 5 μg/L, and all exceeded the RSL of 0.045 μg/L. None of the samples exceeded the MCL for arsenic, which is 10 μg/L. This was the only instance of arsenic detected in surface water bodies during the three sampling events (2009, 2010, and 2011). Arsenic was not detected in the temporary water body when it was sampled in 2011.

Mercury was detected in Spearfish Lake at a concentration of 0.828 μg/L in 2011, which did not exceed the MTCA concentration value of 2 μg/L. This spring 2011 event was the only instance in which mercury was detected in a surface water sample above the method detection limit.

Vanadium was detected at each surface water body sampling location once in 2010: at Joe's Pond (2.43 μg/L), Spearfish Lake (3.91 μg/L), and Little Spearfish Lake (4.66 μg/L), all exceeding MTCA screening values for groundwater standard of 1.12 μg/L. In 2011 the concentration of vanadium from the temporary water body was 299 μg/L, which exceeded the MTCA screening value and the EPA RSL for tap water of 180 μg/L. There is no MCL for vanadium.

Additionally, three surface water body samples exceeded the MCL for iron (300 μg/L), two locations exceeded the MCL for manganese (50 μg/L), and one location exceeded the MCL for aluminum.

Inorganics

The temporary water body sample from 2011 was the only surface water sample with concentrations of inorganics in excess of MCL, EPA RSL for tap water, or MTCA screening value for groundwater:

- Chloride was detected at 4,610,000 μg/L, exceeding the MCL of 250,000 μg/L.
- Total dissolved solids were detected at 10,500,000 μg/L, exceeding the MCL of 500,000 μg/L.
- Nitrate was detected at 369,000 μg/L, exceeding both the MCL and EPA RSL of 10,000 and 58,000 μg/L, respectively.
- Nitrite was detected at 72,900 μg/L, exceeding both the MCL and EPA RSL of 1,000 and 3,700 μg/L, respectively.
- Ammonia was detected at 162,00 μg/L. There are no screening values for ammonia.

PAHs

No PAH concentrations exceeded the MCL, EPA RSL, or MTCA screening value in any surface water body samples.

8.2 Groundwater Results Detected Above Screening Values

Dissolved Metals

In September 2010, arsenic was detected in the Dallesport Industrial Park's public water supply well at a concentration of 8.43 μg/L, exceeding the EPA RSL and MTCA screening value. Three out of four groundwater monitoring wells sampled exceeded all three standards, including the MCL of 10 μg/L. Arsenic concentrations in monitoring wells MW-3 through MW-5 ranged from 186 to 235 μg/L. Monitoring well MW-2 was sampled once and arsenic was not detected.

Barium concentrations in excess of the MCL (2,000 μg/L) and MTCA screening value (3,200 μg/L) were detected during the 2009 sampling event in monitoring well MW-4 at 3,500 μg/L and during the 2010 sampling event in monitoring well MW-3 at 3,430 μg/L.

Cobalt was consistently detected at elevated concentrations in monitoring wells MW-2 though MW-5, with the highest concentrations of cobalt coming from monitoring well MW-4 at 82 µg/L and monitoring well MW-3 at 62.5 µg/L. The EPA RSL for cobalt is 11 µg/L. There is no MCL for cobalt.

Moderate to elevated concentrations of manganese were detected in monitoring wells MW-3 through MW-5 in each sampling event, with concentrations above the MCLs, RSL, or MTCA.

Vanadium was detected in all five wells in concentrations that exceed the MTCA screening value (1.12 µg/L). The Dallesport Industrial Park's water supply and monitoring well MW-2 had the highest concentrations of vanadium, at 7.99 and 9 µg/L, respectively.

Aluminum and iron were also detected in monitoring wells MW-3 through MW-5 in each sampling event with values exceeding the MCL, and selenium was detected above the MCL in MW-3.

Inorganics

The Dallesport Industrial Park's public water supply well contained ammonia, chloride, total dissolved solids, and nitrates in both the 2010 and 2011 sampling events; however, none of these concentrations exceeded even the most conservative MCL, EPA RSL, or MTCA screening value. There is no screening value for ammonia.

Monitoring wells MW-2 through MW-5 consistently exceeded the MCL for both chlorides and total dissolved solids during each sampling event, often at concentrations 10 to 100 times greater than the MCL.

Monitoring wells MW-2 through MW-5 contained concentrations of cyanide (as hydrogen cyanide) that exceeded the EPA RSL of 1.6 µg/L. During the most recent sampling event of 2011, the only location to exceed the RSL for cyanide was monitoring well MW-3; cyanide was not detected above the method detection limit in any of the other monitoring wells sampled or the Dallesport Industrial Park's public water supply.

Nitrates were detected in monitoring wells MW-2 through MW-5 consistently at concentrations exceeding both the MCL of 10,000 µg/L and EPA RSL at 58,000 µg/L. During the 2011 sampling event, nitrate was detected in monitoring well MW-2 at 345,000 µg/L and in MW-3 at 239,000 µg/L, which were the highest concentrations of nitrates detected in the monitoring wells over the three-year monitoring period.

Nitrite was detected in monitoring wells MW-2 and MW-5 at concentrations exceeding the MCL of 1,000 ug/L and the EPA RSL of 3,700 ug/L, and nitrite was also detected in MW-3 at a concentration exceeding the MCL. The highest concentration of nitrite detected was in 2011 in monitoring well MW-2 at 88,400 ug/L.

PAHs

No PAH concentrations exceeded the MCL, EPA RSL, or MTCA screening value.

9. SUMMARY, CONCLUSIONS and RECOMMENDATIONS

The EPA completed a focused sampling assessment in the fall of 2009 that showed continued leaching of landfill contaminants to the local groundwater aquifer surrounding the landfill. On November 30, 2009, the EPA approved an Action Memorandum for a time-critical removal action for the remainder of the landfill contents (EPA 2010b).

The EPA performed the removal action from July to September 2010 to remove the aluminum waste material for proper off-site disposal. A total of three waste streams were generated from the site: non-hazardous dross material (18,969 tons), hazardous K088 waste (16 tons), and aluminum slag for recycling (24 tons).

The purpose of the EPA's groundwater and surface water sampling was to verify the chemistry of nearby surface water bodies and to screen these water bodies for contaminants associated with the former RAMCO landfill. Additionally, the Dallesport Industrial Park's industrial supply well was also sampled to determine if groundwater impacted by the former RAMCO landfill is migrating to this public drinking water source (E &E 2009b, 2011).

Groundwater analytical results from sampling the monitoring wells surrounding the former RAMCO landfill show that the local aquifer has been impacted by the leaching of contaminants associated with the waste and unlined landfill. Elevated levels of chloride, nitrates, nitrite, cyanide (as hydrogen cyanide), and ammonia were consistently detected in monitoring wells MW-2 through MW-5.

It is unclear if the Dallesport Industrial Park's water supply well has been affected by the former RAMCO landfill or will be in the future. Arsenic was detected in the public water supply well at a concentration of 8.43 μg/L, exceeding the EPA RSL and MTCA screening value. The public water supply well also contained elevated levels of ammonia, chloride, total dissolved solids, and nitrates in both the 2010 and 2011 sampling events; however, none of these analyte concentrations exceeded even the most conservative MCL, EPA RSL, or MTCA screening value.

Based on the results of surface water sampling it is unclear if the former RAMCO landfill COCs (cyanide, PAHs, ammonia, and metals, including aluminum, cobalt, copper, iron, manganese, and vanadium) have migrated to the surrounding surface water bodies that were sampled as part of this project. Some COCs are present at concentrations below screening levels, and others may be present at concentrations too low to detect. The PAH fluoranthene was detected in Joe's Pond and Spearfish Lake during the April 2011 sampling event, but not previously. Similarly, pyrene was detected in Joe's Pond in April 2011 but not previously. Aluminum, copper, iron, manganese, and vanadium have all been detected in surrounding surface water bodies, with some detections above screening levels, but not consistently enough to establish any trends.

To further evaluate whether there are any long-term effects to groundwater and surface water near the former RAMCO landfill site, additional groundwater and surface water sampling will be necessary.

10. REFERENCES

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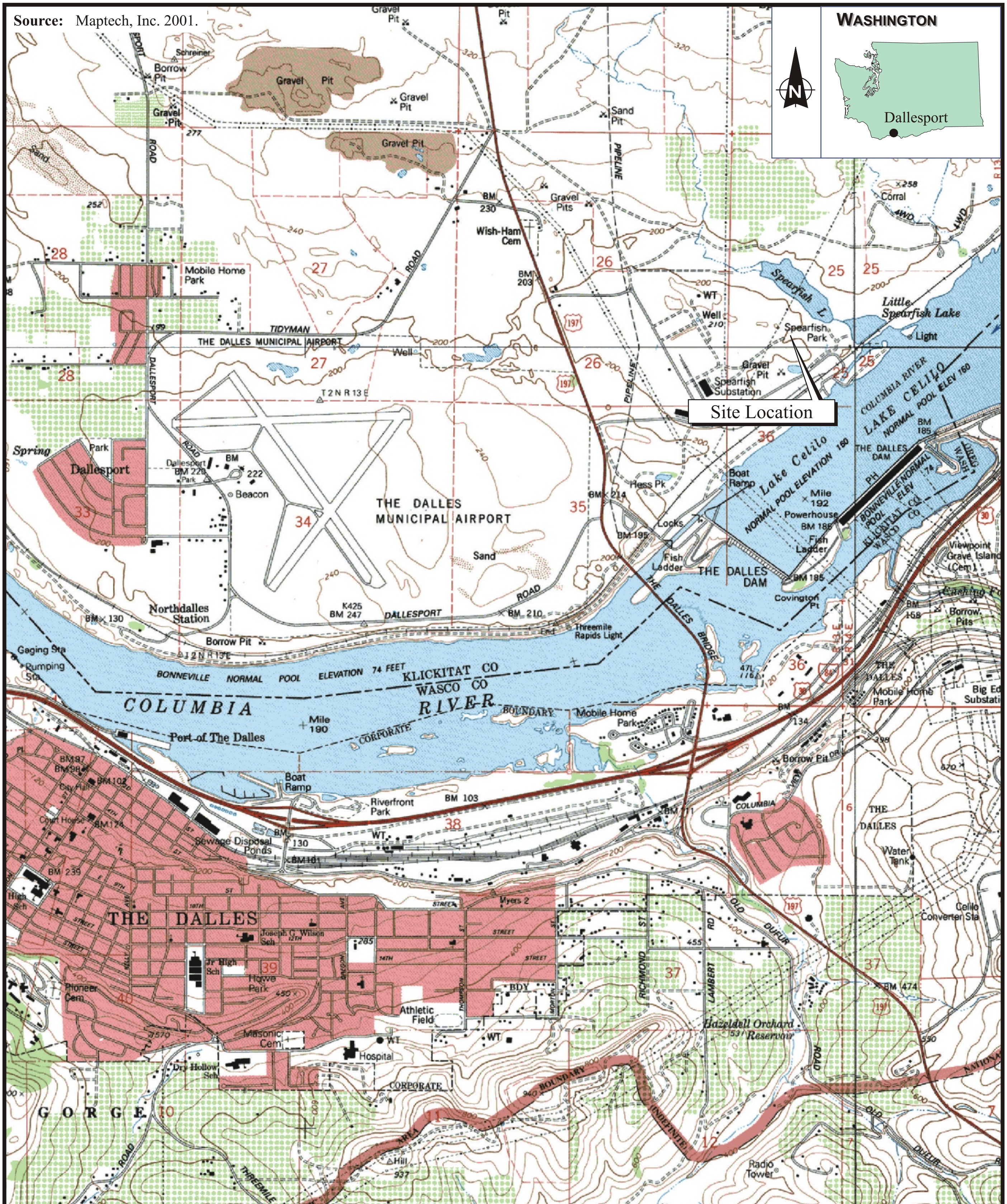

ecology and environment, inc. International Specialists in the Environment Seattle, Washington	RAMCO DISPOSAL SITE Dallesport, Washington	Figure 1 SITE VICINITY MAP
	0 1333 2666 Approximate Scale in Feet	Date: 7-13-09 · Drawn by: AES · 10:START-3\09040015\fig 1

ecology and environment, inc.
Global Specialists in the Environment
Seattle, Washington

RAMCO ALUMINUM DISPOSAL SITE
Dallesport, Washington

0 240 480
Approximate Scale in Feet

Figure 2
GROUNDWATER MONITORING WELL AND SURFACE WATER SAMPLING LOCATIONS

Date: 6/15/11
Drawn by: AES
10:START-3\09040015\fig 2

Table 1 Surface Water Sample Results

Analyte	Federal MCL[1]	EPA Regional Screening Levels for Tapwater [2]	Washington MTCA Cleanup Levels for Groundwater [3]	Joe's Pond (JP)			RAMCO Pond (RP)	Spearfish Lake (SL-01)			Little Spearfish Lake (SL-02)		
				JP	10ZZ-0001	10ZZ-0015	10ZZ-0016	SL-01	10ZZ-0002	10ZZ-0013	SL-02	10ZZ-0003	10ZZ-0014
				8/18/2009	9/8/2010	4/12/2011	4/12/2011	8/18/2009	9/8/2010	4/12/2011	8/18/2009	9/8/2010	4/12/2011
Polycyclic Aromatic Hydrocarbons (PAHs) (µg/L)													
Acenaphthene	NA	2,200	960	0.095 U	0.189 U	0.19 U	0.206 UJK	0.096 U	0.189 U	NA	0.095 U	0.189 U	0.194 U
Acenaphthylene	NA	NA	NA	0.095 U	0.189 U	0.19 U	0.206 UJK	0.096 U	0.189 U	NA	0.095 U	0.189 U	0.194 U
Anthracene	NA	11,000	4,800	0.095 U	0.189 U	0.19 U	0.206 UJK	0.096 U	0.189 U	NA	0.095 U	0.189 U	0.194 U
Benz[a]anthracene	NA	0.029	0.1 [6]	0.0095 U	0.189 U	0.19 U	0.206 UJK	0.0096 U	0.189 U	NA	0.0095 U	0.189 U	0.194 U
Benzo[a]pyrene	0.2	0.0029	0.1	0.0095 U	0.189 U	0.19 U	0.206 UJK	0.0096 U	0.189 U	NA	0.0095 U	0.189 U	0.194 U
Benzo[b]fluoranthene	NA	0.029	0.1 [6]	0.0095 U	0.189 U	0.19 U	0.206 UJK	0.0096 U	0.189 U	NA	0.0095 U	0.189 U	0.194 U
Benzo[k]fluoranthene	NA	0.29	0.1 [6]	0.0095 U	0.189 U	0.19 U	0.206 UJK	0.0096 U	0.189 U	NA	0.0095 U	0.189 U	0.194 U
Benzo[g,h,i]perylene	NA	NA	NA	0.0095 U	0.189 U	0.19 U	0.206 UJK	0.0096 U	0.189 U	NA	0.0095 U	0.189 U	0.194 U
Chrysene	NA	2.9	0.1 [6]	0.0095 U	0.189 U	0.19 U	0.206 UJK	0.0096 U	0.189 U	NA	0.0095 U	0.189 U	0.194 U
Dibenz[a,h]anthracene	NA	0.0029	0.1 [6]	0.0095 U	0.189 U	0.19 U	0.206 UJK	0.0096 U	0.189 U	NA	0.0095 U	0.189 U	0.194 U
Fluoranthene	NA	1,500	640	0.095 U	0.189 U	**0.0667 JQ**	0.206 UJK	0.096 U	0.189 U	NA	0.095 U	0.189 U	**0.0583 JQ**
Fluorene	NA	1,500	640	0.095 U	0.189 U	0.19 U	0.206 UJK	0.096 U	0.189 U	NA	0.095 U	0.189 U	0.194 U
Indeno[1,2,3-cd]pyrene	NA	0.029	0.1 [6]	0.0095 U	0.189 U	0.19 U	0.206 UJK	0.0096 U	0.189 U	NA	0.0095 U	0.189 U	0.194 U
Methylnaphthalene, 1-	NA	2.3	NA	0.095 U	0.189 U	0.19 U	0.206 UJK	0.096 U	0.189 U	NA	0.095 U	0.189 U	0.194 U
Methylnaphthalene, 2-	NA	150	32	0.095 U	0.189 U	0.19 U	**0.113 JQ**	0.096 U	0.189 U	NA	0.095 U	0.189 U	0.194 U
Naphthalene	NA	0.14	160	0.095 U	0.189 U	0.19 U	**0.113 JQ**	0.096 U	0.189 U	NA	0.095 U	0.189 U	0.194 U
Phenanthrene	NA	NA	NA	0.095 U	0.189 U	0.19 U	**0.0825 JQ**	0.096 U	0.189 U	NA	0.095 U	0.189 U	0.194 U
Pyrene	NA	1,100	480	0.095 U	0.189 U	**0.0476 JQ**	0.206 UJK	0.096 U	0.189 U	NA	0.095 U	0.189 U	0.194 U
Inorganics (µg/L)													
Ammonia	NA	NA	NA	**1,200 J**	50 U	**42 JQ**	**162,000**	**290 J**	50 U	**223**	**140 J**	50 U	**50**
Chloride	250,000 [4]	NA	NA	**9,500**	**6,140**	**5,390 JH**	**4,610,000 JH**	**4,100**	**2,170**	**2,760 JH**	**4,400**	**1,680**	**3,660 JH**
Total Dissolved Solids	500,000 [4]	NA	NA	**150,000**	**122,000**	**112,000**	**10,500,000**	**75,000**	**79,000**	**101,000**	**83,000**	**79,000**	**103,000**
Cyanide (as free cyanide)	200	730	NA	50 UJ	**3.31 J**	5 U	**10.2**	50 UJ	5 U	5 U	50 UJ	5 U	5 U
Cyanide (as hydrogen cyanide)	NA	1.6	NA	50 UJ	**3.31 J**	5 U	5 U	50 UJ	5 U	5 U	50 UJ	5 U	5 U
Fluoride	4,000	2,200 [7]	960	**180 J**	NA	NA	NA	**110 J**	NA	NA	**130 J**	NA	NA
Nitrate	10,000	58,000	NA	**120**	100 U	**117**	**369,000 JL**	50 U	100 U	**103**	50 U	100 U	**285**
Nitrite	1,000	3,700	NA	50 U	100 U	100 U	**72,900 JL**	50 U	100 U	100 U	50 U	100 U	**73.9 JQ**
TAL Metals (µg/L)													
Aluminum	50 - 200 [4]	37,000	NA	110 U	68 U	200 U	326 U	110 U	68 U	200 U	110 U	**567**	235 U
Antimony	6	15	6.4	5 U	3 U	10 U	10.7 U	5 U	3 U	10 U	5 U	3 U	10 U
Arsenic	10	0.045	5	4.5 U	**7.64**	30 U	30 U	3 U	**5.48**	30 U	3 U	**9.52**	30 U
Barium	2,000	7,300	3,200	50 U	**9.18**	**15**	**75.8**	50 U	**14.3**	**20.1**	50 U	**43.9**	**30.9**
Beryllium	4	73	32	10 U	1 U	5 U	5 U	10 U	1 U	5 U	10 U	1 U	5 U
Cadmium	5	18	5	4 U	1 U	5 U	5 U	4 U	1 U	5 U	4 U	1 U	5 U
Calcium	NA	NA	NA	**19,000**	**22,400**	**22,600**	**65,100**	**17,000**	**13,900**	**21,000**	**16,000**	**18,000**	**19,000**
Chromium (III)	100 [5]	55,000	50	10 U	1 U	5 U	**4.23 JQ**	10 U	1 U	5 U	10 U	1 U	5 U
Cobalt	NA	11	NA	10 U	1 U	5 U	**7.8**	10 U	1 U	5 U	10 U	**1.25**	5 U
Copper	1,300	1,500	592	10 U	3 U	10 U	**77.2**	10 U	3 U	10 U	10 U	**4.86**	10 U
Iron	300 [4]	26,000	NA	56 U	182 U	**312**	**190**	56 U	125 U	**154**	56 U	**1,990**	**433**
Lead	15	NA	15	1 U	3.3 U	10 U	10 U	1 U	3.3 U	10 U	1 U	3.3 U	10 U
Magnesium	NA	NA	NA	**6,900**	**7,700**	**7,260**	**28,400**	**5,600**	**5,160**	**6,410**	**4,200**	**5,140**	**5,620**
Manganese	50 [4]	880	2,240	10 U	**9.54**	**12**	**52**	10 U	**3.58**	**10.1**	10 U	**91.1**	**38.8**
Mercury	2	0.63	2	0.5 U	0.066 U	0.2 U	0.2 U	0.5 U	0.066 U	**0.828**	0.5 U	0.066 U	0.2 U
Nickel (as soluble salts)	NA	730	320	20 U	1.5 U	5 U	5 U	20 U	1.5 U	5 U	20 U	1.5 U	5 U
Potassium	NA	NA	NA	**2,000**	**2,640**	**2,110**	**871,000**	**2,100**	**1,340**	**1,670**	**1,300**	**1,330**	**1,370**
Selenium	50	180	80	5 U	5 U	30 U	**29.2 JQ**	5 U	5 U	30 U	5 U	5 U	30 U
Silver	100 [4]	180	80	10 U	1 U	5 U	5 U	10 U	1 U	5 U	10 U	1 U	5 U
Sodium	NA	NA	NA	**6,900**	**7,000**	**5,970**	**3,020,000**	**12,000**	**5,590**	**5890**	**6,000**	**4,700**	**6340**
Thallium (as soluble salts)	2	0.37	1.12	5 U	8.19 U	20 U	20 U	5 U	5 U	20 U	5 U	5 U	20 U
Vanadium	NA	180	1.12	10 U	**2.43**	5 U	**299**	10 U	**3.91**	5 U	10 U	**4.66**	5 U
Zinc	5,000 [4]	11,000	4,800	25 U	**4.68**	**5.17 JQ**	**12.8**	25 U	**4.9**	**4.33 JQ**	25 U	**10.8**	**7.24 JQ**

Notes:

1 - National Primary Drinking Water Standards - Maximum Contaminant Level (MCL) (May 2009)
2 - EPA Regional Screening Levels for Tapwater (April 2009)
3 - Washington State Model Toxics Control Act (MTCA) (173-340 WAC, November 2007) Method A levels. If no Method A level available, Method B levels for unrestricted use are presented.
4 - National Secondary Drinking Water Standards (May 2009)
5 - Value is for the MCL for Total Chromium
6 - Value is for benzo(a)pyrene and applies to total carcinogenic PAHs
7 - Value is for soluble fluoride

A **BOLD** value indicates that the compound was detected.

A yellow highlighted cell indicates the sample result exceeds the maximum contaminant level (MCL).

A red highlighted cell indicates a concentration in excess of the EPA Regional Screening Levels for Tapwater or the Washington MTCA Cleanup Levels for Groundwater.

A blue highlighted cell indicates a screening level that was exceeded by the concentration of a sample.

Key:

NA =	Not Analyzed/Not Available
TAL =	Target Analyte List
ug/L =	micrograms per liter

Data Qualifiers:

U -	The analyte was analyzed for, but was not detected above the reported sample quantitation limit.
J -	The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.
JH -	The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample with a high bias.
JL -	The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample with a low bias.
JQ -	The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample with an unknown direction of bias and falls between the MDL and the Minimum (or Practical) Quantitation Limit (MQL, PQL).
UJ -	The analyte was not detected above the reported sample quantitation limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.
UJL -	The analyte was analyzed for and identified, the associated numerical value is the approximate concentration of the analyte in the sample with a low bias.
UJK -	The analyte was analyzed for and identified, the associated numerical value is the approximate concentration of the analyte in the sample with an unkown direction of bias.
R -	The sample results are rejected due to serious deficiencies in the bility to analyze the sample and meet quality control criteria. The presence of absence of the analyte cannot be verified.

Table 2 Groundwater Sample Results

Analyte	Federal MCL[1]	EPA Regional Screening Levels for Tapwater [2]	Washington MTCA Cleanup Levels for Groundwater [3]	Public Water Supply (PW)		Monitoring Well 2 (MW-02)	Monitoring Well 3 (MW-03)			Monitoring Well 4 (MW-04)			Monitoring Well 5 (MW-05)			
				10ZZ-0004	10ZZ-0009	10ZZ-0012	MW-03	10ZZ-0005	10ZZ-0011	MW-04	10ZZ-0007	10ZZ-0008 (Dup)	MW-05	10ZZ-0006	10ZZ-0017 (Dup)	10ZZ-0010
				9/8/2010	4/12/2011	4/12/2011	8/18/2009	9/8/2010	4/12/2011	8/18/2009	9/8/2010	9/8/2010	8/18/2009	9/8/2010	4/12/2011	4/12/2011
Polycyclic Aromatic Hydrocarbons (PAHs) (µg/L)																
Acenaphthene	NA	2,200	960	0.189 U	0.189 U	0.196 U	0.10 U	0.189 U	0.192 U	0.092 U	0.189 U	0.189 U	0.096 U	0.189 U	0.189 U	0.19 U
Acenaphthylene	NA	NA	NA	0.189 U	0.189 U	0.196 U	**0.11**	0.189 U	0.192 U	0.092 U	0.189 U	0.189 U	0.096 U	0.189 U	0.189 U	0.19 U
Anthracene	NA	11,000	4,800	0.189 U	0.189 U	0.196 U	0.10U	0.189 U	0.192 U	0.092 U	0.189 U	0.189 U	0.096 U	0.189 U	0.189 U	0.19 U
Benz[a]anthracene	NA	0.029	0.1 [6]	0.189 U	0.189 U	0.196 U	0.010 U	0.189 U	0.192 U	0.0092 U	0.189 U	0.189 U	0.0096 U	0.189 U	0.189 U	0.19 U
Benzo[a]pyrene	0.2	0.0029	0.1	0.189 U	0.189 U	0.196 U	0.010 U	0.189 U	0.192 U	0.0092 U	0.189 U	0.189 U	0.0096 U	0.189 U	0.189 U	0.19 U
Benzo[b]fluoranthene	NA	0.029	0.1 [6]	0.189 U	0.189 U	0.196 U	0.010 U	0.189 U	0.192 U	0.0092 U	0.189 U	0.189 U	0.0096 U	0.189 U	0.189 U	0.19 U
Benzo[k]fluoranthene	NA	0.29	0.1 [6]	0.189 U	0.189 U	0.196 U	0.010 U	0.189 U	0.192 U	0.0092 U	0.189 U	0.189 U	0.0096 U	0.189 U	0.189 U	0.19 U
Benzo[g,h,i]perylene	NA	NA	NA	0.189 U	0.189 U	0.196 U	0.010 U	0.189 U	0.192 U	0.0092 U	0.189 U	0.189 U	0.0096 U	0.189 U	0.189 U	0.19 U
Chrysene	NA	2.9	0.1 [6]	0.189 U	0.189 U	0.196 U	0.010 U	0.189 U	0.192 U	0.0092 U	0.189 U	0.189 U	0.0096 U	0.189 U	0.189 U	0.19 U
Dibenz[a,h]anthracene	NA	0.0029	0.1 [6]	0.189 U	0.189 U	0.196 U	0.010 U	0.189 U	0.192 U	0.0092 U	0.189 U	0.189 U	0.0096 U	0.189 U	0.189 U	0.19 U
Fluoranthene	NA	1,500	640	0.189 U	0.189 U	0.196 U	0.10 U	0.189 U	0.192 U	0.092 U	0.189 U	0.189 U	0.096 U	0.189 U	0.189 U	0.19 U
Fluorene	NA	1,500	640	0.189 U	0.189 U	0.196 U	0.10 U	0.189 U	0.192 U	0.092 U	0.189 U	0.189 U	0.096 U	0.189 U	0.189 U	0.19 U
Indeno[1,2,3-cd]pyrene	NA	0.029	0.1 [6]	0.189 U	0.189 U	0.196 U	0.010 U	0.189 U	0.192 U	0.0092 U	0.189 U	0.189 U	0.0096 U	0.189 U	0.189 U	0.19 U
Methylnaphthalene, 1-	NA	2.3	NA	0.189 U	0.189 U	**0.0882 JQ**	0.10 U	0.189 U	0.192 U	0.092 U	0.189 U	0.189 U	0.096 U	0.189 U	0.189 U	0.19 U
Methylnaphthalene, 2-	NA	150	32	0.189 U	0.189 U	**0.0588 JQ**	0.10 U	0.189 U	0.192 U	0.092 U	0.189 U	0.189 U	0.096 U	0.189 U	0.189 U	0.19 U
Naphthalene	NA	0.14	160	0.189 U	0.189 U	**0.108 JQ**	0.10 U	**0.124 J**	**0.0769 JQ**	0.092 U	**0.0583 J**	**0.0641 J**	0.096 U	0.189 U	0.189 U	0.19 U
Phenanthrene	NA	NA	NA	0.189 U	0.189 U	**0.216**	0.10 U	**0.0671 J**	0.192 U	0.092 U	0.189 U	0.189 U	0.096 U	**0.0744 J**	0.189 U	0.19 U
Pyrene	NA	1,100	480	0.189 U	0.189 U	0.196 U	0.10 U	0.189 U	0.192 U	0.092 U	0.189 U	0.189 U	0.096 U	0.189 U	0.189 U	0.19 U
Inorganics (µg/L)																
Ammonia	NA	NA	NA	**21 J**	**16.4 JQ**	**731,000**	**160,000 J**	**542,000**	**125,000**	**2,400,000 J**	**79,600**	**90,000**	**100,000 J**	**251,000**	**69,000**	**62,500**
Chloride	250,000 [4]	NA	NA	**16,300**	**24,400 JH**	**11,600,000 JH**	**16,000,000**	**35,400,000**	**14,300,000 JH**	**39,000,000**	**12,400,000**	**12,900,000**	**4,900,000**	**8,430,000**	**3,700,000 JH**	**3,700,000 JH**
Total Dissolved Solids	500,000 [4]	NA	NA	**185,000**	**192,000**	**18,200,000**	**23,000,000**	**57,400,000**	**25,800,000**	**12,000,000**	**20,800,000**	**21,700,000**	**8,000,000**	**15,300,000**	**7,840,000**	**8,010,000**
Cyanide (as free cyanide)	200	730	NA	5 U	5 U	29.4	50 UJ	**46.6**	**17.7**	**64 J**	**32.4**	5 U	50 UJ	**14.5**	**8.08**	**9.15**
Cyanide (as hydrogen cyanide)	NA	1.6	NA	5 U	5 U	5 U	50 UJ	**9.3**	**17.7**	**64 J**	**18.7**	5 U	50 UJ	**7.13**	5 U	5 U
Fluoride	4,000	2,200 [7]	960	NA	NA	NA	**770 J**	NA	NA	100 UJ	NA	NA	**11,000 J**	NA	NA	NA
Nitrate	10,000	58,000	NA	**1,070**	**1,555 JL**	**345,000 JL**	**60,000**	**133,000 J**	**239,000 JL**	**21,000**	**68,100 J**	**68,100**	**24,000**	**79,400 J**	**35,700 JL**	**35,400 JL**
Nitrite	1,000	3,700	NA	100 U	100 UJL	**88,400 JL**	**1,300**	100,000 UJ	200,000 UJL	**960**	10.0 UJ	10 UJ	**110**	**11,400 J**	50,000 UJL	1,000 UJL
TAL Metals (µg/L)																
Aluminum	50 - 200 [4]	37,000	NA	68 U	200 U	4,000 U	110 U	**1,560 J**	4,000 U	110 U	68 UJ	**644 J**	110 U	68 UJ	**799**	**617**
Antimony	6	15	6.4	3 U	10 U	10 U	5 U	30 U	200 U	5 U	30 U	30 U	5 U	30 U	10 U	10 U
Arsenic	10	0.045	5	**8.43**	30 U	30 U	4.5 U	**186**	30 U	9 U	**223**	**187**	4.5 U	**235**	30 U	30 U
Barium	2,000	7,300	3,200	**1.75**	5 U	437 U	**870**	**3,430**	**943**	**3,500**	**747**	**770**	**320**	**373**	**320**	**344**
Beryllium	4	73	32	1 U	5 U	100 U	10 U	1 U	100 U	10 U	1 U	1 U	10 U	1 U	5 U	5 U
Cadmium	5	18	5	1 U	5 U	5 U	4 U	**1.45 J**	5 U	4 U	1 UJ	1 UJ	4 U	1 UJ	5 U	5 U
Calcium	NA	NA	NA	**26,600**	**27,700**	**740,000**	**3,400,000**	**3,340,000**	**3,440,000**	**3,500,000**	**2,960,000**	**3,060,000**	**550,000**	**1,390,000**	**494,000**	**475,000**
Chromium (III)	100 [5]	55,000	50	1 U	5 U	**5.32**	10 U	1 U	**8.15**	10 U	1 U	1 U	10 U	1 U	**4.93 JQ**	**4.43 JQ**
Cobalt	NA	11	NA	1 U	5 U	**26.7**	**26**	**62.5 J**	**21.6**	**82**	**17.7 J**	**18.4 J**	10 U	**14 J**	**3.26 JQ**	**3.71 JQ**
Copper	1,300	1,500	592	3 U	10 U	**14.7**	10 U	**15.3**	**7.18 JQ**	**17**	**5.65**	**5.03**	10 U	3 U	**7.69 JQ**	**8.12 JQ**
Iron	300 [4]	26,000	NA	42.3 U	100 U	**131**	56 U	**5,690**	**44.4 JQ**	**150**	**127**	**2,030**	56 U	**85.1**	**296**	**796**
Lead	15	NA	15	3.3 U	10 U	200 U	1 U	330 UJ	200 U	1 U	330 UJ	330 UJ	1 U	330 UJ	50 U	10 U
Magnesium	NA	NA	NA	**10,500**	**10,800**	**123,000**	**1,100,000**	**884,000**	**1,020,000**	**920,000**	**898,000**	**930,000**	**230,000**	**454,000**	**211,000**	**206,000**
Manganese	50 [4]	880	2,240	2 U	10 U	**24**	**40**	**2,610**	**49.8 JQ**	**3,100**	20 U	**87**	**170**	**14.3**	**174**	**189**
Mercury	2	0.63	2	0.066 U	0.2 U	0.2 U	0.5 U	0.066 UJ	0.2 U	0.5 U	0.15 UJ	0.139 UJ	0.5 U	0.126 UJ	0.2 U	0.2 U
Nickel (as soluble salts)	NA	730	320	1.5 U	5 U	5 U	**110**	**35.4 J**	**4.33 JQ**	**190**	1.5 UJ	**1.87 J**	**22**	1.5 UJ	**3.01 JQ**	**2.93 JQ**
Potassium	NA	NA	NA	**3,270**	**3,120**	**596,000**	**100,000**	**1,130,000**	**120,000**	**1,000,000**	**107,000**	**116,000**	**100,000**	**272,000**	**93,400**	**84,700**
Selenium	50	180	80	5 U	30 U	**27.7 JQ**	**59**	50 UJ	**19.1 JQ**	130 U	50 UJ	50 UJ	**18**	50 UJ	30 U	**6.92 JQ**
Silver	100 [4]	180	80	1 U	5 UJL	**11.4**	10 U	10 U	**49.4**	10 U	10 U	10 U	10 U	10 U	**7.47**	**8.31**
Sodium	NA	NA	NA	**12,400**	**11,300**	**5,110,000**	**3,000,000**	**14,300,000**	**3,310,000**	**16,000,000**	**2,850,000**	**3,090,000**	**1,800,000**	**2,970,000**	**1,420,000**	**1,350,000**
Thallium (as soluble salts)	2	0.37	1.12	6.19 U	20 U	20 U	5 U	R	20 U	**12**	R	R	5 U	R	20 U	20 U
Vanadium	NA	180	1.12	**7.99**	7.71 U	**9**	10 U	**1.55**	5.54 U	10 U	**1.96**	**4.54**	10 U	**4.46**	5 U	5 U
Zinc	5,000 [4]	11,000	4,800	**5.63**	**5.27 JQ**	**21.2**	25 U	**50**	**27.3**	10 U	33 U	**34.9**	50 U	**42.4**	**20.5**	**21**

Notes:

1 - National Primary Drinking Water Standards - Maximum Contaminant Level (MCL) (May 2009)
2 - EPA Regional Screening Levels for Tapwater (April 2009)
3 - Washington State Model Toxics Control Act (MTCA) (173-340 WAC, November 2007) Method A levels. If no Method A level available, Method B levels for unrestricted use are presented.
4 - National Secondary Drinking Water Standards (May 2009)
5 - Value is for the MCL for Total Chromium
6 - Value is for benzo(a)pyrene and applies to total carcinogenic PAHs
7 - Value is for soluble fluoride

A **BOLD** value indicates that the compound was detected.
A yellow highlighted cell indicates the sample result exceeds the maximum contaminant level (MCL).
A red highlighted cell indicates a concentration in excess of the EPA Regional Screening Levels for Tapwater or the Washington MTCA Cleanup Levels for Groundwater.
A blue highlighted cell indicates a screening level that was exceeded by the concentration of a sample.

Key:

NA = Not Analyzed/Not Available
TAL = Target Analyte List
ug/L = micrograms per liter

Data Qualifiers:

U - The analyte was analyzed for, but was not detected above the reported sample quantitation limit.
J - The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample
JH - The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample with a high bias.
JL - The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample with a low bias.
JQ - The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample with an unknown direction of bias and falls between the MDL and the Minimum (or Practical) Quantitation Limit (MQL, PQL).
UJ - The analyte was not detected above the reported sample quantitation limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.
UJL - The analyte was analyzed for and identified, the associated numerical value is the approximate concentration of the analyte in the sample with a low bias.
UJK - The analyte was analyzed for and identified, the associated numerical value is the approximate concentration of the analyte in the sample with an unkown direction o
R - The sample results are rejected due to serious deficiencies in the bility to analyze the sample and meet quality control criteria. The presence of absence of the analyte cannot be verified.

ATTACHMENT A

Photographic Documentation

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Photo 1 Monitoring well MW-1 (abandoned) at the west end of landfill. Stockpile of crushed dross behind well.

Direction: *West* *Date: 5/6/09*

Photo 2 Basalt wall on southern side of landfill. Note Monitoring well MW-5 at west end and on far right of picture.

Direction: *Southwest* *Date: 5/6/09*

Photo 3 Basalt wall to south, entrance to landfill on opposite side, monitoring well MW-3 close up.

Direction: *West* *Date: 5/6/09*

Photo 4 Site walk looking at silt fence border of US Army Corp property and extents of landfill.

Direction: *East* *Date: 5/6/09*

Photo 5 Sidewall and dross embedded in matrix. Monitoring well MW-3. Silt fence is Army Corps property line.

Direction: *Northeast* *Date: 5/6/09*

Photo 6 Aluminum waste inclusions, clast sizes several feet across.

Direction: *Northeast* *Date: 5/6/09*

Photo 7 Dross material left exposed to dessicate for easier crushing.

Direction: *Down* *Date: 5/6/09*

Photo 8 Aluminum inclusion stockpile estimated to be 25 tons.

Direction: *West* *Date: 5/6/09*

Photo 9 Landfill north boundary and silt fence along Army Corps property. Monitoring well MW-3 in right center of picture.

Direction: *North* *Date: 5/6/09*

Photo 10 Landfill southern extent and US Army Corps border. Monitoring well MW-2 in top center of picture.

Direction: *South* *Date: 5/6/09*

Photo 11 Spearfish lake western edge along basalt outcrop. Landfill is west of lake about 150 yards.

Direction: *Northwest* *Date: 5/6/09*

Photo 12 Spearfish Lake and Little Spearfish Lake on the right from above. Note: landfill is behind view.

Direction: *East* *Date: 5/6/09*

Photo 13 Shot of basalt outcrop on south side of landfill taken from saddle point between Spearfish lake and Ramco landfill.

Direction: West-Southwest *Date: 5/6/09*

Photo 14 Spearfish lake full view.

Direction: North *Date: 5/6/09*

Photo 15 Aluminum dross (white dross, metallic form), a by-product of primary aluminum smelting. Chunks of aluminum/metal, silver/gray, dense, high metal content.

Direction: Down *Date: 9/1/10*

Photo 16 Aluminum dross (white dross, powder form) Silver/gray, powdery. Non-hazardous waste stream.

Direction: Down *Date: 9/1/10*

Photo 17 Salt cake, a by-product of secondary aluminum production Rock-like, black to silver/grey with blue. Non-hazardous waste stream.

Direction: Down *Date: 9/1/10*

Photo 18 Anodes (cylinders/rods) and spent potliner. Black, carbon, relatively light. K088 waste stream.

Direction: Down *Date: 9/1/10*

Photo 19 Spent potliner black, carbon, relatively light. K088 waste stream. Typical example, covered with gray dust.

Direction: Down *Date: 9/1/10*

Photo 20 Spent potliner black, carbon, relatively light. K088 waste stream. Example with visible black carbon.

Direction: Down *Date: 9/1/10*

Photo 21 West entrance to the landfill post removal view. Note the fence post and large rocks to be used to gate the west entrance.

Direction: *East* *Date: 9/11/10*

Photo 22 Landfill and aluminum waste material post removal view. In the background are Little Spearfish Lake and the Columbia River.

Direction: *Southeast* *Date: 9/11/10*

Photo 23 Temporary water body formed over the post removal site due to precipitation the winter of 2010/2011.

Direction: *East* *Date: 4/12/11*

Photo 24 Temporary water body formed over the post removal site due to precipitation the winter of 2010/2011.

Direction: *East* *Date: 4/12/11*