Public Review Draft

Remedial Investigation Report
Arimetco Facilities Operable Unit 8

Anaconda Copper Yerington Mine

Prepared for:

Contract No. 68-W-98-225/WA No. 273-RICO-09GU
U.S. Environmental Protection Agency
Region 9
75 Hawthorne Street
San Francisco, California 94105

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July 2008

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ARIMETCO FACILITIES OPERABLE UNIT 8
ANACONDA COPPER YERINGTON MINE
REMEDIAL INVESTIGATION REPORT

EPA CONTRACT NO. 68-W-98-225
EPA WORK ASSIGNMENT NO. 273-RICO-09GU
CH2M HILL PROJECT NO. 354946.RR.01

Executive Summary

The U.S. Environmental Protection Agency (EPA), under the authority of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) as amended, is conducting a remedial investigation (RI) and feasibility study (FS) to characterize potential contamination associated with the Arimetco Facilities Operable Unit 8 (OU-8) of the Anaconda Copper Yerington Mine (Anaconda or Site). This RI report, prepared as part of Work Assignment No. 273-RICO-09GU, summarizes the RI fieldwork and presents the results of Arimetco heap leach pad (HLP) tailings and drain-down solution sample analyses.

Data from five Arimetco HLPs were obtained to characterize the OU-8 HLPs and provide preliminary data regarding HLP-specific drain-down solutions. These data assess residual chemicals in the HLPs, evaluate the quantity and drain-down rate of entrained drain-down solution within the HLPs, provide initial chemical data for the Arimetco ponds, and assess threats to human and ecological receptors.

HLP materials were found to contain some areas with slightly elevated radiological counts, although none of the counts were greater than three standard deviations above the mean background count rate. Samples were collected for analysis of physical properties; total petroleum hydrocarbons (TPH) as diesel, kerosene, and motor oil; metals; synthetic precipitation leaching procedure (SPLP); geochemical; geotechnical; and agricultural properties. The analyses show that pH values ranged from 2.66 to 7.89; arsenic, copper, and iron concentrations exceeded the EPA Region 9 residential preliminary remediation goal (PRG); and, according to the SPLP results, aluminum, copper, iron, and manganese concentrations exceeded the primary or secondary maximum contaminant level (MCL). One sample contained TPH (as diesel) above Nevada’s cleanup goal of 100 milligrams per kilogram. Geochemical results indicated that all Arimetco HLPs are classified as having a low potential to generate acid.

Trace element concentrations in Meteoric Water Mobility Procedure (MWMP) leachate were generally higher than in SPLP leachate because of the lower amount of extractant liquid used. Overall, MWMP results corroborate the main tendencies predicted by the SPLP results and indicate that the HLPs have some metal leachability capacity left, mainly in the form of soluble aluminum, copper, iron, and manganese, and, to a lesser extent, arsenic, beryllium, cadmium, chromium, cobalt, mercury, and nickel.

Agricultural data show that low pH values and water-holding capacity would limit establishment and growth of plant communities on the HLPs. Geotechnical results suggest that the HLPs are mostly composed of well-graded sand to well-graded gravel. Fines typically did not exceed 15 percent and the wet density ranged from 104 to 154 pounds per cubic foot (lb/ft^3). Moisture content ranged from 3.1 to 13.4 percent, dry density ranged from 97 to 141 pounds per cubic foot, and specific gravity ranged from 2.64 to 2.81. Cohesion values ranged from 109 to 3,084 pounds per square foot and varied more than any other geotechnical parameter measured. The friction angle ranged from 34 to 43 degrees and was within the anticipated range.

Samples from drain-down solutions exhibited pH and specific conductance values ranging from 1.9 to 2.8 and 31,000 to 45,000 micromhos per centimeter, respectively. Metals, specifically aluminum, antimony, arsenic, beryllium, boron, cadmium, chromium, copper, iron, lead, manganese, mercury, thallium and zinc exceeded primary or secondary drinking water MCLs. Radiological measurements generally exceeding the MCL for thorium isotopes 228, 230, and 232; uranium isotopes 234, 235, 238; and gross alpha particles. TPH (as diesel and kerosene) ranged from 750 to 2,100 micrograms per liter (μg/L), and all but one drain-down solution sample exceeded Nevada's cleanup guideline of 1,000 μg/L for TPH.

An assessment of data quality for HLP material and drain-down solution samples concludes that these data satisfy the assumptions under which the data quality objectives (CH2M HILL, 2007a) and the data collection design were developed. The data are within tolerable decision error rates and support the stated objectives; the data are adequate and complete pursuant to EPA guidelines (EPA, 1994).

Remedial investigation activities have characterized the nature and distribution of radiological isotopes, physical properties and base metals in the HLPs and their associated ponds and ditches. Potential remaining sources of contamination include the following:

- Metals, specifically arsenic, copper, and iron on the surface and within the HLPs
- Radiological constituents
- Drain-down solution entrained within the HLPs
- Drain-down solution stored at the base of the HLPs or contained within their associated ponds and ditches

Geochemical and physical techniques were used to evaluate the fate and transport of mining-related constituents in connection with Arimetco HLPs to assist with evaluating potential risks. The evaluation shows that the leaching capacity of the HLPs is significant mainly because of large amounts of sulfate and trace metals that remain. Although stable, the HLPs each contain between 1,076,000 and 7,599,000 cubic yards of material, and substantial quantities of drain-down solutions are expected to remain entrained in the HLPs.

Screening-level risk assessments were performed to assess whether HLP materials and the drain-down solutions pose a threat to human health or the environment. The evaluation of human health risks used conservative screening criteria (residential/industrial PRGs, drinking water MCLs, and tap water PRGs). The evaluation concluded that potential exposure to Group A HLP materials are at the upper end of the EPA cancer risk management range. The residential cancer risk for potential exposure to Group B HLP materials exceeds the EPA cancer risk management range. Industrial cancer risk is at the upper end of the EPA cancer risk management range. The noncancer health hazards for exposure to Group A HLP materials exceed a hazard index of 1 for residential exposures; noncancer health hazards for exposure to Group B HLP materials exceed a hazard index of 1 for residential and industrial exposures. Drain-down solutions exceeded the drinking water MCLs for eight metals. Risks to terrestrial receptors were Indicated by the screening-level ecological risk assessment of HLP materials; six metals exceeded the screening values for virtually all receptor groups. Lead exceeded screening values for all receptors except soil invertebrates; antimony, cadmium, and zinc exceeded screening levels in upper trophic level receptors (i.e., birds and mammals). Evidence suggests that drain-down solution in the leachate ponds adversely affects birds. A comparison of metal concentrations and pH in the ponds having the acute toxicity values found in literature suggest that aluminum, copper, and pH are at levels acutely lethal to birds and mammals. Radiological constituents in drain-down solutions exceeded the chronic effects threshold but might not adversely affect ecological receptors because of the limited habitat and the scarcity of available food resources. In summary, drain-down solutions are adversely affecting ecological receptors, specifically birds, and potentially the environment.

CH2M HILL concludes that sufficient data and information are available to support the OU-8 FS process. The RI provides the following summary:

- The composition and characteristics of the HLPs are sufficiently determined.
- HLP geotechnical and geochemical parameters are characterized.
- HLP slopes appear to be relatively stable, are close to the angle of repose; surface unraveling is evident.
- Long-term steady-state outflow (for precipitation only) for each uncapped HLP was modeled to range from 1.2 to 9.0 gallons per minute. These steady-state outflow rates could be reached in 2.7 to 20 years.
- HLP materials can pose adverse threats to human health if exposure pathways are created in the future.
- HLP materials can pose adverse threats to ecological receptors, although the current exposure is minimal because of the lack of habitat.
- Seasonal drain-down solutions can pose adverse threats to human health.
- Drain-down solutions pose adverse threats to ecological receptors.

Capping the HLPs would reduce the infiltration of precipitation and reduce the quantity of drain-down fluids generated. This would result in lower mobility of sulfate and trace metals. If the design of the cap limits oxygen infiltration, stabilization of certain trace metals might also be achieved in the long term. Aluminum, copper, and pH levels in drain-down solutions are acutely lethal to birds and mammals. These solutions should be actively managed to reduce these threats, and they should be evaluated as part of the FS.

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Acronyms and Abbreviations

°F	degrees Fahrenheit
μg/L	micrograms per liter
ABA	acid-base accounting
Anaconda	Anaconda Copper Yerington Mine
ANOVA	analysis of variance
APPL	Agricultural and Priority Pollutants Laboratory, Inc.
ARC	Atlantic Richfield Company
Arimetco	Arimetco, Inc.
ASTM	American Society for Testing and Materials
BCG	biota concentration guides
bgs	below ground surface
$CaCO_3$	calcium carbonate
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CoC	chain-of-custody
COPC	contaminant of potential concern
cpm	counts per minute
DGPS	differential global positioning system
EDi	Environmental Dimensions, Incorporated
EPA	U.S. Environmental Protection Agency
EW	electro winning
FD	field duplicate
FS	feasibility study
FSP	field sampling plan
g	acceleration of gravity
g/L	grams per liter
GIS	geographic information system
gpm	gallons per minute
GPS	global positioning system
HDPE	high-density polyethylene

HHRA	human health risk assessment
HI	hazard index
HLP	heap leach pads
ICP	inductively coupled plasma
ICP/AES	inductively coupled plasma /atomic emission spectrometry
ICP/MS	inductively coupled plasma / mass spectrometry
kg $CaCO_3$/t	kilograms of calcium carbonate per ton
kg H_2SO_4/t	kilograms of hydrogen sulfide per ton
kg	kilogram
lbs/ft^2	pounds per square foot
lbs/ft^3	pounds per cubic foot
MCL	maximum contaminant levels
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
mil	0.001 inch
MWMP	Meteoric Water Mobility Procedure
NA	not applicable
NAD	North American Datum
NAERL	National Air and Radiation Environmental Laboratory
NAG	net acid generation
NDEP	Nevada Department of Environmental Protection
NNP	net neutralization potential
NPR	neutralization potential ratio
OU-8	Arimetco Facilities Operable Unit
PAG	potentially acid generating
PET	potential evapotranspiration
PGA	peak ground acceleration
PLS	pregnant leach solution
PRG	preliminary remediation goals
QAPP	quality assurance project plan
RI	remedial investigation
Site	Anaconda Copper Yerington Mine
SLERA	screening-level ecological risk assessment

SPLP	synthetic precipitation leaching procedure
SX	solvent extraction
t $CaCO_3$/kt	tons of calcium carbonate per kiloton
TAL	target analyte list
TDS	total dissolved solids
TPH	total petroleum hydrocarbons
USGS	U.S. Geological Survey
VLT	vat leach tailings

SECTION 1

Introduction

The U.S. Environmental Protection Agency (EPA), under the authority of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) as amended, is conducting a remedial investigation (RI) and feasibility study (FS) to characterize potential contamination associated with the Arimetco Facilities Operable Unit (OU-8) of the Anaconda Copper Yerington Mine (Anaconda or Site). This RI report was prepared as part of Work Assignment No. 273-RICO-09GU in accordance with the *Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA* (EPA, 1988). This report summarizes the RI fieldwork and presents the results of Arimetco heap leach pads (HLP) tailings and drain-down solution sample analyses.

The Site is located approximately 2 miles west of Yerington, Nevada, directly off U.S. Highway 95, at 103 Birch Drive, Lyon County, Nevada (see Figure 1-1) (figures appear at the end of the sections in which they are first referenced). The Site comprises almost 3,600 acres and is situated in portions of Township 13 North, Range 25 East, Sections 4, 5, 8, 9, 16, 17, 20, and 21 of the Mount Diablo Baseline and Meridian. The Site is presented on the Mason Valley and Yerington U.S. Geological Survey (USGS) 7.5-minute topographic quadrangle maps. Facilities associated with copper mining operations at the Site include an open-pit mine, mill buildings, tailing piles, waste solution ponds, and the adjacent residential community, Weed Heights. A network of leach vats, HLPs, and evaporation ponds remain throughout the Site in addition to a lead working shop, a welding shop, a maintenance shop, two warehouses, an electrowinning (EW) plant, and an office building.

The RI was conducted in accordance with the field sampling plan (FSP) (CH2M HILL, 2007a) to characterize the HLPs, which represent one of the three primary components of OU-8. Another component of OU-8 is the fluid management system (e.g., ponds and ditches that stored and conveyed drain-down solution from each HLP to the former Arimetco Process Area), which was sampled as part of the RI to obtain baseline data. The other component of OU-8 is the solvent extraction (SX) and EW plant. The RI described in this report did not address the SX/EW plant.

In addition to OU-8, EPA has divided the Site into seven other operable units to better manage implementation of the sitewide RI/FS efforts. The other seven operable units include the following:

- Sitewide Groundwater – OU-1
- Pit Lake – OU-2
- Anaconda Process Area – OU-3
- Evaporation Ponds and Sulfide Tailings Ponds– OU-4
- Waste Rock Areas – OU-5
- Oxide Tailings – OU-6
- Wabuska Drain – OU-7

Figure 1-2 shows the locations of the operable units; OU-1 encompasses groundwater underlying the entire Site.

Under an EPA administrative order, Atlantic Richfield Company (ARC) will be conducting RI/FS activities for OU-1 through OU-7. Under a separate EPA administrative order, ARC is conducting ongoing field studies at the Site, including air quality and groundwater monitoring, hydrogeologic assessment activities, and background sampling. Specific work currently undertaken by ARC at the Site includes the following:

- Continued routine Site operations and maintenance and security activities
- Plan for characterization and removal of selected materials from the Anaconda Radiological Control Area
- Continued collection of monthly elevation data from groundwater monitor wells
- Continued collection of quarterly water quality data from groundwater monitoring wells
- Plan for short-term investigation of lined evaporation ponds
- Plan for short-term investigation of pump-back evaporation ponds
- Continued operation and maintenance of the pump back well system established in 1986
- Continued maintenance of Arimetco HLP drain-down solution management system (fluid management)

1.1 Purpose of Report

This report presents the results of streamlined RI activities performed by CH2M HILL. The work included collection and analysis of field data from five Arimetco HLPs to characterize the materials contained within each and to obtain preliminary data regarding the drain-down solution associated with these HLPs. Data from the field investigation were used to characterize each HLP, assess residual chemicals in the HLPs, evaluate the quantity and drain-down rate of entrained drain-down solution within the HLPs, and obtain initial data pertaining to residual chemicals in the Arimetco ponds. In conjunction with physical Site data, the RI results have been used to assess threats to human and ecological receptors. CH2M HILL concludes that the data provide sufficient information to develop and evaluate remedial alternatives for the HLP portion of OU-8. Preliminary remedial action objectives for this component of OU-8 are detailed in Table 1-1.

1.2 Site Background

Operations began at the Site around 1918 as the Empire Nevada Mine. Anaconda Copper Mining Company acquired the Site in 1941 and conducted active mining operations from 1953 through 1977, when ARC acquired Anaconda. In June 1978, ARC terminated mining operations at the Site and sold its interests to Don Tibbals, a local resident. Mr. Tibbals sold his interests, with the exception of the Weed Heights community, to Arimetco, Inc. (Arimetco) in 1988. Arimetco had a HLP copper recovery operation that used existing ore at the Site and ore from MacArthur Pit from 1989 to November 1999, when it terminated operations and filed for bankruptcy protection.

TABLE 1-1
Preliminary Remedial Action Objectives
Remedial Investigation Report, Arimetco Facilities Operable Unit 8, Anaconda Copper Yerington Mine

Protection	Preliminary Remedial Action Objectives
Human Health	• Minimize direct human contact with heaped ore and drain-down solution • Minimize fugitive dust emissions from waste management areas • Monitor for drain-down solution contaminants of concern and COPCs in groundwater • Maintain existing land use controls and restricted access status for the Site
Ecological	• Minimize direct ecological receptor contact with heaped ore and drain-down solution • Minimize generation of drain-down solution • Protect receptors from adverse affects of ponded drain-down solution
Environmental	• Maintain heap stability • Assess HLP liner integrity • Minimize generation of drain-down solution • Mitigate migration of drain-down solution to groundwater

Note:
COPC = contaminant of potential concern

1.2.1 Site Description

The Site comprises nearly 3,600 acres and includes an inactive open pit mine, waste rock piles, tailings piles, leached ore HLPs, evaporation ponds, ore processing facilities, underground utilities, remnant foundations, tanks, and buildings. During the 25-year operational history of Anaconda, nearly 360 million tons of ore were removed from the open pit mine, most of which remains as tailings or heap leach piles within the mine boundaries.

The mined ore contained copper oxides and copper sulfides. In the Anaconda Process Area, copper precipitate was produced from the oxide ore, and copper concentrate was produced from the sulfide ore. Both concentrates were shipped to Montana for smelting. By-products of the milling operation were wet gangue from the sulfide ore, wet tailings, iron, and sulfate-rich acid brine from the oxide ore. Gangue and tailings were deposited in large dumps and ponds and the acid brine was disposed of in evaporation ponds. Some of the ponds were equipped with asphalt liners, and other ponds were unlined.

1.2.2 Site Operational History

Copper was discovered in the Yerington District in the 1860s. Large-scale exploration of the porphyry copper system occurred in the early 1900s when the area was organized into a mining district by Empire-Nevada Copper Mining and Smelting Company. Anaconda Copper Mining Company entered into a lease agreement and acquired the claims in 1941. At that time, World War II placed heavy demands on metal production and, with federal assistance, Anaconda Copper Mining Company developed the ore deposit. The mine began producing copper in 1953. During the 25-year operational period that Anaconda Copper Mining Company owned and operated the mine, approximately 1.7 billion pounds of copper were produced.

Anaconda Copper Mining Company sold the mine and processing facilities to ARC in 1977. ARC sold the mine and processing facilities in 1978 to Mr. Tibbals. Subsequent operators (Tibbals, CopperTek™, and Arimetco) used or salvaged some of the buildings and equipment within the Anaconda Process Area; however, the processing facilities constructed by Anaconda Copper Mining Company (e.g., leach vats, concentrator, and SX/EW plant) were not used after 1978. The following timeline summarizes significant operational and regulatory milestones:

1907 The Yerington deposit was discovered by Empire-Nevada Copper Mining and Smelting Company.

1941 Anaconda Copper Mining Company acquired the property.

1951 The Weed Heights housing community was constructed.

1952 The plant site was constructed.

1952 Mining activities began with stripping of overburden.

1953 The first copper oxide ore was delivered to the leaching plant.

1961 A concentrator for processing sulfide ore and sulfide tailings ponds were constructed.

1965 Dump leaching of low-grade ore in the Anaconda W-3 Waste Rock Dump began.

1967 The concentrator was expanded to double capacity.

1977 ARC purchased Anaconda Copper Mining Company, including the Site.

1978 ARC shut down all mining and processing operations and sold holdings to Don Tibbals.

1979 Unison Corporation leased building space in the Anaconda Process Area to refurbish transformers.

1982 CopperTek™ leased the Site to reprocess tailings and low-grade ore using heap leaching. A new processing facility was constructed south of the Anaconda Process Area, including an SX/EW plant (presently identified as the Arimetco Process Area).

1985 ARC constructed the pump-back well system and began pumping shallow groundwater in March 1986; monitoring and performance reporting were performed.

1988 Don Tibbals sold the Site to Arimetco, including all heap leaching and processing facilities.

1997 Arimetco filed for bankruptcy protection.

1999 Arimetco abandoned operations, and the Site came under the administration of the Nevada Department of Environmental Protection (NDEP) Emergency Management.

2005 EPA assumed regulatory oversight responsibilities for the Site.

2007 EPA issued a Unilateral Administrative Order to ARC.

Processing operations, including volumes and concentrations of materials, changed over time. General descriptions of the Anaconda mining and processing activities are provided in this section, but the values and tonnages provided are approximate. By 1972, approximately 70,000 tons per day were mined, including 28,000 tons of oxide and sulfide ore; 28,000 tons low-grade dump-leach ore; and 14,000 tons of overburden and waste rock. Mined ore characteristics and operations were described in the *Skillings Mining Review* (1972) as follows:

- Ore containing more than 0.3 percent copper was delivered to the primary crusher for leaching.
- The overall average grade of oxide ore was 0.55 percent copper; sulfide ore was 0.6 percent copper.
- Low-grade oxide ore containing 0.2 to 0.3 percent was delivered to the Anaconda W-3 Waste Rock Dump, south of Burch Drive, where it was processed by a heap leach system.
- Low-grade sulfide ore was stockpiled in the S-32 Area, southeast of the Burch Drive Bridge, for possible future treatment.

The open pit was mined in 25-foot benches with a 45-degree pit wall slope. The final dimensions of the pit were approximately 6,200 feet long, 2,500 feet wide, and 800 feet deep. Groundwater was encountered at approximately 100 to 125 feet below ground surface (bgs), and deep wells were installed along the eastern perimeter of the pit to de-water the fractured bedrock as the depth of the pit increased. Water was pumped from these wells at approximately 900 gallons per minute (gpm), and used for Weed Heights housing and plant operations (U.S. Bureau of Mines, 1958).

Oxide and sulfide ore was crushed prior to leaching or processing in the plant. Crushing was a two-step process for the oxide ore and a three-step process for sulfide ore. Oxide ore was loaded into the vat leach tanks by conveyor and overhead loading bridge with the agglomerated ore from the secondary crusher. The ore was bedded into tanks that prevented segregation and allowed circulation of leach solution. Each tank had a capacity of approximately 12,000 dry tons of ore and 800,000 gallons of solution when filled within 6 inches of the top. The vats typically operated on a 96-hour (5-day) or 120-hour (6-day) leaching cycle, with an additional 32 to 40 hour wash period; 24 hours were required to excavate and refill. The entire cycle required approximately 8 days; therefore, eight vat leach tanks were installed and used to maximize efficiency (U.S. Bureau of Mines, 1958).

After the ore was bedded, a solution of 20 to 30 grams of sulfuric acid to 1,000 grams of water (grams per liter [g/L]) was introduced during the conditioning period. The solution was recirculated (drawing it off the bottom and air-lifting it to the top of the tank) for approximately 3 hours until the solution concentration dropped to between 0 and 2 g/L. The reinforced concrete bottoms of the tanks were covered with timbers and cocoa matting as a filter to allow bottom drainage of the solution. The solution was recirculated at a rate of 2,000 gpm, with pregnant solution pumped to one of two 286,000-gallon storage tanks. Solution was transferred from the tank and supplemented with acid to achieve the desired leaching strength of 40 to 60 g/L. This solution was recirculated and transferred to the next tank. This cycle continued for four or five leaching periods. Approximately 1.4 million gallons of water were used each day for leach wash water.

Copper was recovered from the leach solution by precipitating (i.e., cementing) the copper using scrap iron. The precipitation plant was divided into five separate banks or cells: (1) primary, (2) secondary, (3) stripping/settling, (4) scavenger, and (5) dump leach (Jacky, 1967 and Anaconda Copper Mining Company, 1954).

After cementation, the copper cement product was washed in place, excavated by overhead gantry crane with a clamshell digger and loaded into a hopper southeast of the precipitation tanks. It was then washed again, and unused scrap iron was separated from the copper cement. The copper cement was loaded onto hotplates for drying prior to shipment. The copper cement product averaged 83 percent copper; it was hauled, via the Wabuska rail spur, to the Washoe Smelter in Anaconda, Montana, for final smelting.

A sulfide ore froth floatation system was constructed in 1961 that mixed ground ore with water and a chemical (typically xanthate) to make the sulfide hydrophobic. The mixture was then sparged with air and a surfactant chemical (typically pine oil) to create froth. The actual chemicals used in the Yerington concentrator have not been determined. The concentrator was designed to take this initial concentrate, separate the solids in a 75-foot -diameter thickener, and regrind the thickened solids to a pulp size of -325 mesh (approximately 44 micrometers). This reground material was sent through a scavenger floatation circuit, a cleaner circuit, and a re-cleaner circuit. The final concentrate was thickened in 50-foot-diameter thickeners, dewatered by a vacuum filter, and dried in a 24-foot rotary dryer. The concentrate averaged 28 percent copper; it was transported to the Washoe smelter in Anaconda, Montana, for final smelting (Skillings Mining Review, 1972). Excess pulp was disposed of in the sulfide tailings ponds as a slurry mixture of solids and water.

Sulfuric acid was produced at the Site in the fluosolids and acid plant by using raw sulfur ore shipped from the Leviathan Mine in Alpine County, California. The production of sulfuric acid from sulfur ore included the following 5 steps: (1) crushing, (2) grinding, (3) roasting, (4) dust precipitation, and (5) contact acid plant. The final product was 93 percent sulfuric acid, which was used in the tank leach and the dump leach of the oxide ore (Anaconda Copper Mining Company, 1954 and U.S. Bureau of Mines, 1958).

After 25 years of operations, the Site was sold to Don Tibbals, who reportedly planned to develop the Site as an industrial park. Mr. Tibbals leased a 5-acre portion of the Site to Unison Corporation (formerly Environmental Resources Management), a subsidiary of Union Carbide Corporation. Unison Corporation salvaged drained electrical transformers for metals such as copper and brass (Ecology and Environment, Inc., 1990). Mr. Tibbals leased another portion of the Site to Arimetco for a closed-system copper extraction operation using the Anaconda tailings. Mr. Tibbals renovated approximately 130 of the 200 homes in Weed Heights, and, operating under the Tibbals Construction Company, CopperTek reprocessed mine tailings using the SX/EW process between 1982 and 1989.

1.2.3 Arimetco Operational History

When the mine was purchased by Arimetco in 1989, the process facility was not used; a new facility was constructed on the south side of Burch Drive. Copper was primarily processed from Anaconda dump ores using conventional heap leaching and SX/EW technology.

Approximately 40,000 tons of copper ore per day were hauled to the HLPs and dumped into 20-foot lifts. Each lift was leached for 30 to 40 days. A brief description of each HLP constructed by Arimetco is presented in the following sections.

1.2.3.1 Phase I/II Heap Leach Pads

The Phase I/II HLP was constructed by CopperTek/Arimetco, beginning in 1989, to leach low-grade oxide ore from the original Anaconda W-3 Waste Rock Dump. Initial leaching ended in 1996 and resumed for approximately 5 months in early 1997 at a rate of 400 to 500 gpm. A solution ditch was constructed in the northeast corner of the HLPs, with 11 leak detection points around the HLP and proximal to the SX/EW plant. Phase I covers approximately 6 acres and extends approximately 100 feet aboveground. Phase II extended west and north from Phase I and covers an additional 8 acres. A variable 2- to 10-foot-thick layer of vat leach tailings (VLT) was placed on a single 40-mil (0.04-inch-thick) high-density polyethylene (HDPE) liner (ARC, 2002a). The 40-mil liner was placed over compacted alluvium and fill materials. A sump is located west of the HLP and was initially used as a sediment control basin for the Phase I HLP but now collects drain-down solution from the south end of the Phase I/II HLP. The top-deck of the Phase I/II HLP occupies approximately 3 acres. Drain-down rates have reportedly been on the order of 1 gpm or less and completely cease during some summer months (ARC, 2002a).

1.2.3.2 Phase III Heap Leach Pads

The Phase III South HLP was constructed between 1990 and 1992 to leach low-grade oxide ore from the W-3 Waste Rock Dump, VLT material, and material mined from the MacArthur Pit. The Phase III 4X HLP was constructed between 1992 and 1995 to leach low-grade oxide ore from the W-3 Waste Rock Dump, VLT material, and material mined from the MacArthur Pit. A single 40-mil HDPE liner was installed to recover drain-down solution, and the drainage ditch was designed with a leak detection system over a second, 40-mil HDPE membrane. Historically, the solution ditch surrounding Phase III South HLP drained either to the Phase III Bathtub Pond or the Mega Pond. Phase III South HLP covers approximately 46 acres; the collection basin is to the southeast; the top deck is generally flat and covers approximately 15 acres in two benches. Phase III 4X HLP covers approximately 50 acres; solution is collected in the southeastern corner and conveyed to the Mega Pond. The top deck is generally flat and covers approximately 22 acres in three benches.

The ditches surrounding both Phase III HLPs are double HDPE-lined with leak detection between the membranes. Historically, drain-down solution flowed either to the Plant Feed PLS Pond (where it was redirected to the VLT solution ditch by pumping it into the 16-inch-diameter gravity drain line) or to the Mega Pond (where it was pumped by a barge pump through the 16-inch-diameter gravity drain line to the VLT solution ditch). Drain-down solution also flowed to a depressed sump in the Anaconda Plant Site area. Drain-down solution in Phase III 4X HLP flows to the southeast corner and is collected by a screened 4-inch-diameter pipe. Historically, the pipe drained by gravity alongside the 16-inch-diameter gravity drain line and flowed to the southern corner of the VLT solution ditch.

Leaching at Phase III South HLP ended in early 1997 and restarted for several months in early 1998 at a rate of 400 to 500 gpm on the southern portion of the HLP. Drain-down rates decreased from 1,620 gpm during active operations to approximately 3 gpm in recent years (ARC, 2002b). Nine leak detection points exist around the Phase III HLPs.

1.2.3.3 Phase IV Slot Heap Leach Pad

The area of the Phase IV Slot HLP was originally used by Anaconda to dump, and later to leach, low-grade oxide ore that was described on maps as "tailings." The area expanded in different directions and eventually formed one contiguous dump known as the W-3 Waste Rock Dump. This waste rock pile is discussed in detail in the *Draft Waste Rock Areas Work Plan* (ARC, 2002b). In 1965, Anaconda began leaching copper on portions of the W-3 Waste Rock Dump; in the late 1970s it began mining a portion of the W-3 Waste Rock Dump to augment the vat leach operation. Their incursion into the dump became known as the "slot." The Phase IV Slot HLP was initially constructed by Arimetco on a starter pad excavated into the W-3 Waste Rock Dump and an asphalt-lined area. The HLP expanded northward between 1993 and 1996 and includes a primary 40-mil HDPE liner overlying a secondary liner of compacted, naturally occurring, gray, lean clay. The solution drainage ditch is designed with a leak detection system over a second 40-mil HDPE membrane; the surrounding Phase IV Slot drains to the east and is routed to one of two pregnant leach solution (PLS) ponds. A variable 2- to 10-foot-thick layer of VLT was placed on the liner during construction. The Phase IV Slot HLP was constructed in 20-foot lifts and covers approximately 86 acres. The HLP top deck is relatively flat and covers approximately 37 acres in five benches.

The Phase IV Slot HLP is surrounded by a berm and a double HDPE-lined ditch designed with leak detection between the membranes and seven leak detection monitoring points. Historically (until late 2003), drain-down solution flowed to one of two PLS ponds east of the HLP, where it was pumped to the surface of the HLP for evaporation using mechanical evaporators (wobbler and modified wobbler misters). Drain-down solution was pumped through an 8-inch-diameter HDPE line to the Plant Feed PLS Pond. Because the northern Phase IV Slot PLS Pond historically leaked, solution was periodically pumped to the southern Phase IV Slot PLS Pond. In 2006, EPA relined the northern Phase IV Slot PLS Pond. Solution from the northern pond is currently pumped to the EPA 4-acre evaporation pond. Arimetco ceased adding solution to the HLP in November 1998, and the drain-down rate has reportedly decreased from 2,200 gpm during active operation to approximately 34 gpm (ARC, 2002a).

1.2.3.4 Phase IV VLT Heap Leach Pad

The Phase IV VLT HLP was constructed on the southern portion of the former finger evaporation ponds and alluvium north of the Phase IV VLT HLP. The VLT consists primarily of oxide tailings and run-of-mine and crushed ore from the MacArthur Pit. The Phase IV VLT HLP was extended to the south, into the VLT; construction occurred between 1995 and 1998. The HLP has a 40-mil HDPE liner overlying a secondary liner of compacted, naturally occurring, gray, lean clay. The solution drainage ditch includes a leak detection system over a 40-mil HDPE membrane designed with five leak detection points. The solution ditch drains to the northeast corner of the HLP and is routed to a single PLS pond. The HLP was constructed in 20-foot lifts and covers approximately 54 acres. A generally flat top deck surface of about 29 acres exists in two benches.

A lined berm and solution ditch surround the HLP. Historically, solution flowed to the Phase IV VLT PLS Pond at the northeast corner of the HLP. Solution was pumped to evaporators on a 3-acre bench on the southeastern face of the HLP. The Phase IV VLT PLS Pond was designed to store 5.04 million gallons. Until recently, drain-down solution was sprayed on the HLP using one or more high-efficiency snowmaker-type evaporators. Currently, all drain-down solution is routed to the EPA 4-acre evaporation pond. Arimetco ceased adding make-up water and acid to the Phase IV VLT HLP in November 1998. The solution drain-down rate has decreased from 3,300 gpm during active operation to approximately 35 gpm (ARC, 2002a).

Table 1-2 summarizes the details regarding ore that was processed during Arimetco's operations (herein after referred to as "HLP materials"), as discussed in the *Draft Final Arimetco Heap Leach and Process Components Work Plan* (ARC, 2002a).

Arimetco's heap leaching process applied acidic, water-based solution over the heaped ore surface at a coverage rate of approximately 0.0025 gpm per square foot. The solution (raffinate) contained approximately 12 grams of sulfuric acid per 1,000 grams of water (1.2 percent hydrogen sulfide). The solution drained through the heap, leaching copper oxides as it permeated the ore. The resultant PLS that emerged at the toe of the heap contained elevated concentrations of elemental copper and reduced the sulfuric acid to less than 4 g/L. The leaching reaction created copper sulfate and water that typically contained more than 1 g/L of copper. The PLS was collected and delivered to the SX facility in flows that normally exceeded 5,000 gpm. The SX process consisted of two stages that used three cycling solutions that were alternately mixed and separated as follows:

- Stage 1 – extraction was accomplished by mixing the water-based PLS feed with a reagent carried by an organic solution (kerosene). The PLS, kerosene, and an organic reagent (Agora) were mixed before entering three process vats (approximately 200,000 gallons total capacity) where they were slowly separated. During contact, the reagent carried by the organic exchanged hydrogen ions for copper ions in the PLS. Through ion exchange, the PLS was relieved of its copper and became raffinate, which was reacidized and recycled to the heaps to repeat the process.
- Stage 2, Part 1 – the organic solution was recycled from the EW tank house and thoroughly mixed with an electrolyte. During contact, the exchange of hydrogen ions for copper ions was reversed, producing copper sulfate. The copper-rich electrolyte settled from the organic and advanced to the EW tank house for plating; the organic was recycled.
- Stage 2, Part 2 – ionic copper was electrowinned from the electrolyte solution to sheet-plate copper on stainless steel cathodes. Electrolysis plated the copper by using sheets of insoluble lead anodes that were alternately placed opposite sheets of cathodes and immersed in the conductive electrolyte bath. Copper slowly deposited on the immersed cathode sheet; oxygen was liberated at the anode. Sulfuric acid was regenerated to the electrolyte bath at a ratio of approximately 1.5 pounds per pound of plated copper.

TABLE 1-2
Summary of Arimetco Heap Leach Pad Construction Details
Remedial Investigation Report, Arimetco Facilities Operable Unit 8, Anaconda Copper Yerington Mine

	Group A				Group B
	Phase I/II HLP	**Phase III South HLP**	**Phase III 4X HLP**	**Phase IV Slot HLP**	**Phase IV VLT HLP**
Time Period	1990 – May 1997	August 1992 – early 1997 (plus several months in 1998)	August 1995 – 1999	March 1996 – November 1998	August 1998 – November 1998
Material	Low-grade oxide ore (low-mica quartz monzonite with some oxide alteration on joint faces and replacement minerals, such as chlorite and trace metal sulfides) from the Anaconda W-3 Waste Rock Dump. VLT oxide tailings (2 to 10 feet thick) were placed on the bottom as drain rock.	Low-grade oxide ore (low-mica quartz monzonite with some oxide alteration on joint faces and replacement minerals, such as chlorite, and trace metal sulfides) from the Anaconda W-3 Waste Rock Dump. MacArthur Pit run-of-mine and crushed ore (quartz monzonite with replacement minerals, such as chlorite, and trace metal sulfides). VLT oxide tailings (2 to 10 feet thick) were placed on the bottom as drain rock.	Low-grade oxide ore (low-mica quartz monzonite with some oxide alteration on joint faces and replacement minerals, such as chlorite, and trace metal sulfides) from the Anaconda W-3 Waste Rock Dump. MacArthur Pit run-of-mine and crushed ore (quartz monzonite with replacement minerals, such as chlorite, and trace metal sulfides). VLT oxide tailings (2 to 10 feet thick) were placed on the bottom as drain rock.	Low-grade oxide ore (low-mica quartz monzonite with some oxide alteration on joint faces and replacement minerals, such as chlorite, and trace metal sulfides) from the Anaconda W-3 Waste Rock Dump. VLT oxide tailings (2 to 10 feet thick) were placed on the bottom as drain rock.	Oxide tailings from crusher. MacArthur Pit run-of-mine and crushed ore (quartz monzonite with replacement minerals, such as chlorite and trace metal sulfides). Phase III HLPs material covers slope faces and benches to protect the finer VLT from erosion.
Particle Size and Sorting	6-inch-plus to silt size; poorly sorted	12-inch-plus to silt size; poorly sorted	12-inch-plus to silt size; poorly sorted	12-inch-plus blast rock to silt size; poorly sorted	0.5-inch-minus to sand-size crusher product
Maximum Drain-down	400 to 500 gpm	400 to 500 gpm	1,620 gpm	2,200 gpm	3,300 gpm
Current Drain-down	1 gpm	Less than 4 gpm	3 gpm	34 gpm	35 gpm
Bottom Area	14 acres	46 acres	50 acres	86 acres	54 acres
Top Area	3 acres	15 acres – two benches	22 acres – three benches	37 acres	29 acres – two benches
Maximum Height[a]	120 feet	168 feet	156 feet	145 feet	128 feet
Berms	East-west lined berm in middle of the two heaps. A lined berm and solution ditch around perimeter.	A lined berm and solution ditch around perimeter.	A lined berm and solution ditch around perimeter.	A lined berm and solution ditch around perimeter. Berms within the heap.	A lined berm and solution ditch around perimeter. Overlies finger ponds.
Slopes	Gentle			2.4H:1V	2.4H:1V

[a]According to analysis of topography and slope elevations.

Notes:
H = horizontal
V = vertical

In the EW process, copper was electroplated to stainless steel sheets to produce 99.999 fine copper. A stronger sulfuric acid solution subsequently removed copper from the kerosene solution, and a final EW process plated the copper onto stainless steel sheets. Arimetco recirculated the acid solution from the EW vats back to the HLPs but stopped adding acid and mining minerals to the HLPs in November 1998. Processing ceased in November 1999, and the state of Nevada took control of the Site January 27, 2000. Upon cessation of Arimetco's activities, there was an estimated 90 million gallons of PLS present in the HLPs. The flow rate in the pumping system during January 2000 was approximately 1,200 gpm; the current flow rate is estimated to be less than 50 gpm.

1.2.4 Previous Investigations

Previous investigations have been undertaken by Arimetco, with NDEP conducting work after the Arimetco bankruptcy filing. ARC has completed numerous investigations, assessments, and monitoring activities; EPA-directed investigations have also occurred since about 2004.

Because the HLPs and associated process components contained approximately 90 million gallons of PLS, NDEP conducted fluid management activities in 2000 to prevent releases of drain-down solution. Fluid management activities undertaken by NDEP included the following:

- Documenting drain-down solution flow rates by using weirs
- Monitoring leak detection systems and recording leakages
- Removing process solution from the SX/EW plant site
- Pumping drain-down solution (and leakage) from containment systems (ponds) to the Phase IV VLT HLP for evaporation

During the engineering design of the Phase IV Slot and Phase IV VLT HLPs, Arimetco had samples of the proposed leach materials tested using Nevada's Meteoric Water Mobility Procedure (MWMP) and static-tests (i.e., acid-base accounting [ABA]). The ABA results indicated that the tested materials were slightly acid consuming (net neutralization potential [NNP] greater than 0 and less than 10). Test results have been summarized by ARC (2002b).

Anaconda sulfide tailings ponds were tested to assess their use as secondary liner materials for the HLPs. The compacted permeability of the sulfide tailings ponds was on the order of $1x10^{-7}$ to $1x10^{-8}$ centimeters per second. The pH results suggest that the materials possess acid-neutralizing minerals. Test results have been summarized by ARC (2002b).

Pursuant to Nevada Water Pollution Control Permit NEV88039, Arimetco analyzed Phase III South and Phase III 4X HLPs, Phase IV Slot Ponds, Phase IV VLT Pond, Plant Feed PLS Pond (combined solution from all the pads) and Raffinate Pond (mineral-depleted solution from all the pads) drain-down solution in 1999. Permit-required analyses of the solution and weekly records were published in quarterly reports to NDEP. Testing results have been summarized by ARC (2002b).

EPA sampled materials from the Phase I/II, Phase III South, Phase IV Slot, and Phase IV VLT HLPs for whole-rock geochemical analyses. The results and a set of regional background data results (Shacklette and Boerngen, 1984) are included in Table 1-3.

TABLE 1-3
Historical Heap Leach Pad Geochemical Data
Remedial Investigation Report, Arimetco Facilities Operable Unit 8, Anaconda Copper Yerington Mine

Parameter	Phase I/II[a] T-3	Phase III South[a] T-5	Phase IV Slot[a] T-1	Phase IV VLT[a] T-6	Yerington Area[b]	BK-1[a]
Aluminum	12,000	9,900	9,200	17,000	70,000	5,300
Antimony	<20	<20	<20	<20	NA	NA
Arsenic	10	10	10	6	16 – 100	NA
Barium	60	70	90	90	700	NA
Beryllium	0.8	0.2	0.2	0.6	<1	NA
Cadmium	<1	<1	<1	<1	NA	0.47
Calcium	6,400	900	1,800	12,000	18,000 – 28,000	NA
Chromium, Total	6	6	6	14	30	NA
Cobalt	7	2	2	23	15 – 70	2.8
Copper	2,400	1,000	1,100	2,500	50 – 700	42
Iron	13,000	22,000	26,000	18,000	30,000	5,300
Lead	8	4	5	4	30 – 700	2.4
Magnesium	8,400	5,600	5,200	12,000	15,000 – 100,000	2,500
Manganese	100	50	50	220	700	140
Mercury	0.18	0.006	0.55	0.30	0.082 – 0.13	Non-detect
Nickel	9	5	<10	20	15	6.3
Potassium	700	2,000	2,000	2,000	25,000 – 65,000	Non-detect
Selenium	3	3	5	<8	0.15 – 0.2	NA
Silver	<2	<2	<2	<2	NA	NA
Sodium	500	100	90	900	15,000 – 100,000	NA
Thallium	<100	<100	<100	<100	NA	NA
Vanadium	21	30	31	43	150 – 500	NA
Zinc	14	16	14	22	190 – 3,500	NA

[a]Samples analyzed using inductively coupled plasma (ICP)

[b]Background data results (Shacklette and Boerngen, 1984). These values will be replaced with data from the recent study conducted by ARC on completion of the review and approval process.

Notes:

Results are in milligrams per kilogram (mg/kg)
< = less than
NA = not applicable

1.2.5 Recent Investigations

In 2006, EPA conducted removal activities associated with OU-8, including the following:

- Analysis of sediment samples from the northern and southern Phase IV Slot PLS Ponds
- Removal of sediment from the northern Phase IV Slot Pond and Mega Pond

- Analysis of transite pipe samples for asbestos-containing materials
- Global positioning system (GPS) surveys of existing pipelines
- Radiation surveys within and near the Mega Pond, northern and southern Phase IV Slot PLS Ponds, Phase IV VLT HLP, and the 4-acre evaporation pond
- Construction of a 4-acre evaporation pond to manage drain-down solution and stormwater runoff from all HLPs

As of late 2006, drain-down solution that had historically flowed into and from Mega Pond and to the VLT solution ditch is now conveyed to the EPA 4-acre evaporation pond. Currently, ARC monitors ponds and ditches for drain-down solution and pumps the solution, as necessary, to the evaporation pond.

1.2.5.1 Contaminants of Potential Concern

Drain-down solution stored in the ditches and ponds and emanating from the HLPs exhibits low pH and contains elevated levels of arsenic, cadmium, chromium, copper, and iron, which are the COPCs at the Site. Salts precipitating from the drain-down solution contains relatively higher levels of metals and radionuclides, including radium, thorium, and uranium. Additional COPCs include aluminum, beryllium, boron, chloride, lead, manganese, mercury, selenium sulfate, and zinc. Kerosene was used as a reagent in the EW process, some of which remained in the acidic solution applied to the HLPs. Petroleum hydrocarbons are also COPCs in drain-down solution at the Site.

HLP materials contain metals (arsenic, cadmium, chromium, copper, and iron) and radiological constituents; these are also COPCs. Kerosene was used as a reagent in the EW process, some of which remained in the acidic solution applied to the HLPs. Petroleum hydrocarbons are also considered to be a potential COPCs in HLP materials at the Site.

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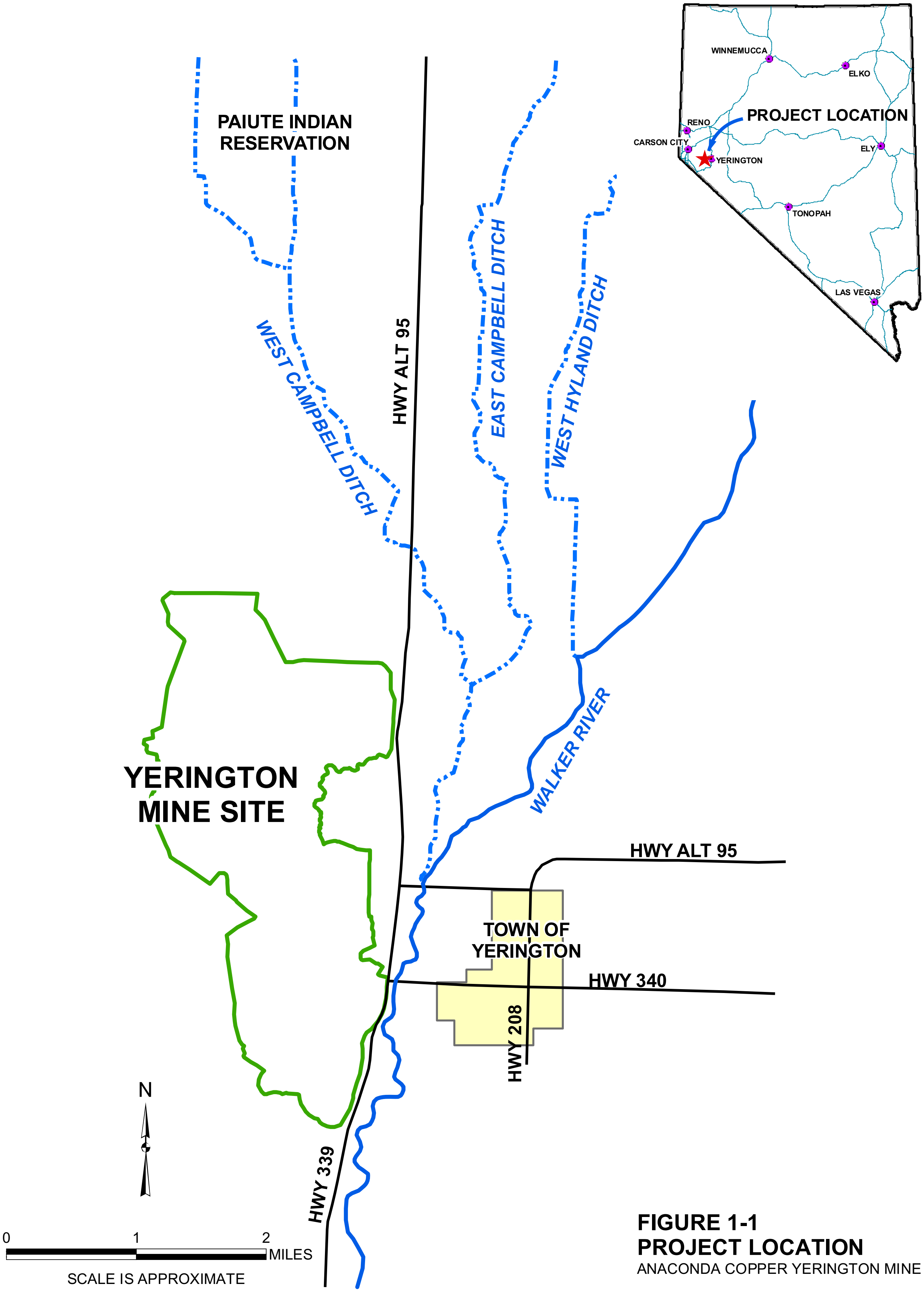

FIGURE 1-1
PROJECT LOCATION
ANACONDA COPPER YERINGTON MINE

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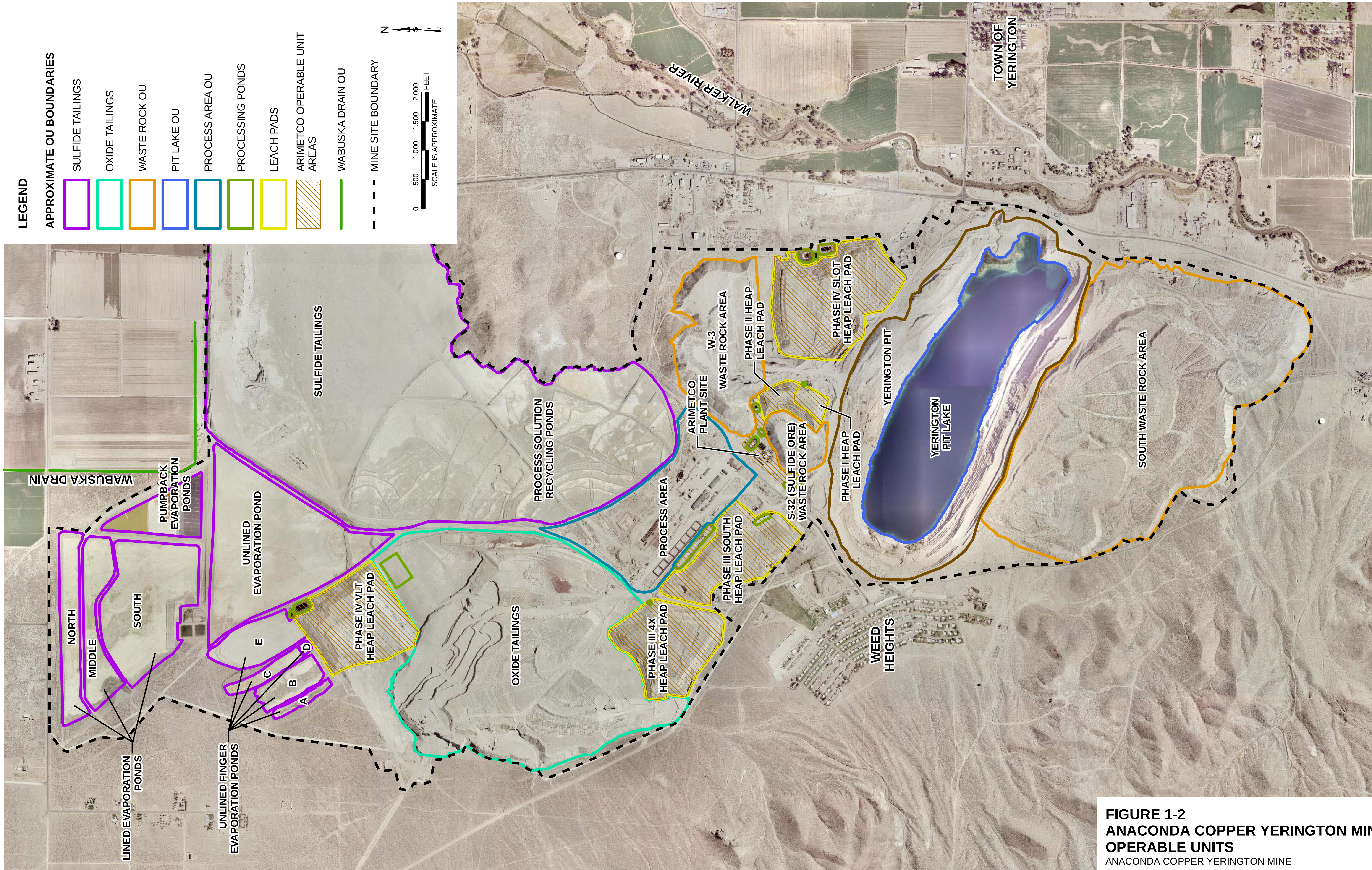

FIGURE 1-2
ANACONDA COPPER YERINGTON MINE
OPERABLE UNITS
ANACONDA COPPER YERINGTON MINE

SECTION 2

Remedial Investigation

In preparation for the RI field program, an FSP and a quality assurance project plan (QAPP) were developed (CH2M HILL, 2007b). The FSP and QAPP documented the procedures for implementing the fieldwork and associated laboratory and data evaluation activities. EPA approved the FSP and QAPP in September 2007. The field program objectives were as follows:

- Characterize HLP materials and drain-down solution
- Collect sufficient data to evaluate the nature and extent of contamination associated with the HLPs
- Group together Phase I/II, Phase III South, Phase III 4X, and Phase IV Slot HLPs (Group A)
- Characterize Phase IV VLT HLP separately (Group B)
- Develop basic risk management decisions regarding human health and the environment
- Support evaluation of HLP closure alternatives

The work included collection of surface/subsurface samples for geotechnical, geochemical, and radiological analyses. Additional samples were collected to assess agricultural parameters. Samples of drain-down solution were collected from ponds and ditches for NDEP Profile II and radiological analyses, pursuant to Section 4 of the FSP. A summary of proposed versus actual surface and subsurface samples, drain-down solution samples, and quality control samples is presented in Table 2-1.

TABLE 2-1
Sample Collection Summary
Remedial Investigation Report, Arimetco Facilities Operable Unit 8, Anaconda Copper Yerington Mine

Type of Sampling	Sampling Locations	FD Locations	Field Blanks	Total Samples	Matrix Spike/Matrix Spike Duplicates (1 per 20)
Borehole and Subsurface Samples	16/16	12/7	4/NR	218/239	6/6
Surface Samples	44/44	12/7	4/NR	118/105	6/6
Drain-down Solution Samples	10/8	2/2	2/NR	60/48	1/1

Notes:

Values indicate the number of samples proposed/obtained for each type of sampling.

The number of geotechnical samples do not include FDs or matrix spike/matrix spike duplicates.

FD = field duplicate
NR = not required; no reusable equipment used during drain-down solution or soil sampling

The number of samples analyzed varied slightly from the FSP, primarily because of changing field conditions and the professional judgment of senior technical personnel. The number of planned versus actual samples collected for each analytical method are summarized in Table 2-2.

TABLE 2-2
Summary of Planned versus Actual Samples Collected, by Analysis
Remedial Investigation Report, Arimetco Facilities Operable Unit 8, Anaconda Copper Yerington Mine

Soil Analysis	Planned	Actual	Comments
Inorganics, TPH, and Physical Properties			
Twenty-three TAL Metals	60	64 (10 FD)	Five FD samples were submitted for analyses on 1/28/2008
TPH	19	23 (3 FD)	
Bulk Rietveld X-ray Diffraction (multiple size fraction)	17	0	Senior geochemist reviewed ABA and NAG data and determined that x-ray diffraction analyses were not required.
Whole Rock	17	0	Senior geochemist reviewed ABA and NAG data and determined that whole-rock analyses were not required.
SPLP	33	26 (6 FD)	Two FD samples were submitted for analyses 1/28/2008
Inorganic Analyses	29	23	
Radiological			
Radium 226	42	29	Partial data pending from laboratory. Outstanding data will be presented in a technical memorandum and submitted as an addendum to the RI. There were fewer samples collected because drilling depths were less than planned.
Radium 228	42	29	Partial data pending from laboratory. Outstanding data will be presented in a technical memorandum and submitted as an addendum to the RI. There were fewer samples collected because drilling depths were less than planned.
Isotopic Thorium	42	29	Fewer samples collected because drilling depths were less than planned.
Total Thorium	42	29	Fewer samples collected because drilling depths were less than planned.
Isotopic Uranium	42	29	Fewer samples collected because drilling depths were less than planned.
Total Uranium	42	29	Fewer samples collected because drilling depths were less than planned.
Gross Alpha	42	29	Fewer samples collected because drilling depths were less than planned.
Gross Beta	42	29	Fewer samples collected because drilling depths were less than planned.
Gross Gamma	42	29	Partial data pending from laboratory; awaiting description from laboratory regarding how gross gamma analyses were performed and reviewed. There were fewer samples collected because drilling depths were less than planned.
Agricultural			
Sodium Adsorption Ratio	12	13	

TABLE 2-2
Summary of Planned versus Actual Samples Collected, by Analysis
Remedial Investigation Report, Arimetco Facilities Operable Unit 8, Anaconda Copper Yerington Mine

Soil Analysis	Planned	Actual	Comments
Calcium, Magnesium, and Sodium	12	13	
Nitrogen, Phosphorous, and Potassium	12	13	
Boron and Chlorine	12	13	
Geochemical			
Nevada MWMP	11	12	
NAG	33	25	Fewer samples collected because drilling depths were less than planned.
ABA	33	25	Fewer samples collected because drilling depths were less than planned.
Geotechnical			
Direct Shear Tests (ASTM D3080)	17	18	
Wet/Dry Densities (ASTM D2937)	13	18	Number of samples determined by actual field conditions.
Moisture Content (ASTM D2216-98)	95	64	Reduced by the senior geotechnical advisor because of the observed consistency of Group A HLP materials.
Moisture Retention Capacity (ASTM D2325 or D3152)	31	0	Senior geotechnical advisor determined that the analysis was not necessary at this time.
Compaction Curves (ASTM D1557)	113	23	Reduced by the senior geotechnical advisor because of the observed consistency of Group A HLP materials.
Grain Size (ASTM D422/C136)	113	40	Reduced by the senior geotechnical advisor because of the observed consistency of Group A HLP materials.
Specific Gravity (ASTM D854)	113	23	Reduced by the senior geotechnical advisor because of the observed consistency of Group A HLP materials.

Notes:

ASTM = American Society for Testing and Materials
NAG = net acid generation
SPLP = synthetic precipitation leaching procedure
TAL = target analyte list
TPH = total petroleum hydrocarbons

The following sections summarize the results of the RI fieldwork and the methodologies used to obtain the data. The sampling methodologies for the radiological walkover survey, drain-down solution sampling, subsurface/boring sampling methods, and surface sampling are discussed in the following sections.

2.1 Radiological Walkover Survey

A nonintrusive radiological gamma walkover survey was performed in accessible areas on the top decks of the HLPs to identify the presence of gamma radiation at the surface.

Environmental Dimensions, Inc. (EDi) in Albuquerque, New Mexico, conducted the survey between September 10 and September 21, 2007 to answer the following questions:

- Did surface gamma radiation count rates on the HLPs exceed three standard deviations above the mean background count rate?
- Would additional radiological surveys or field sampling are needed to satisfy the objectives and complete the RI?
- Was the health and safety program adequate for the protection of field personnel?

The walkover survey was performed using a Ludlum Model 2221 Scalar Ratemeter with a Ludlum Model 43-10, 2-inch by 2-inch sodium iodide gamma scintillation detector. The detector was suspended approximately 15 centimeters above the ground surface and moved in parallel lines approximately 3 meters apart at a speed of 0.5 meters per second. The measurements were correlated with position and data were automatically logged with the measurement coordinates by using 9-channel Trimble® Pathfinder® Pro XRS differential global positioning system (DGPS). The DGPS linked survey data to spatial locations using state plane coordinates North American Datum (NAD) U.S. State Plane 1927, Nevada West 2703. The DGPS instrument was checked daily to ensure accuracy and repeatability.

The equipment setup for the walkover survey consisted of the roving DGPS/gamma-survey package and a base station transmitter/receiver. The roving unit combined the Trimble® Pathfinder® Pro XRS with a TDC1 data logger for the global positioning and the Ludlum Model 2221 Scalar Ratemeter for gamma detection. The rover simultaneously logged gamma count rates and position data. The fixed base station, located at a known coordinate site near the HLPs, was the reference point for differential correction of the rover unit data.

The rover instrumentation was mounted on a four-wheel-drive, all-terrain vehicle in a manner that allowed consistent, near-surface scanning of the entire area of interest. To the extent possible, areas not accessible by the survey vehicle were measured on foot by using the same instrumentation mounted on a backpack. Because of steep terrain and uneven footing conditions, some portions of the planned survey area were inaccessible.

As part of the initial DGPS/gamma survey, EDi used one of the known coordinate stations nearest the HLP as the fixed-base station. Using data collected by the fixed-base station during the gamma surveys, the Trimble® software differentially corrected the rover's position data. Differential correction allowed submeter accuracy. The data were then uploaded into a geographic information system (GIS) database for the HLPs that accurately displays the location of collected gamma data. Gamma data were sorted and displayed to identify the location and distribution of peak gamma values. These values were compared with background gamma values from a nearby unaffected area; the results are presented in Section 4.1. The *Radiological Walkover Survey Report* (EDi, 2007) is included in Appendix A.

2.2 Drain-down Solution Sampling

Drain-down solution samples were collected to obtain baseline data from HLP perimeter ditches and ponds. The samples were collected between September 9 and 13, 2007 for NDEP Profile II and radiological analysis. Samples were collected by using a peristaltic pump with disposable tubing and appropriate sample containers, as specified by the analytical laboratory and in accordance with Table 5-5 of the FSP (CH2M HILL, 2007a).

Immediately after sampling the drain-down solution, the containers were labeled and placed on ice. Prior to shipping to the laboratory, all samples were field screened for radiological activity. No readings exceeded background levels, as interpreted by EDi radiological field personnel. According to the FSP, 10 drain-down solution sampling locations (2 per HLP) were initially planned. These locations were selected discretely, with one sample per HLP intended to characterize the primary collection pond associated with that HLP and a second sample selected to assess the perimeter collection ditch associated with the HLP. Of the 10 planned sampling locations, 8 contained sufficient volumes of solution for sampling. Two of the planned sampling locations, one each at the Phase III 4X HLP and the Mega Pond, were dry at the time of sampling. Two of the perimeter ditch sampling locations were changed in the field to areas that contained sufficient drain-down solution for sampling. The actual drain-down solution sampling locations, relative to planned sampling locations, are shown on Figure 2-1 (Group A) and Figure 2-2 (Group B). Table 2-3 shows drain-down fluid sampling information, including the sampling locations and coordinates.

TABLE 2-3
Summary of Drain-down Solution Sampling Locations
Remedial Investigation Report, Arimetco Facilities Operable Unit 8, Anaconda Copper Yerington Mine

HLP	Sample Identifier	Solution Location	Notes	Sampling Location Coordinates[a]
Phase I/II	H12DD01	Phase I Sump/Pond		N 38° 59' 25.5" W 119° 11' 39.8"
Phase I/II	H12DD02	Phase I/II PLS Pond		N 38° 59' 35.0" W 119° 11' 43.5"
Phase III South	H3SDD01	Phase III Bathtub Pond	Pond subsequently backfilled and closed by EPA	N 38° 59' 33.0" W 119° 12' 08.7"
Phase III South	H3SDD02	Mega Pond	Dry	
Phase III IVX	H3XDD01	Low Point		N 38° 59' 51.6" W 119° 12' 27.4"
Phase III IVX	H3XDD02	Drainage Ditch	Dry	
Phase IV Slot	H4SDD01	Phase IV Slot PLS Pond		N 38° 59' 15.5" W 119° 11' 08.0"
Phase IV Slot	H4SDD02	Drainage Ditch		N 38° 59' 25.0" W 119° 11' 12.2"
Phase IV VLT	H4VDD01	Phase IV VLT PLS Pond		N 39° 00' 52.0" W 119° 23' 28.8"
Phase IV VLT	H4VDD02	Drainage Ditch		N 39° 00' 42.8" W 119° 23' 21.8"

[a]Nevada State Plane (NAD), Nevada West, U.S. Survey Feet

Notes:
N = north
W = west

Drain-down fluid samples were shipped in accordance with chain-of-custody (CoC) protocols to the EPA Region 9 Laboratory for inorganic and chemical analyses and to the National Air and Radiation Environmental Laboratory (NAERL) for radiochemistry analyses. Analytical results are presented and evaluated in Section 4.2.

2.3 Heap Leach Pad Borings

Drilling and subsurface sampling were conducted between September 25 and October 17, 2007, by using a Boart Longyear sonic drilling rig configured with an 8-inch-diameter drill pipe and a 7-inch core. The sonic drilling process provided a continuous core comprised primarily of fine to boulder-size particles. Drilling and subsurface sampling was performed to characterize the composition of the HLPs and assess the presence and distribution of COPCs within the HLPs.

Sixteen borehole locations were randomly selected by using a polygon overlay of the upper decks of both HLP groups (Groups A and B). Thirteen borehole locations were selected for Group A and three borehole locations were selected for Group B (CH2M HILL, 2007a). In general, drilling depths were less than estimated in the FSP because the HLP heights at the borehole locations were lower than the heights listed in Table 2-2 of the FSP (CH2M HILL, 2007a).

Composite samples were collected at 20-foot intervals; discrete samples were collected at specific depths, as stated in the FSP (CH2M HILL, 2007a). Borehole sample intervals and depths are shown on the boring logs (see Appendix B). Composite sampling for chemical and radiological analysis was conducted by collecting an equal mass of HLP material every 20 feet over the sampling interval. The HLP material was thoroughly mixed in a 5-gallon bucket configured with a heavy-duty disposable drum liner and placed into the appropriate sample container. Drum liners used for composite sampling were discarded after each borehole to prevent cross contamination between sampling locations. Discrete sampling for geotechnical analysis was conducted at specified intervals. At the conclusion of drilling, boreholes were backfilled with drill cuttings to within approximately 20 feet of the HLP surface (except at locations H4VSU03 and H12SU02, where collapse occurred within approximately 10 and 3 feet of the HLP surface, respectively). The upper portion of each borehole was capped with cement slurry to the surface of the HLP.

Three drilling locations were moved because of safety considerations or drill rig accessibility. Actual boring and subsurface sampling locations are shown on Figure 2-3 (Group A) and Figure 2-2 (Group B). Subsurface sampling/drilling within Group A and Group B HLPs is discussed in the following sections.

2.3.1 Group A Heap Leach Pads

Group A includes the contiguous Phase I/II, Phase III South, Phase III 4X, and Phase IV Slot HLPs. Two borings were advanced on the Phase I/II HLP, and four borings were advanced on the Phase III South HLP. Phase III 4X had three borings, and four borings were advanced in the Phase IV Slot HLP. Table 2-4 presents the Group A subsurface sampling information, including sampling depths and sampling location coordinates.

TABLE 2-4
Summary of Group A Subsurface Sampling Locations
Remedial Investigation Report, Arimetco Facilities Operable Unit 8, Anaconda Copper Yerington Mine

HLP	Sample Identifier	Total Depth of Boring (feet)	Sampling Depth (feet)	Sampling Location Coordinates[a]
Phase I/II	H12SU01	77	20, 40, 60	N 38° 59' 29.5" W 119° 11' 43.1"
Phase I/II	H12SU02	77	20, 40, 60	N 38° 59' 24.5" W 119° 11' 45.0"
Phase III South	H3SSU01	97	20,40,60, 80	N 38° 59' 38.9" W 119° 12' 11.5"
Phase III South	H3SSU02	112	20,40,60,80,100, 112	N 38° 59' 36.4" W 119° 12' 15.3"
Phase III South	H3SSU03	117	20,40,60,80,100	N 38° 59' 40.3" W 119° 12' 19.0"
Phase III South	H3SSU04	117	20,40,60,80,100	N 38° 59' 41.8" W 119° 12' 21.3"
Phase III 4X	H3XSU01	67	20, 40, 60	N 38° 59' 44.7" W 119° 12' 36.9"
Phase III 4X	H3XSU02	67	20, 40, 60	N 38° 59' 45.9" W 119° 12' 41.2"
Phase III 4X	H3XSU03	67	20, 40, 60	N 38° 59' 50.1" W 119° 12' 38.4"
Phase IV Slot	H4SSU01	77	20, 40, 60	N 38° 59' 19.6" W 119° 11' 18.9"
Phase IV Slot	H4SSU02	27	20	N 38° 59' 16.0" W 119° 11' 22.2"
Phase IV Slot	H4SSU03	77	20, 40, 60	N 38° 59' 21.2" W 119° 11' 23.3"
Phase IV Slot	H4SSU04	57	20,40	N 38° 59' 23.6" W 119° 11' 23.4"

[a]Nevada State Plane (NAD), Nevada West, U.S. Survey Feet

Notes:
N = north
W = west

Group A subsurface samples were shipped in accordance with CoC protocols to four laboratories. NAERL conducted radiochemistry analyses. Physical analysis (pH and electrical conductivity, and geotechnical parameters [NAG, ABA]) and agricultural analysis (sodium adsorption ratio) were performed by Agricultural and Priority Pollutants Laboratory, Inc. (APPL). Samples for SPLP, TAL metals, and TPH (as diesel and kerosene) were analyzed by the EPA Region 9 Laboratory; geotechnical analysis was performed by Sierra Testing Laboratory. Analytical results are presented and evaluated in Section 4.3.

The estimated height of the Phase III South HLP was 168 feet; the actual drilling depth at borehole location H3SSU02 extending to 112 feet before contacting the HLP liner. This was the only borehole where the HLP liner was encountered. The borehole was sealed at total depth by using four bags of hydrated bentonite and 50 gallons of water; the borehole was then backfilled with cuttings and capped with Quickcrete. Borehole sample intervals and depths are shown in the boring logs (see Appendix B).

2.3.2 Group B Heap Leach Pad

Group B specifically refers to the Phase IV VLT HLP, which is comprised almost exclusively of processed VLT and oxide tailing materials. The material had been previously crushed to 0.5 inches in diameter and vat leached by Anaconda. The three locations were randomly selected for subsurface sampling/drilling for Group B. Table 2-5 presents the Group B subsurface sampling information, including the sampling depths and sampling location coordinates.

TABLE 2-5
Summary of Group B Subsurface Sampling Locations
Remedial Investigation Report, Arimetco Facilities Operable Unit 8, Anaconda Copper Yerington Mine

HLP	Sample Identifier	Total Depth of Boring (feet)	Sampling Depth (feet)	Sampling Location Coordinates[a]
Phase IV VLT	H4VSU01	107	20, 40, 60, 80, 100	N 39° 00’ 43.2” W 119° 12’ 32.4”
Phase IV VLT	H4VSU02	107	20, 40, 60, 80, 100	N 39° 00’ 39.8” W 119° 12’ 30.0”
Phase IV VLT	H4VSU03	87	20, 40, 60, 80	N 39° 00’ 38.4” W 119° 12’ 29.6”

[a]Nevada State Plane (NAD), Nevada West, U.S. Survey Feet

Notes:
N = north
W = west

Group B subsurface samples were shipped in accordance with CoC protocols to the same four laboratories as Group A samples (APPL, EPA Region 9, NAERL, APPL, and Sierra Testing Laboratories). Analytical results are presented and evaluated in Section 4.3.

2.4 Surface Heap Leach Pad Material Sampling

As described in the FSP (CH2M HILL, 2007a), 40 surface sampling locations were randomly selected for data collection. All locations were identified by using a hand-held GPS instrument. Several locations were repositioned for safety reasons, including the presence of broken and uneven terrain or because the location was situated on the side slope of an individual lift. Surface sampling locations are shown on Figure 2-3 (Group A) and Figure 2-2 (Group B).

Random sampling locations were found to be representative of surface visual and physical conditions of the area being sampled. Prior to surface sample collection, the upper 1 to 2 inches of HLP materials were scraped by using a decontaminated stainless steel trowel to expose a fresh surface. After approximately 3 square-feet of “cemented” surface material had been removed to a depth of approximately 3 inches, a disposable trowel was used to collect and homogenize the HLP surface sample. As specified in the FSP

(CH2M HILL, 2007a), HLP surface samples were collected to a maximum depth of 9 inches below the HLP surface.

Group A and Group B surface samples were shipped in accordance with CoC protocols to four laboratories. NAERL conducted radiochemistry analyses. Physical analysis (pH and electrical conductivity, geotechnical parameters [NAG, ABA]) and agricultural analysis (sodium adsorption ratio) were performed by APPL. Samples for SPLP, TAL metals and TPH (as kerosene) were analyzed by the EPA Region 9 Laboratory, and geotechnical analyses were performed by Sierra Testing Laboratory. Analytical results are presented and evaluated in Section 4.3.

2.4.1 Group A Heap Leach Pads

As previously described, Group A comprises Phase I/II, Phase III South, Phase III 4X, and Phase IV Slot HLPs. Thirty surface samples were obtained from the Group A. Four samples were collected from the Phase I/II HLP. Eight surface samples were collected from Phase III South HLP and Phase III 4X HLP. Ten samples were collected from Phase IV Slot HLP. Table 2-6 presents the Group A surface sampling information, including sampling depths and sampling location coordinates.

TABLE 2-6
Summary of Group A Surface Sampling Locations
Remedial Investigation Report, Arimetco Facilities Operable Unit 8, Anaconda Copper Yerington Mine

HLP	Sample Identifier	Depth (inches)	Notes	Sampling Location Coordinates[a]
Phase I/II	H12SS01	0 – 9	Collected on HLP slope above Phase I/II PLS Pond	N 38° 59' 33.7" W 119° 11' 43.2"
Phase I/II	H12SS02	0 – 9	Collected above second bench on side slope	N 38° 59' 25.3" W 119° 11' 47.8"
Phase I/II	H12SS03	0 – 9	Collected above second bench above Phase I Pond	N 38° 59' 26.3" W 119° 11' 41.5"
Phase I/II	H12SS04	0 – 9	Collected adjacent to Borehole H12SU02 on top of HLP; moved from original location because it was too steep to access	N 38° 59' 23.0" W 119° 11' 45.4"
Phase III South	H3SSS01	0 – 9	Collected adjacent to Borehole H3SSU01 below the berm	N 38° 59' 39.1" W 119° 12' 12.0"
Phase III South	H3SSS02	0 – 9		N 38° 59' 37.7" W 119° 12' 23.2"
Phase III South	H3SSS03	0 – 9		N 38° 59' 32.1" W 119° 12' 19.0"
Phase III South	H3SSS04	0 – 9	Collected from collection ditch on south side of HLP	N 38° 59' 29.9" W 119° 12' 09.3"
Phase III South	H3SSS05	0 – 9	Moved to top of the HLP; original location was on steep slope with poor access	N 38° 59' 44.2" W 119° 12' 20.5"
Phase III South	H3SSS06	0 – 9		N 38° 59' 37.1" W 119° 12' 19.5"
Phase III South	H3SSS07	0 – 9	Collected immediately below road, adjacent to Borehole H3SSS04	N 38° 59' 42.5" W 119° 12' 22.9"

TABLE 2-6
Summary of Group A Surface Sampling Locations
Remedial Investigation Report, Arimetco Facilities Operable Unit 8, Anaconda Copper Yerington Mine

HLP	Sample Identifier	Depth (inches)	Notes	Sampling Location Coordinates[a]
Phase III South	H3SSS08	0 – 9	Collected in “mogul” area on southwest side of the HLP, above the former Phase III Bathtub Pond	N 38° 59’ 30.9” W 119° 12’ 11.4”
Phase III 4X	H3XSS01	0 – 9	Collected immediately above collection ditch	N 38° 59’ 58.4” W 119° 12’ 33.9”
Phase III 4X	H3XSS02	0 – 9		N 38° 59’ 45.7” W 119° 12’ 44.5”
Phase III 4X	H3XSS03	0 – 9		N 38° 59’ 43.6” W 119° 12’ 34.5”
Phase III 4X	H3XSS04	0 – 9	Very fine precipitate collected between “groove” on top of the HLP	N 38° 59’ 46.9” W 119° 12’ 33.4”
Phase III 4X	H3XSS05	0 – 9	Moved from steep slope to top of pad	N 38° 59’ 53.4” W 119° 12’ 37.8”
Phase III 4X	H3XSS06	0 – 9		N 38° 59’ 49.4” W 119° 12’ 32.5”
Phase III 4X	H3XSS07	0 – 9		N 38° 59’ 44.0” W 119° 12’ 37.2”
Phase III 4X	H3XSS08	0 – 9		N 38° 59’ 51.8” W 119° 12’ 34.4”
Phase IV Slot	H4SSS01	0 – 9	Moved to bottom of pad; original location was on steep slope	N 38° 59’ 21.4” W 119° 11’ 32.1”
Phase IV Slot	H4SSS02	0 – 9		N 38° 59’ 14.1” W 119° 11’ 16.0”
Phase IV Slot	H4SSS03	0 – 9		N 38° 59’ 20.5” W 119° 11’ 19.3”
Phase IV Slot	H4SSS04	0 – 9		N 38° 59’ 20.7” W 119° 11’ 16.6”
Phase IV Slot	H4SSS05	0 – 9		N 38° 59’ 28.0” W 119° 11’ 28.7”
Phase IV Slot	H4SSS06	0 – 9		N 38° 59’ 26.7” W 119° 11’ 17.6”
Phase IV Slot	H4SSS07	0 – 9	Moved from proposed location because of poor access	N 38° 59’ 19.1” W 119° 11’ 25.4”
Phase IV Slot	H4SSS08	0 – 9	Collected from side slope on north end of the HLP	N 38° 59’ 28.7” W 119° 11’ 31.4”
Phase IV Slot	H4SSS09	0 – 9		N 38° 59’ 18.1” W 119° 11’ 13.2”
Phase IV Slot	H4SSS10	0 – 9	Collected immediately above collection ditch where H4SDD01 was sampled	N 38° 59’ 15.9” W 119° 11’ 09.3”
Phase IV VLT	CAPSS01	0 – 9	Collected from “red dust” outcrop on south side of VLT	N 39° 00’ 14.2” W 119° 12’ 31.0”
Phase IV VLT	CAPSS02	0 – 9	Collected from “green” layer on east side of VLT	N 38° 00’ 01.6” W 119° 12’ 38.2”

TABLE 2-6
Summary of Group A Surface Sampling Locations
Remedial Investigation Report, Arimetco Facilities Operable Unit 8, Anaconda Copper Yerington Mine

HLP	Sample Identifier	Depth (inches)	Notes	Sampling Location Coordinates[a]
Phase IV VLT	CAPSS03	0 – 9	Collected from outside “explosives area”; high concentration of disposed tin cans	N 38° 00’ 09.7” W 119° 12’ 58.1”
Phase IV VLT	CAPSS04	0 – 9	Collected from top bench on west side of VLT; “yellowish” deposit	N 38° 00’ 11.0” W 119° 12’ 38.7”

[a]Nevada State Plane (NAD), Nevada West, U.S. Survey Feet

Notes:
N = north
W = west

2.4.2 Group B Heap Leach Pad

The Phase IV VLT HLP (Group B) was characterized by collecting and analyzing 10 surface samples. Table 2-7 presents Group B surface sampling information, including sampling depths and sampling location coordinates.

TABLE 2-7
Summary of Group B Surface Sampling Locations
Remedial Investigation Report, Arimetco Facilities Operable Unit 8, Anaconda Copper Yerington Mine

HLP	Sample Identifier	Depth (inches)	Notes	Sampling Location Coordinates[a]
Phase IV VLT	H4VSS01	0 – 9	Collected sample adjacent to the collection ditch	N 39° 00’ 39.7” W 119° 12’ 19.7”
Phase IV VLT	H4VSS02	0 – 9		N 39° 00’ 31.8” W 119° 12’ 35.1”
Phase IV VLT	H4VSS03	0 – 9		N 39° 00’ 38.5” W 119° 12’ 24.2”
Phase IV VLT	H4VSS04	0 – 9		N 39° 00’ 43.2” W 119° 12’ 32.4”
Phase IV VLT	H4VSS05	0 – 9		N 39° 00’ 39.8” W 119° 12’ 30.0”
Phase IV VLT	H4VSS06	0 – 9		N 39° 00’ 38.4” W 119° 12’ 29.6”
Phase IV VLT	H4VSS07	0 – 9		N 39° 00’ 43.2” W 119° 12’ 32.4”
Phase IV VLT	H4VSS08	0 – 9		N 39° 00’ 41.1” W 119° 12’ 41.3”
Phase IV VLT	H4VSS09	0 – 9		N 39° 00’ 38.4” W 119° 12’ 29.6”
Phase IV VLT	H4VSS10	0 – 9	Encountered high concentration of copper salts on the HLP	N 39° 00’ 38.4” W 119° 12’ 29.6”

[a]Nevada State Plane (NAD), Nevada West, U.S. Survey Feet

Notes:
N = north
W = west

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FIGURE 2-1
DRAIN-DOWN SAMPLING LOCATIONS – GROUP A HEAP LEACH PADS
ANACONDA COPPER YERINGTON MINE

ES052008022RDD_2-1 (5/30/08)

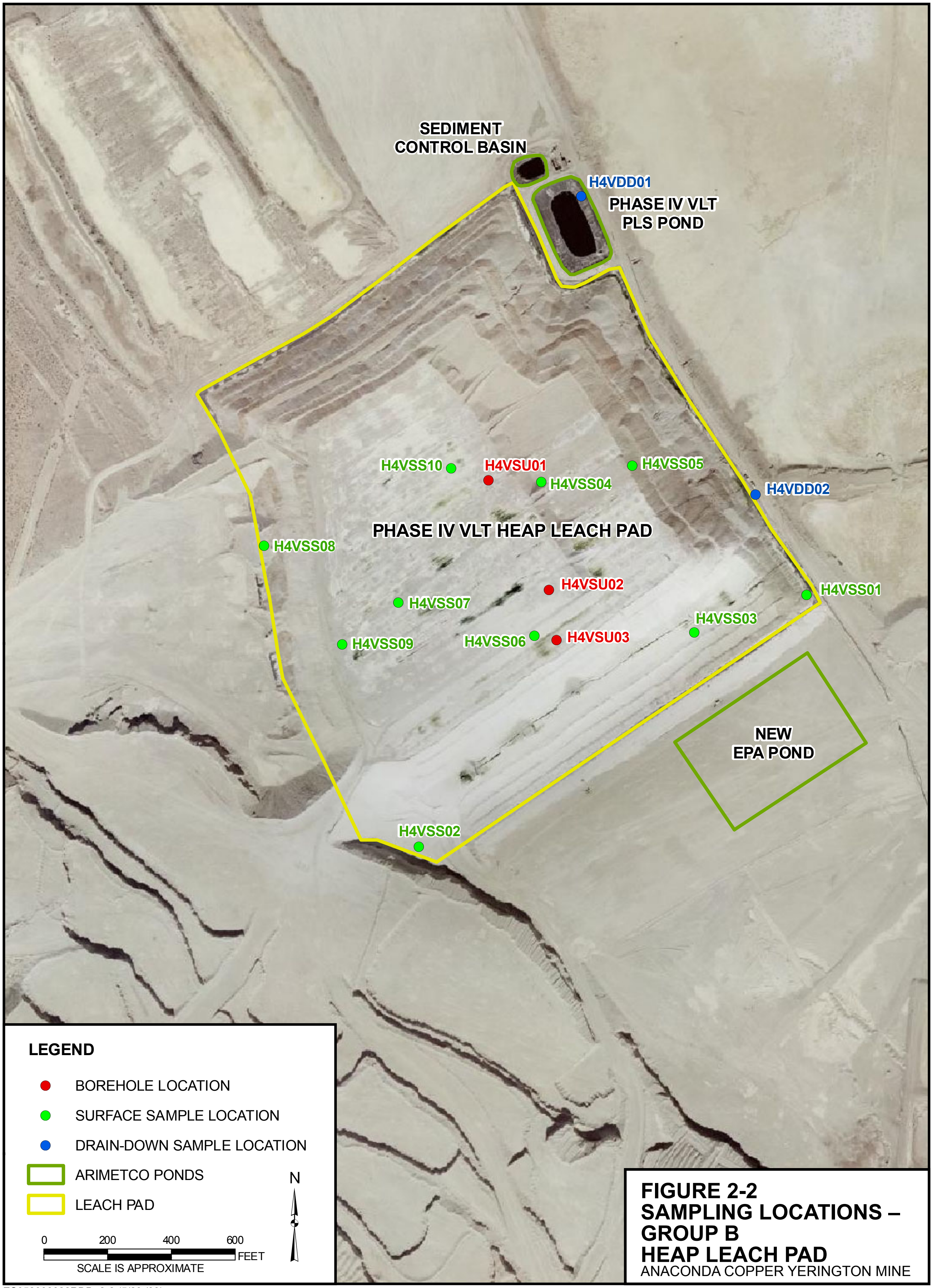

FIGURE 2-2
SAMPLING LOCATIONS –
GROUP B
HEAP LEACH PAD
ANACONDA COPPER YERINGTON MINE

ES052008022RDD_2-2 (5/29 /08)

FIGURE 2-3
BOREHOLE AND SURFACE SAMPLING LOCATIONS – GROUP A HEAP LEACH PADS
ANACONDA COPPER YERINGTON MINE

ES052008022RDD_2-3 (5/29 /08)

SECTION 3

Site Physical Characteristics

This section describes the climate, topography, geologic, hydrogeologic, and soil conditions at the Site. The ecologic setting and vegetation communities are also described. This section summarizes and supplements information provided in the *Draft Revised Conceptual Site Model, Yerington Mine Site* (ARC, 2007).

3.1 Demographics

Lyon County, Nevada covers approximately 1,993 square miles, and its population in 2005 was 47,515 (U.S. Census Bureau, 2005). Communities near the Site include Yerington (population 3,486), Weed Heights (population 500), and the Yerington Paiute Tribe (approximate population 575). The regional population and industrial centers near the Site include Fernley (47 miles north), Fallon (59 miles northwest), Hawthorne (57 miles southeast), and Reno (85 miles northwest). Yerington's economic base is primarily agriculture.

3.2 Climate

The climate in Lyon County is warm and arid. The average annual precipitation is approximately 5.13 inches in Yerington (Desert Research Institute, 2007). The average monthly temperature for the period of record (from January 1, 1914 through October 31, 2006) ranges from a maximum of 92.2 degrees Fahrenheit (°F) in July to a minimum of 17.6°F in January.

3.3 Topography, Geology, and Soils

The Site is located on the west side of Mason Valley, a structural basin surrounded by uplifted mountain ranges. Mason Valley is bordered by the Singatse Range to the west, the Desert Mountains to the north, and the Wassuk Range to the east. The Site is located on the flank of the Singatse Range, on an east-facing alluvial fan. The mountain blocks are primarily composed of granitic, metamorphic, and volcanic rocks with minor amounts of semiconsolidated to unconsolidated alluvial fan deposits. The Singatse Range has been subject to metals mineralization, as evidenced by the large copper porphyry ore deposit at the Site. A geologic map of the Yerington District that describes these features has been published (Proffett and Dilles, 1984). The Yerington orebody is contained in the Yerington Batholith, a series of Jurassic-age, hydrothermally altered, granodioritic, intrusive rocks that comprise the local crystalline basement. The basement rock is exposed in the McLeod Hill region east of the Site and in the walls of the Yerington Pit. The Yerington Batholith is overlain by a Tertiary volcanic series, which is overlain by Quaternary alluvial and fluvial deposits associated with the post basin and range extension.

Unconsolidated alluvial deposits, derived from erosion of the uplifted Singatse Range mountain block and alluvial materials deposited by the Walker River fill the Mason Valley near the Site. These unconsolidated deposits, collectively called the valley-fill deposits (Huxel, 1969), comprise four geologic units: younger alluvium (including the lacustrine deposits of Lake Lahontan), younger fan deposits, older alluvium, and older fan deposits. Lake Lahontan lacustrine deposits appear to have been removed and reworked by the Walker River as it meandered across the valley (Huxel, 1969). Huxel estimated that Pleistocene Lake Lahontan in Mason Valley existed for a relatively short time and was less than 60 feet deep.

The geologic setting of the area around the Site is described in existing literature and subsurface data obtained by the USGS in 1978 while drilling test wells (i.e., monitoring wells) north of the Site (Seitz et. al, 1982). Alluvial fan deposits along the west margin of the valley and stream and lake sediments on the valley floor underlie the tailings and evaporation ponds. The lithology of core samples collected during this investigation indicate that the alluvial fan underlying the Site comprises generally fine-grained mud-flow deposits and coarser-grained channel deposits.

3.4 Seismicity

The state of Nevada lies within the Basin and Range Province, one of the most seismically active regions in the United States. Along with California and Alaska, Nevada ranks in the top three states subject to the largest earthquakes over the last 150 years. Magnitude 3 and 4 earthquakes are commonly felt, but rarely cause damage. Minor to moderate damage can accompany a Magnitude 5 or 6 event, and major damage commonly occurs from earthquakes of Magnitude 7 and greater. The average frequency of Magnitude 6 earthquakes and greater in Nevada has been about once every 10 years; Magnitude 7 earthquakes and greater average once every 27 years (Nevada Seismological Laboratory, 2008).

The most recent USGS Seismic Hazard Map (2008) shows the peak ground acceleration (PGA) for the Yerington area is approximately 35 percent g (g = the acceleration of gravity). The Nevada Bureau of Mines and Geology (2006) estimates that a Magnitude 6.0 earthquake has an approximate 60 percent chance of occurring within 50 kilometers of Yerington, Nevada, within the next 50 years; a Magnitude 6.5 earthquake has a 40 to 45 percent chance and a Magnitude 7.0 earthquake has a 12 percent chance of occurring there within that time.

3.5 Hydrology and Groundwater

The principal source of recharge to the alluvial aquifer beneath the Site is the Walker River (Huxel, 1969), which is located immediately east of the site. Minor recharge from the Singatse Range to the groundwater flow system beneath the Site might also occur. Recharge from direct precipitation is negligible (Huxel, 1969) because of the low annual average precipitation (5.13 inches per year) at the Site (Desert Research Institute, 2007). Additional recharge to groundwater in the area comes from agricultural practices, including the use of surface water and the conveyance of surface water in the West Walker Ditch to agricultural areas immediately east and north of the Site (ARC, 2002a). Groundwater flow is generally to the north and northwest (Seitz et. al, 1982).

The ponds and ditches associated with the HLPs have exhibited leakage through primary liners into the leak detection systems, and there is potential leakage through the secondary liners (ARC, 2002a). Degradation of groundwater quality caused by solution leakage might have occurred. ARC is currently conducting groundwater investigations at the Site and will initiate a detailed sitewide assessment of groundwater conditions. Although the ARC sitewide investigation may include an evaluation of groundwater flow and quality near the HLPs, EPA will identify any data gaps pertaining to the Arimetco facilities that will not be addressed by the ARC investigation and may propose supplemental RI data collection to fill those data gaps.

3.6 Ecological Setting

The ecological setting throughout much of the Site has experienced significant disturbance as a result of past mining. Other areas are less severely disturbed and retain areas of sandy soil interspersed with vegetation typical of the sagebrush-steppe vegetative mix of shrubs, forbs, and grasses.

The major natural aquatic feature near the Site is the Walker River, which flows north-northeast between the Site and the town of Yerington. The Walker River flows within 0.25 mile of the southeastern end of the Site. Although riparian systems comprise an extremely small fraction of the Great Basin region, they are critical centers of biodiversity; more than 75 percent of the species in the region are strongly associated with riparian vegetation (Brussard and Dobkin 2006). The Walker River is typical of Great Basin riparian systems, which are dominated by woody plants, such as cottonwood, aspen, and willow. Saltbush may be abundant where riverbank soil is saline. The riparian corridor of the Walker River provides habitat for resident and migrating wildlife. The proximity of the Site to the Walker River likely increases use of the Site by wildlife.

Past activities at the Site have created aquatic areas that could attract wildlife. These areas include Pit Lake, wastewater treatment ponds; pump-back evaporation ponds, and the lined evaporation and drain-down ponds that seasonally retain water and drain-down solution. These features may provide drinking water for wildlife at the Site, resting areas for migratory birds, and a source of emergent vegetation for forage and cover for migrating and resident wildlife.

3.7 Vegetation

The terrestrial ecosystem near the Site is characterized by an arid sagebrush-steppe vegetative community that is dominated by sagebrush and other low-lying woody vegetation, interspersed with a variety of forbs and grasses (ARC, 2007). Livestock and wildlife preference for grasses contributes to the domination of vegetation in this system by sagebrush and other shrubs (Ricketts et al. 1999).

SECTION 4

Nature and Extent of Contamination

From the investigation data (see Section 2), the nature and extent of COPCs within the HLPs were evaluated. Results of the radiological survey and the drain-down solution and HLP material analyses (i.e., metals, geochemical, and geotechnical analyses) are summarized in the following sections.

4.1 Radiological Survey Results

Background radiological measurements were collected at several onsite locations prior to the walkover survey and on a daily basis during the survey. The background count rates ranged from approximately 13,000 counts per minute (cpm) to 16,000 cpm. The average background count rate was 14,595 cpm; the standard deviation was ±2,895 cpm.

Relative to these background radiological values, there were some areas with slightly elevated counts during the walkover survey, but none of the values were greater than three standard deviations above the mean background count rate. The walkover survey was designed to cover as much area as possible on the HLP top decks. Several areas were not accessible because of large boulders and shoulder-high mounds. Inaccessible areas (identified by safety concerns, uneven footing, and hazardous terrain) were not surveyed. These areas appear as gaps on the figures in the *Radiological Gamma Walkover Survey* (EDi, 2007) (see Appendix A).

Data files were plotted on a cumulative frequency diagram that represents the path of the walkover survey and the corresponding gamma count rates. The HLP survey maps provide a color-coded representation of count rate ranges as well as the minimum, maximum, and average count rates. These count rates are summarized in Table 4-1.

TABLE 4-1
Summary of Heap Leach Pad Minimum, Maximum, and Average Gross Gamma Count Rates
Remedial Investigation Report, Arimetco Facilities Operable Unit 8, Anaconda Copper Yerington Mine

Phase I/II HLP: Maximum Count Rate: 14,248 cpm Minimum Count Rate: 9,807 cpm Average Count Rate: 12,908 cpm	Phase III 4X HLP: Maximum Count Rate: 23,417 cpm Minimum Count Rate: 10,267 cpm Average Count Rate: 14,887 cpm
Phase III South HLP and Phase III Bathtub Pond: Maximum Count Rate: 16,625 cpm Minimum Count Rate: 9,766 cpm Average Count Rate: 14,068 cpm	Phase IV Slot HLP: Maximum Count Rate: 19,965 cpm Minimum Count Rate: 9,418 cpm Average Count Rate: 15,911 cpm
Phase IV Vat HLP: Maximum Count Rate: 21,675 cpm Minimum Count Rate: 11,691 cpm Average Count Rate: 15,640 cpm	

HLP material samples collected for laboratory analyses of radiological isotopes were screened in the field for gross alpha, beta, and gamma activity in the field. EDi did not identify any samples that had elevated (above background) radiological readings during the field screening.

An assessment of data quality for HLP material radiological samples concluded that these data satisfy the assumptions under which the DQOs (CH2M HILL, 2007a) and the data collection design were developed (e.g., if radiological results support a consistent interpretation of the data, data evaluation, risk assessment, development of remedial alternatives can proceed). The data are within tolerable decision error rates and support the stated objectives; the data are adequate and complete pursuant to EPA guidelines (EPA, 1994).

4.2 Drain-down Solution Sample Results

The drain-down solution samples obtained to support the RI represent a single data point for each of the ponds and ditches tested. The limited scope of this sampling may not yield results representative of the full range of potential COPC concentrations in Arimetco ponds and ditches.

Between September 9 and 13, 2007, eight drain-down solution samples were collected from HLP perimeter ditches and ponds for NDEP Profile II and radiological analysis. Two of the planned 10 sampling locations (Phase III 4X HLP and Mega Pond) contained insufficient volumes of drain-down solution for sampling. Two quality control samples (FDs) were also collected during the September sampling event, which is during the driest part of the year, when solution is concentrated and the volume of drain-down solution is minimal.

The pH ranged from 1.9 to 2.8, specific conductance ranged from 31,000 to 45,000 micromhos per centimeter, and numerous metals (aluminum, antimony, arsenic, beryllium, boron, cadmium, chromium, copper, iron, lead, manganese, mercury, thallium and zinc) exceeded primary or secondary drinking water maximum contaminant levels (MCL). Radiological data results were found to generally exceed the MCL for thorium isotopes 228, 230, and 232; uranium isotopes 234, 235, 238; and gross alpha particles. Concentrations of TPH (as diesel) ranged from 750 to 2,100 micrograms per liter (μg/L). All samples exceeded the Nevada cleanup guideline for TPH of 1,000 μg/L, except for the Phase III 4X HLP, which was 750 μg/L. Concentrations of TPH as kerosene ranged from 1,500 to 2,100 μg/L and also exceed the Nevada TPH cleanup guideline of 1,000 μg/L. A summary of TPH, metals and geochemical detections for drain-down solution samples, including the minimum and maximum detections, geometric mean and standard deviation, number of detections, number of results, and frequency of detection are presented in Table 4-2.

TABLE 4-2
Summary of Detections Drain-down Solution Samples
Remedial Investigation Report, Arimetco Facilities Operable Unit 8, Anaconda Copper Yerington Mine

Analyte	Units	Number of Results	Number of Detects	Frequency of Detection (%)	Range of Detected Concentrations	Geomean	Standard Deviation
Metals							
Aluminum	µg/L	8	8	100	9,000,000 to 27,000,000	17,300,000	6,820,000
Antimony	µg/L	8	2	25	160 to 200	550	287
Arsenic	µg/L	8	3	37.5	110 to 280	181	44.7
Barium	µg/L	8	0	0	Non-detect	100	0.00
Beryllium	µg/L	8	8	100	550 to 1,500	1,010	366
Boron	µg/L	8	8	100	1,100 to 2,500	1,670	412
Cadmium	µg/L	8	8	100	170 to 420	287	95.2
Calcium	µg/L	8	8	100	420,000 to 600,000	510,000	73,700
Chromium	µg/L	8	8	100	460 to 2,100	1,330	550
Cobalt	µg/L	8	8	100	28,000 to 70,000	44,700	15,200
Copper	µg/L	8	8	100	1,700,000 to 5,700,000	3,100,000	1,420,000
Iron	µg/L	8	8	100	210,000 to 1,100,000	466,000	282,000
Lead	µg/L	8	0	0	Non-detect	800	0.00
Lithium	µg/L	8	8	100	6,900 to 17,000	11,600	3,510
Magnesium	µg/L	8	8	100	8,600,000 to 23,000,000	15,300,000	5,720,000
Manganese	µg/L	8	8	100	270,000 to 740,000	451,000	172,000
Mercury	µg/L	8	8	100	4.7 to 29	9.61	7.69
Molybdenum	µg/L	8	0	0	Non-detect	200	0.00
Nickel	µg/L	8	8	100	17,000 to 41,000	26,500	8,470
Potassium	µg/L	8	7	87.5	66,000 to 140,000	77,700	36,200
Selenium	µg/L	8	0	0	Non-detect	200	0.00
Silica (SiO_2)	µg/L	8	8	100	100,000 to 250,000	168,000	54,800
Silver	µg/L	8	1	12.5	50	91.7	17.7
Sodium	µg/L	8	8	100	970,000 to 2,400,000	1,660,000	516,000
Strontium	µg/L	8	8	100	140 to 15,000	3,380	4,490
Thallium	µg/L	8	4	50	380 to 890	717	157
Tin	µg/L	8	0	0	Non-detect	9,460	6,140
Titanium	µg/L	8	8	100	180 to 1,100	466	368
Vanadium	µg/L	8	8	100	65 to 1,100	180	347
Zinc	µg/L	8	8	100	26,000 to 67,000	44,100	15,900
TPH							
As diesel	µg/L	8	8	100	750 to 2,100	1,470	430
As kerosene	µg/L	8	3	37.5	1,500 to 2,100	1,420	516

Appendix C contains a tabular data summary for the analytes reported as non-detect, where the reporting limit is higher than the screening level (e.g., preliminary remediation goal [PRG], MCL, and tap water standards). The table includes the sample dilution factor and the most restrictive screening level (usually tap water standards for drain-down solution). The dilution factors represent the analytical dilution factor. There is an additional factor of 10 dilutions applied during sample preparation that is not included by the laboratory in the Tier 1 deliverable or the electronic data deliverable. The samples were analyzed by the EPA Region 9 Laboratory by EPA Method 200.7, which is an inductively coupled plasma /atomic emission spectrometry (ICP/AES) method essentially identical to the planned Contract Laboratory Program statement of work method. Because of the high concentrations of metals and minerals in the drain-down solution, some reporting limits are higher than planned because the samples were not appropriate for inductively coupled plasma /mass spectrometry analysis (ICP/MS).

An assessment of data quality for drain-down solution samples concluded that these data satisfy the assumptions under which the DQOs (CH2M HILL, 2007a) and the data collection design were developed. However, because limited data were obtained from the drain-down ponds and ditches, statistical calculations could not be performed to verify the assumptions for these DQOs, and the data are likely insufficient to support decisions within tolerable decision error rates. Although this might represent a data gap, these initial drain-down sample results were not used to evaluate whether the data were below applicable action levels but rather to support consideration of potential future fluids-management response actions.

4.3 Heap Leach Pad Material Sample Results

Surface and subsurface samples from the HLPs were collected for physical property, TPH (as diesel, kerosene, and motor oil), metals, SPLP, radiological, geotechnical, geochemical, and agricultural analyses. Samples were also collected from VLT that could potentially be used to cap the HLPs. Sampling locations are shown on Figures 2-3 and 2-4. A summary of TPH (as diesel, kerosene, and motor oil), metals, and geochemical detections for HLP material samples, including the minimum and maximum detections, geometric mean and standard deviation, number of detections, number of results, and frequency of detection are presented in Table 4-3. Tabular summaries of the data results are provided in Appendix D.

In general, data show that pH values for surface and subsurface soil samples ranged from 2.66 to 7.89, and metal concentrations exceeded EPA Region 9 residential PRGs for arsenic, copper, and iron. SPLP results indicated that aluminum, copper, iron, and manganese exceeded the primary or secondary MCL. One surface soil sample (H4SSS03) contained 170 mg/kg TPH (as diesel), which exceeds the Nevada cleanup goal of 100 mg/kg for TPH. Additional discussions about metals, TPH, geochemical, agricultural, geotechnical, and radiological results are presented in the following sections.

TABLE 4-3
Summary of Detections Heap Leach Pad Material Samples
Remedial Investigation Report, Arimetco Facilities Operable Unit 8, Anaconda Copper Yerington Mine

Analyte	Units	Number of Results	Number of Detects	Frequency of Detection (%)	Range of Detected Concentrations	Geomean	Standard Deviation
Geochemicals							
Acid Generation Potential (calc on Sulfur total)	t $CaCO_3$/kt	25	25	100	12 to 37	21.5	5.34
Acid Neutralization Potential (calc)	t $CaCO_3$/kt	25	9	36	3 to 26	1.27	6.21
Acid-base Accounting (calc on Sulfur total)	t $CaCO_3$/kt	25	0	0	Non-detect	0.50	0.00
NAG Procedure	kg H_2SO_4/t	6	6	100	4 to 6	4.78	0.753
Neutralization Potential as $CaCO_3$	%	25	9	36	0.3 to 2.6	0.127	0.621
Sulfur Organic Residual	%	25	23	92	0.01 to 0.05	0.0222	0.014
Sulfur Pyritic Sulfide	%	25	17	68	0.01 to 0.02	0.00871	0.00455
Sulfur, Sulfate	%	25	25	100	0.36 to 1.17	0.651	0.173
Sulfur, Total	%	25	25	100	0.39 to 1.19	0.686	0.171
Total Sulfur minus Sulfate	%	25	25	100	0.01 to 0.07	0.0296	0.017
Metals							
Aluminum	mg/kg	64	64	100	1,970 to 27,100	7,250	3,420
Antimony	mg/kg	64	64	100	.25 to 7.2	1.03	1.35
Arsenic	mg/kg	64	64	100	1.7 to 119	9.23	14.9
Barium	mg/kg	64	63	98.44	30.9 to 283	62.8	39.6
Beryllium	mg/kg	64	44	68.75	0.06 to 2.6	0.291	0.315
Cadmium	mg/kg	64	8	12.5	0.03 to 1.7	0.278	0.272
Calcium	mg/kg	64	64	100	1,540 to 60,700	5,250	9,340
Chromium	mg/kg	64	64	100	2.1 to 24.2	5.00	3.88
Cobalt	mg/kg	64	57	89.06	1.5 to 69	5.45	10.9
Copper	mg/kg	64	64	100	200 to 22,100	1,250	3,430
Iron	mg/kg	64	64	100	8,510 to 61,100	16,000	7,680
Lead	mg/kg	64	64	100	1.7 to 271	5.45	34.3
Magnesium	mg/kg	64	64	100	735 to 19,800	5,270	2,860
Manganese	mg/kg	64	64	100	20 to 825	65.1	105
Mercury	mg/kg	64	59	92.19	0.029 to 20.2	0.305	2.57
Molybdenum	mg/kg	5	5	100	2.7 to 19	4.97	6.91

TABLE 4-3
Summary of Detections Heap Leach Pad Material Samples
Remedial Investigation Report, Arimetco Facilities Operable Unit 8, Anaconda Copper Yerington Mine

Analyte	Units	Number of Results	Number of Detects	Frequency of Detection (%)	Range of Detected Concentrations	Geomean	Standard Deviation
Nickel	mg/kg	64	56	87.5	0.35 to 49.4	5.02	8.35
Potassium	mg/kg	64	64	100	448 to 14,600	1,280	1,790
Selenium	mg/kg	64	44	68.75	0.47 to 83.3	3.34	10.2
Silver	mg/kg	64	36	56.25	0.09 to 1.9	0.315	0.277
Sodium	mg/kg	64	64	100	64.2 to 3,410	225	441
Thallium	mg/kg	64	44	68.75	0.43 to 6.6	1.03	0.768
Vanadium	mg/kg	64	64	100	8.5 to 53	20.7	7.71
Zinc	mg/kg	64	51	79.69	6.1 to 108	10.1	16.6
TPH							
As diesel	mg/kg	19	13	68.42	2.9 to 170	10.2	41.6
As kerosene	mg/kg	23 0	0	0	Non-detect	8.27	33.1
As motor oil	mg/kg	15	10	66.67	13 to 85	22.1	22.1

Notes:
$CaCO_3$ = calcium carbonate
kg H_2SO_4/t = kilograms of hydrogen sulfide per ton
t $CaCO_3$/kt = tons of calcium carbonate per kiloton

4.3.1 Metals

After receipt of the metals data, and in accordance with FSP Sections 2.4 and 3.0 (CH2M HILL, 2007a), statistical analyses were conducted to determine whether there was significant variability between Group A and Group B data. The HLP analytical results were compared statistically using analysis of variance (ANOVA). When performed on raw data, ANOVA is most valid when the residuals, the differences between actual values, and the calculated means for each potential partition are normally distributed. This assumption is seldom verifiable with environmental data and was shown not to be the case with these data. Therefore, a nonparametric ANOVA method, the Kruskal-Wallis test (which does not depend on any distributional assumptions such as normality), was performed. This test considered the ranks of the data (all concentrations ranked from lowest to highest) and whether there was a tendency for higher or lower ranks to be more prevalent within one or more of the HLPs.

The results of this ANOVA (see Appendix E) suggest that the concentrations were typically statistically similar. For most constituents, there was not a significant difference in concentration between the various HLPs using significance levels of 0.05 or 0.01. The exceptions using a significance level of 0.05 were antimony, mercury, and potassium. The calculated probability for antimony (0.041) was barely below the significance level of 0.05. The calculated probabilities for mercury and potassium (0.021) were below 0.05 but above 0.01. No constituents demonstrated significant differences at the 0.01 significance level.

It is unusual for a study comparing partitions within the data (e.g., lithology, depth, or in this instance, HLPs) to demonstrate a lack of significant differences for all cases. Using a significance level of 0.05, it is anticipated that 1 of 20 to be calculated have a significant difference even if all data are drawn from a random data set. With this data set, only 3 of the 22 constituents demonstrated significant differences, which suggests a small overall level of difference.

A useful complement to the ANOVA results is a graphical presentation of the data for each HLP. Box-and-Whisker plots are also presented in Appendix E for this purpose. The ANOVA results indicate statistical similarity for all constituents at the 0.05 significance level and similarity for all but three constituents (antimony, mercury, and potassium) at the 0.01 significance level. The Box-and-Whisker plots for all constituents, including these three, display relative agreement from each HLP. A review of this graphical inspection and the ANOVA statistical evaluation show that data for Group A can be combined into a single data set for subsequent risk screening and technical evaluations.

An assessment of inorganic data quality for HLP material samples concludes that these data satisfy the assumptions under which the DQOs (CH2M HILL, 2007a) and the data collection design were developed. Statistical calculations (previously discussed) support the conclusion that the data are representative and adequate for the assumptions stated in the FSP (Table 3-1 in CH2M HILL, 2007a). These data support the stated objectives (i.e., if inorganic results support a consistent interpretation of the data, the data evaluation, risk assessment, and development of remedial alternatives can proceed) and are adequate and complete pursuant to EPA guidelines (EPA, 1994).

4.3.2 Total Petroleum Hydrocarbons

Twenty-six surface and subsurface samples were analyzed for TPH (as diesel, kerosene, and motor oil). Only one surface soil sample TPH (as diesel) exceeded the Nevada cleanup goal of 100 mg/kg for TPH; Sample H4SSS03 contained 170 mg/kg (see Appendix D).

An assessment of organic (TPH) data quality for HLP material samples concludes that these data satisfy the assumptions under which the DQOs and the data collection plan (CH2M HILL, 2007a) were developed. The data are representative and adequate for the assumptions stated in the FSP and support the stated objectives (i.e., if TPH results support a consistent interpretation of the data, the data evaluation, risk assessment, and development of remedial alternatives can proceed) and are, therefore, adequate and complete pursuant to EPA guidelines (EPA, 1994).

4.3.3 Geochemical

The geochemical investigation focused on characterizing acid-base and metal leachability properties of the HLP materials. Acid-base characteristics were assessed by two conventional static tests, ABA and NAG. In addition, metal leachability characteristics of HLP materials were evaluated using the SPLP and the Nevada MWMP.

The ABA test determines the acid producing potential of a material by measuring sulfur content and the neutralization potential of neutralizing agents available in the material. The difference between the two measurements yields the NNP of the material; the ratio of the two measurements yields the neutralization potential ratio (NPR) of the material. The NNP is reported in kilograms of calcium carbonate per ton (kg $CaCO_3$/t) or t $CaCO_3$/kt; the NPR is a unitless parameter. Comparison of the NNP and NPR to set criteria based on experience or regulations allows classification of the material into potentially acid generating (PAG), uncertain potential PAG, and non-PAG material. Criteria in this RI report correspond to the generally accepted guidelines for the prediction of acid rock drainage from metal mines in British Columbia (Price et al., 1997) and are summarized in Table 4-4.

TABLE 4-4
Generally Accepted Guidelines for Prediction of Acid Rock Drainage
Remedial Investigation Report, Arimetco Facilities Operable Unit 8, Anaconda Copper Yerington Mine

ABA Parameter	Criteria	Prediction
NNP	< -20 kg $CaCO_3$/t,	PAG
	> -20 kg $CaCO_3$/t, and < +20 kg $CaCO_3$/t	Uncertain potential PAG
	> +20 kg $CaCO_3$/t	Non-PAG
NPR	< 1	PAG
	>1 and <4	Uncertain potential PAG
	>4	Non-PAG

Notes:
< = less than
> = more than

The NAG test measures the net amount of acid, in kg H_2SO_4/t of material, generated by the oxidation of the material. The test simulates the net amount of acid generated due to weathering of a material. The NAG test is generally used to confirm ABA results and ascertain whether theoretical acid producing potential and neutralization potential would be generated and available when the material undergoes oxidation. Interpretation of NAG results have been performed using the generally accepted criteria for metal mines in Australia (Miller et al, 1997) and summarized in Table 4-5.

TABLE 4-5
Generally Accepted Criteria for Interpretation of NAG Results
Remedial Investigation Report, Arimetco Facilities Operable Unit 8, Anaconda Copper Yerington Mine

NAG Parameter			
NAG pH	NAG value	NNP	Prediction
<4	<10	Negative	PAG (low capacity)
<4	>10	Negative	PAG (high capacity)
≥4	0	Negative	Uncertain potential PAG
≥4	0	Positive	Non-PAG

Notes:
< = less than
> = more than
≥ = greater than or equal to

Short-term leaching tests such as the SPLP or MWMP measure readily soluble components of weathered samples. The SPLP test was developed by EPA to evaluate metal mobility in an engineered landfill subjected to acid rain. The test uses a 20:1 liquid-to-solid ratio. Two different extraction fluids can be used for the extraction, depending on the region the materials tested will be disposed of. For the Arimetco HLP samples, Extraction Fluid 2 (a reagent water to pH 5.0 with 60:40, nitric acid [HNO_3] to hydrogen sulfide [H_2SO_4]), was used.

The MWMP was developed by the Nevada Mining Association, and is mainly used in the state of Nevada. The test also measures short-term mobility of soluble components, but it uses a much lower liquid-to-solid ratio (1:1) than the SPLP. In addition, the test is slightly less aggressive than the SPLP test, because it uses distilled water as extraction fluid, which is weaker than either SPLP Extraction Fluid 1 or 2.

4.3.3.1 Acid-Base Accounting Results

Twenty-five composite samples from Groups A and B were subjected to ABA testing (see Table 4-6). Samples were obtained from 14 randomly selected borings in accordance with the FSP (CH2M HILL, 2007a). From the results in Table 4-6, four samples from two borings were composited for Phase I/II HLP. Four samples from three borings were composited for Phase III 4X HLP, and three samples from two borings were composited for Phase IV Slot HLP. Eight samples from four borings were composited from Phase III South HLP, and six samples from three borings were composited from Phase IV VLT HLP (see Appendix D). Because HLP materials consist mainly of low-grade ore that has been subjected to continuous leaching, mild ABA characteristics were expected for these materials; the current ABA testing was designed to confirm this premise.

As summarized in Table 4-6, ABA results indicated that all 25 samples had a total sulfur-based NNP less than -12.1 t $CaCO_3$/kt. NNP results for samples collected from Phase I/II HLP ranged from -19 to -12 t $CaCO_3$/kt and, according to the ABA criteria, have an uncertain acid generation potential. NNP results for the four samples from Phase III 4X HLP ranged from -24 t to -12 t $CaCO_3$/kt, and all but one sample are classified as having an uncertain acid generation potential by ABA criteria. The one Phase III 4X sample, with NNP equal to -24 t $CaCO_3$/kt, would be classified as PAG material by ABA criteria. Phase III South HLP samples had NNP values ranging from -28 to -18 t $CaCO_3$/kt, and all except one would be classified as PAG material by ABA criteria. The sample with an NNP of -18 t $CaCO_3$/kt would be classified as having an uncertain PAG by ABA criteria. Three samples from Phase IV Slot HLP had NNP values ranging from -34 to -20 t $CaCO_3$/kt, and all would be classified as PAG materials by ABA criteria. Phase IV VLT HLP samples had NNP values ranging from -33 to -1 t $CaCO_3$/kt; half of them would be classified as PAG materials, and the other half would be classified as having uncertain acid generation potential by ABA criteria.

4.3.3.2 Net Acid Generation Results

Six HLP samples were submitted for static NAG testing to confirm ABA results and assess the net amount of acid that would be generated should HLP materials undergo further weathering (see Appendix D). Table 4-7 presents the NAG results for four samples from Phase III South HLP and two samples from Phase IV VLT HLP. According to Table 4-7, NAG pH values for these samples ranged from 3.38 to 3.97. These values are close to the pH of 4 cut-off for PAG and non-PAG classification according to NAG criteria. Assuming negative NNP values for these samples (based on the ABA results for similar samples), and with NAG values ranging from 3.8 to 5.8 kg H_2SO_4/t, the results indicate that all HLP samples would be classified as "low capacity" PAG materials by NAG criteria.

4.3.3.3 Metal Leaching Results

SPLP Results. Of the 25 HLP samples submitted for the SPLP, 6 samples were obtained from Phase I/II HLP, 6 from Phase III South HLP, 3 from Phase III 4X HLP, 4 from Phase IV Slot HLP, and 6 from Phase IV VLT HLP (see Appendix D). Subsurface sampling depths are discussed in Section 2.3. Trace-level constituents were detected in SPLP leachate (see Table 4-8); aluminum, copper, and manganese were readily available for leaching in all HLP samples. Most other trace constituents were non-detect, or detected in only a few SPLP leachate samples (see Appendix D). Trace constituents were detected in only a few samples include cobalt, iron, mercury, and silver (see Table 4-8).

Aluminum concentrations ranged from non-detect to 39 milligrams per liter (mg/L). While there is no primary MCL for aluminum, all detected aluminum concentrations exceeded the secondary MCL of 0.2 mg/L (see Appendix D). Copper in SPLP leachate samples ranged from 1.3 to 8.8 mg/L; all except two samples exceeding the primary MCL of 1.3 mg/L and all samples exceeding the secondary MCL of 1 mg/L. Manganese ranged from 0.3 to 1.5 mg/L, exceeding the secondary MCL of 0.05 mg/L.

Cobalt was detected in 5 samples, iron in 7 samples, mercury in 11 samples, and silver in 1 sample. Cobalt detections ranged from 0.1 to 0.13 mg/L; there are no primary or secondary MCLs for cobalt. Iron concentrations ranged from 5.6 to 14 mg/L, all of which exceed the secondary MCL of 0.3 mg/L; there is no primary MCL for iron. Mercury concentrations range from 0.00015 to 0.011 mg/L, none of which exceed the primary MCL of 0.002 mg/L. Silver was detected in one sample from the Phase I/II HLP at a concentration of 0.05 mg/L; there are no primary or secondary MCLs for silver.

MWMP Results. The MWMP was performed on 10 HLP samples for comparison with the NDEP Profile II Standards. These samples were collected from each HLP at depths ranging from the surface to 9 inches bgs (see Section 2.4).

Detectable MWMP results (see Table 4-9) indicate that all but one sample have acidic leachates, with pH ranging from 3.4 to 7.1. MWMP pH results differ slightly from the draindown solution pH results of between 1.9 and 2.8, with variations attributed primarily to (1) more concentrated acidic solutions stored in the ponds at the time of sampling and (2) MWMP reflecting the pH of precipitation in Nevada to evaluate the mobility of inorganic materials from mining waste. The only sample with neutral pH was Sample H3SSS03, which was collected from Phase III South HLP. Sample H3SSS03 contained detectable alkalinity (75 mg/L) and low sulfate and total dissolved solids (TDS) concentrations. The remaining HLP samples were non-detect for alkalinity and showed high sulfate and TDS concentrations (see Appendix D). Sample H3SSS03 results suggest that this sample might not be representative of materials contained in the Phase III South HLP. An explanation for the Sample H3SSS03 results is not readily available. Results for the remaining samples are consistent with weathered ore materials that have been subjected to acid leaching. Acid leaching results in the consumption of available alkalinity, oxidation of sulfide minerals, and production of large quantities of soluble sulfates, which is reflected in high concentrations of TDS. Except for Sample H3SSS03, sulfate and TDS concentrations exceed applicable secondary MCLs (see Appendix D).

TABLE 4-6
Summary of Acid-Base Accounting Results for Heap Leach Pad Samples
Remedial Investigation Report, Arimetco Facilities Operable Unit 8, Anaconda Copper Yerington Mine

Sample ID	HLP	Acid Generation Potential (calculated on sulfur total)	Acid Neutralization Potential (calculated)	Acid-base Accounting (calculated on sulfur total)	ABA (calculated on sulfur total)	ABA (calculated on sulfide sulfur)	NPR (calculated on sulfide sulfur)	Neutralization Potential as $CaCO_3$	Neutralization Potential (lab qualifier)	Sulfur Organic Residual	Sulfur Organic Residual (lab qualifier)	Sulfur Pyritic Sulfide (lab qualifier)	Acid Generation Potential (calculated on sulfide sulfur)	Sulfur Pyritic Sulfide (lab qualifier)	Sulfur Sulfate	Sulfur Total	Acid Producing Potential	Total Sulfur Minus Sulfate
H12SU01-1-8	PHASE I/II	12	0	-12	-12.1	-0.2125	0.008	0.1	U	0.02		0.01	0.3125		0.36	0.39	12.2	0.03
H12SU01-2-8	PHASE I/II	19	0	-19	-19.3	-0.2125	0.005	0.1	U	0.04		0.01	0.3125		0.57	0.62	19.4	0.05
H12SU02-1-8	PHASE I/II	16	0	-16	-15.5	-0.2125	0.006	0.1	U	0.02		0.01	0.3125	U	0.49	0.5	15.6	0.01
H12SU02-2-8	PHASE I/II	16	4	-12	-15.5	0.0875	0.025	0.4		0.02		0.01	0.3125		0.48	0.51	15.9	0.03
H3XSU01-1-8	PHASE III 4X	19	7	-12	-18.4	0.3875	0.037	0.7		0.03		0.01	0.3125		0.57	0.61	19.1	0.04
H3XSU01-2-8	PHASE III 4X	24	0	-24	-23.7	-0.2125	0.004	0.1	U	0.02		0.01	0.3125	U	0.74	0.76	23.8	0.02
H3XSU02-2-8	PHASE III 4X	18	12	-6	-16.3	0.8875	0.069	1.2		0.03		0.01	0.3125	U	0.53	0.56	17.5	0.03
H3XSU03-1-8	PHASE III 4X	19	6	-13	-18.5	0.2875	0.031	0.6		0.01	U	0.01	0.3125		0.6	0.61	19.1	0.01
H3SSU01-1-8	PHASE III South	23	0	-23	-22.4	-0.2125	0.004	0.1	U	0.02		0.01	0.3125	U	0.7	0.72	22.5	0.02
H3SSU01-2-8	PHASE III South	23	0	-23	-22.7	-0.2125	0.004	0.1	U	0.03		0.01	0.3125		0.69	0.73	22.8	0.04
H3SSU02-2-8	PHASE III South	21	0	-21	-20.5	-0.2125	0.005	0.1	U	0.02		0.01	0.3125	U	0.64	0.66	20.6	0.02
H3SSU02-3-8	PHASE III South	23	0	-23	-23.3	-0.2125	0.004	0.1	U	0.02		0.01	0.3125		0.72	0.75	23.4	0.03
H3SSU03-1-8	PHASE III South	28	0	-28	-27.7	-0.2125	0.004	0.1	U	0.04		0.01	0.3125		0.84	0.89	27.8	0.05
H3SSU03-3-8	PHASE III South	20	0	-20	-19.6	-0.525	0.005	0.1	U	0.05		0.02	0.625		0.56	0.63	19.7	0.07
H3SSU04-2-8	PHASE III South	18	0	-18	-18.0	-0.2125	0.006	0.1	U	0.05		0.01	0.3125	U	0.53	0.58	18.1	0.05
H3SSU04-3-8	PHASE III South	22	0	-22	-21.5	-0.2125	0.005	0.1	U	0.05		0.01	0.3125		0.63	0.69	21.6	0.06
H4SSU01-1-8	PHASE IV Slot	23	0	-23	-23.0	-0.2125	0.004	0.1	U	0.01		0.01	0.3125		0.72	0.74	23.1	0.02
H4SSU01-2-8	PHASE IV Slot	37	3	-34	-36.9	-0.0125	0.008	0.3		0.01		0.01	0.3125		1.17	1.19	37.2	0.02
H4SSU03-2-8	PHASE IV Slot	20	0	-20	-20.2	-0.2125	0.005	0.1	U	0.02		0.01	0.3125	U	0.63	0.65	20.3	0.02
H4VSU01-1-8	PHASE IV VLT	23	0	-23	-23.3	-0.2125	0.004	0.1	U	0.03		0.01	0.3125		0.71	0.75	23.4	0.04
H4VSU01-2-8	PHASE IV VLT	33	0	-33	-32.7	-0.2125	0.003	0.1	U	0.03		0.01	0.3125	U	1.02	1.05	32.8	0.03
H4VSU02-1-8	PHASE IV VLT	18	3	-15	-18.1	-0.0125	0.016	0.3		0.03		0.01	0.3125		0.55	0.59	18.4	0.04
H4VSU02-2-8	PHASE IV VLT	27	26	-1	-24.6	2.2875	0.096	2.6		0.01		0.01	0.3125		0.85	0.87	27.2	0.02
H4VSU03-1-8	PHASE IV VLT	24	3	-21	-23.8	-0.325	0.012	0.3		0.05		0.02	0.625		0.7	0.77	24.1	0.07

Note:

U = Non-detect at reporting limit

TABLE 4-7
Summary of NAG Results for Heap Leach Pad Samples
Remedial Investigation Report, Arimetco Facilities Operable Unit 8, Anaconda Copper Yerington Mine

Sample Identifier	Location	Depth Interval	NAG pH	NAG (kg H_2SO_4/t)
H3SSU01-1-7	Phase III South HLP	0–50 feet	3.93	3.77
H3SSU01-2-7	Phase III South HLP	20–97 feet	3.87	4.87
H3SSU04-2-7	Phase III South HLP	50–100 feet	3.6	5.32
H3SSU04-3-7	Phase III South HLP	100–116.5 feet	3.66	4.65
H4VSU01-1-7	Phase IV VLT HLP	50–107 feet	3.38	5.76
H4VSU01-2-7	Phase IV VLT HLP	0–50 feet	3.97	3.77

Trace elements that exceed applicable standards in at least one MWMP sample include aluminum, arsenic, beryllium, cadmium, chromium, copper, iron, manganese, mercury, nickel, and selenium. Aluminum exceeded the secondary MCL of 0.05 mg/L in all samples, including Sample H3SSS03. Copper, iron, and manganese exceeded primary or secondary MCLs in all samples except Sample H3SSS03 (see Appendix D). Nickel exceeded the NDEP Profile II Standard of 0.1 mg/L in all samples, except Samples H3SSS03 and H4SSS07. Beryllium and cadmium exceeded primary or secondary MCLs in six samples. Mercury exceeded the primary MCL of 0.002 mg/L in four samples. Arsenic, which was non-detect in the SPLP leaching tests, exceeded the primary MCL of 0.01 mg/L in two samples. Chromium exceeded the primary MCL of 0.1 mg/L in one sample collected from Phase IV VLT HLP.

Although trace element concentrations in MWMP leachate were generally higher than in SPLP leachate because of the lower amount of extractant liquid used in the MWMP, the overall MWMP results corroborate the main tendencies predicted by the SPLP results and indicate that the HLPs have some metal leachability capacity left, mainly in the form of soluble aluminum, copper, iron, and manganese. Soluble forms of these trace elements might exceed applicable standards in runoff and snowmelt water. In addition, trace elements (arsenic, beryllium, cadmium, chromium, cobalt, mercury, and nickel) that did not exceed standards in SPLP leachate because of the dilute nature of the test might result in potential exceedances, according to the MWMP results.

Although DQOs were not specifically established for geochemical data quality of HLP material samples (CH2M HILL, 2007a), these data are representative and adequate to support the RI and are complete pursuant to EPA guidelines (EPA, 1994).

4.3.4 Agricultural

Unlike typical agricultural testing that focuses on available plant nutrients, the analytical methods used for samples collected from Group A and Group B HLPs were based on total analysis. From these data, the most important issue that would affect plant establishment and growth on a future cover is pH. In general, agricultural data show that the pH was low and that this level of acidity would limit establishment and growth of plant communities. The pH measured in all samples except one (from the Phase IV VLT HLP) was below pH 4; the Phase IV VLT HLP sample had a much more favorable pH (7.89).

Soils in arid regions are typically alkaline and native plants are adapted to these conditions. Soil nitrogen is very low, but this is typical of arid region soils. Total chloride and sodium values are low, suggesting that salinity is not a major issue, but more specific data (such as electrical conductivity of the HLP material saturation extract) would be needed for a more thorough evaluation. Total boron levels are also very low, suggesting that the more typical hot water extract values used in agronomic assessments would be even lower.

Aluminum and other metals are significant issues when pH is acidic. There are several soil amendments that could be used to increase pH, such as lime or calcium oxide. Further testing to measure buffer capacity (e.g., Shoemaker-McLean-Pratt buffer test) would determine the quantities of amendments that would be required.

The water-holding capacity is low and unlikely to support plant growth. Finer textured materials would need to be mixed into at least the upper 1 foot of surface material to have a reasonable chance of plant establishment and sustainability. Soil amendments such as lime or calcium oxide could be used, but the system might be highly buffered and could require impractically large amounts of these amendments to establish and sustain plant growth. Organic amendments such as biosolids or compost would provide nutrients, improve water-holding capacity, and buffer toxicities.

Although DQOs were not specifically established for agricultural data quality of HLP material samples (CH2M HILL, 2007a), the data obtained can support the RI. However, additional agricultural data collection and analysis would be required as part of the FS or remedial design phase of work to address the data deficiencies.

4.3.5 Geotechnical

Samples were taken from HLP material borings and submitted for physical testing at Sierra Testing Laboratories. One hundred twelve samples were tested for one or some combination of the following tests:

- Density of soil in place by the drive-cylinder method (ASTM D2937)
- Laboratory determination of water (moisture) content of soil and rock by mass (ASTM 2216)
- Particle size analysis of soils (ASTM D422) and sieve analysis of fine and coarse aggregate (C136)
- Specific gravity (ASTM DC128)
- Laboratory compaction characteristics of soil using modified effort (ASTM D1557)
- Direct shear test of soils under consolidated drained conditions (ASTM D3080)

TABLE 4-8
Summary of Detectable SPLP Results for Heap Leach Pad Samples
Remedial Investigation Report, Arimetco Facilities Operable Unit 8, Anaconda Copper Yerington Mine

HLP Name and Sample Type	Sample Identifier	Depth Interval	Aluminum	Calcium	Cobalt	Copper	Iron	Magnesium	Manganese	Mercury	Silver	Sodium	Strontium
Phase I/II HLP: Soil Boring Composite	H12SU01	0–50	40 U	90	0.8 U	3.4	40 U	17	0.65 J	0.00015 J	0.4 U	11 J	0.52
	H12SU01	50–77	22	110	0.8 U	2.5	40 U	36	1.2	0.0006 U	0.4 U	13 J	0.62
	H12SU01	50–77	21	100	0.11 J	2.5	8.6 J	35	1.2	0.0006 U	0.05 J	11 J	0.53
	H12SU01 (FD)	0–50	40 U	86	0.8 U	3.3	40 U	17	0.6 J	0.0006 U	0.4 U	9.8 J	0.49
	H12SU01 (FD)	50–77	22	100	0.8 U	2.5	40 U	36	1.2	0.00021 J	0.4 U	12 J	0.51
	H12SU02	50–77	17 J	100	0.8 U	7.2	40 U	29	0.51 J	0.00081	0.4 U	13 J	0.51
	H12SU02	0–50	17	120	0.4 U	8.6	14	37	1	0.0006 U	0.1 U	12 J	0.54
	H12SU02	0–50	16 J	110	0.8 U	8.6	14 J	35	1	0.00015 J	0.4 U	9.5 J	0.54
	H12SU02 (FD)	0–50	15	110	0.4 U	8.1	11	34	0.95	0.0006 U	0.1 U	11 J	0.51
	H12SU02 (FD)	50–77	17	100	0.4 U	7.2	20 U	29	0.53	0.00041	0.1 U	11 J	0.49
Phase III 4X HLP: Soil Boring Composite	H3XSU01	0–50	23	88	0.11 J	1.6	20 U	36	0.96	0.0006 U	0.1 U	11 J	0.28
	H3XSU01	50–67	26	110	0.4 U	3.3	20 U	39	0.91	0.0006 U	0.1 U	11 J	0.37
	H3XSU02	50–67	18	83	0.1 J	1.4	20 U	31	0.89	0.0006 U	0.1 U	11 J	0.31
	H3XSU02 (FD)	50–67	16	77	0.4 U	1.3	20 U	29	0.86	0.0006 U	0.1 U	11 J	0.3
Phase III 4X HLP: Surface Discrete	H3XSS07 (FD)	0.25–0.75	8.5 J	104	0.2 U	1.1	10 U	20	0.57	0.0006 U	0.1 U	10.1	0.17
Phase III South HLP: Soil Boring Composite	H3SSU01	0–50	7.3 J	130	0.4 U	5.1	20 U	19	0.43 J	0.00016 J	0.2 U	11 J	0.68
	H3SSU01	20–97	8.8 J	99	0.4 U	8.8 J	5.6 J	23	0.52	0.00016 J	0.2 U	11 J	0.6
	H3SSU02	50–100	19 J	110	0.8 U	2.9	40 U	33	1.1	0.0011	0.4 U	12 J	0.52
	H3SSU02	100–112	22	120	0.8 U	5.2	40 U	36	1.3	0.0006 U	0.4 U	13 J	0.45
	H3SSU03	100–117	19 J	88	0.8 U	3.3	13 J	37	1.4	0.0006 U	0.4 U	13 J	0.4
	H3SSU04	50–100	18	100	0.4 U	2.9	5.8 J	34	0.89	0.0006 U	0.2 U	12 J	0.44
Phase IV Slot HLP: Soil Boring Composite	H4SSU01	0–50	16 J	100	0.8 U	3.5	40 U	30	0.88 J	0.0006 U	0.4 U	11 J	0.41
	H4SSU01	50–97	30	240	0.8 U	6.4	40 U	43	1.3	0.00015 J	0.4 U	12 J	1.2
	H4SSU02	0–50	13 J	96	0.8 U	5.4	40 U	27	0.79 J	0.0006 U	0.4 U	11 J	0.49
	H4SSU03	50–77	27	100	0.13 J	6.8	20 U	41	1.3	0.0006 U	0.1 U	12 J	0.57
Phase IV VLT HLP: Soil Boring Composite	H4VSU01	50–107	20 U	220	0.4 U	1.3	20 U	30	1.5	0.0006 U	0.2 U	13 J	0.72
	H4VSU01	0–50	27	88	0.11 J	5	20 U	39	1.2	0.00015 J	0.2 U	12 J	0.3
	H4VSU02	0–50	23	84	0.8 U	4.7	40 U	33	1	0.00017 J	0.4 U	11 J	0.3
	H4VSU02	50–107	34	91	0.8 U	6.1	40 U	46	1.4	0.0006 U	0.4 U	12 J	0.37
	H4VSU03	0–50	36	78	0.8 U	5	40 U	48	1.4	0.0006 U	0.4 U	9.4 J	0.26
	H4VSU03	50–87	25	97	0.8 U	4.4	40 U	37	1.1	0.0006 U	0.4 U	12 J	0.44
	H4VSU03 (FD)	0–50	39	83	0.8 U	5.3	40 U	52	1.6	0.0006 U	0.4 U	12 J	0.27
Phase IV VLT HLP: Surface Discrete	H4VSS04 (FD)	0.25–0.75	10 U	10 U	0.2 U	0.4 U	10 U	5 U	0.5 U	0.0006 U	0.1 U	12	0.05 U
VLT: Surface Discrete	CAPSS02	0.25–0.75	20 U	95	0.4 U	7.1	20 U	3.8 J	1 U	0.00045	0.1 U	7.8 J	0.35

Notes:

Results in mg/L

J = estimated result

U = non-detect at reporting limit

TABLE 4-9
Summary of Detectable MWMP Results for Heap Leach Pad Samples
Remedial Investigation Report, Arimetco Facilities Operable Unit 8, Anaconda Copper Yerington Mine

HLP Name and Sample Type	Sample ID	Depth	pH	Total Alkalinity	Bicarbonate as $CaCO_3$	Chloride	Nitrate + Nitrite as N	Nitrate as N	Nitrite as N	Phosphorus, ortho dissolved	Sulfate	TDS	Aluminum	Antimony	Arsenic	Barium	Beryllium	Boron	Cadmium	Calcium	Chromium	Cobalt	Copper	Iron	Lead	Magnesium	Manganese	Mercury	Nickel	Potassium	Selenium	Sodium	Thallium	Vanadium	Zinc
Phase I/II HLP: Surface Discrete	H12SS01	0.25-0.75	3.7	2 U	2 U	4	0.73	0.73	0.01 U	0.56	3650	5260	164	0.0004 U	0.0035	0.022	0.014	0.16	0.0052	478	0.02 U	0.53	169	2.43	0.0004	319	5.89	0.0017	0.37	5.4	0.0106	30.3	0.0003	0.01 U	0.71
	H12SS04	0.25-0.75	3.6	2 U	2 U	5	0.71	0.71	0.01 U	0.38	6010	8220	441	0.0004 U	0.0067	0.006 U	0.031	0.15	0.0099	409	0.05	1.82	102	11.4	0.0004	651	18.4	0.0104	1.03	0.6 U	0.0167	18.6	0.0002	0.01	1.58
Phase III 4X HLP: Surface Discrete	H3XSS05	0.25-0.75	4	2 U	2 U	2	0.14	0.13	0.01	0.31	1340	1980	67.9	0.0011	0.0009	0.003 U	0.007	0.12	0.0018	254	0.01 U	0.26	14.5	0.96	0.0008	105	2.74	0.0008	0.16	0.3 U	0.0042	9.2	0.0001 U	0.005 U	0.28
	H3XSS07	0.25-0.75	4.1	2 U	2 U	2	0.06	0.06	0.01 U	0.07	660	900	46.9	0.0004 U	0.0005 U	0.003 U	0.004	0.11	0.0011	61.4	0.01 U	0.18	3.45	0.98	0.0002	64.9	1.79	0.0002 U	0.11	0.3 U	0.0025	5.4	0.0001 U	0.005 U	0.22
Phase III South HLP: Surface Discrete	H3SSS03	0.25-0.75	7.1	75	75	1	1.97	1.91	0.06	0.4	130	310	0.09	0.0018	0.0217	0.029	0.004 U	0.54	0.0001 U	57.8	0.02 U	0.02 U	0.07	0.04 U	0.0001 U	5.9	0.01 U	0.0002 U	0.02 U	2.8	0.0001 U	29.7	0.0001 U	0.01	0.02
	H3SSS07	0.25-0.75	3.6	2 U	2 U	5	0.78	0.78	0.01 U	6	7330	10400	532	0.0004 U	0.0075	0.003 U	0.029	0.16	0.0116	299	0.04	1.17	283	17.3	0.0004	812	14.6	0.039	0.88	0.3 U	0.0256	39.4	0.0002	0.005 U	2.03
Phase IV Slot HLP: Surface Discrete	H4SSS06	0.25-0.75	4	2 U	2 U	3	0.68	0.68	0.01 U	0.66	2540	3740	46.4	0.001	0.0023	0.003 U	0.004	0.16	0.0056	62	0.01 U	0.18	3.47	0.99	0.0002	65.7	1.81	0.0067	0.12	0.3 U	0.0073	5.5	0.0001 U	0.005 U	0.22
	H4SSS07	0.25-0.75	4.4	2 U	2 U	1	0.09	0.09	0.01 U	0.04	380	640	14.5	0.0004 U	0.0005 U	0.003 U	0.002	0.13	0.0008	75.4	0.01 U	0.1	18.5	0.35	0.0002	39.3	1.09	0.0002 U	0.06	0.6	0.0013	4.2	0.0001 U	0.005 U	0.12
Phase IV VLT HLP: Surface Discrete	H4VSS03	0.25-0.75	3.4	2 U	2 U	11	1.52	1.52	0.01 U	6.8	19200	26100	2170	0.0012	0.0278	0.003 U	0.121	0.2	0.0427	425	0.16	5.47	290	36.1	0.0005	2110	59.1	0.028	3.31	0.3 U	0.101	146	0.0006	0.072	5
	H4VSS06	0.25-0.75	3.7	2 U	2 U	5	0.47	0.46	0.01	1.1	1330	8300	488	0.0004	0.007	0.003 U	0.035	0.11	0.0109	420	0.02	1.77	60.2	7.47	0.0004	651	17	0.0015	1.09	0.3 U	0.0268	23.1	0.0001	0.01	1.63
VLT Material: Surface Discrete	CAPSS02	0.25-0.75	5.1	2 U	2 U	7	1.49	1.49	0.01 U	0.16	2050	2970	11.2	0.002 U	0.026	0.029	0.002 U	0.17	0.0045	458	0.01 U	0.13	200	0.03	0.0092	80.2	1.08	0.022	0.13	17.5	1.11	18	0.111	0.005 U	0.23

Notes:

Depth interval presented in feet bgs

Results are in mg/L.

N = Nitrogen

Test results are summarized in Table 4-10; the averages and standard deviation for all tests are presented in Table 4-11.

In general, the HLP materials tested ranged from well-graded sand to well-graded gravel. The amount of fines varied, but typically did not exceed 15 percent. A tabular summary of test results are presented in Appendix D, and boring logs are included in Appendix B.

4.3.5.1 Density, Moisture Content, and Maximum Dry Density

In the laboratory, the samples were weighed and measured to determine their moist density. Moisture content was measured for field conditions on oven-dried samples, and the dry density was calculated. Wet density ranged from 104 to 154 pounds per cubic foot (lbs/ft^3) (standard deviation [σ] 14 and 12, respectively). Moisture content for all samples ranged from 3.1 to 13.4 percent ($\sigma = 2.3$) with an average of 7.1 percent. Dry density ranged from 97 to 141 lbs/ft^3.

The maximum dry density for compacted samples ranged from 132 to 151 lbs/ft^3; optimum moisture ranged from 3.5 to 8.1 percent. The average dry density is 10 to 20 lbs/ft^3 less than the maximum dry density (overall average was 140 lbs/ft^3). This equates to approximately 86 percent relative compaction for the HLPs based on the samples tested. Because of the small sample volume for the field density test and exclusion of larger rocks, the actual field density and relative compaction is likely higher.

Moisture content of the field samples was generally close to the optimum moisture content of 6.1 percent. Layers of HLP material that were tested wet (exceeding optimum moisture content) likely result from either rainfall or percolation of drain-down solution. When compared with optimum moisture content of 6.1 percent, the average field moisture content was 1 percent higher than optimum.

4.3.5.2 Specific Gravity

The specific gravity of the samples tested ranged from 2.64 to 2.81 ($\sigma = 0.05$). The specific gravity of quartz is 2.67, and hematite (an iron-rich mineral) can be as high as 5.2. Therefore, these values were within an anticipated range.

4.3.5.3 Direct Shear Strength

Seventeen direct shear tests were completed on small-diameter samples collected from the HLPs. The results contain a cohesion component and friction angle representing the overall shear strength. The cohesion values for these samples varied much more than any other parameter (109 to 3,084 pounds per square foot [lbs/ft^2] [$\sigma = 871$]). This can be partially attributed to the range of normal pressures applied to samples at the high end of the test range. It might also be the result of partial cementation of the samples. The high degree of variability of this result indicates that conservative values should be used to evaluate slope stability.

TABLE 4-10
Summary of Heap Leach Pad Material Geotechnical Results
Remedial Investigation Report, Arimetco Facilities Operable Unit 8, Anaconda Copper Yerington Mine

Soil Boring	Top Depth (feet)	Bottom Depth (feet)	Wet/Dry Density (lbs/ft^3)	Moisture Content (percent)	Unified Soil Classification (sieve analysis)	Specific Gravity	Maximum Dry Density/Optimum Moisture Content (lbs/ft^3/percent)	Cohesion/Friction Angle (lbs/ft^2/degrees)
H12SU01	19.5	22				2.70	145.6/4.1	
	20	20		4.7 (4.2)				
	22	25			GW			
	37.5	38	119.4/113.4	5.3	GW			598/43.3
	38	38.5	122.8/117.5	4.5	SW			633/43.4
	40	40		4.9				
	42	43.5			GW			
	43.5	47				2.81	142.4/5.8	
	59	61.5			GW			
	60	60		7.6				
	61.5	63.5				2.70		
H12SU02	20	20		4.2				
	40	40		3.1				
	60	60		10.3				
	61	63.5					140.3/6.7	
	78	78.5	120/112.4	6.8	SW			1636/36.9
H3SSU01	17	19.5				2.77	145.2/5.0	
	19.5	22			SM			
	20	20		4.2				
	39.3	42.4				2.68	138.3/6.5	
	40	40		3.1				
	57	60.5				2.76	142.0/6.2	
	60	60		10.3				
	60.5	62.9	134.5/126.9	5.9	GW			931/43.0
	77	84				2.66	143.3/5.6	
	84	86.4			GM			

TABLE 4-10
Summary of Heap Leach Pad Material Geotechnical Results
Remedial Investigation Report, Arimetco Facilities Operable Unit 8, Anaconda Copper Yerington Mine

Soil Boring	Top Depth (feet)	Bottom Depth (feet)	Wet/Dry Density (lbs/ft^3)	Moisture Content (percent)	Unified Soil Classification (sieve analysis)	Specific Gravity	Maximum Dry Density/Optimum Moisture Content (lbs/ft^3/percent)	Cohesion/Friction Angle (lbs/ft^2/degrees)
H3SSU02	42.4	45.1						
	57.5	58	138.3/128.6	7.5	SW			109/43.2
	58	58.5	153.6/140.6	9.2	GW			1378/43.3
	60.5	62.9						
H3SSU03	20	20		6.6				
	40	40		9.1				
	60	60		8.5				
	80	80		5.7				
	100	100		7.1				
	87.5	88	145.2/137.1	5.9	SW			2509/33.7
	88	88.5						
HSS3U04	19	22.3				2.76	146.2/5.6	
	20	20		10.5				
	22.3	25.2			GW			
	38.6	42				2.78	132.1/8.1	
	40	40		8.1				
	42	45			SW-SM			
	60	60		11.2				
	60.6	63.3					140.0/6.7	
	63.3	66			GM/SM			
	79.8	83					134.6/7.8	
	80	80		7.3				
	83	85.5			GM/SM			
	99	103.9						
	97.5	98			GW/SW			1596/36.6
	98	98.5	117.3/108.6	8.1				

TABLE 4-10
Summary of Heap Leach Pad Material Geotechnical Results
Remedial Investigation Report, Arimetco Facilities Operable Unit 8, Anaconda Copper Yerington Mine

Soil Boring	Top Depth (feet)	Bottom Depth (feet)	Wet/Dry Density (lbs/ft^3)	Moisture Content (percent)	Unified Soil Classification (sieve analysis)	Specific Gravity	Maximum Dry Density/Optimum Moisture Content (lbs/ft^3/percent)	Cohesion/Friction Angle (lbs/ft^2/degrees)
	99	103.9			GW	2.71	139.4/6.6	
	100	100		9.7				
H3XSU01	19.5	22				2.76	135.3/7.1	
	20	20		7.3				
	22	25.4			SM			
	39.9	42				2.66		
	40	40		9.6				
	42	44.5			SW			
	60	60		6				
	60	63.5	129.4/123.9	4.5		2.73	144.7/4.9	
	63.5	67			GW			
	68	68.5			GW			3084/43.3
H3XSU02	20	20		7.5				
	38	38.5						
	40	40		8.9				
	60	60		9.7				
H3XSU03	17.5	18	134.8/122.1	10.3	SW			337/40.4
	20	20		8.2				
	40	40		8.9				
	60	60		6.7				
H4SSU01	20	20		8.4				
	40	40		5.8				
	47.5	48	104.5/96.9	7.8	SW			640/43.3
	60	60		7.7				

TABLE 4-10
Summary of Heap Leach Pad Material Geotechnical Results
Remedial Investigation Report, Arimetco Facilities Operable Unit 8, Anaconda Copper Yerington Mine

Soil Boring	Top Depth (feet)	Bottom Depth (feet)	Wet/Dry Density (lbs/ft^3)	Moisture Content (percent)	Unified Soil Classification (sieve analysis)	Specific Gravity	Maximum Dry Density/Optimum Moisture Content (lbs/ft^3/percent)	Cohesion/Friction Angle (lbs/ft^2/degrees)
H4SSU02	28	28.5	128.5/122.3	5.1	SW			416/38.9
H4SSU03	7.5	8.0	110.3/106.4	3.7	GW			272/41.7
	20	20		7.7				
	20.5	23				2.80	150.5/3.5	
	23	25.5			GW			
	38.9	42				2.71	134.5/6.7	
	40	40		5.7				
	42	44			GW			
	59	61.5				2.74	133.0/7.0	
	60	60		10.4				
	61.5	64			GW			
H4SSU04	20	20		3.9				
	40	40		4.1				
	58	58.5	115.4/110.0	4.9	GW			2175/38.6
H4VSU01	20	20		8				
	20.4	23.7				2.67	136.5/6.5	
	23.7	26			SW			
	40	40		8.6				
	40.3	43				2.64	138.4/7.0	
	43	43.5			SW			
	47.5	48	148.4/136.2	8.9	SW			1263/43.0
	48	48.5						
	60	60		8				
	60	62.5				2.72	137.1/7.5	
	62.5	65			GW			
	80	80		4.7				

TABLE 4-10
Summary of Heap Leach Pad Material Geotechnical Results
Remedial Investigation Report, Arimetco Facilities Operable Unit 8, Anaconda Copper Yerington Mine

Soil Boring	Top Depth (feet)	Bottom Depth (feet)	Wet/Dry Density (lbs/ft^3)	Moisture Content (percent)	Unified Soil Classification (sieve analysis)	Specific Gravity	Maximum Dry Density/Optimum Moisture Content (lbs/ft^3/percent)	Cohesion/Friction Angle (lbs/ft^2/degrees)
	80.5	83.7				2.67	147.3/4.2	
	83.7	87			GW			
	100	100		4.9				
	100.3	104				2.77	145.5/5.1	
	104	107			SW			
H4VSU02	20	20		9.7				
	27.5	28						
	28	28.5	135.5/124.3	9.1	GW/SW			130/40.0
	40	40		7.9				
	60	60		13.4				
	80	80		3.1				
	100	100		3.5				
H4VSU03	20	20		9.4				
	40	40		8.5				
	60	60		7.1				
	80	80		6.5				
	87.5	88	139.5/132.2	5.5	GW			844/41.0

Notes:

A rock correction factor was applied to the test results for maximum dry density and optimum moisture content.

GM = silty gravel
GW = well-graded gravel
SM = silty sand
SW = well-graded soil

TABLE 4-11
Heap Leach Pad Material Property Averages and Standard Deviations
Remedial Investigation Report, Arimetco Facilities Operable Unit 8, Anaconda Copper Yerington Mine

Location	Wet/Dry Density (lbs/ft^3)	Moisture Content (percent)	Specific Gravity	Maximum Dry Density/Optimum Moisture Content (lbs/ft^3/percent)	Cohesion/Friction Angle (lbs/ft^2/degrees)
Phase I/II	120.7/114.4	5.7	2.74	142.8/5.5	955.7/41.2
Phase III South	137.8/128.4	7.7	2.73	140.1/6.5	1304.6/40.0
Phase III 4X	132.1/123.0	8.0	2.72	140.0/6.0	1710.5/41.9
Phase IV Slot	114.7/108.9	6.3	2.75	139.3/5.7	875.8/40.6
Phase IV VLT	141.1/130.9	7.5	2.69	141.0/6.1	745.7/41.3
Average for All HLPs	129.3/121.1	7.1	2.73	140.4/6.1	1097.4/40.8
Standard Deviation	13.8/12.1	2.3	0.050	5.1/1.2	871.3/3.0

Note:

A rock correction factor was applied to the test results for maximum dry density and optimum moisture content.

The angle of repose of loose sand is approximately 33 degrees, and the friction angle for rough, angular riprap is typically 40 to 45 degrees. The friction angle ranged from 34 to 43 degrees ($\sigma = 3.0$); these results were within the anticipated range.

An assessment of geotechnical data quality for HLP material samples concluded that these data satisfy the assumptions under which the DQOs (CH2M HILL, 2007a) and the data collection plan were developed (i.e., if the results of physical and geotechnical analyses are adequate to determine the water balance and assess the stability of individual HLPs, proceed with the data evaluation). These data are representative and adequate for the assumptions stated in the FSP, support the stated objectives, and are adequate and complete pursuant to EPA guidelines (EPA, 1994).

SECTION 5

Fate and Transport of Contaminants and Heap Leach Pad Characteristics

Past ore processing activities conducted at OU-8 involved the consolidation of heaped ore and application of acidic solutions to leach copper and other base metals from these materials. Drain-down solution remains entrained in the HLP materials, potentially causing ecological harm, releasing contaminants, and impacting portions of the Site. The potential contaminant release or migration pathways discussed in this section include infiltration of drain-down fluids, and settling/structural failure of ore heaps.

The Site is fenced and posted, which restricts direct human exposure to HLPs and drain-down solution. Although another potential route of exposure to humans is via consumption of mine-impacted groundwater from offsite residential drinking water wells, this pathway is being evaluated as part of sitewide groundwater (OU-1) activities. The chemical factors affecting contaminant transport include geochemical interactions or reactions with metals, primarily arsenic, copper, and iron. The physical factors affecting transport include the integrity of HLP, pond, and ditch liners; the quantity of entrained drain-down solution; and effective management of consolidated drain-down solution. The objective of the fate and transport analysis is to use available chemical and physical evaluation tools to assess the extent that residual wastes are impacting the environment.

5.1 Site Conceptual Model

Figure 5-1 provides a conceptual model of a typical HLP at the Site. It illustrates the HLP, entrained drain-down solution, corresponding ponds and ditches, and the locations of potential releases from this system in this portion of the Site. Ore heaps are presumed to have been constructed (e.g., lined) as described in Section 1.2.3, with liner and entrained fluid management functioning as designed.

OU-8 remedial activities have characterized the nature and distribution of radiological isotopes, physical properties (pH and electrical conductivity), NAG, ABA, TPH (as diesel and kerosene), and base metals in each of the HLPs and their associated ponds and ditches. Potential remaining sources of contamination include the following:

- Metals, specifically arsenic, copper, and iron on the surface of and within the HLPs
- Radiological constituents
- Drain-down solution entrained within the HLPs
- Drain-down solution stored at the base of the HLPs or contained within their associated ponds and ditches

For the purposes of this RI, mining-related impacts are considered to be confined to the HLPs and drain-down solution attributed to each. Both geochemical and physical techniques were used to evaluate the fate and transport of mining-related constituents in connection with former Arimetco operations. These included general chemistry and geotechnical analyses of specific HLPs to identify and categorize COPCs (see Appendices C and D) to help evaluate potential risks from these source areas.

5.2 Geochemistry

The HLPs consist of low-grade ore that has undergone intense leaching. As a result of leaching, multiple unstable constituents remain available for immediate leaching in these HLPs. In addition, more resistant constituents are also present and available for further leaching and reaction in the long term. Among the constituents available for immediate leaching are proton acidity, sulfate, and certain trace elements such as aluminum, copper, iron, manganese, and others. These constituents are readily soluble and can be liberated as a result of intense storm events at concentrations that could exceed applicable standards.

More resistant constituents that have the potential to generate acidity and cause further metal leaching in the long term include sulfide minerals and other metal-bearing phases. While the amounts of sulfide minerals have been determined to be low, the nature and amounts of other metal-bearing phases are uncertain. Therefore, the acid generation capacity of HLP materials is expected to be low, and the amount of leaching capacity in the long term is unknown, although it can be significant according to the results of whole rock analyses conducted during previous investigations.

5.2.1 Acid-Base Accounting

Calculated NNP values were based on the total sulfur content of the samples. This calculation was adequate mainly for fresh subsurface rock samples, where most of the sulfur present is in the form of sulfide. This would be the case of rocks from supergene and hypogene zones in the subsurface of pre-mined deposits. However, this is not the case for these HLP samples, which consist of ore that has been subjected to continuous acid leaching. For these samples, NNP calculated on sulfide sulfur content rather than total sulfur is more appropriate. Table 4-6 shows NNP calculated by CH2M HILL based on sulfide sulfur content and NNP values calculated by the laboratory. As shown in Table 4-6, the 25 HLP samples have sulfide sulfur NNP values ranging from -0.5 to +2.3 t $CaCO_3$/kt, and all would be categorized as "uncertain acid potential" according to the ABA evaluation criteria (see Section 4).

Comparison of NPR values with the ABA criteria suggests that all 25 HLP samples are likely PAG materials because all NPR values are less than 1. Further analysis of ABA data for HLP material indicates that NNP and NPR values are controlled by acid-producing potential values only; neutralization potential values are negligible to non-existent. Low to non-existent neutralization potential values were expected for these samples because they have been subjected to continuous acid leaching in the past, and their neutralization potential has already been consumed. Sulfide sulfur-based, acid-producing potential values appear to be independent of total sulfur amounts measured in all samples. This is consistent with the fact that sulfides are only a minor percentage of total sulfur and the sulfate sulfur results (see Table 4-6), which account for 89 to 98 percent of the total sulfur content of all samples.

Sulfate sulfur has no acid-producing potential other than perhaps residual acidity in the form of proton acidity associated with jarosites.

Therefore, the actual acid generation potential of the HLP samples should be assessed by evaluating the remaining sulfide sulfur content rather than the NNP or NPR values. As shown in Table 4-6, all 25 samples have sulfide sulfur content that range from non-detect to 0.02 percent. Using the generally accepted sulfide sulfur cutoff of 0.3 percent (Hutt and Morin, 1999), all HLP samples would be classified as non-PAG materials. The 0.3 percent cutoff criteria is based on the fact that materials with sulfide sulfur content less than 0.3 percent are not capable of sustaining acid generation.

5.2.2 Net Acid Generation

ABA results indicated that HLP samples have limited acid generation potential because of their remaining low sulfide sulfur content and their negligible neutralization potential. NAG results confirm this prediction and indicate that the acid generation potential of the samples is low, with an overall maximum acid production of approximately 5 kg H_2SO_4/t of material and a pH below 4 after oxidation.

5.2.3 Metals Leachability

SPLP results (see Table 4-8) indicate that Arimetco HLPs have some remaining metal leachability capacity. According to the results of whole rock geochemical analysis conducted during previous investigations (EPA, 2000), the Arimetco HLPs still contain significant amounts of aluminum, copper, iron, and manganese that may be available in the long-term for leaching. The HLPs also contain arsenic, barium, chromium, cobalt, nickel, vanadium and zinc in limited amounts. Although arsenic has been non-detect in SPLP leachate, this could be due to the dilute nature of SPLP leachate or the elevated detection limits used during analytical testing. Similar to arsenic, leachable antimony, thallium, and others with MCLs lower than the detection limits have not been detected in the SPLP leachate.

MWMP results (see Table 4-9) indicate that Arimetco HLP materials have proton acidity readily available for leaching and large amounts of soluble sulfate. In addition, these materials have some capacity to leach trace elements. Proton acidity available for leaching in these materials can lower the pH of neutral waters upon contact to values as low as 3.4. Soluble sulfate concentrations can result in exceedance of the sulfate secondary MCL (250 mg/L) and TDS secondary MCL (500 mg/L) in runoff and snowmelt water.

5.2.4 Geochemistry Conclusions

ABA results indicate that after having undergone acid leaching for several years, the HLP materials only have small acid-producing potential and no neutralization potential. The remaining acid-producing potential in the samples appears to be incapable of sustaining acid generation because of the very low sulfide sulfur content of the samples.

The leaching capacity of the HLPs is significant mainly because of the presence of large amounts of sulfate and trace metals. Changes over time, however, cannot be assessed by using short-term leaching procedures such as those used in this investigation. Long-term leaching procedures would be necessary to predict changes over time, in particular for metal leaching characteristics. Results of ABA tests suggest that the HLPs contain significant amounts of sulfate (up to 1.2 percent), most of which should be readily soluble and capable of sustained leaching for a long period of time.

Capping of the HLPs would reduce precipitation and infiltration, which in turn would result in lower amounts of sulfate and trace metals being released to the environment. In addition to limiting infiltration of water, if the design of the cap limits infiltration of oxygen, further benefits, including stabilization of certain trace metals, might be achieved in the long term.

5.3 Slope Stability Evaluation

The HLPs were analyzed under both static and earthquake conditions to estimate slope stability. The analysis was performed by a computer program, SLIDE, Version 5.032 (Rocscience, 2002). The material strength properties measured for samples submitted for laboratory testing were typical for soil that consists primarily of sand and gravel. There does not appear to be a significant difference in soil strength between the HLPs. Regarding slope stability, it is anticipated that all HLPs are similar; therefore, a representative slope was analyzed using conservative estimates of slope geometry and soil properties. For free-draining, granular material the slope can be evaluated as an “infinite slope” (a slope with a constant slope angle) (Washington Department of Transportation, 2006).

5.3.1 Heap Leach Pad Slope Geometry

Most of the HLPs extend 100 feet or more above their liners at their highest point and were constructed within the last 20 years. The HLP material appears to have been placed in approximate 20-foot lifts. Except for localized failures on the north side of Phase III 4X HLP, Phase I/II HLP, and the west side of Phase IV VLT HLP, the slopes show no indication of massive failure; however, surface unraveling is common. Slope geometry was obtained from Site topography (see Figure 5-2); however, the topography was altered after the topographic data had been digitized to create the map.

Cross sections were generated for the steepest portions of each HLP, and the results are presented in Appendix F. According to the cross sections, the HLP slopes appear to be close to the angle of repose for well-graded sand and gravel, with the steeper portions ranging from 32 to 37 degrees from the horizontal. The steepest slope (37 degrees) was selected for the slope stability analysis.

5.3.2 Slope Physical Parameters

Physical properties were estimated from the results of the laboratory analyses presented in Section 4.3.4.

5.3.2.1 Unit Weight

The average moist unit weight for soil in all pads was 129 lbs/ft^3; the highest average for an individual pad (Phase IV VLT HLP) was 141 lbs/ft^3. A moist unit weight (135 lbs/ft^3) was selected for the analysis.

5.3.2.2 Cohesion

Cohesion showed the highest degree of variability in laboratory test results. Also, all samples were collected from borings drilled away from the outer slope of the pads and might provide a higher degree of cementation. The lowest average cohesion for an individual HLP (Phase IV VLT HLP) was 746 lbs/ft^2. The overall average cohesion for all HLPs was approximately 1,000 lbs/ft^2. It is anticipated that most of the HLP material strength is frictional and that the material has relatively low cohesion. The apparent cohesion measured in the shear testing could be the result of cementation, which might not be present on the slopes of the HLPs. For the analysis, it is conservative to assign a low value for cohesion; therefore, the cohesion for slope stability analysis was assumed to be relatively low (150 lbs/ft^2).

5.3.2.3 Friction Angle

The friction angle measured in all samples averaged 41 degrees, with little variability; therefore, 41 degrees is considered a reliable estimate.

5.3.3 Slope Stability Factor of Safety

The factor-of-safety analysis evaluated the long-term stability of the HLPs under static and pseudostatic conditions (with horizontal acceleration from an earthquake). A typical target value for factor-of-safety for slopes under static conditions is 1.5. For pseudostatic analysis, a typical target factor-of-safety is 1.1. A factor-of-safety less than 1.0 indicates that movement is likely to occur because the driving forces exceed the resisting forces.

5.3.4 Seismic Evaluation

The most recent (2007) USGS Seismic Hazard Maps were reviewed to estimate site seismicity. The Site lies in the Basin and Range Geomorphic Province and has a relatively high seismicity. The PGA for the Yerington area is approximately 0.32g (g = the acceleration of gravity). This type of earthquake has a probable exceedance of 10 percent over 50 years. The sustained ground motion during an earthquake is approximated by applying a horizontal force equal to approximately 60 percent of the PGA (0.19g); this was the value selected for the seismic coefficient in the pseudostatic analysis.

5.3.5 Liquefaction

Liquefaction is the rapid loss of soil strength due to an increase in pore pressure resulting from an earthquake. Liquefaction is most often a problem in saturated, loose sand. At the Site, liquefaction is not considered a significant concern for the following reasons:

- The overall average dry soil density (121.1 lbs/ft^3) is approximately 86 percent of the average maximum dry density (140.4 lbs/ft^3), indicating that these materials are relatively dense.
- The material is assumed to have sufficient sand and gravel and few fines (according to the particle size analyses), and saturation of water within the pads is not anticipated.
- The bottoms of the HLPs are constructed with collection and drainage systems that prevent significant accumulation of water at their bases.

Additional data and information should be obtained during the FS to verify the assumption that the HLPs were constructed to prevent accumulation of solution at their bases. If the HLPs are not sufficiently drained, liquefaction could be a problem under earthquake conditions. Settlement of the pads under earthquake conditions is possible, but the magnitude cannot be quantified.

5.3.6 Stability Analysis

The slope configuration and selected soil properties of the HLPs for the static and pseudostatic analyses are shown on Figures 5-3 and 5-4, respectively. For the static condition, a factor of safety of 1.5 was calculated by using the SLIDE model under the stated configuration; this meets the target value for maintaining slope stability. For the pseudostatic condition, a factor of safety of 1.1 was calculated by using the SLIDE model under the same conditions and a seismic coefficient of 0.19. This also meets the target value for maintaining slope stability. These estimated values only apply to the assumptions and parameters used. Similarities between the calculated and target factor of safety values are a function of the physical properties of the materials evaluated. The HLPs have been at rest for a relatively long time and have "naturally" stabilized. The analysis used strength parameters derived from laboratory test results and field observations. The stability analysis confirms the observations—under static conditions the slopes are stable, and under the acceleration of an earthquake the slopes are just as stable.

Areas with slopes steeper than 37 degrees might be present and would not have the same factor-of-safety. Because of the loose materials on the surface of the HLPs, some movement of the slopes is likely to occur during strong earthquake shaking. Also, weathering of the materials over time will cause changes to the strength and permeability properties, which will likely decrease the slope stability.

5.4 Heap Leach Pad Characteristics

This section provides a brief overview of each HLP, including material volumes, surface characteristics, water balance and projected drain-down rates, pad and slope stability, and geometry.

5.4.1 Heap Leach Pad Material Volumes and Surface Characteristics

Table 5-1 presents a summary of HLP characteristics based on slope stability (geometry and physical parameters) and supplements the summary of HLP characteristics presented in Section 1.2.3 and Table 1-2. Topography is presented in Figure 5-2 and selected cross sections from each HLP group are presented in Appendix F.

The HLPs generally consist of low-grade ore placed in approximate 20-foot lifts over an HDPE liner. The surface characteristics of each HLP are summarized as follows:

- **Phase I/II HLP** – The top surface is very hummocky and irregular. The surface includes rocks up to 2 feet in diameter.
- **Phase III South HLP** – The top surface is very hummocky (similar to the Phase I/II HLP). The south and west sides of the HLP have a mogul-like surface.

- **Phase III 4X HLP** – The surface is smooth, with rock less than 1 inch in diameter. The edges are bermed (possibly to prevent wind erosion).
- **Phase IV Slot HLP** – The surface ranges from smooth to hummocky. Rock sizes on the surface are up to 1 foot in diameter. The eastern edges are bermed. The northwestern portion of the pad has plastic piping (acrylonitrile-butadiene-styrene) on the surface in various sizes, including 1-inch, 8-inch, and 1-foot diameters.
- **Phase IV VLT HLP** – The surface is smooth over the entire pad, with less than 0.5-inch rock (VLT or oxide tailings). Liquids tend to pool on the surface and evaporitic copper sulfate salts are prevalent on the surface. The edges are bermed.

TABLE 5-1
Summary of Heap Leach Pad Characteristics and Estimated Material Volumes
Remedial Investigation Report, Arimetco Facilities Operable Unit 8, Anaconda Copper Yerington Mine

HLP	Time of Construction	Approximate Height (feet)	Volume (cubic yards)	Maximum Drain-down (gpm)
Phase I/II	1989–1990	100	1,076,000	450
Phase III South	1990–1992	130	5,453,000	450
Phase III 4X	1992–1995	100	5,215,000	1,620
Phase IV Slot	1992–1996	110	7,599,000	2,200
Phase IV VLT	1995–1998	120	6,502,000	3,300

5.4.2 Heap Leach Pad Water Balance and Projected Drain-down Rates

Vadose zone modeling has been performed to evaluate HLP water balance and drain-down rates. The HYDRUS-1D model (Simunek et al., 1998) was used to simulate the movement of water through the HLPs. HYDRUS-1D is a one-dimensional finite element model that numerically solves the Richards equation for variably-saturated water flow through porous media. In addition, the hydraulic properties of each HLP were estimated from the results of laboratory testing (i.e., bulk density, grain size analysis, and moisture content) (see Section 4.3. HLP height, area, and period of irrigation (i.e., leaching) were estimated based on topographic analysis and the HLP characteristics presented in Table 5-1.

5.4.2.1 Model Description

Individual HYDRUS-1D models were constructed for the Phase I/II, Phase III South, Phase III 4X, Phase IV Slot, and Phase IV VLT HLPs. The models were set up as follows:

- The upper boundary condition was set to an atmospheric boundary.
- The bottom boundary was set to a free drainage condition to allow simulated mass outflow via gravity drainage.
- The rate of irrigation was determined from the maximum drain-down value reported in Table 5-1.
- Precipitation was determined using daily records from June 1972 to September 2007 from the Western Regional Climate Center online database.

- Potential evapotranspiration (PET) was estimated from average monthly pan evaporation rates for Fallon, Nevada (approximately 40 miles northeast of Yerington and nearly the same elevation). PET was set to zero for days that received precipitation.
- The percent vegetative cover was set to zero in the equation used to estimate PET.
- Uniform soil hydraulic properties were assumed for each HLP.
- It was assumed that during the period of operation, the piles were irrigated at a constant rate. It was also assumed that only the top area of each pad was irrigated; the side slopes received only natural precipitation.

A detailed description of the modeling approach and output is included in Appendix G.

5.4.2.2 Model Results

The model simulations show similar results for each of the HLPs. The results are summarized as follows:

1. Prior to irrigation, HLPs reach a steady-state outflow resulting from the average precipitation rate. The outflow is a function of the volume and surface area of each pile and the annual average precipitation.
2. Irrigation results in a nearly simultaneous increase in outflow from the bottom of the HLP, equal to the amount of irrigation.
3. Cessation of irrigation results in a drain-down in each HLP until the outflow becomes equal or nearly equal to the steady state value. The period of drain-down is a function of the soil hydraulic properties, which are unique to each HLP. Some fluctuation is likely, depending on the magnitude and timing of precipitation events.
4. Moisture content was generally observed to increase with depth in each HLP. Simulated moisture content was observed to vary in a similar manner.

These results are summarized in Table 5-2 and presented in detail in Appendix G.

TABLE 5-2
Summary of HYDRUS-1D Modeling Results
Remedial Investigation Report, Arimetco Facilities Operable Unit 8, Anaconda Copper Yerington Mine

HLP	Steady State Outflow without Irrigation (gpm)	Time for Outflow to Return to Steady State (years)
Phase I/II	1.2	> 11
Phase III	2.8	> 11
Phase III 4X	5.6	2.7
Phase IV Slot	9.0	4.7
Phase IV VLT	2.4	> 20

The models predicted moisture profiles and outflow rates for the HLPs. However, the predicted values must be used with caution. The models were calibrated with a limited data set. Model results should be confirmed by further monitoring and field investigations. Regular monitoring of outflow from the individual HLPs would expand the calibration target data set and greatly enhance the calibration of the models. With a more rigorous calibration, models could predict the effect of capping the surface of the HLPs or other potential remediation strategies.

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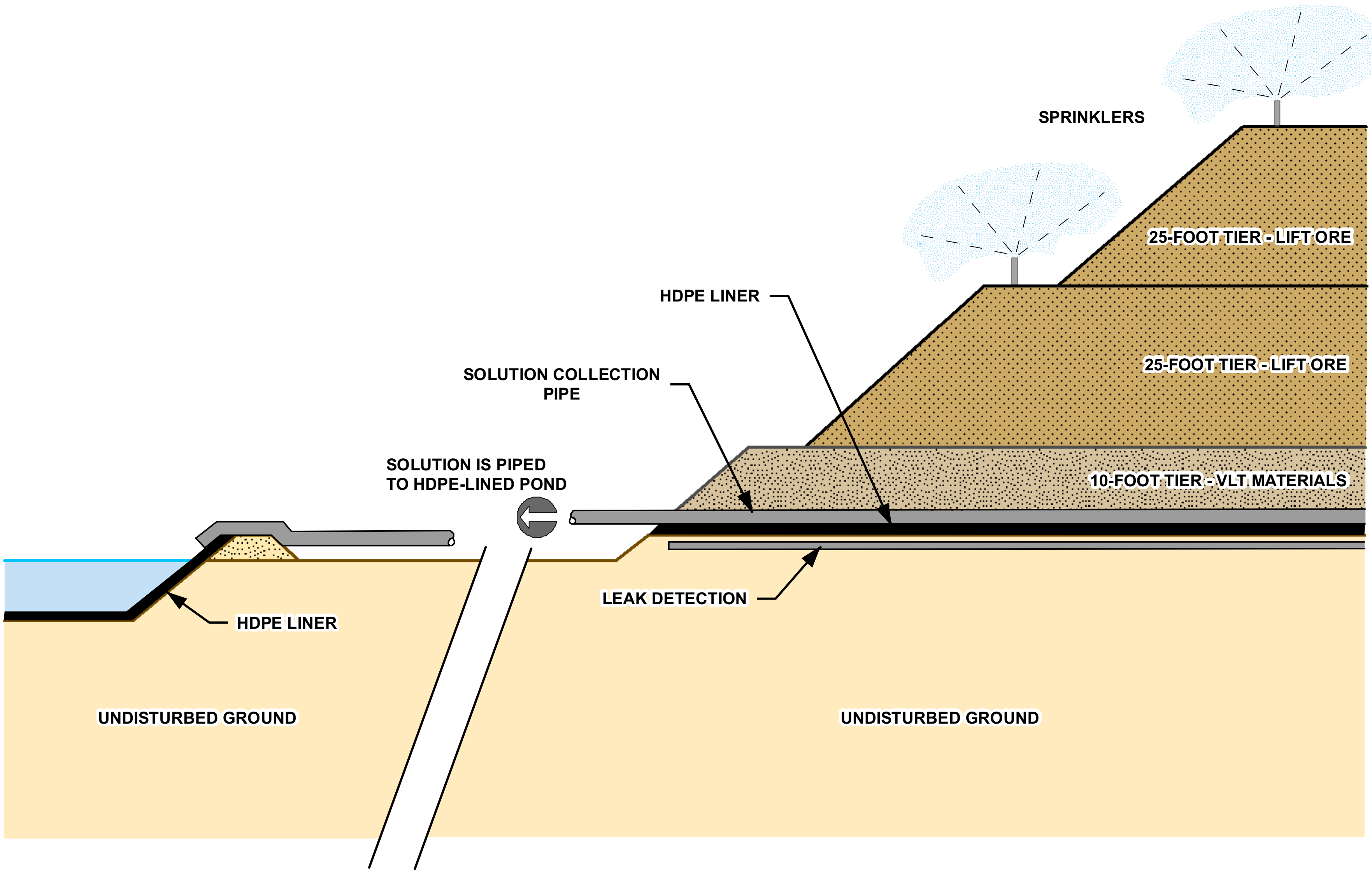

FIGURE 5-1
CONCEPTUAL ARIMETCO HEAP LEACH PAD CONDITIONS
ANACONDA COPPER YERINGTON MINE

\\LOKI\PROJECTS\RDDGIS\354946_ANACONDA_COPPER\MAPFILES\LEACH_PAD_DIAG\FIG5-1_LEACH_PAD_DIAG_NB.MXD 6/2/2008 10:42:48

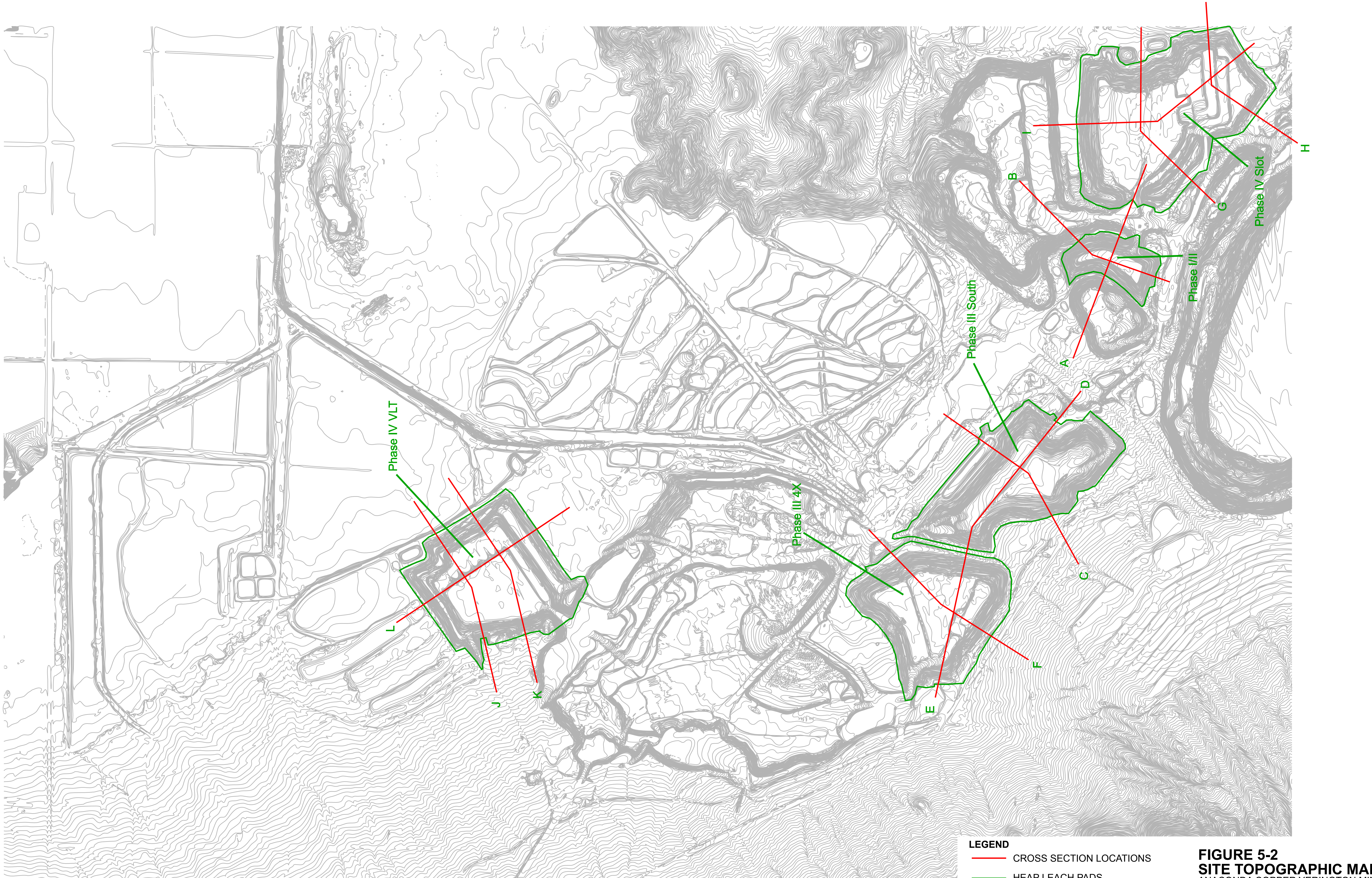

FIGURE 5-2
SITE TOPOGRAPHIC MAP
ANACONDA COPPER YERINGTON MINE

ES052008022RDD_5-2 (5/30/08)

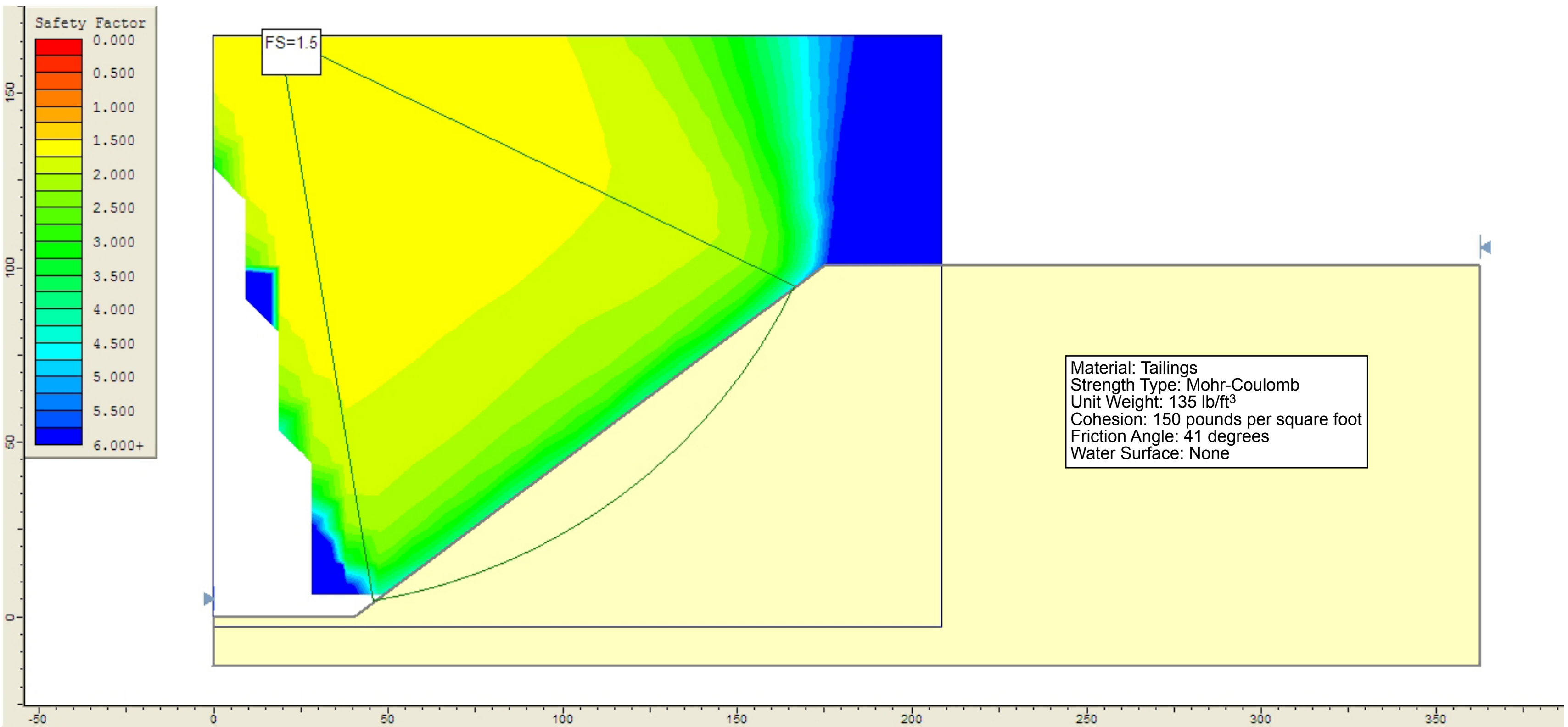

FIGURE 5-3
STATIC ANALYSIS OF SLOPE CONFIGURATION AND SOIL PROPERTIES
ANACONDA COPPER YERINGTON MINE

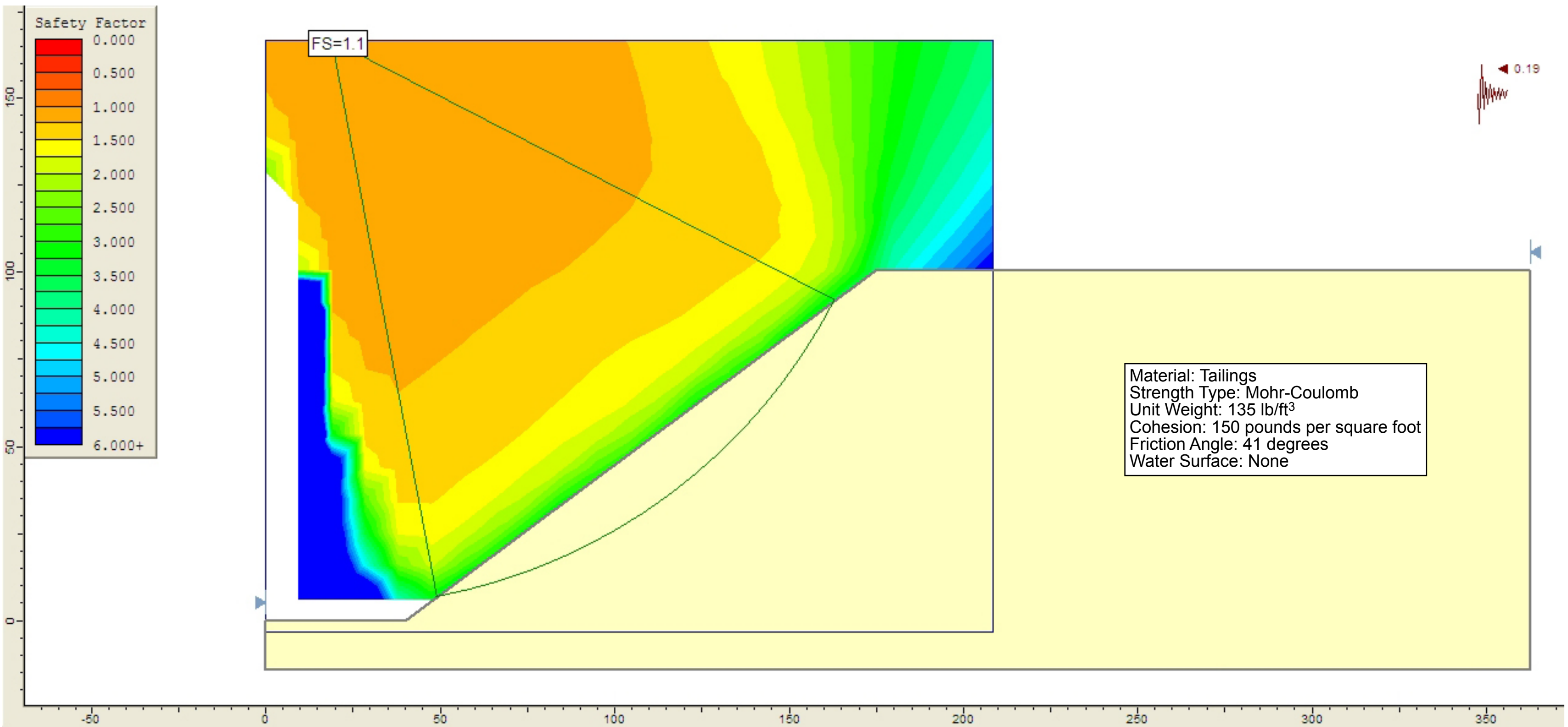

FIGURE 5-4
PSEUDOSTATIC ANALYSIS OF SLOPE CONFIGURATION AND SOIL PROPERTIES
ANACONDA COPPER YERINGTON MINE

SECTION 6

Human Health Screening-level Assessment

The screening-level human health risk assessment (HHRA) was performed to assess whether contaminated HLP materials and drain-down solution pose a significant risk to human health. The HHRA was performed in accordance with EPA guidance. Drinking water MCLs and tap water PRGs were used to evaluate drain-down solution; residential and industrial soil PRGs were used to evaluate HLP material. The use of these conservative human health screening criteria tends to overestimate potential exposures and risks for this HHRA. This section summarizes the results of the screening-level HHRA. Appendix H includes a technical memorandum detailing the problem formulation, human health effects evaluation, screening-level exposure estimates, risk characterization, results, and conclusions.

6.1 Human Health Hazard Identification

Cancer risks and health hazards associated with exposure to HLP materials were estimated, and the potential for unacceptable cancer risk or human health hazard was identified by using the following criteria:

- Excess lifetime cancer risk values were compared with the risk management range of 1E-06 to 1E-04 (EPA, 2004).
- A hazard index (HI) (the sum of ratios of chemical intake to the reference dose for all noncarcinogens) greater than 1 indicates that there is potential for adverse noncancer health effects associated with exposure to the COPCs (EPA, 1991).

For metals in the drain-down solution, primary MCL exceedance ratios ranged from 15 times the MCL for mercury to 4,385 times the MCL for copper. Eight metals had primary MCL exceedances: antimony (33 times the MCL), arsenic (28 times the MCL), beryllium (375 times the MCL), cadmium (84 times the MCL), chromium (21 times the MCL), copper (4,385 times the MCL), mercury (15 times the MCL), and thallium (445 times the MCL).

For TPH in the drain-down solution, Nevada cleanup standards were exceeded two-fold. For radionuclides in the drain-down solution, the maximum alpha radiation concentration exceeded the primary MCL by a factor of 1,087 times and the cancer risk for radionuclides (thorium 227, thorium 228, thorium 230, thorium 232, uranium 234, uranium 235, and uranium 238) ranged from 2E-04 for thorium 232 to 2E-02 for uranium 234. The cumulative cancer risk was 3E-02 for radionuclides.

For metals in Group A surface samples, the results of the cumulative residential and industrial cancer risks were 8E-05 and 2E-05, respectively. The primary contributor to residential and industrial risks was arsenic. Cumulative noncancer HIs were 7 and less than 1, respectively. The primary contributors to residential noncancer hazards were arsenic, copper, and iron.

For Group B surface samples, the results of the cumulative residential and cumulative industrial cancer risks were 3E-04 and 7E-05, respectively. The primary contributor to residential and industrial risks was arsenic; cumulative noncancer HIs were 19 and 2, respectively. The primary contributors to residential and industrial noncancer hazards were arsenic, copper, iron, and thallium. The Box-and-Whisker plots comparing metal concentrations with residential and industrial PRGs are presented in Appendix H.

6.2 Exposure and Effects Assessment

Conservative exposure and effects assumptions were used to evaluate potential risks receptors. Analytical results for drain-down solution were compared with drinking water MCLs and tap water PRGs; however, drain-down solution would not be expected to be ingested. The use of these conservative comparison criteria overestimates potential exposures and associated risks resulting from drain-down solution. For HLP materials, comparisons with the soil PRG were used. There is uncertainty associated with using soil PRGs for comparison criteria for HLP materials because the HLP materials are solid wastes from mining and leaching operations; they are not soil. The exposure assumptions for soil might not be directly applicable for estimating exposure to HLP materials. For example, dermal adherence, and consequently incidental soil ingestion related to hand-to-mouth contact, might be less for the HLP materials than for soil. Consequently, risks could be overestimated by using the soil PRGs as comparison criteria.

6.3 Summary and Conclusions

The screening-level HHRA suggests that the drain-down solution exceeds the drinking water MCLs for eight metals and that drain-down solution should not be ingested as drinking water. Cancer risks for potential exposure to Group A HLP materials are at the upper end of the EPA cancer risk management range of 1E-06 to 1E-04. The residential cancer risk for potential exposure to Group B HLP materials exceeds the EPA cancer risk management range of 1E-04. Industrial cancer risk is at the upper end of the EPA cancer risk management range. The noncancer health hazards for exposure to Group A HLP materials exceeded an HI of 1 for residential exposures; the noncancer health hazards for exposure to Group B HLP materials exceeded an HI of 1 for residential and industrial exposures.

Potential impacts of drain-down solution to groundwater beneath the HLPs were not evaluated as part of the screening-level HHRA or this RI. If impacted by drain-down solution, groundwater beneath the HLPs may present a potential exposure pathway and would be considered when selecting a cleanup alternative for the HLPs. EPA will identify data gaps pertaining to the Arimetco HLPs and may propose supplemental RI data collection to fill those data gaps.

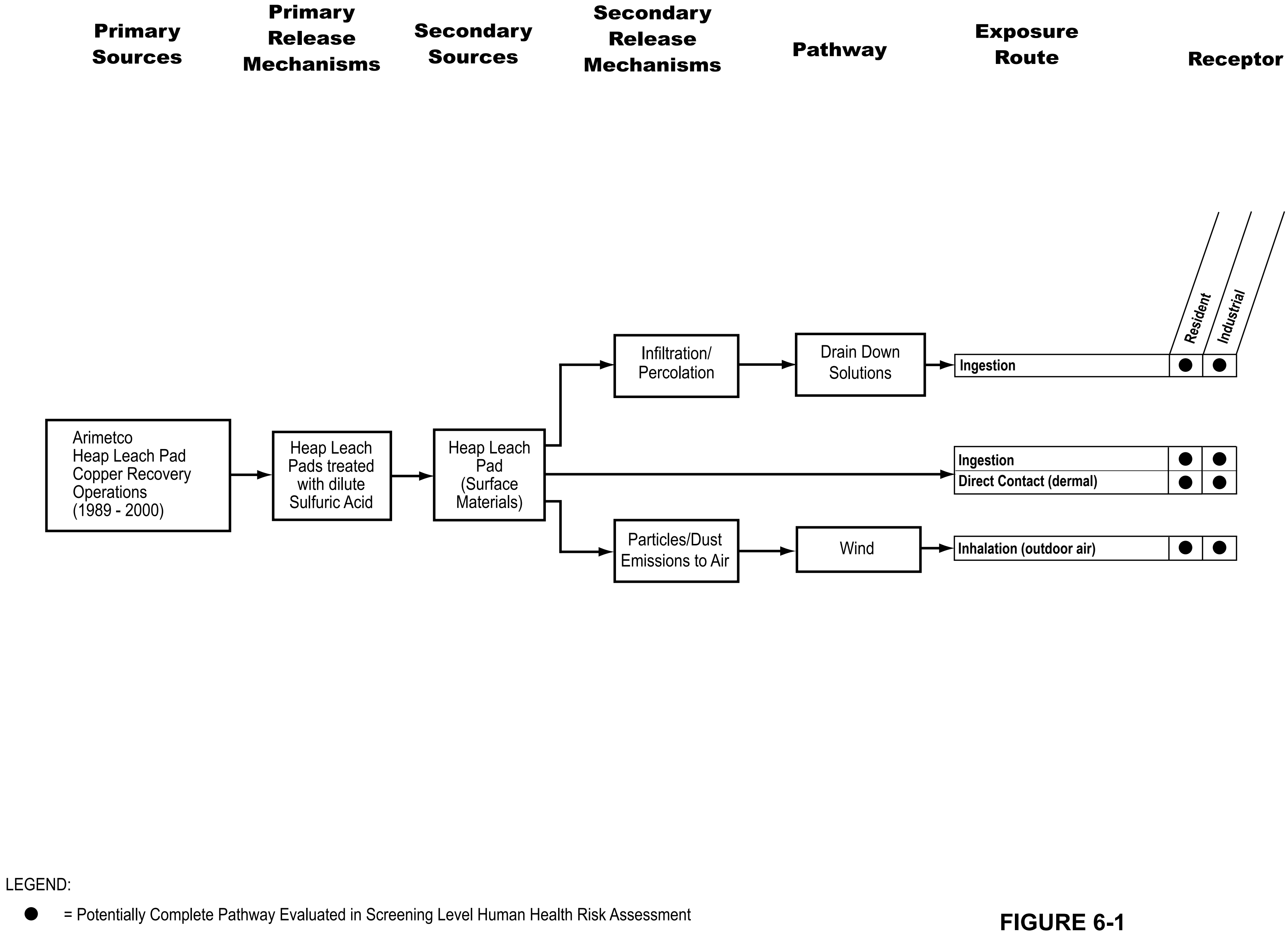

FIGURE 6-1
CONCEPTUAL SITE MODEL FOR HUMAN HEALTH EXPOSURES
ANACONDA COPPER YERINGTON MINE

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SECTION 7

Ecological Screening-level Risk Assessment

The screening-level ecological risk assessment (SLERA) was performed in accordance with EPA guidance to evaluate the potential for adverse effects to resident biota due to exposure to metals and radionuclides in drain-down solution and surficial HLP materials in portions of OU-8. These metals and radionuclides are chemicals of potential ecological concern. This section summarizes the SLERA. Appendix I contains a technical memorandum that details the problem formulation, ecological effects evaluation, screening-level exposure estimates, risk characterization, SLERA results, and conclusions.

7.1 Ecological Hazard Indentification

Concentrations of multiple metals in HLP surface materials and drain-down solution are sufficiently elevated to potentially cause adverse effects for plants, invertebrates, birds, and mammals that are exposed to the materials (see Table 7-1).

TABLE 7-1
Summary of Ecological Screening Results for Heap Leach Pad Surface Materials and Drain-down Solution
Remedial Investigation Report, Arimetco Facilities Operable Unit 8, Anaconda Copper Yerington Mine

	Risks from HLP Surface Materials				Risks from Drain-down Solution	
Analyte	**Plants**	**Soil Invertebrates**	**Birds**	**Mammals**	**Birds**	**Mammals**
Metals (mg/kg)						
Aluminum	X=100%	--	X	X=100%	X	X
Antimony	NR	NR	--	X	--	--
Arsenic	X	X	X	X	NR	NR
Barium	NR	NR	--	NR	--	NR
Beryllium	NR	NR	--	NR	--	NR
Cadmium	NR	NR	X	X	NR	NR
Chromium (assumed 3+)	--	--	NR	NR	--	--
Chromium (assumed 6+)	--	--	--	NR	--	--
Chromium (total)	X=100%	X=100%	--	--	NR	NR
Cobalt	X	--	NR	NR	--	NR
Copper	X	X=100%	X=100%	X=100%	X	X
Lead	X	NR	X	X	--	--
Manganese	NR	NR	NR	NR	--	NR
Mercury	X=100%	X=100%	X-100%	X=100%	--	--
Molybdenum	X=100%	--	X=100%	X=100%	NR	NR
Nickel	NR	NR	NR	NR	--	NR

TABLE 7-1
Summary of Ecological Screening Results for Heap Leach Pad Surface Materials and Drain-down Solution
Remedial Investigation Report, Arimetco Facilities Operable Unit 8, Anaconda Copper Yerington Mine

	Risks from HLP Surface Materials				Risks from Drain-down Solution	
Analyte	**Plants**	**Soil Invertebrates**	**Birds**	**Mammals**	**Birds**	**Mammals**
Selenium	X=100%	X	X=100%	X=100%	NR	NR
Silver	NR	--	NR	NR	--	--
Thallium	X	--	--	X	--	--
Vanadium	X=100%	--	X=100%	NR	NR	NR
Zinc	NR	NR	X	X	NR	NR
Radionuclides (picocuries per gram)						
Thorium 227	NR	NR	NR	NR	NR	NR
Thorium 228	NR	NR	NR	NR	NR	NR
Thorium 230	NR	NR	NR	NR	NR	NR
Thorium 232	NR	NR	NR	NR	NR	NR
Uranium 234	NR	NR	NR	NR	X	X
Uranium 235	NR	NR	NR	NR	NR	NR
Uranium 238	NR	NR	NR	NR	X	X

Notes:
NR = no risk
-- = no screening value; not evaluated
X = maximum exceeded screening value; X=100% means all samples exceeded screening value

In surficial HLP materials, six metals (aluminum, arsenic, copper, mercury, molybdenum, and selenium) exceeded the screening values for virtually all receptor groups. In many instances, 100 percent of the sample results exceeded screening values. Lead concentrations exceeded screening values for all receptors except soil invertebrates. Antimony, cadmium, and zinc screening values were only exceeded in upper trophic level receptors (i.e., birds and mammals). In contrast, total chromium and cobalt screening values were only exceeded in lower trophic levels (i.e., plants and soil invertebrates). Five metals (barium, beryllium, manganese, nickel, and silver) did not exceed any of the available screening values for any of the receptor groups; therefore, these analytes are considered to present no significant risks. Unlike metals, no soil-based radionuclide screening values (biota concentration guides [BCG]) were exceeded. Consequently adverse effects due to exposure to radionuclides in HLP surficial material are unlikely.

7.2 Exposure and Effects Assessment

Conservative exposure and effects assumptions (i.e., maximum concentrations and no effect levels) were used to evaluate potential risks to terrestrial plants, soil invertebrates, birds, and mammals.

7.3 Summary and Conclusions

Although the screening evaluation for HLP surficial materials suggests risks to terrestrial receptors, significant uncertainties exist. Implicit in the risk evaluation for plants and soil invertebrates was the assumption that HLP materials were comparable to soil and, therefore, could be evaluated using soil screening benchmarks. Because the HLP material is mined and processed rock and acid solution has been added to extract metals, this assumption is not likely valid. Therefore risks to plants and soil invertebrates might be overestimated. Similarly, the risk evaluation for birds and mammals assumes that the HLP materials can produce prey (soil invertebrates and small mammals) and cover such that receptors will reside at and forage at the sites and be exposed. Because the amount of prey is probably limited, risks to wildlife from HLP materials are likely to be overestimated. However, should the surfaces of the HLPs be modified or improved so that plants and other biota become established, potential exposure and adverse effects to plants, soil invertebrates, and wildlife might result because of the elevated levels of metals in the HLP materials.

In contrast to the potential overestimated risks to ecological receptors that might be exposed to surficial HLP materials, anecdotal evidence suggests that drain-down solution in the leachate ponds is adversely affecting birds. Comparison of metal concentrations and pH in the ponds with the acute toxicity values found in literature suggest that aluminum, copper, and pH, are at levels acutely lethal to birds and mammals. This is supported by recent research by Hooper et al., (2007) where 78 percent mortality occurred among mallards acutely exposed to synthetic acid mine water that had a composition comparable to the drain-down solution present in the OU-8 leachate ponds. The mortality was attributed to copper toxicity (Hooper et al., 2007).

Uranium-234 and uranium-235 concentrations in drain-down solution were elevated such that summed BCGs exceeded the chronic effects threshold. However, because habitat and food resources are lacking at the drain-down ponds, effects caused by exposure to radiation from the solution are considered unlikely.

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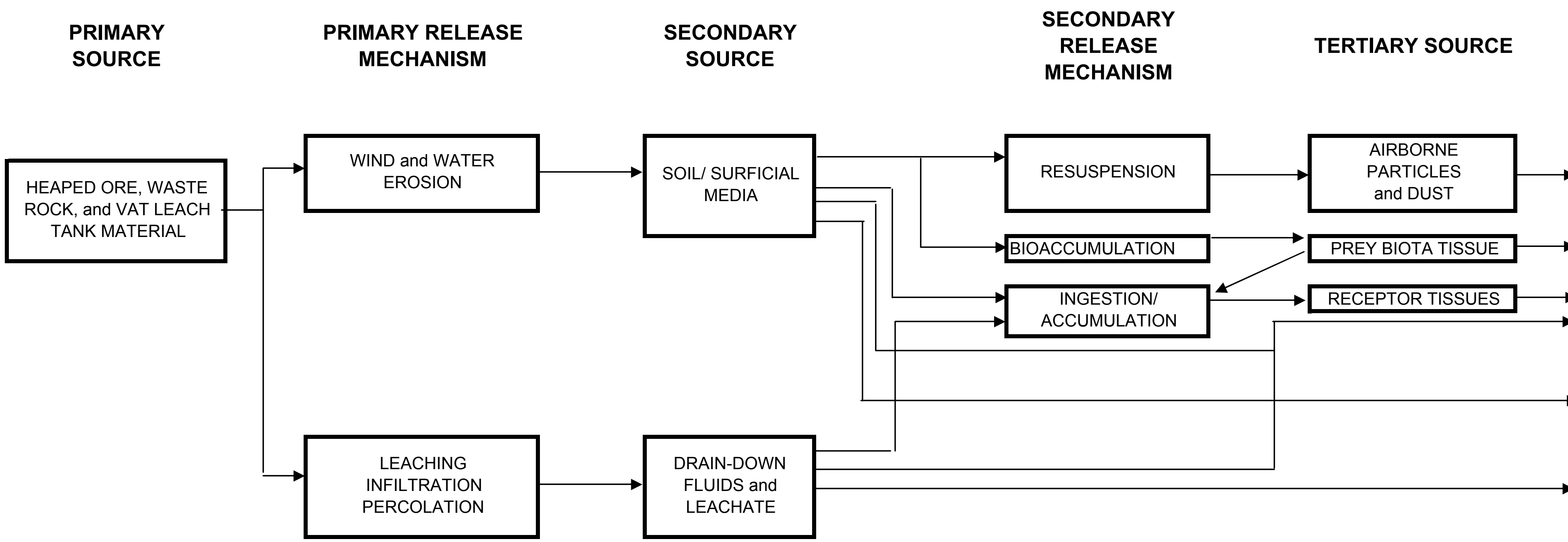

Exposure Route	Terrestrial Plants	Terrestrial Invertebrates	Chukar	Killdeer	Mallard	American Kestrel	Pocket Gopher	Merriam's Shrew	Kit Kox
	Ecological Receptors								
Inhalation (dust)	--	--	Ci	Ci	Ci	Ci	Ci	Ci	Ci
Foliar Uptake	Ci	--	--	--	--	--	--	--	--
Ingestion	--	Ci	C	C	Ci	C	C	C	C
Internal Radiation Dose	C	C	C	C	C	C	C	C	C
External Radiation Dose	C	C	C	C	C	C	C	C	C
Root Contact	C	--	--	--	--	--	--	--	--
Dermal Contact	--	C	Ci	Ci	Ci	Ci	Ci	Ci	Ci
Ingestion	--	C	C	C	Ci	C	C	C	C
Dermal Contact	--	I	Ci	Ci	Ci	Ci	Ci	Ci	Ci
Ingestion	--	I	C	C	C	C	C	C	C

Legend

C	Pathway considered complete and significant (quantitatively evaluated)
Ci	Pathway considered complete but insignificant (not quantitatively evaluated)
I	Pathway considered incomplete
--	Pathways not applicable

FIGURE 7-1
CONCEPTUAL SITE MODEL OF ECOLOGICAL EXPOSURES
ANACONDA COPPER YERINGTON MINE

SECTION 8

Conclusions and Recommendations

Mine-related contaminants associated with former Arimetco operations and have adversely impacted portions of the Site. These impacts are primarily confined to the footprints of each HLP and their drain-down fluid management systems but might extend to contaminate groundwater. Evaluations of sitewide impacts to groundwater, including localized contributions from Arimetco, are being evaluated by ARC separately. EPA will identify any data gaps pertaining to the Arimetco facilities that will not be addressed by the ARC investigation and may propose supplemental RI data collection efforts to fill those data gaps. Elevated concentrations of mining wastes occur in ponded surface waters, with relatively lower concentrations of these wastes remaining on or within the HLPs. A summary of the Site physical characteristics, the nature and extent of contamination, fate and transport mechanisms, and ecological and human health risk evaluation results are presented in the following sections. From these results, recommendations are provided in Section 8.6.

8.1 Site Physical Characteristics

The physical characteristics of the Site are summarized as follows:

- Annual precipitation is approximately 5 inches, and average temperatures range from approximately 18°F in winter to 92°F in summer.
- The dominant surface water drainage is the Walker River, portions of which flow within 0.25 mile of the Site at its southeastern end. Other surface water bodies at the Site, including the Pit Lake, wastewater treatment ponds, pump-back evaporation ponds, and lined evaporation and drain-down ponds are present, although some are only present seasonally.

8.2 Nature and Extent of Contamination

The nature and extent of Site contamination related to the HLPs is summarized in the following sections.

8.3 Fate and Transport

Heaped ore and drain-down solution remains entrained in the HLPs; the drain-down solution causes ecological harm, releasing contaminants, and impacting portions of the Site. As discussed in Section 5, the potential contaminant release or migration pathways are infiltration of drain-down solution, and the settling/structural failure of the HLPs.

NAG results indicate that the acid generation potential is low, although proton acidity can lower the pH of neutral waters upon contact to values as low as 3.4, resulting in runoff and snowmelt water that exceed the sulfate and TDS secondary MCLs (250 mg/L and 500 mg/L, respectively).

In addition to the drain-down solution in the drain-down ponds, Group A and Group B steady-state outflow (without irrigation) is estimated to be between 1.2 and 9.0 gpm.

8.4 Human Health Screening-level Assessment

The screening-level HHRA conservatively estimates potential risks to human receptors. Drain-down solution was compared to drinking water MCLs and tap water PRGs; however, it is not expected that drain-down solution would be ingested. The use of these conservative comparison criteria overestimate the potential exposures and associated risks from drain-down solution. The screening-level HHRA suggests that drain-down solution exceeds the drinking water MCLs for eight metals.

For HLP materials, comparisons with the soil PRGs were used to evaluate associated risks and hazards. Cancer risks for potential exposure to Group A HLP materials are at the upper end of the EPA cancer risk management range of 1E-06 to 1E-04. The residential cancer risk for potential exposure to Group B HLP materials exceed the EPA cancer risk management range of 1E-04. Industrial cancer risk is at the upper end of the EPA cancer risk management range. The noncancer health hazard for exposure to Group A HLP materials exceeded an HI of 1 for residential exposures; noncancer health hazards for exposure to Group B HLP materials exceed an HI of 1 for residential and industrial exposures.

8.5 Ecological Screening-level Risk Assessment

The screening evaluation for surficial HLP materials incorporated multiple significant uncertainties that likely overestimate the exposure risk to plants and soil invertebrates resulting from these materials. Similarly the risk evaluation for birds and mammals assumed the HLP materials can produce prey and cover so that receptors will reside and forage at the sites and, becoming exposed. Because these assumptions are unlikely, the magnitude of adverse risk to wildlife from HLP materials might be lower than anticipated, given the concentrations detected. Should the surfaces of the HLPs be modified or improved to establish vegetation, potentially introducing other biota, potential exposure and adverse effects to plants, soil invertebrates, and wildlife might result.

Risks to ecological receptors from drain-down solution in the evaporation ponds exist and appear to be adversely affecting birds. Aluminum, copper, and pH are at levels acutely lethal to birds and mammals. Radionuclides (uranium-234 and uranium-235) in drain-down fluids were elevated and the summed BCGs exceeded the chronic effects threshold. However, because habitat and food resources are not present at the drain-down fluid ponds, impacts caused by exposure to radiation from the fluids are considered unlikely.

8.6 Recommendations

Sufficient data and information are available to support the OU-8 FS process, which includes the following:

- The composition and geotechnical and geochemical characteristics of the HLPs are sufficiently determined.
- HLP materials do not pose an adverse threat to human health receptors assuming that HLP materials remain in place and that institutional controls and land use controls are maintained indefinitely. If HLP materials are removed from the site for residential or recreational applications, further risk analyses would be needed for the following reasons:
  - The residential cancer risk to potential exposure to Group B HLP materials exceed the EPA risk management range.
  - The cumulative noncancer HIs are 7 and 19 for Group A and Group B HLP materials, respectively.
- In their current form, and assuming maintenance and enforcement of institutional controls and land use controls, HLP materials present minimal risks to ecological receptors. If the following changes occur, this conclusion would change:
  - If the HLP surfaces are modified or improved to establish vegetation, potentially introducing other biota, potential exposure and adverse effects to plants, soil invertebrates, and wildlife might result.
  - If the HLPs are altered to provide habitat for birds and mammals, further risk analysis would be needed.
- Drain-down solutions are seasonally present and represent a substantial risk to ecological receptors.
- HLP steady-state outflow (without irrigation) ranges from 1.2 to 9.0 gpm.

Capping the HLPs would reduce the infiltration of precipitation, which would reduce the quantity of fluids generated, resulting in lower mobility of sulfate and trace metals. If the design of the cap limits the infiltration of oxygen, stabilization of certain trace metals might also be achieved in the long term.

Drain-down solution is adversely affecting ecological receptors, specifically birds. A comparison of metal concentrations and pH data from the ponds with acute toxicity values found in literature suggest that aluminum, copper, and pH are at levels acutely lethal to birds and mammals. In the short term, the drain-downsolutions should be actively managed to reduce the threat to ecological receptors; permanent or long-term alternatives should be evaluated as part of the FS.

SECTION 9

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Appendix A
Radiological Walkover Survey Report

EXECUTIVE SUMMARY

This report presents the results of the Radiological Gamma Walkover Survey (GWS) of the Heap Leach Pads, Yerington Mine Site in Yerington, Nevada. The survey was conducted from September 10 through September 21, 2007. This site consists of five heap leach pads including Phase I/II contiguous, Phase III South, Phase III 4x, Phase IV Slot and Phase IV Vat Leach Tailings. The heap leach pads were used to leach copper form low-grade oxide ore with a dilute sulfuric acid solution. The walkover data was compared to background values determined at the site and may be compared at a later date to background values determined during background soil surveys currently being conducted by Atlantic Richfield Company, which was not part of this scope of work. Non-intrusive GWS were performed over accessible areas to identify the presence of elevated gamma radiation at the surface.

Purpose

The purpose of the survey was to confirm that the area was correctly identified as a MARRSIM Class III area. No specific DCGLs were established because it was known that the sensivity of the detection system was below any potential DCGL.

Scope

The GWS was designed to determine if surface gamma radiation count rates exist that exceeded 3 standard deviations above the mean background count rate. The GWS data was used to determine if soil sampling might be required and to suggest any additional surveys that might be required to complete the site investigation.

Gross Gamma Walkover Survey

Gross gamma walkover survey data were collected using a Ludlum Model 2221 scaler/ratemeter with a Ludlum Model 43-10 2 inch × 2 inch sodium iodide (NaI) gamma scintillation detector. The detector was suspended at a height of approximately 15 centimeters (cm) above the ground and moved in parallel lines meters apart at a speed of 0.5 meters per second. The measurements were position correlated and data were automatically logged with the measurement coordinates using the Trimble Pro-XRS GPS system. The GPS link tied survey data to spatial locations using state plane coordinates North American Datum (NAD) US State Plane 1927, Nevada West 2703. The GPS was checked daily to ensure accuracy and repeatability. Background measurements were collected at several onsite locations prior to initiation of the survey and on a daily basis during the GWS. The background count rates ranged from approximately 13,000 counts per minute (cpm) to 16,000 cpm. The average background count rate was determined to be 14,595 cpm with a standard deviation of ±2,895 cpm. Background count rates were collected at three locations; 1) near the temporary trailer; 2) near the old post office (Atlantic Richfield) 3) at the intersection of Birch Drive at Highway 95. Please see Site Map 1-2 for the background locations.

The gross gamma walkover survey was designed to cover as much area as possible of the 5 Heap Leach Pads identified (approximately 480 acres). A low degree of accessibility was encountered at the site due to large boulders and shoulder high mounds of mineral deposits. Inaccessible areas were identified based on safety concerns of uneven footing and hazardous terrain and were not surveyed and appear as gaps in the survey coverage. The survey was conducted using an all-terrain vehicle (ATV) to offset these safety concerns.

Data files were plotted on a cumulative frequency diagram that represents the direction path of the GWS and the corresponding count rates of the gamma detection instrumentation. The heap leach pads survey maps provide representation of count rate ranges with corresponding colors along with minimum detected count rate, maximum detected count rate and average count rate:

<u>Phase I and II Heap Leach Pads:</u>
Maximum Count Rate: 14,248 cpm
Minimum Count Rate: 9,807 cpm
Average Count Rate: 12,908 cpm
Standard Deviation:

<u>Phase III 4x Heap Leach Pad:</u>
Maximum Count Rate: 23,417 cpm
Minimum Count Rate: 10,267 cpm
Average Count Rate: 14,887 cpm
Standard Deviation:

<u>Phase III South and Phase III Bathtub:</u>
Maximum Count Rate: 16,625 cpm
Minimum Count Rate: 9,766 cpm
Average Count Rate: 14,068 cpm
Standard Deviation

<u>Phase IV Slot Heap Leach Pad:</u>
Maximum Count Rate: 19,965 cpm
Minimum Count Rate: 9,418 cpm
Average Count Rate: 15,911 cpm
Standard Deviation:

<u>Phase IV Vat Heap Leach Pad:</u>
Maximum Count Rate: 21,675 cpm
Minimum Count Rate: 11,691 cpm
Average Count Rate: 15,640 cpm
Standard Deviation:

This site yielded results consistent with a normal background distribution.

Gross gamma count rate data from the relative background population were used to calculate an average.

GWS System Description

The GWS system consisted of a roving GPS/gamma-survey package and a base station transmitter/receiver. The roving unit combined a 9 channel Trimble Pro-XRS with a TDC1 data logger for the global positioning and a Ludlum scaler/rate meter with a 2x2 NaI scintillation detector for gamma detection. The rover simultaneously logged gamma count rates and position data. The data logging frequency was one measurement every second. The fixed base station, located at a known coordinate site near the landfill, was used as a reference point for differential correction of the rover unit data.

The rover instrumentation was mounted on a four-wheeled all-terrain vehicle in a manner that allowed for consistent, near-surface scanning of the entire area of interest. To the extent possible, areas not accessible to the survey vehicle were measured on foot utilizing the same instrumentation mounted on a backpack. Due to steep terrain, and uneven footing conditions, some areas of the site remained inaccessible.

The plat map provided the coordinates of survey points which were used to digitize a general outline of the area of interest. These points were imported into an Arcview geographic information program to generate a map of the heap leach pads in relation to the entire base map.

As part of the initial GPS/gamma survey, EDi used one of the known coordinate stations nearest the heap leach pads as the fixed base station site. Using data collected by the fixed base station data collected during the gamma surveys, Trimble's Pathfinder software differentially corrected the rover position data. Differential correction allowed for position accuracy in the sub-meter range. The data was then used to create an Arc/Info coverage for the landfill that would accurately display all of the gamma data collected. Gamma data was sorted and displayed to identify the location and distribution of peak gamma values for the property. These values were compared to background gamma values from a nearby unaffected area.

Radiological Survey Results

Although some areas of the heap leach were inaccessible and some position data was not correctable due to satellite signal loss, the available data met the USEPA's quality assurance guidance document's (QAM/005) definition for completeness. That is, greater than 90% of data collected were available for use in analysis of site conditions. Considering this, the radiological survey results of the heap leach pads indicate that no points were identified where gamma count rates exceeded 3 standard deviations above the mean background count rate. Computer generated survey maps clearly demonstrate these findings. Due to the fact that no truly elevated gamma levels were identified, no soil samples were collected.

Based on review of the available radiological survey data, EDi suggests radiological parameters at this site to be within the normal range of background.

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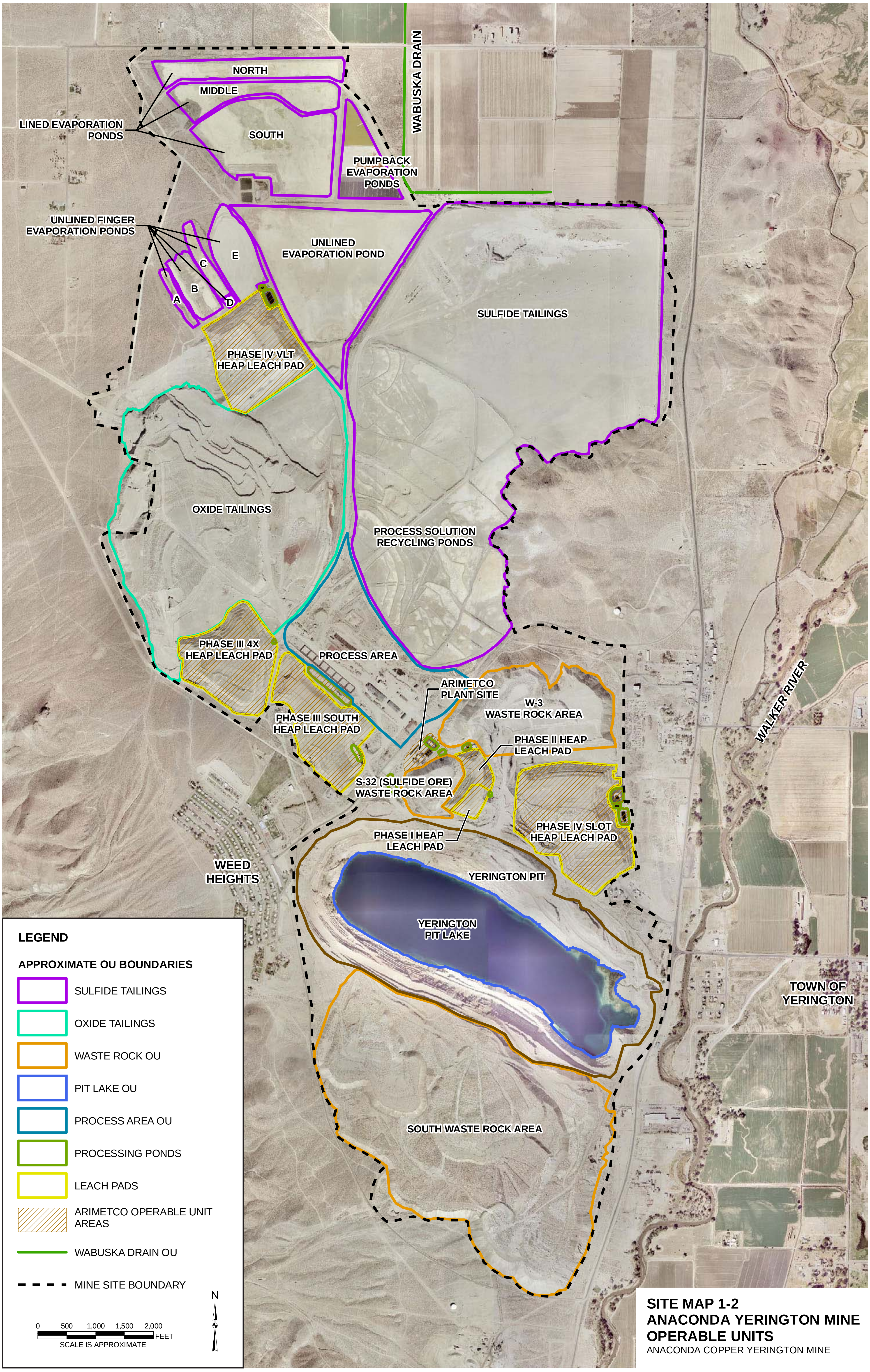
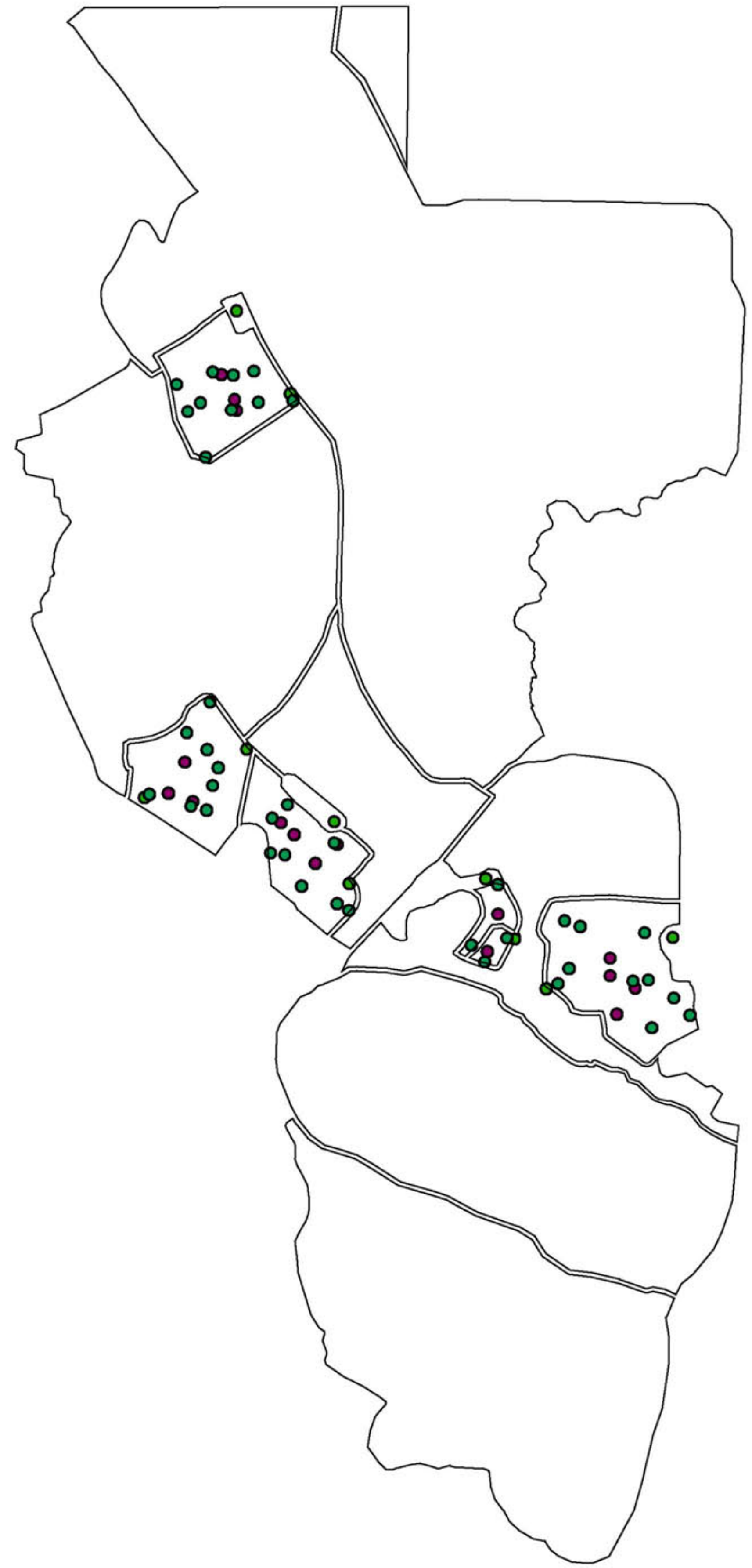


SITE MAP 1-2
ANACONDA YERINGTON MINE OPERABLE UNITS
ANACONDA COPPER YERINGTON MINE

\\LOKI\PROJECTS\RDDGIS\354946_ANACONDA_COPPER\MAPFILES\FIG1_2_OP_UNIT.MXD 6/13/2007 11:51:52
ES052008022RDD_SM_1-2



PREPARED FOR:

PREPARED BY:

ENVIRONMENTAL
DIMENSIONS INC.
1901 CANDELARIA RD NW
ALBUQUERQUE, NM 87197

LEGEND:

SURVEY DATE:

TITLE:

ANACONDA PROJECT BASE MAP

DRAWN BY:

PRINT DATE:

0 0.25 0.5 1 Miles

N
W E
S

PREPARED FOR:
CH2M HILL inc.
Redding Office
2525 Airpark Drive
Redding, CA 96001

PREPARED BY:
ENVIRONMENTAL
DIMENSIONS INC.
1901 CANDELARIA RD NW
ALBUQUERQUE, NM 87197

Legend

- Proposed Boreholes
- Proposed Drain Down
- Proposed Surface Samples

2X2_CPM

- 9807 - 12000
- 12001 - 15000
- 15001 - 20000

HIGH- 14248
LOW- 9807
AVG.- 12908

SURVEY DATE: 9/12/07

TITLE:

PHASE I HEAP LEACH PAD
PHASE II HEAP LEACH PAD

DRAWN BY: M.PLONSKI

DRAFT DATE: 9/15/07

0 0.005 0.01 0.02 Miles

N
W E
S

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CH2M HILL inc.
Redding Office
2525 Airpark Drive
Redding, CA 96001

PREPARED BY:
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DIMENSIONS INC.
1901 CANDELARIA RD NW
ALBUQUERQUE, NM 87197

Legend

Proposed Boreholes
Proposed Drain Down
Proposed Surface Samples

PHASE34X

2X2_CPM

2 - 12000
12001 - 18000
18001 - 23417

HIGH- 23417
LOW- 10267
AVG.- 14887

SURVEY DATE: 9/12/07

TITLE:
PHASE III 4X
HEAP LEACH PAD

DRAWN BY: M.PLONSKI

DRAFT DATE: 9/15/07

0 0.015 0.03 0.06 Miles

N
W E
S

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CH2M HILL inc.
Redding Office
2525 Airpark Drive
Redding, CA 96001

PREPARED BY:
ENVIRONMENTAL
DIMENSIONS INC.
1901 CANDELARIA RD NW
ALBUQUERQUE, NM 87197

Legend

- Proposed Boreholes
- Proposed Drain Down
- Proposed Surface Samples

PHASE 3 S

2X2_CPM

- 0 - 12000
- 12001 - 16625

HIGH- 16625
LOW- 9768
AVG.- 14068

SURVEY DATE: 9/12/07

TITLE:
PHASE III SOUTH
&
PHASE III BATHTUB

DRAWN BY: M.PLONSKI

DRAFT DATE: 9/15/07

0 0.01250.025 0.05 Miles

N
W E
S

PREPARED FOR:
CH2M HILL inc.
Redding Office
2525 Airpark Drive
Redding, CA 96001

PREPARED BY:
ENVIRONMENTAL DIMENSIONS INC.
1901 CANDELARIA RD NW
ALBUQUERQUE, NM 87197

Legend

- Proposed Boreholes
- Proposed Drain Down
- Proposed Surface Samples

PHASE 4

2X2_CPM

- 2 - 12000
- 12001 - 18000
- 18001 - 21675

HIGH- 21675
LOW- 11691
AVG.- 15640

SURVEY DATE: 9/12/07

TITLE:

PHASE IV VLTG
HEAP LEACH PAD

DRAWN BY: M.PLONSKI

DRAFT DATE: 9/15/07

0 0.015 0.03 0.06 Miles

Appendix B
Boring Logs

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:
354946. FI.02	H3SSU01 SHEET 1 OF 3

SOIL BORING LOG

PROJECT: Anaconda/Yerington
LOCATION : W 119 12 11.987 N 38 59 39.126
ELEVATION: ft ()
DRILLING CONTRACTOR: Boart Long Year
DRILLING EQUIPMENT: SR 114
DRILLING EQUIPMENT: 8-inch casing, 7-inch core barrel
WATER LEVELS: Not Encountered
START: 1600
END: 1800
LOGGER: S. Montieth

DEPTH (ft bgs)	INTERVAL (ft)	RECOVERY (%)	TYPE/NUMBER	USCS CODE	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	PID (ppm)	COMMENTS: OBSERVATIONS (E.G., DEBRIS, SHEEN, STAINING), SAMPLING AND TESTING NOTES, DRILLING OPERATIONS (e.g., REFUSAL, DRILL RATE)
		100		SW	WELL-GRADED SAND WITH GRAVEL (SW). 7.5YR 6/6, dry to moist, disturbed.		Colors from Munsell color chart. Samples are disturbed and cannot be estimate density.
		100		SW	Same as above (SW). Moist.		Bags slightly larger than core and gaps between bags allow for difference, no lack of recovery.
5		100		GW	WELL-GRADED GRAVEL WITH SAND AND TRACE FINES (GW). 7.5YR 5/6, moist, gravel up to 3 inches.		
				SW-GW	WELL-GRADED SAND WITH GRAVEL (SW) grading to WELL-GRADED GRAVEL WITH SAND (GW). 10YR 6/6, dry to moist.		
10				GW	WELL-GRADED GRAVEL WITH SAND (GW). 7.5YR 5/6, moist, trace fines.		
				GW	Same as above (GW). With trace gravel up to 3 inches.		
15				GW	WELL-GRADED GRAVEL WITH SAND (GW). 10YR 7/4, moist.		
				GW	Same as above (GW). 10YR 5/6, moist.		
				GW	Same as above (GW). 10YR 6/3, dry to moist.		
20				SW	WELL-GRADED SAND WITH GRAVEL AND FINES (SW). 10YR 7/3, dry to moist.		
				SW	Same as above (SW). 10YR 7/4, moist.		
				SW	Same as above (SW).		
25				SW	Same as above (SW).		
				GW	WELL-GRADED GRAVEL WITH SAND AND FINES (GW). 10YR 6/6, moist.		
				GW	Same as above (GW).		
30				SM	SILTY SAND WITH GRAVEL (SM). 10YR 7/3, dry to moist, well-graded.		
				SW	WELL-GRADED SAND WITH GRAVEL AND FINES (SW). 2.5Y 6/4, dry to moist.		
35				SW	Same as above (SW). 2.5Y 6/2.		

PROJECT NUMBER:	BORING NUMBER:
354946. FI.02	H3SSU01 SHEET 2 OF 3

SOIL BORING LOG

PROJECT: Anaconda/Yerington
LOCATION : W 119 12 11.987 N 38 59 39.126
ELEVATION: ft ()
DRILLING CONTRACTOR: Boart Long Year
DRILLING EQUIPMENT: SR 114
DRILLING EQUIPMENT: 8-inch casing, 7-inch core barrel
WATER LEVELS: Not Encountered
START: 1600
END: 1800
LOGGER: S. Montieth

DEPTH (ft bgs)	INTERVAL (ft)	RECOVERY (%)	TYPE\NUMBER	USCS CODE	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	PID (ppm)	COMMENTS: OBSERVATIONS (E.G., DEBRIS, SHEEN, STAINING), SAMPLING AND TESTING NOTES, DRILLING OPERATIONS (e.g., REFUSAL, DRILL RATE)
				SM	SILTY SAND WITH GRAVEL (SM). 2.5Y 6/2, moist, well-graded.		
				GP	POORLY GRADED GRAVEL WITH SAND AND FINES (GP). 2.5Y 6/4, moist.		
40				GP	Same as above (GP). At 41: WELL-GRADED GRAVEL WITH SAND AND FINES (GW). 7.5YR 6/8, moist.		
				GW			Notable lithology change.
				GW	Same as 41 feet bgs.		
				GM	SILTY GRAVEL WITH SAND (GM). 10YR 3/6, moist, well-graded with some cobbles.		
45				GM	Same as above (GM).		
				GW	WELL-GRADED GRAVEL WITH SAND AND COBBLES (GW). 10YR 6/4, moist, some fines, cobbles up to 4 inches.		
				GW	Same as above (GW). 10YR 6/6.		
50				GW	Same as above (GW). No cobbles from 50 to 51 feet bgs.		
				GW	Same as above (GW). No cobbles from 53 to 52.8 feet bgs., 10YR 6/2.		
55				GW	Same as above (GW). 10YR 7/4.		
				GW	Same as above (GW). 10YR 7/3.		
				GW	Same as above (GW). 10YR 7/6, more fines (10 to 15%).		
60				GW	Same as above (GW).		
				GM	SILTY GRAVEL WITH SAND (GM). 10YR 7/6, moist, well-graded.		Drillers replacing part on rig 1230 to 1330.
				GM	Same as above (GM).		
				GW	WELL-GRADED GRAVEL WITH 15 TO 25% COBBLES (up to 4 inches). 10YR 6/6, dry to moist.		
65				GW	WELL-GRADED GRAVEL WITH SAND AND SILT (GW). 10YR 7/6, moist. Trace cobbles at 66 to 67 feet bgs.		
				GW	WELL-GRADED GRAVEL WITH SAND AND SILT (GW). 2.5Y 7/4, trace cobbles.		
70				GW	Same as above. (GW).		Cobbles are mostly granitic, color is variable.

PROJECT NUMBER: 354946. FI.02	BORING NUMBER: H3SSU01 SHEET 3 OF 3

SOIL BORING LOG

PROJECT: Anaconda/Yerington | LOCATION : W 119 12 11.987 N 38 59 39.126

ELEVATION: ft () | DRILLING CONTRACTOR: Boart Long Year

DRILLING EQUIPMENT: SR 114 | DRILLING EQUIPMENT: 8-inch casing, 7-inch core barrel

WATER LEVELS: Not Encountered | START: 1600 | END: 1800 | LOGGER: S. Montieth

DEPTH (ft bgs)	INTERVAL (ft)	RECOVERY (%)	TYPE/NUMBER	USCS CODE	SOIL DESCRIPTION SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	PID (ppm)	COMMENTS OBSERVATIONS (E.G., DEBRIS, SHEEN, STAINING), SAMPLING AND TESTING NOTES, DRILLING OPERATIONS (e.g., REFUSAL, DRILL RATE)
					Cobbles up to 5 inches and gravel with trace fines, dry to moist.		
					Same as above (cobbles with gravel and sand).		
					Up to 25% silty sand. 2.5Y 7/2, dry.		
				GW	WELL-GRADED GRAVEL WITH SILT AND SAND (GW). 10YR 6/6, 5 to 15% cobbles.		
75				GW	Same as above. (GW).		
				GW	WELL-GRADED GRAVEL WITH SAND AND SILT (GW). 10YR 6/6, moist, trace cobbles.		
80					Cobbles with gravel, sand and silt, well-graded, moist.		Too coarse to classify colors.
				GW	Same as above changing to WELL-GRADED GRAVEL (GW). With sand, silt and cobbles, 10YR 7/3.		
				SM	SILTY SAND WITH GRAVEL (SM). 10YR 7/6, moist, well-graded.		
85				SM	Same as above (SM). 2.5Y 8/2, dry.		
				SM	SILTY SAND WITH UP TO 40% GRAVEL (SM). Dry, well-graded.		
90					Gravel and cobbles up to 5 inches. Dry to moist, some sand and fines.		Too dark to use color chart.
				GW	WELL-GRADED GRAVEL WITH SAND (GW). moist, trace fines and cobbles.		
				GW	Same as above (GW). Moist, with up to 15% fines.		
95				SM	SILTY SAND WITH WELL-GRADED GRAVEL (SM). Moist.		
							Abandoned hole by backfilling with cuttings with redimix concrete.
100					Bottom of hole at 97 ft below ground surface		
105							

PROJECT NUMBER: 354946. FI.02	BORING NUMBER: H3SSU02	SHEET 1 OF 4

CH2MHILL

SOIL BORING LOG

PROJECT: Anaconda/Yerington | LOCATION : W 119 12 23.164 N 38 59 37.714

ELEVATION: ft () | DRILLING CONTRACTOR: Boart Long Year

DRILLING EQUIPMENT: SR 114 | DRILLING EQUIPMENT: 8-inch casing, 7-inch core barrel

WATER LEVELS: Not Encountered | START: 925 | END: | LOGGER: S. Duffy

DEPTH (ft bgs)	INTERVAL (ft)	RECOVERY (%)	TYPE/NUMBER	USCS CODE	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	PID (ppm)	COMMENTS: OBSERVATIONS (E.G., DEBRIS, SHEEN, STAINING), SAMPLING AND TESTING NOTES, DRILLING OPERATIONS (e.g., REFUSAL, DRILL RATE)
				GW	WELL-GRADED GRAVEL WITH SILT AND SAND (GW). 10YR 6/3, dry to moist, with few cobbles up to 6 inches.		
				GW	Same as above. 10YR 7/6, moist, trace cobbles up to 3.5 inches.		
5				GW	Same as above. 10YR 7/4, dry to moist.		
				SW	WELL-GRADED SAND WITH SILT AND GRAVEL (SW). 10YR 7/6, dry to moist, unconsolidated.		
10				SW	Same as above. 2.5Y 8/4.		
				SW	Same as above. 2.5Y 7/4, trace cobbles up to 5 inches.		
15				SW	Same as above. 10YR 7/6, trace cobbles up to 6 inches.		
				SW	Same as above. 10YR 7/6, dry to moist, with gravel to 3 inches.		
				GW	WELL-GRADED GRAVEL WITH SAND AND SILT (GW). 10YR 6/4, dry to moist, trace cobbles to 4 inches.		
20				GW	WELL-GRADED GRAVEL WITH SILT AND SAND (GW). 2.5Y 6/4, dry to moist, few cobbles 3.5 to 4 inches.		
				SW	WELL-GRADED SAND WITH SILT, CLAY, AND GRAVEL. 2.5Y 6/4, moist, trace cobble to 5 inches.		
				SW	WELL-GRADED SAND WITH SILT AND GRAVEL (SW). 2.5Y 5/4, moist, trace cobble to 5 inches.		
25				GW	WELL-GRADED GRAVEL WITH SILT AND SAND (GW). 10YR 7/5, dry to moist, little cobble to 5 inches.		
				SW	WELL-GRADED GRAVEL WITH SILT AND SAND (SW). 10YR 7/5, dry to moist, trace cobble to 4 inches.		
				SW	WELL-GRADED SAND WITH SILT AND GRAVEL (SW). 2.5Y 7/4, dry to moist, gravel to 2 inches.		
30				SW	WELL-GRADED SAND WITH SILT AND GRAVEL (SW). 2.5 6/4, moist.		
				SW	WELL-GRADED SAND WITH SILT, CLAY, AND GRAVEL (SW). 7.5Y 6/4, moist, trace cobble to 4 inches.		~6 inches lense of higher clay concentration at 29.5 to 30 feet bgs. Weak to moderate cementation.
				SW	WELL-GRADED SAND WITH SILT, CLAY, AND GRAVEL (SW). 2.5Y 7/4, dry to slightly moist, gravel less than 1 inch.		
				SW	WELL-GRADED SAND WITH SILT, AND GRAVEL (SW). 2.5Y 7/4, dry to slightly moist, gravel less than 1 inch.		
35							

PROJECT NUMBER: **354946. FI.02**	BORING NUMBER: **H3SSU02** SHEET 2 OF 4

CH2MHILL

SOIL BORING LOG

PROJECT: Anaconda/Yerington | LOCATION : W 119 12 23.164 N 38 59 37.714

ELEVATION: ft () | DRILLING CONTRACTOR: Boart Long Year

DRILLING EQUIPMENT: SR 114 | DRILLING EQUIPMENT: 8-inch casing, 7-inch core barrel

WATER LEVELS: Not Encountered | START: 925 | END: | LOGGER: S. Duffy

DEPTH (ft bgs)	INTERVAL (ft)	RECOVERY (%)	TYPE/NUMBER	USCS CODE	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	PID (ppm)	COMMENTS: OBSERVATIONS (E.G., DEBRIS, SHEEN, STAINING), SAMPLING AND TESTING NOTES, DRILLING OPERATIONS (e.g., REFUSAL, DRILL RATE)
				SW	WELL-GRADED SAND WITH SILT, AND GRAVEL (SW). 2.5Y 6/4, dry to slightly moist, gravel less than 1 inch.		
				SW	WELL-GRADED SAND WITH SILT, CLAY AND GRAVEL (SW). 2.5Y 7/4, moist, gravel less than 1 inch.		Start of a 4 foot lense. Higher clay content. Weak to moderate cementation.
40				SW	Same as above.		Part of the lense listed above.
				SW	WELL-GRADED SAND WITH SILT, CLAY AND GRAVEL (SW). 2.5Y 6/4, dry to slightly moist, gravel less than 1 inch.		
				SW	Same as above. 2.5Y 6/4.		
45				SW	Same as above. Higher clay content at 47 feet bgs. 2.5Y 6/4.		
				SW	WELL-GRADED SAND WITH SILT, CLAY AND GRAVEL (SW). 10Y 7/5, dry to moist, gravel less than 1 inch.		
				SW	Same as above. 10YR 7/5, moist.		
50				SW	Same as above. 10YR 7/5, moist.		
				SW	Same as above. 10YR 7/5, moist.		
55				SW-SC	First half is same as above, then SC. Higher clay content at 55 feet bgs., 10YR 7/5.		
				SW	WELL-GRADED SAND WITH SILT AND GRAVEL (SW). 2.5Y 7/4, dry to slightly moist, gravel less than 1 inch.		
				SW	WELL-GRADED SAND WITH SILT, CLAY AND GRAVEL (SW). 2.5Y 6/4, moist, gravel less than 1 inch.		Weak to moderate cementation.
60				SW	WELL-GRADED SAND WITH SILT AND GRAVEL (SW). 10YR 6/5, dry to moist, trace cobble to 3.5 inches.		
				GW	WELL-GRADED GRAVEL WITH SILT AND SAND (GW). 10YR 6/5, dry to moist, gravel to 3 inches.		
				GW	WELL-GRADED GRAVEL WITH SILT AND SAND (GW). 10YR 6/5, dry to moist, gravel to 2.5 inches.		Weak cementation.
65				SW	WELL-GRADED SAND WITH SILT, CLAY AND GRAVEL (SW). 10YR 6/5, slightly moist, gravel to 2 inches.		
				SW	WELL-GRADED SAND WITH SILT, CLAY AND GRAVEL (SW). 10YR 7/4, dry to slightly moist, gravel to 3 inches.		
				SW	Same as above. 10YR 7/4, with trace cobble to 4 inches.		
70					WELL-GRADED SAND WITH SILT, CLAY AND GRAVEL		

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:
354946. FI.02	H3SSU02 SHEET 3 OF 4

SOIL BORING LOG

PROJECT: Anaconda/Yerington LOCATION : W 119 12 23.164 N 38 59 37.714

ELEVATION: ft () DRILLING CONTRACTOR: Boart Long Year

DRILLING EQUIPMENT: SR 114 DRILLING EQUIPMENT: 8-inch casing, 7-inch core barrel

WATER LEVELS: Not Encountered START: 925 END: LOGGER: S. Duffy

DEPTH (ft bgs)	INTERVAL (ft)	RECOVERY (%)	TYPE\NUMBER	USCS CODE	SOIL DESCRIPTION SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	PID (ppm)	COMMENTS OBSERVATIONS (E.G., DEBRIS, SHEEN, STAINING), SAMPLING AND TESTING NOTES, DRILLING OPERATIONS (e.g., REFUSAL, DRILL RATE)
				SW	(SW). 10YR 6/5, dry to moist, weak cementation, gravel to 3 inches.		
				SW	Same as above. 10YR 6/4, with few cobbles to 4 inches.		
				SW	Same as above. Unconsolidated. 10YR 7/5.		Bottom 8 inches high quartz feldspar. Gravel with sand.
75				SW	WELL-GRADED SAND WITH SILT, CLAY AND GRAVEL (SW). 2.5Y 5/4, moist, weak cementation, trace cobble.		
				SW	Same as above. Unconsolidated. 2.5Y 6/4, dry to moist.		
				SW	Same as above. 2.5Y 6/4, dry to moist.		
80				SW	WELL-GRADED SAND WITH SILT, CLAY AND GRAVEL (SW). Dry to moist, moderate cementation, few cobbles.		
				SW	WELL-GRADED SAND WITH SILT AND GRAVEL (SW). 10YR 6/5, unconsolidated, trace cobbles to 5 inches.		
				SW	WELL-GRADED SAND WITH SILT AND GRAVEL (SW). 10YR 6/5, dry to slightly moist, unconsolidated, few cobbles to 4 inches.		
85				SW	Same as above. 10YR 6/5, dry.		
				SW	Same as above. 10YR 6/5, dry, trace cobble to 3.5 inches.		
				SW	Same as above. 10YR 6/5, dry to moist, trace cobble to 5 inches.		
90				SW	WELL-GRADED SAND WITH SILT AND GRAVEL (SW). 2.5Y 6/5, dry, unconsolidated, trace cobble up to 3.5 inches.		
				SW	WELL-GRADED SAND WITH SILT AND GRAVEL (SW). 10YR 6/5, dry, unconsolidated, trace cobble up to 3.5 inches.		
				SW	Same as above. 10YR 7/5, dry, unconsolidated, few cobble to 5 inches.		
95				SW	WELL-GRADED SAND WITH SILT, CLAY AND GRAVEL (SW). 10YR 6/6, dry, weak cementation, gravel to 2 inches.		
				GW	WELL-GRADED GRAVEL WITH SILT AND SAND (GW). 10YR 6/4, dry, unconsolidated, few cobbles to 6 inches.		
				GW	WELL-GRADED GRAVEL WITH SILT AND SAND (GW). 10YR 6/5, slightly moist, unconsolidated, trace cobble to 3.5 inches.		
100				GW	WELL-GRADED GRAVEL WITH SILT AND SAND (GW). 10YR 6/5, dry, weak cementation, trace cobble to 3.5 inches.		
				GW	WELL-GRADED GRAVEL WITH SILT AND SAND (GW). 10YR 6/5, dry, unconsolidated, gravel to 2 inches.		
				SW	WELL-GRADED SAND WITH SILT, CLAY AND GRAVEL (SW). 10YR 6/6, dry to moist, weak cementation, gravel to 2 inches.		
105				SW	WELL-GRADED SAND WITH SILT, CLAY AND GRAVEL (SW). 10YR 6/6, dry to moist, weak cementation, trace cobble		

CH2MHILL

PROJECT NUMBER: 354946. FI.02

BORING NUMBER: H3SSU02 SHEET 4 OF 4

SOIL BORING LOG

PROJECT: Anaconda/Yerington | LOCATION : W 119 12 23.164 N 38 59 37.714

ELEVATION: ft () | DRILLING CONTRACTOR: Boart Long Year

DRILLING EQUIPMENT: SR 114 | DRILLING EQUIPMENT: 8-inch casing, 7-inch core barrel

WATER LEVELS: Not Encountered | START: 925 | END: | LOGGER: S. Duffy

DEPTH (ft bgs)	INTERVAL (ft)	RECOVERY (%)	TYPE/NUMBER	USCS CODE	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	PID (ppm)	COMMENTS: OBSERVATIONS (E.G., DEBRIS, SHEEN, STAINING), SAMPLING AND TESTING NOTES, DRILLING OPERATIONS (e.g., REFUSAL, DRILL RATE)
					to 4 inches.		
				SW	WELL-GRADED SAND WITH SILT, AND GRAVEL (SW). Dry, some cobbles up to 8 inches.		
				SW	WELL-GRADED SAND WITH SILT AND GRAVEL (SW). 10YR 7/6, dry to moist, trace cobbles up to 4.5 inches.		
				SW	WELL-GRADED SAND WITH SILT, CLAY AND GRAVEL (SW). 2.5Y 7/4, moist, slightly cemented.		
110				SW	WELL-GRADED SAND WITH SILT, CLAY AND GRAVEL (SW). 2.5Y 7/1, moist to dry, consolidated. At 110 feet bgs: lithology changes to a poorly graded sand with silt, 2.5Y 7/1.		
				SW	POORLY GRADED SAND WITH SILT (SW). 5Y 6/4, dry to moist.		
							Immediately filled hole with medium bentonite chips (4 bags) and nearly 50 gallons of water. Waited 45 minutes until set and backfilled with core cutting to 20.5 feet bgs. and filled with Quikcrete.
115					Bottom of hole at 112 ft below ground surface		
120							
125							
130							
135							
140							

PROJECT NUMBER:	BORING NUMBER:
354946. FI.02	H3SSU03 SHEET 1 OF 4

SOIL BORING LOG

PROJECT: Anaconda/Yerington | LOCATION : W 119 12 18.993 N 38 59 40.280

ELEVATION: ft () | DRILLING CONTRACTOR: Boart Long Year

DRILLING EQUIPMENT: SR 114 | DRILLING EQUIPMENT: 8-inch casing, 7-inch core barrel

WATER LEVELS: Not Encountered | START: 1340 | END: | LOGGER: I. Dinkleman

DEPTH (ft bgs)	INTERVAL (ft)	RECOVERY (%)	TYPE/NUMBER	USCS CODE	SOIL DESCRIPTION SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	PID (ppm)	COMMENTS OBSERVATIONS (E.G., DEBRIS, SHEEN, STAINING), SAMPLING AND TESTING NOTES, DRILLING OPERATIONS (e.g., REFUSAL, DRILL RATE)
				SM	WELL-GRADED SAND WITH SILT AND GRAVEL (SM). 2.5Y 8/4, dry.		
				GW	WELL-GRADED GRAVEL WITH SILT AND SAND (GW). 10YR 7/6, dry to moist.		
5				GW	Same as above. 10YR 6/6, dry to moist, trace cobbles up to 4 inches.		
				GW	Same as above. 10YR 6/6, dry to moist, no cobbles.		
				SW	WELL-GRADED SAND WITH SILT AND GRAVEL (SW). 10YR 6/8, dry to moist.		
10				SW	Same as above.		
				GW	WELL-GRADED GRAVEL WITH SILT AND SAND (GW). 10YR 6/8, moist.		
15				GW	Same as above. 2.5Y 7/8, dry to moist, trace cobbles up to 4 inches.		
				GW	Same as above. 10YR 6/6, moist, no cobbles, gravel up to 2.5 inches.		
20				GW	WELL-GRADED GRAVEL WITH SILT AND SAND. 10YR 6/6, dry to moist.		
				GW	Same as above. 10YR 6/6, moist, trace cobbles.		
				GW	Same as above. 10YR 6/8, moist.		
25				GW	WELL-GRADED GRAVEL WITH SILT AND SAND (GW). 10YR 7/6, moist.		
				GW	Same as above. 10YR 7/8, moist.		
				SW	WELL-GRADED SAND WITH SILT AND GRAVEL (SW). 2.5Y 8/4, dry to moist, few cobbles up to 6 inches diameter.		
30				GW	WELL-GRADED GRAVEL WITH SILT AND SAND (GW). 2.5Y 6/4, moist, increase in fines with depth.		Beginning to see an increase in weathered rock. Friable. Crumble under pressure.
				GW	Same as above. 2.5Y 6/6.		
35				GW	Same as above. 2.5Y 7/6.		

PROJECT NUMBER: 354946. FI.02	BORING NUMBER: H3SSU03 SHEET 2 OF 4

SOIL BORING LOG

PROJECT: Anaconda/Yerington | LOCATION : W 119 12 18.993 N 38 59 40.280

ELEVATION: ft () | DRILLING CONTRACTOR: Boart Long Year

DRILLING EQUIPMENT: SR 114 | DRILLING EQUIPMENT: 8-inch casing, 7-inch core barrel

WATER LEVELS: Not Encountered | START: 1340 | END: | LOGGER: I. Dinkleman

DEPTH (ft bgs)	INTERVAL (ft)	RECOVERY (%)	TYPE/NUMBER	USCS CODE	SOIL DESCRIPTION SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	PID (ppm)	COMMENTS OBSERVATIONS (E.G., DEBRIS, SHEEN, STAINING), SAMPLING AND TESTING NOTES, DRILLING OPERATIONS (e.g., REFUSAL, DRILL RATE)
				GW	Same as above. 10YR 6/6, moist.		
				GW	Same as above. 2.5Y 7/6, dry to moist, trace cobbles up to 6.5 inches.		
40				SW	WELL-GRADED SAND WITH SILT AND GRAVEL (SW). 2.5Y 8/4, dry to moist, few cobbles up to 4.5 inches.		
				GW	WELL-GRADED GRAVEL WITH SILT AND SAND (GW). 2.5Y 5/6, moist, compact and dense, high concentration of weathered rock, friable.		
				GW	Same as above.		
45				GW	Same as above.		
				GW	Same as above. 2.5Y 6/6.		
				GW	WELL-GRADED GRAVEL WITH SAND (GW). 2.5Y 8/3, dry to moist, trace cobbles up to 4.5 inches.		
50				GW	WELL-GRADED GRAVEL WITH SILT AND SAND (GW). 10YR 6/6, moist.		
				GW	Same as above. Increase in fines and moisture with depth.		
				GW	Same as above.		
55				GW	Same as above.		
				GW	Same as above.		
60				GW	Same as above.		
				GW	Same as above.		
				GW	Same as above.		
65				GW	Same as above.		
				GW	WELL-GRADED GRAVEL WITH SILT AND SAND (GW). 10YR 6/6, moist, little cobbles up to 5 inches.		
				GW	Same as above. 2.5Y 6/3, moist, trace cobbles up to 3.5 inches.		
70				GW	Same as above.		

PROJECT NUMBER: 354946. FI.02	BORING NUMBER: H3SSU03 SHEET 3 OF 4

SOIL BORING LOG

PROJECT: Anaconda/Yerington | LOCATION : W 119 12 18.993 N 38 59 40.280

ELEVATION: ft () | DRILLING CONTRACTOR: Boart Long Year

DRILLING EQUIPMENT: SR 114 | DRILLING EQUIPMENT: 8-inch casing, 7-inch core barrel

WATER LEVELS: Not Encountered | START: 1340 | END: | LOGGER: I. Dinkleman

DEPTH (ft bgs)	INTERVAL (ft)	RECOVERY (%)	TYPE/NUMBER	USCS CODE	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	PID (ppm)	COMMENTS: OBSERVATIONS (E.G., DEBRIS, SHEEN, STAINING), SAMPLING AND TESTING NOTES, DRILLING OPERATIONS (e.g., REFUSAL, DRILL RATE)
				GW	Same as above. 10YR 6/6.		
				GW	Same as above. 10YR 6/6, dry to moist.		See increase in weathered rock. Friable.
75				GW	Same as above. Dry to moist.		
				GW	Same as above. Dry to moist.		
				GW	WELL-GRADED GRAVEL WITH SAND (GW). 10YR 6/6, moist, with some fines and trace cobbles.		
80				GW	Same as above.		
				GW	Same as above.		
				SM	SILTY SAND WITH GRAVEL (SM). 10YR 5/6, moist.		
85				SM	Same as above.		
				SW	Same as above. Lithology changes at 86 feet bgs.: WELL-GRADED SAND WITH CLAY AND GRAVEL (SW). 10YR 5/8, moist, very compact. Grading to: 10YR 6/6, dry to moist.		See archive.
				SW			
90				SW	Same as above (SW). 2.5Y 7/6, moist.		
				SW	Same as above (SW). 2.5Y 7/6, moist.		
95				SW	WELL-GRADED SAND WITH SILT AND GRAVEL (SW). 2.5Y 7/6, moist.		
				SW	Same as above. Moist.		
				SW	WELL-GRADED SAND WITH SILT AND GRAVEL. 10YR 6/6, moist, highly compact, concentrated weathered rock and fines.		
100				SW	Same as above. 2.5YR 7/6, dry to moist.		
				SW	Same as above.		
				SW	Same as above. 10YR 5/6, moist.		
105							

PROJECT NUMBER: 354946. FI.02	BORING NUMBER: H3SSU03 SHEET 4 OF 4

SOIL BORING LOG

PROJECT: Anaconda/Yerington | LOCATION : W 119 12 18.993 N 38 59 40.280

ELEVATION: ft () | DRILLING CONTRACTOR: Boart Long Year

DRILLING EQUIPMENT: SR 114 | DRILLING EQUIPMENT: 8-inch casing, 7-inch core barrel

WATER LEVELS: Not Encountered | START: 1340 | END: | LOGGER: I. Dinkleman

DEPTH (ft bgs)	INTERVAL (ft)	RECOVERY (%)	TYPE\NUMBER	USCS CODE	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	PID (ppm)	COMMENTS: OBSERVATIONS (E.G., DEBRIS, SHEEN, STAINING), SAMPLING AND TESTING NOTES, DRILLING OPERATIONS (e.g., REFUSAL, DRILL RATE)
				SW	Same as above. 10YR 5/8, increase in fines and moisture with depth.		
				SW	Same as above. Lithology changes at 108 feet bgs.: WELL-GRADED SAND WITH SILT AND GRAVEL (SW). Very red in color (5YR 4/6), dry to moist, less compact.		
110				SW	Same as above. 5YR 4/6.		
				GW	Same as above. 5YR 4/6. Lithology changes at 112.5 feet bgs.: WELL-GRADED GRAVEL WITH SILT AND SAND (GW). 10YR 6/6, moist.		
115				GW	WELL-GRADED GRAVEL WITH SILT AND SAND (GW). 2.5Y 8/4, dry.		
				SW	Same as above. Lithology changes at 116 feet bgs.: WELL-GRADED SAND WITH SILT AND GRAVEL (SW). 2.5Y 8/3, dry to moist, unconsolidated.		Abandoned bore hole by backfill core with cuttings to 20.5 feet bgs. and topping off with Quikcrete.
120					Bottom of hole at 117 ft below ground surface		Stopped drilling at 117 feet bgs. because H3SSU04 location is in sight and encountered VLT tailing at 117 feet bgs. at that location. H3SSU03 is only ~6 to 8 feet in elevation change. Not wanting to risk breaking lines.
125							
130							
135							
140							

PROJECT NUMBER: 354946. FI.02	BORING NUMBER: H3SSU04 SHEET 1 OF 4

SOIL BORING LOG

PROJECT: Anaconda/Yerington | LOCATION : W 119 12 21.342 N 38 59 41.843

ELEVATION: ft () | DRILLING CONTRACTOR: Boart Long Year

DRILLING EQUIPMENT: SR 114 | DRILLING EQUIPMENT: 8-inch casing, 7-inch core barrel

WATER LEVELS: Not Encountered | START: 9/25/2007 1600 | END: 9/26/2007 1630 | LOGGER: S. Montieth

DEPTH (ft bgs)	INTERVAL (ft)	RECOVERY (%)	TYPE/NUMBER	USCS CODE	SOIL DESCRIPTION SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	PID (ppm)	COMMENTS OBSERVATIONS (E.G., DEBRIS, SHEEN, STAINING), SAMPLING AND TESTING NOTES, DRILLING OPERATIONS (e.g., REFUSAL, DRILL RATE)
				SM	SILTY SAND (SM). 7.5YR 5/4, dry to moist, with up to 40% well-graded gravel.		
				SM	Same as above (SM). 7.5YR 5/4, moist.		
5				GW	WELL-GRADED GRAVEL WITH SAND AND SILT (GW). 10YR 5/4, moist, gravel up to 2 inches.		
				GW	Same as above (GW). 7.5YR 5/4, more gravel.		
				GW	Same as above (GW). 7.5YR 5/4.		
10				GW	Same as above (GW). 7.5YR 5/4.		
				SM	SILTY SAND WITH WELL-GRADED GRAVEL (SM). 7.5YR 5/4, moist.		
				SM	Same as above (SM). 7.5YR 5/6, moist.		
15				SM	Same as above (SM). 7.5YR 5/6, moist, up to 3 inches.		
				SM	Same as above (SM). 7.5YR 5/4, moist, trace cobbles.		
20				GW	WELL-GRADED GRAVEL WITH TRACE FINES AND COBBLES (GW). 7.5YR 5/4, moist.		
				SM	SILTY SAND WITH GRAVEL (SM). 10YR 5/4. moist.		
25				GW	WELL-GRADED GRAVEL WITH SAND AND SILT (GW). 10YR 6/4, moist, trace cobbles.		
				SM	SILTY SAND WITH GRAVEL (SM). 7.5YR 5/4, well-graded.		Start at 0840. Abundance of weathered rock. Increased silt content.
				SM	Same as above (SM). 10YR 5/4.		
30				SM	Same as above (SM). 7.5YR 5/4.		
				SM	SILTY SAND WITH GRAVEL (SM). WELL-GRADED, few cobbles up to 4.5 inches. Lithology changes at 31 feet bgs.: GRAVEL WITH SILT AND SAND (GW). 10YR 6/6, moist.		
				GW	WELL-GRADED GRAVEL WITH SILT AND SAND (GW). 10YR 6/6, moist, well-graded.		
35							

PROJECT NUMBER:	BORING NUMBER:
354946. FI.02	H3SSU04 SHEET 2 OF 4

SOIL BORING LOG

PROJECT: Anaconda/Yerington — LOCATION : W 119 12 21.342 N 38 59 41.843
ELEVATION: ft () — DRILLING CONTRACTOR: Boart Long Year
DRILLING EQUIPMENT: SR 114 — DRILLING EQUIPMENT: 8-inch casing, 7-inch core barrel
WATER LEVELS: Not Encountered — START: 9/25/2007 1600 — END: 9/26/2007 1630 — LOGGER: S. Montieth

DEPTH (ft bgs)	INTERVAL (ft)	RECOVERY (%)	TYPE/NUMBER	USCS CODE	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	PID (ppm)	COMMENTS: OBSERVATIONS (E.G., DEBRIS, SHEEN, STAINING), SAMPLING AND TESTING NOTES, DRILLING OPERATIONS (e.g., REFUSAL, DRILL RATE)
				GW	Same as above. 10YR 6/6, moist, well-graded, increase in silt content, trace cobbles up to 5 inches.		
				SW-SM	SILTY SAND WITH WELL-GRADED GRAVEL (SW-SM). 10YR 7/4.		
40				SW-SM	Same as above.		
				SW-SM	Same as above.		
				SW-SM	Same as above.		
45				SW-SM	Same as above.		
				SW-SM	Same as above.		
				SM	SILTY SAND WITH GRAVEL (SM). 10YR 7/6, moist, fine gravel.		
				SM	Same as above. 10YR 6/4, slightly less gravel.		
50				SM	Same as above. 10YR 6/4, with less gravel (~15 to 25%).		
				SM	Same as above (SM). 10YR 6/4.		
				SW	WELL-GRADED SAND WITH SILT AND GRAVEL (SW). 10YR 6/4, moist.		
55				SW	Same as above (SW). 10YR 6/4.		Varying amounts of gravel.
				SW	Same as above (SW). 10YR 6/5.		Distinct color change.
				SW	Same as above (SW). With more silt.		
60				SM	SILTY SAND WITH GRAVEL AND TRACE COBBLES (SM). 7.5YR 6/3, dry.		Very dry.
				SM	Same as above (SM). Moist, trace cobbles.		
				SW	Same as above (SW). 10YR 5/4.		
65				SW	Same as above (SW). 10YR 5/6.		
				GM-SM	SILTY GRAVEL AND SAND (GM-SM).		
				SW	WELL-GRADED SAND WITH SILT AND GRAVEL (SW). 7.5YR 5/4, moist.		Abundance of weathered rock.
70							

PROJECT NUMBER: 354946. FI.02	BORING NUMBER: H3SSU04 SHEET 3 OF 4

SOIL BORING LOG

PROJECT: Anaconda/Yerington | LOCATION : W 119 12 21.342 N 38 59 41.843

ELEVATION: ft () | DRILLING CONTRACTOR: Boart Long Year

DRILLING EQUIPMENT: SR 114 | DRILLING EQUIPMENT: 8-inch casing, 7-inch core barrel

WATER LEVELS: Not Encountered | START: 9/25/2007 1600 | END: 9/26/2007 1630 | LOGGER: S. Montieth

DEPTH (ft bgs)	INTERVAL (ft)	RECOVERY (%)	TYPE/NUMBER	USCS CODE	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	PID (ppm)	COMMENTS: OBSERVATIONS (E.G., DEBRIS, SHEEN, STAINING), SAMPLING AND TESTING NOTES, DRILLING OPERATIONS (e.g., REFUSAL, DRILL RATE)
				SW	Same as above (SW). 10YR 5/4.		
				SM	SILTY SAND WITH GRAVEL (SM). 7.5YR 4/4, moist, mostly fine.		
75				SM	Same as above. 10YR 6/3, dry.		
				SM	SILTY SAND WITH GRAVEL (SM). 10YR 6/6, moist, mostly fine.		
				SW	WELL-GRADED SAND WITH SILT AND FINE GRAVEL (SW). 10YR 6/4, moist.		
				SW	Same as above (SW). 10YR 6/3, moist.		
80				SW	Same as above (SW). Moist.		Red staining on gravel.
				SM	SILTY SAND WITH GRAVEL (SM). 10YR 6/3, moist, mostly fine.		
				SM-GM	SILTY SAND AND GRAVEL (SM-GM).		
85				SM-GM	SILTY SAND AND GRAVEL (SM-GM).		
				GW	WELL-GRADED GRAVEL WITH SILT AND SAND (GW). 7.5YR 5/6, moist, trace cobbles.		
90				GW	Same as above (GW).		
				GW	Same as above (GW). 10YR 6/6, more cobbles up to 4 inches.		
				GW	Same as above (GW). 10YR 6/4, no cobbles.		
95				GW	Same as above (GW).		
				GW	Same as above (GW).		Decide to core 10 feet further since there is no notable difference in lithology or moisture content.
				GW-SM	WELL-GRADED GRAVEL AND SAND (GW-SM).		
100				GW	WELL-GRADED GRAVEL (GW).		
105				GW	Same as above (GW). Dry.		Dry samples are much hotter (temp) coming out of core barrel.

PROJECT NUMBER: 354946. FI.02	BORING NUMBER: H3SSU04 SHEET 4 OF 4

SOIL BORING LOG

PROJECT: Anaconda/Yerington — LOCATION : W 119 12 21.342 N 38 59 41.843

ELEVATION: ft () — DRILLING CONTRACTOR: Boart Long Year

DRILLING EQUIPMENT: SR 114 — DRILLING EQUIPMENT: 8-inch casing, 7-inch core barrel

WATER LEVELS: Not Encountered — START: 9/25/2007 1600 — END: 9/26/2007 1630 — LOGGER: S. Montieth

DEPTH (ft bgs)	INTERVAL (ft)	RECOVERY (%)	TYPE/NUMBER	USCS CODE	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	PID (ppm)	COMMENTS: OBSERVATIONS (E.G., DEBRIS, SHEEN, STAINING), SAMPLING AND TESTING NOTES, DRILLING OPERATIONS (e.g., REFUSAL, DRILL RATE)
				GW	Same as 97 to 103.9 feet bgs. 10YR 6/3, moist.		
110							
115				ML	SILT WITH GRAVEL AND COBBLES (ML). White powdery, dry.		VLT tailings.
					Bottom of hole at 117 ft below ground surface		End drilling when VLT tailings are encountered. Abandoned borehole by backfilling with cuttings up to 15 feet bgs and then topping off with wet Quikcrete. Not clear how moisture content varies throughout boring. Also, not clear why there is only 1 foot of VLT tailings and then becomes the same again or why the VLT tailings are so dry when overlying and underlying layers are moist.
120							
125							
130							
135							
140							

PROJECT NUMBER:	BORING NUMBER:
354946. FI.02	**H3XSU01** SHEET 1 OF 2

SOIL BORING LOG

PROJECT: Anaconda/Yerington — LOCATION : W 119 12 33.881 N 38 59 58.367

ELEVATION: ft () — DRILLING CONTRACTOR: Boart Long Year

DRILLING EQUIPMENT: SR 114 — DRILLING EQUIPMENT: 8-inch casing, 7-inch core barrel

WATER LEVELS: Not Encountered — START: 1445 — END: — LOGGER: I Dinkleman

DEPTH (ft bgs)	INTERVAL (ft)	RECOVERY (%)	TYPE/NUMBER	USCS CODE	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	PID (ppm)	COMMENTS: OBSERVATIONS (E.G., DEBRIS, SHEEN, STAINING), SAMPLING AND TESTING NOTES, DRILLING OPERATIONS (e.g., REFUSAL, DRILL RATE)
				SW	WELL-GRADED SAND WITH SILT AND GRAVEL (SW). 2.5Y 8/4, dry.		Extremely windy.
				SW	WELL-GRADED SAND WITH SILT AND GRAVEL (SW). 2.5Y 7/6, dry to moist.		
				SW	Same as above. 10YR 7/6, moist.		
5							
				SW	WELL-GRADED SAND WITH SILT AND GRAVEL (SW). 2.5Y 7/4, moist.		Increase in weathered rock.
				SM	Soil lithology changes to a compact silty sand with gravel.		
				SW	2.5Y 6/4, dry to moist.		
				GW	WELL-GRADED GRAVEL WITH SILT AND SAND (GW). 2.5Y 7/6, moist.		
				GW	Same as above. 2.5Y 7/6, moist.		
10							
				GW	Same as above. 2.5Y 7/6. Increase in moisture content and fines with depth.		
				SW	WELL-GRADED SAND WITH SILT AND GRAVEL (SW). 2.5Y 7/6, moist, gravel is moderately friable.		
15							
				SW	WELL-GRADED SAND WITH SILT AND GRAVEL (SW). 2.5Y 7/4, compact, core intact.		
				SW	WELL-GRADED SAND WITH SILT AND GRAVEL. 2.5Y 7/6, moist.		
				SW	Same as above. 2.5Y 7/6, moist.		
20							
				SW	Same as above 2.5Y7/6, increase in gravel.		
					Same as above. 2.5Y 7/4, moist.		
				SM	Soil lithology changes to a compact silty sand with gravel.		
				SW	2.5Y 7/3, core intact.		
				SW	WELL-GRADED SAND WITH SILT AND GRAVEL. 2.5Y 8/4, dry to moist.		
25							
				SM	SILTY SAND WITH GRAVEL (SM). 2.5Y 7/4, slight increase in silt and moisture.		
				SW	WELL-GRADED SAND WITH SILT AND GRAVEL (SW). 2.5Y 7/3, moist, gravel is weathered and moderately friable.		
				SW	Same as above. 2.5Y 6/3, moist.		
30							
				SW	WELL-GRADED SAND WITH SILT AND GRAVEL (SW). 2.5Y 7/4, dry to moist.		
				SW	Same as above. 2.5Y 8/4, increase in silt content and moisture, greater compaction, core intact.		
35							

PROJECT NUMBER: 354946. FI.02	BORING NUMBER: H3XSU01 SHEET 2 OF 2

SOIL BORING LOG

PROJECT: Anaconda/Yerington — LOCATION : W 119 12 33.881 N 38 59 58.367

ELEVATION: ft () — DRILLING CONTRACTOR: Boart Long Year

DRILLING EQUIPMENT: SR 114 — DRILLING EQUIPMENT: 8-inch casing, 7-inch core barrel

WATER LEVELS: Not Encountered — START: 1445 — END: — LOGGER: I Dinkleman

DEPTH (ft bgs)	INTERVAL (ft)	RECOVERY (%)	TYPE/NUMBER	USCS CODE	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	PID (ppm)	COMMENTS: OBSERVATIONS (E.G., DEBRIS, SHEEN, STAINING), SAMPLING AND TESTING NOTES, DRILLING OPERATIONS (e.g., REFUSAL, DRILL RATE)
				SW	WELL-GRADED SAND WITH SILT AND GRAVEL (SW). 2.5Y 7/6, moist.		
				SW	WELL-GRADED SAND WITH SILT AND GRAVEL (SW). 2.5Y 7/6, moist, compact.		
				SW	Same as above.		
40				SW	Same as above.		
				SW	WELL-GRADED SAND WITH SILT AND GRAVEL (SW). 2.5Y 7/8, moist, rock is friable (weathered).		Smell a distinct sulfur odor when pulling up core from drilling. Can also detect odor while logging sample.
				SW	Same as above. 2.5Y 7/4, moist.		
45				SW	Same as above. 2.5Y 7/4, increase in compaction and silt content.		
				SW	Same as above. 2.5Y 8/6.		
50				SW SW	Same as above until 50 feet bgs. Soil lithology changes to less silt and less dense. 2.5Y 7/6, moist.		
				SW	WELL-GRADED SAND WITH SILT AND GRAVEL (SW). 5Y 6/4, with trace cobbles up to 4 inches. Distinct color change at 52 feet bgs to 10YR 7/6.		
				GW	WELL-GRADED GRAVEL WITH SILT AND SAND (GW). 10YR 6/6, moist, trace cobbles up to 4 inches.		
55				GW	Same as above. Moist.		
				SW	WELL-GRADED SAND WITH SILT AND GRAVEL (SW). Moist, compact.		
60				GW SW	Same as above until 59 feet bgs. Lithology changes to WELL-GRADED GRAVEL WITH SAND AND SILT (GW). Dry.		
				GW			
				GW	WELL-GRADED GRAVEL WITH SILT AND SAND (GW). Dry.		
65				GW	WELL-GRADED SAND WITH SILT AND GRAVEL (GW). Dry.		
70					Bottom of hole at 67 ft below ground surface		Abandoned well by backfilling to 19.5 feet bgs. and filling remainder of core with Quikcrete.

PROJECT NUMBER: 354946. FI.02	BORING NUMBER: H3XSU02 SHEET 1 OF 2

SOIL BORING LOG

PROJECT: Anaconda/Yerington
LOCATION : W 119 12 44.521 N 38 59 45.683
ELEVATION: ft ()
DRILLING CONTRACTOR: Boart Long Year
DRILLING EQUIPMENT: SR 114
DRILLING EQUIPMENT: 8-inch casing, 7-inch core barrel
WATER LEVELS: Not Encountered
START:
END:
LOGGER:

DEPTH (ft bgs)	INTERVAL (ft)	RECOVERY (%)	TYPE/NUMBER	USCS CODE	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	PID (ppm)	COMMENTS: OBSERVATIONS (E.G., DEBRIS, SHEEN, STAINING), SAMPLING AND TESTING NOTES, DRILLING OPERATIONS (e.g., REFUSAL, DRILL RATE)
				SW	WELL-GRADED SAND WITH SILT AND GRAVEL (SW). 2.5YR 7/6, dry to moist.		
				SW	Same as above. 2.5Y 7/6.		
				SW	Same as above. 2.5Y 7/4.		
5				SW	Same as above. 2.5Y 6/6, increase in fines, compaction.		Weathered rock, increased friability.
				SW	WELL-GRADED SAND WITH SILT AND GRAVEL (SW). 2.5Y 8/4, dry. Lithology changes as 8.5 feet bgs to: WELL-GRADED SAND WITH SILT AND GRAVEL (SW). 10YR 5/8, moist, more compact.		
10				GW	WELL-GRADED GRAVEL WITH SILT AND SAND (GW). 2.5Y 8/6, moist.		
				GW	Same as above. 2.5Y 7/6.		
				GW	Same as above. 2.5Y 7/6.		
15				GW	Same as above. 2.5Y 7/4, increase in moisture.		
				SW	WELL-GRADED SAND WITH SILT AND GRAVEL (SW). 2.5Y 7/6, moist.		
20				SW	Same as above. 2.5Y 7/6, increase in moisture content.		
				SW	Same as above.		
				SW	Same as above. 2.5Y 7/6, slight increase in moisture content.		
25				SM	SILTY SAND WITH GRAVEL (SM). 2.5Y 7/6, dry to moist, compact.		
				SW	WELL-GRADED SAND WITH SILT AND GRAVEL (SW). 2.5Y 7/6, moist.		
30				SW	Same as above. 2.5Y 8/3, dry.		
				GW	WELL-GRADED GRAVEL WITH SILT AND SAND (GW). 2.5Y 7/4.		
35							

CH2MHILL

PROJECT NUMBER: 354946. FI.02	BORING NUMBER: H3XSU02 SHEET 2 OF 2

SOIL BORING LOG

PROJECT: Anaconda/Yerington | LOCATION : W 119 12 44.521 N 38 59 45.683

ELEVATION: ft () | DRILLING CONTRACTOR: Boart Long Year

DRILLING EQUIPMENT: SR 114 | DRILLING EQUIPMENT: 8-inch casing, 7-inch core barrel

WATER LEVELS: Not Encountered | START: | END: | LOGGER:

DEPTH (ft bgs)	INTERVAL (ft)	RECOVERY (%)	TYPE/NUMBER	USCS CODE	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	PID (ppm)	COMMENTS: OBSERVATIONS (E.G., DEBRIS, SHEEN, STAINING), SAMPLING AND TESTING NOTES, DRILLING OPERATIONS (e.g., REFUSAL, DRILL RATE)
				GW	Same as above. 2.5Y 7/4.		
				GW	Same as above. 2.5Y 8/4.		Collect composite RAD samples.
40				SW	WELL-GRADED SAND WITH SILT AND GRAVEL (SW). 2.5 7/6, dry to moist.		
				SW	Same as above. 2.5Y 7/4, increase in silt and moisture content, compact, weathered rock, friable.		
				SW	Same as above. 2.5Y 7/4.		
45				SW	Same as above. 2.5Y 7/4.		
				SW	Same as above. 2.5Y 7/6.		
50				SW	Same as above. 2.5Y 7/6, increase in fines and compaction.		
				SW	Same as above. 2.5Y 7/6.		
				SW	Same as above. 2.5Y 7/6.		
55				SW	Same as above. WELL-GRADED SAND WITH SILT AND GRAVEL (SW). 2.5Y 7/6, compact, weathered rock, friable. Lithology changes at 66 feet bgs to: WELL-GRADED SAND WITH SILT AND GRAVEL (SW). 5YR 5/3, dry, few cobbles up to 5.5 inches.		
				SW	WELL-GRADED SAND WITH SILT AND GRAVEL (SW). 5YR 5/3, dry, with trace cobble up to 4 inches. Lithology changes at 58.3 feet bgs to: WELL-GRADED SAND WITH SILT AND GRAVEL (SW). 10YR 5/8, moist, compact, trace cobble up to 7 inches.		
60				SW	WELL-GRADED SAND WITH SILT AND GRAVEL (SW). 10YR 5/8, some cobble up to 6.5 inches.		
				SW	Same as above.		
				SW	Same as above. 10YR 6/6, less moist and compact.		
65				GW	WELL-GRADED GRAVEL WITH SAND AND SILT (GW). 10YR 6/6, dry, little cobble up to 4.5 inches. Lithology changes at 66 feet bgs to: WELL-GRADED SAND WITH SILT AND GRAVEL (SW). 10YR 7/4, dry.		Change abrupt in moisture content, compaction and color yellow to red. Abandoned hole with drill, backfill to 20.5 feet bgs. and capped with Quikrete.
70					Bottom of hole at 67 ft below ground surface		

PROJECT NUMBER:	BORING NUMBER:
354946. FI.02	H3XSU03 SHEET 1 OF 2

SOIL BORING LOG

PROJECT: Anaconda/Yerington | LOCATION : W 119 12 38.357 N 38 59 50.069

ELEVATION: ft () | DRILLING CONTRACTOR: Boart Long Year

DRILLING EQUIPMENT: SR 114 | DRILLING EQUIPMENT: 8-inch casing, 7-inch core barrel

WATER LEVELS: Not Encountered | START: | END: | LOGGER: I. Dinkleman

DEPTH (ft bgs)	INTERVAL (ft)	RECOVERY (%)	TYPE/NUMBER	USCS CODE	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	PID (ppm)	COMMENTS: OBSERVATIONS (E.G., DEBRIS, SHEEN, STAINING), SAMPLING AND TESTING NOTES, DRILLING OPERATIONS (e.g., REFUSAL, DRILL RATE)
				SW	WELL-GRADED SAND WITH SILT AND GRAVEL (SW). 2.5Y 7/4, dry to moist.		Trace red deposit in core section.
				SW	Same as above. 2.5Y 7/4, dry to moist.		
				SW	Same as above. 5YR 7/4, dry to moist.		Red color to core from 2.8 to 3.5 feet bgs.
5				SW	WELL-GRADED SAND WITH SILT AND GRAVEL (SW). 2.5Y 7/4, dry to moist.		
				SW	POORLY GRADED SAND WITH SILT AND SOME GRAVEL. 2.5Y 7/4, dry. Lithology changes at 8 feet bgs: WELL-GRADED SAND WITH SILT AND GRAVEL (SW). 2.5Y 6/4, moist.		Some trace amounts of red deposits on sediment from 8 to 9 feet bgs.
10				SW	Same as above. Reddish 7.5YR 6/4 to 10YR 7/3, dry to moist.		
				SW	Same as above until ~12.5. Lithology changes to: WELL-GRADED SAND WITH SILT AND GRAVEL (SW). 2.5Y 7/4, moist, compact fines, compaction increasing with depth.		More to mostly reddish hue at 12.5 feet bgs.
15				SW	Same as above. 2.5Y 7/4.		
				SW	WELL-GRADED SAND WITH SILT AND GRAVEL (SW). 2.5Y 6/4, moist, compact/consolidated.		
20				SW	Same as above. 2.5Y 7/6, moist.		
				SW	Same as above. 2.5Y 6/4, moist.		
				SM	SILTY SAND WITH GRAVEL (SM). 2.5Y 6/6, moist, core intact, weakly cemented.		
25				SM	Same as above. 2.5Y 6/6.		
				GW	WELL-GRADED GRAVEL WITH SILT AND SAND (GW). 2.5Y 7/3, moist, compact, moderately cemented.		
30				SW	WELL-GRADED SAND WITH SILT AND GRAVEL (SW). 10YR 5/6, compact.		
				SW	Same as above. 10YR 5/6, moist.		Note slight variations in color at 30.5 feet bgs. for 2 inches to more yellow.
				SW	Same as above. 2.5Y 7/6.		Trace of red deposit.
35							

PROJECT NUMBER: 354946. FI.02	BORING NUMBER: H3XSU03 SHEET 2 OF 2

SOIL BORING LOG

PROJECT: Anaconda/Yerington | LOCATION : W 119 12 38.357 N 38 59 50.069

ELEVATION: ft () | DRILLING CONTRACTOR: Boart Long Year

DRILLING EQUIPMENT: SR 114 | DRILLING EQUIPMENT: 8-inch casing, 7-inch core barrel

WATER LEVELS: Not Encountered | START: | END: | LOGGER: I. Dinkleman

DEPTH (ft bgs)	INTERVAL (ft)	RECOVERY (%)	TYPE/NUMBER	USCS CODE	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	PID (ppm)	COMMENTS: OBSERVATIONS (E.G., DEBRIS, SHEEN, STAINING), SAMPLING AND TESTING NOTES, DRILLING OPERATIONS (e.g., REFUSAL, DRILL RATE)
				SW	Same as above until 36 inches, then color changes abruptly to 10YR 6/8.		
				SW	WELL-GRADED SAND WITH SILT AND GRAVEL (SW). 2.5Y 6/3, moist, increase in fines and compaction, weakly cemented.		
40				SW	Same as above. 10YR 6/3. Lithology changes at 40 feet bgs to: SILT WITH SAND AND GRAVEL (SW). 2.5Y 6/3, weakly cemented.		
				SW	Same as above. 2.5Y 6/4, moist.		
45				SW	Same as above. 2.5Y 6/4.		
				SW	Same as above. 2.5Y 7/4.		
				GW	WELL-GRADED GRAVEL WITH SAND AND SILT (GW). 2.5Y 7/6, moist.		
50				SM	SILTY SAND AND GRAVEL (SM). 2.5Y 7/6, moist, compact, core intact.		
				SM	Same as above. 2.5Y 7/6, moist.		
				GW	Same as above. 2.5Y 7/6, moist. Lithology changes abruptly to: WELL-GRADED GRAVEL WITH SILT AND SAND (GW). 2.5Y 8/2, dry.		
55				GW	Same as above. 10YR 6/8, dry to moist.		Change in color.
				SW	WELL-GRADED SAND WITH SILT AND GRAVEL (SW). 2.5Y 8/4, moist.		Color changes abruptly.
				SW	WELL-GRADED SAND WITH SILT AND GRAVEL (SW). 10YR 4/6, moist.		Color changes abruptly.
60				SW	WELL-GRADED SAND WITH SILT AND GRAVEL (SW). 10YR 5/6, moist, few cobbles up to 5 inches.		
				SW	Same as above. 10YR 5/8, moist.		
				SW	Same as above. 10YR 5/8, moist. Lithology changes at 64 feet bgs to: WELL-GRADED SAND WITH GRAVEL (SW). 10YR 6/8, few fines, trace cobble up to 4 inches.		
65				SW	WELL-GRADED SAND WITH GRAVEL (SW). 10YR 6/8, trace cobble up to 4 inches.		
70					Bottom of hole at 67 ft below ground surface		Abandoned core by backfilling to 20 feet bgs. and filling borehole with Quikrete.

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:
354946. FI.02	H4SSU01 SHEET 1 OF 3

SOIL BORING LOG

PROJECT: Anaconda/Yerington
LOCATION : W 119 11 18.898 N 38 59 19.554
ELEVATION: ft ()
DRILLING CONTRACTOR: Boart Long Year
DRILLING EQUIPMENT: SR 114
DRILLING EQUIPMENT: 8-inch casing, 7-inch core barrel
WATER LEVELS: Not Encountered
START:
END:
LOGGER:

DEPTH (ft bgs)	INTERVAL (ft)	RECOVERY (%)	TYPE/NUMBER	USCS CODE	SOIL DESCRIPTION SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	PID (ppm)	COMMENTS OBSERVATIONS (E.G., DEBRIS, SHEEN, STAINING), SAMPLING AND TESTING NOTES, DRILLING OPERATIONS (e.g., REFUSAL, DRILL RATE)
					WELL-GRADED SAND WITH SILT AND GRAVEL. 10YR 6/4, dry, unconsolidated, few cobbles to 4 inches.		
					Same as above. 10YR 6/4, dry, some (35%) cobble to 9 inches.		
					Same as above. 10YR 6/4, dry, few cobble to 3.5 inches.		
5							
					Same as above. 10YR 6/4, trace cobble to 7 inches.		
					Same as above. 10YR 7/4, dry, few cobble to 5 inches.		
					Same as above. 10YR 6/4, slightly moist, trace cobble to 5 inches.		
10							
					WELL-GRADED GRAVEL WITH SILT AND SAND. 10YR 7/4, moist, unconsolidated, few cobble to 4 inches.		
					Same as above. 2.5Y 6/5, dry to moist.		One rock core (8"X4") small pocket of copper/sulfer rich rock.
					WELL-GRADED SAND WITH SILT, CLAY, AND GRAVEL. 2.5Y 6/4, moist, weak consolidation at 14.5 to 15.6 feet bgs., few cobble.		
15							
					Same as above. 2.5Y 6/4, dry, unconsolidated.		
					Same as above. 2.5Y 6/4, no cobble.		
					WELL-GRADED SAND WITH SILT AND GRAVEL. 2.5Y 7/4, dry, unconsolidated, few cobble to 7 inches.		
					WELL-GRADED GRAVEL WITH SILT AND SAND. 2.5Y 6/4, dry, unconsolidated, few cobble to 8 inches.		
20							
					WELL-GRADED SAND WITH CLAY, SILT, AND GRAVEL. 2.5Y 6/4, moist, weak consolidation, few cobbles to 8 inches.		
					WELL-GRADED GRAVEL WITH SILT AND SAND. 2.5Y 6/4, dry, unconsolidated, some (40%) cobble to 7 inches.		
					WELL-GRADED SAND WITH SILT AND GRAVEL. 10YR 6/4, dry, unconsolidated, trace cobble to 5 inches.		
25							
					Same as above. 10YR 6/4, dry, unconsolidated, few cobbles to 4 inches.		
					Same as above. With clay. 10YR 6/5, moist, unconsolidated, trace cobble 9 inches.		
					WELL-GRADED GRAVEL WITH SAND AND SILT. 10YR 6/5, dry to slightly moist, some (35%) cobble to 8 inches.		
30							
					WELL-GRADED SAND WITH SILT AND GRAVEL. 10YR 8/1, dry, unconsolidated, some (40%) cobble to 8 inches.		2 rock cores, one 10"X 8".
35							

PROJECT NUMBER: 354946. FI.02	BORING NUMBER: H4SSU01 SHEET 2 OF 3

SOIL BORING LOG

PROJECT: Anaconda/Yerington — LOCATION : W 119 11 18.898 N 38 59 19.554

ELEVATION: ft () — DRILLING CONTRACTOR: Boart Long Year

DRILLING EQUIPMENT: SR 114 — DRILLING EQUIPMENT: 8-inch casing, 7-inch core barrel

WATER LEVELS: Not Encountered — START: — END: — LOGGER:

DEPTH (ft bgs)	INTERVAL (ft)	RECOVERY (%)	TYPE/NUMBER	USCS CODE	SOIL DESCRIPTION SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	PID (ppm)	COMMENTS OBSERVATIONS (E.G., DEBRIS, SHEEN, STAINING), SAMPLING AND TESTING NOTES, DRILLING OPERATIONS (e.g., REFUSAL, DRILL RATE)
					WELL-GRADED SAND WITH SILT AND GRAVEL. 10YR 5/5, dry, unconsolidated, few cobble to 4 inches.		Normal color returns at 35 feet bgs.
					Same as above. 2.5Y 6/4, dry, unconsolidated, few cobble to 4 inches.		
40					Same as above. 2.5Y 6/4, dry, unconsolidated, few cobble to 4 inches.		
					Same as above. 10YR 6/5, moist, unconsolidated, few cobble to 6 inches.		
					Same as above. 10YR 6/5, dry, unconsolidated, few cobbles to 4 inches.		
45							
					Same as above. 2.5Y 6/4, dry to slightly moist, unconsolidated, trace cobble to 3.5 inches.		
					Same as above. 2.5Y 5/4, slightly moist, unconsolidated.		
					WELL-GRADED GRAVEL WITH SILT AND SAND. 10YR 6/5, dry, unconsolidated, few cobble to 5 inches.		
50					Same as above. 10YR 6/5, dry, trace cobble to 3.5 inches.		
					Same as above to 52.5 feet bgs. 10YR 6/5, dry to slightly moist, trace cobble to 6 inches.		
					WELL-GRADED SAND WITH HIGH SILT AND CLAY CONTENT AND GRAVEL. 10YR 7/5, dry, weak consolidation, gravel to 2 inches.		
55					Top foot: WELL-GRADED GRAVEL WITH SILT AND SAND. Unconsolidated. Bottom foot: WELL-GRADED SAND WITH HIGH SILT AND CLAY CONTENT. 10YR 6/5, weak consolidation.		
					WELL-GRADED SAND WITH SILT AND GRAVEL. 2.5Y 7/4, dry, unconsolidated, trace cobble to 3.5 inches.		
60					WELL-GRADED SAND WITH SILT, CLAY, AND GRAVEL. 2.5Y 7/5, slightly moist, very weak consolidation, trace cobble to 3.5 inches.		
					First foot is same as above. Transitioning to a 6 inch cobble layer (cobble up to 7 inches), 2.5Y 7/5, dry.		
					WELL-GRADED SAND WITH SILT, CLAY, AND GRAVEL. 2.5Y 7/5, slighly moist, very weak consolidation, trace cobble to 4 inches.		
65					First foot: Same as above. Higher silt and clay content, 2.5Y 4/3, moist, moderate consolidation, no cobble. 2nd foot: WELL-GRADED SAND WITH SILT AND GRAVEL. 2.5Y 4/4, dry, unconsolidated, trace cobble to 4 inches.		
					WELL-GRADED SAND WITH SILT AND GRAVEL. 10YR 6/4, dry, unconsolidated.		
					WELL-GRADED SAND WITH SILT, CLAY, AND GRAVEL. 10YR 6/4, slightly moist, very weak consolidation, no cobble.		
70							

PROJECT NUMBER: 354946. FI.02	BORING NUMBER: H4SSU01 SHEET 3 OF 3

SOIL BORING LOG

PROJECT: Anaconda/Yerington | LOCATION : W 119 11 18.898 N 38 59 19.554

ELEVATION: ft () | DRILLING CONTRACTOR: Boart Long Year

DRILLING EQUIPMENT: SR 114 | DRILLING EQUIPMENT: 8-inch casing, 7-inch core barrel

WATER LEVELS: Not Encountered | START: | END: | LOGGER:

DEPTH (ft bgs)	INTERVAL (ft)	RECOVERY (%)	TYPE/NUMBER	USCS CODE	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	PID (ppm)	COMMENTS: OBSERVATIONS (E.G., DEBRIS, SHEEN, STAINING), SAMPLING AND TESTING NOTES, DRILLING OPERATIONS (e.g., REFUSAL, DRILL RATE)
					WELL-GRADED SAND WITH SILT AND GRAVEL. 10YR 6/4, moist, few cobbles to 4 inches.		
					WELL-GRADED SAND WITH SILT, CLAY, AND GRAVEL. 10YR 5/4, moist, weak consolidation, few cobble.		
					Same as above. 10YR 4/4, moist, weak to moderate consolidation, few cobbles to 8 inches.		
75					Same as above. 10YR 5/4, slightly moist.		
							Abandoned hole by backfilling with cuttings and Redimix concrete.
					Bottom of hole at 77 ft below ground surface		
80							
85							
90							
95							
100							
105							

PROJECT NUMBER: 354946. FI.02	BORING NUMBER: H4SSU02 SHEET 1 OF 1

SOIL BORING LOG

PROJECT: Anaconda/Yerington
LOCATION : W 119 11 22.174 N 38 59 15.986
ELEVATION: ft ()
DRILLING CONTRACTOR: Boart Long Year
DRILLING EQUIPMENT: SR 114
DRILLING EQUIPMENT: 8-inch casing, 7-inch core barrel
WATER LEVELS: Not Encountered
START: 1330
END: 1545
LOGGER: S. Duffy

DEPTH (ft bgs)	INTERVAL (ft)	RECOVERY (%)	TYPE/NUMBER	USCS CODE	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	PID (ppm)	COMMENTS: OBSERVATIONS (E.G., DEBRIS, SHEEN, STAINING), SAMPLING AND TESTING NOTES, DRILLING OPERATIONS (e.g., REFUSAL, DRILL RATE)
				SW	WELL-GRADED SAND WITH SILT AND GRAVEL (SW). 10YR 6/4, dry, unconsolidated, trace cobble to 3.5 inches.		
				SW	Same as above.		
				SW	Same as above. 10YR 6/4, slightly moist, unconsolidated, few cobble to 4 inches.		
5				SW	Same as above.		
				SW	Same as above. Trace cobble to 3.5 inches.		
				SW	Same as above. Few cobble to 7 inches.		
10				SW	Same as above. Trace cobble to 5 inches.		
				SW	WELL-GRADED SAND WITH SILT, CLAY, AND GRAVEL (SW). 10YR 6/4, moist, very weak consolidation, trace cobble.		
				SW	WELL-GRADED SAND WITH SILT AND GRAVEL (SW). 10YR 6/4, dry, unconsolidated, some (35%) cobble to 8 inches.		
15				SW	WELL-GRADED SAND WITH SILT AND GRAVEL (SW). 10YR 6/4, dry to slightly moist, few cobble to 7 inches, unconsolidated.		
				SW	Same as above. Slightly moist, few cobble to 6 inches.		
20				SW	WELL-GRADED SAND WITH SILT, CLAY, AND GRAVEL (SW). 10YR 6/5, moist, weak to very weak consolidation, few cobble to 4 inches.		
				SW	Same as above. Less clay, slightly moist, unconsolidated.		
25				SW	WELL-GRADED SAND WITH SILT AND GRAVEL (SW). 10YR 6/5, slightly moist, unconsolidated, gravel to 2 inches.		
					Bottom of hole at 27 ft below ground surface		Abandoned hole by backfilling with cuttings and redimix concrete.
30							
35							

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:
354946. FI.02	H4SSU03 SHEET 1 OF 3

SOIL BORING LOG

PROJECT: Anaconda/Yerington | LOCATION : W 119 11 23.279 N 38 59 21.226

ELEVATION: ft () | DRILLING CONTRACTOR: Boart Long Year

DRILLING EQUIPMENT: SR 114 | DRILLING EQUIPMENT: 8-inch casing, 7-inch core barrel

WATER LEVELS: Not Encountered | START: | END: | LOGGER: S. Duffy

DEPTH (ft bgs)	INTERVAL (ft)	RECOVERY (%)	TYPE/NUMBER	USCS CODE	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	PID (ppm)	COMMENTS: OBSERVATIONS (E.G., DEBRIS, SHEEN, STAINING), SAMPLING AND TESTING NOTES, DRILLING OPERATIONS (e.g., REFUSAL, DRILL RATE)
				GW	WELL-GRADED GRAVEL WITH SILT AND SAND (GW). 10YR 7/4, dry, unconsolidated, few cobble.		
				SW	WELL-GRADED SAND WITH SILT AND GRAVEL (SW). 10YR 6/5, moist, unconsolidated, trace cobble.		
5				SW	Top foot: Same as above. 10YR 6/5, some cobble to 8 inches (45%). Bottom foot: Same as above. 10YR 8/2, dry, powdered rock.		
				SW	WELL-GRADED SAND WITH SILT, CLAY, AND GRAVEL (SW). 10YR 6/5, dry to slightly moist, unconsolidated, trace cobble to 4 inches.		
				SW	Same as above. Less gravel. 10YR 6/4, dry, unconsolidated, few cobble to 4 inches.		
10				SW	WELL-GRADED SAND AND GRAVEL (SW). 10YR 6/5, moist, unconsolidated, trace cobble, trace silt.		
				SW	WELL-GRADED SAND WITH SILT, CLAY, AND GRAVEL (SW). 2.5Y 6/5, moist, very weak consolidation, cobble to 4 inches.		
15				SW	Same as above. Higher silt/clay content.		
				SW	WELL-GRADED SAND WITH SILT AND GRAVEL. 2.5Y 6/3, unconsolidated, dry, 35% cobble.		
20				SW	WELL-GRADED SAND WITH SILT AND GRAVEL. 10YR 5/4, unconsolidated, dry, few cobble to 7 inches.		
				SW	POORLY GRADED GRAVEL WITH SAND. 10YR 6/5, unconsolidated, few cobble to 7 inches.		Small gravel on top with larger gravel giving way to cobble.
25				SW	WELL-GRADED SAND WITH SILT, CLAY, AND GRAVEL. 10YR 5/5, moist, very weak consolidation, few cobble to 4 inches.		
				SW	Same as above. 10YR 5/5, weak consolidation.		
				SW	WELL-GRADED SAND WITH SILT, AND GRAVEL. 10YR 6/4, dry, unconsolidated, some cobble to 7 inches.		
30				SW	Same as above. 10YR 6/4, dry, unconsolidated, trace cobble to 3.5 inches.		
				SW	Same as above. 2.5Y 6/4, dry, trace cobble to 6 inches.		
				SW	WELL-GRADED SAND WITH SILT, CLAY, AND GRAVEL. 10YR 5/6, moist, very weak consolidation, gravel to 3 inches.		
35				SW	Same as above. 10YR 5/6, dry, weak consolidation, 50% intact.		

PROJECT NUMBER: 354946. FI.02	BORING NUMBER: H4SSU03 SHEET 2 OF 3

SOIL BORING LOG

PROJECT: Anaconda/Yerington
LOCATION : W 119 11 23.279 N 38 59 21.226
ELEVATION: ft ()
DRILLING CONTRACTOR: Boart Long Year
DRILLING EQUIPMENT: SR 114
DRILLING EQUIPMENT: 8-inch casing, 7-inch core barrel
WATER LEVELS: Not Encountered
START:
END:
LOGGER: S. Duffy

DEPTH (ft bgs)	INTERVAL (ft)	RECOVERY (%)	TYPE/NUMBER	USCS CODE	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	PID (ppm)	COMMENTS: OBSERVATIONS (E.G., DEBRIS, SHEEN, STAINING), SAMPLING AND TESTING NOTES, DRILLING OPERATIONS (e.g., REFUSAL, DRILL RATE)
				SW	Same as above. 10YR 5/6, dry, shattered.		
				SW	Same as above. 10YR 5/6, slightly moist, unconsolidated, less clay.		
40				GW	WELL-GRADED GRAVEL WITH SILT, CLAY, AND SAND. 10YR 5/5, moist, unconsolidated, few cobble to 5 inches.		
				GW	Same as above.		
				SW	WELL-GRADED SAND WITH SILT, AND GRAVEL. 10YR 6/5, slightly moist, unconsolidated, cobble to 5 inches.		
45				SW	Same as above.		
				SW	Same as above. No cobble, gravel to 2.5 inches.		
				SW	Same as above. No cobble.		
50				SW	Same as above. Few cobble to 5 inches.		
				SW	Same as above. Dry to slightly moist, few cobble to 4 inches.		
				SW	Same as above. Few cobble to 7 inches.		
55				GW	WELL-GRADED GRAVEL WITH SILT, CLAY, AND SAND (GW). 10YR 6/4, moist, weak consolidation, no cobble.		
				GW	Same as above. 10YR 8/2, trace cobble.		
60				GW	Same as above. 10YR 6/5, dry to slightly moist, trace cobble.		
				GW	Same as above. 10YR 6/5 and 10YR 5/5, consolidation not as weak, trace cobble.		
				GW	Same as above.		
65				GW	Same as above.		
				GW	Same as above. Moist.		
				GW	Same as above. Moist, very weak consolidation.		
70					WELL-GRADED GRAVEL WITH SILT AND SAND. 10YR		

PROJECT NUMBER: 354946. FI.02	BORING NUMBER: H4SSU03 SHEET 3 OF 3

SOIL BORING LOG

PROJECT: Anaconda/Yerington — LOCATION : W 119 11 23.279 N 38 59 21.226

ELEVATION: ft () — DRILLING CONTRACTOR: Boart Long Year

DRILLING EQUIPMENT: SR 114 — DRILLING EQUIPMENT: 8-inch casing, 7-inch core barrel

WATER LEVELS: Not Encountered — START: — END: — LOGGER: S. Duffy

DEPTH (ft bgs)	INTERVAL (ft)	RECOVERY (%)	TYPE/NUMBER	USCS CODE	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	PID (ppm)	COMMENTS: OBSERVATIONS (E.G., DEBRIS, SHEEN, STAINING), SAMPLING AND TESTING NOTES, DRILLING OPERATIONS (e.g., REFUSAL, DRILL RATE)
				GW	6/5, dry to slightly moist, unconsolidated, some (30%) cobble to 9 inches.		
				GW	WELL-GRADED GRAVEL WITH SILT, CLAY, AND SAND (GW). 10YR 6/5, unconsolidated, trace cobble to 4 inches.		
				GW	WELL-GRADED GRAVEL WITH SILT, AND SAND (GW). 10YR 6/4, moist, unconsolidated, trace cobble to 4 inches.		
75				GW	Same as above. 10YR 6/3, dry to slightly moist, trace cobble to 4 inches.		
							Abandoned hole by backfilling with cuttings and redimix concrete.
					Bottom of hole at 77 ft below ground surface		
80							
85							
90							
95							
100							
105							

PROJECT NUMBER: 354946. FI.02	BORING NUMBER: H4SSU04 SHEET 1 OF 2

SOIL BORING LOG

PROJECT: Anaconda/Yerington | LOCATION : W 119 11 23.374 N 38 59 23.597

ELEVATION: ft () | DRILLING CONTRACTOR: Boart Long Year

DRILLING EQUIPMENT: SR 114 | DRILLING EQUIPMENT: 8-inch casing, 7-inch core barrel

WATER LEVELS: Not Encountered | START: 1615 | END: 1745 | LOGGER:

DEPTH (ft bgs)	INTERVAL (ft)	RECOVERY (%)	TYPE/NUMBER	USCS CODE	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	PID (ppm)	COMMENTS: OBSERVATIONS (E.G., DEBRIS, SHEEN, STAINING), SAMPLING AND TESTING NOTES, DRILLING OPERATIONS (e.g., REFUSAL, DRILL RATE)
					WELL-GRADED SAND WITH SILT AND GRAVEL. 10YR 7/3, dry, unconsolidated, trace cobble to 4 inches.		
					Same as above. 10YR 6/4, slightly moist, trace cobble to 4 inches.		
5					Same as above.		
					First foot: Same as above. Dry. Bottom foot: Same as above. 10YR 4/4, dry, some (35%) cobble.		
10					WELL-GRADED SAND WITH SILT AND GRAVEL. 10YR 5/5, slightly moist, unconsolidated, some (40% cobble).		
					WELL-GRADED SAND WITH SILT AND GRAVEL. 2.5YR 8/4, moist, unconsolidated, trace cobble to 4 inches.		
					Same as above. 2.5Y 8/2.		
15					Same as above. 10YR 7/3, moist, very weak consolidation, trace cobble to 3.5 inches.		
					WELL-GRADED SAND WITH SILT AND GRAVEL. 2.5Y 7/3, dry, unconsolidated, few cobbles to 4 inches.		
20					Top foot: Same as above. 10YR 7/5, trace cobble. Bottom: Same as above. 10YR 8/3, moist.		
					WELL-GRADED SAND WITH GRAVEL. 2.5Y 8/3, moist, unconsolidated, some (35%) cobble to 5 inches.		
					Same as above. 2.5Y 8/4, slightly moist, few cobble to 5 inches.		
25					WELL-GRADED SAND WITH SILT, CLAY, AND GRAVEL. 2.5Y 7/4, slightly moist, unconsolidated, trace cobble.		
					Same as above. 10YR 7/4, slightly moist, few cobble to 4 inches, no clay.		
30					WELL-GRADED SAND WITH SILT AND GRAVEL. 10YR 7/4, dry, unconsolidated, trace cobble to 4 inches.		
					Same as above. 10YR 6/5, slightly moist.		
					Same as above. Some cobble (35%).		
35							

PROJECT NUMBER: 354946. FI.02	BORING NUMBER: H4SSU04	SHEET 2 OF 2

SOIL BORING LOG

PROJECT: Anaconda/Yerington | LOCATION : W 119 11 23.374 N 38 59 23.597

ELEVATION: ft () | DRILLING CONTRACTOR: Boart Long Year

DRILLING EQUIPMENT: SR 114 | DRILLING EQUIPMENT: 8-inch casing, 7-inch core barrel

WATER LEVELS: Not Encountered | START: 1615 | END: 1745 | LOGGER:

DEPTH (ft bgs)	INTERVAL (ft)	RECOVERY (%)	TYPE\NUMBER	USCS CODE	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	PID (ppm)	COMMENTS: OBSERVATIONS (E.G., DEBRIS, SHEEN, STAINING), SAMPLING AND TESTING NOTES, DRILLING OPERATIONS (e.g., REFUSAL, DRILL RATE)
					Same as above.		
					WELL-GRADED SAND WITH SILT AND GRAVEL. 10YR 7/4, unconsolidated, few cobbles to 5 inches.		
					Same as above. Dry to slightly moist.		
40							
					Same as above. 10YR 6/5, slightly moist, few cobble to 8 inches.		
					Same as above.		
45					Same as above.		
					WELL-GRADED SAND WITH SILT, CLAY, AND GRAVEL. 10YR 5/6, moist, very weak consolidation, trace cobble to 3.5 inches.		
					WELL-GRADED SAND WITH SILT, CLAY, AND GRAVEL. 10YR 5/6, moist, unconsolidated, trace cobble to 5 inches.		
					Same as above. 10YR 5/6, moist to slightly moist, unconsolidated, few cobble to 4 inches.		
50					Same as above. Moist.		
					WELL-GRADED SAND WITH SILT AND GRAVEL. 10YR 6/4, dry, unconsolidated, few cobble to 4 inches.		
					Same as above. Few cobble to 6 inches.		
55					WELL-GRADED SAND WITH SILT, CLAY, AND GRAVEL. 10YR 6/6, dry, weak consolidation, no cobble.		
							Abandoned hole by backfilling with cuttings and redimix concrete.
60					Bottom of hole at 57 ft below ground surface		
65							
70							

PROJECT NUMBER: **354946. FI.02**

BORING NUMBER: **H4VSU01** SHEET 1 OF 4

SOIL BORING LOG

PROJECT: Anaconda/Yerington | LOCATION : W 119 12 19.735 N 39 00 39.703

ELEVATION: ft () | DRILLING CONTRACTOR: Boart Long Year

DRILLING EQUIPMENT: SR 114 | DRILLING EQUIPMENT: 8-inch casing, 7-inch core barrel

WATER LEVELS: Not Encountered | START: 9/27/2008 | END: | LOGGER: S. Monteith

DEPTH (ft bgs)	INTERVAL (ft)	RECOVERY (%)	TYPE/NUMBER	USCS CODE	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	PID (ppm)	COMMENTS: OBSERVATIONS (E.G., DEBRIS, SHEEN, STAINING), SAMPLING AND TESTING NOTES, DRILLING OPERATIONS (e.g., REFUSAL, DRILL RATE)
				SW	WELL-GRADED SAND WITH GRAVEL AND FINES (SW). 10YR 6/6, moist.		Mostly fine gravel.
				GP	POORLY GRADED GRAVEL WITH SAND AND FINES (GP). 10YR 6/4, moist, mostly fines.		
5				GP	Same as above. 10YR 7/3.		
				GP	Same as above.		
				GP	Same as above. 10YR 6/4.		
10				GP	Same as above.		
				SM	SILTY SAND (SM), WELL GRADED WITH FINE GRAVEL. 10YR 6/3, moist.		
				SM	Same as above (SM). Except more silt.		
15				GM	SILTY GRAVEL WITH SAND (GM). 10YR 6/3, mostly fine gravel.		Notable increase in fines.
				SW	WELL-GRADED SAND WITH SILT AND FINE GRAVEL (GW). 10YR 6/6, moist.		
				SW	WELL-GRADED SAND WITH SILT AND GRAVEL (SW). 10YR 7/6, moist, mostly fine with well-graded sand.		
20				SW	Same as above.		
				SW	Same as above.		
				SW	Same as above.		Very difficult to distinguish coarse sand from fine gravel in these samples.
25				SW	Same as above.		
				SW	Same as above.		
				SW	Same as above. 10YR 6/4, moist.		
30				SW	Same as above.		
				SW	Same as above. Increased moisture.		
				SW	Same as 27 to 28.9 feet bgs.		
35				SW	Same as above.		

SOIL BORING LOG

PROJECT: Anaconda/Yerington
LOCATION : W 119 12 19.735 N 39 00 39.703
ELEVATION: ft ()
DRILLING CONTRACTOR: Boart Long Year
DRILLING EQUIPMENT: SR 114
DRILLING EQUIPMENT: 8-inch casing, 7-inch core barrel
WATER LEVELS: Not Encountered
START: 9/27/2008
END:
LOGGER: S. Monteith

DEPTH (ft bgs)	INTERVAL (ft)	RECOVERY (%)	TYPE/NUMBER	USCS CODE	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	PID (ppm)	COMMENTS: OBSERVATIONS (E.G., DEBRIS, SHEEN, STAINING), SAMPLING AND TESTING NOTES, DRILLING OPERATIONS (e.g., REFUSAL, DRILL RATE)
				SW	Same as above. With coarser gravel up to 1 inch.		
				SW	Same as above.		
40				SW	Same as above.		
				SW	Same as above. Increased silt from 42 to 43.5 feet bgs.		
				SW	Same as above.		
45				SW	Same as above.		
				SW	Same as above.		
				SW	SILTY GRAVEL WITH SAND (SW). 10YR 6/6 , moist.		Collect split spoon sample.
50				SW	Same as above.		
				SW	Same as above.		
				SW	Same as above.		
55				SW	Same as above.		
				SW	Same as above.		
				SW	SILTY GRAVEL WITH WELL-GRADED SAND (SW). 10YR 6/6, moist, gravel up to 1 inch.		
60				SW	Same as above.		
				GW	WELL-GRADED GRAVEL WITH SILT AND SAND (GW). 10YR 6/6, moist.		
				GW	Same as above. Moist, more coarse gravel.		
65				GW	Cobbles or boulders with silty sand. Moist.		Large (up to 6 inches) rock with freshly broken surface suggest boulder.
				GW	SILTY GRAVEL WITH SAND, COBBLES, POSSIBLY BOULDERS (GW). Moist.		Fewer fresh rock fragments.
				GW	Same as above (GW). Moist, with more gravel.		
70				GW	GRAVEL, COBBLES, BOULDER, WITH TRACE SILT AND SAND (GW). Moist.		Large (up to 6 inches) rock with freshly broken surface suggest boulder.

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:
354946. FI.02	H4VSU01 SHEET 3 OF 4

SOIL BORING LOG

PROJECT: Anaconda/Yerington
LOCATION : W 119 12 19.735 N 39 00 39.703
ELEVATION: ft ()
DRILLING CONTRACTOR: Boart Long Year
DRILLING EQUIPMENT: SR 114
DRILLING EQUIPMENT: 8-inch casing, 7-inch core barrel
WATER LEVELS: Not Encountered
START: 9/27/2008
END:
LOGGER: S. Monteith

DEPTH (ft bgs)	INTERVAL (ft)	RECOVERY (%)	TYPE/NUMBER	USCS CODE	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	PID (ppm)	COMMENTS: OBSERVATIONS (E.G., DEBRIS, SHEEN, STAINING), SAMPLING AND TESTING NOTES, DRILLING OPERATIONS (e.g., REFUSAL, DRILL RATE)
				GW	WELL-GRADED GRAVEL WITH SILT AND SAND (GW). 7.5YR 5/6, moist.		Freshly broken gravel.
				GW	Same as above.		
				GW	Same as above. With more coarse gravel.		Gravel is more weathered.
					GRAVEL AND COBBLES WITH TRACE SILT AND SAND.		Weathered and freshly broken.
75							
				GW	WELL-GRADED GRAVEL WITH SILT AND SAND (GW). Dry to moist.		
80				GW	Same as above.		
				GW	Same as above.		
				GW	Same as above.		
				GW	SILT WITH GRAVEL AND SAND (GW). 7.5YR 6/4, dry.		
85							
				GW	Same as above. 10YR 7/1.		
				GW	GRAVEL AND COBBLES WITH SAND AND SILT. Moist.		Freshly broken.
				GW	Same as above.		
				GW	Same as above. More moisture, with more silt and sand.		
90							
				GW	Same as 87 to 87.4 feet bgs.		
				GW	Same as 87 to 87.4 feet bgs.		
95							
				GW	GRAVEL AND COBBLES WITH SILT AND SAND. 10YR 7/2, dry.		
				GW	Same as above. Dry.		
100							
				GW	Same as above. 10YR 6/4, moist, with more fines.		
				GW	Same as above. Moist.		
105					WELL-GRADED GRAVEL WITH SILT AND SAND (SW).		

PROJECT NUMBER: 354946. FI.02	BORING NUMBER: H4VSU01	SHEET 4 OF 4

SOIL BORING LOG

PROJECT: Anaconda/Yerington | LOCATION : W 119 12 19.735 N 39 00 39.703

ELEVATION: ft () | DRILLING CONTRACTOR: Boart Long Year

DRILLING EQUIPMENT: SR 114 | DRILLING EQUIPMENT: 8-inch casing, 7-inch core barrel

WATER LEVELS: Not Encountered | START: 9/27/2008 | END: | LOGGER: S. Monteith

DEPTH (ft bgs)	INTERVAL (ft)	RECOVERY (%)	TYPE\NUMBER	USCS CODE	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	PID (ppm)	COMMENTS: OBSERVATIONS (E.G., DEBRIS, SHEEN, STAINING), SAMPLING AND TESTING NOTES, DRILLING OPERATIONS (e.g., REFUSAL, DRILL RATE)
				SW	5YR 6/6, moist.		
				SW	Same as above.		
							Abandoned hole with native material to 15 feet bgs. Topped off with wet Quikcrete.
					Bottom of hole at 107 ft below ground surface		
110							
115							
120							
125							
130							
135							
140							

PROJECT NUMBER: 354946. FI.02	BORING NUMBER: H4VSU02 SHEET 1 OF 4

SOIL BORING LOG

PROJECT: Anaconda/Yerington — LOCATION : W 119 12 29.979 N 39 00 39.802

ELEVATION: ft () — DRILLING CONTRACTOR: Boart Long Year

DRILLING EQUIPMENT: SR 114 — DRILLING EQUIPMENT: 8-inch casing, 7-inch core barrel

WATER LEVELS: Not Encountered — START: — END: — LOGGER:

DEPTH (ft bgs)	INTERVAL (ft)	RECOVERY (%)	TYPE/NUMBER	USCS CODE	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	PID (ppm)	COMMENTS: OBSERVATIONS (E.G., DEBRIS, SHEEN, STAINING), SAMPLING AND TESTING NOTES, DRILLING OPERATIONS (e.g., REFUSAL, DRILL RATE)
				SW	WELL-GRADED SAND WITH SILT AND GRAVEL (SW). 10YR 7/6, moist.		Colors determined with Munsel color chart. Samples disturbed, can't estimate density. Core bags are larger (10 inches) than core.
				SW	Same as above. Increase in moisture content.		
				SW	Same as above.		
5							
				SW	Same as above.		
				SW	SILTY SAND (SW). 10YR 7/6, dry to slightly moist, little gravel, poorly graded.		
				SW	Same as above until 8 feet bgs. 2.5Y 7/6, moisture and silt content increase with depth.		
10							
				SW	SILTY SAND WITH GRAVEL (SW) WELL-GRADED. 10YR 7/6, moist.		
				SW	Same as above. Moist.		Slight increase in silt content.
				SW	Same as above.		
15							
				SW	SILTY SAND WITH WELL-GRADED GRAVEL (SM). 2.5Y 7/4, moisture content has increased.		
				GW	WELL-GRADED GRAVEL WITH CLAY AND SAND (GW). 2.5Y 6/4, moist, well-graded.		
				GW	Same as above until 19 feet bgs. Silt content decreases, sand increases. 2.5Y 7/4, moist.		
20							
				GM	WELL-GRADED GRAVEL WITH SAND (GM). 2.5Y 7/4, moist.		
				GM	Same as above. 2.5Y 6/4, moist.		Notice trace amount of red deposit.
				GM	Same as above. 2.5Y 6/6, moist.		
25							
				GW	WELL-GRADED GRAVEL WITH SILT AND SAND (GW). 2.5Y 7/6, moist.		Collect brass sleeve sample (split spoon).
				GW	WELL-GRADED GRAVEL WITH SILT AND SAND (GW). 10YR 7/6, moist.		
				GW	Same as above. Increase in moisture content.		
30							
				GW	WELL-GRADED GRAVEL WITH SILT AND SAND (GW). 10YR 6/6, moist.		
				GW	Same as above.		
35				GW	Same as above. Increase in fines.		

PROJECT NUMBER: 354946. FI.02	BORING NUMBER: H4VSU02 SHEET 2 OF 4

SOIL BORING LOG

PROJECT: Anaconda/Yerington | LOCATION : W 119 12 29.979 N 39 00 39.802

ELEVATION: ft () | DRILLING CONTRACTOR: Boart Long Year

DRILLING EQUIPMENT: SR 114 | DRILLING EQUIPMENT: 8-inch casing, 7-inch core barrel

WATER LEVELS: Not Encountered | START: | END: | LOGGER:

DEPTH (ft bgs)	INTERVAL (ft)	RECOVERY (%)	TYPE/NUMBER	USCS CODE	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	PID (ppm)	COMMENTS: OBSERVATIONS (E.G., DEBRIS, SHEEN, STAINING), SAMPLING AND TESTING NOTES, DRILLING OPERATIONS (e.g., REFUSAL, DRILL RATE)
				GW	Same as above. 10YR 7/6, increase in fines and moisture content with depth.		Notice trace amount of red deposit.
				GW	Same as above.		
				GW	Same as above until 39 feet bgs. Fines decrease. WELL-GRADED GRAVEL WITH SILT AND SAND (GW). 2.5Y 6/6, moist.		
40				GW	Same as above. 2.5Y 7/4.		
				GW	Same as above. 10YR 7/6.		
				GW	Same as above. 10YR 6/6.		
45				GW	Same as above. 10YR 7/6.		
				GW	Same as above. 10YR 6/6.		
				GW	Same as above. 10YR 6/6.		Increased compaction
50				GW	Same as above. 10YR 6/6.		
				GW	GRAVEL WITH SILT AND SAND (GW). 10YR 6/6, moist.		
				GW	Same as above. 10YR 6/6.		Increase of fines and moisture with depth.
55				GW	Same as above. 10YR 6/6.		
				CL	Same as above until 56 feet bgs. Fines increase. At 56 feet bgs. lithology changes: SANDY LEAN CLAY WITH GRAVEL (CL). 2.5Y 6/6, moist.		
				CL	Same as above. SANDY LEAN CLAY WITH GRAVEL. 2.5Y 7/6, moist.		Clay.
60				CL	Same as above. 2.5Y 7/6.		
				CL	Same as above. 2.5Y 6/3, wet.		Clay.
				GC	Same as above (SC). At 63 feet bgs. lithology changes: GRAVELLY LEAN CLAY WITH SAND (GC).		Clay. Gravel content is increasing with depth.
65				GC	Same as above.		Clay.
				GC	Same as above.		Clay.
				GC	GRAVELLY LEAN CLAY WITH SAND (GC). 2.5Y 7/4, moist to wet.		Clay.
70				GC	Same as above.		Clay.

PROJECT NUMBER:	BORING NUMBER:	
354946. FI.02	H4VSU02	SHEET 3 OF 4

SOIL BORING LOG

PROJECT: Anaconda/Yerington | LOCATION : W 119 12 29.979 N 39 00 39.802

ELEVATION: ft () | DRILLING CONTRACTOR: Boart Long Year

DRILLING EQUIPMENT: SR 114 | DRILLING EQUIPMENT: 8-inch casing, 7-inch core barrel

WATER LEVELS: Not Encountered | START: | END: | LOGGER:

DEPTH (ft bgs)	INTERVAL (ft)	RECOVERY (%)	TYPE/NUMBER	USCS CODE	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	PID (ppm)	COMMENTS: OBSERVATIONS (E.G., DEBRIS, SHEEN, STAINING), SAMPLING AND TESTING NOTES, DRILLING OPERATIONS (e.g., REFUSAL, DRILL RATE)
				GC	Same as above. 2.5Y 6/6.		Clay.
				GM	Same as above until 73 feet bgs. At 73 feet bgs. lithology changes: WELL-GRADED SILTY GRAVEL WITH SAND (GM).		
75				GC	GRAVELLY LEAN CLAY WITH SAND (GC). 2.5Y 6/4, moist. At 74.5 feet bgs. lithology changes: WELL-GRADED GRAVEL WITH SILT AND SAND. 10YR 6/6.		
				GW	WELL-GRADED GRAVEL WITH SILT AND SAND (GW). 10YR 6/6, moist, trace cobbles up to 4 inch diameter.		Increase in coarse material with depth.
				GW	Same as above. 2.5Y 7/4, dry to moist.		
80				GW	WELL-GRADED GRAVEL WITH SAND (GW). 10YR 6/6, dry to moist, some cobbles up to 5.5 inches diameter.		
				GW	WELL-GRADED GRAVEL WITH SAND (GW). 10YR 5/6, dry to moist, trace cobbles up to 3.5 inches.		
				GW	Same as above.		
85				GW	WELL-GRADED GRAVEL WITH SAND (GW). 2.5Y 7/6, dry to moist.		
				GW	Same as above.		
90				GW	WELL-GRADED GRAVEL WITH SAND (GW). 10YR 5/6, some cobbles up to 5.5 inches.		
				GW	Same as above. Dry to moist, cobbles up to 3.5 inches.		
95				GW	Same as above.		
				GW	WELL-GRADED GRAVEL WITH SAND (GW). 10YR 7/6, moist.		
				GW	WELL-GRADED GRAVEL WITH SAND (GW). 2.5Y 6/6, dry to moist.		
100				GW	Same as above.		
				GW	Same as above. 10YR 5/6.		Black deposit on side surface from drill barrel.
				GW	Same as above. 10YR 5/6, moist.		
105							

PROJECT NUMBER: 354946. FI.02	BORING NUMBER: H4VSU02 SHEET 4 OF 4

SOIL BORING LOG

PROJECT: Anaconda/Yerington | LOCATION : W 119 12 29.979 N 39 00 39.802

ELEVATION: ft () | DRILLING CONTRACTOR: Boart Long Year

DRILLING EQUIPMENT: SR 114 | DRILLING EQUIPMENT: 8-inch casing, 7-inch core barrel

WATER LEVELS: Not Encountered | START: | END: | LOGGER:

DEPTH (ft bgs)	INTERVAL (ft)	RECOVERY (%)	TYPE\NUMBER	USCS CODE	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	PID (ppm)	COMMENTS: OBSERVATIONS (E.G., DEBRIS, SHEEN, STAINING), SAMPLING AND TESTING NOTES, DRILLING OPERATIONS (e.g., REFUSAL, DRILL RATE)
				GW	WELL-GRADED GRAVEL WITH SAND (GW). 2.5Y 8/2, dry.		
					Bottom of hole at 107 ft below ground surface		Backfill with core samples to 20 foot depth and fill with Quickrete to surface. Grade out remaining core sample at site.
110							
115							
120							
125							
130							
135							
140							

PROJECT NUMBER:	BORING NUMBER:
354946. FI.02	H4VSU03 SHEET 1 OF 3

SOIL BORING LOG

PROJECT: Anaconda/Yerington
LOCATION : W 119 12 29.979 N 39 00 39.802
ELEVATION: ft ()
DRILLING CONTRACTOR: Boart Long Year
DRILLING EQUIPMENT: SR 114
DRILLING EQUIPMENT: 8-inch casing, 7-inch core barrel
WATER LEVELS: Not Encountered
START:
END:
LOGGER: I. Dinkleman

DEPTH (ft bgs)	INTERVAL (ft)	RECOVERY (%)	TYPE/NUMBER	USCS CODE	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	PID (ppm)	COMMENTS: OBSERVATIONS (E.G., DEBRIS, SHEEN, STAINING), SAMPLING AND TESTING NOTES, DRILLING OPERATIONS (e.g., REFUSAL, DRILL RATE)
				GW-GM	WELL-GRADED GRAVEL WITH SILT AND SAND (GW-GM). 2.5Y 6/6, dry to moist.		
				GW-GM	Same as above. Moist.		
				GW-GM	Same as above. Moist.		
5				GW-GM	Same as above. 2.5Y 6/6, increase in silt content with depth.		
				GW-GM	Same as above.		
10				GW-GM	Same as above. 2.5Y 6/6, Increase in moisture content.		
				GW-GM	Same as above.		
				GW-GM	Same as above.		
15				GW	WELL-GRADED GRAVEL WITH CLAY AND SAND (GW). 2.5Y 6/4, moist.		
				GW	Same as above.		
20				GW	WELL-GRADED GRAVEL WITH SILT AND SAND (GW). 2.5Y 7/6, moist.		Increase in weathered rock.
				GW	Same as above.		
				GW	WELL-GRADED CLAY AND SAND (GW). 2.5Y 7/4, moist.		Increase in fines and compaction.
25				GW	Same as above. 2.5Y 7/4, moist.		
				GW	Same as above.		
				GW	WELL-GRADED GRAVEL WITH SILT AND SAND (GW). 10YR 7/6, moist to wet.		
30				GW	28.3 to 29 feet bgs: WELL-GRADED GRAVEL WITH CLAY AND SAND (GW). 10YR 7/6. At 29 feet bgs, lithology changes to: WELL-GRADED GRAVEL WITH SILT AND SAND. 10YR 7/6, moist, less compact.		Highly compact.
				GW	WELL-GRADED GRAVEL WITH CLAY AND SAND (GW). 10YR 6/6, moist, compaction increases.		
				GW	Same as above.		
35				GW	Same as above.		

PROJECT NUMBER:	BORING NUMBER:
354946. FI.02	H4VSU03 SHEET 2 OF 3

SOIL BORING LOG

PROJECT: Anaconda/Yerington LOCATION : W 119 12 29.979 N 39 00 39.802

ELEVATION: ft () DRILLING CONTRACTOR: Boart Long Year

DRILLING EQUIPMENT: SR 114 DRILLING EQUIPMENT: 8-inch casing, 7-inch core barrel

WATER LEVELS: Not Encountered START: END: LOGGER: I. Dinkleman

DEPTH (ft bgs)	INTERVAL (ft)	RECOVERY (%)	TYPE/NUMBER	USCS CODE	SOIL DESCRIPTION SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	PID (ppm)	COMMENTS OBSERVATIONS (E.G., DEBRIS, SHEEN, STAINING), SAMPLING AND TESTING NOTES, DRILLING OPERATIONS (e.g., REFUSAL, DRILL RATE)
				GW	Same as above.		10/5/07 1450: Stopped drilling due to poor weather conditions. Affecting HSP.
				GW	Same as above.		
40				GW	WELL-GRADED GRAVEL WITH SILT AND SAND (GW). 10YR 7/6, moist.		
				GW	Same as above.		
				GW	Same as above. 10YR 7/6.		Observing trace amounts of red deposits.
45				GW	Same as above.		
				GW	Same as above.		
				GW	WELL-GRADED GRAVEL WITH CLAY AND SAND (GW). 2.5Y 6/6, moist.		
50				GW	Same as above.		
				GW	Same as above.		
55				GW	Same as above. At 54 feet bgs, lithology changes to: WELL-GRADED GRAVEL WITH SILT AND SAND (GW). 2.5Y 7/6, moist.		
				GW	WELL-GRADED GRAVEL WITH SILT AND SAND (GW). 2.5Y 7/6, moist.		
				GW	WELL-GRADED GRAVEL WITH CLAY AND SAND (GW). 10YR 7/4, moist.		
60				GW	WELL-GRADED GRAVEL WITH SILT AND SAND (GW). 10YR 6/6, moist.		
				GW	Same as above.		
65				GW	Same as above. 10YR 6/6, with trace cobbles up to 3.5 inches diameter.		
				GW	Same as above. No cobbles.		
				GW	WELL-GRADED GRAVEL WITH CLAY AND SAND (GW). 10YR 6/4, moist.		
70					Same as above. At 70 feet bgs, lithology changes to : WELL-GRADED GRAVEL WITH SILT AND SAND (GW).		

PROJECT NUMBER: 354946. FI.02	BORING NUMBER: H4VSU03 SHEET 3 OF 3

SOIL BORING LOG

PROJECT: Anaconda/Yerington | LOCATION : W 119 12 29.979 N 39 00 39.802

ELEVATION: ft () | DRILLING CONTRACTOR: Boart Long Year

DRILLING EQUIPMENT: SR 114 | DRILLING EQUIPMENT: 8-inch casing, 7-inch core barrel

WATER LEVELS: Not Encountered | START: | END: | LOGGER: I. Dinkleman

DEPTH (ft bgs)	INTERVAL (ft)	RECOVERY (%)	TYPE/NUMBER	USCS CODE	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	PID (ppm)	COMMENTS: OBSERVATIONS (E.G., DEBRIS, SHEEN, STAINING), SAMPLING AND TESTING NOTES, DRILLING OPERATIONS (e.g., REFUSAL, DRILL RATE)
				GW	10YR 5/8, moist.		
				GW	Same as above.		
				GW	WELL-GRADED GRAVEL WITH SAND (GW). 2.5Y 6/6, dry to moist.		
75				GW	WELL-GRADED GRAVEL WITH SILT AND SAND (GW). 2.5Y 7/4, moist.		
				GW	Same as above.		
80				GW	Same as above. 2.5Y 7/4.		
				GW	Same as above. 2.5Y 6/6.		
				GW	Same as above.		
85				GW	Same as above.		
					Bottom of hole at 87 ft below ground surface		
90							
95							
100							
105							

PROJECT NUMBER: 354946. FI.02	BORING NUMBER: H12SU01 SHEET 1 OF 3

SOIL BORING LOG

PROJECT: Anaconda/Yerington — LOCATION : W 119 11 43.115 N 38 59 29.522

ELEVATION: ft () — DRILLING CONTRACTOR: Boart Long Year

DRILLING EQUIPMENT: SR 114 — DRILLING EQUIPMENT: 8-inch casing, 7-inch core barrel

WATER LEVELS: Not Encountered — START: — END: — LOGGER: S. Duffy

DEPTH (ft bgs)	INTERVAL (ft)	RECOVERY (%)	TYPE/NUMBER	USCS CODE	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	PID (ppm)	COMMENTS: OBSERVATIONS (E.G., DEBRIS, SHEEN, STAINING), SAMPLING AND TESTING NOTES, DRILLING OPERATIONS (e.g., REFUSAL, DRILL RATE)
				GW	WELL-GRADED GRAVEL WITH SAND (GW). 2.5Y 8/1, dry, unconsolidated, few cobble to 7 inches.		
				GW	Same as above. 10YR 7/5, slightly moist, more sand (30%).		
5				GW	WELL-GRADED SILT WITH SAND AND GRAVEL (GW). 2.5Y 7/4, dry, unconsolidated, trace cobble to 4 inches.		
				GW	Same as above. 10YR 6/4, dry to slightly moist.		
10				SW	WELL-GRADED SAND WITH TRACE CLAY AND GRAVEL (SW). 10YR 6/5, moist, unconsolidated, trace cobble to 6 inches.		
				SW	WELL-GRADED SAND WITH SILT AND GRAVEL (SW). 10YR 6/5, slightly moist, unconsolidated, trace cobble to 4 inches.		
				SW	WELL-GRADED SAND WITH SILT AND GRAVEL (SW). 10YR 6/4, slightly moist, unconsolidated, gravel to 3 inches.		
15				SW	Same as above. Trace cobble to 8 inches.		
20				SW	WELL-GRADED SAND WITH SILT AND GRAVEL (SW). 10YR 8/4, dry, unconsolidated, gravel to 2 inches.		
				SW	WELL-GRADED SAND WITH GRAVEL AND SILT (SW). 10YR 7/4, slightly moist, unconsolidated, trace cobble to 3.5 inches.		
25				GW	WELL-GRADED GRAVEL WITH SILT AND SAND (GW). 10YR 5/5, slightly moist, unconsolidated, trace clay, gravel to 3 inches.		
				SW	WELL-GRADED SAND WITH SILT, CLAY, AND GRAVEL (SW). 10YR 5/5, slightly moist, weak consolidation, gravel to 2 inches.		
30				SW	WELL-GRADED SAND WITH SILT AND GRAVEL (SW). 10YR 7/4, dry, unconsolidated, gravel to 2 inches.		
35				GW	WELL-GRADED GRAVEL WITH SILT, CLAY, AND SAND (GW). 10YR 5/5 to 10YR 4/4, dry to slightly moist near top, moist at bottom, clay content increases as you approach 37 feet bgs.		

PROJECT NUMBER: 354946. FI.02	BORING NUMBER: H12SU01 SHEET 2 OF 3

SOIL BORING LOG

PROJECT: Anaconda/Yerington | LOCATION : W 119 11 43.115 N 38 59 29.522

ELEVATION: ft () | DRILLING CONTRACTOR: Boart Long Year

DRILLING EQUIPMENT: SR 114 | DRILLING EQUIPMENT: 8-inch casing, 7-inch core barrel

WATER LEVELS: Not Encountered | START: | END: | LOGGER: S. Duffy

DEPTH (ft bgs)	INTERVAL (ft)	RECOVERY (%)	TYPE\NUMBER	USCS CODE	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	PID (ppm)	COMMENTS: OBSERVATIONS (E.G., DEBRIS, SHEEN, STAINING), SAMPLING AND TESTING NOTES, DRILLING OPERATIONS (e.g., REFUSAL, DRILL RATE)
40				SW	WELL-GRADED SAND WITH SILT AND GRAVEL (SW). 10YR 6/4, dry, unconsolidated, trace cobbles to 5 inches.		
				GW	WELL-GRADED GRAVEL WITH SAND (GW). Slightly moist.		
45				SW	WELL-GRADED SAND WITH CLAY AND GRAVEL (SW). 10YR 4/5, dry to slightly moist, very weak consolidation, trace cobble to 3.5 inches.		
				SW	Top 4 inches: WELL-GRADED SAND WITH SILT (powdered rock?) AND GRAVEL (SW). 10YR 8/2, dry, unconsolidated, trace cobble to 4 inches. Bottom: WELL-GRADED SAND WITH SILT, CLAY, AND GRAVEL (SW). 10YR 6/5, slightly moist, weak consolidation, trace cobble to 4 inches.		
50				SW	WELL-GRADED SAND WITH SILT, CLAY, AND GRAVEL. 10YR 6/5, slightly moist, weak consolidation, trace cobble to 3.5 inches.		
				SW	Same as above. 10YR 5/5.		
55				SW	Same as above. 10YR 5/6.		
				SW	Same as above.		
				SW	WELL-GRADED SAND WITH SILT, CLAY, AND GRAVEL (SW). 10YR 5/5, dry to slightly moist, weak consolidation, gravel to 3 inches, no cobble.		
60				GW	WELL-GRADED GRAVEL WITH SAND (GW). 10YR 6/5, moist.		
				GW	Same as above. 10YR 7/5.		
65				GW	Same as above. Cobble layer.		
				SW	WELL-GRADED SAND WITH SILT, CLAY, AND GRAVEL (SW). 10YR 7/5, dry to slightly moist, very weak consolidation, trace cobble to 4 inches.		
				SW	WELL-GRADED SAND WITH SILT, CLAY, AND GRAVEL (SW). 10YR 5/5, moist, weak consolidation, cobble to 4 inches.		
70				GW	WELL-GRADED GRAVEL WITH SAND (GW). 10YR 7/5, slightly moist, unconsolidated, few cobble to 6 inches.		

PROJECT NUMBER: 354946. FI.02	BORING NUMBER: H12SU01 SHEET 3 OF 3

SOIL BORING LOG

PROJECT: Anaconda/Yerington | LOCATION : W 119 11 43.115 N 38 59 29.522

ELEVATION: ft () | DRILLING CONTRACTOR: Boart Long Year

DRILLING EQUIPMENT: SR 114 | DRILLING EQUIPMENT: 8-inch casing, 7-inch core barrel

WATER LEVELS: Not Encountered | START: | END: | LOGGER: S. Duffy

DEPTH (ft bgs)	INTERVAL (ft)	RECOVERY (%)	TYPE/NUMBER	USCS CODE	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	PID (ppm)	COMMENTS: OBSERVATIONS (E.G., DEBRIS, SHEEN, STAINING), SAMPLING AND TESTING NOTES, DRILLING OPERATIONS (e.g., REFUSAL, DRILL RATE)
				SW	WELL-GRADED SAND WITH SILT, CLAY, AND GRAVEL (SW). 10YR 6/5, slightly moist, weak consolidation, trace cobble to 4 inches.		
				SW	Same as above. 10YR 8/2 and 10YR 5/5.		
75				SW	Same as above. 10YR 8/2 and 10YR 5/6.		
					Bottom of hole at 77 ft below ground surface		Abandoned hole by backfilling with cuttings and Redimix concrete.
80							
85							
90							
95							
100							
105							

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:
354946. FI.02	H12SU02 SHEET 1 OF 3

SOIL BORING LOG

PROJECT: Anaconda/Yerington
LOCATION : W 119 11 44.968 N 38 59 24.461
ELEVATION: ft ()
DRILLING CONTRACTOR: Boart Long Year
DRILLING EQUIPMENT: SR 114
DRILLING EQUIPMENT: 8-inch casing, 7-inch core barrel
WATER LEVELS: Not Encountered
START:
END:
LOGGER:

DEPTH (ft bgs)	INTERVAL (ft)	RECOVERY (%)	TYPE/NUMBER	USCS CODE	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	PID (ppm)	COMMENTS: OBSERVATIONS (E.G., DEBRIS, SHEEN, STAINING), SAMPLING AND TESTING NOTES, DRILLING OPERATIONS (e.g., REFUSAL, DRILL RATE)
				SW	WELL-GRADED SAND WITH SILT AND SAND (SW). 10YR 8/4, dry, unconsolidated, few cobble to 5 inches.		
				GW	WELL-GRADED GRAVEL (GW). 10YR 8/3, dry, unconsolidated, some (40%) cobble to 8 inches.		
				GW	Top 1 foot: Same as above. Bottom foot: WELL-GRADED SAND WITH SILT AND GRAVEL. 10YR 7/4, dry, unconsolidated, gravel to 3 inches.		
5				GW	WELL-GRADED GRAVEL WITH SAND. 10YR 7/5, dry with moisture, sand content increasing at bottom, unconsolidated, cobble to 7 inches.		
					WELL-GRADED COBBLE WITH GRAVEL. 10YR 8/3, dry, trace sand, cobble to 12 inches.		
10				GP	POORLY GRADED GRAVEL WITH SAND AND SILT. 10YR 7/4, gravel and cobble (4 inches) at top transitioning to sand, silt, and gravel at bottom.		
				GW	WELL-GRADED GRAVEL WITH SILT AND SAND (GW). 10YR 6/5, dry to slightly moist, unconsolidated, few cobble to 4 inches.		
15				SW	WELL-GRADED SAND WITH SILT AND GRAVEL (SW). 10YR 6/5, slightly moist, unconsolidated, few cobbles to 6 inches.		
				SW	WELL-GRADED SAND WITH SILT, CLAY, AND GRAVEL (SW). 10YR 5/5, dry to slightly moist, very weak consolidation, trace cobble to 4 inches.		
				SW	WELL-GRADED SAND WITH SILT AND GRAVEL (SW). 10YR 7/3, dry, unconsolidated, gravel to 3 inches.		
20				SW	Top 1/2: Same as above. Then, a layer of large cobbles to 8 inches. Bottom: WELL-GRADED SAND WITH GRAVEL (SW). 10YR 6/4, slightly moist, unconsolidated, trace cobble.		
				SW	Top 1/2: Same as above. Bottom: WELL-GRADED SAND WITH SILT, CLAY, AND GRAVEL (SW). 10YR 5/5, slightly moist, weak consolidation.		
				SW	WELL-GRADED SAND WITH SILT AND GRAVEL (SW). 10YR 8/2, dry, unconsolidated, few cobble to 8 inches.		
25				SW	WELL-GRADED SAND WITH SILT, CLAY, AND GRAVEL (SW). 10YR 6/5, dry to slightly moist, very weak consolidation, few cobble to 4.5 inches.		
				SW	Same as above. Cobble layer at 27 feet bgs.		
				SW	WELL-GRADED SAND WITH SILT AND SAND (SW). Dry, unconsolidated, few cobbles to 5 inches.		
30				SW	WELL-GRADED SAND WITH SILT AND GRAVEL (SW). 10YR 7/4, dry, unconsolidated, trace cobble to 4 inches.		
				SW	WELL-GRADED SAND WITH SILT, CLAY, AND GRAVEL (SW). 2.5Y 7/3, dry, unconsolidated, no cobble, gravel to 2 inches.		
35				SW	WELL-GRADED SAND WITH SILT AND GRAVEL (SW). 10YR 6/5, moist, very weak consolidation, trace cobble to 4 inches.		

CH2MHILL

PROJECT NUMBER: **354946. FI.02**

BORING NUMBER: **H12SU02**

SOIL BORING LOG

PROJECT: Anaconda/Yerington

LOCATION : W 119 11 44.968 N 38 59 24.461

ELEVATION: ft ()

DRILLING CONTRACTOR: Boart Long Year

DRILLING EQUIPMENT: SR 114

DRILLING EQUIPMENT: 8-inch casing, 7-inch core barrel

WATER LEVELS: Not Encountered

START:

END:

LOGGER:

DEPTH (ft bgs)	INTERVAL (ft)	RECOVERY (%)	TYPE/NUMBER	USCS CODE	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	PID (ppm)	COMMENTS: OBSERVATIONS (E.G., DEBRIS, SHEEN, STAINING), SAMPLING AND TESTING NOTES, DRILLING OPERATIONS (e.g., REFUSAL, DRILL RATE)
				SW	Top 1/3: WELL-GRADED SAND WITH GRAVEL (SW). 10YR 6/5, moist, unconsolidated, no cobble. Middle 1/3: WELL-GRADED GRAVEL WITH SAND. 10YR 8/2, dry, unconsolidated. Bottom 1/3: WELL-GRADED SAND WITH SILT, CLAY, AND GRAVEL (SW). 10YR 6/6, moist, very weak consolidation.		
				SW	WELL-GRADED SAND WITH SILT AND GRAVEL (SW). 10YR 7/4, dry, unconsolidated, trace cobble to 4 inches.		
40				SW	Same as above.		
				SW	Same as above.		
				SW	WELL-GRADED SAND WITH SILT, CLAY, AND GRAVEL (SW). 10YR 5/5, moist, weak consolidation, trace cobble to 4 inches.		
45				SW	Same as above. 10YR 7/5, cobble to 8 inches.		
				SW	Same as above. 10YR 7/4, dry to slightly moist, very weak consolidation, few cobble to 8 inches.		
				SW	WELL-GRADED SAND WITH SILT, CLAY, AND GRAVEL (SW). 10YR 6/4, slightly moist, unconsolidated, trace cobbles to 4.5 inches.		
50				SW	Same as above.		
				SW	Same as above. Few cobbles to 6 inches.		
55				SW	Same as above. 10YR 5/5, moist, weak consolidation, trace cobble to 3.5 inches.		
				SW	Same as above. 10YR 6/5, dry to slightly moist.		
				SW	Top foot: WELL GRADED SAND WITH SILT AND GRAVEL (SW). 10YR 6/4, dry, unconsolidated, trace cobble to 4 inches. Bottom foot: WELL-GRADED SAND WITH CLAY, SILT, AND GRAVEL (SW). 10YR 6/5, slightly moist, very weak consolidation, trace cobbles to 4 inches.		
60				SW	Same as above.		
				SW	Same as above.		
65				SW	WELL-GRADED SAND WITH SILT AND GRAVEL (SW). 10YR 6/4, moist, unconsolidated, trace cobble to 4.5 inches.		
				SW	WELL-GRADED SAND WITH SILT AND GRAVEL (SW). 10YR 8/3, slightly moist, unconsolidated, trace cobble to 5 inches.		
				SW	Same as above.		
				SW	Top 4 inch layer: WELL-GRADED SAND WITH SILT, CLAY, AND GRAVEL (SW). 10YR 5/5, moist, unconsolidated. Middle 4 inch layer: WELL-GRADED SAND WITH GRAVEL		
70							

PROJECT NUMBER: 354946. FI.02	BORING NUMBER: H12SU02 SHEET 3 OF 3

SOIL BORING LOG

PROJECT: Anaconda/Yerington LOCATION : W 119 11 44.968 N 38 59 24.461

ELEVATION: ft () DRILLING CONTRACTOR: Boart Long Year

DRILLING EQUIPMENT: SR 114 DRILLING EQUIPMENT: 8-inch casing, 7-inch core barrel

WATER LEVELS: Not Encountered START: END: LOGGER:

DEPTH (ft bgs)	INTERVAL (ft)	RECOVERY (%)	TYPE\NUMBER	USCS CODE	SOIL DESCRIPTION SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	PID (ppm)	COMMENTS OBSERVATIONS (E.G., DEBRIS, SHEEN, STAINING), SAMPLING AND TESTING NOTES, DRILLING OPERATIONS (e.g., REFUSAL, DRILL RATE)
				SW	(SW). 2.5YR 4/3, dry, unconsolidated. Bottom 4 inch layer: WELL-GRADED GRAVEL WITH SAND. 10YR 5/5, dry, unconsolidated, same (35%) cobble.		
				SW	WELL-GRADED SAND WITH SILT, CLAY, AND GRAVEL (SW). 10YR 6/5, moist, very weak consolidation, trace cobble to 4 inches. Same as above. Dry to slightly moist, few cobble to 5 inches.		
75				SW	Same as above.		
				SW	Same as above. 10YR 7/4, more moisture near bottom.		
							Abandoned hole by backfilling with cuttings and Redimix concrete.
80					Bottom of hole at 77 ft below ground surface		
85							
90							
95							
100							
105							

Appendix C
Summary of Drain-down Analytical Results

APPENDIX C
Summary of Drain-Down Analytical Results
Arimetco Heap Leach Pads, Anaconda Yerington Mine

Parameter:		Silica (SiO2)	Aluminum	Antimony	Arsenic	Barium	Beryllium	Boron	Cadmium	Calcium	Chromium	Cobalt	Copper	Iron	Lead	Lithium	Magnesium	Manganese	Mercury
Primary MCL:		--	--	6	10	2,000	4	--	5	--	100	--	1,300	--	15	--	--	--	2
Secondary MCL:		--	50 - 200	--	--	--	--	--	--	--	--	--	1,000	300	--	--	--	50	--
Tap Water PRG:		--	36,000	15	0.0071	2,600	73	7,300	18	--	--	730	1,500	11,000	--	730	--	880	--
Units:		ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
Location	Sample Date	Analytical Results																	
PHASE 1 POND																			
H12DD01	9/13/2007	230,000	**19,000,000**	1,600 U	400 U	200 U	**1,200**	2,500	**340**	600,000	**1,300**	**45,000**	**5,700,000**	**650,000**	1,600 U	**13,000**	17,000,000	**460,000**	**29**
PHASE I/II PLS POND																			
H12DD02	9/13/2007	250,000	**27,000,000**	1,600 U	**130 J**	200 U	**1,500**	1,800	**400**	450,000	**2,100**	**66,000**	**4,600,000**	**460,000**	1,600 U	**15,000**	23,000,000	**700,000**	**8.7**
PHASE III 4X HEAP LEACH PAD - LOW POINT																			
H3XDD01	9/12/2007	120,000	**11,000,000**	**160 J**	**110 J**	200 U	**640**	1,100	**180**	480,000	**460**	**29,000**	**1,700,000**	**210,000**	1,600 U	**7,500**	9,600,000	**280,000**	**8.3**
PHASE III BATHTUB POND																			
H3SDD01	9/13/2007	190,000	**23,000,000**	1,600 U	400 U	200 U	**1,300**	1,800	**360**	490,000	**1,900**	**47,000**	**4,300,000**	**1,100,000**	1,600 U	**14,000**	21,000,000	**500,000**	**4.7**
PHASE IV SLOT HEAP LEACH PAD																			
H4SDD01	9/13/2007	220,000	**27,000,000**	1,600 U	400 U	200 U	**1,500**	1,900	**420**	420,000	**1,900**	**70,000**	**3,500,000**	**420,000**	1,600 U	**17,000**	23,000,000	**740,000**	**6.7**
PHASE IV SLOT III PLS POND																			
H4SDD02	9/13/2007	160,000	**15,000,000**	1,600 U	400 U	200 U	**890**	1,400	**250**	600,000	**1,600**	**41,000**	**2,000,000**	**470,000**	1,600 U	**11,000**	13,000,000	**410,000**	**10**
H4SDD02 (FD)	9/13/2007	160,000	**15,000,000**	1,600 U	400 U	200 U	**890**	1,400	**250**	600,000	**1,600**	**41,000**	**2,000,000**	**470,000**	1,600 U	**11,000**	13,000,000	**410,000**	**11**
PHASE IV VLT HEAP LEACH PAD																			
H4VDD02	9/12/2007	100,000	**9,000,000**	1,600 U	400 U	200 U	**550**	1,500	**170**	480,000	**940**	**28,000**	**2,200,000**	**250,000**	1,600 U	**6,900**	8,600,000	**270,000**	**14**
PHASE IV VLT PLS POND																			
H4VDD01	9/12/2007	140,000	**17,000,000**	**200**	**250**	200 U	**960**	1,700	**290**	600,000	**1,400**	**49,000**	**2,900,000**	**650,000**	1,600 U	**12,000**	15,000,000	**460,000**	**7.9**
H4VDD01 (FD)	9/12/2007	140,000	**17,000,000**	1,600 U	**280**	200 U	**970**	1,800	**300**	600,000	**1,500**	**50,000**	**2,900,000**	**640,000**	1,600 U	**12,000**	15,000,000	**470,000**	**7.6**

Notes:

Bolded values exceed Primary or Secondary Federal MCL or Tap Water PRG
ug/L - micrograms per Liter
J - Estimated result
U - Not detected at reporting limit
FD - Field Duplicate
MCL - Federal Maximum Contaminant Level
PRG - Preliminary Remediation Goal (EPA, 2004)
-- - no PRG available
-- - no MCL available

APPENDIX C
Summary of Drain-Down Analytical Results
Arimetco Heap Leach Pads, Anaconda Yerington Mine

Location	Sample Date	Molybdenum	Nickel	Potassium	Selenium	Silver	Sodium	Strontium	Thallium	Tin	Titanium	Vanadium	Zinc
Parameter:		Molybdenum	Nickel	Potassium	Selenium	Silver	Sodium	Strontium	Thallium	Tin	Titanium	Vanadium	Zinc
Primary MCL:		--	--	--	50	--	--	--	2	--	--	--	--
Secondary MCL:		--	--	--	--	--	--	--	--	--	--	--	5,000
Tap Water PRG:		180	730	--	180	180	--	22,000	2.4	22,000	150,000	36	11,000
Units:		ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
Location	**Sample Date**	**Analytical Results**											
PHASE 1 POND													
H12DD01	9/13/2007	400 U	**26,000**	120,000	400 U	200 U	1,900,000	15,000	1,600 U	20,000 U	1,000	**230**	**47,000**
PHASE I/II PLS POND													
H12DD02	9/13/2007	400 U	**36,000**	75,000	400 U	200 U	2,200,000	3,700	**660 J**	40,000 U	410	**300**	**63,000**
PHASE III 4X HEAP LEACH PAD - LOW POINT													
H3XDD01	9/12/2007	400 U	**17,000**	93,000	400 U	200 U	1,100,000	4,500	**380**	8,000 U	180	**70 J**	**26,000**
PHASE III BATHTUB POND													
H3SDD01	9/13/2007	400 U	**30,000**	40,000 U	400 U	50 J	2,100,000	140	1,600 U	20,000 U	900	**1,100**	**60,000**
PHASE IV SLOT HEAP LEACH PAD													
H4SDD01	9/13/2007	400 U	**41,000**	86,000	400 U	200 U	2,400,000	2,500	**760 J**	40,000 U	330	**370**	**67,000**
PHASE IV SLOT III PLS POND													
H4SDD02	9/13/2007	400 U	**24,000**	100,000	400 U	200 U	1,500,000	6,800	1,600 U	20,000 U	310	**86 J**	**39,000**
H4SDD02 (FD)	9/13/2007	400 U	**24,000**	99,000	400 U	200 U	1,500,000	6,800	1,600 U	20,000 U	300	**81 J**	**39,000**
PHASE IV VLT HEAP LEACH PAD													
H4VDD02	9/12/2007	400 U	**17,000**	66,000	400 U	200 U	970,000	3,800	1,600 U	8,000 U	300	**65 J**	**26,000**
PHASE IV VLT PLS POND													
H4VDD01	9/12/2007	400 U	**30,000**	140,000	400 U	200 U	1,700,000	7,600	**890**	20,000 U	1,100	**100**	**46,000**
H4VDD01 (FD)	9/12/2007	400 U	**30,000**	140,000	400 U	200 U	1,700,000	7,700	1,600 U	20,000 U	1,100	**100 J**	**46,000**

Notes:

Bolded values exceed Primary or Secondary Federal MCL or Tap Water PRG
ug/L - micrograms per Liter
J - Estimated result
U - Not detected at reporting limit
FD - Field Duplicate
MCL - Federal Maximum Contaminant Level
PRG - Preliminary Remediation Goal (EPA, 2004)
-- - no PRG available
-- - no MCL available

APPENDIX C
Summary of Drain-Down Analytical Results
Arimetco Heap Leach Pads, Anaconda Yerington Mine

Location	Sample Date	Alpha	Beta	Thorium 227	Thorium 228	Thorium 230	Thorium 232	Uranium 234	Uranium 235	Uranium 238	Yield
Parameter:											
Primary MCL:		**15**	**4 millirems per year**	--	--	--	--	--	--	--	--
Secondary MCL:		--	--	--	--	--	--	--	--	--	--
Tap Water PRG:		--	--	**1.00E+00**	**4.45E-01**	**5.23E-01**	**4.71E-01**	**6.74E-01**	**6.84E-01**	**7.44E-01**	--
Units:		**pCi/L ± unc**	**pCi/L ± unc**	**pCi/L ± unc**	**pCi/L ± unc**	**pCi/L ± unc**	**pCi/L ± unc**	**pCi/L ± unc**	**pCi/L ± unc**	**pCi/L ± unc**	**%**
Location	**Sample Date**									**Analytical Results**	
PHASE 1 POND											
H12DD01	9/13/2007	**16300 (3620)**	4460 (2110)	-11 U (243)	**641 (288)**	**196 (121)**	35.6 U (121)	**6860 (154)**	**500 (75)**	**5280 (142)**	86.2
PHASE I/II PLS POND											
H12DD02	9/13/2007	**8690 (4730)**	6280 (2120)	11.1 U (49.2)	54.2 U (58.4)	**72.3 (24.6)**	**46.9 (24.5)**	**8390 (32)**	**377 (16.9)**	**7010 (32)**	99.8
PHASE III 4X HEAP LEACH PAD - LOW POINT											
H3XDD01	9/12/2007	**6190 (3040)**	3200 (1940)	20.9 U (312)	175 U (298)	73.5 U (103)	56.4 U (103)	**5660 (159)**	**217 (72.3)**	**4440 (105)**	99.3
PHASE III BATHTUB POND											
H3SDD01	9/13/2007	**7510 (4430)**	7290 (2040)	21.8 U (52.4)	**79.6 (59.2)**	**182 (10.7)**	**54.6 (21.7)**	**9950 (41.9)**	**336 (33.4)**	**7990 (34.6)**	98.4
PHASE IV SLOT HEAP LEACH PAD											
H4SDD01	9/13/2007	**9850 (4420)**	5130 (2080)	-15 U (64)	53.6 U (61.3)	**57.1 (21.3)**	8.14 U (21.3)	**11000 (11.2)**	**433 (23.3)**	**8870 (22.8)**	96.3
PHASE IV SLOT III PLS POND											
H4SDD02	9/13/2007	**8460 (3350)**	5480 (2020)	37 U (53.8)	**155 (57.4)**	**83.1 (19.3)**	**36.8 (16.4)**	**6120 (22.9)**	**291 (23.4)**	**5360 (19.5)**	84.4
H4SDD02 (FD)	9/13/2007	**8640 (3040)**	5270 (1940)	-9.28 U (61.3)	**140 (71.4)**	**67.7 (11.3)**	**21.3 (19.5)**	**6020 (12.5)**	**400 (15)**	**4870 (25.5)**	93.3
PHASE IV VLT HEAP LEACH PAD											
H4VDD02	9/12/2007	**4270 (2130)**	1690 U (1860)	-2.27 U (50.3)	**132 (57.4)**	**51.5 (25)**	17.1 U (19.1)	**3210 (21.4)**	**109 (33.6)**	**2470 (12.4)**	93.4
PHASE IV VLT PLS POND											
H4VDD01	9/12/2007	**6670 (3010)**	6680 (1910)	13.3 U (55.8)	**268 (65)**	**156 (22)**	**42 (18.7)**	**6590 (27.5)**	**289 (25.2)**	**5420 (24.7)**	98.8
H4VDD01 (FD)	9/12/2007	**8980 (3700)**	4890 (2020)	16.7 U (62.4)	**274 (51.6)**	**114 (25.1)**	**75.7 (20.7)**	**6230 (28.2)**	**368 (33.8)**	**5330 (25.3)**	82.5

Notes:

Bolded values exceed Tap Water PRG or Primary MCL
All results listed as result (MDC)
MDC - Minimum Detectable Concentration
pCi/L - picocuries per Liter
ND - Not detected at MDC
FD - Field Duplicate
unc - radiological measurement uncertainty
MCL - Federal Maximum Contaminant Level
PRG - Preliminary Remediation Goal (EPA, 2004)
-- - no MCL or PRG available

APPENDIX C
Summary of Drain-Down Analytical Results
Arimetco Heap Leach Pads, Anaconda Yerington Mine

Parameter:		pH	Bicarbonate Alkalinity	Carbonate Alkalinity	Hydroxide Alkalinity	Total Alkalinity	Chloride	Fluoride	Nitrate + Nitrite as N	Phosphorus, Total	Silica (SiO2)	Specific Conductance	Sulfate	TPH, as diesel	TPH, as kerosene
Nevada Cleanup Standard:		--	--	--	--	--	--	--	--	--	--	--	--	1,000	1,000
Primary MCL:		--	--	--	--	--	--	--	--	--	--	--	--	--	--
Secondary MCL:		6.5 - 8.5	--	--	--	--	250	2	--	--	--	--	250	--	--
Tap Water PRG:		--	--	--	--	--	--	2.2	--	--	--	--	--	--	--
Units:		pH units	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	ug/L	umhos/cm	mg/L	ug/L	ug/L
Location	**Sample Date**	**Analytical Results**													
PHASE 1 POND															
H12DD01	9/13/2007	2.2 J	20 U	20 U	20 U	20 U	220	**2,600**	16	160	230,000	45,000	**200,000**	**2,000**	**2,100**
PHASE I/II PLS POND															
H12DD02	9/13/2007	1.9 J	20 U	20 U	20 U	20 U	170	**2,100**	21	360	250,000	45,000	**170,000**	**1,700 J**	1,700 UJ
PHASE III 4X HEAP LEACH PAD - LOW POINT															
H3XDD01	9/12/2007	2.43	20 U	20 U	20 U	20 U	115	**1,600**	8.2	110	120,000	44,000	**140,000**	750	1,580 U
PHASE III BATHTUB POND															
H3SDD01	9/13/2007	2 J	20 U	20 U	20 U	20 U	**330**	**3,300**	7	320	190,000	39,000	**280,000**	**1,600**	3,200 U
PHASE IV SLOT HEAP LEACH PAD															
H4SDD01	9/13/2007	2 J	20 U	20 U	20 U	20 U	**360**	**3,100**	18	270	220,000	42,000	**250,000**	**2,100**	4,400 U
PHASE IV SLOT III PLS POND															
H4SDD02	9/13/2007	2.4 J	20 U	20 U	20 U	20 U	190	**2,100**	14	170	160,000	45,000	**170,000**	**1,300**	2,800 U
H4SDD02 (FD)	9/13/2007	2.4 J	20 U	20 U	20 U	20 U	**310**	**3,900**	14	170	160,000	31,000	**340,000**	**1,600**	**1,700**
PHASE IV VLT HEAP LEACH PAD															
H4VDD02	9/12/2007	2.8 J	20 U	20 U	20 U	20 U	210	**1,200**	9.4	210	100,000	38,000	**93,000**	**1,500**	**1,500**
PHASE IV VLT PLS POND															
H4VDD01	9/12/2007	2.6 J	20 U	20 U	20 U	20 U	190	**2,400**	16	380	140,000	44,000	**180,000**	**1,300**	2,600 U
H4VDD01 (FD)	9/12/2007	2.5 J	20 U	20 U	20 U	20 U	190	**2,400**	16	400	140,000	44,000	**190,000**	**1,200**	2,600 U

Notes:

Bolded values exceed or are outside the range of the Nevada Cleanup Standard, Primary or Secondary Federal MCL, or Tap Water PRG
ug/L - micrograms per Liter
J - Estimated result
U - Not detected at reporting limit
TPH-Total Petroleum Hydrocarbons
FD - Field Duplicate
MCL - Federal Maximum Contaminant Level
PRG - Preliminary Remediation Goal (EPA, 2004)
-- - no Nevada Cleanup Standard, MCL,or PRG available

Appendix D
Summary of Heap Leach Pad Material Analytical Results

Location	Sample Date	Depth [1]	Acid Generation Potential (calc on Sulfur total)	Acid Neutralization Potential (calc)	Acid-Base Potential (calc on Sulfur total)	Net Acid Generation Procedure	Neutralization Potential as CaCO3	Sulfur Organic Residual	Sulfur Pyritic Sulfide	Sulfur Sulfate	Sulfur Total	Total Sulfur minus Sulfate
		Units:	t CaCO3/Kt	t CaCO3/Kt	t CaCO3/Kt	Kg H2SO4/t	%	%	%	%	%	%
			Analytical Results									
PHASE I/II HEAP LEACH PAD: Soil Boring Composite												
H12SU01	10/11/2007	0-50	12	0	-12	---	0.1 U	0.02	0.01	0.36	0.39	0.03
H12SU01	10/11/2007	50-77	19	0	-19	---	0.1 U	0.04	0.01	0.57	0.62	0.05
H12SU02	10/10/2007	0-50	16	0	-16	---	0.1 U	0.02	0.01 U	0.49	0.5	0.01
H12SU02	10/10/2007	50-77	16	4	-12	---	0.4	0.02	0.01	0.48	0.51	0.03
PHASE III 4X HEAP LEACH PAD: Soil Boring Composite												
H3XSU01	10/16/2007	0-50	19	7	-12	---	0.7	0.03	0.01	0.57	0.61	0.04
H3XSU01	10/16/2007	50-67	24	0	-24	---	0.1 U	0.02	0.01 U	0.74	0.76	0.02
H3XSU02	10/17/2007	50-67	18	12	-6	---	1.2	0.03	0.01 U	0.53	0.56	0.03
H3XSU03	10/17/2007	0-50	19	6	-13	---	0.6	0.01 U	0.01	0.6	0.61	0.01
PHASE III SOUTH HEAP LEACH PAD: Soil Boring Composite												
H3SSU01	9/25/2007	0-50	23	0	-23	4	0.1 U	0.02	0.01 U	0.7	0.72	0.02
H3SSU01	9/25/2007	20-97	23	0	-23	5	0.1 U	0.03	0.01	0.69	0.73	0.04
H3SSU02	10/7/2007	100-112	23	0	-23	---	0.1 U	0.02	0.01	0.72	0.75	0.03
H3SSU02	10/7/2007	50-100	21	0	-21	---	0.1 U	0.02	0.01 U	0.64	0.66	0.02
H3SSU03	10/6/2007	0-50	28	0	-28	---	0.1 U	0.04	0.01	0.84	0.89	0.05
H3SSU03	10/6/2007	100-117	20	0	-20	---	0.1 U	0.05	0.02	0.56	0.63	0.07
H3SSU04	9/26/2007	100-116.5	22	0	-22	5	0.1 U	0.05	0.01	0.63	0.69	0.06
H3SSU04	9/26/2007	50-100	18	0	-18	5	0.1 U	0.05	0.01 U	0.53	0.58	0.05
PHASE IV SLOT HEAP LEACH PAD: Soil Boring Composite												
H4SSU01	10/8/2007	0-50	23	0	-23	---	0.1 U	0.01	0.01	0.72	0.74	0.02
H4SSU01	10/8/2007	50-97	37	3	-34	---	0.3	0.01	0.01	1.17	1.19	0.02
H4SSU03	10/9/2007	50-77	20	0	-20	---	0.1 U	0.02	0.01 U	0.63	0.65	0.02
PHASE IV VLT HEAP LEACH PAD: Soil Boring Composite												
H4VSU01	9/27/2007	0-50	23	0	-23	6	0.1 U	0.03	0.01	0.71	0.75	0.04
H4VSU01	9/27/2007	50-107	33	0	-33	4	0.1 U	0.03	0.01 U	1.02	1.05	0.03
H4VSU02	10/2/2007	0-50	18	3	-15	---	0.3	0.03	0.01	0.55	0.59	0.04
H4VSU02	10/5/2007	50-107	27	26	-1	---	2.6	0.01	0.01	0.85	0.87	0.02
H4VSU03	10/6/2007	0-50	24	3	-21	---	0.3	0.05	0.02	0.7	0.77	0.07
H4VSU03	10/6/2007	50-87	25	17	-8	---	1.7	0.01 U	0.02	0.78	0.8	0.02

Notes:

[1] - depth in feet below ground surface
t CaCO3/Kt - Calcium carbonate / kilogram / ton
% - percent
U - Not detected at reporting limit
calc - calculation

DRAFT

Parameter:		pH	Alkalinity, Bicarbonate (as CACO3)	Alkalinity, Carbonate (as CACO3)	Alkalinity, Hydroxide (as CACO3)	Alkalinity, Total (as CACO3)	Chloride	Moisture	Nitrogen, Kjeldahl Total	Phosphorus, Total (as P)	Sodium Absorption Ratio	Total Nitrogen	Total Oxidizable Nitrogen	Boron	Calcium	Magnesium	Potassium	Sodium	TPH, as diesel
Industrial PRG:		--	--	--	--	--	--	--	--	--	--	--	--	200,000	--	--	--	--	--
Residential PRG:		--	--	--	--	--	--	--	--	--	--	--	--	16,000	--	--	--	--	--
NV Cleanup Standard		--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	100
Units:		pH units	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	%	mg/Kg	mg/Kg	NA	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg
Location	**Sample Date**	**Analytical Results**																	
PHASE I/II HEAP LEACH PAD: Soil Boring Composite																			
H12SU01	10/11/2007	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	6.3
H12SU01 (FD)	10/11/2007	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	6.8
H12SU02	10/11/2007	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	10 U
H12SU02 (FD)	10/10/2007	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
PHASE I/II HEAP LEACH PAD: Surface Discrete																			
H12SS01	10/23/2007	3.58	0.88 U	0.88 U	0.88 U	0.88 U	43	3.6	250	849	0.041	250	3.6	18.2	3,460	5,630	592	173	---
H12SS01 (FD)	10/23/2007	3.64	0.88 U	0.88 U	0.88 U	0.88 U	38 J	3.7	180	730	0.046	180	2.3	18	3,970	5,500	648	202	---
H12SS02	10/23/2007	3.46	0.89 U	0.89 U	0.89 U	0.89 U	57	4.9	92	529	0.075	94	1.9	15.5	5,850	6,310	457	348	10 U
H12SS02 (FD)	10/23/2007	3.84	0.89 U	0.89 U	0.89 U	0.89 U	80 J	4.3	220	534	0.083	220	1.6	15.9	5,870	6,200	517	387	---
H12SS03	10/23/2007	3.41	0.88 U	0.88 U	0.88 U	0.88 U	13 J	2.9	110	519	0.032	110	0.74 J	10.1	8,920	4,400	908	146	---
H12SS03 (FD)	10/23/2007	3.8	0.87 U	0.87 U	0.87 U	0.87 U	13 J	2.4	110	300	0.021	110	0.66 U	8.8	7,270	4,080	543	93.1 J	---
PHASE III 4X HEAP LEACH PAD: Soil Boring Composite																			
H3XSU01	10/16/2007	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
H3XSU02	10/17/2007	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
H3XSU02 (FD)	10/17/2007	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
H3XSU03	10/17/2007	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
PHASE III 4X HEAP LEACH PAD: Surface Discrete																			
H3XSS05	10/25/2007	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	11
H3XSS06	10/25/2007	3.28	1.1 U	1.1 U	1.1 U	1.1 U	98 J	22.7	390	719	0.11	400	2	26.9	33,500	10,500	2,550	1,030	---
H3XSS06 (FD)	10/25/2007	3.29	1.1 U	1.1 U	1.1 U	1.1 U	98 J	22.6	420	798	0.1	420	2.4	31.3	57,900	11,700	3,050	1,210	---
H3XSS07	10/25/2007	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	32
H3XSS08	10/25/2007	3.7	0.9 U	0.9 U	0.9 U	0.9 U	15 J	5.2	120	392	0.025	120	0.68 U	12.8	1,590	6,310	1,190	107	---
PHASE III SOUTH HEAP LEACH PAD: Soil Boring Composite																			
H3SSU01	9/25/2007	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	9.1
H3SSU02	10/7/2007	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	5.4 J
PHASE III SOUTH HEAP LEACH PAD: Surface Discrete																			
H3SSS02	10/25/2007	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	2.9 J
H3SSS04	10/25/2007	3.76	0.85 U	0.85 U	0.85 U	0.85 U	21	2 U	120	409	0.089	130	4.9	10.7	3,800	3,220	1,470	322	---
H3SSS04 (FD)	10/25/2007	3.81	0.85 U	0.85 U	0.85 U	0.85 U	14 J	2 U	1,500	416	0.098	1,400	0.64 U	10.7	4,580	3,240	1,460	373	---
H3SSS05	10/24/2007	3.44	0.92 U	0.92 U	0.92 U	0.92 U	18 J	7.8	250	1,370	0.063	250	0.69 U	23.1	2,110	4,520	1,380	242	---
H3SSS05 (FD)	10/24/2007	3.44	0.92 U	0.92 U	0.92 U	0.92 U	18 J	8.1	81	1,320	0.062	81	0.94 J	20.6	2,130	3,820	1,180	215	---
H3SSS06	10/25/2007	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	15
PHASE IV SLOT HEAP LEACH PAD: Soil Boring Composite																			
H4SSU01	10/8/2007	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	96
H4SSU02	10/9/2007	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	10 U
H4SSU03	10/9/2007	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
PHASE IV SLOT HEAP LEACH PAD: Surface Discrete																			
H4SSS01	10/24/2007	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	10 U
H4SSS03	10/23/2007	3.63	0.89 U	0.89 U	0.89 U	0.89 U	17 J	4.9	180	269	0.048	180	0.67 U	9.3	6,470	4,680	508	215	**170**

Parameter:		pH	Alkalinity, Bicarbonate (as CACO3)	Alkalinity, Carbonate (as CACO3)	Alkalinity, Hydroxide (as CACO3)	Alkalinity, Total (as CACO3)	Chloride	Moisture	Nitrogen, Kjeldahl Total	Phosphorus, Total (as P)	Sodium Absorption Ratio	Total Nitrogen	Total Oxidizable Nitrogen	Boron	Calcium	Magnesium	Potassium	Sodium	TPH, as diesel
Industrial PRG:		--	--	--	--	--	--	--	--	--	--	--	--	**200,000**	--	--	--	--	--
Residential PRG:		--	--	--	--	--	--	--	--	--	--	--	--	**16,000**	--	--	--	--	--
NV Cleanup Standard		--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	**100**
Units:		pH units	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	%	mg/Kg	mg/Kg	NA	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg
Location	**Sample Date**	**Analytical Results**																	
PHASE IV SLOT HEAP LEACH PAD: Surface Discrete																			
H4SSS05	10/23/2007	3.51	0.92 U	0.92 U	0.92 U	0.92 U	19 J	7.5	160	441	0.029	150	0.69 U	8.5	3,760	2,300	480	98.7 J	---
H4SSS06	10/24/2007	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	3.7 J
PHASE IV VLT HEAP LEACH PAD: Soil Boring Composite																			
H4VSU01	9/27/2007	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	10 U
H4VSU02	10/5/2007	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	5.8
PHASE IV VLT HEAP LEACH PAD: Surface Discrete																			
H4VSS02	10/26/2007	3.57	0.87 U	0.87 U	0.87 U	0.87 U	34 J	2.8	130	848	0.071	130	0.66 U	13	5,900	7,190	1,600	349	---
H4VSS04	10/26/2007	3.25	0.95 U	0.95 U	0.95 U	0.95 U	120	10.7	110	900	0.089	120	2.8	18.6	14,200	7,180	3,490	578	---
H4VSS04 (FD)	10/26/2007	3.26	0.98 U	0.98 U	0.98 U	0.98 U	120	12.9	130	1,260	0.11	130	2.4	25.4	16,000	6,700	4,990	719	---
H4VSS08	10/26/2007	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	10 U
H4VSS09	10/26/2007	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	19
H4VSS10	10/26/2007	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	30
VLT SOIL: Surface Discrete																			
CAPSS01	10/29/2007	5.9	1,200	0.85 U	0.85 U	1,200	37	2 U	120	374	0.05	120	2.8	11	11,000	4,400	1,030	252	---
CAPSS01 (FD)	10/29/2007	**7.89**	1,700	0.85 U	0.85 U	1,700	37	2 U	130	559	0.038	130	2	14	13,900	4,860	1,060	207	---
CAPSS02	10/26/2007	4.04	0.85 U	0.85 U	0.85 U	0.85 U	15 J	2 U	110	430	0.015	110	2.2	26	5,420	5,830	1,420	67.4 J	---
CAPSS03	10/29/2007	2.7	0.9 U	0.9 U	0.9 U	0.9 U	32 J	5.3	300	305	0.41	300	0.68 U	28.3	2,180	674	1,690	913	---
CAPSS03 (FD)	10/29/2007	2.66	0.89 U	0.89 U	0.89 U	0.89 U	24	5	270	303	0.27	270	0.67 U	28.3	2,630	1,070	1,590	674	---

Notes:

[1] - depth in feet below ground surface
mg/Kg - milligrams per kilogram
% - percent
J - Estimated result
U - Not detected at reporting limit
P - Phosphorous
PRG - Preliminary Remediation Goal (EPA, 2004)
-- - no PRG available
FD1 - Sample was not originally designated as a field duplicate, but laboratory analyzed more analytes than requested on chain of custody

 DRAFT

		TPH, as kerosene	TPH, as motor oil
Parameter:			
Industrial PRG:		--	--
Residential PRG:		--	--
NV Cleanup Standard		100	100
Units:		mg/Kg	mg/Kg
Location	**Sample Date**	**Analytical Results**	
PHASE I/II HEAP LEACH PAD: Soil Boring Composite			
H12SU01	10/11/2007	10 U	---
H12SU01 (FD)	10/11/2007	10 U	---
H12SU02	10/11/2007	5 U	---
H12SU02 (FD)	10/10/2007	10 U	40 U
PHASE I/II HEAP LEACH PAD: Surface Discrete			
H12SS01	10/23/2007	---	---
H12SS01 (FD)	10/23/2007	---	---
H12SS02	10/23/2007	10 U	40 U
H12SS02 (FD)	10/23/2007	---	---
H12SS03	10/23/2007	---	---
H12SS03 (FD)	10/23/2007	---	---
PHASE III 4X HEAP LEACH PAD: Soil Boring Composite			
H3XSU01	10/16/2007	10 U	40 U
H3XSU02	10/17/2007	10 U	19 J
H3XSU02 (FD)	10/17/2007	10 U	16 J
H3XSU03	10/17/2007	10 U	17 J
PHASE III 4X HEAP LEACH PAD: Surface Discrete			
H3XSS05	10/25/2007	16 U	14 J
H3XSS06	10/25/2007	---	---
H3XSS06 (FD)	10/25/2007	---	---
H3XSS07	10/25/2007	52 U	29
H3XSS08	10/25/2007	---	---
PHASE III SOUTH HEAP LEACH PAD: Soil Boring Composite			
H3SSU01	9/25/2007	32 U	---
H3SSU02	10/7/2007	10 U	---
PHASE III SOUTH HEAP LEACH PAD: Surface Discrete			
H3SSS02	10/25/2007	5 U	40 U
H3SSS04	10/25/2007	---	---
H3SSS04 (FD)	10/25/2007	---	---
H3SSS05	10/24/2007	---	---
H3SSS05 (FD)	10/24/2007	---	---
H3SSS06	10/25/2007	22 U	25
PHASE IV SLOT HEAP LEACH PAD: Soil Boring Composite			
H4SSU01	10/8/2007	196 U	---
H4SSU02	10/9/2007	10 U	---
H4SSU03	10/9/2007	10 U	13 J
PHASE IV SLOT HEAP LEACH PAD: Surface Discrete			
H4SSS01	10/24/2007	10 U	40 U
H4SSS03	10/23/2007	280 U	85

Parameter:		TPH, as kerosene	TPH, as motor oil
Industrial PRG:		--	--
Residential PRG:		--	--
NV Cleanup Standard		100	100
Units:		mg/Kg	mg/Kg
Location	**Sample Date**	**Analytical Results**	
PHASE IV SLOT HEAP LEACH PAD: Surface Discrete			
H4SSS05	10/23/2007	---	---
H4SSS06	10/24/2007	12 U	75
PHASE IV VLT HEAP LEACH PAD: Soil Boring Composite			
H4VSU01	9/27/2007	10 U	---
H4VSU02	10/5/2007	10 U	---
PHASE IV VLT HEAP LEACH PAD: Surface Discrete			
H4VSS02	10/26/2007	---	---
H4VSS04	10/26/2007	---	---
H4VSS04 (FD)	10/26/2007	---	---
H4VSS08	10/26/2007	10 U	13 J
H4VSS09	10/26/2007	32 U	13 J
H4VSS10	10/26/2007	34 U	40 U
VLT SOIL: Surface Discrete			
CAPSS01	10/29/2007	---	---
CAPSS01 (FD)	10/29/2007	---	---
CAPSS02	10/26/2007	---	---
CAPSS03	10/29/2007	---	---
CAPSS03 (FD)	10/29/2007	---	---

Notes:

[1] - depth in feet below ground surface
mg/Kg - milligrams per kilogram
% - percent
J - Estimated result
U - Not detected at reporting limit
P - Phosphorous
PRG - Preliminary Remediation Goal (EPA, 2004)
-- - no PRG available
FD1 - Sample was not originally designated as a field duplicate, but laboratory analyzed more analytes than requested on chain of custody

APPENDIX D
Summary of HLP Material Analytical Results
Arimetco Heap Leach Pads, Anaconda Yerington Mine

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Location	Sample Date	Depth [1]	Alpha	Beta	Thorium 227	Thorium 228	Thorium 230	Thorium 232	Uranium 234	Uranium 235	Uranium 238	Yield
		Parameter:	**Alpha**	**Beta**	**Thorium 227**	**Thorium 228**	**Thorium 230**	**Thorium 232**	**Uranium 234**	**Uranium 235**	**Uranium 238**	**Yield**
		Residential PRG:	--	--	113	24.2	3.49	3.1	4.01	0.205	4.46	--
		Units:	pCi/g ± unc	pCi/g ± unc	pCi/g ± unc	pCi/g ± unc	pCi/g ± unc	pCi/g ± unc	pCi/g ± unc	pCi/g ± unc	pCi/g ± unc	%
			Analytical Results									
PHASE I/II HEAP LEACH PAD: Soil Boring Composite												
H12SU01	10/11/2007	0-50	23.6 ± 15.5	29 ± 5.87	ND ± 0.0943	1.28 ± 0.247	1.38 ± 0.253	0.884 ± 0.189	0.996 ± 0.221	0.0642 ± 0.0592	0.874 ± 0.204	92.9
H12SU02	10/10/2007	50-77	18 ± 14	28.9 ± 5.8	0.15 ± 0.106	1.54 ± 0.273	1.46 ± 0.256	1.31 ± 0.236	0.849 ± 0.201	0.0816 ± 0.0626	0.727 ± 0.183	93.9
PHASE I/II HEAP LEACH PAD: Surface Discrete												
H12SS01	10/23/2007	0.25-0.75	42.9 ± 19.4	32.1 ± 6.18	---	---	---	---	---	---	---	---
H12SS02	10/23/2007	0.25-0.75	33.9 ± 16.9	31 ± 5.89	---	---	---	---	---	---	---	---
H12SS03	10/23/2007	0.25-0.75	60 ± 22.2	29.9 ± 5.96	---	---	---	---	---	---	---	---
PHASE III 4X HEAP LEACH PAD: Soil Boring Composite												
H3XSU01	10/16/2007	50-67	21.1 ± 15.3	30.8 ± 6.03	0.171 ± 0.125	1.41 ± 0.267	0.986 ± 0.206	1 ± 0.208	1.28 ± 0.256	0.0471 ± 0.047	1.24 ± 0.249	98
H3XSU02	10/16/2007	0-50	32.1 ± 16.8	26.5 ± 5.58	ND ± 0.131	1.22 ± 0.267	1.8 ± 0.331	0.809 ± 0.197	1.68 ± 0.307	0.0623 ± 0.0543	1.21 ± 0.244	85.8
H3XSU03	10/17/2007	50-67	31.1 ± 16.9	26.1 ± 5.43	0.174 ± 0.125	1.9 ± 0.341	**3.67 ± 0.546**	1.45 ± 0.275	2.5 ± 0.399	0.154 ± 0.0755	2.04 ± 0.34	85.4
PHASE III 4X HEAP LEACH PAD: Surface Discrete												
H3XSS06	10/25/2007	0.25-0.75	73.7 ± 24.5	60 ± 8.69	---	---	---	---	---	---	---	---
H3XSS08	10/25/2007	0.25-0.75	35.8 ± 17.5	33.5 ± 6.24	---	---	---	---	---	---	---	---
PHASE III SOUTH HEAP LEACH PAD: Soil Boring Composite												
H3SSU01	9/25/2007	20-97	35.4 ± 18	25.7 ± 5.52	0.191 ± 0.145	1.35 ± 0.275	1.57 ± 0.292	1.03 ± 0.221	1.63 ± 0.313	ND ± 0.0531	1.46 ± 0.289	92.4
H3SSU01	10/7/2007	0-50	24.3 ± 15.4	34.2 ± 6.37	ND ± 0.113	1.41 ± 0.271	1.6 ± 0.287	1.04 ± 0.215	1.28 ± 0.262	0.0923 ± 0.0664	1.33 ± 0.27	88.5
H3SSU03	10/6/2007	50-100	34 ± 17	27 ± 5.66	0.136 ± 0.102	1.04 ± 0.216	1.46 ± 0.262	0.858 ± 0.184	1.27 ± 0.242	0.0625 ± 0.0503	1.23 ± 0.235	90.7
H3SSU04	9/26/2007	0-50	26.6 ± 16.1	27.7 ± 5.74	ND ± 0.117	1.24 ± 0.256	1.94 ± 0.335	1.03 ± 0.219	1.5 ± 0.311	0.134 ± 0.0911	1.38 ± 0.294	95.3
PHASE III SOUTH HEAP LEACH PAD: Surface Discrete												
H3SSS04	10/25/2007	0.25-0.75	22.9 ± 15.8	34 ± 6.38	---	---	---	---	---	---	---	---
H3SSS05	10/24/2007	0.25-0.75	38.3 ± 17.8	29.5 ± 5.81	---	---	---	---	---	---	---	---
PHASE IV SLOT HEAP LEACH PAD: Soil Boring Composite												
H4SSU01	10/8/2007	0-50	33 ± 17.3	30.9 ± 6.06	0.268 ± 0.155	1.68 ± 0.311	3.18 ± 0.483	1.26 ± 0.249	1.81 ± 0.319	0.0876 ± 0.0657	1.68 ± 0.302	97
H4SSU02	10/9/2007	0-50	16.7 ± 14.4	26.5 ± 5.58	0.234 ± 0.144	1.33 ± 0.272	2.68 ± 0.429	0.957 ± 0.211	2 ± 0.351	0.102 ± 0.0683	1.6 ± 0.299	90.4
H4SSU03	10/9/2007	50-77	23.8 ± 15	33.8 ± 6.27	0.354 ± 0.157	1.58 ± 0.283	1.79 ± 0.302	1.4 ± 0.254	1.55 ± 0.274	0.0756 ± 0.0534	1.51 ± 0.269	91.1
H4SSU04	10/9/2007	0-50	19.2 ± 14.3	27.2 ± 5.58	0.162 ± 0.0965	1.72 ± 0.284	1.47 ± 0.25	1.13 ± 0.208	1.37 ± 0.264	ND ± 0.0463	1.32 ± 0.258	93
PHASE IV SLOT HEAP LEACH PAD: Surface Discrete												
H4SSS03	10/23/2007	0.25-0.75	48.8 ± 20.7	29.3 ± 5.98	---	---	---	---	---	---	---	---
H4SSS05	10/23/2007	0.25-0.75	66.9 ± 23.5	38.7 ± 6.79	---	---	---	---	---	---	---	---
PHASE IV VLT HEAP LEACH PAD: Soil Boring Composite												
H4VSU01	9/27/2007	0-50	60.9 ± 22.4	30.8 ± 6.13	0.236 ± 0.141	1.28 ± 0.256	2.25 ± 0.367	0.8 ± 0.183	1.97 ± 0.371	0.132 ± 0.087	1.63 ± 0.324	88.5
H4VSU02	10/5/2007	50-107	13.2 ± 13.3	19 ± 4.91	ND ± 0.144	1.77 ± 0.328	1.82 ± 0.324	1.96 ± 0.341	2.22 ± 0.382	0.0651 ± 0.0567	1.77 ± 0.323	91.5
H4VSU03	10/6/2007	0-50	93.6 ± 29.3	48.3 ± 7.82	ND ± 0.146	1.15 ± 0.253	2.64 ± 0.43	0.953 ± 0.215	1.68 ± 0.308	0.132 ± 0.0752	1.49 ± 0.283	89.1
PHASE IV VLT HEAP LEACH PAD: Surface Discrete												
H4VSS04	10/26/2007	0.25-0.75	50.6 ± 20	33.3 ± 6.15	---	---	---	---	---	---	---	---
VLT SOIL: Surface Discrete												
CAPSS01	10/29/2007	0.25-0.75	25.5 ± 16.5	34.5 ± 6.45	---	---	---	---	---	---	---	---
CAPSS03	10/29/2007	0.25-0.75	40 ± 17.9	29.7 ± 5.75	---	---	---	---	---	---	---	---
CAPSS04	10/29/2007	0.25-0.75	36.3 ± 18.1	27.9 ± 5.79	---	---	---	---	---	---	---	---

Notes:

Bolded values exceed Residential PRG
All results listed as result (MDC)
[1] - depth in feet below ground surface
MDC - Minimum Detectable Concentration
pCI/g - picocuries per gram
ND - Not detected at MDC
unc - radiological measurement uncertainty
PRG - Preliminary Remediation Goal (EPA, 2004)
-- - no PRG available

APPENDIX D
Summary of HLP Material Analytical Results
Arimetco Heap Leach Pads, Anaconda Yerington Mine

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		Parameter:	Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Calcium	Chromium	Cobalt	Copper	Iron	Lead	Magnesium	Manganese	Mercury	Molybdenum	Nickel	Potassium
		Industrial PRG:	**920,000**	**410**	**1.6 (ca) 260 (nc)**	**67,000**	**1,900**	**450**	**--**	**--**	**1,900**	**41,000**	**310,000**	**--**	**--**	**19,000**	**--**	**5,100**	**20,000**	**--**
		Residential PRG:	**76,000**	**31**	**0.39 (ca) 22 (nc)**	**5,400**	**150**	**37**	**--**	**--**	**900**	**3,100**	**23,000**	**--**	**--**	**1,800**	**--**	**390**	**1,600**	**--**
		Units:	**mg/Kg**	**mg/Kg**	**mg/Kg**	**mg/Kg**	**mg/Kg**	**mg/Kg**	**mg/Kg**	**mg/Kg**	**mg/Kg**	**mg/Kg**	**mg/Kg**	**mg/Kg**	**mg/Kg**	**mg/Kg**	**mg/Kg**	**mg/Kg**	**mg/Kg**	**mg/Kg**
Location	**Sample Date**	**Depth ¹**	**Analytical Results**																	
PHASE I/II HEAP LEACH PAD: Soil Boring Composite																				
H12SU01	10/11/2007	0-50	5,340	1.7 J	**9.5 J**	55	0.15 UJ	1.2 J	3,240	5.7	2.8 J	1,080	20,300	3	4,310	43.9	0.13	---	4.2 U	1,120
H12SU01 (FD)	10/11/2007	0-50	5,160	0.85 J	**5.7 J**	62.5	0.12 UJ	1 UJ	2,690	4.8	2.3 J	1,040	19,600	2.4	4,480	41.6	0.15	---	4.2 U	1,260
H12SU02	10/10/2007	0-50	5,920	1.4 J	**8.6 J**	45.5	0.14 UJ	0.75 UJ	3,310	3.9	1.7 J	955	15,700	2.7	5,140	44.2	0.17	---	4.3 U	963 J
H12SU02 (FD)	10/10/2007	50-77	5,970	1 J	**7.7**	50.6	0.15 UJ	0.7 UJ	3,250	4.1	1.5 J	875	14,800	2.8	4,620	40.2	0.2	---	1.2 UJ	1,110 J
PHASE I/II HEAP LEACH PAD: Surface Discrete																				
H12SS01	10/23/2007	0.25-0.75	7,860	1.3 J	**22.6**	68.3	0.36 J	0.52 U	3,720	2.8 J	5.8	2,830 J	19,400	6.1	6,290	71.7	0.18	---	6.5	708
H12SS01 (FD)	10/23/2007	0.25-0.75	11,000	1 J	**26**	81	0.39	1 U	6,700	5	4.7	2,100	**24,000**	5.8	7,500	66	0.12	3.7 J	7.3	830
H12SS02	10/23/2007	0.25-0.75	7,760	1.1 J	**21.4**	74.7	0.35 J	0.53 U	5,430	2.5 J	7.3	1,450 J	14,400	3.9	5,950	78.4	0.17	---	6.3	490 J
H12SS03	10/23/2007	0.25-0.75	5,440	1.5 J	**9.1**	60.6	0.27 J	0.51 U	6,670	3.3 J	3.2 J	1,100 J	8,510	4.2	3,230	28.7	1	---	4.5	803
H12SS04	10/23/2007	0.25-0.75	5,770	0.36 J	**12.5**	73	0.28 J	0.54 U	5,540	2.1 J	2.9 J	1,040 J	20,100	7	3,560	33.8	0.11	---	3.5 J	1,300
PHASE III 4X HEAP LEACH PAD: Soil Boring Composite																				
H3XSU01	10/16/2007	0-50	4,360	0.69 J	**1.7 J**	30.9 J	0.11 UJ	0.49 UJ	2,530	3	3.3 J	1,570	10,100	2 J	4,160	55.5	0.098 J	---	2.8 UJ	925 J
H3XSU02	10/17/2007	50-67	3,910	0.47 J	**3.7**	34.2 J	0.13 UJ	0.5 UJ	1,990	2.7	2.1 J	554	10,900	1.8 J	2,930	35.2	0.33	---	1.3 UJ	860 J
H3XSU02 (FD)	10/17/2007	50-67	4,050	0.7 J	**6.8**	32.1 J	0.15 UJ	0.55 UJ	2,180	2.6	2.2 J	617	11,100	1.7 J	3,210	47.8	0.22	---	1.7 UJ	1,310
H3XSU03	10/17/2007	50-67	8,210	1.7 J	**7.5**	71.2	0.33 UJ	0.97 UJ	3,630	8.2	5.8 J	2,060	18,900	2.5	6,620	73	0.42	---	4.4 UJ	1,230
PHASE III 4X HEAP LEACH PAD: Surface Discrete																				
H3XSS01	10/25/2007	0.25-0.75	11,800	0.28 J	**12**	81.4	0.49 J	0.51 U	11,200	19.1 J	12.3	3,090 J	20,600	3.4	7,710	118	0.033 J	---	12.1	1,360
H3XSS02	10/25/2007	0.25-0.75	11,500	6.2 J	**24.8**	105	0.55	0.51 U	16,800	5.1 J	9.1	**8,060 J**	**23,800**	6	6,490	123	0.83	---	9.4	1,650
H3XSS03	10/25/2007	0.25-0.75	7,600	1 J	**7.8**	60.4	0.25 J	0.52 U	5,160	7.7 J	5.2	520 J	12,400	5.5	5,350	55.2	0.31	---	7.5	1,300
H3XSS04	10/25/2007	0.25-0.75	5,850	0.48 J	**6.8**	44.1	0.19 J	0.51 U	3,270	3.9 J	3.5 J	540 J	10,500	6.5	4,710	32.9	0.35	---	5	1,360
H3XSS05	10/25/2007	0.25-0.75	4,950	2.7 J	**13**	65.7	0.23 J	0.52 U	10,200	4.5 J	4 J	655 J	12,400	6.7	3,230	41.8	0.36	---	3.9 J	1,420
H3XSS06	10/25/2007	0.25-0.75	13,700	1.5 J	**19.4**	110	0.52 J	0.67 U	48,300	11 J	13.3	1,080 J	**24,700**	53.2	8,730	125	1.8	---	11.5	3,110
H3XSS07	10/25/2007	0.25-0.75	6,810	1.2 J	**9.3**	70.8	0.23 J	0.52 U	4,520	4.9 J	4.6 J	539 J	12,200	7.9	5,060	48.7	0.48	---	6	1,390
H3XSS08	10/25/2007	0.25-0.75	7,690	0.53 J	**7.7**	60.4	0.2 J	0.53 U	1,990	4.5 J	5.1 J	585 J	13,000	4.9	6,960	56	0.47	---	7.1	1,670
H3XSS08 (FD)	10/25/2007	0.25-0.75	8,800	4 U	**8.5**	58	0.22	1 U	2,600	6	4.2	480	16,000	4.5	7,300	56	0.53	4 J	7.8	1,800
PHASE III SOUTH HEAP LEACH PAD: Soil Boring Composite																				
H3SSU01	9/25/2007	0-50	5,270	2.2 J	**8.8 J-**	65.7	0.2 UJ	0.76 J	4,320	4.3	2.7 J	947	13,800	3.8	3,830	42.9	0.5 J-	---	4.4 U	998 J
H3SSU02	10/7/2007	50-100	5,520	1.1 J	**6.1 J**	50.1	0.18 UJ	0.67 UJ	3,800	4.6	4.5 J	619	13,800	3	4,300	59.1	1.8	---	1.7 J	984 J
H3SSU03	10/6/2007	100-117	5,790	0.86 J	**3.9 J**	60.2	0.16 UJ	1.7 J	2,150	7.7	3.9 J	905	**29,800**	2.5	3,970	65	0.092 UJ	---	4.3 U	1,620
H3SSU04	9/26/2007	50-100	5,640	1.2 J	**5 J-**	56.5	0.19 UJ	1.3 J	2,930	4.8	3.1 J	831	22,600	2.6	3,900	51	0.11 U	---	4.4 U	1,090
PHASE III SOUTH HEAP LEACH PAD: Surface Discrete																				
H3SSS01	10/24/2007	0.25-0.75	7,680	0.96 J	**9.8**	71.5	0.34 J	0.53 U	6,770	3.9 J	6.2	1,420 J	18,500	4.6	4,660	81.9	0.22	---	5.4	1,150
H3SSS02	10/25/2007	0.25-0.75	7,390	1.2 J	**18.4**	76.9	0.38 J	0.55 U	4,660	4.8 J	5.5	1,670 J	19,800	5.5	5,030	64.7	0.082 J	---	6.1	1,300
H3SSS03	10/25/2007	0.25-0.75	12,700	0.93 J	**14.8**	57.3	0.44 J	0.51 U	7,000	2.7 J	9.3	**6,060 J**	20,600	4.3	9,960	68.5	0.28	---	7.6	448 J
H3SSS04	10/25/2007	0.25-0.75	3,890	0.26 J	**2.6**	40.5	0.08 J	0.5 U	1,730	5.3 J	2.6 J	207 J	12,500	1.8	4,280	32.3	0.37	---	5.6	1,610
H3SSS04 (FD)	10/25/2007	0.25-0.75	4,500	2 U	**2.4**	39	0.09 J	1 U	3,700	7.1	2.3	200	16,000	1.7 J	4,700	37	0.22	2.7 J	6.3	2,300
H3SSS05	10/24/2007	0.25-0.75	6,960	0.29 J	**11.3**	52.7	0.19 J	0.55 U	1,540	5.3 J	2.6 J	990 J	19,700	5.7	3,740	37.8	0.097 J	---	3.5 J	1,170
H3SSS06	10/25/2007	0.25-0.75	5,580	0.55 J	**11.4**	72.3	0.21 J	0.52 U	7,530	3.5 J	2.6 J	518 J	12,500	6.7	2,570	41.2	0.25	---	3.5 J	1,170
H3SSS07	10/24/2007	0.25-0.75	8,640	0.42 J	**10.6**	45.2	0.31 J	0.53 U	4,000	2.4 J	8	1,960 J	16,800	5.7	7,320	98.1	0.27	---	7.6	993
H3SSS08	10/24/2007	0.25-0.75	7,080	0.25 J	**11.6**	124	0.21 J	0.51 U	4,810	3.3 J	1.9 J	1,300 J	**28,000**	3.2	3,190	43.6	0.11	---	2.6 J	1,660

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		Parameter:	Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Calcium	Chromium	Cobalt	Copper	Iron	Lead	Magnesium	Manganese	Mercury	Molybdenum	Nickel	Potassium
		Industrial PRG:	920,000	410	1.6 (ca) 260 (nc)	67,000	1,900	450	--	--	1,900	41,000	310,000	--	--	19,000	--	5,100	20,000	--
		Residential PRG:	76,000	31	0.39 (ca) 22 (nc)	5,400	150	37	--	--	900	3,100	23,000	--	--	1,800	--	390	1,600	--
		Units:	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg
Location	**Sample Date**	**Depth ¹**	**Analytical Results**																	
PHASE IV SLOT HEAP LEACH PAD: Soil Boring Composite																				
H4SSU01	10/8/2007	50-97	7,420	1.8 J	**8.3 J**	86.4	0.25 UJ	0.81 UJ	8,090	5.3	5.2 J	1,180	15,600	3.5	4,680	77.6	0.31	---	1.7 J	1,390
H4SSU01	10/8/2007	0-50	6,940	0.87 J	**5.3 J**	61.7	0.22 UJ	0.66 UJ	4,660	4.5	4.5 J	681	13,300	3.2	6,000	62.9	0.17	---	2.4 J	1,650
H4SSU02	10/9/2007	0-50	5,500	1.5 J	**4.4 J**	52.5	0.2 UJ	0.6 UJ	3,610	6.8	4.3 J	756	12,600	2.6	4,410	54.7	0.27	---	3 J	915 J
H4SSU03	10/9/2007	50-77	5,780	1.2 J	**5.5 J**	74.9	0.19 UJ	0.82 UJ	3,190	4.4	4 J	856	15,400	3.1	4,770	57.7	0.093 UJ	---	1.3 J	1,500
H4SSU03 (FD)	10/9/2007	50-77	6,280	1.2 J	**11.5 J**	56.6	0.22 UJ	1.1 UJ	4,630	5.5	4.3 J	946	21,200	3.5	4,860	63.2	0.14	---	0.35 J	1,590
H4SSU04	10/9/2007	0-50	6,470	4.5 J	**8.6 J**	101	0.2 UJ	0.68 UJ	12,800	4.6	3.8 J	1,010	14,200	3.9	4,310	53.1	1.3	---	0.63 J	1,090
PHASE IV SLOT HEAP LEACH PAD: Surface Discrete																				
H4SSS01	10/24/2007	0.25-0.75	6,920	1.5 J	**8.7**	47.1	0.15 J	0.53 U	1,810	4.6	3.6 UJ	543	11,600	3.6 J	5,530	37	0.81	---	6.1	684
H4SSS02	10/23/2007	0.25-0.75	8,560	0.57 J	**10.2**	62.8	0.34 J	0.53 U	3,450	4.9	6.9	973	16,300	5.8 J	4,770	66.8	0.29	---	6.4	1,110
H4SSS03	10/23/2007	0.25-0.75	7,990	2.1 J	**9.1**	47.1	0.25 J	0.52 U	5,480	6.2	6.2	594	11,100	8.1 J	6,160	47.9	1.1	---	6.8	697
H4SSS04	10/23/2007	0.25-0.75	7,750	7.2	**15.3**	45.6	0.31 J	0.53 U	4,600	5.5	6.1	1,030	11,500	16.4 J	5,300	36.4	2.7	---	6.5	507 J
H4SSS05	10/23/2007	0.25-0.75	5,990	0.78 J	**12**	54.3	0.25 J	0.54 U	8,080	2.3	2.8 UJ	668	14,100	20.4 J	3,990	38.3	0.31	---	3.1 J	768
H4SSS06	10/24/2007	0.25-0.75	12,500	4.6 J	**31.6**	106	0.73	0.52 U	8,320	7.6	5.6	**3,690**	**24,100**	8.2 J	5,850	69.4	0.72	---	7.9	1,460
H4SSS06 (FD)	10/24/2007	0.25-0.75	14,000	6.9	**28**	120	0.74	1 U	7,500	9.7	5.9	**3,600**	**27,000**	7.6	6,200	75	0.66	19	8.9	1,700
H4SSS07	10/24/2007	0.25-0.75	8,480	1.8 J	**12.8**	87.9	0.4 J	0.52 U	4,820	4.2	4.4 UJ	1,320	18,000	7.1 J	5,660	57.9	0.94	---	5.9	1,080
H4SSS08	10/24/2007	0.25-0.75	7,430	0.87 J	**17.1**	72.6	0.27 J	0.52 U	7,690	2.9	4.7 UJ	909	17,300	9.3 J	5,140	49.7	0.29	---	4.7	1,020
H4SSS09	10/24/2007	0.25-0.75	7,410	0.95 J	**13.5**	86.2	0.36 J	0.54 U	4,540	6.6	4.5 UJ	614	17,400	6.2 J	3,920	49.4	0.44	---	5.3	1,510
H4SSS10	10/24/2007	0.25-0.75	11,100	4.1 J	**22.5**	221	0.69	0.51 U	13,800	3.9	23.2	**7,360**	17,900	5 J	6,610	152	5.1	---	8	936
PHASE IV VLT HEAP LEACH PAD: Soil Boring Composite																				
H4VSU01	9/27/2007	50-107	6,700	0.75 J	**3 J-**	49	0.3 UJ	0.54 J	6,400	4.7	5.7 J	702	10,400	2.8	6,360	105	0.086 U	---	2.9 J	1,680
H4VSU01	9/27/2007	0-50	6,190	1.1 J	**4.5 J-**	47.4	0.22 UJ	0.47 J	3,200	4.8	5.6 J	579	9,610	2.2	5,720	63.9	0.34 J-	---	3.9 J	1,600
H4VSU02	10/2/2007	0-50	7,610	2.3 J	**9.6 J**	51.4	0.25 UJ	0.86 UJ	3,760	4.9	5.8 J	1,020	17,700	3.8	6,460	71.9	0.37	---	2.1 J	1,040 J
H4VSU02	10/5/2007	50-107	7,970	0.58 J	**2.4 J**	54.7	0.35 UJ	0.55 UJ	4,420	9	6.1 J	906	11,200	2.1 J	8,030	74.9	0.12	---	8 J	2,310
H4VSU03	10/6/2007	0-50	6,370	0.58 J	**3.8 J**	34.5 UJ	0.2 UJ	0.53 UJ	3,020	4.1	6.2 J	686	12,100	2.9	5,820	75.9	0.24	---	3.5 J	1,320
H4VSU03	10/6/2007	50-87	7,690	0.85 J	**2.3 J**	53.8	0.29 UJ	0.56 UJ	3,820	9.7	6.3 J	681	11,100	2.1 J	8,000	83.8	0.076 UJ	---	7.5 J	1,740
H4VSU03 (FD)	10/6/2007	0-50	6,020	0.9 J	**4.4 J**	39.5 UJ	0.19 UJ	0.54 UJ	2,610	3.7	6.2 J	645	12,200	3.8	5,380	73.5	0.23	---	3.7 J	1,140
PHASE IV VLT HEAP LEACH PAD: Surface Discrete																				
H4VSS01	10/26/2007	0.25-0.75	13,700	0.75 J	**9.4**	39.7	0.69	0.03 J	3,810	5.1	51.6	**10,400**	13,400	5.5 J	17,300	336	0.029 J	---	31.4	1,080
H4VSS01 (FD)	10/26/2007	0.25-0.75	8,200	4 U	**8.4**	49	0.25	1 U	4,400	5.6	5.1	1,000	15,000	5.7	6,700	66	0.57	4 J	8	1,300
H4VSS02	10/26/2007	0.25-0.75	11,300	0.77 J	**8.3**	83.1	0.39 J	0.51 U	7,250	10.3	8.3	1,230	16,700	5.3 J	8,280	96.9	0.34	---	10.7	2,150
H4VSS03	10/26/2007	0.25-0.75	6,440	0.56 J	**6**	31.5	0.25 J	0.54 U	11,200	4.4	8.3	643	9,160	6.7 J	4,980	86.3	0.56	---	7.2	1,180
H4VSS04	10/26/2007	0.25-0.75	11,600	0.75 J	**11.5**	46.7	0.49 J	0.55 U	18,200	9.5	19.1	1,620	**27,500**	6.4 J	8,370	181	0.63	---	12.5	5,140
H4VSS05	10/26/2007	0.25-0.75	8,690	0.93 J	**13.9**	90.4	0.3 J	0.51 U	2,690	4.5	4.8 UJ	824	18,200	6.5 J	4,920	52	0.093 J	---	5.7	1,470
H4VSS06	10/26/2007	0.25-0.75	7,260	0.95 J	**8.7**	47.3	0.23 J	0.52 U	5,690	3.7	6.1	703	11,900	4.5 J	5,870	58.4	0.52	---	6.2	958
H4VSS07	10/26/2007	0.25-0.75	10,700	0.43 J	**9.1**	68	0.5 J	0.53 U	7,560	5.6	15.1	896	16,400	5.8 J	8,450	153	0.22	---	12.3	2,030
H4VSS08	10/26/2007	0.25-0.75	8,230	0.47 J	**7.8**	74.8	0.46 J	0.51 U	6,080	6.4	19.4	2,840	13,000	3.8 J	7,420	155	0.04 J	---	12.7	1,880
H4VSS09	10/26/2007	0.25-0.75	6,970	0.52 J	**8.1**	75.8	0.22 J	0.53 U	5,590	2.8	4.9 UJ	559	17,200	7 J	5,220	69.1	0.3	---	5.8	1,480
H4VSS10	10/26/2007	0.25-0.75	27,100	1.2 J	**13.6**	71.9	2.6	0.73 U	60,700	24.2	69	**6,920**	**61,100**	23.3 J	19,800	825	0.41	---	41.2	14,600
VLT SOIL: Surface Discrete																				
CAPSS01	10/29/2007	0.25-0.75	4,910	1.3 J	**4.7 J**	37.7	0.25 J	0.5 U	15,300	3 J	24.6 J	**10,600**	15,100	4	4,450	81.2	0.45	---	10.9	1,290
CAPSS02	10/26/2007	0.25-0.75	6,280	3.6 J	**119 J**	283	0.2 J	0.96	3,950	12.7 J	21 J	1,250	**27,900**	48.5	4,570	29.5	20.2	---	49.4	1,280

Parameter:			Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Calcium	Chromium	Cobalt	Copper	Iron	Lead	Magnesium	Manganese	Mercury	Molybdenum	Nickel	Potassium
Industrial PRG:			**920,000**	**410**	**1.6 (ca) 260 (nc)**	**67,000**	**1,900**	**450**	**--**	**--**	**1,900**	**41,000**	**310,000**	**--**	**--**	**19,000**	**--**	**5,100**	**20,000**	**--**
Residential PRG:			**76,000**	**31**	**0.39 (ca) 22 (nc)**	**5,400**	**150**	**37**	**--**	**--**	**900**	**3,100**	**23,000**	**--**	**--**	**1,800**	**--**	**390**	**1,600**	**--**
Units:			mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg
Location	**Sample Date**	**Depth [1]**	**Analytical Results**																	
VLT SOIL: Surface Discrete																				
CAPSS03	10/29/2007	0.25-0.75	1,970	1.5 J	**13.1 J**	104	0.06 J	0.52 U	2,570	2.8 J	2 J	**6,260**	**30,000**	271	735	20	0.81	---	1.1 J	1,980
CAPSS04	10/29/2007	0.25-0.75	7,500	0.81 J	**29.3 J**	58.8	0.36 J	0.51 U	6,140	15.6 J	4.8 J	**22,100**	20,500	39.1	4,760	65.1	0.68	---	16	770

Notes:

Bolded values exceed Industrial or Residential PRG
[1] - depth in feet below ground surface
mg/Kg - milligrams per kilogram
J - Estimated result
U - Not detected at reporting limit
FD - Field Duplicate
PRG - Preliminary Remediation Goal (EPA, 2004)
-- - no PRG available
(ca) - Cancer PRG
(nc) - Non-cancer PRG

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		Parameter:	Selenium	Silver	Sodium	Thallium	Vanadium	Zinc
		Industrial PRG:	5,100	5,100	--	67	1,000	310,000
		Residential PRG:	390	390	--	5.2	78	23,000
		Units:	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg
Location	**Sample Date**	**Depth ¹**	**Analytical Results**					
PHASE I/II HEAP LEACH PAD: Soil Boring Composite								
H12SU01	10/11/2007	0-50	3.7 UJ	1.1 U	120 J	2.6 U	26.8	5.8 UJ
H12SU01 (FD	10/11/2007	0-50	3.7 UJ	1.1 U	115 J	2.6 U	22.5	5.2 UJ
H12SU02	10/10/2007	0-50	3.8 UJ	1.1 U	134 J	2.7 U	23	8.2 UJ
H12SU02 (FD	10/10/2007	50-77	4.3 UJ	1.2 U	110 J	3.1 UJ	22.4	8.2 J
PHASE I/II HEAP LEACH PAD: Surface Discrete								
H12SS01	10/23/2007	0.25-0.75	3.8 J	0.17 J	206 J	0.99 J	23.8	13.5
H12SS01 (FD	10/23/2007	0.25-0.75	3.6	2 U	210	10 U	30	12
H12SS02	10/23/2007	0.25-0.75	3.7 J	1.1 U	346 J	0.7 J	14.1	13
H12SS03	10/23/2007	0.25-0.75	3.8 J	1 U	117 J	0.43 J	12.1	7.3
H12SS04	10/23/2007	0.25-0.75	4.1 J	0.18 J	154 J	0.92 J	23.2	8.7
PHASE III 4X HEAP LEACH PAD: Soil Boring Composite								
H3XSU01	10/16/2007	0-50	3.8 UJ	1.1 U	78.6 J	2.7 UJ	12.7	11.5 J
H3XSU02	10/17/2007	50-67	4.3 UJ	1.2 U	85.7 J	3.1 UJ	16	6.1 J
H3XSU02 (FD	10/17/2007	50-67	4 UJ	1.2 U	93.2 J	2.9 UJ	17.3	8.7 J
H3XSU03	10/17/2007	50-67	3.8 UJ	1.1 U	160 J	2.7 UJ	31.8	7.5 J
PHASE III 4X HEAP LEACH PAD: Surface Discrete								
H3XSS01	10/25/2007	0.25-0.75	3.5 J	0.09 J	337 J	0.52 J	50.3	12.2
H3XSS02	10/25/2007	0.25-0.75	5.2 J	0.56 J	102 J	1 J	38.1	24.2
H3XSS03	10/25/2007	0.25-0.75	3.1 J	1 U	262 J	0.82 J	18.9	13.2
H3XSS04	10/25/2007	0.25-0.75	5.5 J	0.13 J	135 J	0.7 J	19.1	9.3
H3XSS05	10/25/2007	0.25-0.75	2.9 J	0.12 J	321 J	0.74 J	18.5	8.3
H3XSS06	10/25/2007	0.25-0.75	9.5 J	0.38 J	795	1.2 J	18.8	23.5
H3XSS07	10/25/2007	0.25-0.75	3.9 J	0.2 J	194 J	0.75 J	17.6	12.2
H3XSS08	10/25/2007	0.25-0.75	6.1 J	0.23 J	99.5 J	0.82 J	22.7	14.5
H3XSS08 (FD	10/25/2007	0.25-0.75	5.4	2 U	91	10 U	30	14
PHASE III SOUTH HEAP LEACH PAD: Soil Boring Composite								
H3SSU01	9/25/2007	0-50	3.8 UJ	1.1 U	143 J	2.7 U	21.2	7.1 J
H3SSU02	10/7/2007	50-100	3.8 UJ	1.1 U	177 J	2.7 U	23.4	8.2 UJ
H3SSU03	10/6/2007	100-117	3.8 UJ	1.1 U	172 J	2.7 U	28.6	7.9 UJ
H3SSU04	9/26/2007	50-100	3.8 UJ	1.1 U	163 J	2.7 U	27.2	7.7 J
PHASE III SOUTH HEAP LEACH PAD: Surface Discrete								
H3SSS01	10/24/2007	0.25-0.75	4.3 J	0.25 J	410 J	0.99 J	20.8	14.6
H3SSS02	10/25/2007	0.25-0.75	3.5 J	0.12 J	283 J	0.99 J	27.4	13.4
H3SSS03	10/25/2007	0.25-0.75	3.7 J	0.29 J	143 J	0.89 J	32	10.6
H3SSS04	10/25/2007	0.25-0.75	1.6 J	0.13 J	277 J	0.81 J	25.5	11.4
H3SSS04 (FD	10/25/2007	0.25-0.75	1.3 J	2 U	270	10 U	27	11
H3SSS05	10/24/2007	0.25-0.75	4.6 J	0.2 J	175 J	1.2 J	19.9	10.8
H3SSS06	10/25/2007	0.25-0.75	2.3 J	1 U	100 J	0.62 J	18	13.1
H3SSS07	10/24/2007	0.25-0.75	3.4 J	0.11 J	415 J	0.91 J	15.2	21.2
H3SSS08	10/24/2007	0.25-0.75	6.3 J	0.41 J	194 J	1.4 J	24.3	10.9

		Parameter:	Selenium	Silver	Sodium	Thallium	Vanadium	Zinc
		Industrial PRG:	5,100	5,100	--	67	1,000	310,000
		Residential PRG:	390	390	--	5.2	78	23,000
		Units:	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg
Location	Sample Date	Depth [1]	Analytical Results					
PHASE IV SLOT HEAP LEACH PAD: Soil Boring Composite								
H4SSU01	10/8/2007	50-97	3.9 UJ	1.1 U	296 J	2.8 U	27.8	12.9 UJ
H4SSU01	10/8/2007	0-50	3.8 UJ	1.1 U	188 J	2.7 U	24.6	11.3 UJ
H4SSU02	10/9/2007	0-50	3.8 UJ	1.1 U	232 J	2.7 U	15.7	10 UJ
H4SSU03	10/9/2007	50-77	0.52 J	1.1 U	168 J	2.7 U	25.6	9.4 UJ
I4SSU03 (FD	10/9/2007	50-77	3.8 UJ	1.1 U	212 J	2.7 U	29	10.3 UJ
H4SSU04	10/9/2007	0-50	3.8 UJ	1.1 U	167 J	2.7 U	22.7	8.7 UJ
PHASE IV SLOT HEAP LEACH PAD: Surface Discrete								
H4SSS01	10/24/2007	0.25-0.75	5.2	0.15 J	64.2 J	0.68 J	18.9	9.3
H4SSS02	10/23/2007	0.25-0.75	4.9	0.12 J	433 J	0.9 J	17.8	13.4
H4SSS03	10/23/2007	0.25-0.75	4.9	0.11 J	233 J	0.68 J	19.8	7.7
H4SSS04	10/23/2007	0.25-0.75	6.9	0.22 J	174 J	0.6 J	20.7	7.2
H4SSS05	10/23/2007	0.25-0.75	4.8	0.15 J	131 J	0.76 J	13.1	8.6
H4SSS06	10/24/2007	0.25-0.75	5	0.22 J	298 J	1.1 J	46.8	22.4
I4SSS06 (FD	10/24/2007	0.25-0.75	4.6	2 U	290	10 U	53	22
H4SSS07	10/24/2007	0.25-0.75	4.6	0.11 J	93.8 J	1 J	21.1	13.5
H4SSS08	10/24/2007	0.25-0.75	5.2	0.1 J	171 J	0.97 J	23.6	10.6
H4SSS09	10/24/2007	0.25-0.75	3.9	0.13 J	181 J	0.95 J	19.7	12.2
H4SSS10	10/24/2007	0.25-0.75	2.2 UJ	0.32 J	338 J	0.85 J	33.9	18.2
PHASE IV VLT HEAP LEACH PAD: Soil Boring Composite								
H4VSU01	9/27/2007	50-107	3.8 UJ	1.1 U	190 J	2.7 U	24	8.6 J
H4VSU01	9/27/2007	0-50	3.8 UJ	1.1 U	170 J	2.7 U	19	10.1 J
H4VSU02	10/2/2007	0-50	3.8 UJ	1.1 U	182 J	2.7 U	24.6	11.4 UJ
H4VSU02	10/5/2007	50-107	3.8 UJ	1.1 U	205 J	2.7 U	29.8	8.7 UJ
H4VSU03	10/6/2007	0-50	0.47 J	1.1 U	227 J	2.7 U	16.5	12.6 UJ
H4VSU03	10/6/2007	50-87	3.8 UJ	1.1 U	214 J	2.7 U	30.5	10.1 UJ
I4VSU03 (FD	10/6/2007	0-50	3.9 UJ	1.1 U	211 J	2.8 U	18.5	11.2 UJ
PHASE IV VLT HEAP LEACH PAD: Surface Discrete								
H4VSS01	10/26/2007	0.25-0.75	6.1	0.28 J	990	0.78 J	16.3	62.5
I4VSS01 (FD	10/26/2007	0.25-0.75	5.1	2 U	130	10 U	21	16
H4VSS02	10/26/2007	0.25-0.75	3.9	0.16 J	440 J	1 J	25	23.6
H4VSS03	10/26/2007	0.25-0.75	3.3 UJ	1.1 U	290 J	0.54 J	10.8	11.2
H4VSS04	10/26/2007	0.25-0.75	5.6	1.1 U	822	1.3 J	15	20.8
H4VSS05	10/26/2007	0.25-0.75	4.7	0.12 J	424 J	1 J	22.4	15.9
H4VSS06	10/26/2007	0.25-0.75	4.5	0.17 J	155 J	0.75 J	18.1	10.8
H4VSS07	10/26/2007	0.25-0.75	4.7	1.1 U	614	1 J	18	26.2
H4VSS08	10/26/2007	0.25-0.75	3.8	0.27 J	358 J	0.77 J	27	14
H4VSS09	10/26/2007	0.25-0.75	5.7	0.25 J	343 J	1.2 J	17.9	16.8
H4VSS10	10/26/2007	0.25-0.75	5.3	1.5 U	3,410	2.5 J	9.7	72.6
VLT SOIL: Surface Discrete								
CAPSS01	10/29/2007	0.25-0.75	6.6 J	0.79 J	207 J	0.86 J	10.2	20.5
CAPSS02	10/26/2007	0.25-0.75	83.3 J	1.1	133 J	**6.6**	21.7	108

DRAFT

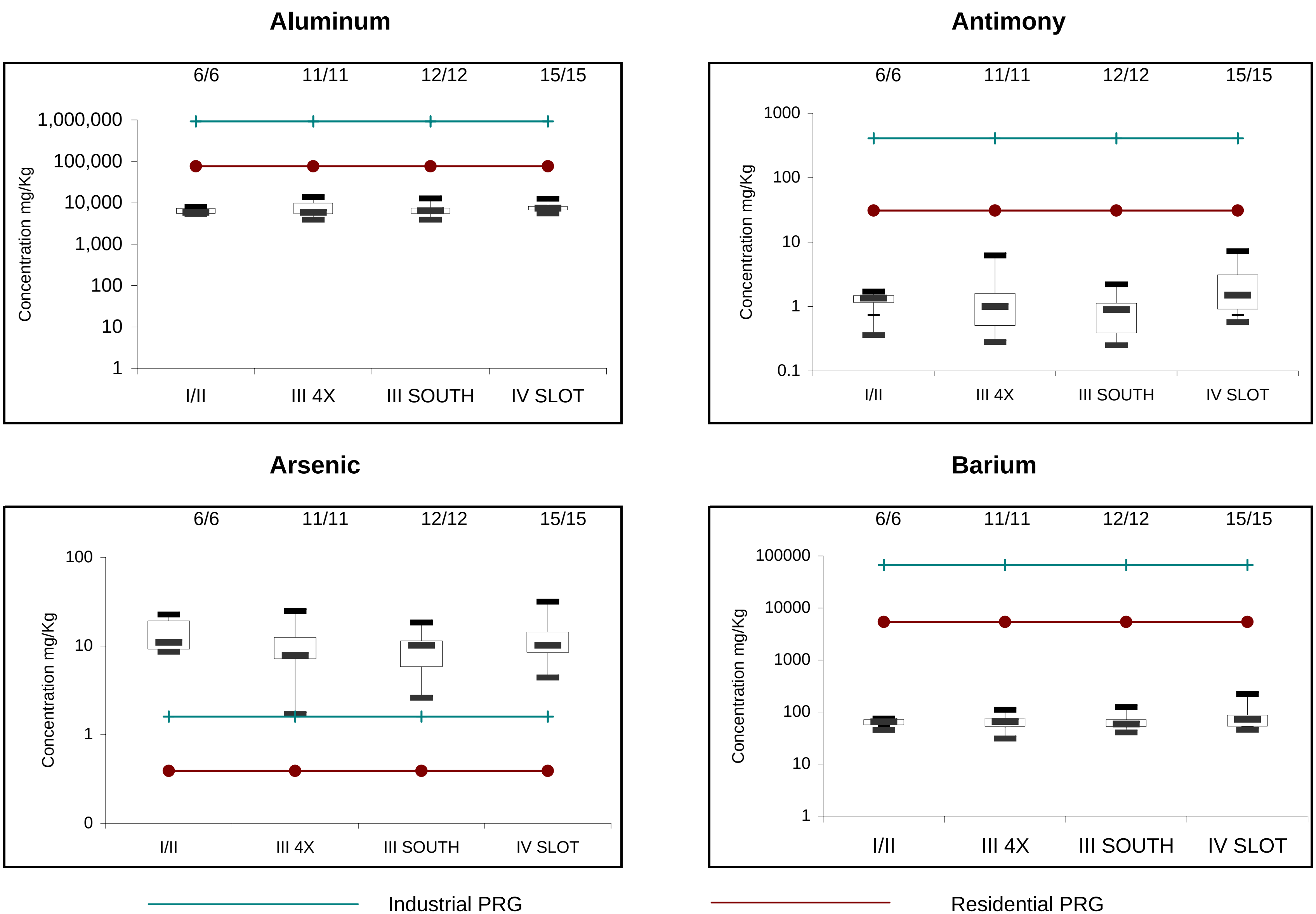
		Parameter:	Selenium	Silver	Sodium	Thallium	Vanadium	Zinc
		Industrial PRG:	5,100	5,100	--	67	1,000	310,000
		Residential PRG:	390	390	--	5.2	78	23,000
		Units:	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg
Location	**Sample Date**	**Depth [1]**	**Analytical Results**					
VLT SOIL:	**Surface Discrete**							
CAPSS03	10/29/2007	0.25-0.75	13.8 J	1.9	1,020	2 J	8.5	13.2
CAPSS04	10/29/2007	0.25-0.75	9.2 J	0.69 J	125 J	1.2 J	17.9	11.1

Notes:

Bolded values exceed Industrial or Residential PRG
[1] - depth in feet below ground surface
mg/Kg - milligrams per kilogram
J - Estimated result
U - Not detected at reporting limit
FD - Field Duplicate
PRG - Preliminary Remediation Goal (EPA, 2004)
-- - no PRG available
(ca) - Cancer PRG
(nc) - Non-cancer PRG

Appendix E
Group A Heap Leach Pad Statistical Plots and ANOVA Analysis

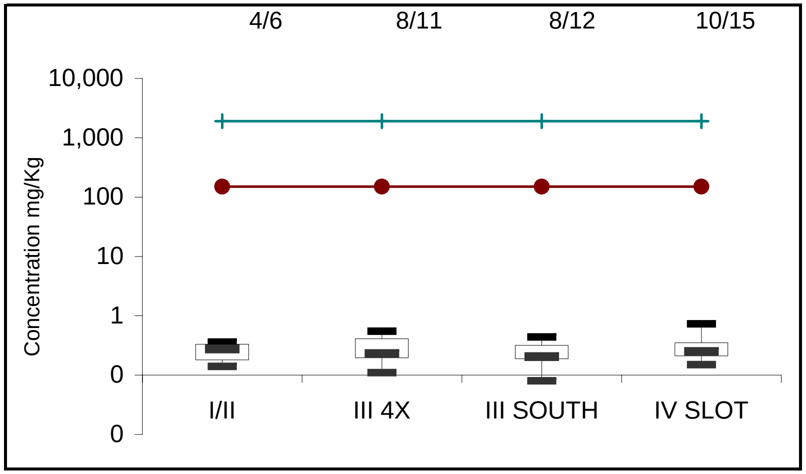
BOX AND WHISKER PLOTS COMPARING CONCENTRATIONS FROM FOUR HEAP LEACH PADS



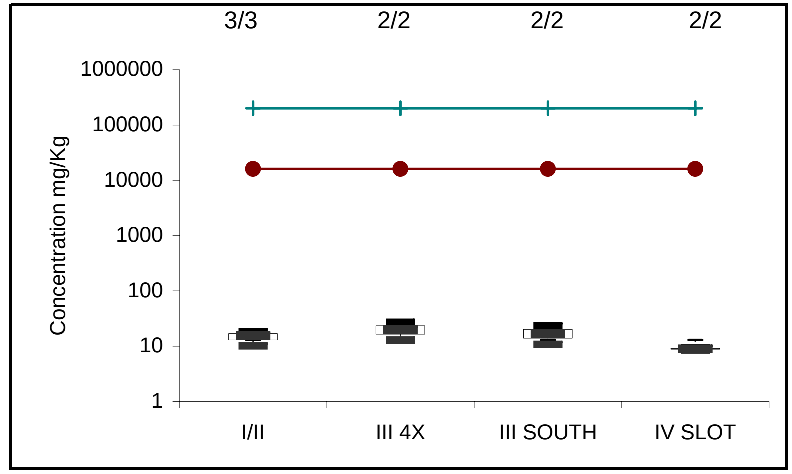
Frequency of Detection at Top of Each Plot

BOX AND WHISKER PLOTS COMPARING CONCENTRATIONS FROM FOUR HEAP LEACH PADS

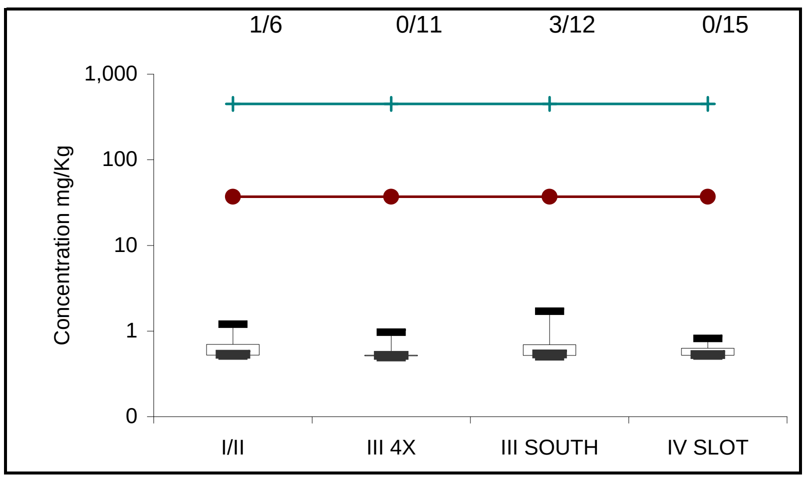
Beryllium



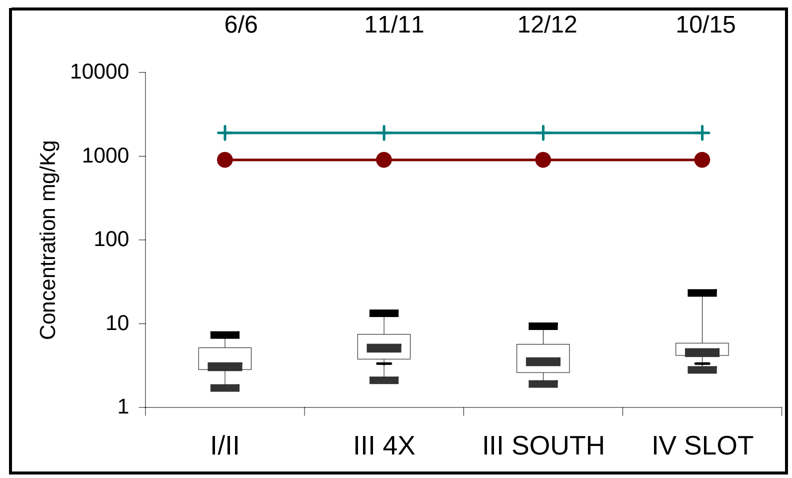
Boron



Cadmium



Cobalt



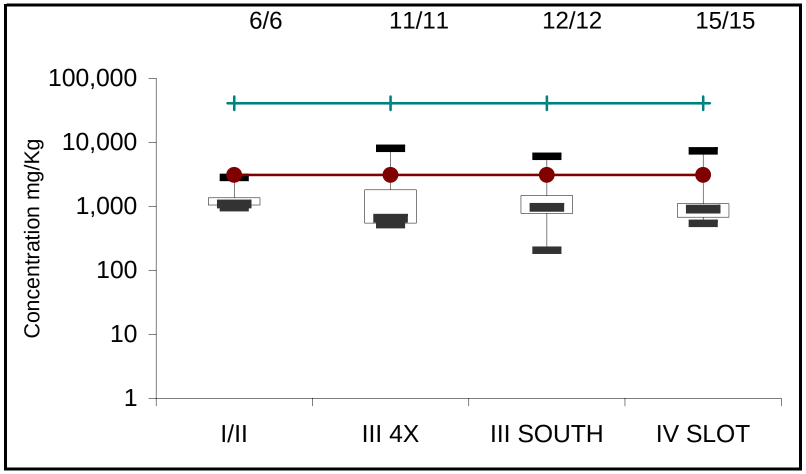
Industrial PRG

Residential PRG

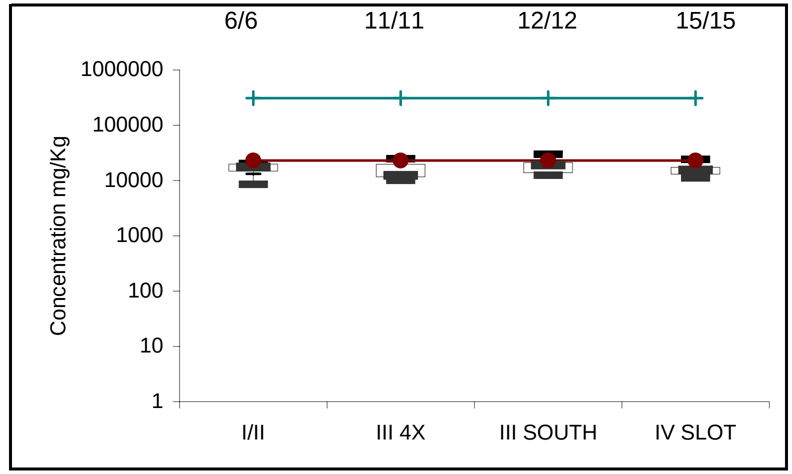
Frequency of Detection at Top of Each Plot

BOX AND WHISKER PLOTS COMPARING CONCENTRATIONS FROM FOUR HEAP LEACH PADS

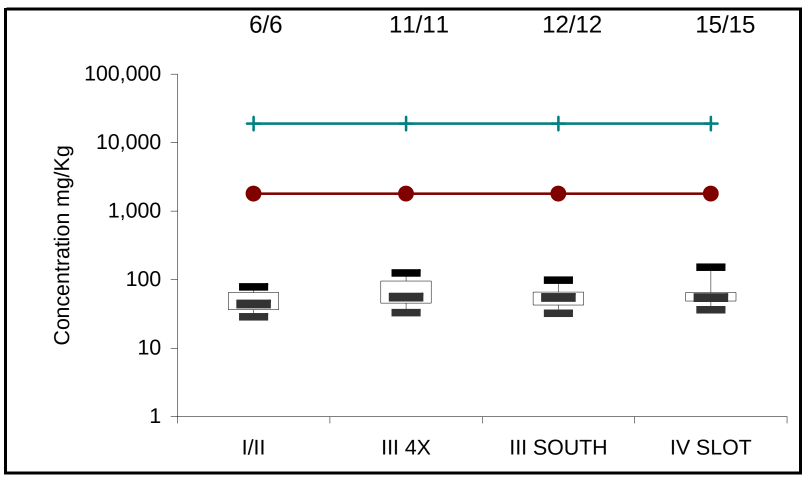
Copper



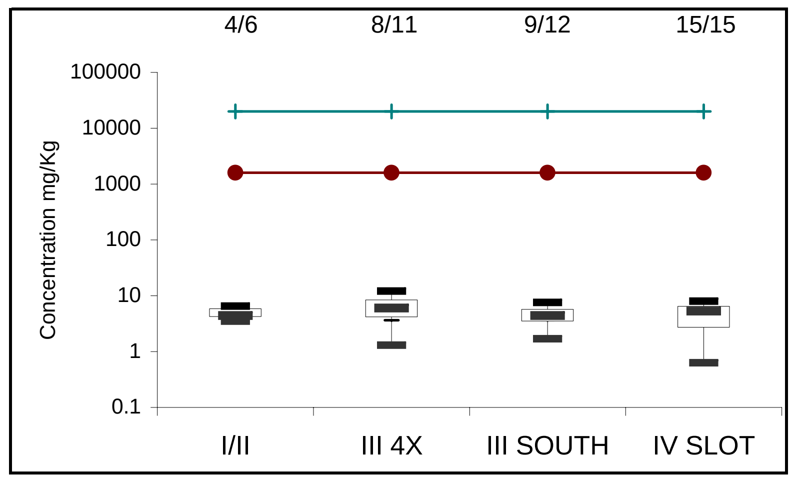
Iron



Manganese



Nickel

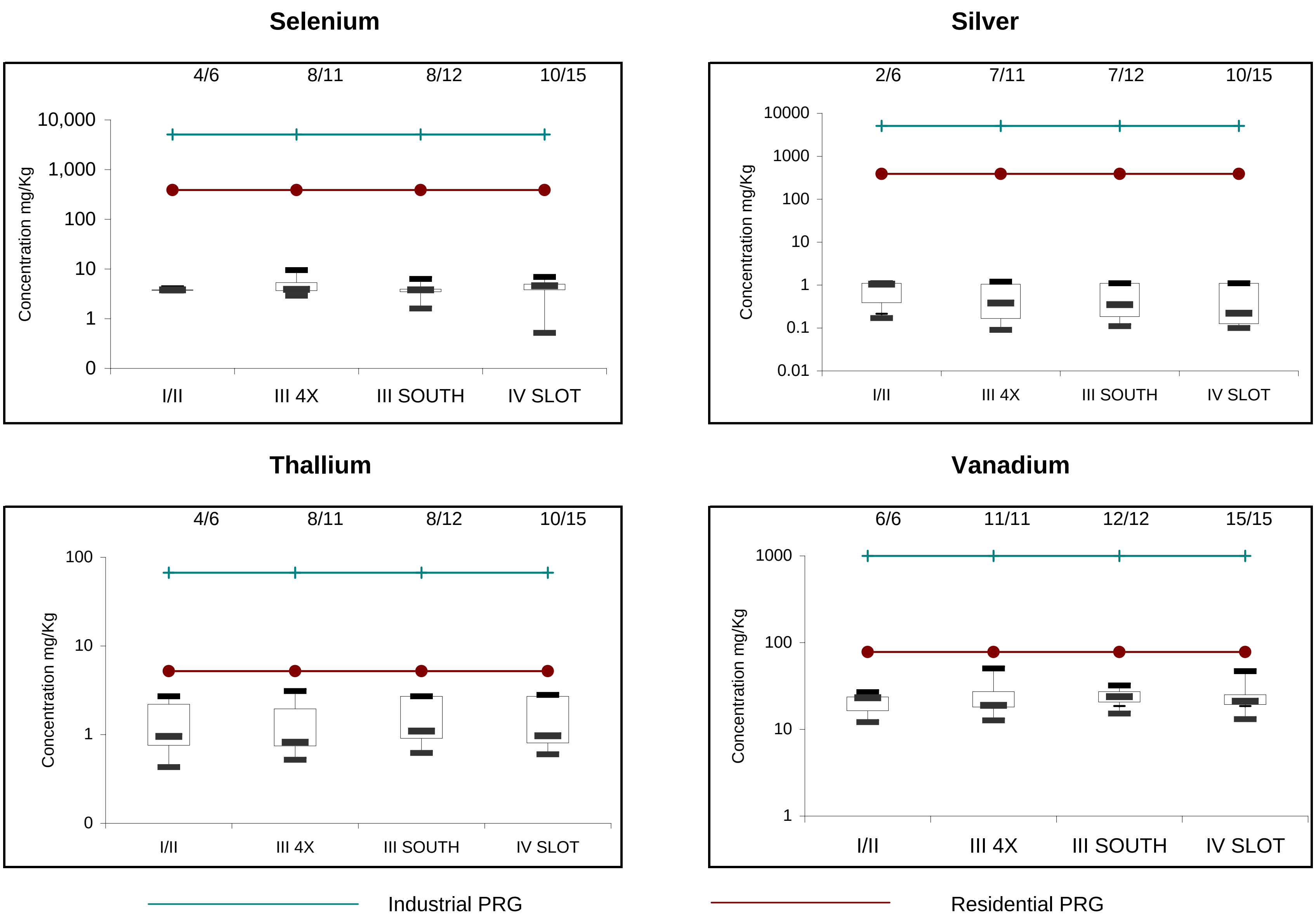


Industrial PRG

Residential PRG

Frequency of Detection at Top of Each Plot

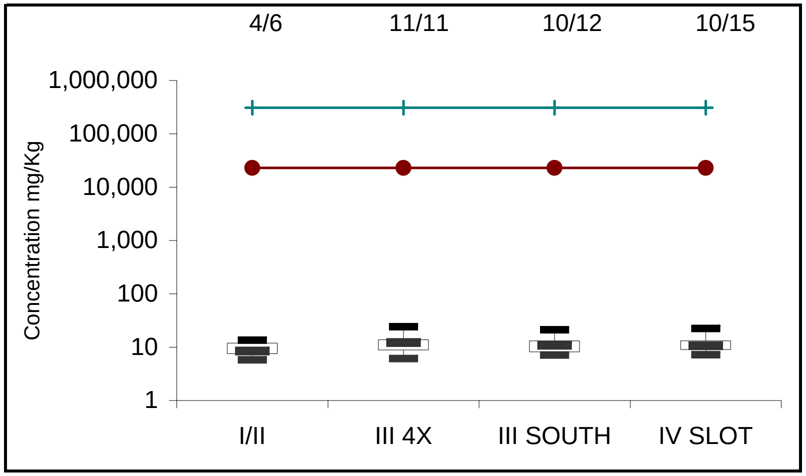
BOX AND WHISKER PLOTS COMPARING CONCENTRATIONS FROM FOUR HEAP LEACH PADS



Frequency of Detection at Top of Each Plot

BOX AND WHISKER PLOTS COMPARING CONCENTRATIONS FROM FOUR HEAP LEACH PADS

Zinc

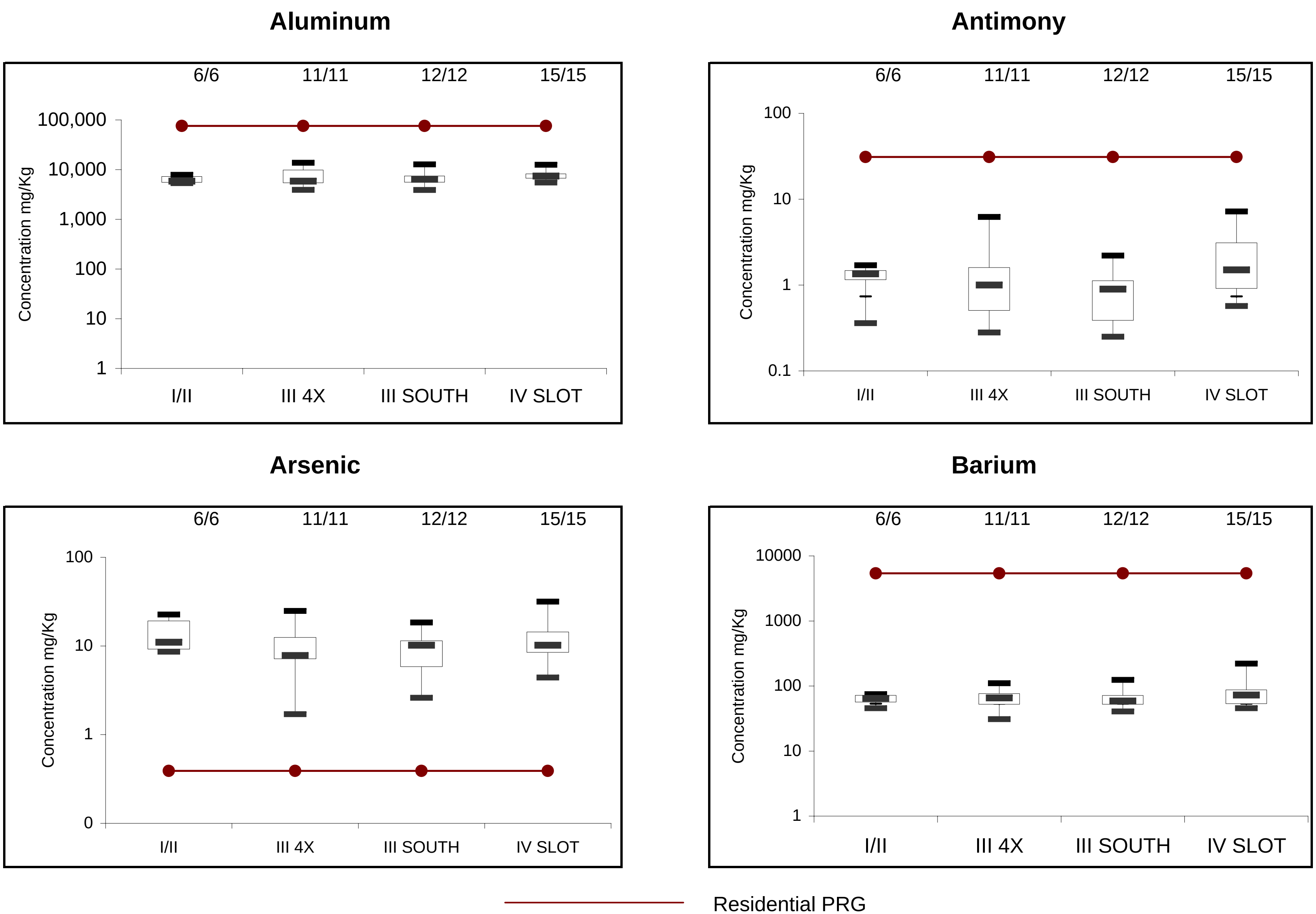


Industrial PRG

Residential PRG

Frequency of Detection at Top of Each Plot

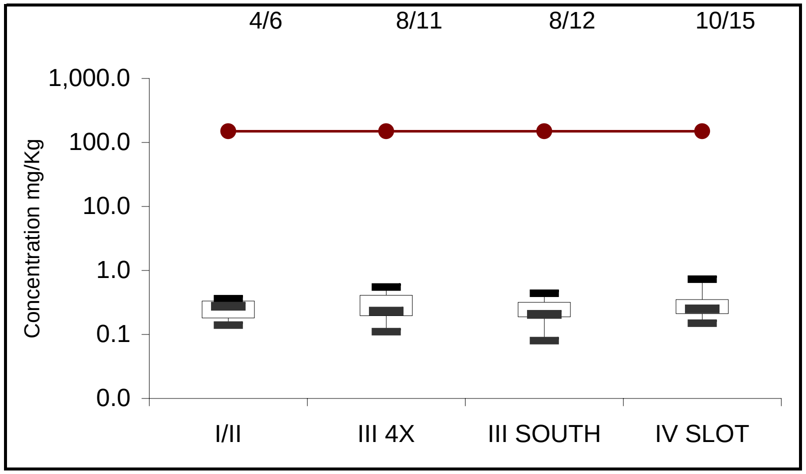
BOX AND WHISKER PLOTS COMPARING CONCENTRATIONS FROM FOUR HEAP LEACH PADS



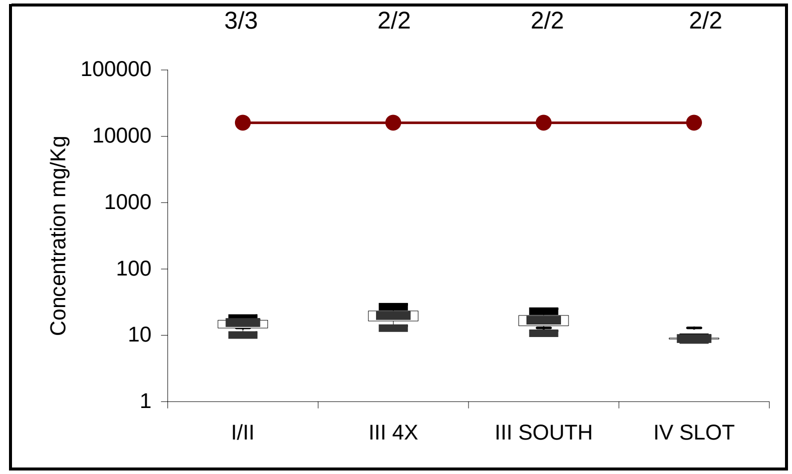
Frequency of Detection at Top of Each Plot

BOX AND WHISKER PLOTS COMPARING CONCENTRATIONS FROM FOUR HEAP LEACH PADS

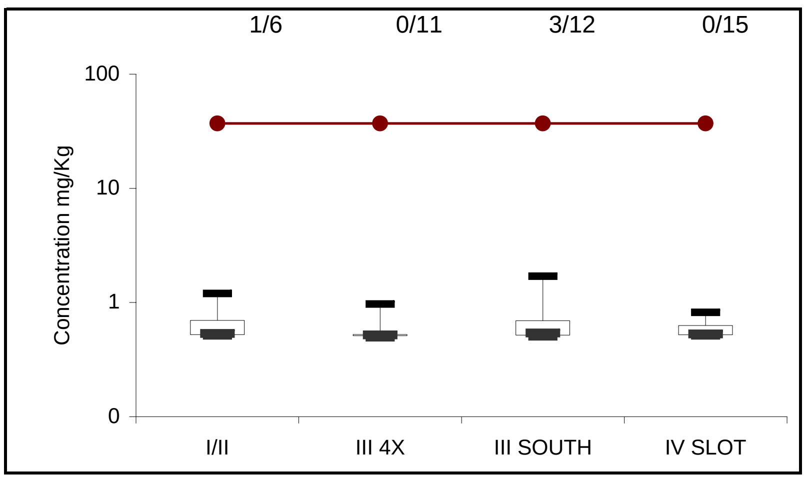
Beryllium



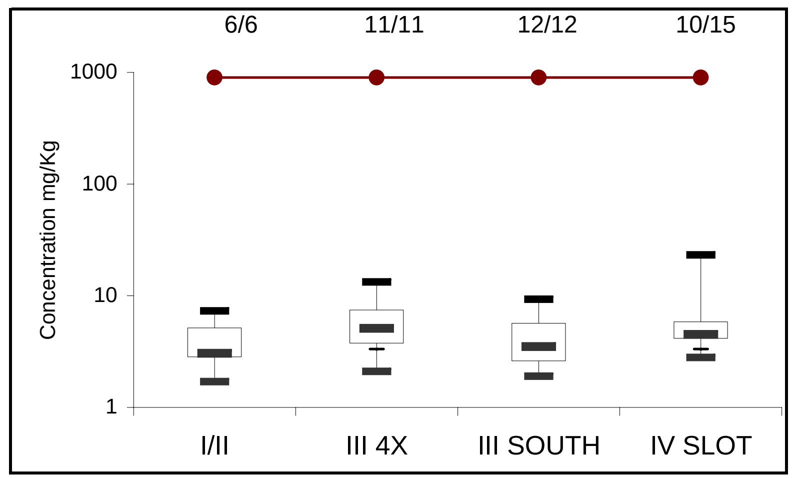
Boron



Cadmium



Cobalt

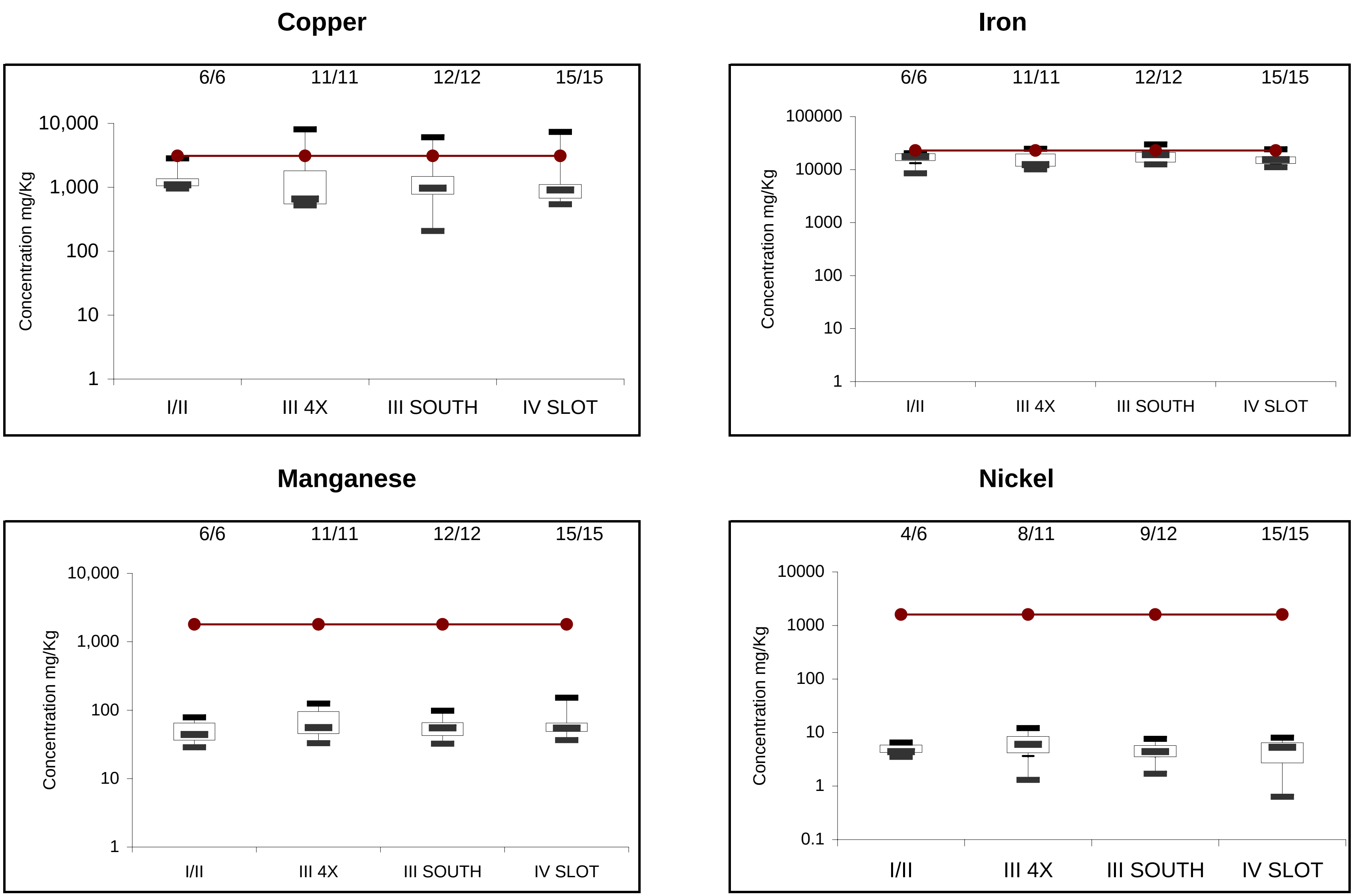


Industrial PRG

Residential PRG

Frequency of Detection at Top of Each Plot

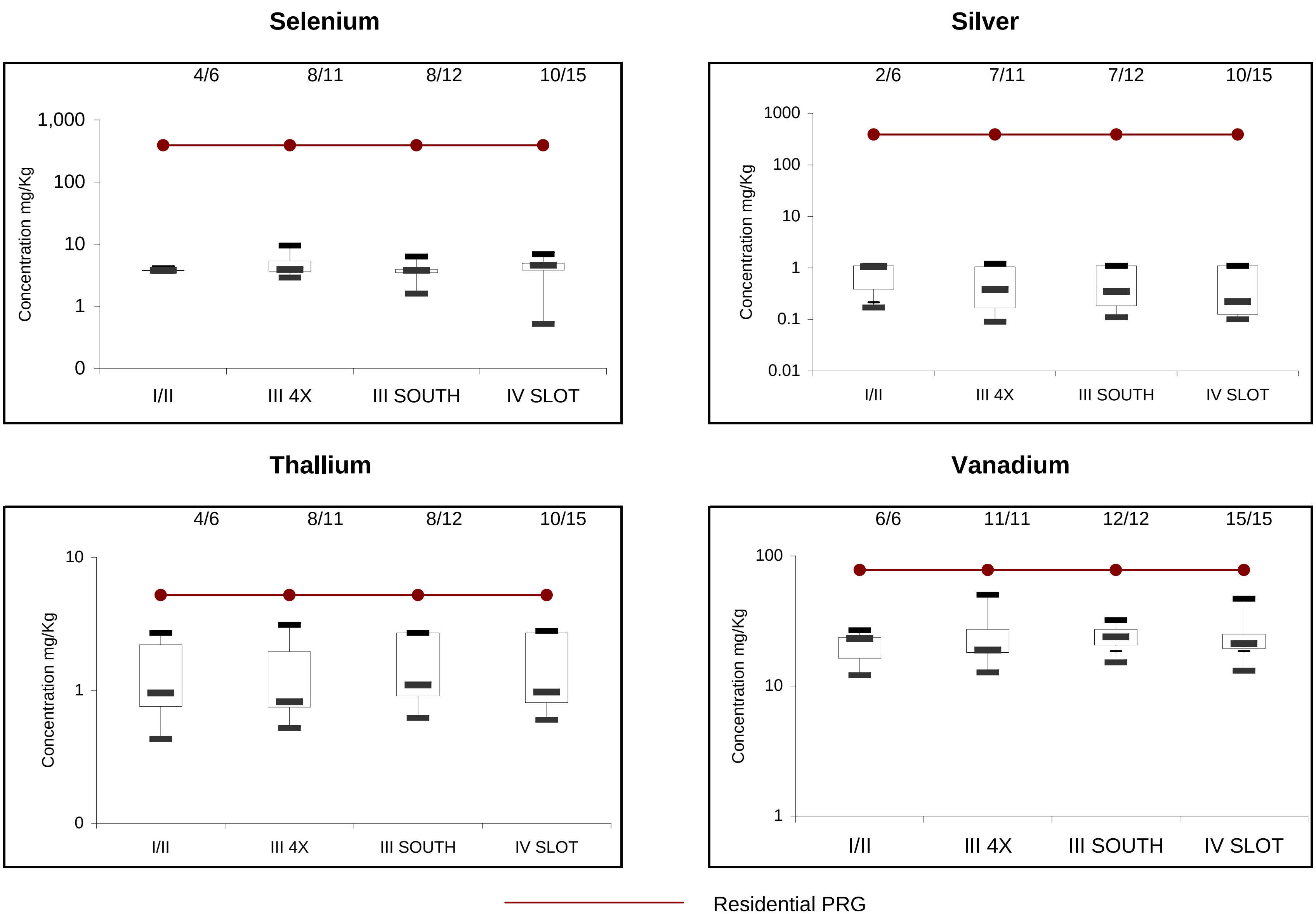
BOX AND WHISKER PLOTS COMPARING CONCENTRATIONS FROM FOUR HEAP LEACH PADS



Residential PRG

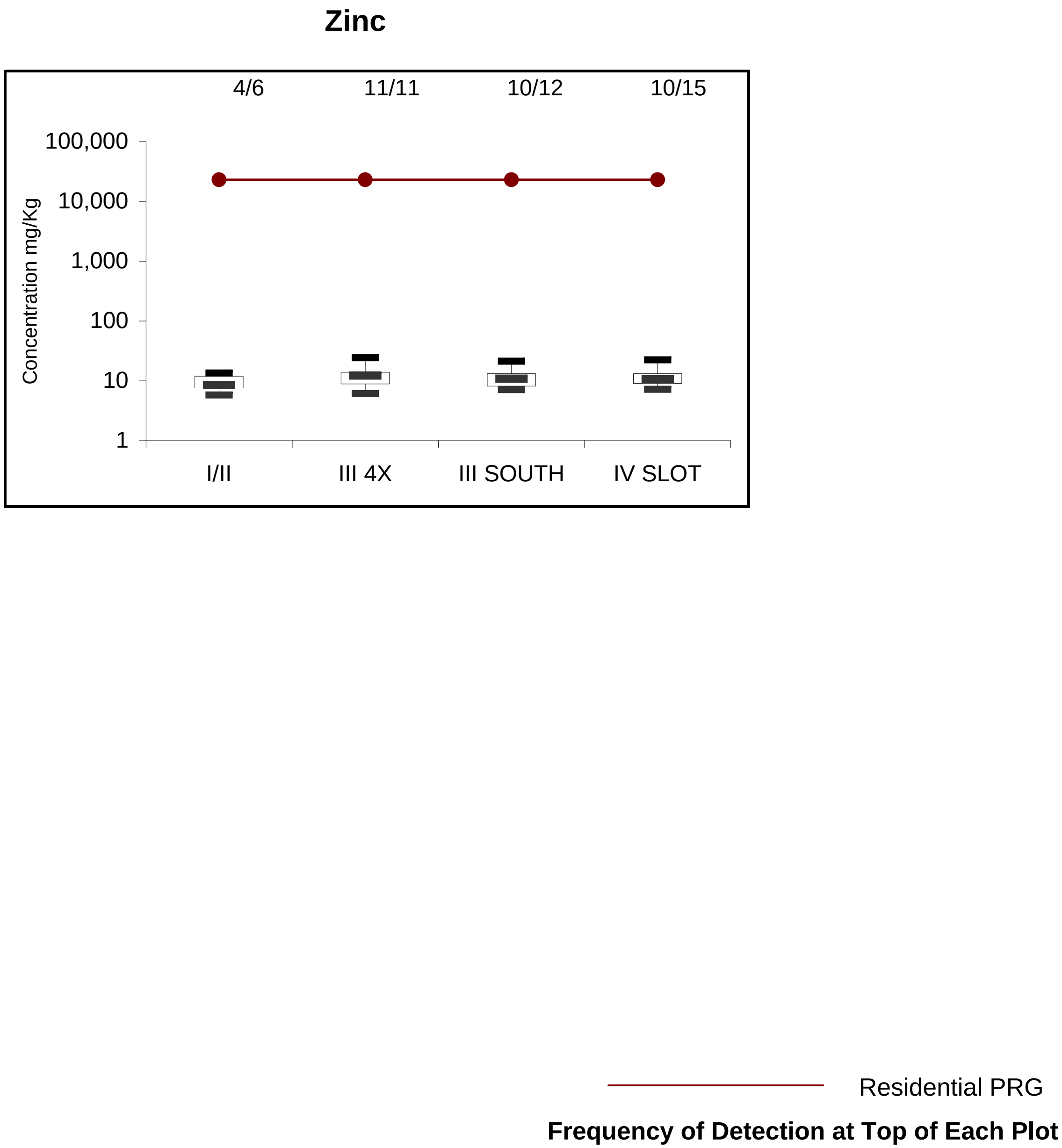
Frequency of Detection at Top of Each Plot

BOX AND WHISKER PLOTS COMPARING CONCENTRATIONS FROM FOUR HEAP LEACH PADS

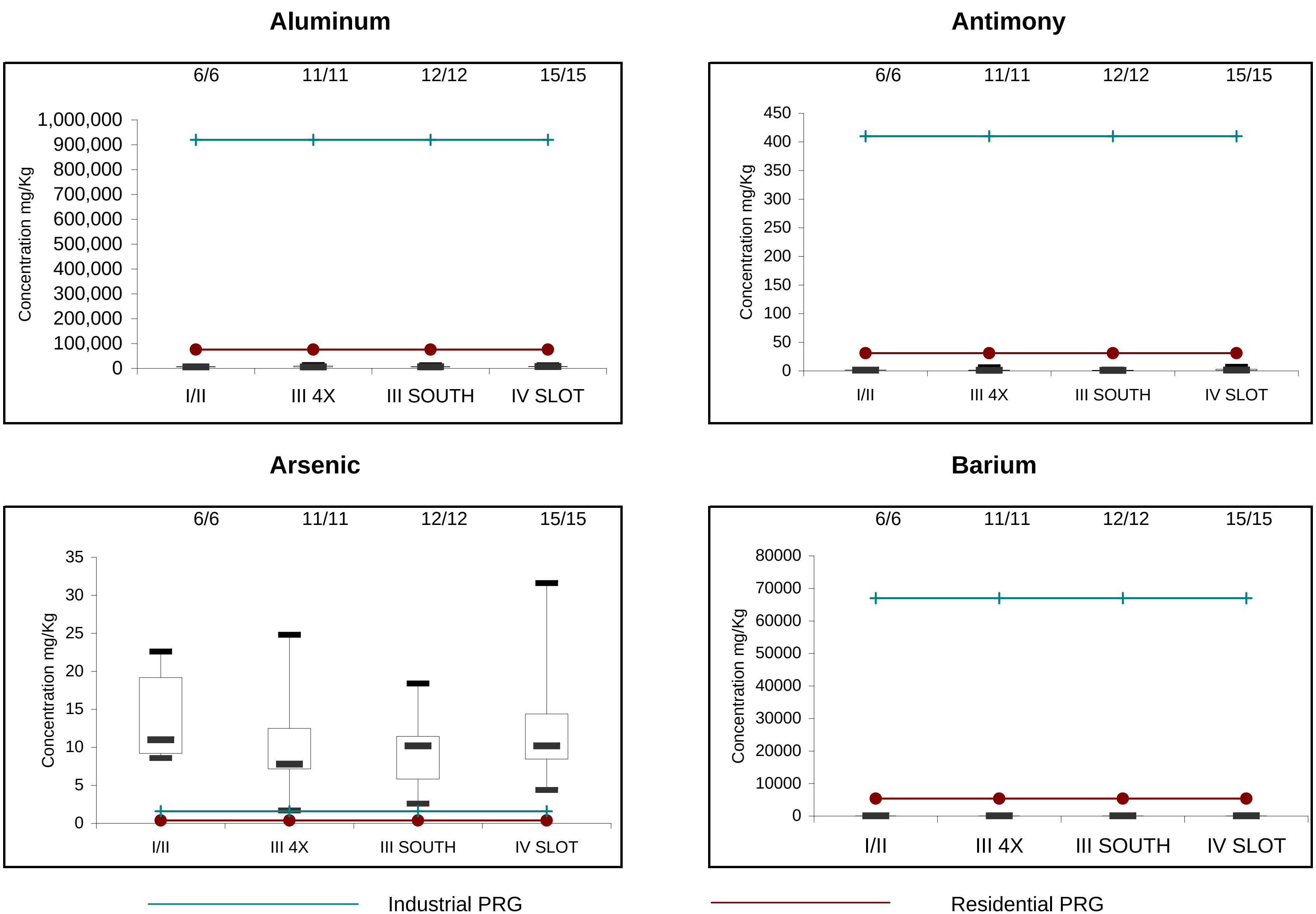


Frequency of Detection at Top of Each Plot

BOX AND WHISKER PLOTS COMPARING CONCENTRATIONS FROM FOUR HEAP LEACH PADS

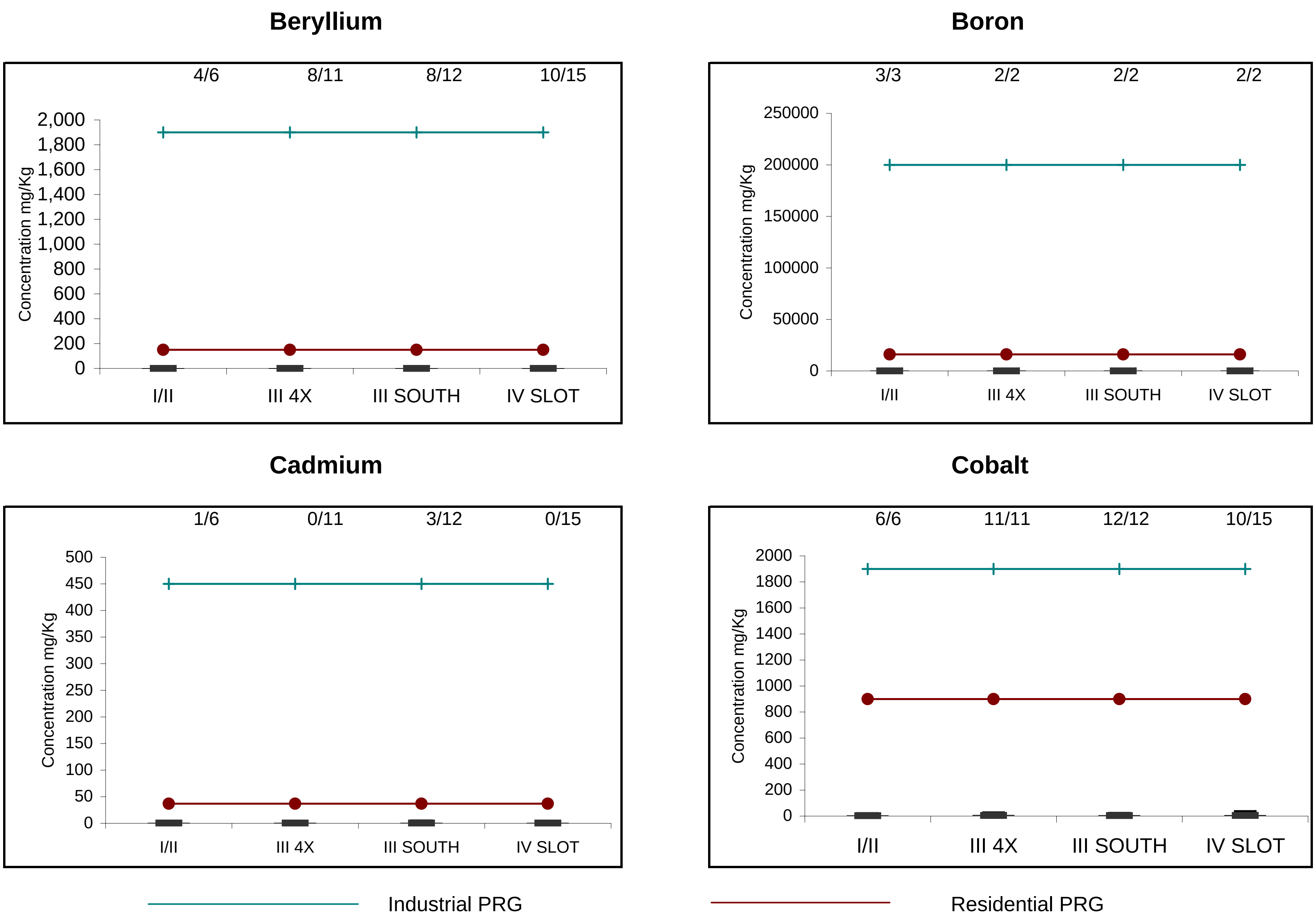


BOX AND WHISKER PLOTS COMPARING CONCENTRATIONS FROM FOUR HEAP LEACH PADS



Frequency of Detection at Top of Each Plot

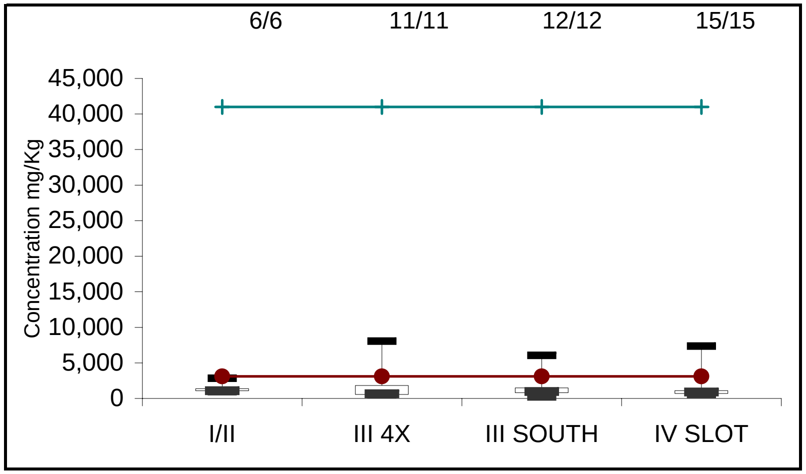
BOX AND WHISKER PLOTS COMPARING CONCENTRATIONS FROM FOUR HEAP LEACH PADS



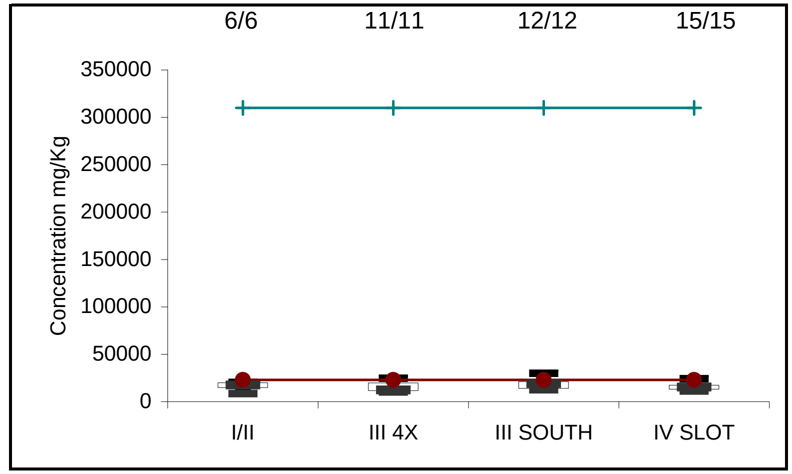
Frequency of Detection at Top of Each Plot

BOX AND WHISKER PLOTS COMPARING CONCENTRATIONS FROM FOUR HEAP LEACH PADS

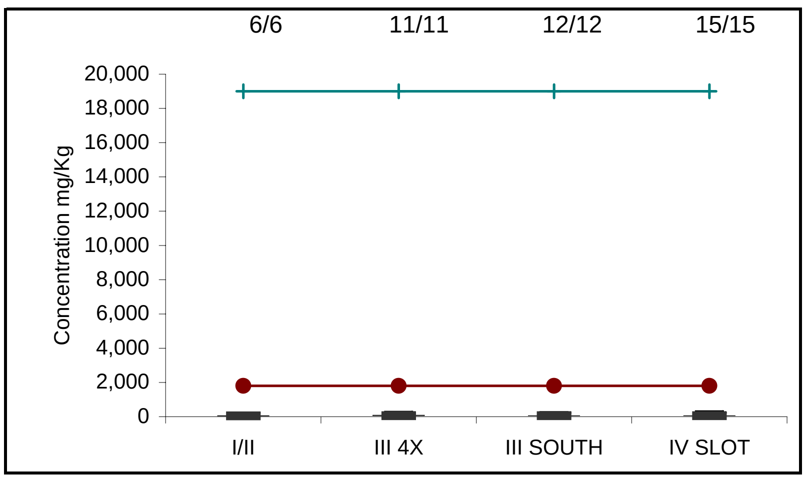
Copper



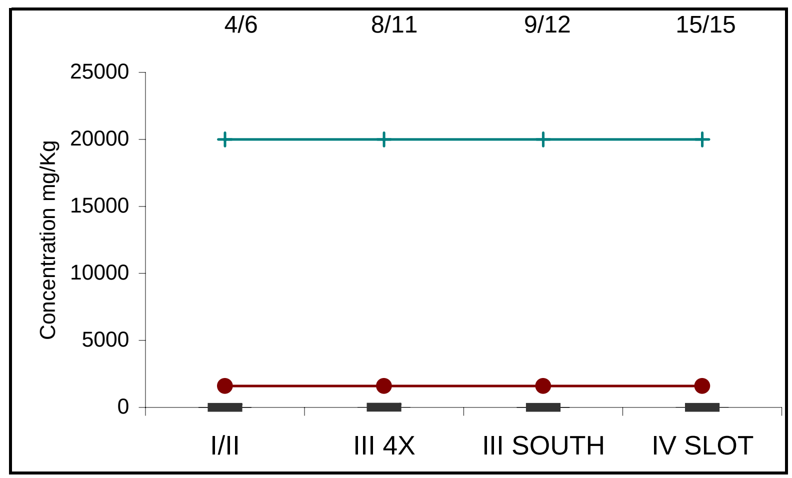
Iron



Manganese



Nickel



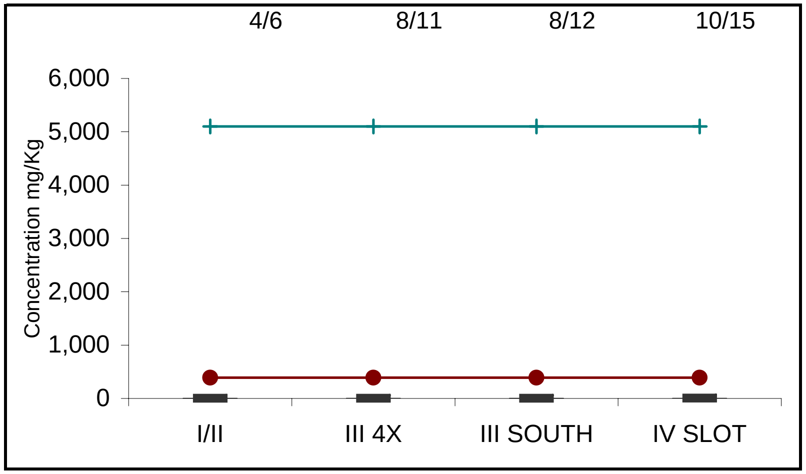
Industrial PRG

Residential PRG

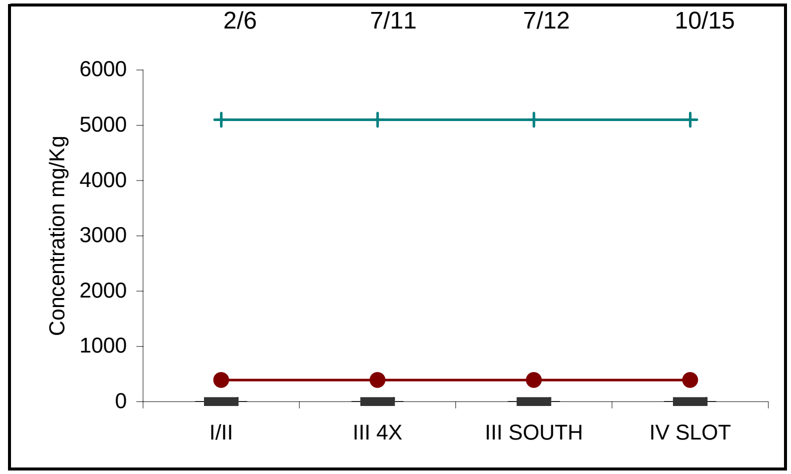
Frequency of Detection at Top of Each Plot

BOX AND WHISKER PLOTS COMPARING CONCENTRATIONS FROM FOUR HEAP LEACH PADS

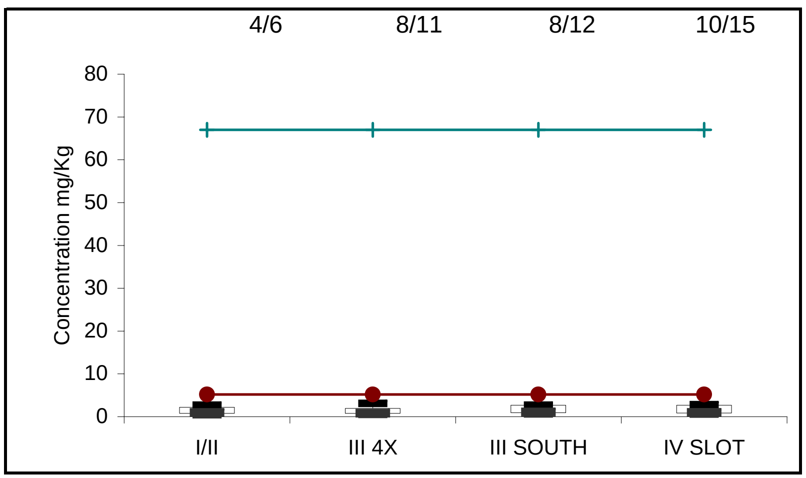
Selenium



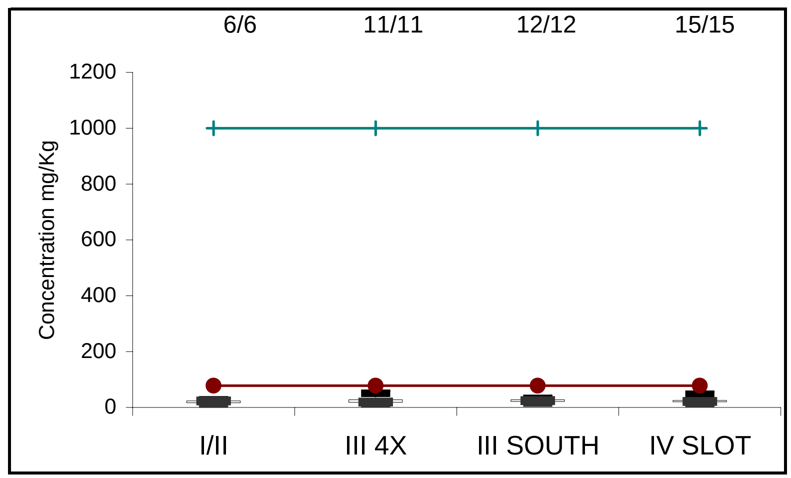
Silver



Thallium

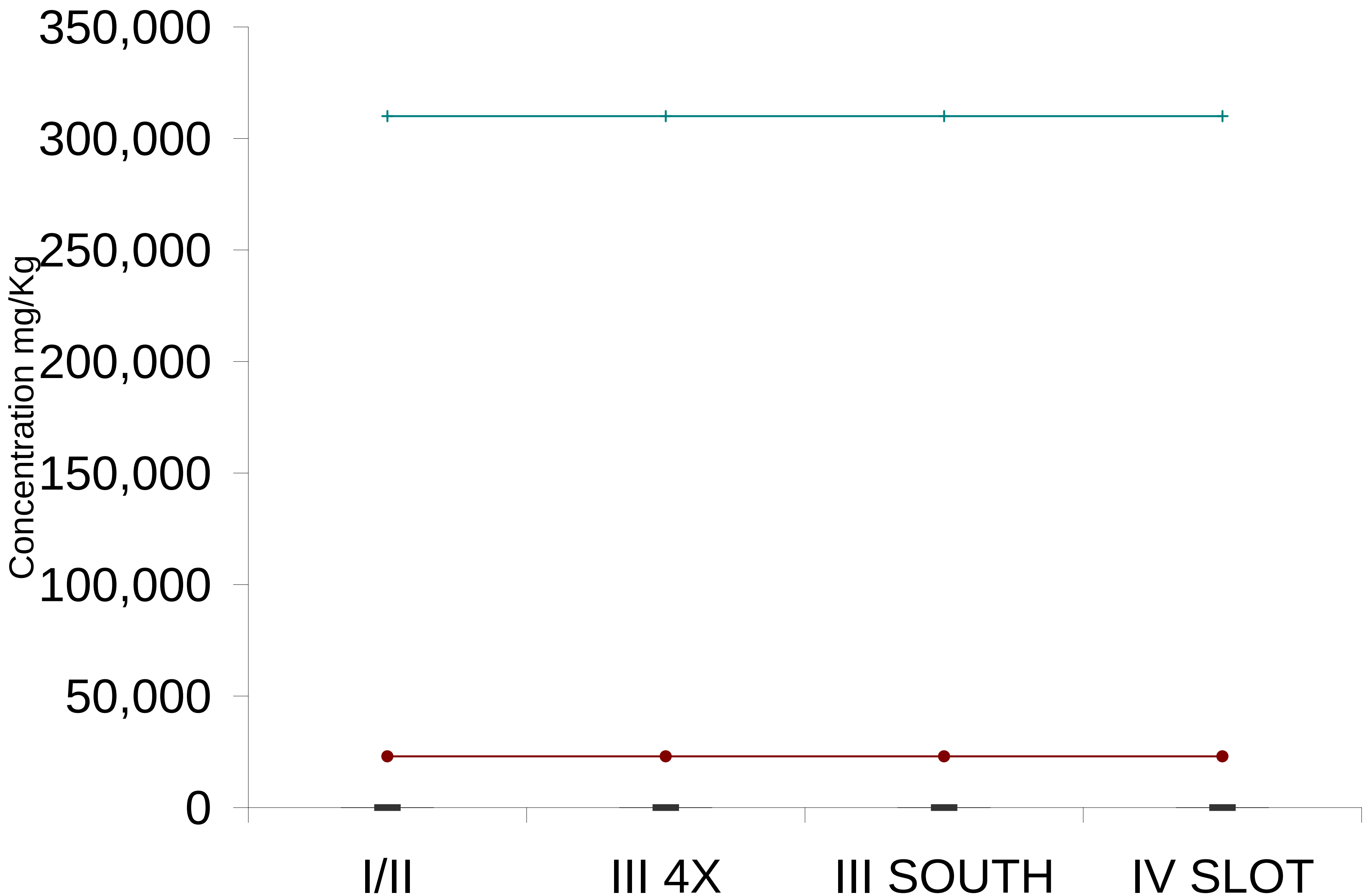


Vanadium

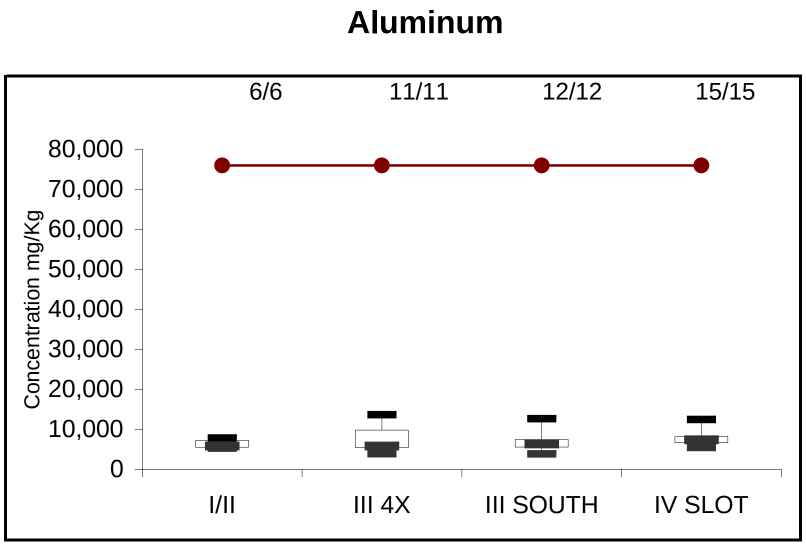


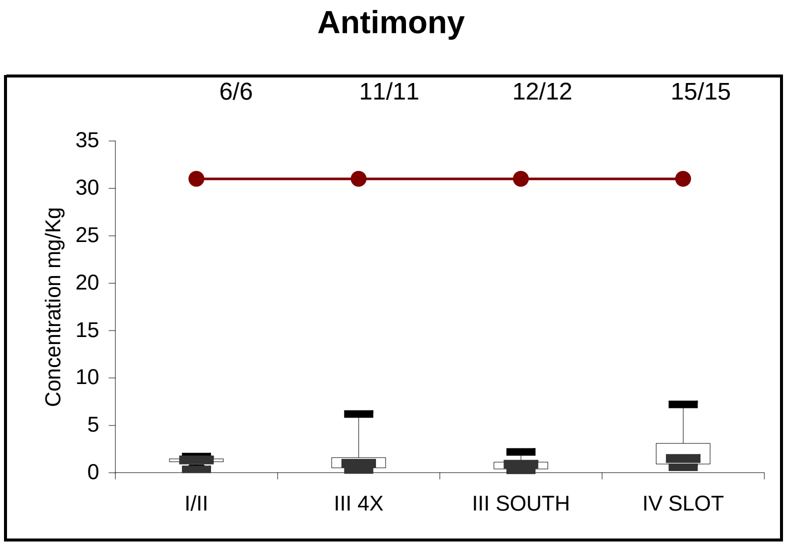
Industrial PRG   Residential PRG

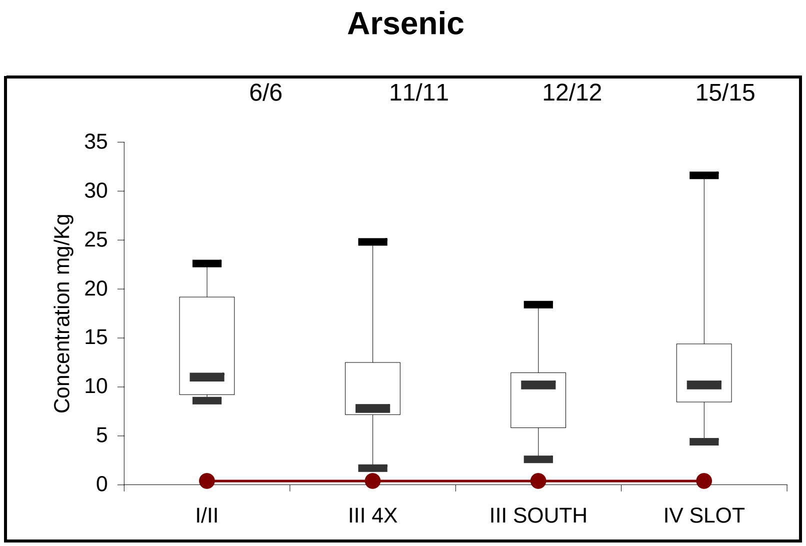
Frequency of Detection at Top of Each Plot

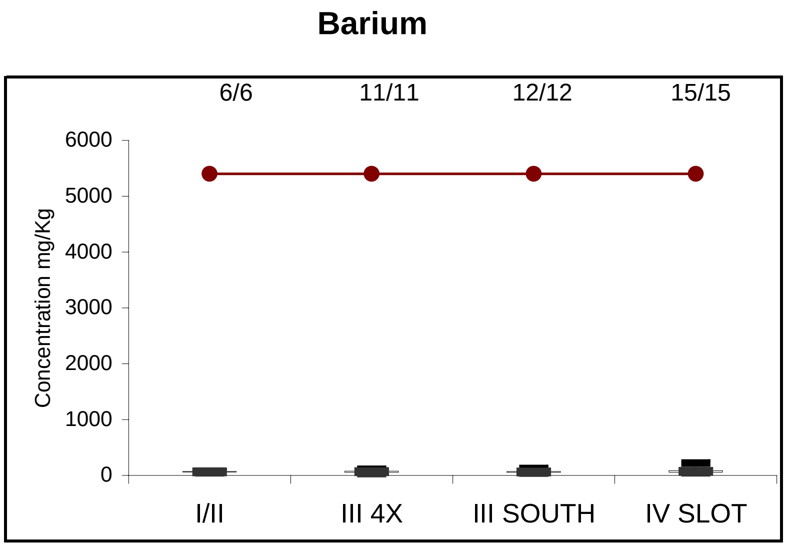

Concentration mg/Kg
350,000
300,000
250,000
200,000
150,000
100,000
50,000
0
I/II
III 4X
III SOUTH
IV SLOT

BOX AND WHISKER PLOTS COMPARING CONCENTRATIONS FROM FOUR HEAP LEACH PADS







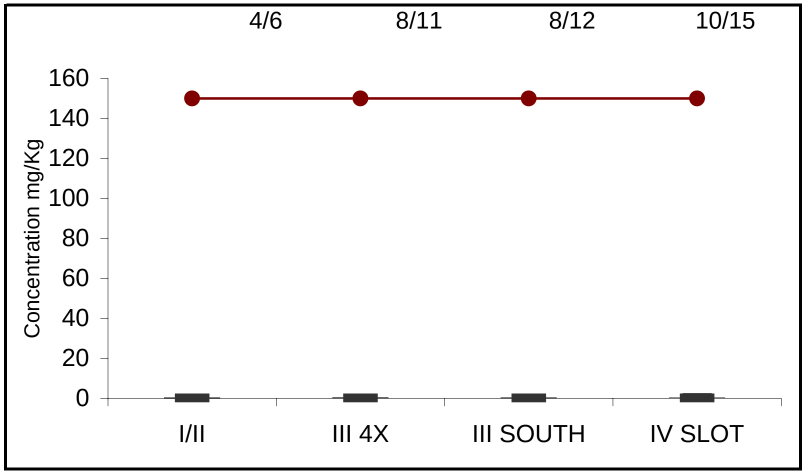


Residential PRG

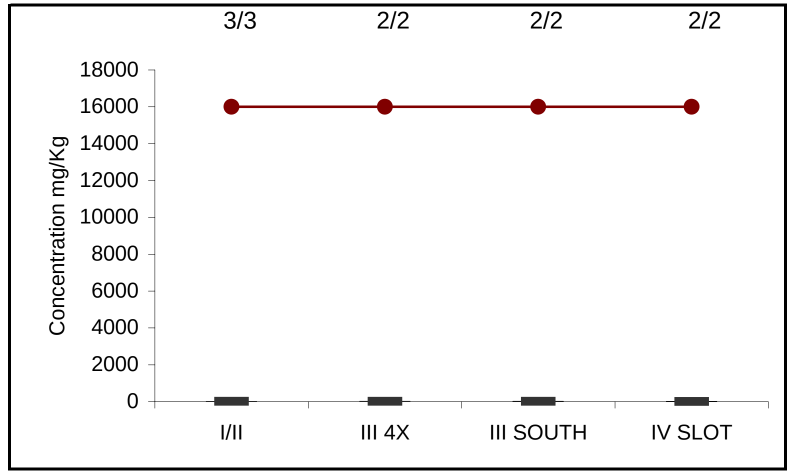
Frequency of Detection at Top of Each Plot

BOX AND WHISKER PLOTS COMPARING CONCENTRATIONS FROM FOUR HEAP LEACH PADS

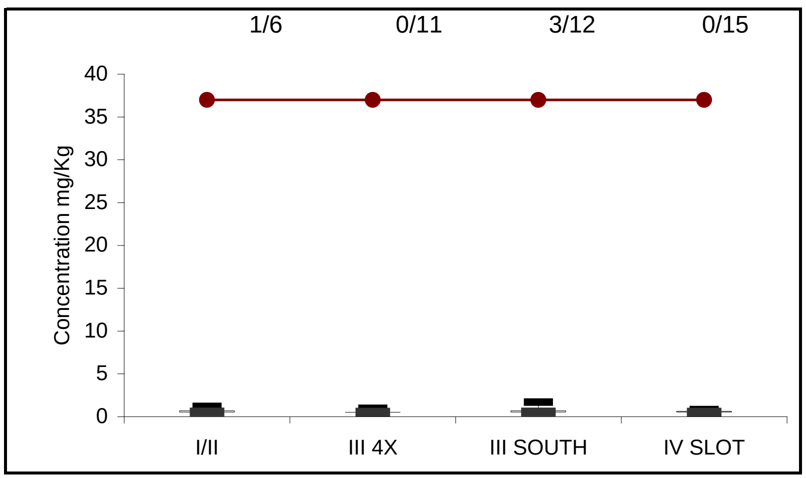
Beryllium



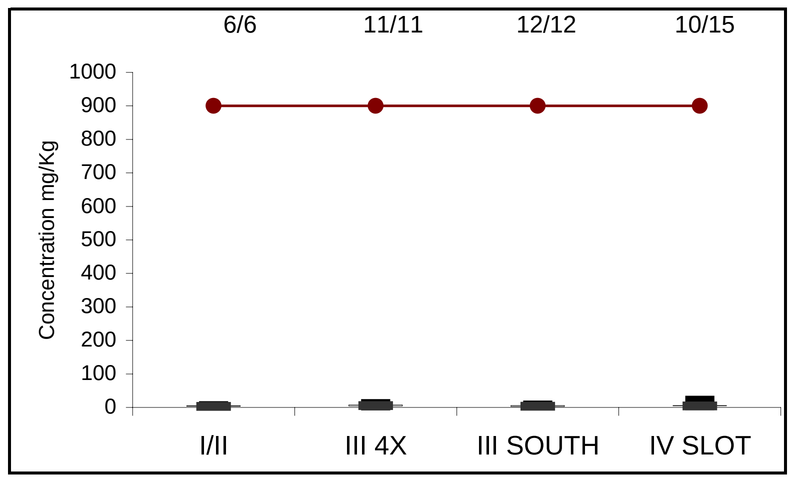
Boron



Cadmium



Cobalt

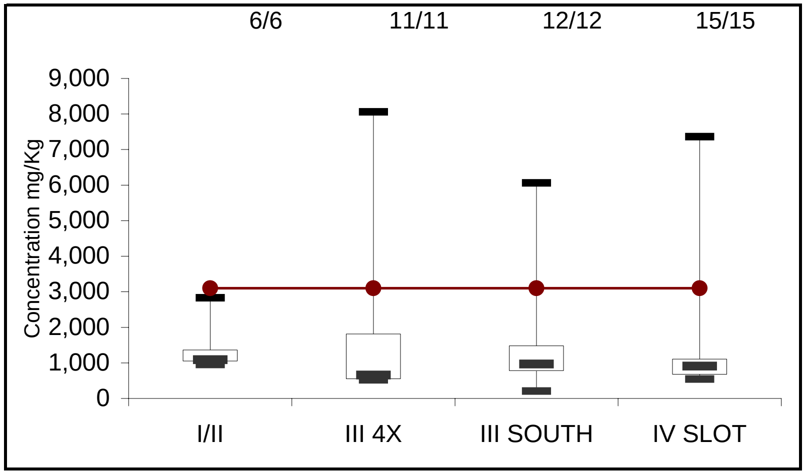


Industrial PRG — Residential PRG

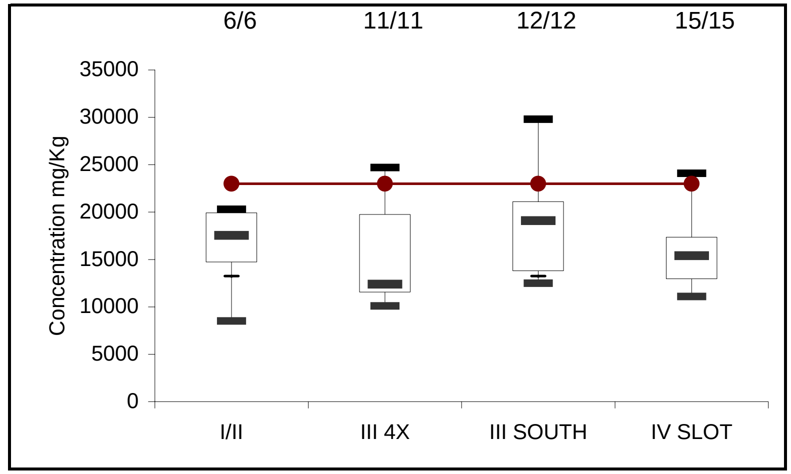
Frequency of Detection at Top of Each Plot

BOX AND WHISKER PLOTS COMPARING CONCENTRATIONS FROM FOUR HEAP LEACH PADS

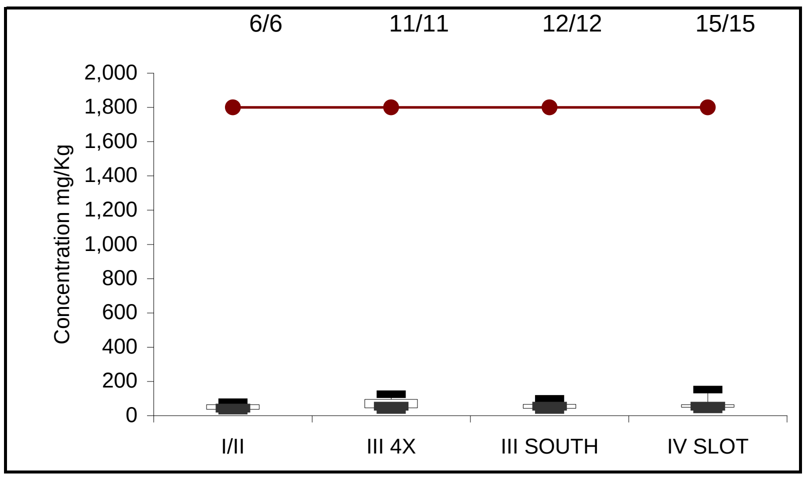
Copper



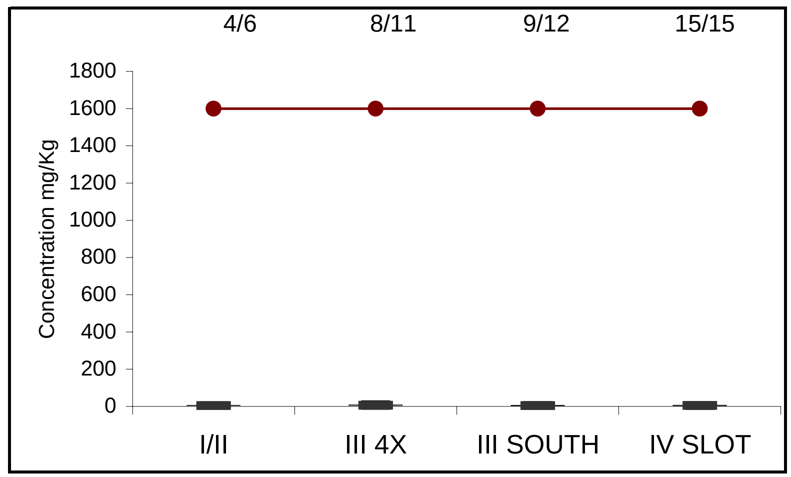
Iron



Manganese



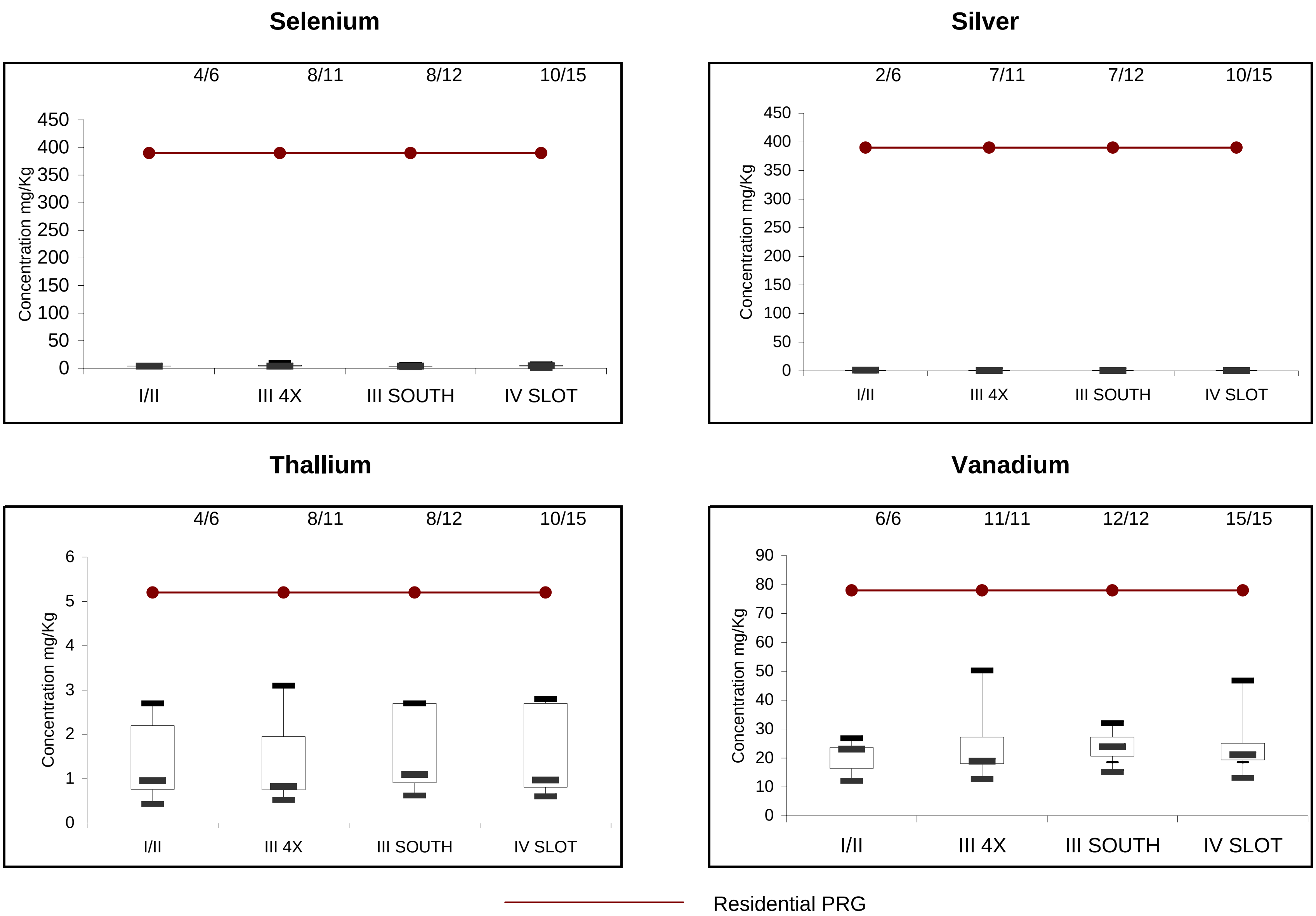
Nickel



Residential PRG

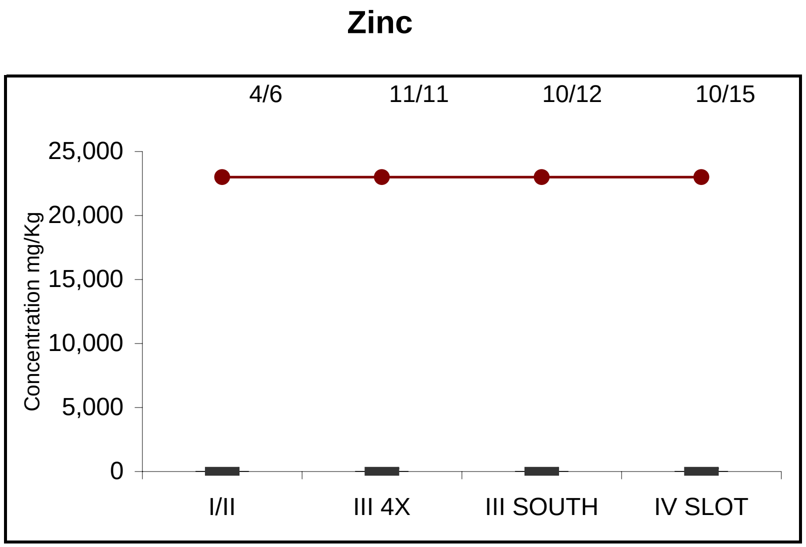
Frequency of Detection at Top of Each Plot

BOX AND WHISKER PLOTS COMPARING CONCENTRATIONS FROM FOUR HEAP LEACH PADS



Frequency of Detection at Top of Each Plot

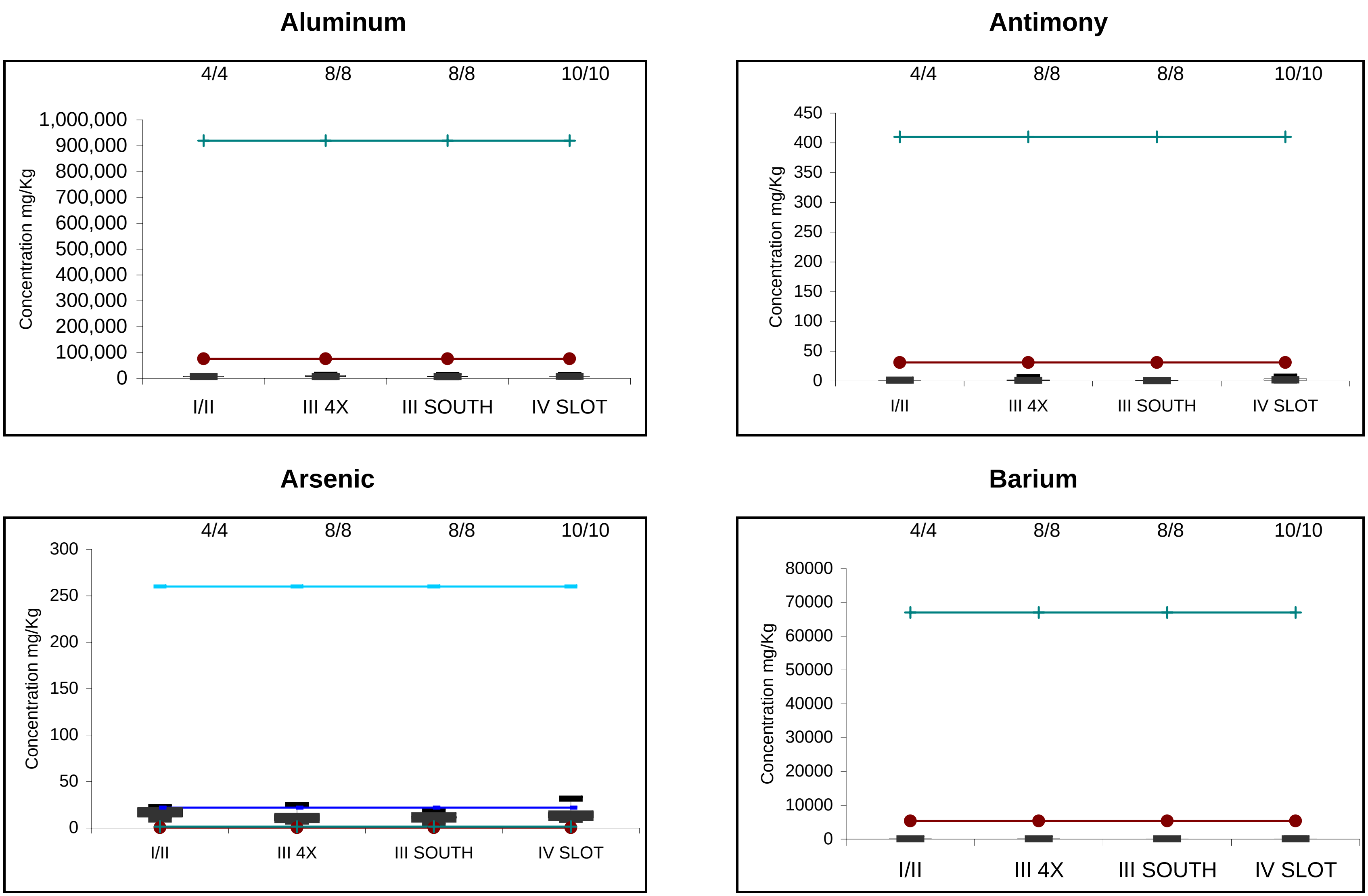
BOX AND WHISKER PLOTS COMPARING CONCENTRATIONS FROM FOUR HEAP LEACH PADS



Residential PRG

Frequency of Detection at Top of Each Plot

BOX AND WHISKER PLOTS COMPARING CONCENTRATIONS FROM FOUR HEAP LEACH PADS

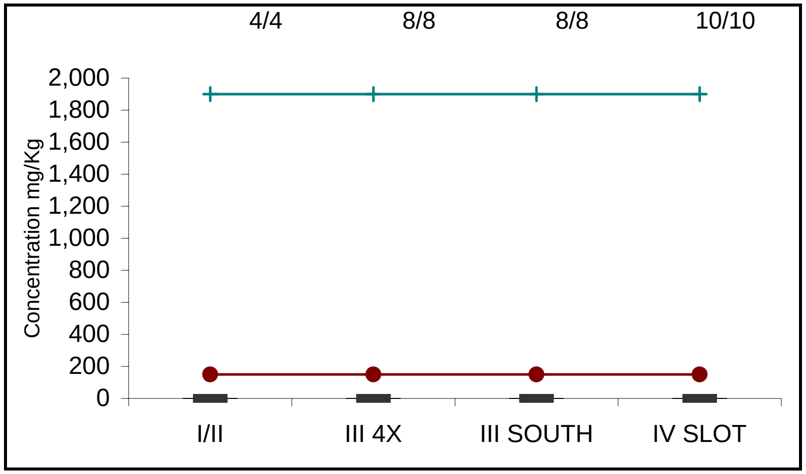


Industrial PRG
Residential PRG
Arsenic Industrial PRG (nc)
Arsenic Residential PRG (nc)

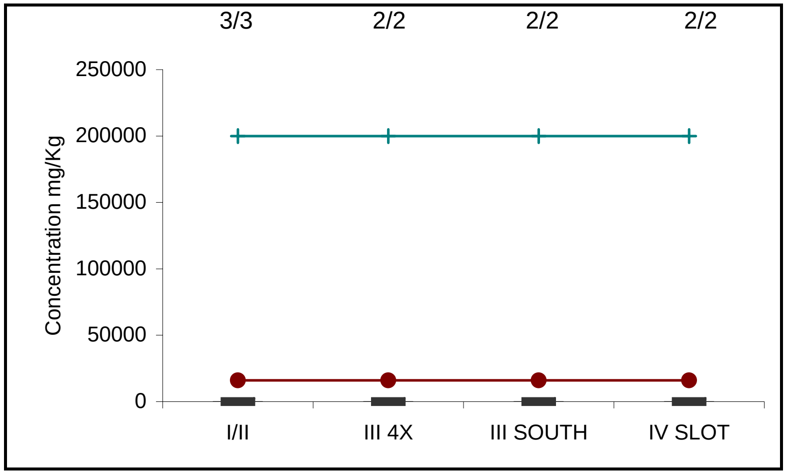
Frequency of Detection at Top of Each Plot

BOX AND WHISKER PLOTS COMPARING CONCENTRATIONS FROM FOUR HEAP LEACH PADS

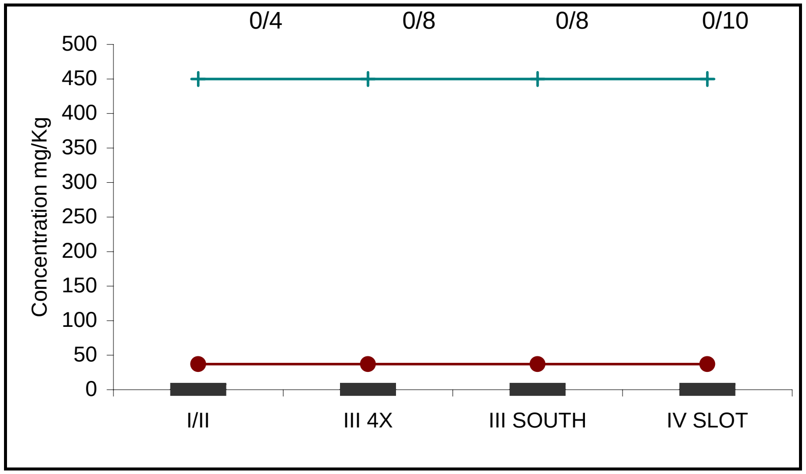
Beryllium



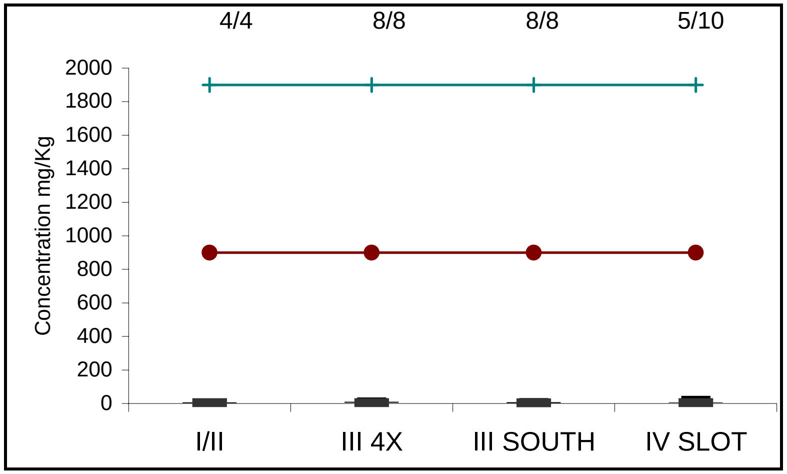
Boron



Cadmium



Cobalt

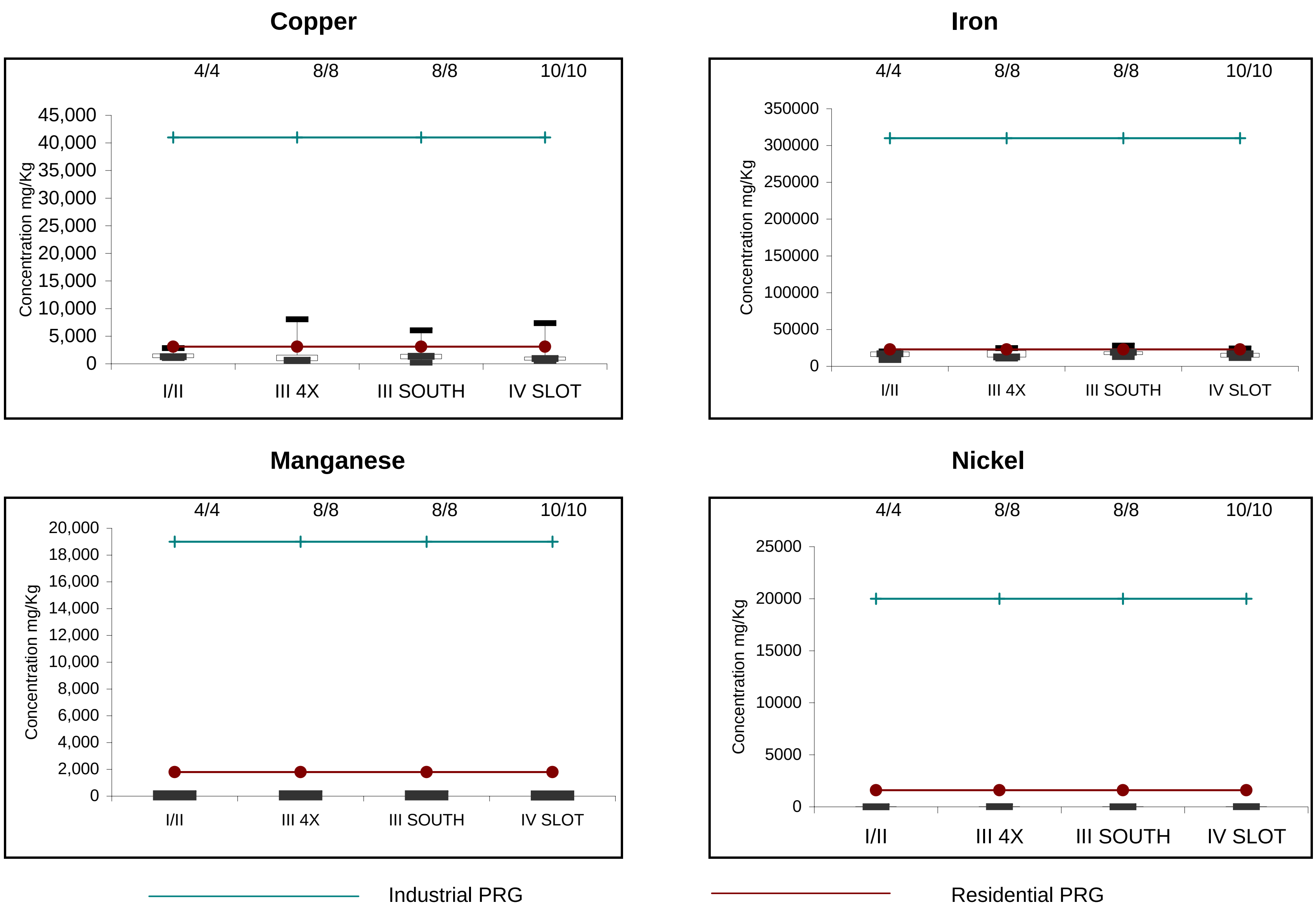


Industrial PRG

Residential PRG

Frequency of Detection at Top of Each Plot

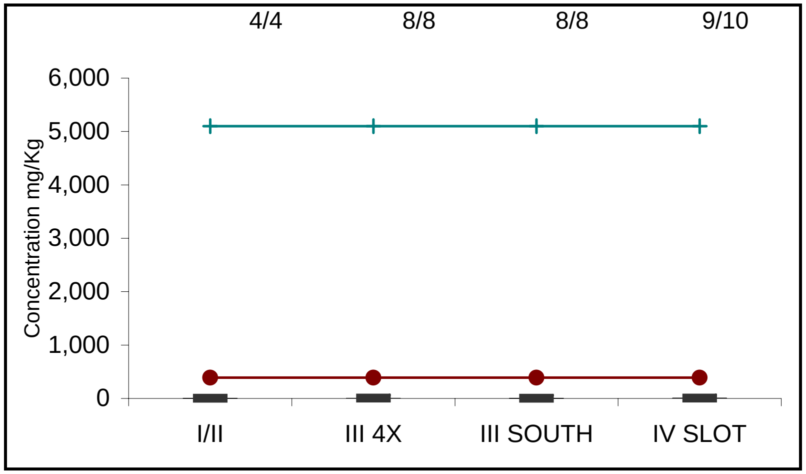
BOX AND WHISKER PLOTS COMPARING CONCENTRATIONS FROM FOUR HEAP LEACH PADS



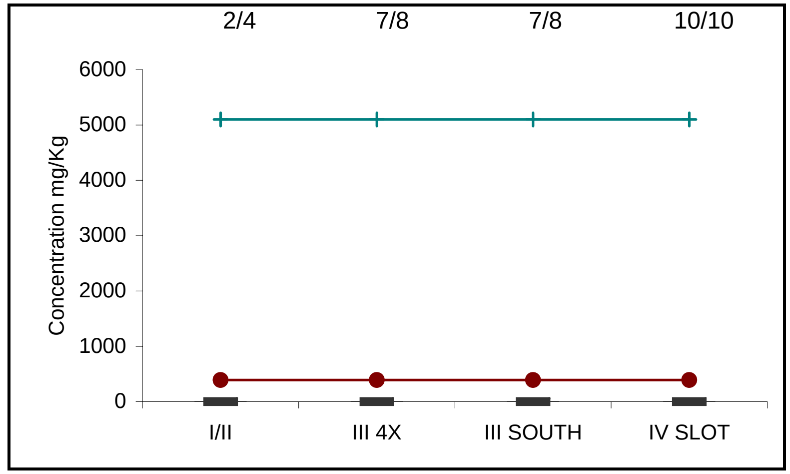
Frequency of Detection at Top of Each Plot

BOX AND WHISKER PLOTS COMPARING CONCENTRATIONS FROM FOUR HEAP LEACH PADS

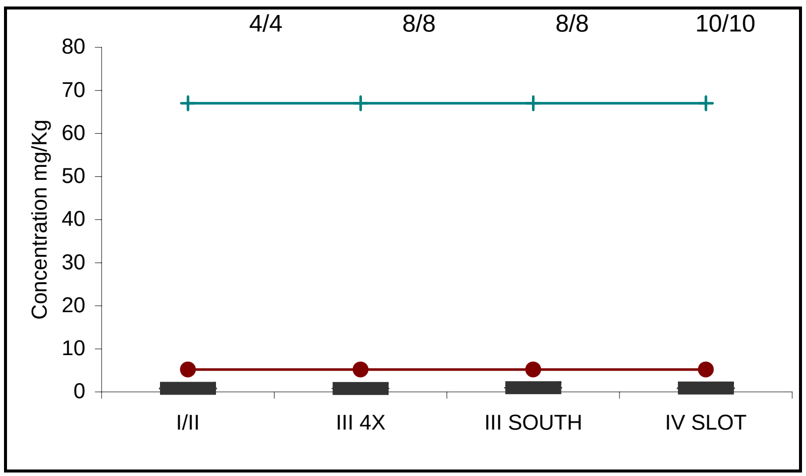
Selenium



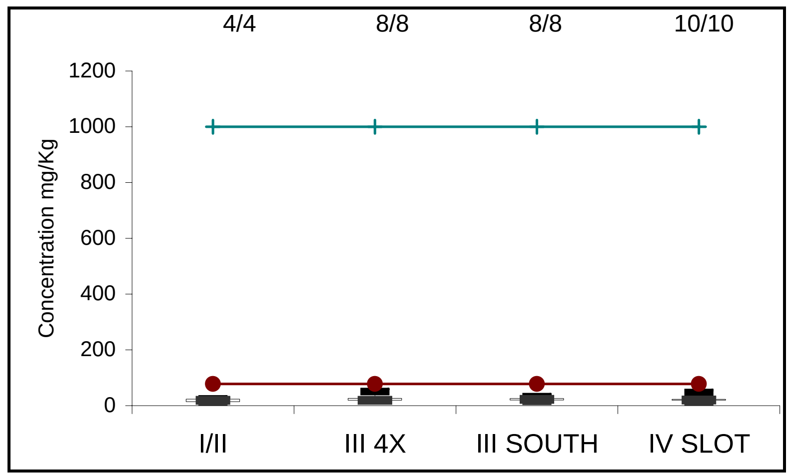
Silver



Thallium



Vanadium



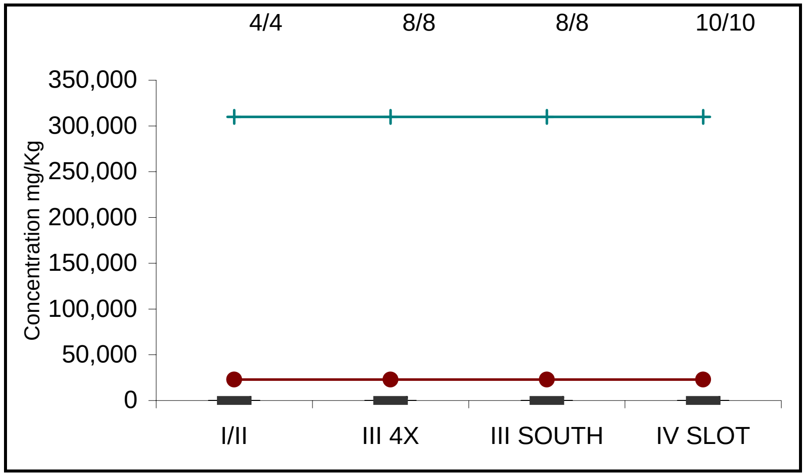
Industrial PRG

Residential PRG

Frequency of Detection at Top of Each Plot

BOX AND WHISKER PLOTS COMPARING CONCENTRATIONS FROM FOUR HEAP LEACH PADS

Zinc



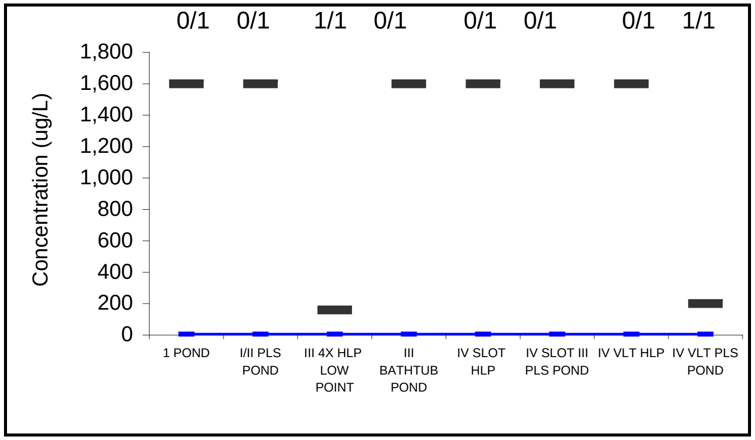
Industrial PRG

Residential PRG

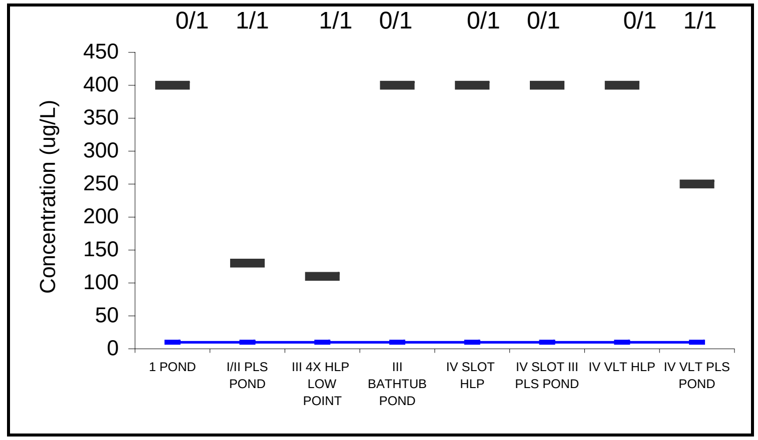
Frequency of Detection at Top of Each Plot

Box and Whisker Plots Comparing Concentrations Drain Down Samples

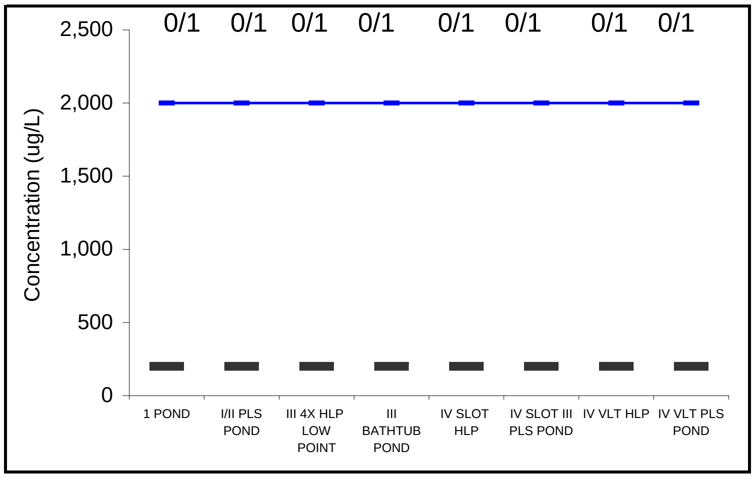
Antimony



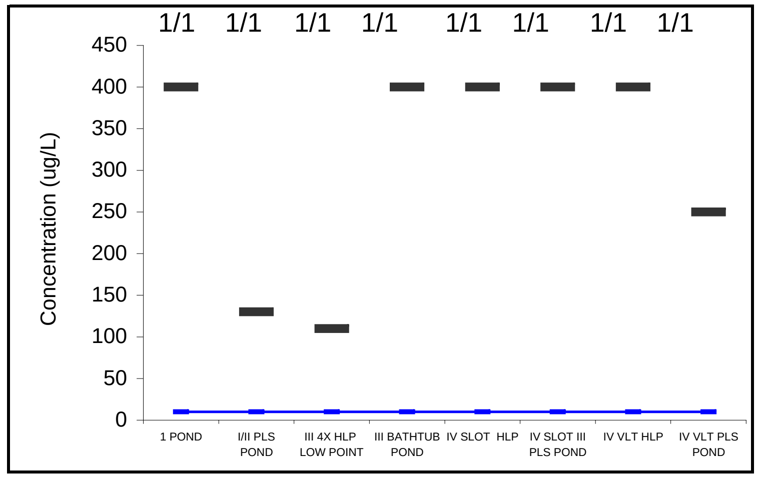
Arsenic



Barium



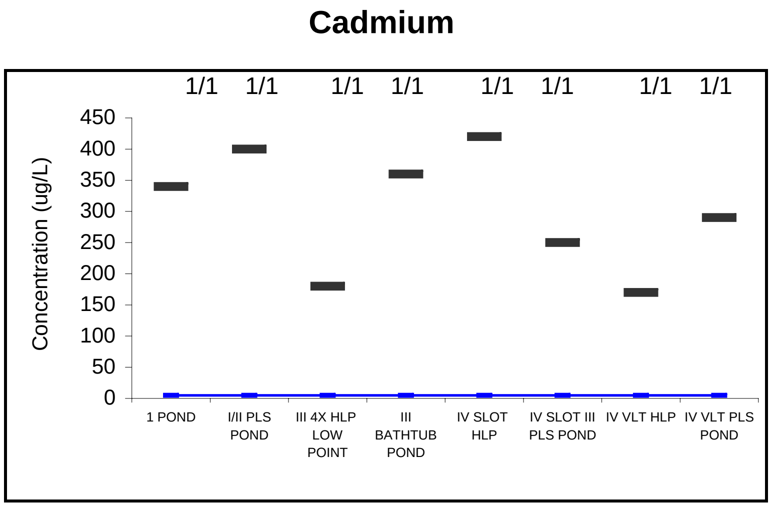
Beryllium

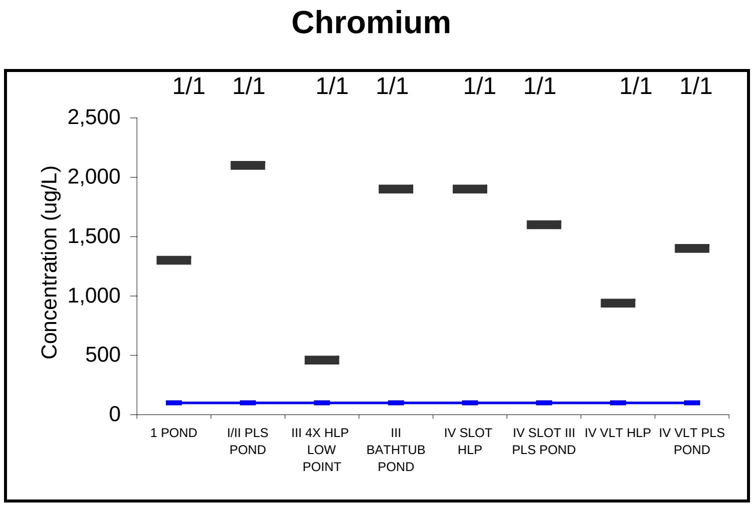


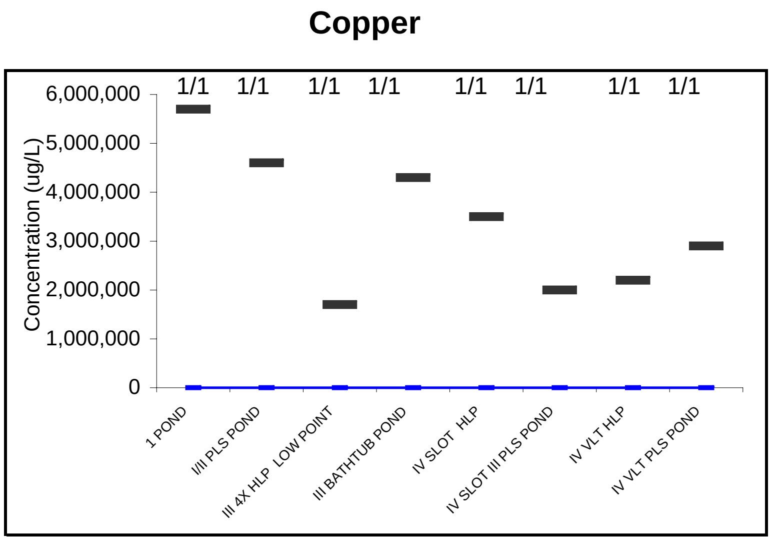
Primary MCL

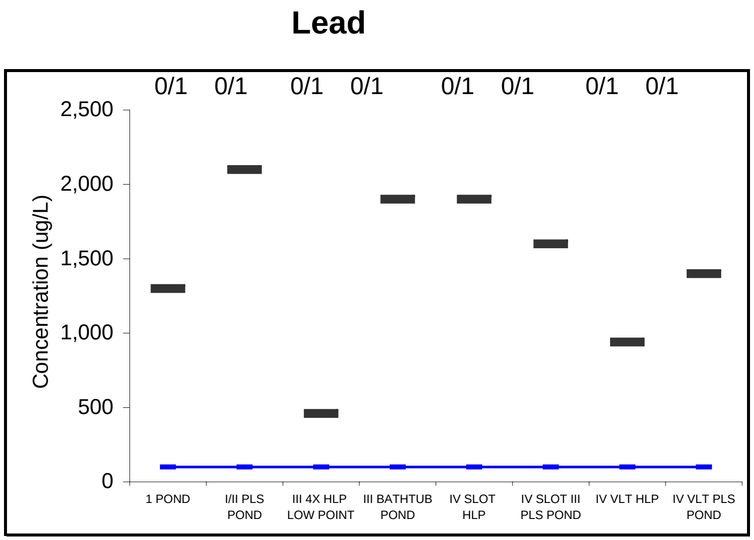
Frequency of Detection at Top of Each Plot

Box and Whisker Plots Comparing Concentrations Drain Down Samples







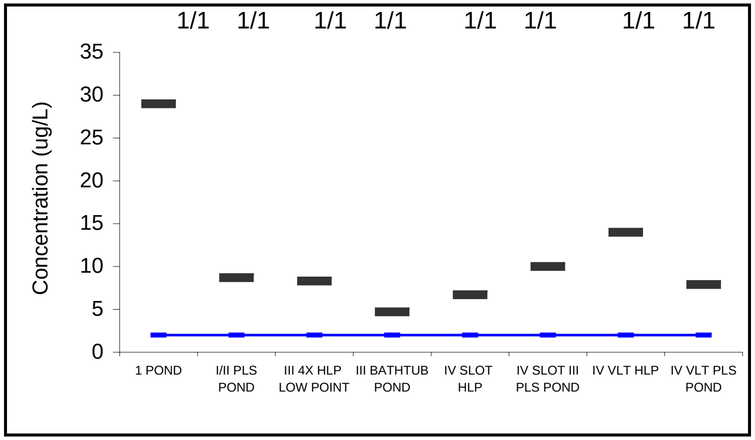


Primary MCL

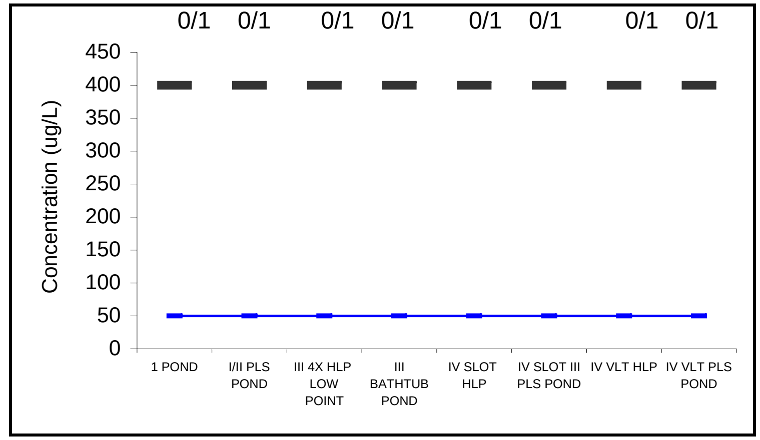
Frequency of Detection at Top of Each Plot

Box and Whisker Plots Comparing Concentrations Drain Down Samples

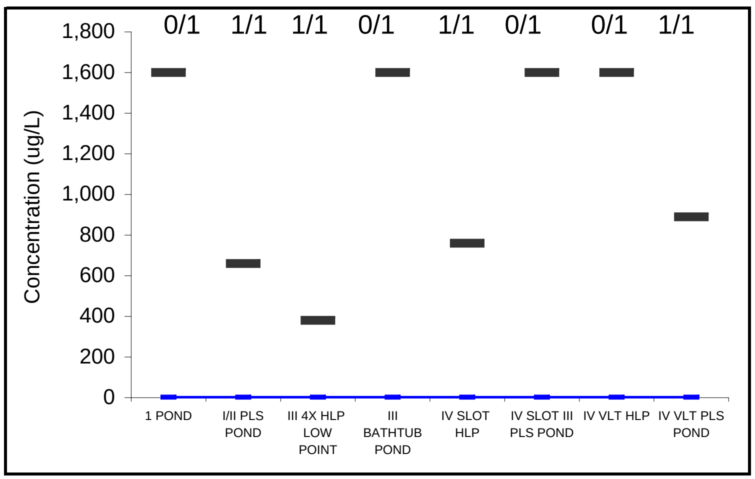
Mercury



Selenium



Thallium

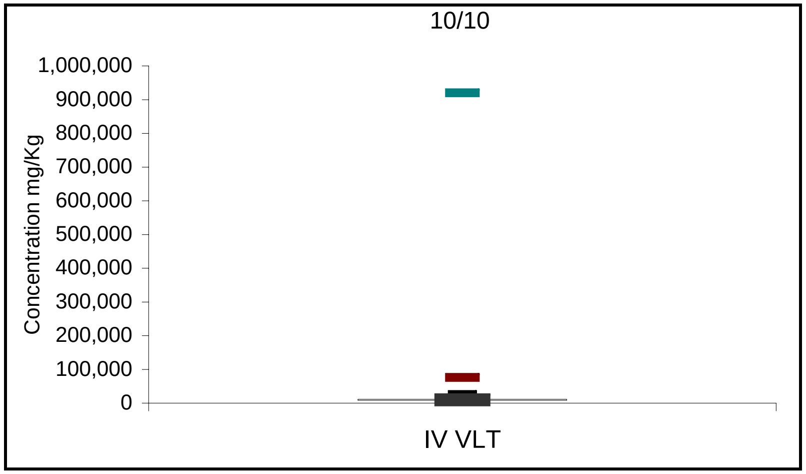


Primary MCL

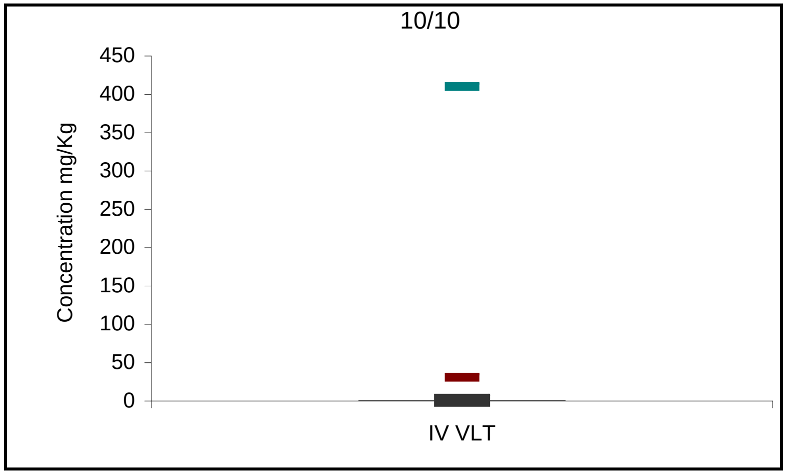
Frequency of Detection at Top of Each Plot

BOX AND WHISKER PLOTS COMPARING CONCENTRATIONS FROM FOUR HEAP LEACH PADS

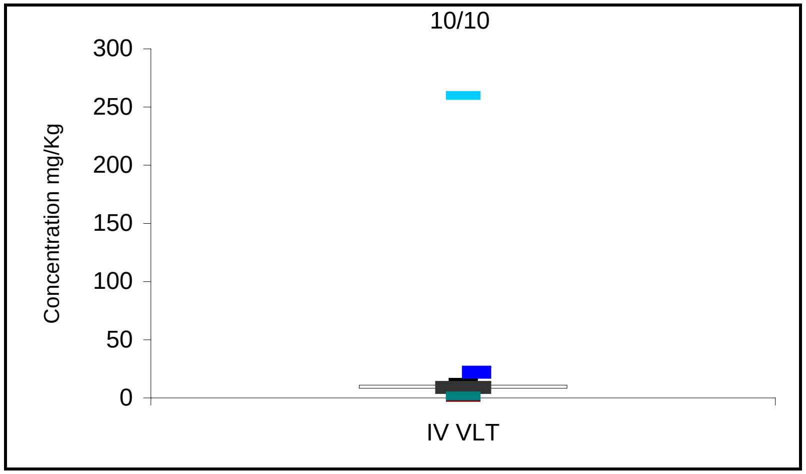
Aluminum



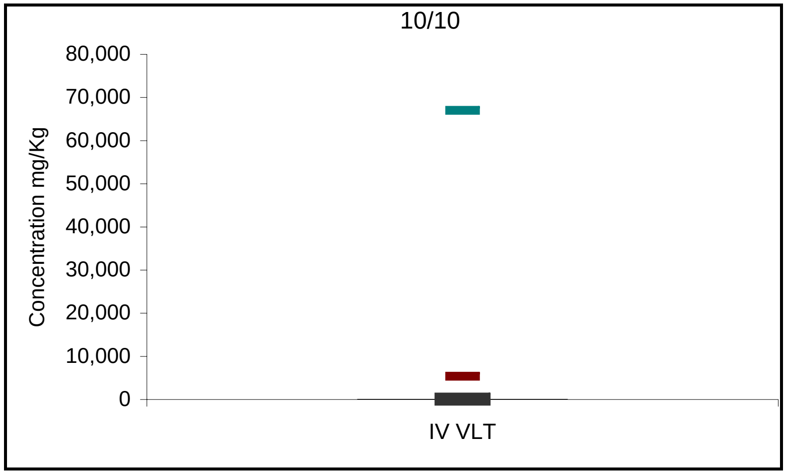
Antimony



Arsenic



Barium

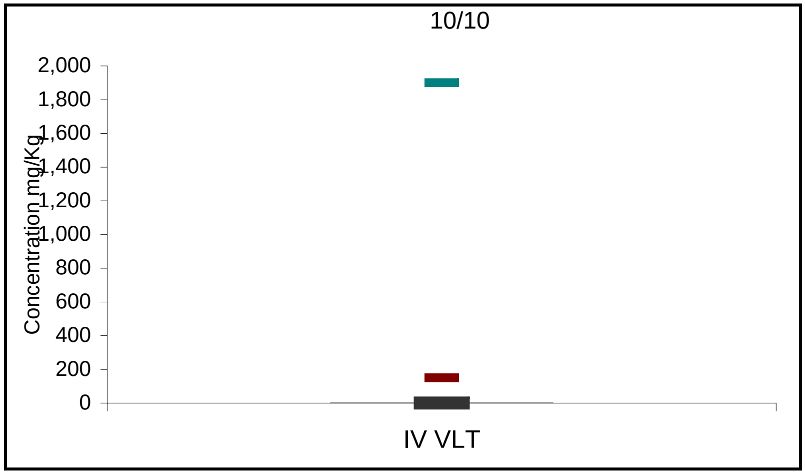


— Industrial PRG
— Arsenic Industrial PRG (nc)
— Residential PRG
— Arsenic Residential PRG (nc)

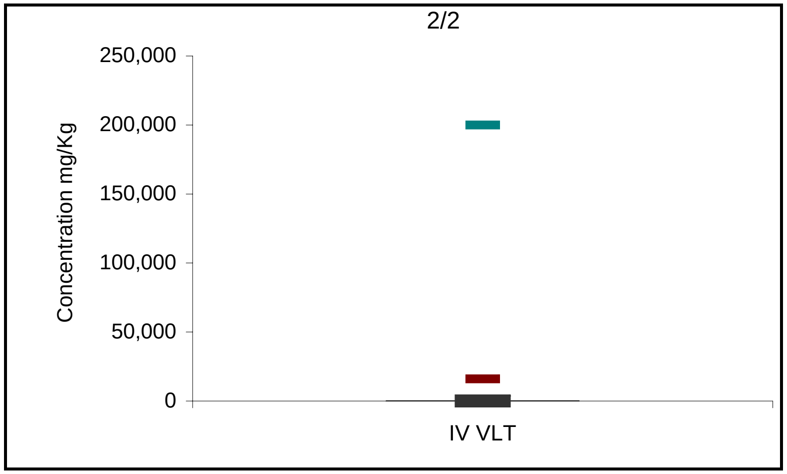
Frequency of Detection at Top of Each Plot

BOX AND WHISKER PLOTS COMPARING CONCENTRATIONS FROM FOUR HEAP LEACH PADS

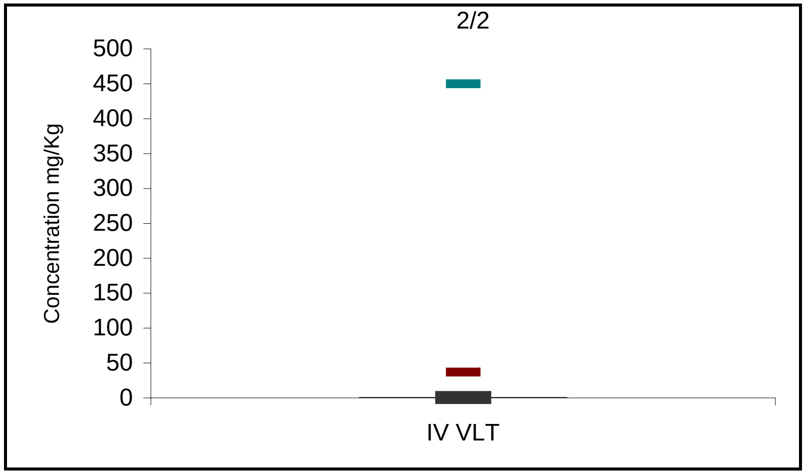
Beryllium



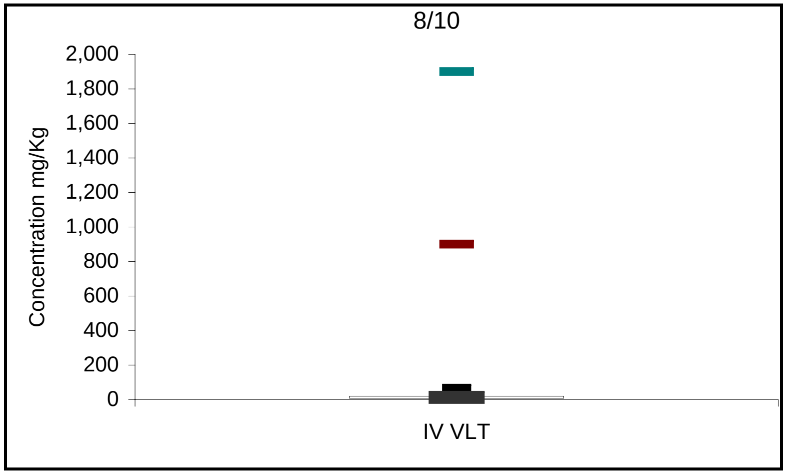
Boron



Cadmium



Cobalt



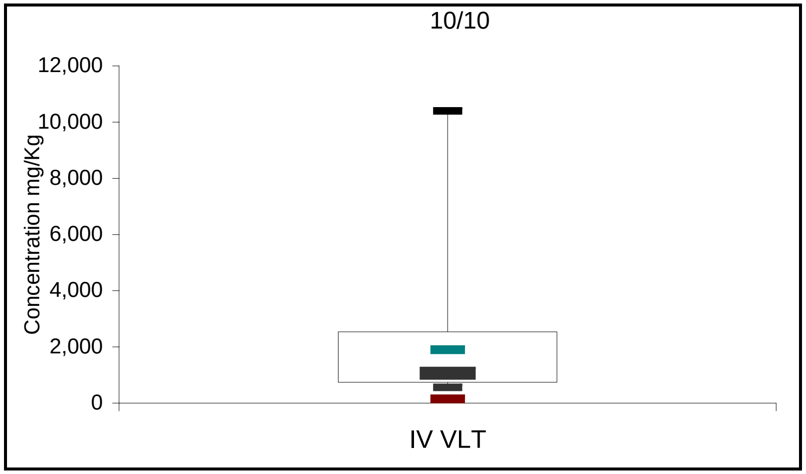
Industrial PRG

Residential PRG

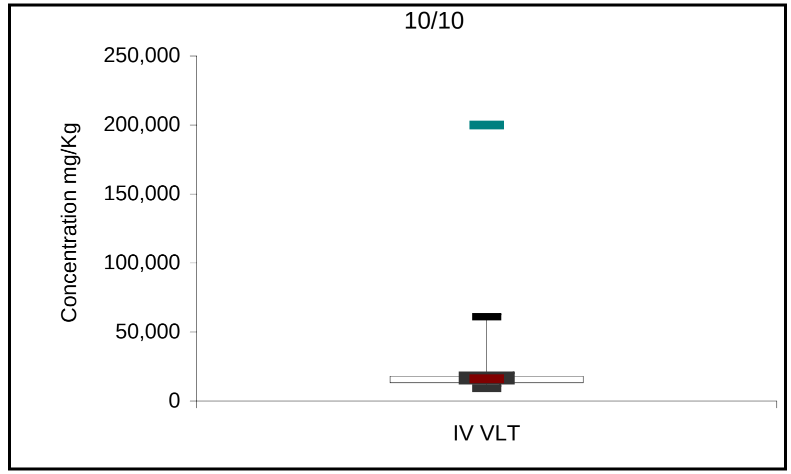
Frequency of Detection at Top of Each Plot

BOX AND WHISKER PLOTS COMPARING CONCENTRATIONS FROM FOUR HEAP LEACH PADS

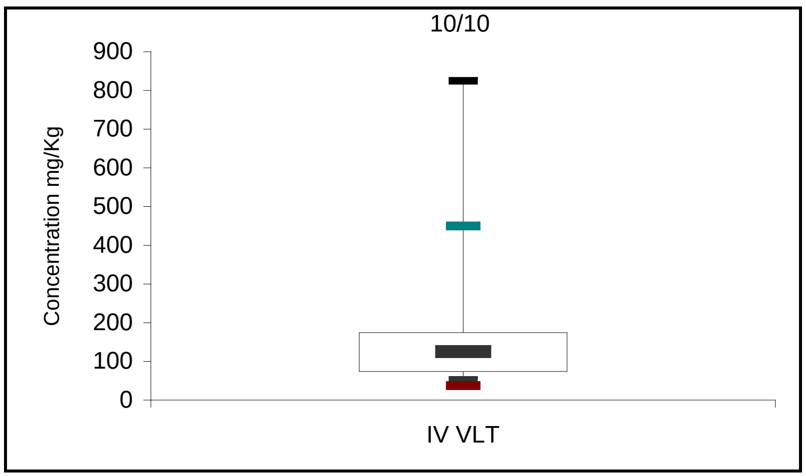
Copper



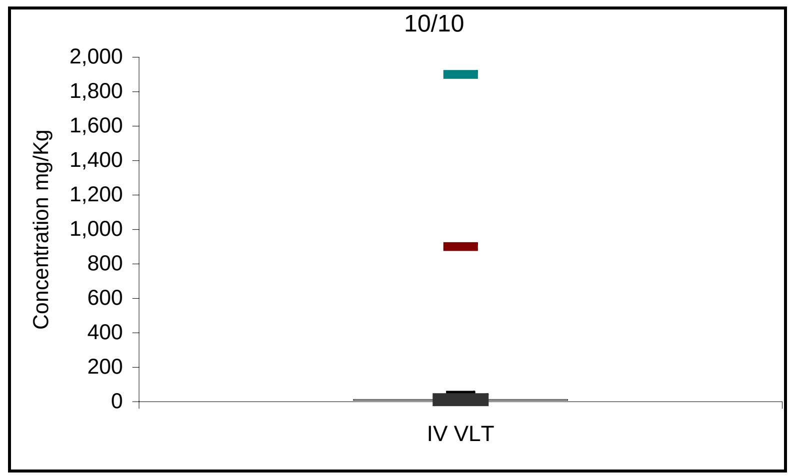
Iron



Manganese



Nickel



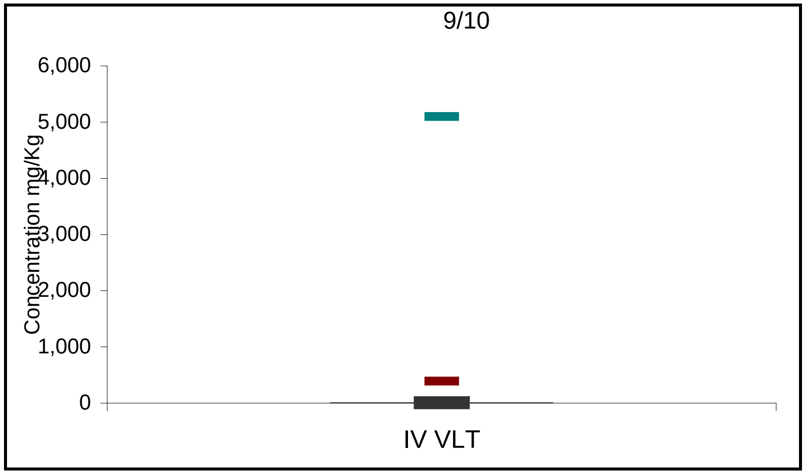
— Industrial PRG

— Residential PRG

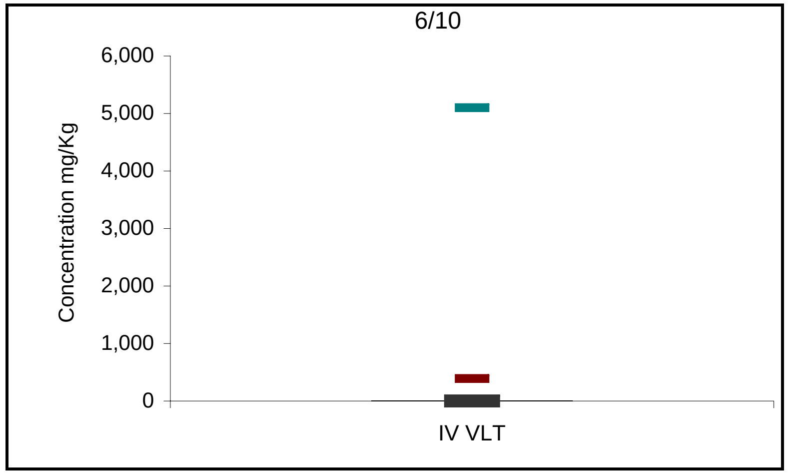
Frequency of Detection at Top of Each Plot

BOX AND WHISKER PLOTS COMPARING CONCENTRATIONS FROM FOUR HEAP LEACH PADS

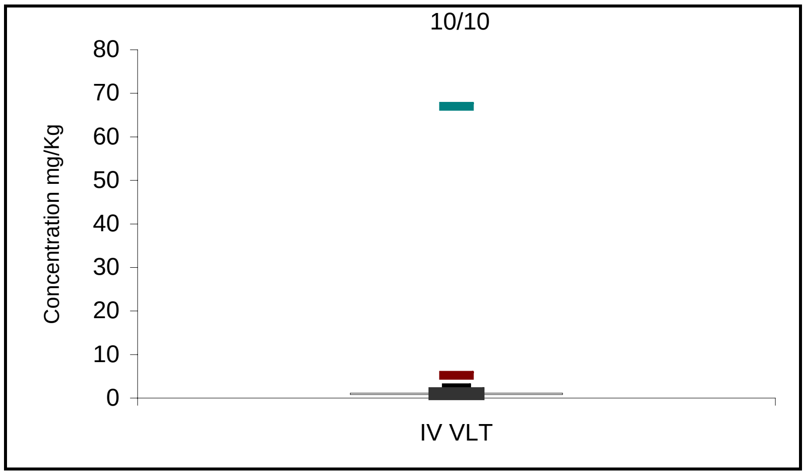
Selenium



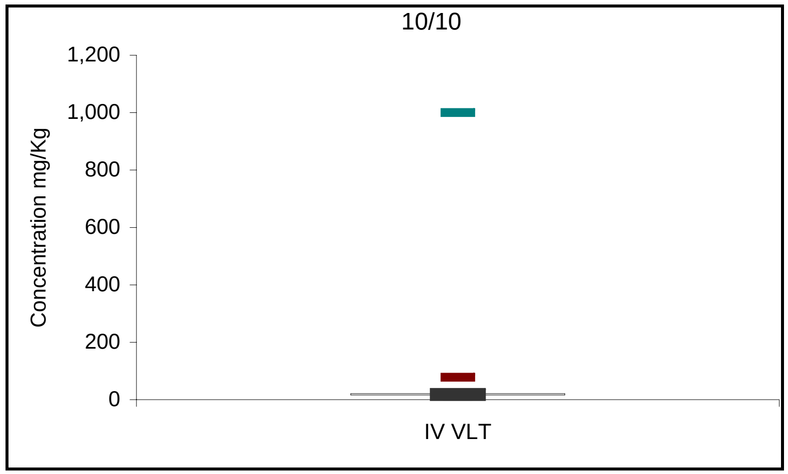
Silver



Thallium



Vanadium

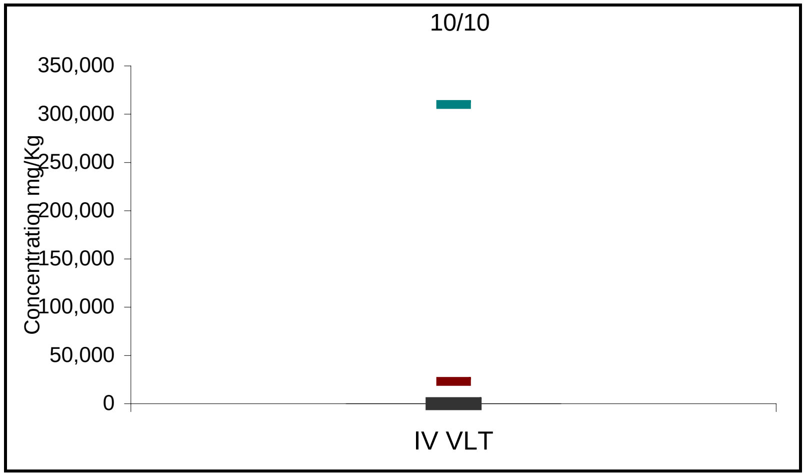


— Industrial PRG — Residential PRG

Frequency of Detection at Top of Each Plot

BOX AND WHISKER PLOTS COMPARING CONCENTRATIONS FROM FOUR HEAP LEACH PADS

Zinc

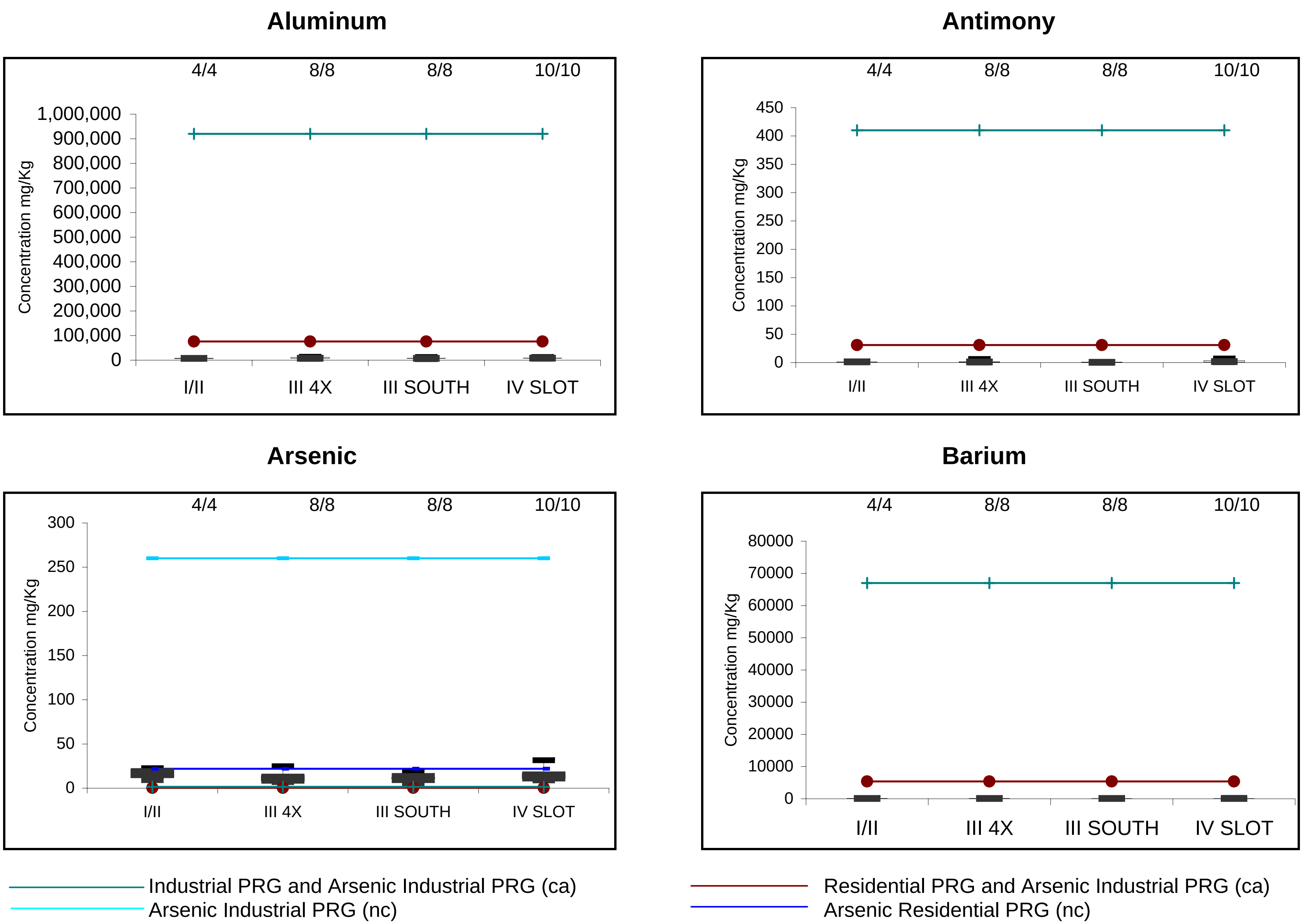


Industrial PRG

Residential PRG

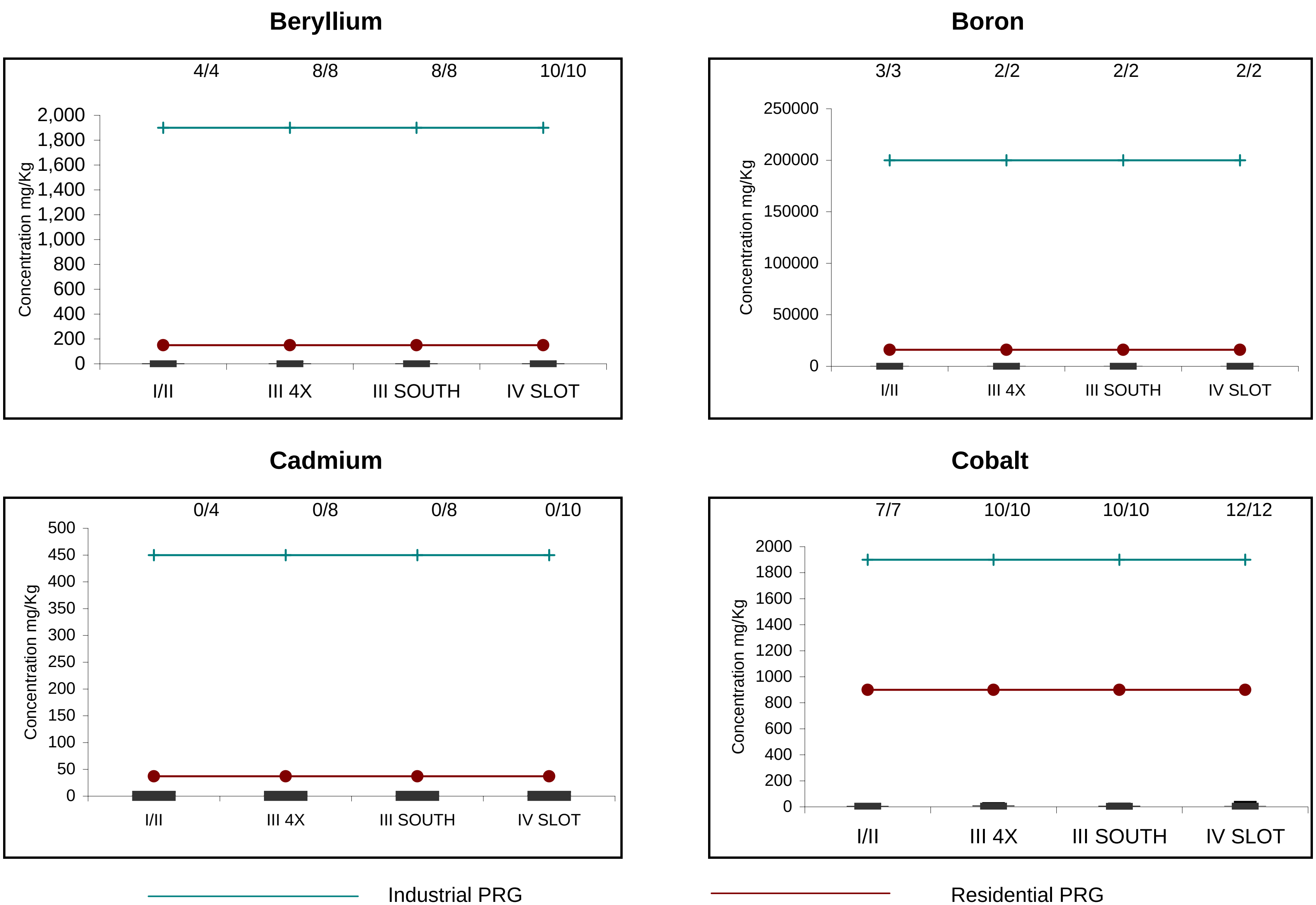
Frequency of Detection at Top of Each Plot

Box and Whisker Plots Comparing Concentrations from Four Heap Leach pads (Group A)



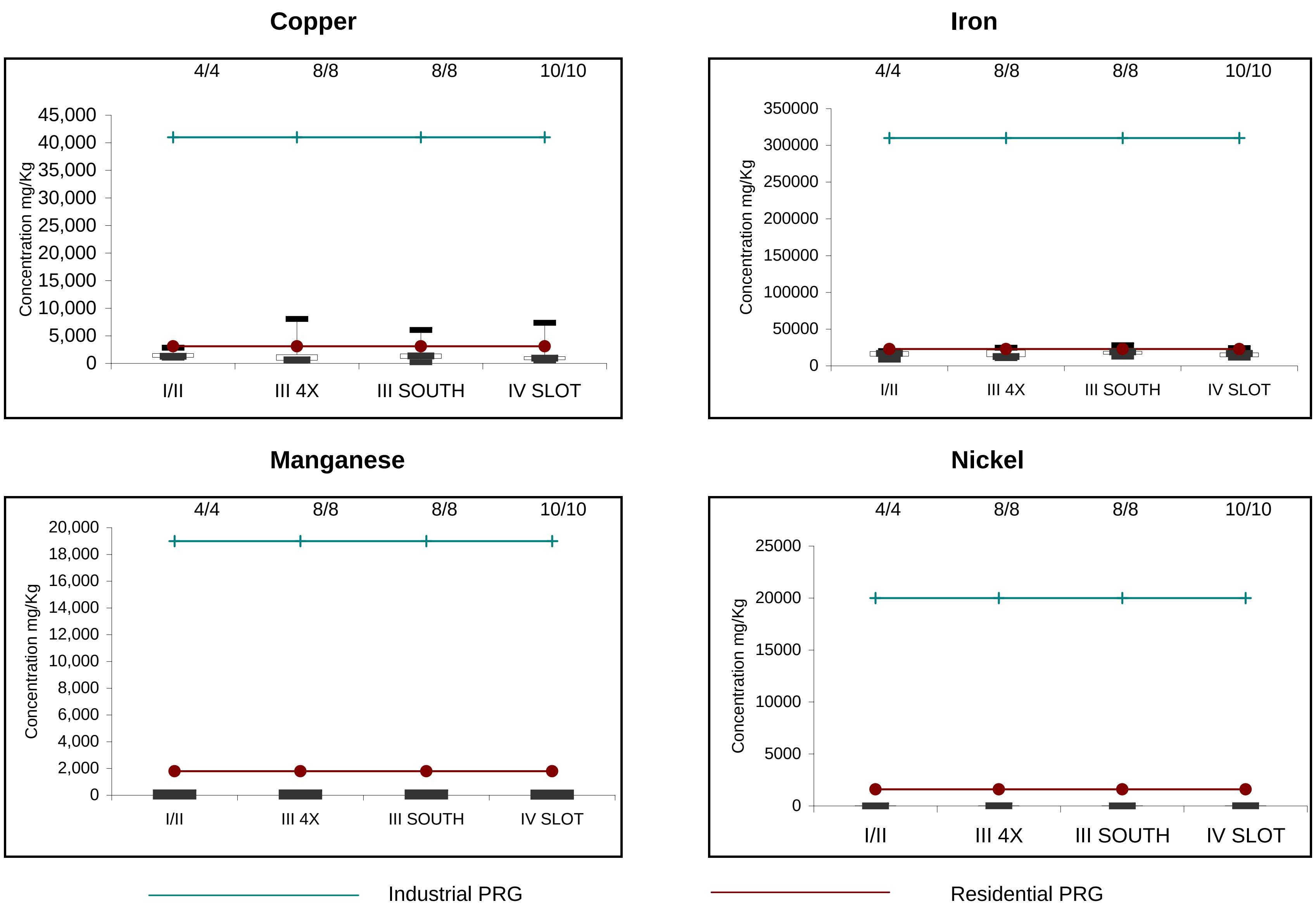
Frequency of Detection at Top of Each Plot

Box and Whisker Plots Comparing Concentrations from Four Heap Leach pads (Group A)



Frequency of Detection at Top of Each Plot

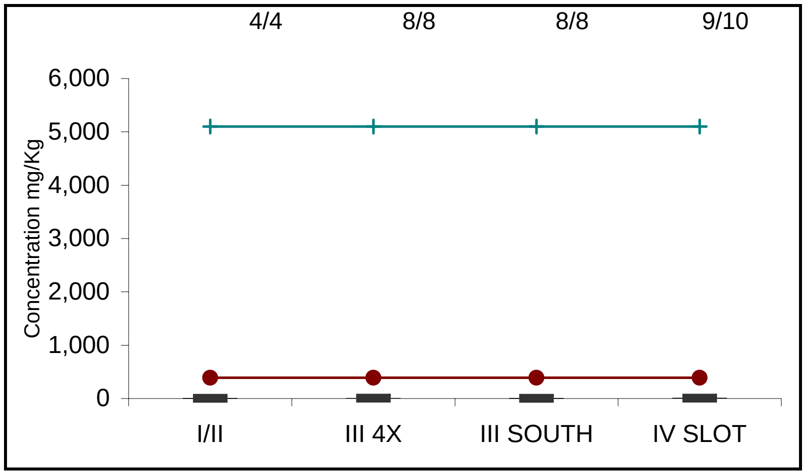
Box and Whisker Plots Comparing Concentrations from Four Heap Leach pads (Group A)



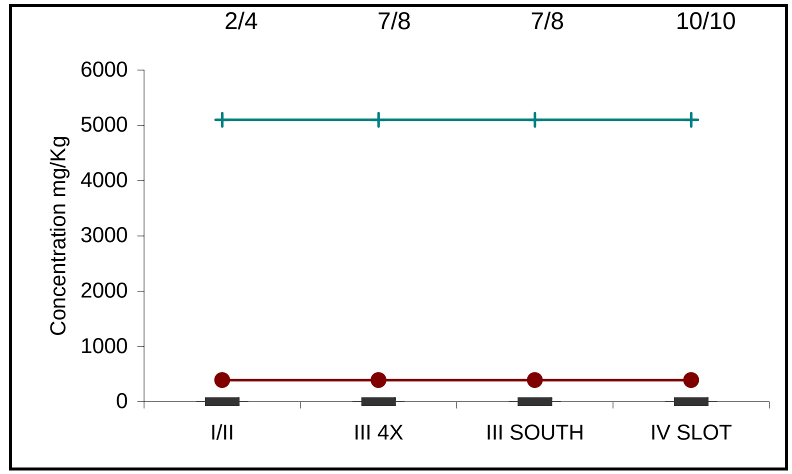
Frequency of Detection at Top of Each Plot

Box and Whisker Plots Comparing Concentrations from Four Heap Leach pads (Group A)

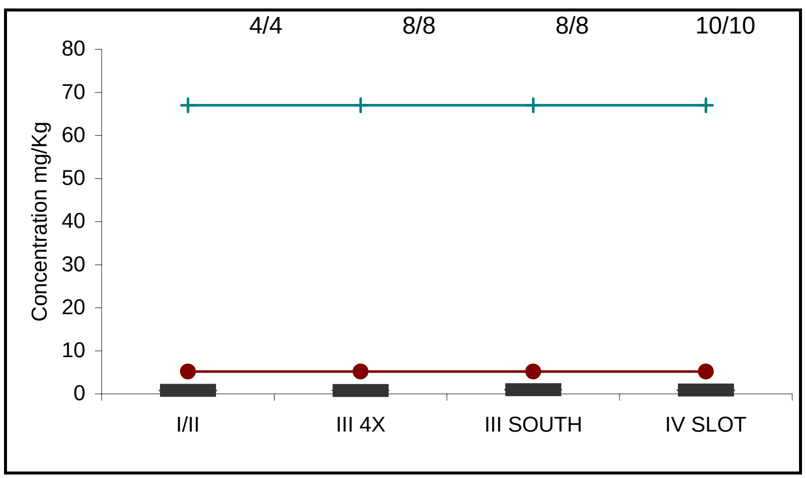
Selenium



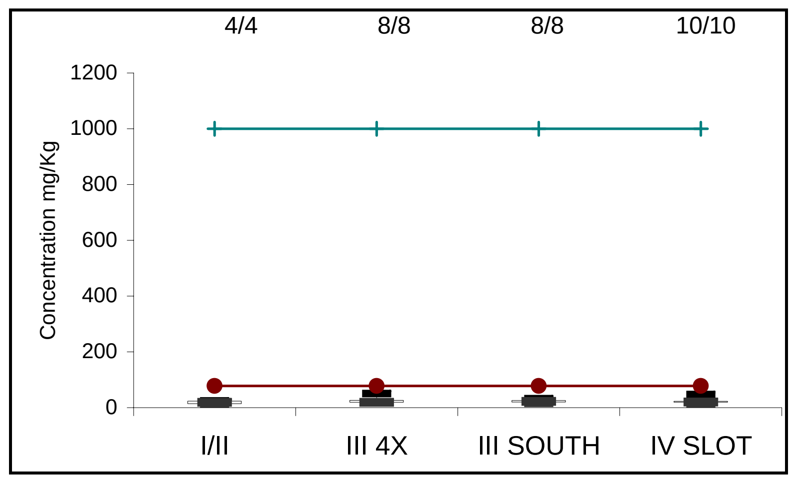
Silver



Thallium



Vanadium



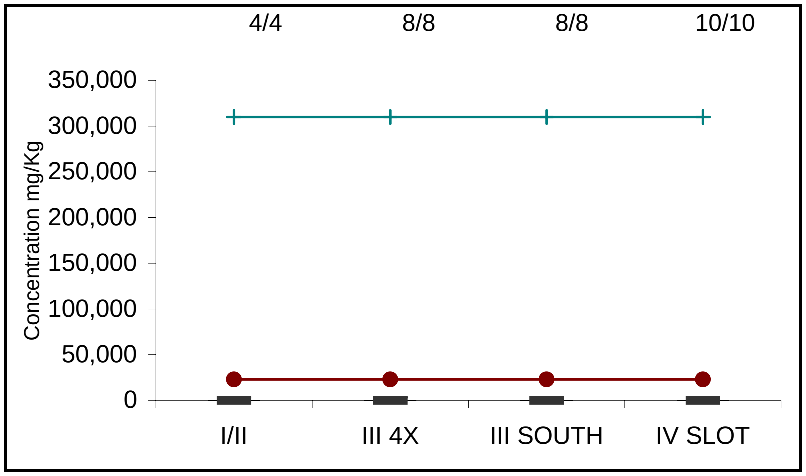
Industrial PRG

Residential PRG

Frequency of Detection at Top of Each Plot

Box and Whisker Plots Comparing Concentrations from Four Heap Leach pads (Group A)

Zinc

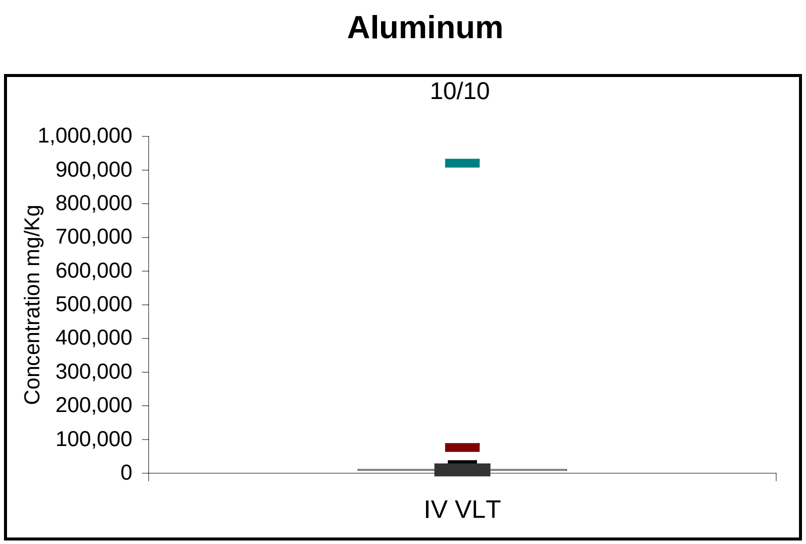


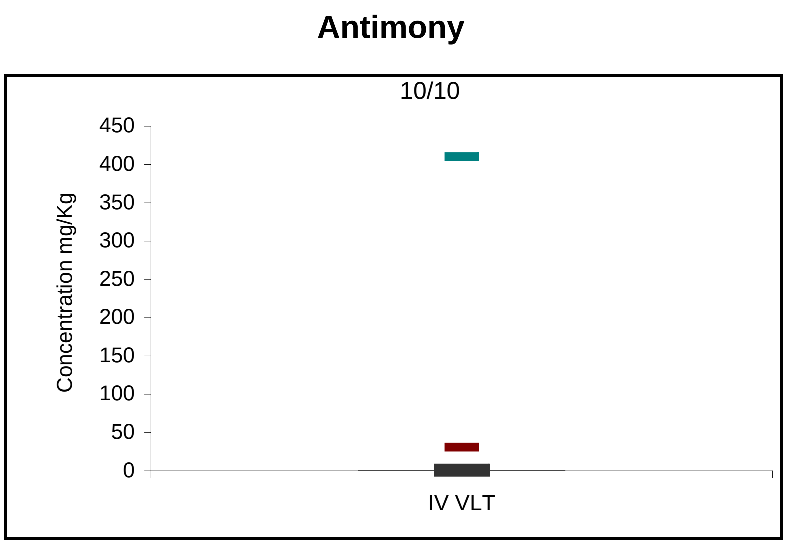
Industrial PRG

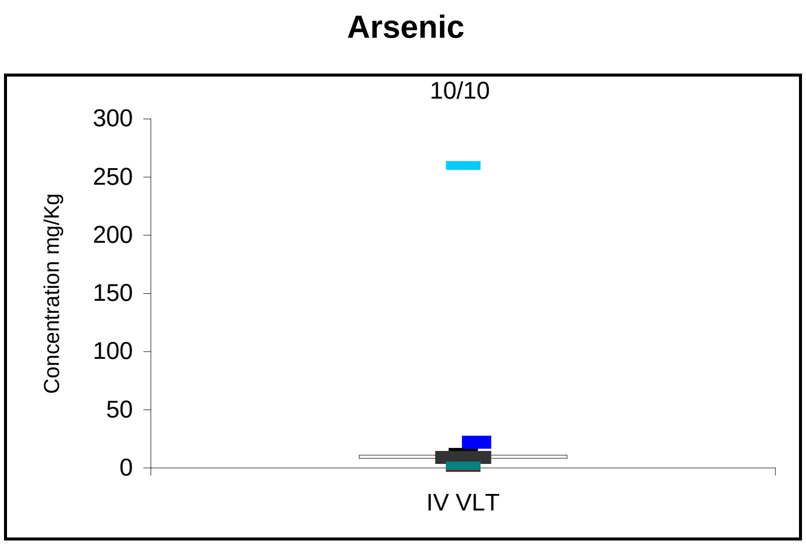
Residential PRG

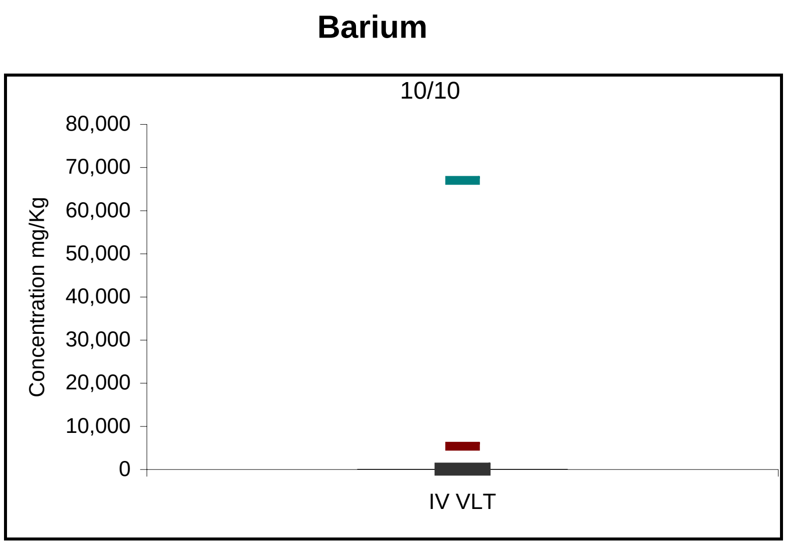
Frequency of Detection at Top of Each Plot

Box and Whisker Plots Comparing Concentrations from the Phase IV VLT Heap Leach Pad and Soil (Group B)







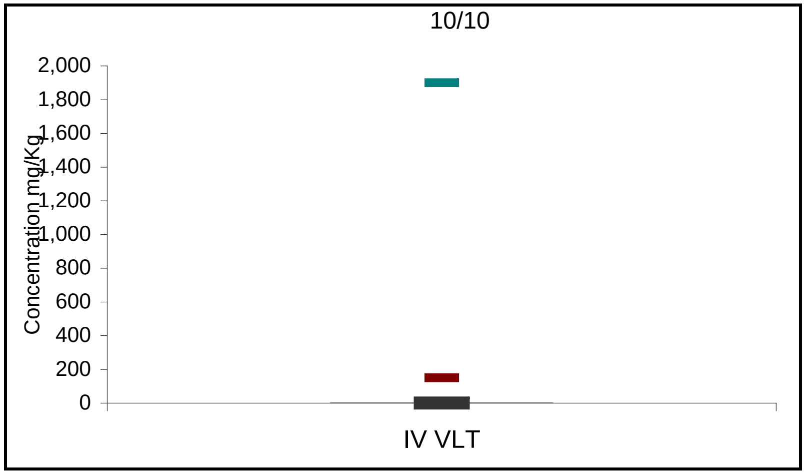


Industrial PRG and Arsenic Industrial PRG (ca)
Residential PRG and Arsenic Industrial PRG (ca)
Arsenic Industrial PRG (nc)
Arsenic Residential PRG (nc)

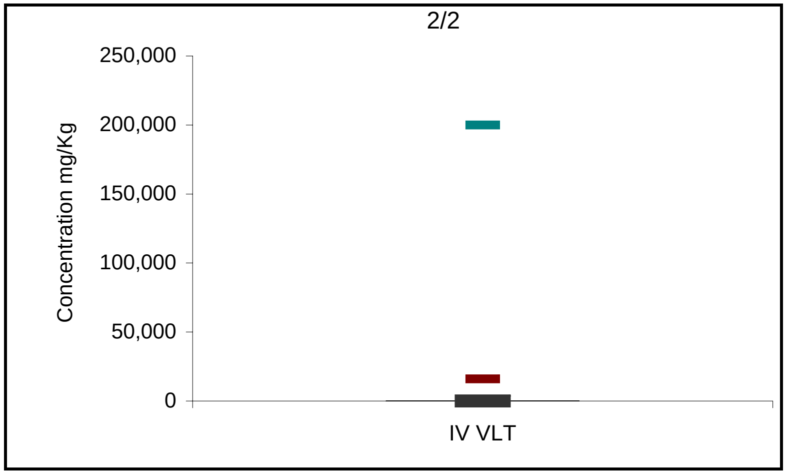
Frequency of Detection at Top of Each Plot

Box and Whisker Plots Comparing Concentrations from the Phase IV VLT Heap Leach Pad and Soil (Group B)

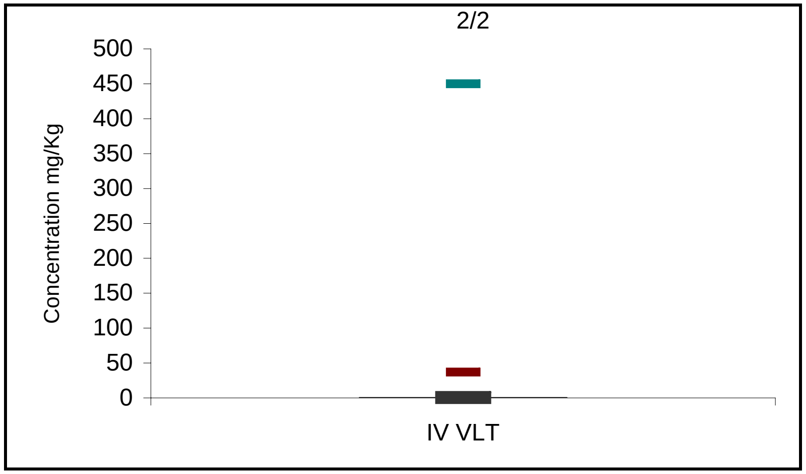
Beryllium



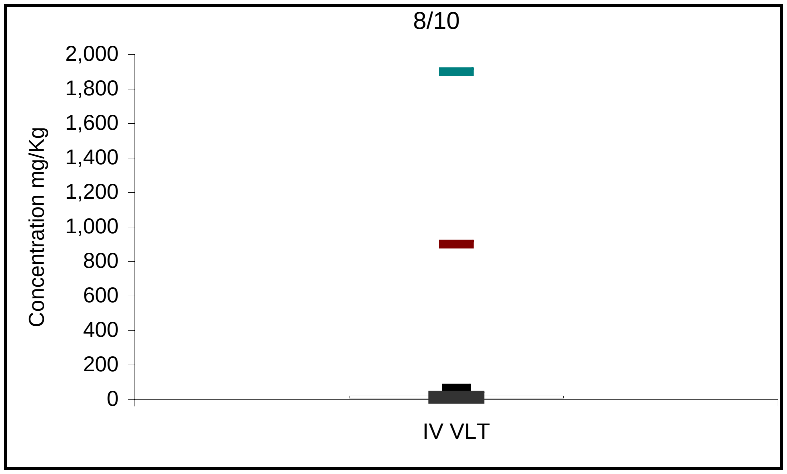
Boron



Cadmium



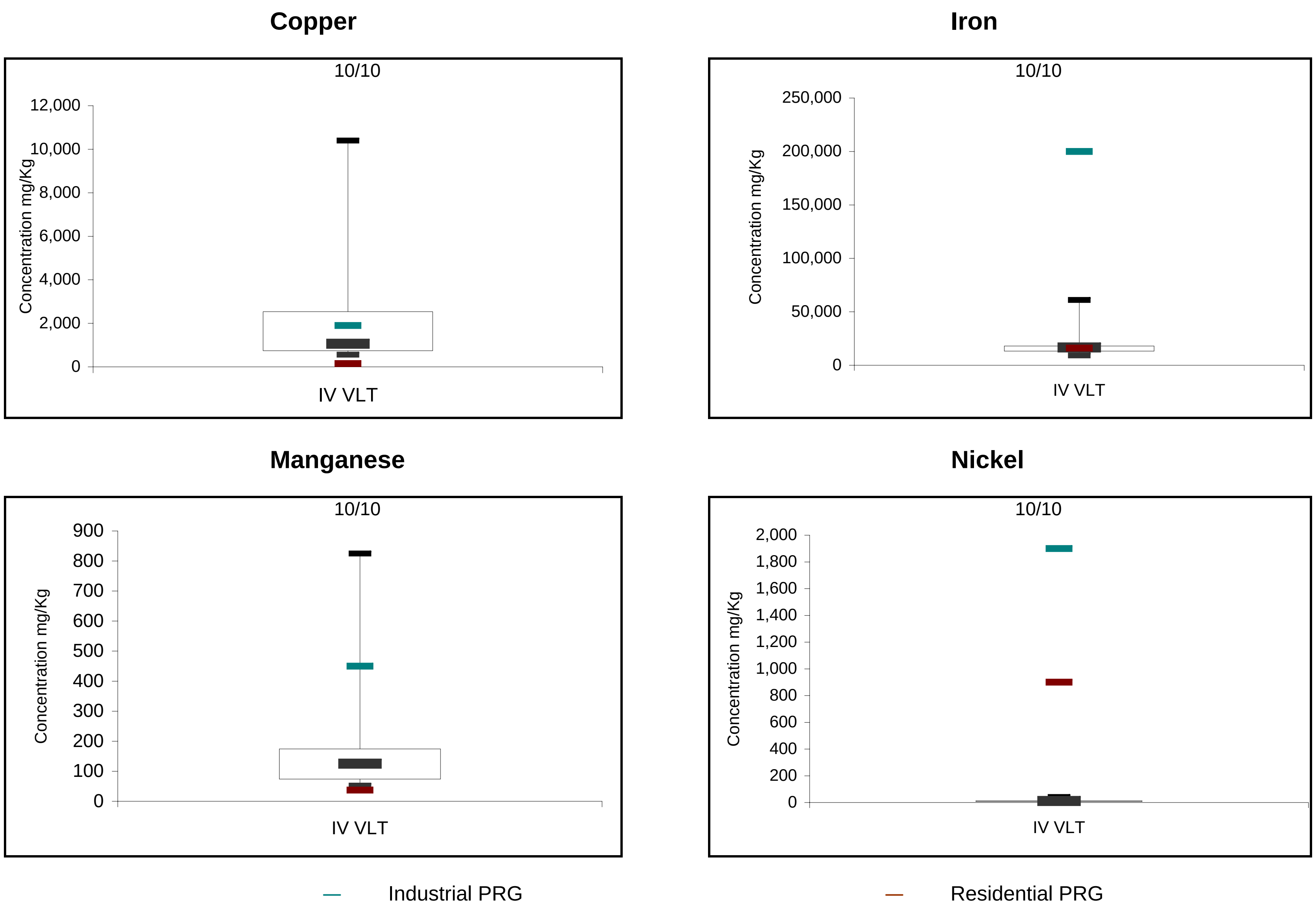
Cobalt



Industrial PRG   Residential PRG

Frequency of Detection at Top of Each Plot

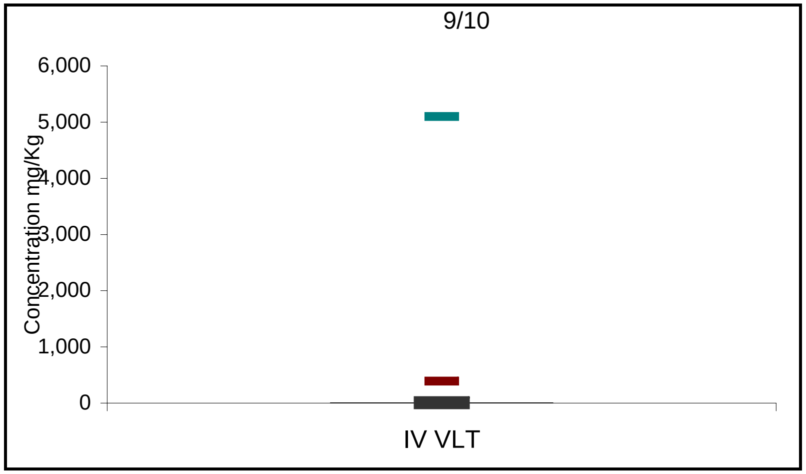
Box and Whisker Plots Comparing Concentrations from the Phase IV VLT Heap Leach Pad and Soil (Group B)



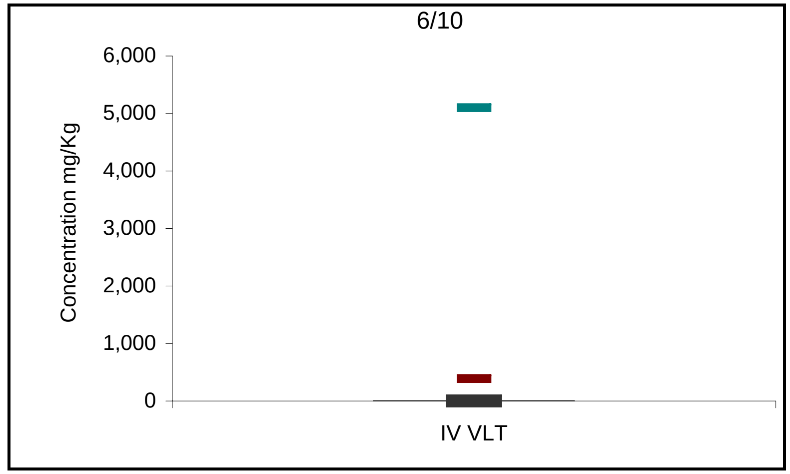
Frequency of Detection at Top of Each Plot

Box and Whisker Plots Comparing Concentrations from the Phase IV VLT Heap Leach Pad and Soil (Group B)

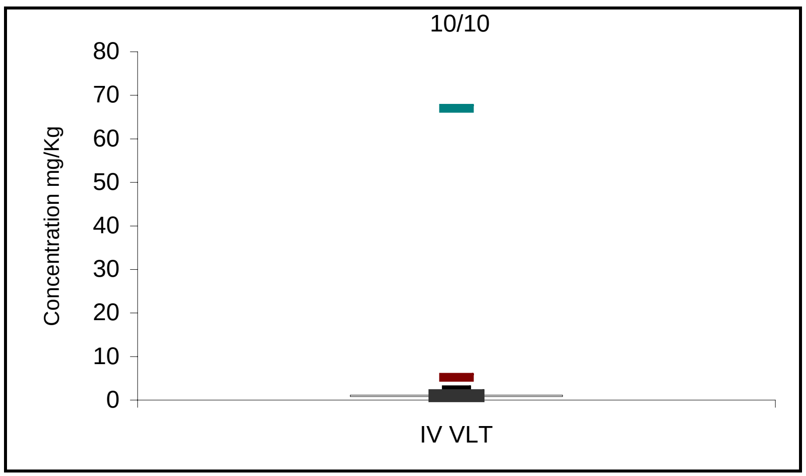
Selenium



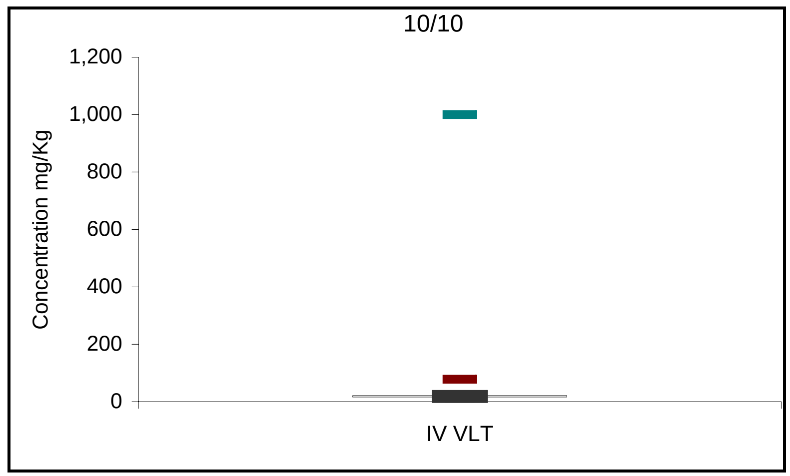
Silver



Thallium



Vanadium

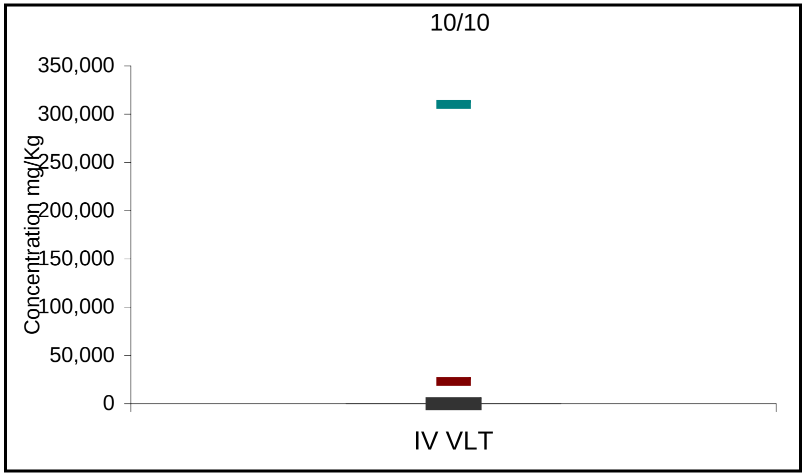


— Industrial PRG — Residential PRG

Frequency of Detection at Top of Each Plot

Box and Whisker Plots Comparing Concentrations from the Phase IV VLT Heap Leach Pad and Soil (Group B)

Zinc



Industrial PRG

Residential PRG

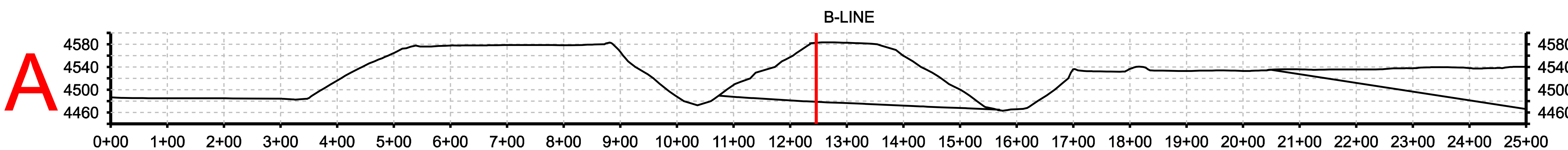
Frequency of Detection at Top of Each Plot

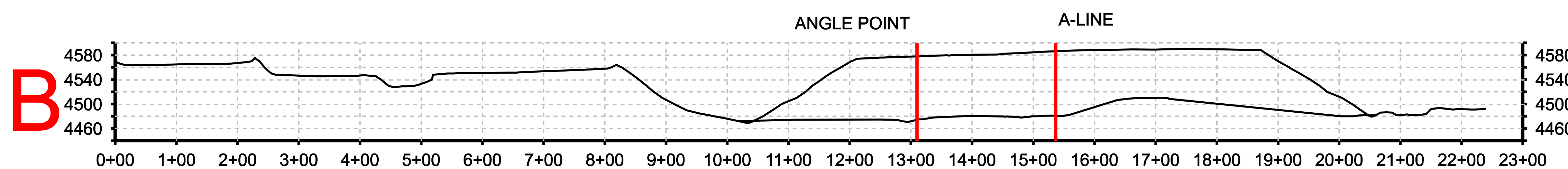
Appendix F
Base Map and Cross-sectional Drawings for Arimetco Heap Leach Pads

FIGURE F-1
CROSS SECTION INDEX MAP
REMEDIAL INVESTIAGATION REPORT
ARIMETCO FACILITIES OPERABLE UNIT 8

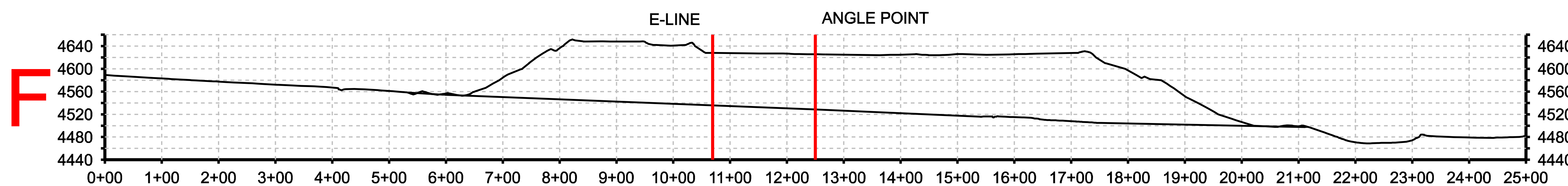
ES052008022RDD_F-1 (7/23/2008)

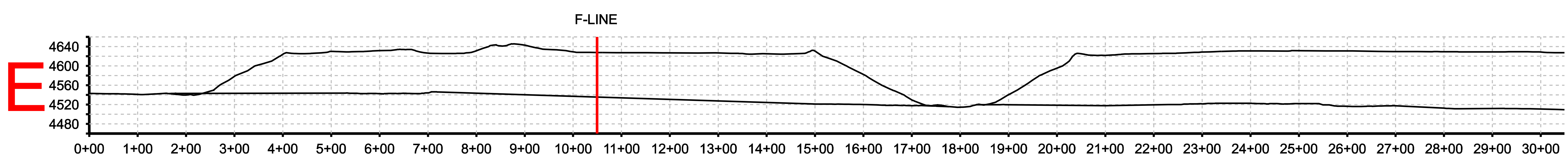
Phase I/II Heap Leach Pad



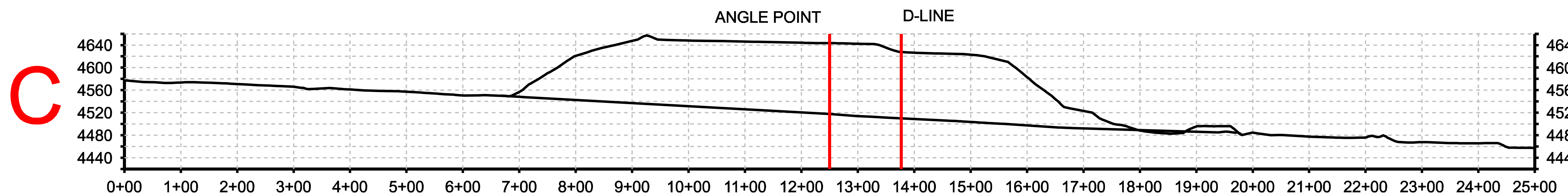


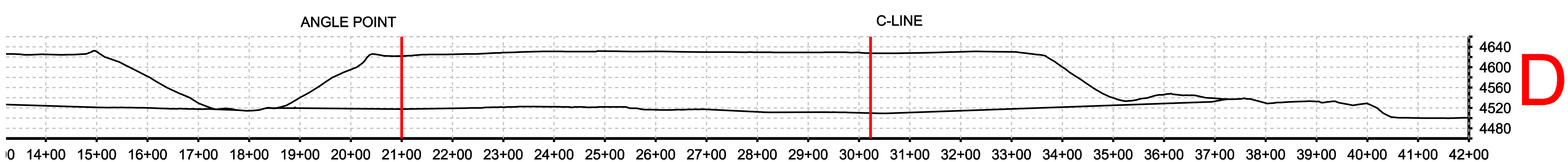
Phase III 4X Heap Leach Pad





Phase III South Heap Leach Pad





Phase IV Slot Heap Leach Pad

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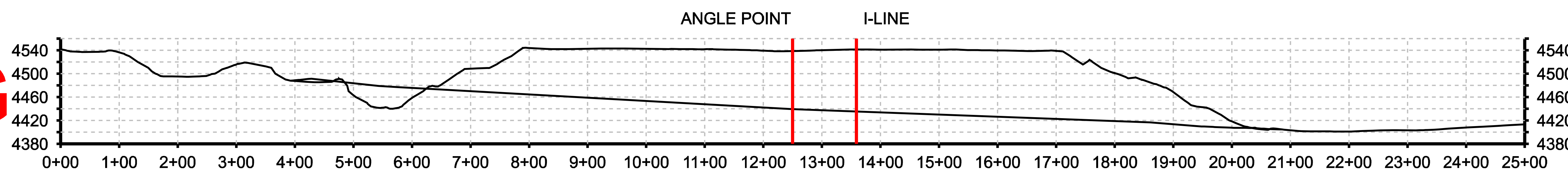

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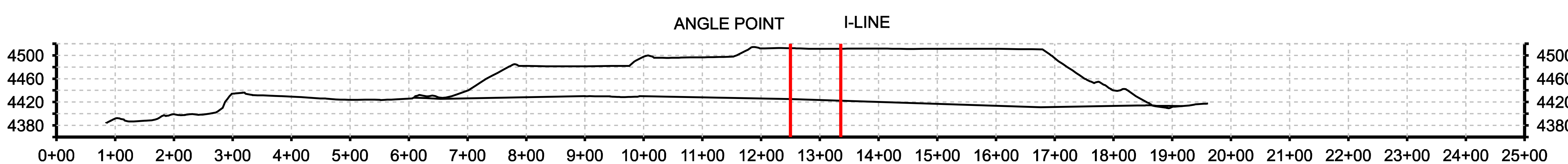

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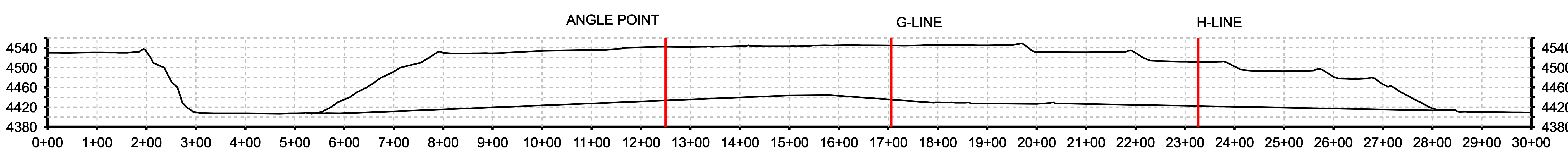

Phase IV VLT Heap Leach Pad

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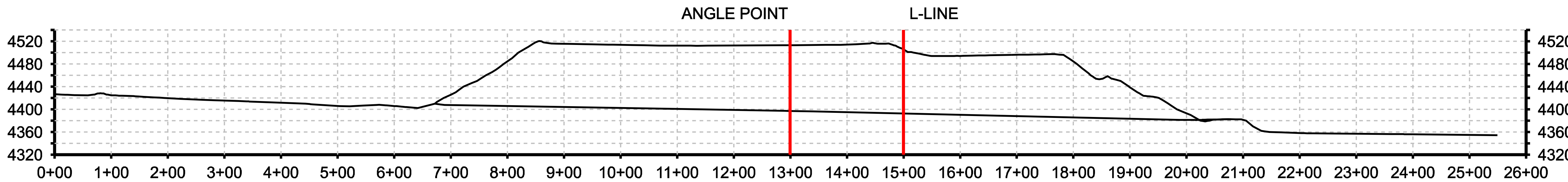

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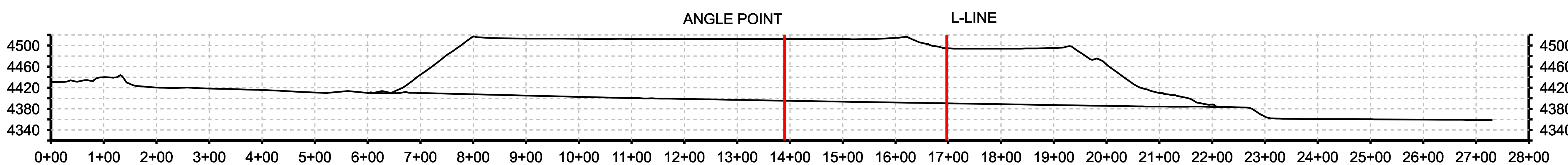

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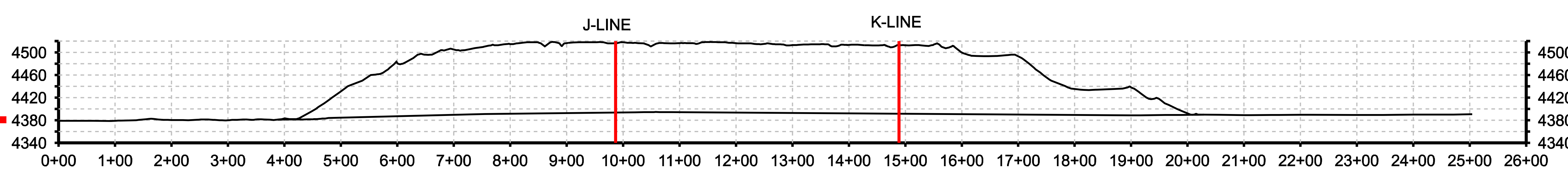

Appendix G
HYDRUS-1D Modeling Summary

APPENDIX G

Numerical Modeling of Water Flow through Heap Leach Pads

To estimate the quantity of solution discharging from the heap leach pads (HLP) and the moisture profiles within the HLPs, the HYDRUS-1D (Simunek et al., 1998) model was used to simulate the movement of water through the HLPs. HYDRUS-1D is a one-dimensional finite element model that numerically solves the Richards equation for variably-saturated water flow through porous media.

Model Description

Five HYDRUS-1D models were constructed, one for each of the HLPs. The upper boundary condition was set to an atmospheric boundary, which allows mass influx representing precipitation and irrigation and mass efflux representing evapotranspiration. The bottom boundary was set to a free drainage condition to allow simulated mass outflow via gravity drainage. Pad height, area, and period of irrigation were taken from the *Field Sampling Plan for the Arimetco Heap Leach Pads Remedial Investigation, Anaconda Copper Yerington Mine Site* CH2M HILL, 2007 (see Table G-1). The assumption was that during the period of operation, the piles were irrigated at a constant rate. The rate of irrigation was determined from the maximum drain-down value reported in Table G-1. It was also assumed that only the "top area" was irrigated; the side slopes only received natural precipitation.

Daily records of precipitation were found dating back to June 1972 and extending to September 2007 from the Western Regional Climate Center online database. The model was run with daily stress periods for the period of record. In addition to precipitation, the atmospheric boundary condition in HYDRUS-1D uses a rate of potential evapotranspiration (PET). However, daily PET data are sparse. To account for PET, average monthly pan evaporation rates for Fallon, Nevada, which is approximately 40 miles northeast of Yerington and nearly the same elevation, were converted to PET using the empirical method found in UNFAO (1997). The percent vegetative cover was set to zero in the equation. PET was set to zero for days that received precipitation.

To estimate the initial moisture conditions, the models were run for the 35-year period for which daily precipitation records were available. These simulations included no irrigation. From these models, cumulative surface flux out of the model domain was subtracted from the cumulative surface flux into the domain. This value was divided by the period of record to calculate the average recharge to the HLP during the period of record. This average recharge was then applied to the model as a constant flux boundary and run to steady state. The final moisture profiles from the steady-state models were then used as the initial conditions for the irrigation simulations.

TABLE G-1
Summary of Arimetco Heap Leach Pad Construction Details
Remedial Investigation Report, Arimetco Facilities Operable Unit 8, Anaconda Copper Yerington Mine

	Group A				Group B
	Phase I/II HLP	**Phase III South HLP**	**Phase III 4X HLP**	**Phase IV Slot HLP**	**Phase IV VLT HLP**
Time Period	1990 – May 1997	August 1992 – early 1997 (plus several months in 1998)	August 1995 – 1999	March 1996 – November 1998	August 1998 – November 1998
Material	Low-grade oxide ore (low-mica quartz monzonite with some oxide alteration on joint faces and replacement minerals, such as chlorite and trace metal sulfides) from the Anaconda W-3 Waste Rock Dump. VLT oxide tailings (2 to 10 feet thick) were placed on the bottom as drain rock.	Low-grade oxide ore (low-mica quartz monzonite with some oxide alteration on joint faces and replacement minerals, such as chlorite, and trace metal sulfides) from the Anaconda W-3 Waste Rock Dump. MacArthur Pit run-of-mine and crushed ore (quartz monzonite with replacement minerals, such as chlorite, and trace metal sulfides). VLT oxide tailings (2 to 10 feet thick) were placed on the bottom as drain rock.	Low-grade oxide ore (low-mica quartz monzonite with some oxide alteration on joint faces and replacement minerals, such as chlorite, and trace metal sulfides) from the Anaconda W-3 Waste Rock Dump. MacArthur Pit run-of-mine and crushed ore (quartz monzonite with replacement minerals, such as chlorite, and trace metal sulfides). VLT oxide tailings (2 to 10 feet thick) were placed on the bottom as drain rock.	Low-grade oxide ore (low-mica quartz monzonite with some oxide alteration on joint faces and replacement minerals, such as chlorite, and trace metal sulfides) from the Anaconda W-3 Waste Rock Dump. VLT oxide tailings (2 to 10 feet thick) were placed on the bottom as drain rock.	Oxide tailings from crusher. MacArthur Pit run-of-mine and crushed ore (quartz monzonite with replacement minerals, such as chlorite and trace metal sulfides). Phase III HLPs material covers slope faces and benches to protect the finer VLT from erosion.
Particle Size and Sorting	6-inch-plus to silt size; poorly sorted	12-inch-plus to silt size; poorly sorted	12-inch-plus to silt size; poorly sorted	12-inch-plus blast rock to silt size; poorly sorted	0.5-inch-minus to sand-size crusher product
Maximum Drain-down	400 to 500 gpm	400 to 500 gpm	1,620 gpm	2,200 gpm	3,300 gpm
Current Drain-down	1 gpm	Less than 4 gpm	3 gpm	34 gpm	35 gpm
Bottom Area	14 acres	46 acres	50 acres	86 acres	54 acres
Top Area	3 acres	15 acres – two benches	22 acres – three benches	37 acres	29 acres – two benches
Maximum Height	120 feet	168 feet	156 feet	145 feet	128 feet
Berms	East-west lined berm in middle of the two heaps. A lined berm and solution ditch around perimeter.	A lined berm and drain-down solution ditch around perimeter.	A lined berm and drain-down solution ditch around perimeter.	A lined berm and drain-down solution ditch around perimeter. Berms within the heap.	A lined berm and drain-down solution ditch around perimeter. Overlies finger ponds.
Slopes	Gentle			2.4H:1V	2.4H:1V

Notes:
gpm = gallon(s) per minute
H = horizontal
V = vertical
VLT = vat leach tailings

The van Genuchten (1980) model was used to parameterize the water retention and hydraulic conductivity functions in HYDRUS-1D. These functions describe the movement of solution through unsaturated porous media. Initial model values of the unsaturated soil hydraulic properties were estimated using the program Rosetta (Schaap et al., 2001), a pedotransfer function that uses neural network analysis to predict the soil hydraulic properties from grain size and bulk density data. Average values of grain size and bulk density were used from samples collected at each HLP. Hydraulic properties for each HLP were then adjusted so that simulated volumetric outflow matched the current drain-down values reported in Table G-1. In addition to volumetric outflow, measured water contents from each pad were used as approximate calibration targets for each simulation. Uniform hydraulic properties were assumed for each pad.

Measured water contents were secondary targets for the modeling because they are point measurements and the large heterogeneity of the grain size distribution within the leach pads. For example, measurements in the Phase III South HLP water content changed by 9 percent within 1.5 feet at a depth of 60 feet below the surface. Matching such large changes in water content at this depth in the profile is not possible with the limited data available. Correlating simulated volumetric outflow to the measured drain-down minimizes the impact of heterogeneity. Drain-down measurements implicitly account for heterogeneity by averaging the flow through the leach pad. Thus, the models were primarily correlated to measured drain-down, and water contents were used as secondary targets.

Model output is presented in two forms: moisture profiles with depth within the pads at the end of the simulation and volumetric outflow from the pads over time. Volumetric outflow was calculated as the sum of the irrigated top area of the pads and the non-irrigated side slopes. The outflow from the non-irrigated portions of the pads was calculated by running the model with only precipitation. From this run, an average value of recharge over the 35-year simulation period was determined. This recharge was multiplied by the non-irrigated area to arrive at a volumetric flow from the side slopes.

Model Results

Figures G-1 through G-5 show the measured and simulated volumetric outflow from the base of the HLPs during the period of the precipitation record. In general, the figures show that the outflow is fairly steady at the beginning of the simulations at a value that correlates to both the size of the pad and the average annual recharge into the pad. Outflow increases significantly once irrigation commences. When irrigation ceases, the outflow decreases as the HLPs drain. The drain-down period is controlled by the hydraulic properties of the pads, which are shown on the figures. Figures G-6 through G-9 focus on the drain-down period for each pad, except for the Phase IV VLT HLP. Drain-down there is clearly seen on Figure G-5. The models match the observed drain-down rates well and also show that the drain-down rates approach a constant value. These results imply that flow from the base of the pads will be steady after the pads have drained, although some fluctuation is likely, depending on the magnitude and timing of precipitation events.

Figure G-5 shows the simulated outflow from the Phase IV VLT HLP. This figure is different from the other outflow figures because Phase IV VLT HLP was operated differently. Phase IV VLT HLP intermittently receives solution when one or more ponds are at capacity, even though the pad is no longer active. Because no records of pumping rates or times were available, it was assumed that the intermittent application of solution was equal to a steady-state rate equivalent to the "current drain-down" in Table G-1 (i.e., a constant rate application of 35 gpm). To simulate the drain-down of the Phase IV VLT HLP, application of all solution was assumed to cease in January, 2005. The extended period of drain-down after the application of solution reflects the presence of finer grained material in the Phase IV VLT HLP.

As previously mentioned, the primary target for the model was volumetric outflow. The limited data and grain size heterogeneity of the HLPs prohibited using the observed water contents as rigorous calibration targets; however, an attempt was made to approximate observed water content values when possible. Figures G-10 through G-14 show observed and simulated volumetric water contents within the four simulated pads. Because uniform hydraulic properties were assigned to each pad, the simulated moisture contents will not match many of the large fluctuations in water content observed with depth. However, three of the four models predicted moisture profiles that approximate the observed values. The model for Phase III 4X HLP exhibits the worst match between simulated and observed water contents. The drain-down curve seen on Figure G-8 shows a steep decrease in outflow upon cessation of irrigation. To match the measured outflow, hydraulic properties must be set to those representative of a very coarse-grained soil. With these properties, the model cannot match the observed water contents, where the profile is driest at the base and gets wetter closer to the surface of the pad.

The models predict moisture profiles and outflow rates for the HLPs. However, predicted values must be viewed with caution. The models were calibrated using a limited data set. Model results should be confirmed by further monitoring and field investigations. Regular monitoring of outflow from the individual HLPs would expand the calibration target data set and greatly enhance the calibration of the models. With more rigorous calibration, models could then be used to predict the effect of capping the surface of the HLPs or other potential remediation strategies.

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Schaap, M.G., F.J. Leij, and M. Th. van Genuchten, 2001. "Rosetta: a computer program for estimating soil hydraulic parameters with hierarchical pedotransfer functions." *Journal of Hydrology*.

Simunek, J., M. Sejna, and M. Th. van Genuchten. 1998. *The HYDRUS-1D Software Package for Simulating the Movement of Water, Heat, and Multiple Solutes in Variably Saturated Media*. Version 3.0. International Groundwater Modeling Center.

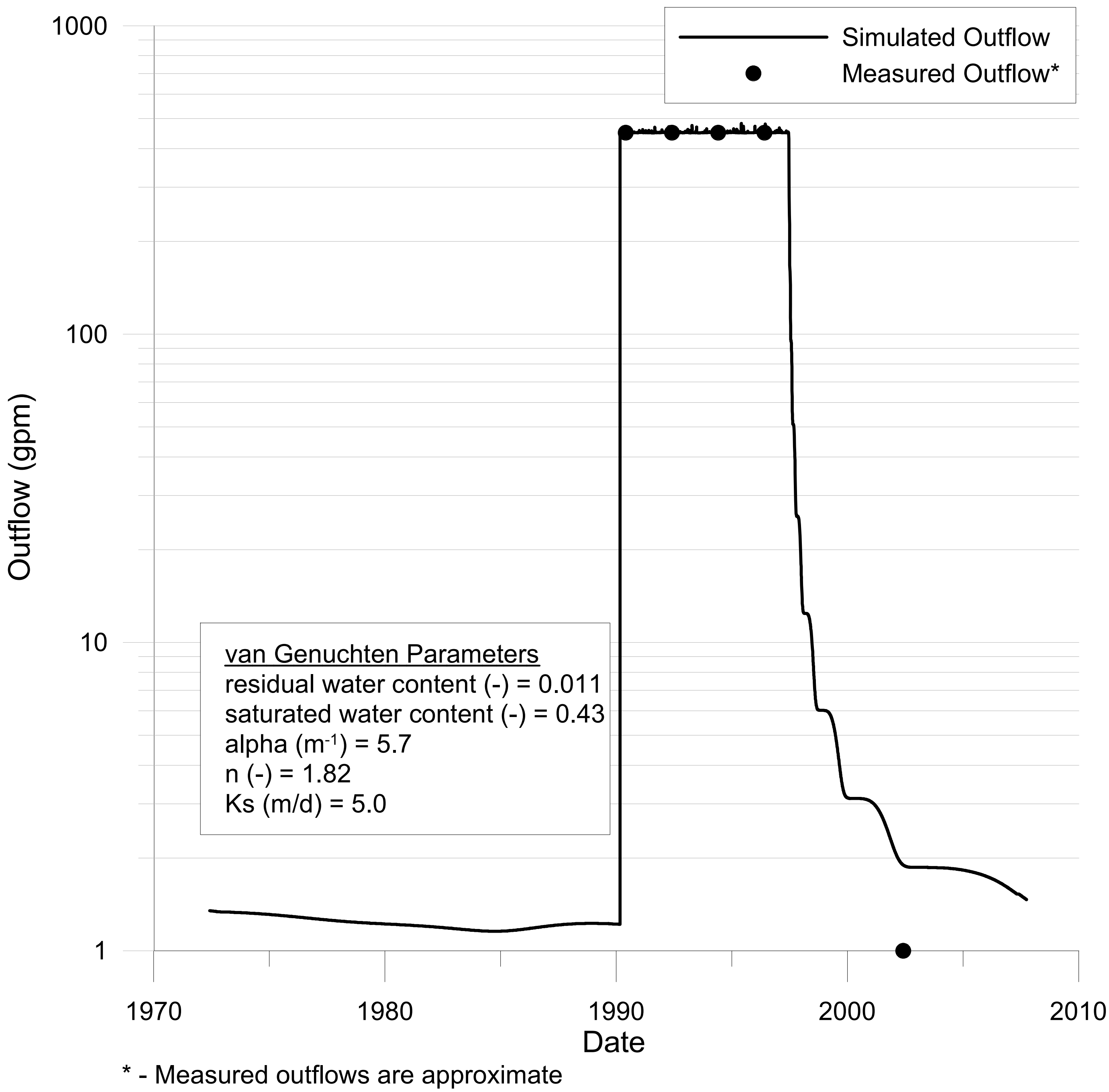
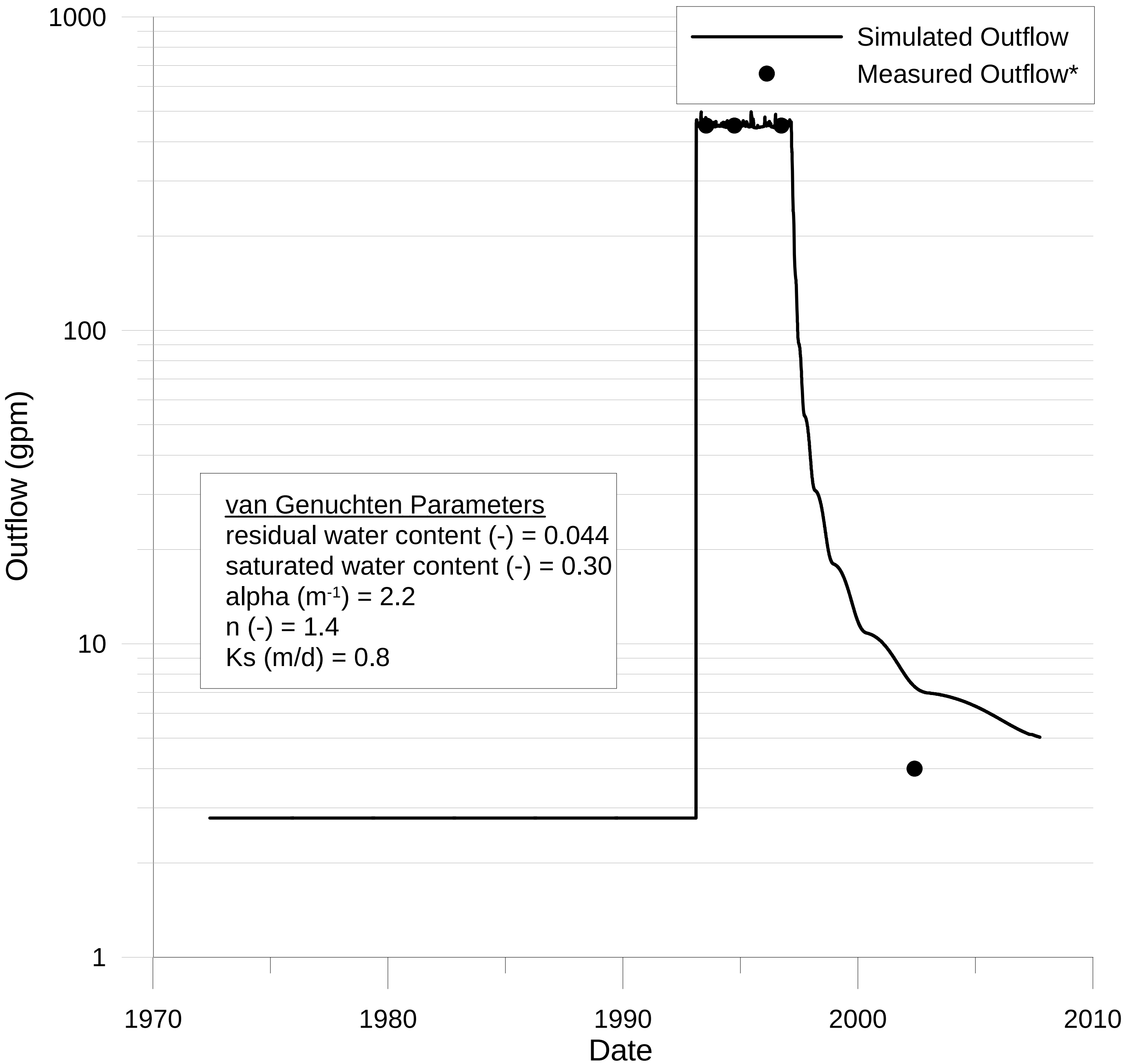


FIGURE G-1
SEEPAGE FROM BASE OF PHASE I/II
ANACONDA COPPER YERINGTON MINE

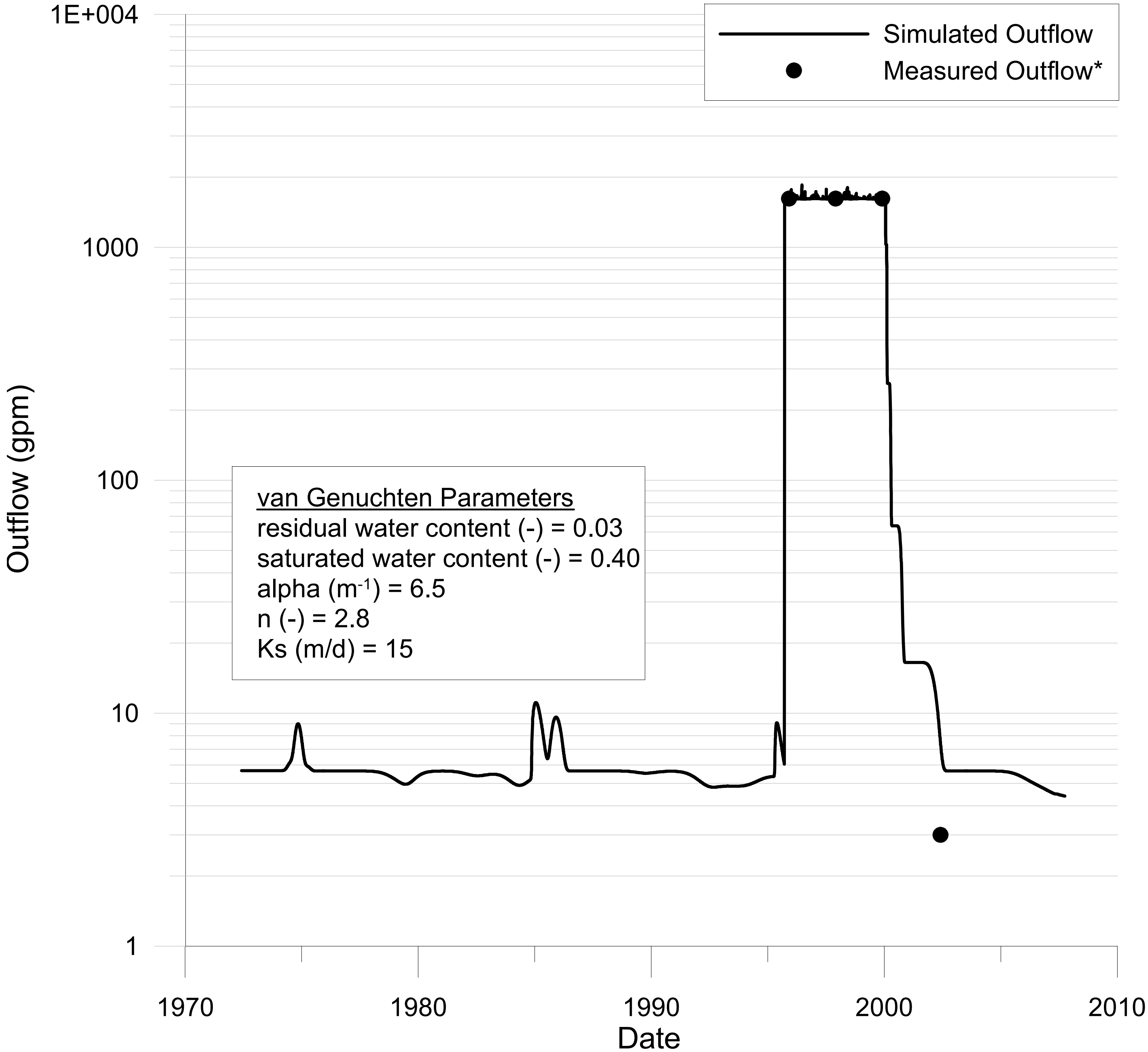
ES052008022RDD_G-1 (5/28/08)



* - Measured outflows are approximate

FIGURE G-2
SEEPAGE FROM BASE OF PHASE III SOUTH
ANACONDA COPPER YERINGTON MINE

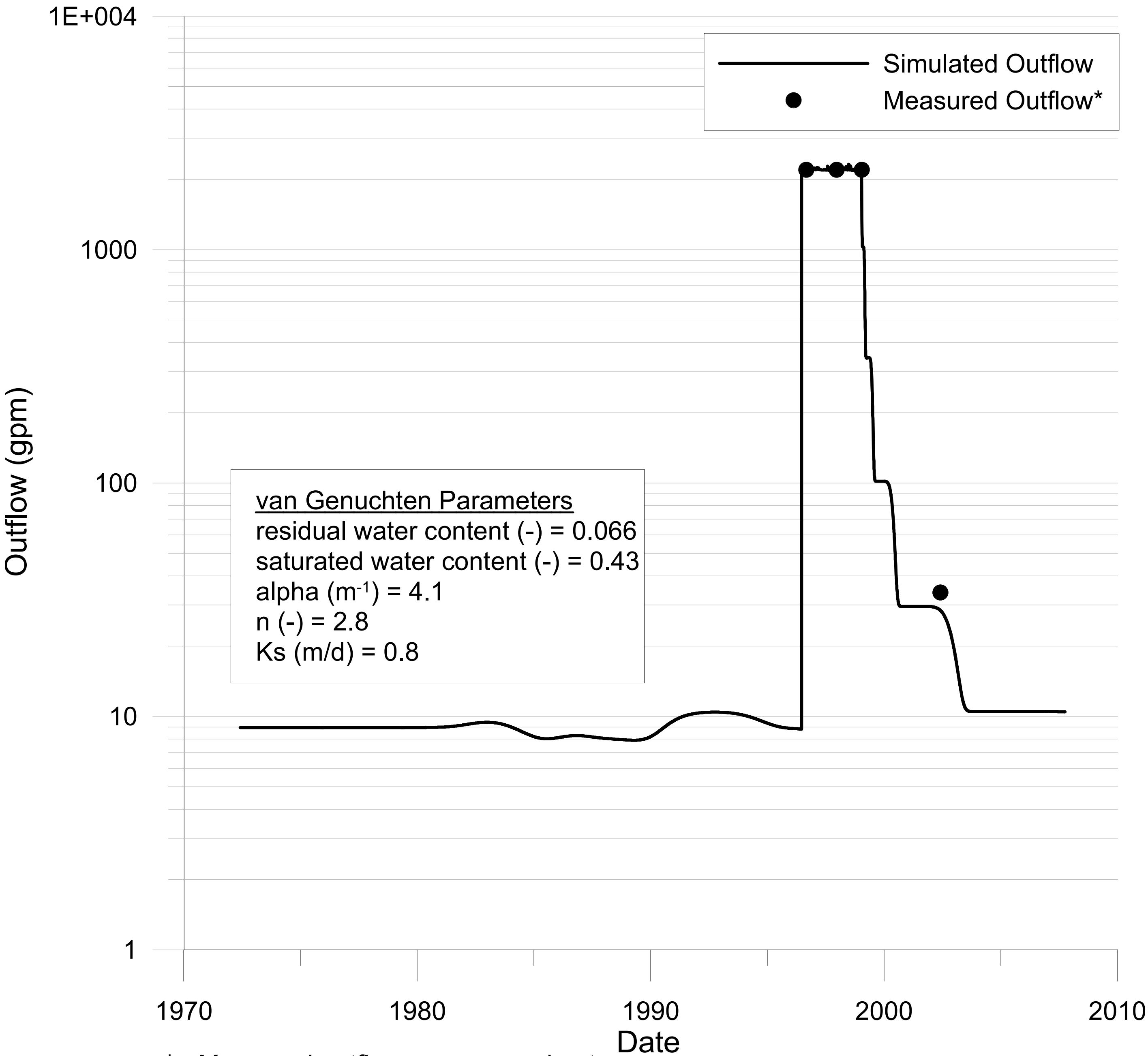
ES052008022RDD_G-02 (5/28/08)



* - Measured outflows are approximate

FIGURE G-3
SEEPAGE FROM BASE OF PHASE III 4X
ANACONDA COPPER YERINGTON MINE

ES052008022RDD_G-03 (5/28/08)



* - Measured outflows are approximate

FIGURE G-4
SEEPAGE FROM BASE OF PHASE IV SLOT
ANACONDA COPPER YERINGTON MINE

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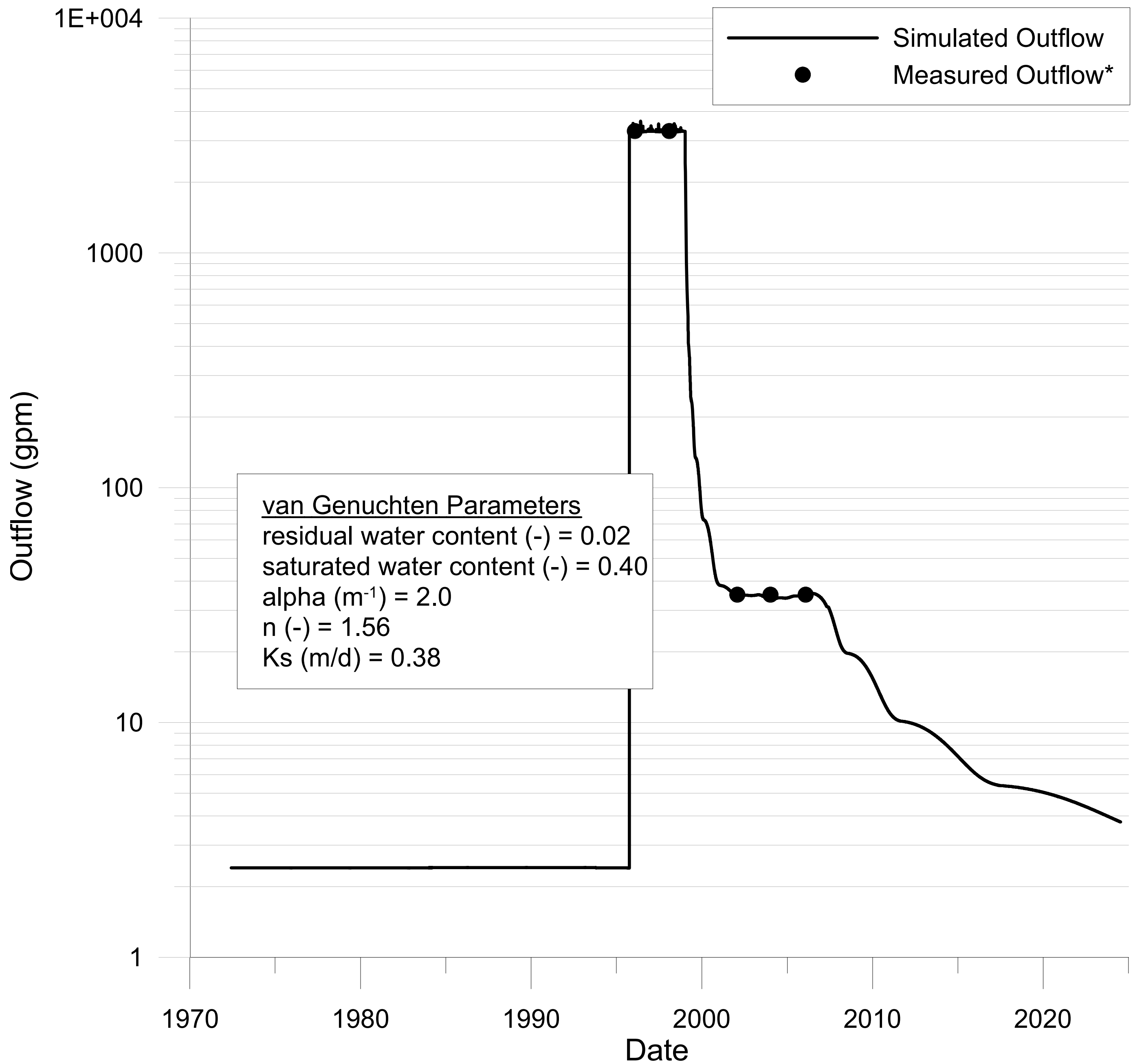
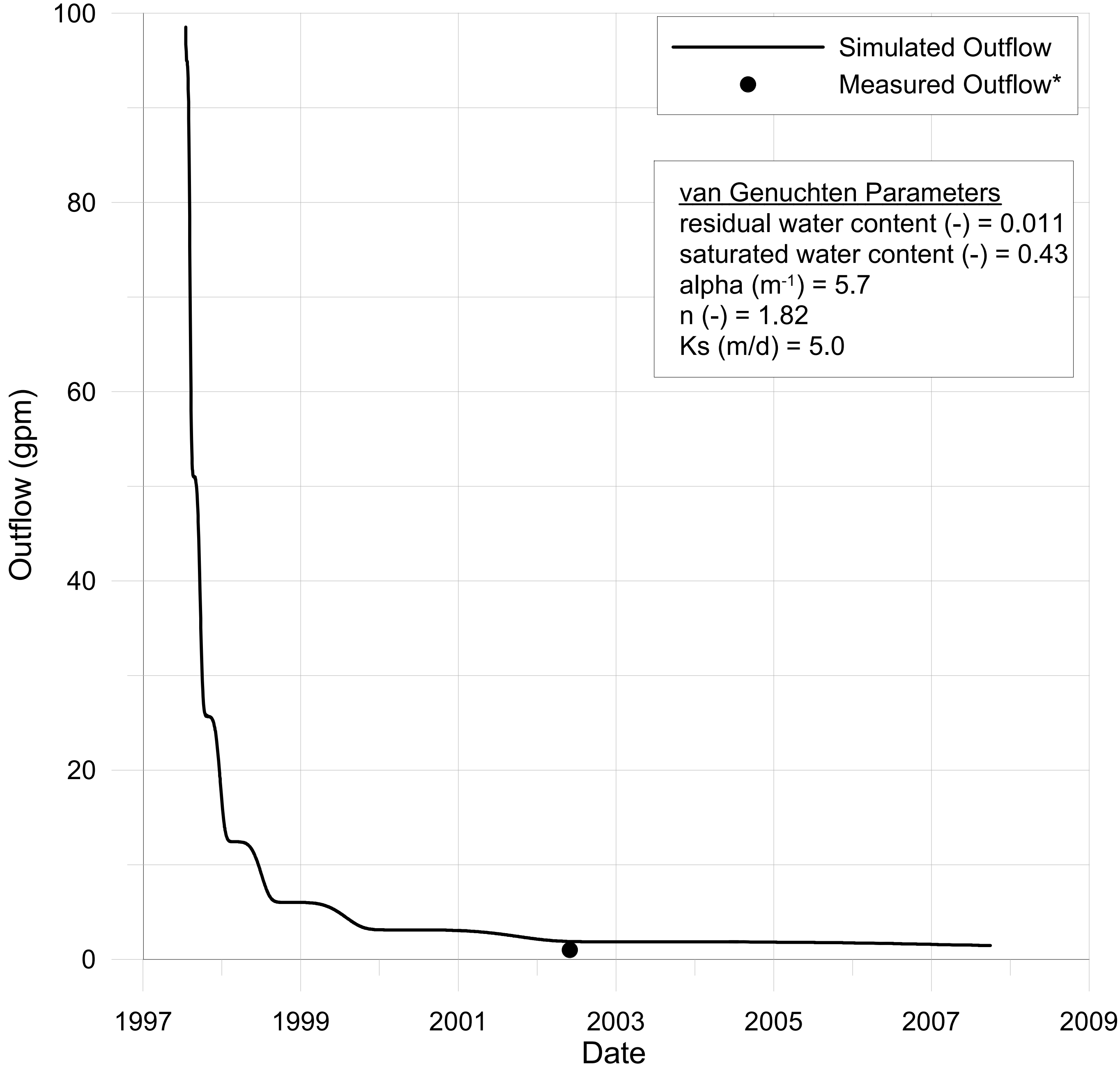


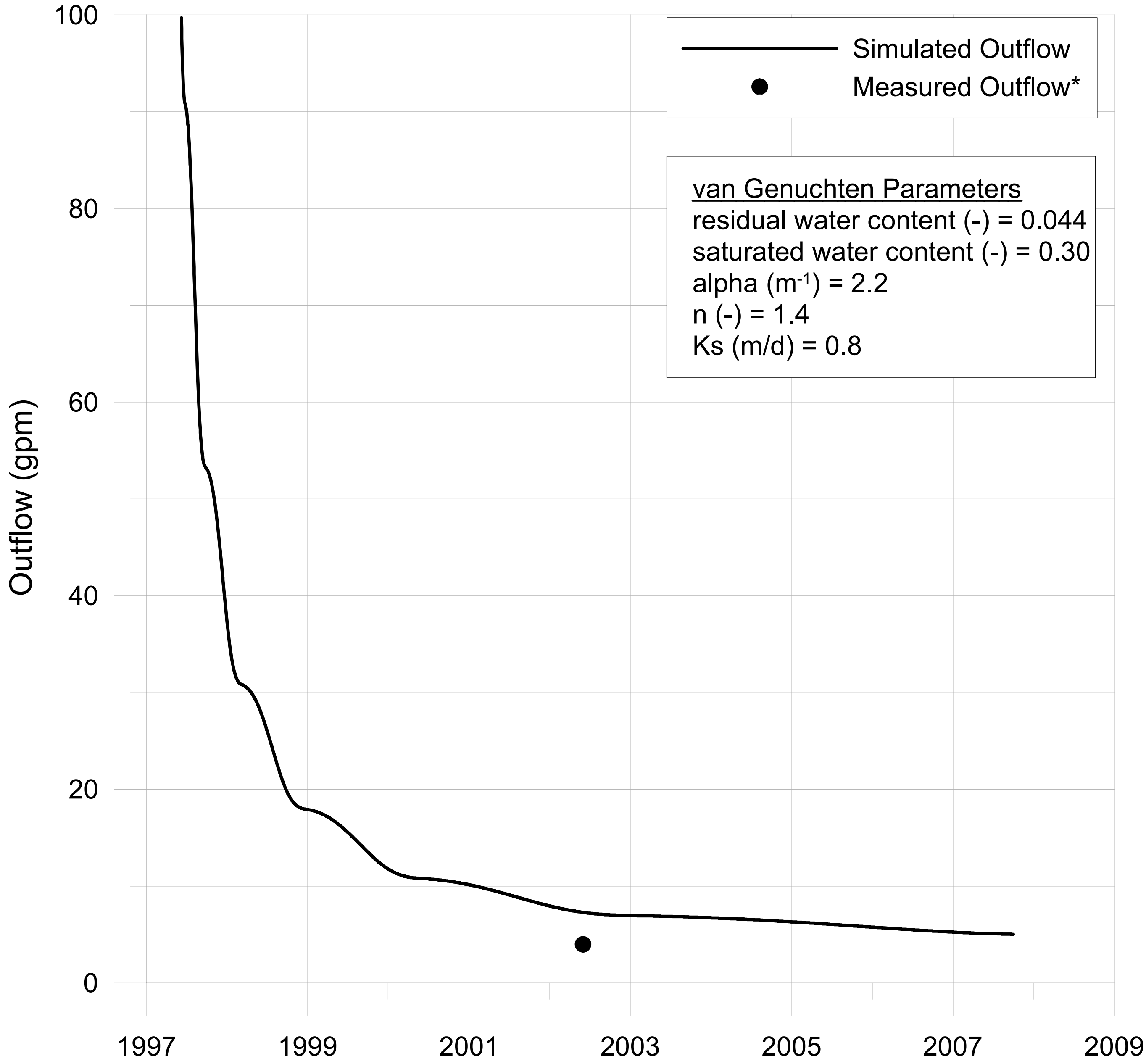
* - Measured outflows are approximate

FIGURE G-5
SEEPAGE FROM BASE OF PHASE IV VLT
ANACONDA COPPER YERINGTON MINE



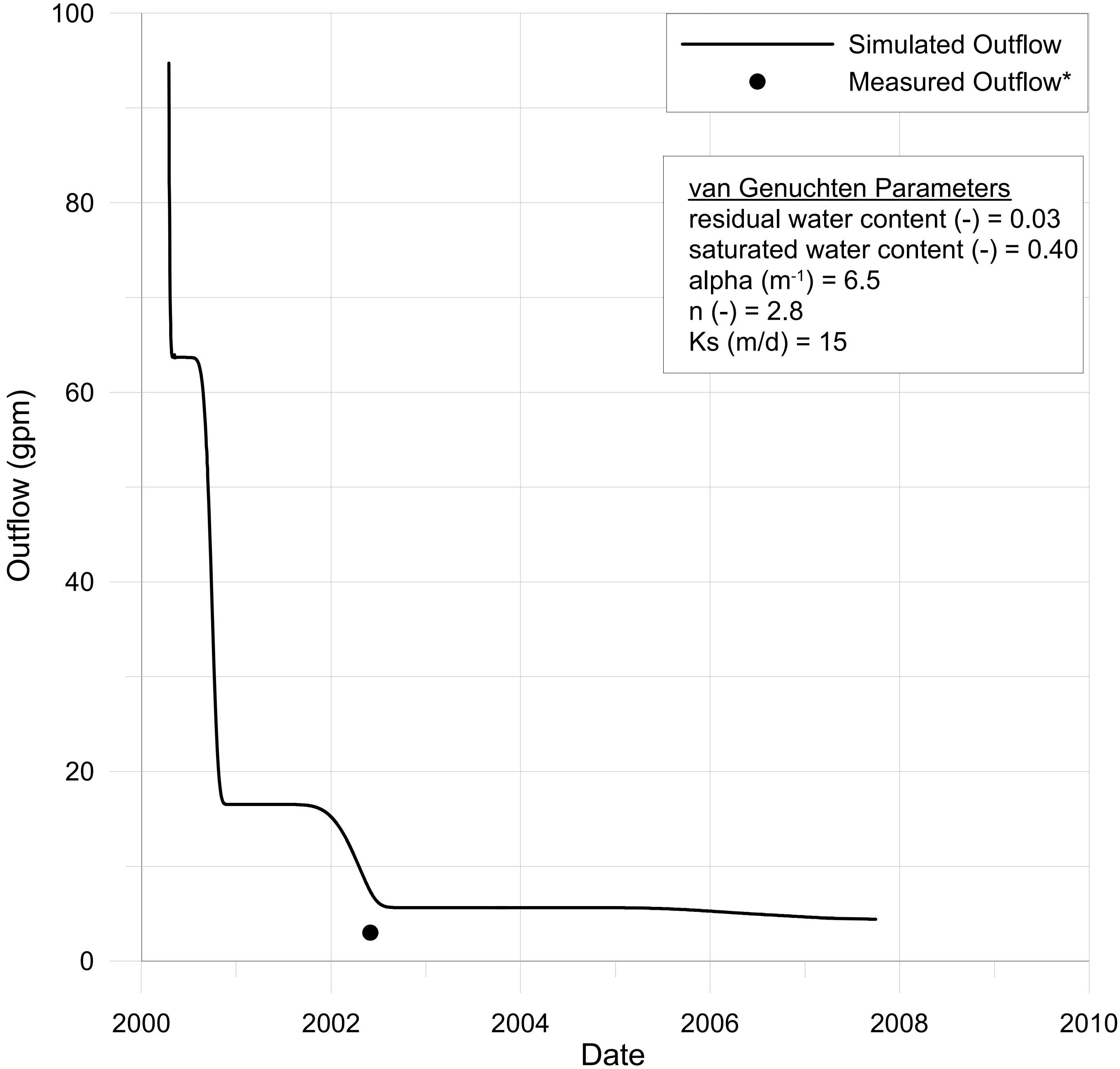
* - Measured outflows are approximate

FIGURE G-6
SEEPAGE FROM BASE OF PHASE I/II
ANACONDA COPPER YERINGTON MINE



* - Measured outflows are approximate

FIGURE G-7
SEEPAGE FROM BASE OF PHASE III SOUTH
ANACONDA COPPER YERINGTON MINE



* - Measured outflows are approximate

FIGURE G-8
SEEPAGE FROM BASE OF PHASE III 4X
ANACONDA COPPER YERINGTON MINE

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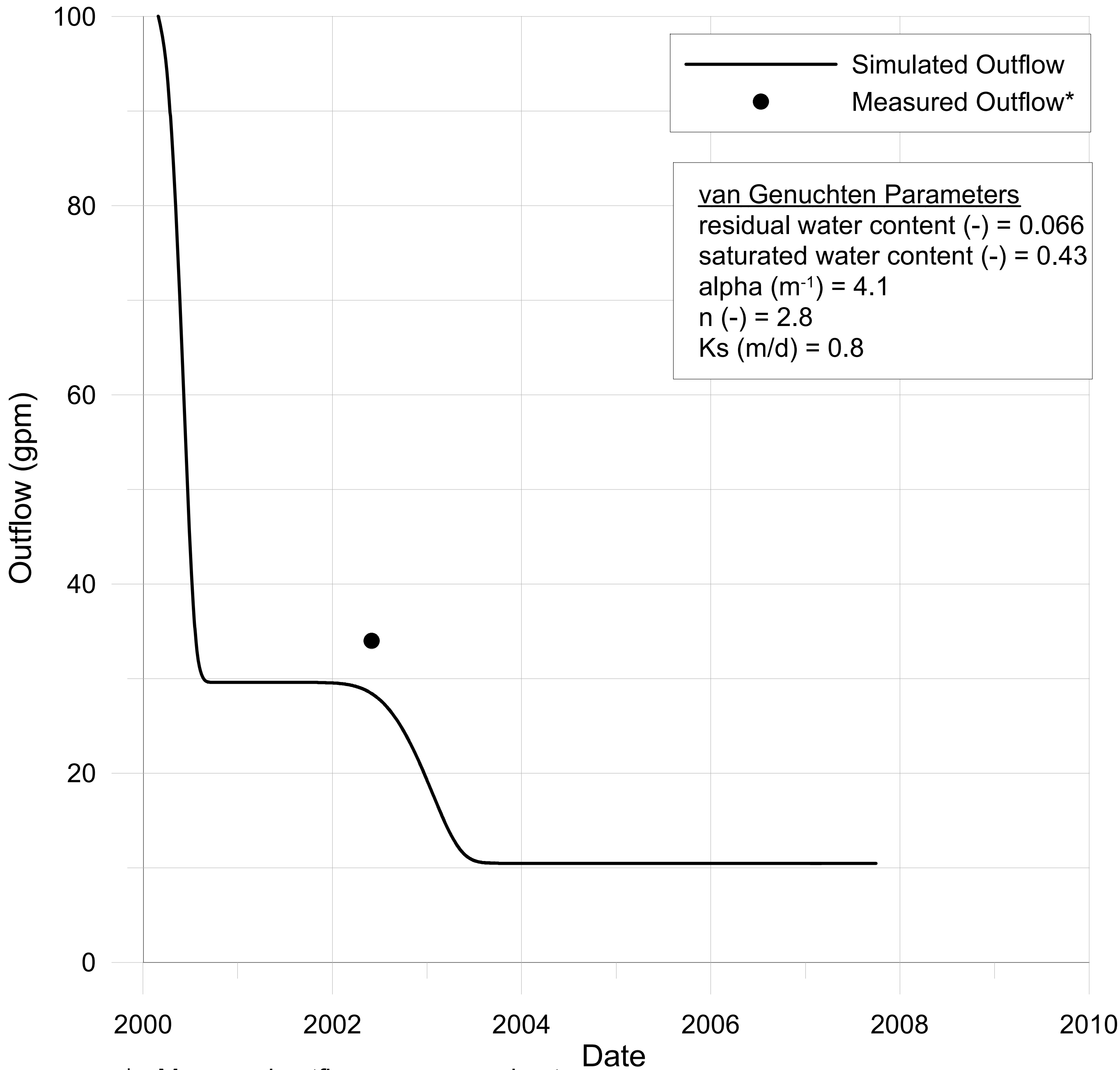

* - Measured outflows are approximate

FIGURE G-9
SEEPAGE FROM BASE OF PHASE IV SLOT
ANACONDA COPPER YERINGTON MINE

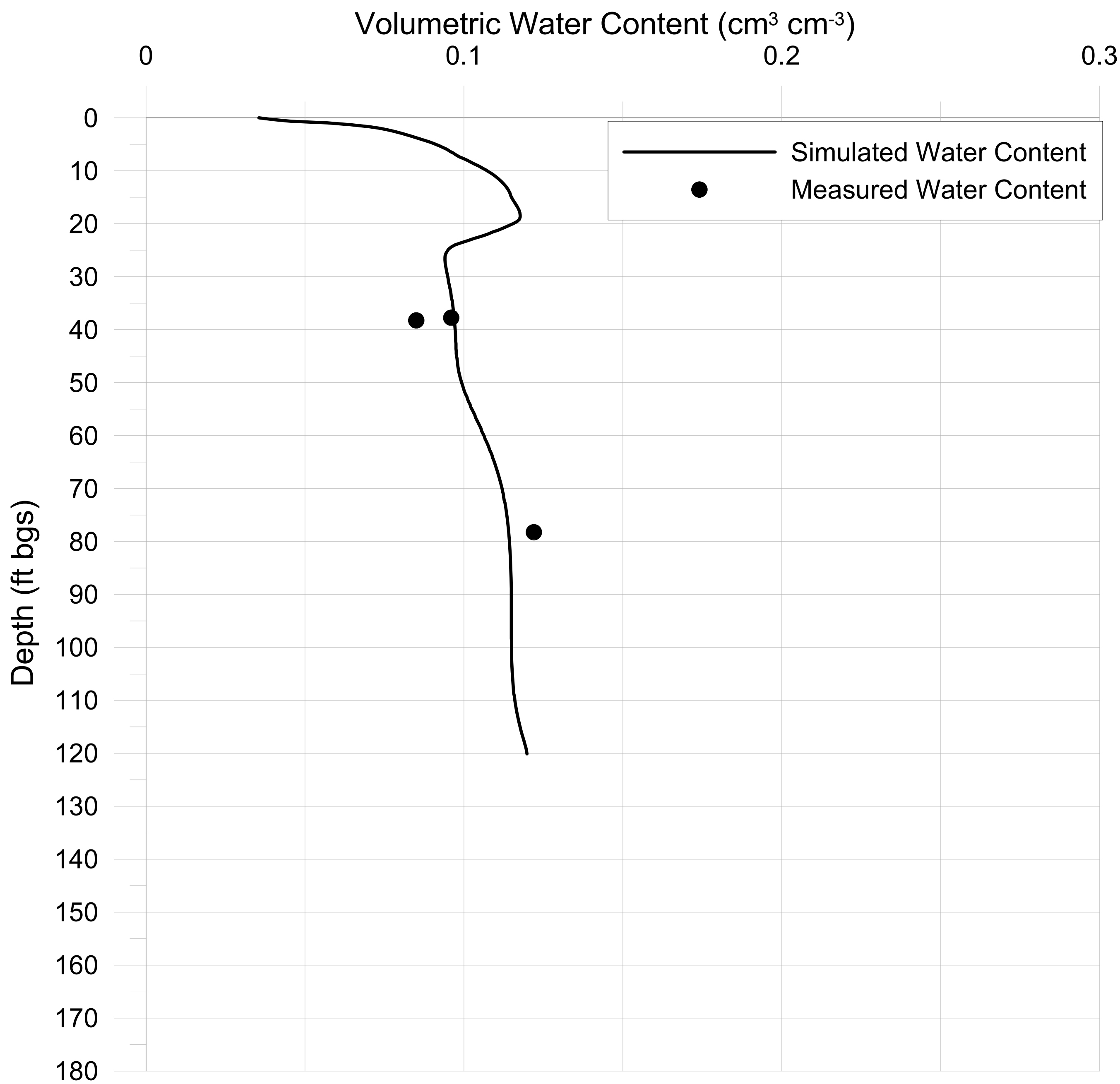

FIGURE G-10
PHASE I/II HEAP LEACH PAD
MOISTURE CONTENT
ANACONDA COPPER YERINGTON MINE

ES052008022RDD_G-10 (5/28/08)

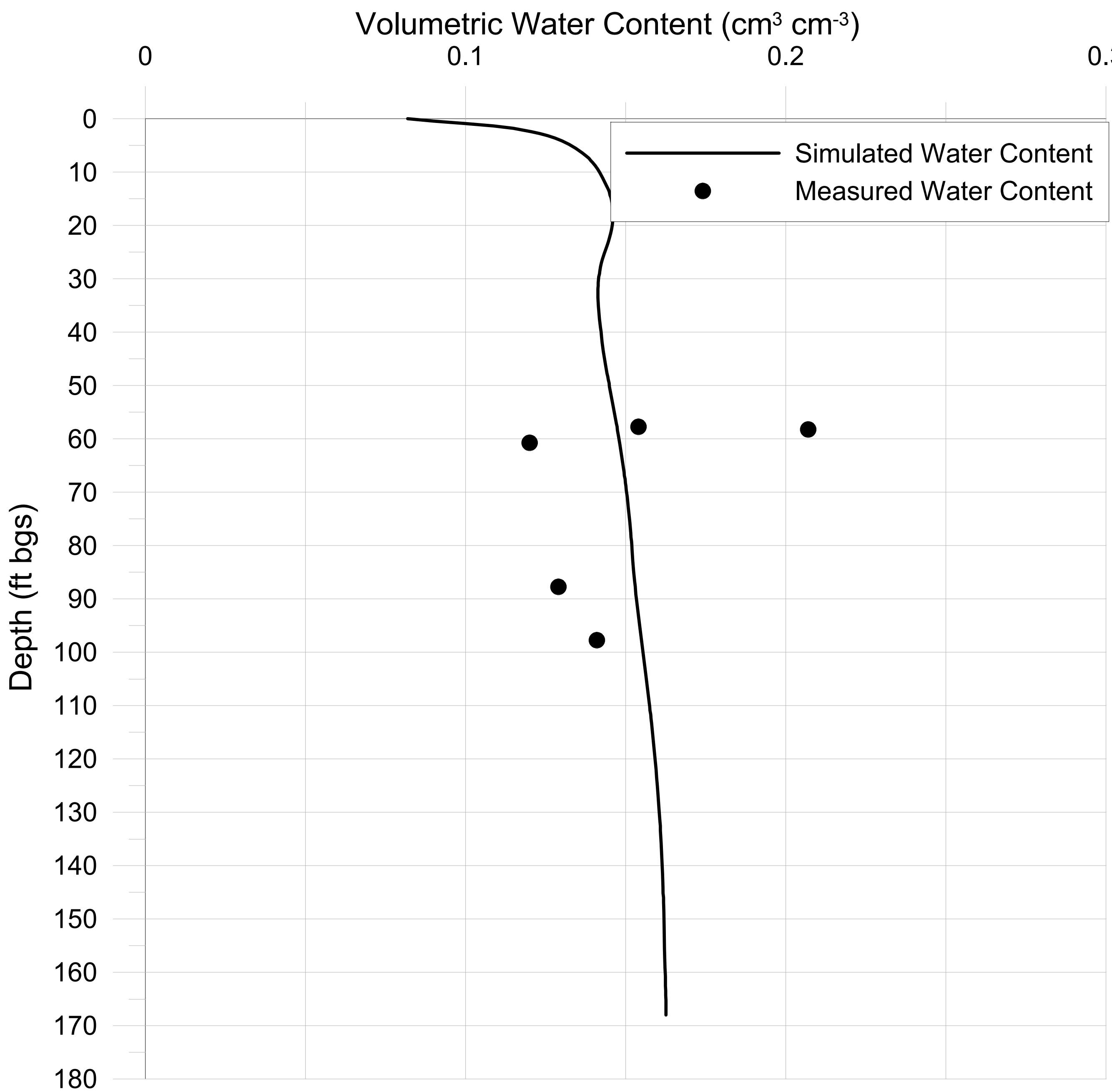

FIGURE G-11
PHASE III SOUTH HEAP LEACH PAD
MOISTURE CONTENT
ANACONDA COPPER YERINGTON MINE

ES052008022RDD_G-11 (5/28/08)

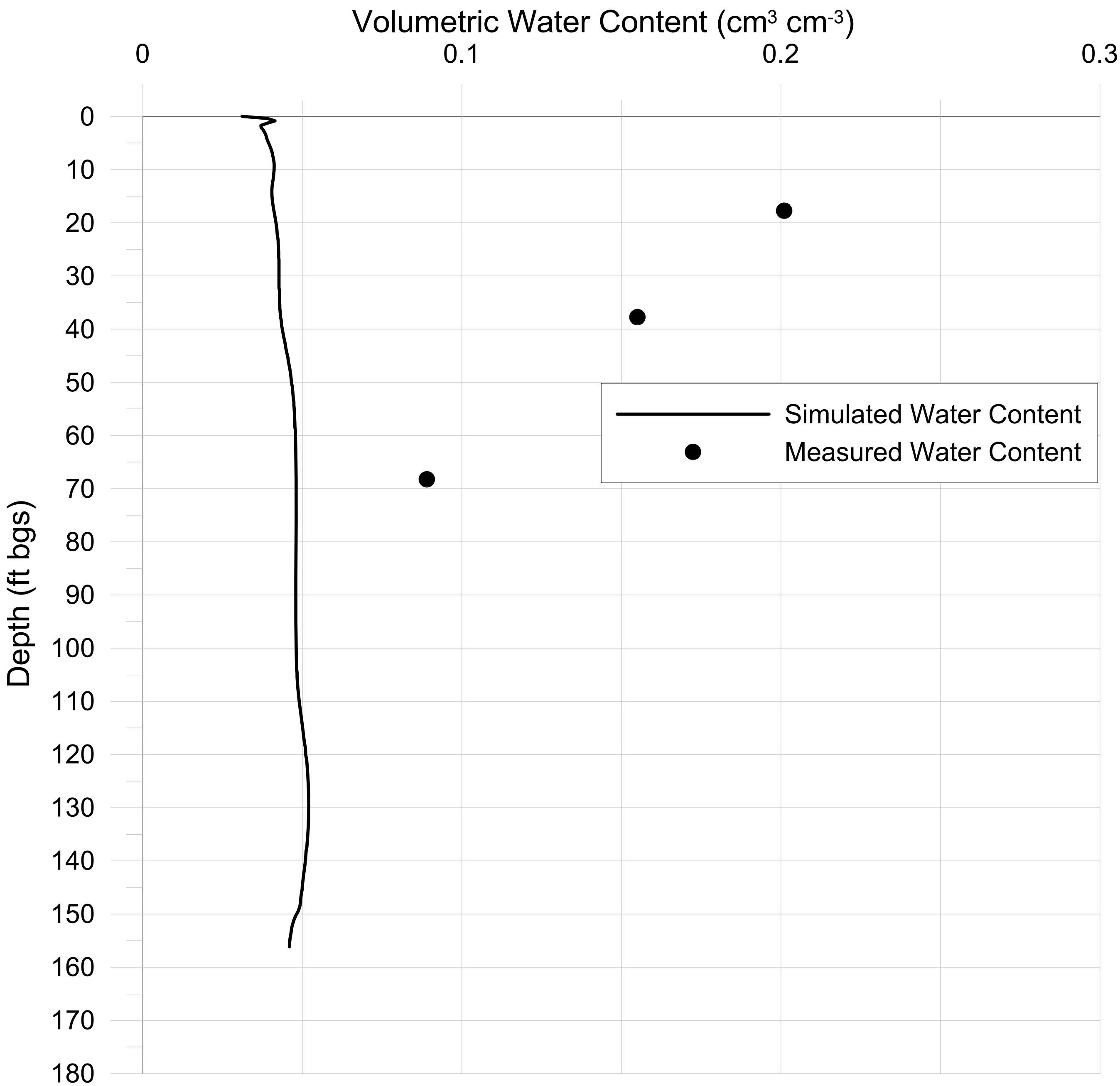

FIGURE G-12
PHASE III 4X HEAP LEACH PAD MOISTURE CONTENT
ANACONDA COPPER YERINGTON MINE

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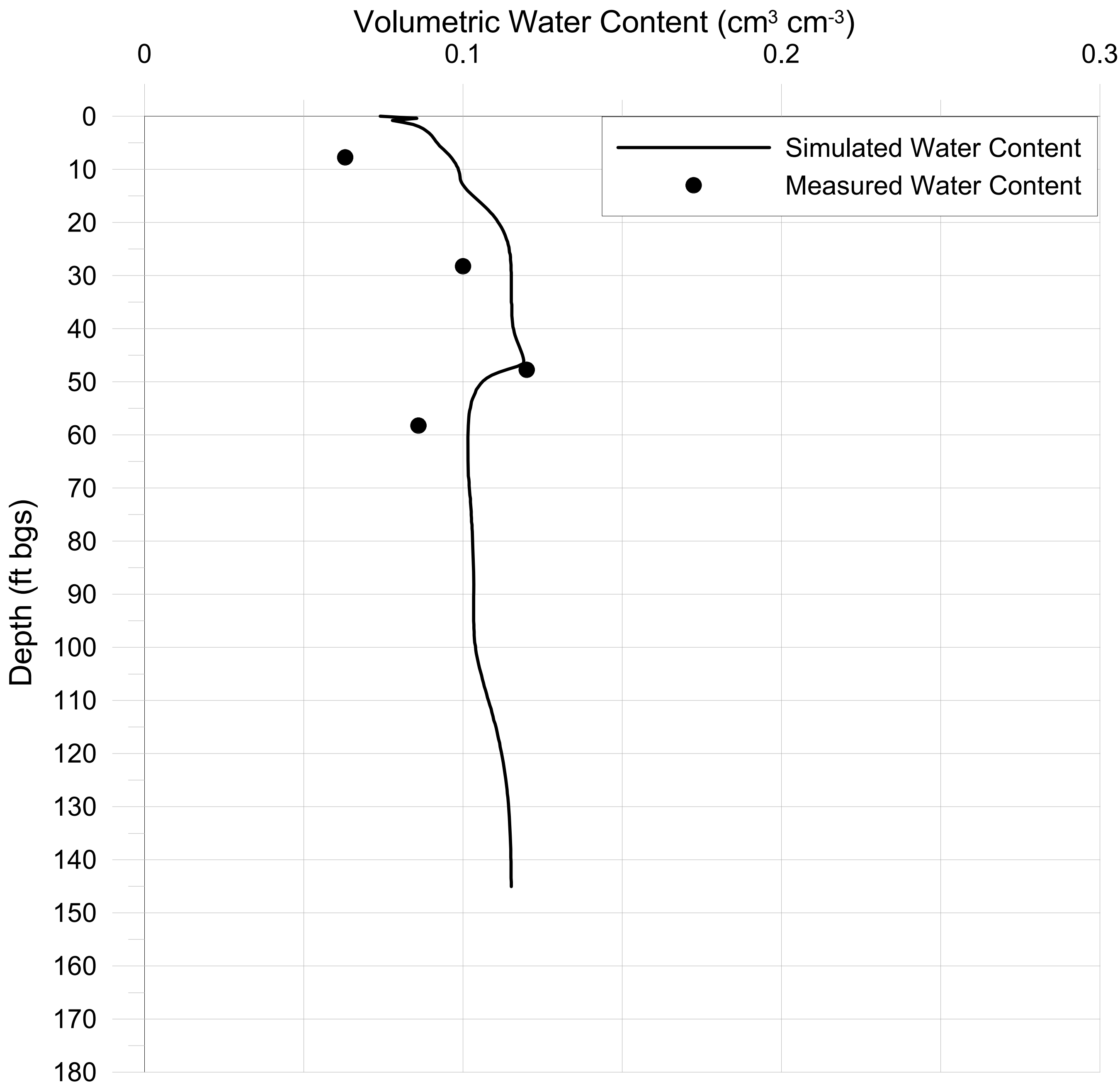

FIGURE G-13
PHASE IV SLOT HEAP LEACH PAD MOISTURE CONTENT
ANACONDA COPPER YERINGTON MINE

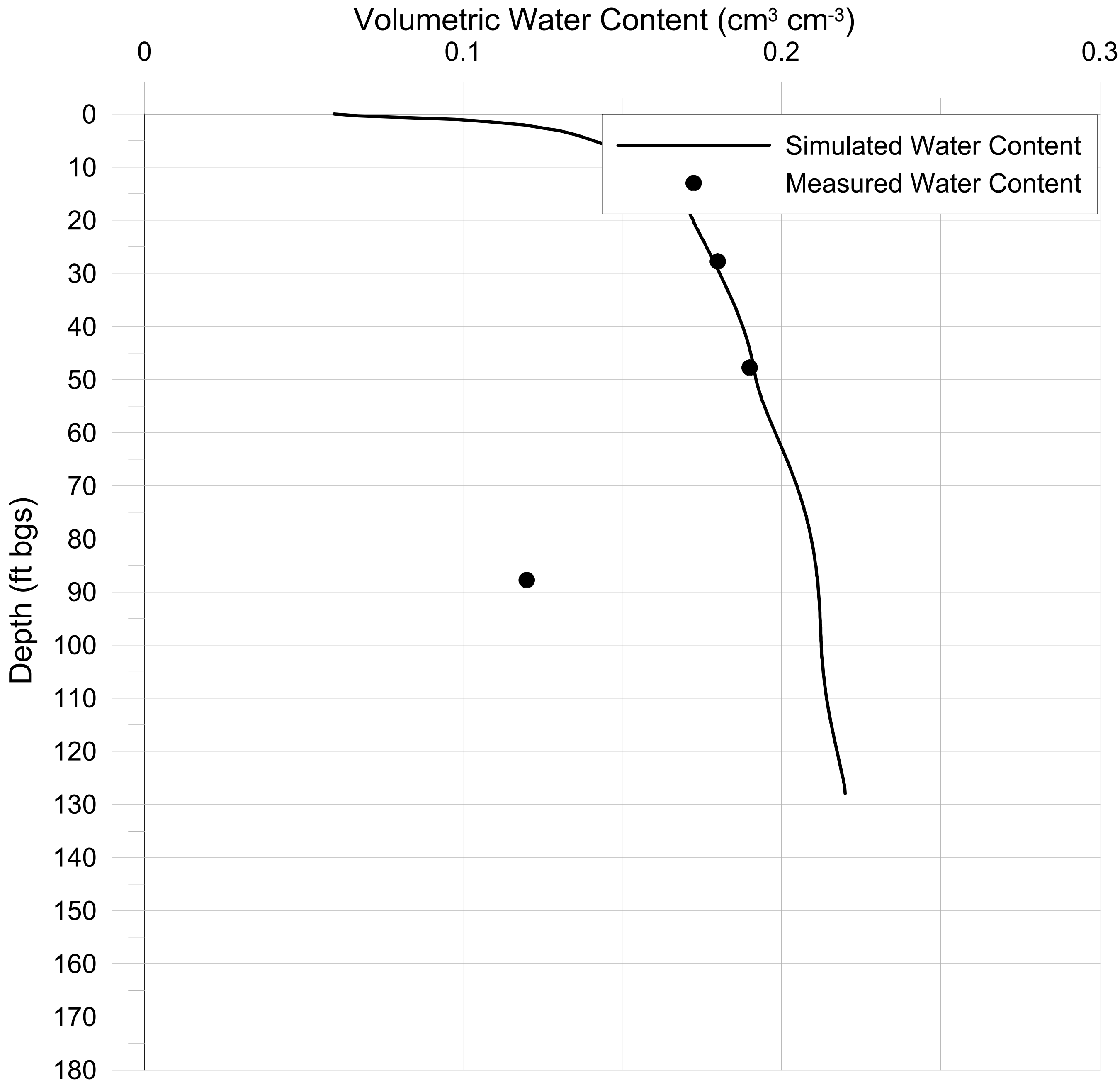

FIGURE G-14
PHASE IV SLOT HEAP LEACH PAD
MOISTURE CONTENT
ANACONDA COPPER YERINGTON MINE

ES052008022RDD_G-14 (5/28/08)

Appendix H
Screening-level Human Health Risk Evaluation

TECHNICAL MEMORANDUM
DRAFT SCREENING-LEVEL HUMAN HEALTH RISK ASSESSMENT

Arimetco Heap Leach Pads

Anaconda Copper/Yerington Mine Site, Yerington, Nevada

USEPA CONTRACT NO. 68-W-98-225
USEPA WORK ASSIGNMENT NO. 273-RICO-09GU

Prepared for
U.S. Environmental Protection Agency
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April 2008

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Acronyms and Abbreviations

ARC	Atlantic Richfield Company
COPC	constituent of potential concern
CSM	conceptual site model
ELCR	excess lifetime cancer risk
HHRA	human health risk assessment
HI	hazard index
HLP	heap leach pad
HQ	hazard quotient
MCL	maximum contaminant level
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
OU	Operable Unit
PRG	preliminary remediation goal
RI	remedial investigation
RME	reasonable maximum exposure
SL	screening-level
SX/EW	solvent extraction/electro-winning
TM	technical memorandum
TPH	total petroleum hydrocarbon
µg/L	micrograms per liter
USEPA	U.S. Environmental Protection Agency
VLT	vat leach tailings

1.0 Introduction

This technical memorandum (TM) presents the methods and results of a screening-level human health risk assessment (HHRA) conducted as part of a remedial investigation (RI) of the Arimetco Facilities Operable Unit (OU) at the Anaconda Copper/Yerington Mine Site (Site).

The Anaconda Copper/Yerington Mine Site is located approximately 2 miles west of Yerington, directly off of Highway 95, at 103 Birch Drive near Yerington, in Lyon County, Nevada (see Figure 1-1). Facilities associated with copper mining operations at the Site include an open-pit mine, mill buildings, tailing piles, waste fluid ponds, and the adjacent residential settlement known as Weed Heights. A network of leach vats, heap leaching pads, and evaporation ponds remain throughout the Site.

The Site began operation in or about 1918, and was originally known as the Empire Nevada Mine. In 1953, Anaconda Minerals Company (Anaconda) acquired the Site and began operating it. In or about 1977, Atlantic Richfield Company (ARC) acquired Anaconda and assumed its operations at the Site. In June 1978, ARC terminated operations at the Site. In or about 1982, ARC sold its interests in the private lands within the Site to Don Tibbals, a local resident. Don Tibbals subsequently sold his interests to Arimetco, Inc. (Arimetco), the current owner. Arimetco operated a copper recovery operation from existing ore heaps within the Site and from the MacArthur Pit from 1989 to November 1999. Arimetco has terminated operations at the Site, which is currently managed under the protection of the United States Bankruptcy Court in Tucson, Arizona. The presently approved bankruptcy plan anticipates a liquidation of Arimetco's operations at the Site.

During the 25-year period in which Anaconda and ARC operated the Site, approximately 360 million tons of ore and debris were removed from the open pit mine, much of which now remains in tailings or heap leach pads (HLP). Arimetco extracted copper from copper oxide ore. The ore was successively leached with a mild acid solution and kerosene in three process vats (approximately 200,000 gallons). The heaps were leached with a dilute sulfuric acid solution. The HLPs remain onsite and continue to precipitate acidic fluids.

The Arimetco OU has been subdivided into three major components, including (1) the HLPs, (2) the solvent extraction/electro-winning (SX/EW) plant, and (3) the Fluids Management System. The RI undertaken by the U.S. Environmental Protection Agency (EPA) focused primarily on the HLPs and associated leachate collection ponds and ditches, which are a component of the Fluids Management System (see Figure 1-2). Arimetco HLPs have been grouped according to similar materials of construction. Group A includes four HLPs - Phase I/II, Phase III South, Phase III 4X, and Phase IV Slot; Group B includes one HLP - Phase IV Vat Leach Tailings (VLT). For the purposes of the RI, VLT materials considered potentially suitable for capping were also assessed during the investigation.

The RI field sampling conducted in September and October 2007 was the source of the drain-down solutions and heap leach pad material data evaluated in this screening-level

HHRA. The screening-level HHRA was performed for Group A and Group B HLP materials and drain-down solutions.

The screening-level HHRA was conducted to assess whether contaminated HLP materials and drain-down solutions pose a significant risk to human health. In keeping with the health-protective nature of this screening-level assessment, drinking water maximum contaminant levels (MCL) and tap water preliminary remediation goals (PRG) were used to evaluate drain-down solutions, while residential and industrial soil PRGs were used to evaluate HLP material. The use of these conservative human health screening criteria will tend to overestimate potential exposures and risks for this HHRA.

This HHRA includes the following:

- A comparison of metal concentrations in drain-down solutions with primary MCLs
- A comparison of total petroleum hydrocarbon (TPH) concentrations in drain-down solutions with Nevada cleanup standards
- A comparison of radionuclides with primary MCLs or estimation of total risk for radionuclides using EPA tap water PRGs for Superfund
- Estimation of cancer risks and noncancer hazards for metals in HLP surface materials using EPA Region 9 PRGs. Potential cumulative cancer risk and noncancer health hazards were evaluated for HLP surface materials (0.25 to 0.75 feet below the heap surface) for residential and industrial exposure scenarios.

The results of this screening-level HHRA include the following:

- **Drain-down Solutions**: Maximum metals concentrations exceeded primary MCLs by at least a factor of 15 times the MCL (see Table 1-1). Maximum TPH concentrations exceeded Nevada groundwater cleanup standards by a factor of 2-fold (see Table 1-2). The maximum alpha radiation concentration exceeded the primary MCL by a factor of 1,087 times the MCL. Cumulative cancer risk was 3E-02 for radionuclides in drain-down solutions from HLPs (see Table 1-3).
- **Group A HLP Surface Materials**: The screening-level cumulative residential and industrial cancer risks were 8E-05 and 2E-05, respectively. Cumulative noncancer hazard indices (HI) were 7 and less than 1, respectively (see Tables 1-4 and 1-5).
- **Group B HLP Surface Materials**: The screening-level cumulative residential and industrial cancer risks were 3E-04 and 7E-05, respectively. Cumulative noncancer HIs were 19 and 2, respectively (see Tables 1-6 and 1-7).

This screening-level HHRA TM includes the following:

- Contamination identification
- Exposure assessment
- Toxicity assessment
- Risk characterization
- Uncertainties
- Conclusions

2.0 Contaminant Identification

All chemicals/radionuclides analyzed and detected in surface HLP materials and in drain-down solutions were identified as contaminants of potential concern (COPC). Chemicals/radionuclides detected in drain-down solutions from HLPs for which MCLs, Nevada cleanup standards or tap water PRGs are available, were compared to MCLs and Nevada TPH cleanup standards or PRGs.

Chemicals detected in surface HLP material samples for which residential and industrial PRGs are available, were compared to PRGs. Cancer risks and noncancer hazards were estimated for the chemicals which were compared to PRGs.

3.0 Exposure Assessment

A human health conceptual site model (CSM) diagram describing receptors and exposure pathways is included as Figure 3-1. Receptors that may be exposed to the HLP materials and drain-down solutions include current and future residential children and adults and industrial workers. Exposure of residential and industrial receptors to HLP materials may occur through incidental ingestion, dermal contact, and outdoor inhalation of windblown dust. Exposure of potential receptors to drain-down solutions may occur through ingestion. Tribal lifeways might represent another potential exposure scenario but have not been incorporated into the CSM or the screening-level risk calculations. Further direction from EPA regarding the potential exposure scenario for tribal lifeways is pending.

Environmental exposure media included surface HLP material samples collected from 0.25 to 0.75 feet below the heap surface and drain-down solution samples obtained from leachate containment systems for each HLP.

Identified exposure areas for this screening-level HHRA include surface HLP materials and drain-down solutions from the HLPs. Each HLP group is considered a separate exposure area. The number of locations sampled at each Arimetco HLP ranged from five (Phase I/II) to ten locations (Phase IV Slot). The number of locations sampled in connection with the VLT materials ranged from four (surface VLT materials) to eleven locations (Phase IV VLT).

Maximum drain-down solution sample result concentrations for Group A and Group B were used for the screening-level comparison with primary MCLs and Nevada groundwater cleanup standards. Group-specific maximum concentrations for HLP materials were used for the screening-level estimate of cancer risks and non cancer hazards.

In keeping with EPA guidance for the approach and methodology for a RI baseline HHRA (EPA, 1989) for the drain-down solutions and HLP material, current institutional access limitations or land-use controls are not considered in this screening-level risk assessment. This approach would tend to overestimate actual onsite exposure and associated risks and hazards because, currently, the Site is entirely bounded by chain-link fencing and is posted with warning signage. These engineering and land-use controls should serve to restrict access to the Site, and specifically the HLPs and drain-down solution ponds being evaluated as part of this screening-level assessment. Evaluating onsite exposures and associated health risks and hazards without considering existing engineering or land-use controls will provide EPA with the justification to continue the use of such onsite access controls.

4.0 Toxicity Assessment

For metals in drain-down solution samples collected from HLPs, primary MCLs (EPA, 2008) were used for screening-level comparisons. For TPH in drain-down solutions, the Nevada groundwater cleanup standards (NDEP, 2008) were used for screening-level comparisons. For radionuclides in drain-down solutions, the primary MCLs (EPA, 2008) were used for screening-level comparisons. Screening-level cancer risks were also estimated utilizing the EPA tap water PRGs (EPA, 2007).

For MCL exceedance ratio estimates, maximum chemical or radionuclide concentration are divided by the primary MCL (EPA, 2008). For Nevada cleanup standard exceedance ratio estimates, maximum chemical concentration is divided by Nevada groundwater TPH cleanup standard (NDEP, 2008).

For surface HLP material samples, screening-level risks and hazards were estimated by utilizing the PRG comparison method using either EPA Region 9 residential or industrial soil PRGs (EPA, 2004). The following is a description of the screening evaluation based on the stepwise screening approach described in the EPA Region 9 PRG user guide (EPA, 2004):

- For cancer risk estimates, the HLP group-specific maximum chemical concentration in HLP materials or maximum radionuclide concentration in drain-down solutions is divided by the PRG concentrations that are designated for cancer evaluation. The resulting ratio is multiplied by 1E-06 to estimate chemical/radionuclide-specific risk for a reasonable maximum exposure (RME). For multiple chemicals, the risks for the chemicals are separately summed to estimate total cancer risk for drain-down solutions or HLP materials.
- For noncancer health hazard estimates, the HLP group-specific maximum chemical concentration in HLP materials or maximum radionuclide concentration in drain-down solutions is divided by the noncancer PRG designated as "nc." For multiple contaminants, the resulting ratios (known as hazard quotients [HQ]) are separately summed for drain-down solutions or HLP materials. The cumulative ratio represents a noncarcinogenic HI. An HI greater than 1 suggests further evaluation may be necessary.

5.0 Risk Characterization

Cancer risks and health hazards associated with exposure to HLP materials were estimated. For the purposes of this evaluation, the potential for unacceptable cancer risk or human health hazard was identified using the following criteria:

- Excess Lifetime Cancer Risk (ELCR) values were compared to the risk management range of 1E-06 to 1E-04 (EPA 2004).
- An HI (the sum of ratios of chemical intake to the reference dose for all noncarcinogens) greater than 1 indicates that there is potential for adverse noncancer health effects associated with exposure to the contaminants of potential concern (EPA, 1991).

For metals in HLP drain-down solutions, primary MCL exceedance ratios are presented in Table 1-1. Metal primary MCL exceedance ratios ranged from 15 times the MCL for mercury to as high as 4,385 times the MCL for copper. Eight metals had primary MCL exceedances (antimony [33 times the MCL], arsenic [28 times the MCL], beryllium [375 times the MCL], cadmium [84 times the MCL], chromium [21 times the MCL], copper [4,385 times the MCL], mercury [15 times the MCL], and thallium [445 times the MCL]). The Box and Whisker plots comparing metal concentrations in drain-down solutions with primary MCLs are presented in the Appendix.

For TPHs in HLP drain-down solutions, Nevada cleanup standard exceedances are presented in Table 1-2. Maximum TPH concentrations exceeded Nevada cleanup standards by a factor of two.

For radionuclides in drain-down solutions from heap leach pads, primary MCL exceedances and cancer risks are presented in Table 1-3. The maximum alpha radiation concentration exceeded the primary MCL by a factor of 1,087 times the MCL. The cancer risk for radionuclides (thorium 227, thorium 228, thorium 230, thorium 232, uranium 234, uranium 235, and uranium 238) ranged from 2E-04 for thorium 232 to as high as 2E-02 for uranium 234. The cumulative cancer risk was 3E-02 for radionuclides.

For metals in Group A surface HLP material samples, the results of the screening-level HHRA are presented in Tables 1-4 and 1-5. Cumulative residential and industrial cancer risks were 8E-05 and 2E-05, respectively. The primary contributor to residential and industrial risks was arsenic. Cumulative noncancer HIs were 7 and less than 1, respectively. The primary contributors to residential noncancer hazards were arsenic, copper and iron. The Box and Whisker plots comparing metal concentrations from the four Group A HLPs with residential and industrial PRGs are presented in the appendices.

For Group B surface HLP material samples, the results of the screening-level HHRA are presented in Tables 1-6 and 1-7. Cumulative residential and industrial cancer risks were 3E-04 and 7E-05, respectively. The primary contributor to residential and industrial risks was arsenic. Cumulative noncancer HIs were 19 and 2, respectively. The primary contributors to residential and industrial noncancer hazards were copper, iron, thallium, and arsenic. The Box and Whisker plots comparing metal concentrations from the Phase IV

VLT HLP material samples with residential and industrial PRGs are presented in the appendices.

6.0 Uncertainties

In keeping with EPA guidance for the approach and methodology for a RI baseline HHRA (EPA, 1989) for the drain-down solutions and HLP material, current institutional access limitations or land use controls are not considered in this screening-level risk assessment. This would tend to overestimate actual onsite exposure and associated risks and hazards.

The drain-down solutions are wastewater leachate from the HLPs and not groundwater or surface water, although the solutions at this site may have the potential to impact groundwater or surface water. In this screening-level assessment the drain-down solutions are compared to drinking water MCLs and tap water PRGs to evaluate potential risks and hazards to future potential receptors. The drain-down solutions would not be expected to be ingested as a source of drinking water. The use of a conservative drinking water comparison criteria, MCLs or PRGs, would serve to overestimate potential exposures and associated risks to drain-down solutions. However this approach is in keeping with the exposure assumptions for a screening-level baseline HHRA.

The HLP material is a solid waste material from mining and subsequent leaching operations and is not soil. The HLP material is evaluated in this screening-level HHRA by comparison to soil PRGs to evaluate potential risks and hazards to future residential and industrial receptors. There is uncertainty associated with the use of soil PRGs as comparison criteria for HLP material because the exposure assumptions for soil might not be directly applicable for estimating exposure to HLP materials (e.g., dermal adherence). Incidental soil ingestion related to hand-to-mouth contact, might be less for the HLP materials than for soil. Consequently, risks might be overestimated by using the soil PRGs as comparison criteria. This approach is in keeping with the exposure assumptions for a screening-level, baseline HHRA.

7.0 Conclusions

The objective of this screening-level HHRA was to assess whether contamination from Arimetco HLPs and contamination contained within drain-down solutions pose a significant risk to human health. From the results of the RI site investigation, the following conclusions can be made for HLP drain-down solutions from HLPs:

- Maximum metals concentrations exceeded primary MCLs for eight metals (antimony, arsenic, beryllium, cadmium, chromium, copper, mercury, and thallium) by a factor ranging from 15 times the MCL for mercury to as high as 4,385 times the MCL for copper.
- Maximum TPH concentrations in HLP drain-down solutions exceeded Nevada groundwater cleanup standards by a factor of 2-fold.
- Maximum alpha radiation concentrations exceeded primary MCL by a factor of 1,087 times the MCL. Cumulative cancer risk was 3E-02 for radionuclides in HLP drain-down solutions.

The following conclusions can be made for HLP surface materials:

- For Group A HLPs, the screening-level cumulative residential and industrial cancer risks were 8E-05 and 2E-05, respectively. Cumulative noncancer HIs were 7 and less than 1, respectively.
- For Group B HLPs, the screening-level cumulative residential and industrial cancer risks were 3E-04 and 7E-05, respectively. Cumulative noncancer HIs were 19 and 2, respectively.

The results of this screening-level HHRA for the Arimetco heap leach pads show that drain-down solutions exceed the drinking water MCLs for 8 metals ranging from 15 times the MCL for mercury to as high as 4,385 times the MCL for copper. The drain-down solutions should not be ingested as drinking water. Continued institutional controls are required for protection of the public from exposure to drain-down solutions.

The cancer risks for potential exposure to Group A HLP materials are at the upper end of the EPA cancer risk management range of 1E-06 to 1E-04. The residential cancer risk for potential exposure to Group B HLP materials exceeds the EPA cancer risk management range of 1E-04; and industrial cancer risk is at the upper end of the EPA cancer risk management range. The noncancer health hazards for exposure to Group A HLP materials exceeded an HI of 1 for residential exposures. The noncancer health hazards for exposure to Group B HLP materials exceeded an HI of 1 for residential and industrial exposures. Continued institutional controls are required for protection of the public from exposure to HLP materials.

The results of this screening-level HHRA support the continuation by EPA of current Site access limitations and/or land use controls. The Site is currently entirely bounded by chain-link fencing and is posted with signage to prohibit access. These controls serve to restrict access to the Site, and specifically to the HLPs and drain-down solution ponds, and should be continued for as long as human exposure to these materials is possible to prevent future reuse of the HLP materials for residential or recreational applications without additional risk-related studies.

Potential drain-down solution impacts to groundwater beneath the Arimetco HLPs are not being investigated as part of this RI and were not evaluated as part of this screening-level HHRA. The results of the comparison of drain-down solutions to MCLs indicate that an investigation of the groundwater beneath the HLPs may be advisable, as part of the Site-wide groundwater investigation. If impacted by drain-down solutions, the groundwater under the HLPs may present a potential exposure pathway, which should be evaluated as part of an overall Site-wide risk assessment.

8.0 References

Nevada Department of Environmental Protection (NDEP). 2008. *Nevada Cleanup Standards, Nevada Division of Environmental Protection*.

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U.S. Environmental Protection Agency (EPA). 2004. *User's Guide and Background Technical Document for USEPA Region 9's Preliminary Remediation Goals (PRG) Table.* October.

U.S. Environmental Protection Agency (EPA). 2007. *Radionuclide Toxicity and Preliminary Remediation Goals for Superfund*. November.

U.S. Environmental Protection Agency (EPA). 2008. *Drinking Water Contaminants and their MCLs*. last updated February.

Tables

TABLE 1-1

pH and Total Petroleum Hydrocarbon Results, Drain-down Solutions; TPH Compared to Nevada Cleanup Standards

Arimetco Heap Leach Pads, Anaconda Yerington Mine

Location	SampleDate	Aluminum	Antimony	Arsenic	Barium	Beryllium	Boron	Cadmium	Calcium	Chromium	Cobalt	Copper	Iron	Lead	Lithium	Magnesium	Manganese	Mercury
	Primary MCL:	--	6	10	2000	4	--	5	--	100	--	1300	--	15	--	--	--	2
	Secondary MCL:	50 - 200	--	--	--	--	--	--	--	--	--	1000	300	--	--	--	50	--
	Tap Water PRG:	36000	15	0.0071	2600	73	7300	18	--	--	730	1500	11000	--	730	--	880	--
	Units:	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
		Analytical Results																
PHASE 1 POND																		
H12DD01	9/13/2007	19000000	1,600 U	400 U	200 U	**1200**	2500	**340**	600000	**1300**	45000	**5700000**	650000	1,600 U	13000	17000000	460000	**29**
PHASE I/II PLS POND																		
H12DD02	9/13/2007	27000000	1,600 U	**130 J**	200 U	**1500**	1800	**400**	450000	**2100**	66000	**4600000**	460000	1,600 U	15000	23000000	700000	**8.7**
PHASE III 4X HEAP LEACH PAD - LOW POINT																		
H3XDD01	9/12/2007	11000000	**160 J**	**110 J**	200 U	**640**	1100	**180**	480000	**460**	29000	**1700000**	210000	1,600 U	7500	9600000	280000	**8.3**
PHASE III BATHTUB POND																		
H3SDD01	9/13/2007	23000000	1,600 U	400 U	200 U	**1300**	1800	**360**	490000	**1900**	47000	**4300000**	1100000	1,600 U	14000	21000000	500000	**4.7**
PHASE IV SLOT HEAP LEACH PAD																		
H4SDD01	9/13/2007	27000000	1,600 U	400 U	200 U	**1500**	1900	**420**	420000	**1900**	70000	**3500000**	420000	1,600 U	17000	23000000	740000	**6.7**
PHASE IV SLOT III PLS POND																		
H4SDD02	9/13/2007	15000000	1,600 U	400 U	200 U	**890**	1400	**250**	600000	**1600**	41000	**2000000**	470000	1,600 U	11000	13000000	410000	**10**
H4SDD02 (FD)	9/13/2007	15000000	1,600 U	400 U	200 U	**890**	1400	**250**	600000	**1600**	41000	**2000000**	470000	1,600 U	11000	13000000	410000	**11**
PHASE IV VLT HEAP LEACH PAD																		
H4VDD02	9/12/2007	9000000	1,600 U	400 U	200 U	**550**	1500	**170**	480000	**940**	28000	**2200000**	250000	1,600 U	6900	8600000	270000	**14**
PHASE IV VLT PLS POND																		
H4VDD01	9/12/2007	17000000	**200**	**250**	200 U	**960**	1700	**290**	600000	**1400**	49000	**2900000**	650000	1,600 U	12000	15000000	460000	**7.9**
H4VDD01 (FD)	9/12/2007	17000000	1,600 U	**280**	200 U	**970**	1800	**300**	600000	**1500**	50000	**2900000**	640000	1,600 U	12000	15000000	470000	**7.6**

Comparison of Maximum Concentration to Primary MCL

	Aluminum	Antimony	Arsenic	Barium	Beryllium	Boron	Cadmium	Calcium	Chromium	Cobalt	Copper	Iron	Lead	Lithium	Magnesium	Manganese	Mercury
Maximum Concentration	27000000	200	280	NA	1500	2500	420	600000	2100	70000	5700000	1100000	NA	17000	23000000	740000	29
Primary MCL Exceedance (Maximum Concentration ÷ MCL)	NA	33	28	NA	375	NA	84	NA	21	NA	4385	NA	NA	NA	NA	NA	15

Notes
Bolded values exceed Primary Federal MCL
µg/L - micrograms per Liter
J - Estimated result
U - Not detected at reporting limit
FD - Field Duplicate
MCL - Federal Maximum Contaminant Level
PRG - Preliminary Remediation Goal (EPA, 2004)
-- - no PRG available
-- - no MCL available
NA - Not applicable

Table 1-1
Metal Results, Drain-down Solutions Compared to MCLs
Arimetco Heap Leach Pads, Anaconda Yerington Mine

	Parameter:	Molybdenum	Nickel	Potassium	Selenium	Silver	Sodium	Strontium	Thallium	Tin	Titanium	Vanadium	Zinc
	Primary MCL:	--	--	--	50	--	--	--	2	--	--	--	--
	Secondary MCL:	--	--	--	--	100	--	--	--	--	--	--	5000
	Tap Water PRG:	180	730	--	180	180	--	22000	2.4	22000	150000	36	11000
	Units:	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
Location	SampleDate										Analytical Results		
PHASE 1 POND													
H12DD01	9/13/2007	400 U	26000	120000	400 U	200 U	1900000	15000	1,600 U	20,000 U	1000	230	47000
PHASE I/II PLS POND													
H12DD02	9/13/2007	400 U	36000	75000	400 U	200 U	2200000	3700	**660 J**	40,000 U	410	300	63000
PHASE III 4X HEAP LEACH PAD - LOW POINT													
H3XDD01	9/12/2007	400 U	17000	93000	400 U	200 U	1100000	4500	**380**	8,000 U	180	70 J	26000
PHASE III BATHTUB POND													
H3SDD01	9/13/2007	400 U	30000	40,000 U	400 U	50 J	2100000	140	1,600 U	20,000 U	900	1100	60000
PHASE IV SLOT HEAP LEACH PAD													
H4SDD01	9/13/2007	400 U	41000	86000	400 U	200 U	2400000	2500	**760 J**	40,000 U	330	370	67000
PHASE IV SLOT III PLS POND													
H4SDD02	9/13/2007	400 U	24000	100000	400 U	200 U	1500000	6800	1,600 U	20,000 U	310	86 J	39000
H4SDD02 (FD)	9/13/2007	400 U	24000	99000	400 U	200 U	1500000	6800	1,600 U	20,000 U	300	81 J	39000
PHASE IV VLT HEAP LEACH PAD													
H4VDD02	9/12/2007	400 U	17000	66000	400 U	200 U	970000	3800	1,600 U	8,000 U	300	65 J	26000
PHASE IV VLT PLS POND													
H4VDD01	9/12/2007	400 U	30000	140000	400 U	200 U	1700000	7600	**890**	20,000 U	1100	100	46000
H4VDD01 (FD)	9/12/2007	400 U	30000	140000	400 U	200 U	1700000	7700	1,600 U	20,000 U	1100	100 J	46000

Comparison of Maximum Concentration to Primary MCL

	Molybdenum	Nickel	Potassium	Selenium	Silver	Sodium	Strontium	Thallium	Tin	Titanium	Vanadium	Zinc
Maximum Concentration	NA	41000	140000	NA	NA	2400000	15000	890	NA	1100	1100	67000
Primary MCL Exceedance (Maximum Concentration ÷ MCL)	NA	NA	NA	NA	NA	NA	NA	445	NA	NA	NA	NA

Notes
Bolded values exceed Primary Federal MCL
ug/L - micrograms per Liter
J - Estimated result
U - Not detected at reporting limit
FD - Field Duplicate
MCL - Federal Maximum Contaminant Level
PRG - Preliminary Remediation Goal (EPA, 2004)
-- - no PRG available
-- - no MCL available
NA - Not applicable

TABLE 1-2

pH and Total Petroleum Hydrocarbon Results, Drain-down Solutions; TPH Compared to Nevada Cleanup Standards

Arimetco Heap Leach Pads, Anaconda Yerington Mine

Parameter:		pH	TPH, as diesel	TPH, as kerosene
Nevada Cleanup Standard:		--	1000	1000
Primary MCL:		--	--	--
Secondary MCL:		6.5 - 8.5	--	--
Tap Water PRG:		--	--	--
Units		pH units	ug/L	ug/L
Location	SampleDate		Analytical Results	
PHASE 1 POND				
H12DD01	9/13/2007	2.2 J	**2000**	**2100**
PHASE I/II PLS POND				
H12DD02	9/13/2007	1.9 J	**1,700 J**	1,700 UJ
PHASE III 4X HEAP LEACH PAD - LOW POINT				
H3XDD01	9/12/2007	2.43	750	1,580 U
PHASE III BATHTUB POND				
H3SDD01	9/13/2007	2 J	**1600**	3,200 U
PHASE IV SLOT HEAP LEACH PAD				
H4SDD01	9/13/2007	2 J	**2100**	4,400 U
PHASE IV SLOT III PLS POND				
H4SDD02	9/13/2007	2.4 J	**1300**	2,800 U
H4SDD02 (FD)	9/13/2007	2.4 J	**1600**	**1700**
PHASE IV VLT HEAP LEACH PAD				
H4VDD02	9/12/2007	2.8 J	**1500**	**1500**
PHASE IV VLT PLS POND				
H4VDD01	9/12/2007	2.6 J	**1300**	2,600 U
H4VDD01 (FD)	9/12/2007	2.5 J	**1200**	2,600 U

Comparison of Maximum TPH Concentration to Nevada Cleanup Standard

	TPH, as diesel	TPH, as kerosene
Maximum Concentration	2100	2100
Nevada Cleanup Standard Exceedance (Maximum Concentration ÷ Nevada TPH Cleanup Standard)	2	2

Notes

Bolded values exceed the Nevada Cleanup Standard

µg/L - micrograms per Liter

J - Estimated result

U - Not detected at reporting limit

TPH-Total Petroleum Hydrocarbons

FD - Field Duplicate

MCL - Federal Maximum Contaminant Level

PRG - Preliminary Remediation Goal (EPA, 2004)

-- - no Nevada Cleanup Standard, MCL,or PRG available

NA - Not applicable

TABLE 1-3

pH and Total Petroleum Hydrocarbon Results, Drain-down Solutions; TPH Compared to Nevada Cleanup Standards

Arimetco Heap Leach Pads, Anaconda Yerington Mine

Metal Results, Drain-down Solutions Compared to MCLs

	Parameter:	Alpha	Beta	Thorium 227	Thorium 228	Thorium 230	Thorium 232	Uranium 234	Uranium 235	Uranium 238
	Primary MCL:	15	4 millirems per year	--	--	--	--	--	--	--
	Secondary MCL:	--	--	--	--	--	--	--	--	--
	Tap Water PRG:	--	--	1.00	0.445	0.523	0.471	0.674	0.684	0.744
	Units:	pCi/L ± unc	pCi/L ± unc	pCi/L ± unc	pCi/L ± unc	pCi/L ± unc	pCi/L ± unc	pCi/L ± unc	pCi/L ± unc	pCi/L ± unc
Location	SampleDate									
PHASE 1 POND										
H12DD01	9/13/2007	**16300 ±3620**	4460 ±2110	-11 U ±243	**641 ±288**	**196 ±121**	**35.6 U ±121**	**6860 ±154**	**500 ±75**	**5280 ±142**
PHASE I/II PLS POND										
H12DD02	9/13/2007	**8690 ±4730**	6280 ±2120	11.1 U ±49.2	54.2 U ±58.4	**72.3 ±24.6**	**46.9 ±24.5**	**8390 ±32**	**377 ±16.9**	**7010 ±32**
PHASE III 4X HEAP LEACH PAD - LOW POINT										
H3XDD01	9/12/2007	**6190 ±3040**	3200 ±1940	20.9 U ±312	175 U ±298	73.5 U ±103	**56.4 U ±103**	**5660 ±159**	**217 ±72.3**	**4440 ±105**
PHASE III BATHTUB POND										
H3SDD01	9/13/2007	**7510 ±4430**	7290 ±2040	21.8 U ±52.4	**79.6 ±59.2**	**182 ±10.7**	**54.6 ±21.7**	**9950 ±41.9**	**336 ±33.4**	**7990 ±34.6**
PHASE IV SLOT HEAP LEACH PAD										
H4SDD01	9/13/2007	**9850 ±4420**	5130 ±2080	-15 U ±64	53.6 U ±61.3	**57.1 ±21.3**	8.14 U ±21.3	**11000 ±11.2**	**433 ±23.3**	**8870 ±22.8**
PHASE IV SLOT III PLS POND										
H4SDD02	9/13/2007	**8460 ±3350**	5480 ±2020	37 U ±53.8	**155 ±57.4**	**83.1 ±19.3**	**36.8 ±16.4**	**6120 ±22.9**	**291 ±23.4**	**5360 ±19.5**
H4SDD02 (FD)	9/13/2007	**8640 ±3040**	5270 ±1940	-9.28 U ±61.3	**140 ±71.4**	**67.7 ±11.3**	**21.3 ±19.5**	**6020 ±12.5**	**400 ±15**	**4870 ±25.5**
PHASE IV VLT HEAP LEACH PAD										
H4VDD02	9/12/2007	**4270 ±2130**	1690 U ±1860	-2.27 U ±50.3	**132 ±57.4**	**51.5 ±25**	17.1 U ±19.1	**3210 ±21.4**	**109 ±33.6**	**2470 ±12.4**
PHASE IV VLT PLS POND										
H4VDD01	9/12/2007	**6670 ±3010**	6680 ±1910	13.3 U ±55.8	**268 ±65**	**156 ±22**	**42 ±18.7**	**6590 ±27.5**	**289 ±25.2**	**5420 ±24.7**
H4VDD01 (FD)	9/12/2007	**8980 ±3700**	4890 ±2020	16.7 U ±62.4	**274 ±51.6**	**114 ±25.1**	**75.7 ±20.7**	**6230 ±28.2**	**368 ±33.8**	**5330 ±25.3**

Comparison of Radionuclide Results to Screening Levels (MCL or Tap Water PRGs)

	Alpha	Beta	Thorium 227	Thorium 228	Thorium 230	Thorium 232	Uranium 234	Uranium 235	Uranium 238	Total Cancer Risk
Maximum Concentration	**16300**	**NA**	**NA**	**641**	**196**	**75.7**	**11000**	**500**	**8870**	
MCL Exceedance (Maximum Concentration ÷ MCL)	**1086.7**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	
Cancer Risk (Maximum Concentration ÷ Tap Water PRG x 1E-06)	**--**	**--**	**NA**	**1.4E-03**	**3.7E-04**	**1.6E-04**	**1.6E-02**	**7.3E-04**	**1.2E-02**	**3.1E-02**

Notes
Bolded values exceed Tap Water PRG or Primary MCL
All results listed as result (MDC)
MDC - Minimum Detectable Concentration
pCi/L - picocuries per Liter
ND - Not detected at MDC
FD - Field Duplicate
unc - radiological measurement uncertainty
MCL - Federal Maximum Contaminant Level
PRG - Preliminary Remediation Goal (EPA, 2007)
-- - no MCL or PRG available
NA - Not applicable

TABLE 1-4

pH and Total Petroleum Hydrocarbon Results, Drain-down Solutions; TPH Compared to Nevada Cleanup Standards — Metal Results, Drain-down Solutions Compared to MCLs

Arimetco Heap Leach Pads (I, II, III 4X, III South, IV Slot), Anaconda Yerington Mine

Location	Sample Date	Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Copper	Iron	Lead	Manganese	Mercury	Molybdenum	Nickel	Selenium	Silver	Thallium	Vanadium	Zinc
Parameter:																					
Residential PRG (Cancer):		--	--	0.39	--	1100	1400	--	900	--	--	--	--	--	--	--	--	--	--	--	--
Residential PRG (Noncancer):		76000	31	22	5400	150	37	--	1400	3100	23000	--	1800	23	390	1600	390	390	5.2	78	23000
Units		mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg
									Analytical Results												
PHASE I/II HEAP LEACH PAD: Surface Discrete																					
H12SS01	10/23/2007	7860	1.3 J	**22.6**	68.3	0.36 J	0.52 U	2.8 J	5.8	2,830 J	19400	6.1	71.7	0.18	---	6.5	3.8 J	0.17 J	0.99 J	23.8	13.5
H12SS01 (FD)	10/23/2007	11000	1 J	**26**	81	0.39	1 U	5	4.7	2100	**24000**	5.8	66	0.12	3.7 J	7.3	3.6	2 U	10 U	30	12
H12SS02	10/23/2007	7760	1.1 J	**21.4**	74.7	0.35 J	0.53 U	2.5 J	7.3	1,450 J	14400	3.9	78.4	0.17	---	6.3	3.7 J	1.1 U	0.7 J	14.1	13
H12SS03	10/23/2007	5440	1.5 J	**9.1**	60.6	0.27 J	0.51 U	3.3 J	3.2 J	1,100 J	8510	4.2	28.7	1	---	4.5	3.8 J	1 U	0.43 J	12.1	7.3
H12SS04	10/23/2007	5770	0.36 J	**12.5**	73	0.28 J	0.54 U	2.1 J	2.9 J	1,040 J	20100	7	33.8	0.11	---	3.5 J	4.1 J	0.18 J	0.92 J	23.2	8.7
PHASE III 4X HEAP LEACH PAD: Surface Discrete																					
H3XSS01	10/25/2007	11800	0.28 J	**12**	81.4	0.49 J	0.51 U	19.1 J	12.3	3,090 J	20600	3.4	118	0.033 J	---	12.1	3.5 J	0.09 J	0.52 J	50.3	12.2
H3XSS02	10/25/2007	11500	6.2 J	**24.8**	105	0.55	0.51 U	5.1 J	9.1	**8,060 J**	**23800**	6	123	0.83	---	9.4	5.2 J	0.56 J	1 J	38.1	24.2
H3XSS03	10/25/2007	7600	1 J	**7.8**	60.4	0.25 J	0.52 U	7.7 J	5.2	520 J	12400	5.5	55.2	0.31	---	7.5	3.1 J	1 U	0.82 J	18.9	13.2
H3XSS04	10/25/2007	5850	0.48 J	**6.8**	44.1	0.19 J	0.51 U	3.9 J	3.5 J	540 J	10500	6.5	32.9	0.35	---	5	5.5 J	0.13 J	0.7 J	19.1	9.3
H3XSS05	10/25/2007	4950	2.7 J	**13**	65.7	0.23 J	0.52 U	4.5 J	4 J	655 J	12400	6.7	41.8	0.36	---	3.9 J	2.9 J	0.12 J	0.74 J	18.5	8.3
H3XSS06	10/25/2007	13700	1.5 J	**19.4**	110	0.52 J	0.67 U	11 J	13.3	1,080 J	**24700**	53.2	125	1.8	---	11.5	9.5 J	0.38 J	1.2 J	18.8	23.5
H3XSS07	10/25/2007	6810	1.2 J	**9.3**	70.8	0.23 J	0.52 U	4.9 J	4.6 J	539 J	12200	7.9	48.7	0.48	---	6	3.9 J	0.2 J	0.75 J	17.6	12.2
H3XSS08	10/25/2007	7690	0.53 J	**7.7**	60.4	0.2 J	0.53 U	4.5 J	5.1 J	585 J	13000	4.9	56	0.47	---	7.1	6.1 J	0.23 J	0.82 J	22.7	14.5
H3XSS08 (FD)	10/25/2007	8800	4 U	**8.5**	58	0.22	1 U	6	4.2	480	16000	4.5	56	0.53	4 J	7.8	5.4	2 U	10 U	30	14
PHASE III SOUTH HEAP LEACH PAD: Surface Discrete																					
H3SSS01	10/24/2007	7680	0.96 J	**9.8**	71.5	0.34 J	0.53 U	3.9 J	6.2	1,420 J	18500	4.6	81.9	0.22	---	5.4	4.3 J	0.25 J	0.99 J	20.8	14.6
H3SSS02	10/25/2007	7390	1.2 J	**18.4**	76.9	0.38 J	0.55 U	4.8 J	5.5	1,670 J	19800	5.5	64.7	0.082 J	---	6.1	3.5 J	0.12 J	0.99 J	27.4	13.4
H3SSS03	10/25/2007	12700	0.93 J	**14.8**	57.3	0.44 J	0.51 U	2.7 J	9.3	**6,060 J**	20600	4.3	68.5	0.28	---	7.6	3.7 J	0.29 J	0.89 J	32	10.6
H3SSS04	10/25/2007	3890	0.26 J	**2.6**	40.5	0.08 J	0.5 U	5.3 J	2.6 J	207 J	12500	1.8	32.3	0.37	---	5.6	1.6 J	0.13 J	0.81 J	25.5	11.4
H3SSS04 (FD)	10/25/2007	4500	2 U	**2.4**	39	0.09 J	1 U	7.1	2.3	200	16000	1.7 J	37	0.22	2.7 J	6.3	1.3 J	2 U	10 U	27	11
H3SSS05	10/24/2007	6960	0.29 J	**11.3**	52.7	0.19 J	0.55 U	5.3 J	2.6 J	990 J	19700	5.7	37.8	0.097 J	---	3.5 J	4.6 J	0.2 J	1.2 J	19.9	10.8
H3SSS06	10/25/2007	5580	0.55 J	**11.4**	72.3	0.21 J	0.52 U	3.5 J	2.6 J	518 J	12500	6.7	41.2	0.25	---	3.5 J	2.3 J	1 U	0.62 J	18	13.1
H3SSS07	10/24/2007	8640	0.42 J	**10.6**	45.2	0.31 J	0.53 U	2.4 J	8	1,960 J	16800	5.7	98.1	0.27	---	7.6	3.4 J	0.11 J	0.91 J	15.2	21.2
H3SSS08	10/24/2007	7080	0.25 J	**11.6**	124	0.21 J	0.51 U	3.3 J	1.9 J	1,300 J	**28000**	3.2	43.6	0.11	---	2.6 J	6.3 J	0.41 J	1.4 J	24.3	10.9
PHASE IV SLOT HEAP LEACH PAD: Surface Discrete																					
H4SSS01	10/24/2007	6920	1.5 J	**8.7**	47.1	0.15 J	0.53 U	4.6	3.6 UJ	543	11600	3.6 J	37	0.81	---	6.1	5.2	0.15 J	0.68 J	18.9	9.3
H4SSS02	10/23/2007	8560	0.57 J	**10.2**	62.8	0.34 J	0.53 U	4.9	6.9	973	16300	5.8 J	66.8	0.29	---	6.4	4.9	0.12 J	0.9 J	17.8	13.4
H4SSS03	10/23/2007	7990	2.1 J	**9.1**	47.1	0.25 J	0.52 U	6.2	6.2	594	11100	8.1 J	47.9	1.1	---	6.8	4.9	0.11 J	0.68 J	19.8	7.7
H4SSS04	10/23/2007	7750	7.2	**15.3**	45.6	0.31 J	0.53 U	5.5	6.1	1030	11500	16.4 J	36.4	2.7	---	6.5	6.9	0.22 J	0.6 J	20.7	7.2
H4SSS05	10/23/2007	5990	0.78 J	**12**	54.3	0.25 J	0.54 U	2.3	2.8 UJ	668	14100	20.4 J	38.3	0.31	---	3.1 J	4.8	0.15 J	0.76 J	13.1	8.6
H4SSS06	10/24/2007	12500	4.6 J	**31.6**	106	0.73	0.52 U	7.6	5.6	**3690**	**24100**	8.2 J	69.4	0.72	---	7.9	5	0.22 J	1.1 J	46.8	22.4
H4SSS06 (FD)	10/24/2007	14000	6.9	**28**	120	0.74	1 U	9.7	5.9	**3600**	**27000**	7.6	75	0.66	19	8.9	4.6	2 U	10 U	53	22
H4SSS07	10/24/2007	8480	1.8 J	**12.8**	87.9	0.4 J	0.52 U	4.2	4.4 UJ	1320	18000	7.1 J	57.9	0.94	---	5.9	4.6	0.11 J	1 J	21.1	13.5
H4SSS08	10/24/2007	7430	0.87 J	**17.1**	72.6	0.27 J	0.52 U	2.9	4.7 UJ	909	17300	9.3 J	49.7	0.29	---	4.7	5.2	0.1 J	0.97 J	23.6	10.6
H4SSS09	10/24/2007	7410	0.95 J	**13.5**	86.2	0.36 J	0.54 U	6.6	4.5 UJ	614	17400	6.2 J	49.4	0.44	---	5.3	3.9	0.13 J	0.95 J	19.7	12.2
H4SSS10	10/24/2007	11100	4.1 J	**22.5**	221	0.69	0.51 U	3.9	23.2	**7360**	17900	5 J	152	5.1	---	8	2.2 UJ	0.32 J	0.85 J	33.9	18.2

Comparison of Maximum Concentration to Region 9 Cancer and Non-Cancer PRGs

	Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Copper	Iron	Lead	Manganese	Mercury	Molybdenum	Nickel	Selenium	Silver	Thallium	Vanadium	Zinc	
Maximum Concentration	14000	7	32	221	1	NA	10	23	7360	28000	53	152	5	19	12	7	NA	NA	53	24	
																					Total Cancer Risk
Cancer Risk (Maximum ÷ PRG (ca) x 1E-06)	NA	NA	8.1E-05	NA	6.7E-10	NA	NA	2.6E-08	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	**8.1E-05**
																					Total Hazard Index
Hazard Quotient (Maximum ÷ PRG (nc))	0.18	0.23	1.44	0.04	0.005	NA	NA	0.02	2.37	1.22	NA	0.08	0.22	0.05	0.01	0.02	NA	NA	0.68	0.001	**6.6**

Bolded values exceed Residential PRG
Depth 0.25-0.75 feet below ground surface
mg/Kg - milligrams per kilogram
J - Estimated result
U - Not detected at reporting limit
FD - Field Duplicate
PRG - Preliminary Remediation Goal (EPA, 2004)
-- - no PRG available
(ca) - Cancer PRG
(nc) - Non-cancer PRG
NA - Not applicable

TABLE 1-5

pH and Total Petroleum Hydrocarbon Results, Drain-down Solutions; TPH Compared to Nevada Cleanup Standards — Metal Results, Drain-down Solutions Compared to MCLs

Arimetco Heap Leach Pads (I/II, III 4X, III South, IV Slot), Anaconda Yerington Mine

Location	Sample Date	Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Copper	Iron	Lead	Manganese	Mercury	Molybdenum	Nickel	Selenium	Silver	Thallium	Vanadium	Zinc
Industrial PRG (Cancer):		--	--	**1.6**	--	**2200**	**3000**	--	**1900**	--	--	--	--	--	--	--	--	--	--	--	--
Industrial PRG (Noncancer):		**920000**	**410**	**260**	**67000**	**1900**	**450**	--	**13000**	**41000**	**310000**	--	**19000**	**310**	**5100**	**20000**	**5100**	**5100**	**67**	**1000**	**310000**
Units		mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg
		Analytical Results																			
PHASE I/II HEAP LEACH PAD: Surface Discrete																					
H12SS01	10/23/2007	7860	1.3 J	**22.6**	68.3	0.36 J	0.52 U	2.8 J	5.8	2,830 J	19400	6.1	71.7	0.18	---	6.5	3.8 J	0.17 J	0.99 J	23.8	13.5
H12SS01 (FD)	10/23/2007	11000	1 J	**26**	81	0.39	1 U	5	4.7	2100	24000	5.8	66	0.12	3.7 J	7.3	3.6	2 U	10 U	30	12
H12SS02	10/23/2007	7760	1.1 J	**21.4**	74.7	0.35 J	0.53 U	2.5 J	7.3	1,450 J	14400	3.9	78.4	0.17	---	6.3	3.7 J	1.1 U	0.7 J	14.1	13
H12SS03	10/23/2007	5440	1.5 J	**9.1**	60.6	0.27 J	0.51 U	3.3 J	3.2 J	1,100 J	8510	4.2	28.7	1	---	4.5	3.8 J	1 U	0.43 J	12.1	7.3
H12SS04	10/23/2007	5770	0.36 J	**12.5**	73	0.28 J	0.54 U	2.1 J	2.9 J	1,040 J	20100	7	33.8	0.11	---	3.5 J	4.1 J	0.18 J	0.92 J	23.2	8.7
PHASE III 4X HEAP LEACH PAD: Surface Discrete																					
H3XSS01	10/25/2007	11800	0.28 J	**12**	81.4	0.49 J	0.51 U	19.1 J	12.3	3,090 J	20600	3.4	118	0.033 J	---	12.1	3.5 J	0.09 J	0.52 J	50.3	12.2
H3XSS02	10/25/2007	11500	6.2 J	**24.8**	105	0.55	0.51 U	5.1 J	9.1	8,060 J	23800	6	123	0.83	---	9.4	5.2 J	0.56 J	1 J	38.1	24.2
H3XSS03	10/25/2007	7600	1 J	**7.8**	60.4	0.25 J	0.52 U	7.7 J	5.2	520 J	12400	5.5	55.2	0.31	---	7.5	3.1 J	1 U	0.82 J	18.9	13.2
H3XSS04	10/25/2007	5850	0.48 J	**6.8**	44.1	0.19 J	0.51 U	3.9 J	3.5 J	540 J	10500	6.5	32.9	0.35	---	5	5.5 J	0.13 J	0.7 J	19.1	9.3
H3XSS05	10/25/2007	4950	2.7 J	**13**	65.7	0.23 J	0.52 U	4.5 J	4 J	655 J	12400	6.7	41.8	0.36	---	3.9 J	2.9 J	0.12 J	0.74 J	18.5	8.3
H3XSS06	10/25/2007	13700	1.5 J	**19.4**	110	0.52 J	0.67 U	11 J	13.3	1,080 J	24700	53.2	125	1.8	---	11.5	9.5 J	0.38 J	1.2 J	18.8	23.5
H3XSS07	10/25/2007	6810	1.2 J	**9.3**	70.8	0.23 J	0.52 U	4.9 J	4.6 J	539 J	12200	7.9	48.7	0.48	---	6	3.9 J	0.2 J	0.75 J	17.6	12.2
H3XSS08	10/25/2007	7690	0.53 J	**7.7**	60.4	0.2 J	0.53 U	4.5 J	5.1 J	585 J	13000	4.9	56	0.47	---	7.1	6.1 J	0.23 J	0.82 J	22.7	14.5
H3XSS08 (FD)	10/25/2007	8800	4 U	**8.5**	58	0.22	1 U	6	4.2	480	16000	4.5	56	0.53	4 J	7.8	5.4	2 U	10 U	30	14
PHASE III SOUTH HEAP LEACH PAD: Surface Discrete																					
H3SSS01	10/24/2007	7680	0.96 J	**9.8**	71.5	0.34 J	0.53 U	3.9 J	6.2	1,420 J	18500	4.6	81.9	0.22	---	5.4	4.3 J	0.25 J	0.99 J	20.8	14.6
H3SSS02	10/25/2007	7390	1.2 J	**18.4**	76.9	0.38 J	0.55 U	4.8 J	5.5	1,670 J	19800	5.5	64.7	0.082 J	---	6.1	3.5 J	0.12 J	0.99 J	27.4	13.4
H3SSS03	10/25/2007	12700	0.93 J	**14.8**	57.3	0.44 J	0.51 U	2.7 J	9.3	6,060 J	20600	4.3	68.5	0.28	---	7.6	3.7 J	0.29 J	0.89 J	32	10.6
H3SSS04	10/25/2007	3890	0.26 J	**2.6**	40.5	0.08 J	0.5 U	5.3 J	2.6 J	207 J	12500	1.8	32.3	0.37	---	5.6	1.6 J	0.13 J	0.81 J	25.5	11.4
H3SSS04 (FD)	10/25/2007	4500	2 U	**2.4**	39	0.09 J	1 U	7.1	2.3	200	16000	1.7 J	37	0.22	2.7 J	6.3	1.3 J	2 U	10 U	27	11
H3SSS05	10/24/2007	6960	0.29 J	**11.3**	52.7	0.19 J	0.55 U	5.3 J	2.6 J	990 J	19700	5.7	37.8	0.097 J	---	3.5 J	4.6 J	0.2 J	1.2 J	19.9	10.8
H3SSS06	10/25/2007	5580	0.55 J	**11.4**	72.3	0.21 J	0.52 U	3.5 J	2.6 J	518 J	12500	6.7	41.2	0.25	---	3.5 J	2.3 J	1 U	0.62 J	18	13.1
H3SSS07	10/24/2007	8640	0.42 J	**10.6**	45.2	0.31 J	0.53 U	2.4 J	8	1,960 J	16800	5.7	98.1	0.27	---	7.6	3.4 J	0.11 J	0.91 J	15.2	21.2
H3SSS08	10/24/2007	7080	0.25 J	**11.6**	124	0.21 J	0.51 U	3.3 J	1.9 J	1,300 J	28000	3.2	43.6	0.11	---	2.6 J	6.3 J	0.41 J	1.4 J	24.3	10.9
PHASE IV SLOT HEAP LEACH PAD: Surface Discrete																					
H4SSS01	10/24/2007	6920	1.5 J	**8.7**	47.1	0.15 J	0.53 U	4.6	3.6 UJ	543	11600	3.6 J	37	0.81	---	6.1	5.2	0.15 J	0.68 J	18.9	9.3
H4SSS02	10/23/2007	8560	0.57 J	**10.2**	62.8	0.34 J	0.53 U	4.9	6.9	973	16300	5.8 J	66.8	0.29	---	6.4	4.9	0.12 J	0.9 J	17.8	13.4
H4SSS03	10/23/2007	7990	2.1 J	**9.1**	47.1	0.25 J	0.52 U	6.2	6.2	594	11100	8.1 J	47.9	1.1	---	6.8	4.9	0.11 J	0.68 J	19.8	7.7
H4SSS04	10/23/2007	7750	7.2	**15.3**	45.6	0.31 J	0.53 U	5.5	6.1	1030	11500	16.4 J	36.4	2.7	---	6.5	6.9	0.22 J	0.6 J	20.7	7.2
H4SSS05	10/23/2007	5990	0.78 J	**12**	54.3	0.25 J	0.54 U	2.3	2.8 UJ	668	14100	20.4 J	38.3	0.31	---	3.1 J	4.8	0.15 J	0.76 J	13.1	8.6
H4SSS06	10/24/2007	12500	4.6 J	**31.6**	106	0.73	0.52 U	7.6	5.6	3690	24100	8.2 J	69.4	0.72	---	7.9	5	0.22 J	1.1 J	46.8	22.4
H4SSS06 (FD)	10/24/2007	14000	6.9	**28**	120	0.74	1 U	9.7	5.9	3600	27000	7.6	75	0.66	19	8.9	4.6	2 U	10 U	53	22
H4SSS07	10/24/2007	8480	1.8 J	**12.8**	87.9	0.4 J	0.52 U	4.2	4.4 UJ	1320	18000	7.1 J	57.9	0.94	---	5.9	4.6	0.11 J	1 J	21.1	13.5
H4SSS08	10/24/2007	7430	0.87 J	**17.1**	72.6	0.27 J	0.52 U	2.9	4.7 UJ	909	17300	9.3 J	49.7	0.29	---	4.7	5.2	0.1 J	0.97 J	23.6	10.6
H4SSS09	10/24/2007	7410	0.95 J	**13.5**	86.2	0.36 J	0.54 U	6.6	4.5 UJ	614	17400	6.2 J	49.4	0.44	---	5.3	3.9	0.13 J	0.95 J	19.7	12.2
H4SSS10	10/24/2007	11100	4.1 J	**22.5**	221	0.69	0.51 U	3.9	23.2	7360	17900	5 J	152	5.1	---	8	2.2 UJ	0.32 J	0.85 J	33.9	18.2

Comparison of Maximum Concentration to Cancer and Non-Cancer PRG

	Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Copper	Iron	Lead	Manganese	Mercury	Molybdenum	Nickel	Selenium	Silver	Thallium	Vanadium	Zinc	
Maximum Concentration	14000	7	32	221	1	NA	10	23	7360	28000	53	152	5	19	12	7	NA	NA	53	24	
																					Total Cancer Risk
Cancer Risk (Maximum ÷ PRG (ca) x 1E-06)	NA	NA	2.0E-05	NA	3.4E-10	NA	NA	1.2E-08	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	**2.0E-05**
																					Total Hazard Index
Hazard Quotient (Maximum ÷ PRG (nc))	0.02	0.02	0.12	0.003	0.0004	NA	NA	0.002	0.18	0.09	NA	0.01	0.02	0.004	0.001	0.001	NA	NA	0.05	0.0001	**0.5**

Bolded values exceed Industrial PRG
Depth 0.25-0.75 feet below ground surface
mg/Kg - milligrams per kilogram
J - Estimated result
U - Not detected at reporting limit
FD - Field Duplicate
PRG - Preliminary Remediation Goal (EPA, 2004)
-- - no PRG available
(ca) - Cancer PRG
(nc) - Non-cancer PRG
NA - Not applicable

TABLE 1-6

pH and Total Petroleum Hydrocarbon Results, Drain-down Solutions; TPH Compared to Nevada Cleanup Standards — Metal Results, Drain-down Solutions Compared to MCLs

Arimetco VLT Heap Leach Pads, Anaconda Yerington Mine

Location	Sample Date	Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Copper	Iron	Lead	Manganese	Mercury	Molybdenum	Nickel	Selenium	Silver	Thallium	Vanadium	Zinc
	Residential PRG (Cancer):	**--**	**--**	**0.39**	**--**	**1100**	**1400**	**--**	**900**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**
	Residential PRG (Noncancer):	**76000**	**31**	**22**	**5400**	**150**	**37**	**--**	**1400**	**3100**	**23000**	**--**	**1800**	**23**	**390**	**1600**	**390**	**390**	**5.2**	**78**	**23000**
	Units	**mg/Kg**	**mg/Kg**	**mg/Kg**	**mg/Kg**	**mg/Kg**	**mg/Kg**	**mg/Kg**	**mg/Kg**	**mg/Kg**	**mg/Kg**	**mg/Kg**	**mg/Kg**	**mg/Kg**	**mg/Kg**	**mg/Kg**	**mg/Kg**	**mg/Kg**	**mg/Kg**	**mg/Kg**	**mg/Kg**
		Analytical Results																			
PHASE IV VLT HEAP LEACH PAD: Surface Discrete																					
H4VSS01	10/26/2007	13700	0.75 J	**9.4**	39.7	0.69	0.03 J	5.1	51.6	**10400**	13400	5.5 J	336	0.029 J	---	31.4	6.1	0.28 J	0.78 J	16.3	62.5
H4VSS01 (FD)	10/26/2007	8200	4 U	**8.4**	49	0.25	1 U	5.6	5.1	1000	15000	5.7	66	0.57	4 J	8	5.1	2 U	10 U	21	16
H4VSS02	10/26/2007	11300	0.77 J	**8.3**	83.1	0.39 J	0.51 U	10.3	8.3	1230	16700	5.3 J	96.9	0.34	---	10.7	3.9	0.16 J	1 J	25	23.6
H4VSS03	10/26/2007	6440	0.56 J	**6**	31.5	0.25 J	0.54 U	4.4	8.3	643	9160	6.7 J	86.3	0.56	---	7.2	3.3 UJ	1.1 U	0.54 J	10.8	11.2
H4VSS04	10/26/2007	11600	0.75 J	**11.5**	46.7	0.49 J	0.55 U	9.5	19.1	1620	**27500**	6.4 J	181	0.63	---	12.5	5.6	1.1 U	1.3 J	15	20.8
H4VSS05	10/26/2007	8690	0.93 J	**13.9**	90.4	0.3 J	0.51 U	4.5	4.8 UJ	824	18200	6.5 J	52	0.093 J	---	5.7	4.7	0.12 J	1 J	22.4	15.9
H4VSS06	10/26/2007	7260	0.95 J	**8.7**	47.3	0.23 J	0.52 U	3.7	6.1	703	11900	4.5 J	58.4	0.52	---	6.2	4.5	0.17 J	0.75 J	18.1	10.8
H4VSS07	10/26/2007	10700	0.43 J	**9.1**	68	0.5 J	0.53 U	5.6	15.1	896	16400	5.8 J	153	0.22	---	12.3	4.7	1.1 U	1 J	18	26.2
H4VSS08	10/26/2007	8230	0.47 J	**7.8**	74.8	0.46 J	0.51 U	6.4	19.4	2840	13000	3.8 J	155	0.04 J	---	12.7	3.8	0.27 J	0.77 J	27	14
H4VSS09	10/26/2007	6970	0.52 J	**8.1**	75.8	0.22 J	0.53 U	2.8	4.9 UJ	559	17200	7 J	69.1	0.3	---	5.8	5.7	0.25 J	1.2 J	17.9	16.8
H4VSS10	10/26/2007	27100	1.2 J	**13.6**	71.9	2.6	0.73 U	24.2	69	**6920**	**61100**	23.3 J	825	0.41	---	41.2	5.3	1.5 U	2.5 J	9.7	72.6
VLT SOIL: Surface Discrete																					
CAPSS01	10/29/2007	4910	1.3 J	**4.7 J**	37.7	0.25 J	0.5 U	3 J	24.6 J	**10600**	15100	4	81.2	0.45	---	10.9	6.6 J	0.79 J	0.86 J	10.2	20.5
CAPSS02	10/26/2007	6280	3.6 J	**119 J**	283	0.2 J	0.96	12.7 J	21 J	1250	**27900**	48.5	29.5	20.2	---	49.4	83.3 J	1.1	**6.6**	21.7	108
CAPSS03	10/29/2007	1970	1.5 J	**13.1 J**	104	0.06 J	0.52 U	2.8 J	2 J	**6260**	**30000**	271	20	0.81	---	1.1 J	13.8 J	1.9	2 J	8.5	13.2
CAPSS04	10/29/2007	7500	0.81 J	**29.3 J**	58.8	0.36 J	0.51 U	15.6 J	4.8 J	**22100**	20500	39.1	65.1	0.68	---	16	9.2 J	0.69 J	1.2 J	17.9	11.1

Comparison of Maximum Concentration to Region 9 Cancer and Non-Cancer PRG

	Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Copper	Iron	Lead	Manganese	Mercury	Molybdenum	Nickel	Selenium	Silver	Thallium	Vanadium	Zinc	
Maximum Concentration	27100	NA	119	283	3	1	24	69	22100	61100	271	825	20	NA	49	6	2	7	27	108	
																					Total Cancer Risk
Cancer Risk (Maximum ÷ PRG (ca) x 1E-06)	NA	NA	3.1E-04	NA	2.4E-09	6.9E-10	NA	7.7E-08	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	**3.1E-04**
																					Total Hazard Index
Hazard Quotient (Maximum ÷ PRG (nc))	0.36	NA	5.41	0.05	0.02	0.03	NA	0.05	7.13	2.66	NA	0.46	0.88	NA	0.03	0.02	0.005	1.27	0.35	0.005	**18.7**

Bolded values exceed Residential PRG
Depth 0.25-0.75 feet below ground surface
mg/Kg - milligrams per kilogram
J - Estimated result
U - Not detected at reporting limit
FD - Field Duplicate
PRG - Preliminary Remediation Goal (EPA, 2004)
-- - no PRG available
(ca) - Cancer PRG
(nc) - Non-cancer PRG
NA - Not applicable

TABLE 1-7

pH and Total Petroleum Hydrocarbon Results, Drain-down Solutions; TPH Compared to Nevada Cleanup Standards

Metal Results, Drain-down Solutions Compared to MCLs

Arimetco VLT Heap Leach Pads, Anaconda Yerington Mine

	Parameter:	**Aluminum**	**Antimony**	**Arsenic**	**Barium**	**Beryllium**	**Cadmium**	**Chromium**	**Cobalt**	**Copper**	**Iron**	**Lead**	**Manganese**	**Mercury**	**Molybdenum**	**Nickel**	**Selenium**	**Silver**	**Thallium**	**Vanadium**	**Zinc**
	Industrial PRG (Cancer):	**--**	**--**	**1.6**	**--**	**2200**	**3000**	**--**	**1900**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**
	Industrial PRG (Noncancer):	**920000**	**410**	**260**	**67000**	**1900**	**450**	**--**	**13000**	**41000**	**310000**	**--**	**19000**	**310**	**5100**	**20000**	**5100**	**5100**	**67**	**1000**	**310000**
	Units	**mg/Kg**	**mg/Kg**	**mg/Kg**	**mg/Kg**	**mg/Kg**	**mg/Kg**	**mg/Kg**	**mg/Kg**	**mg/Kg**	**mg/Kg**	**mg/Kg**	**mg/Kg**	**mg/Kg**	**mg/Kg**	**mg/Kg**	**mg/Kg**	**mg/Kg**	**mg/Kg**	**mg/Kg**	**mg/Kg**
Location	Sample Date								**Analytical Results**												
PHASE IV VLT HEAP LEACH PAD: Surface Discrete																					
H4VSS01	10/26/2007	13700	0.75 J	**9.4**	39.7	0.69	0.03 J	5.1	51.6	10400	13400	5.5 J	336	0.029 J	---	31.4	6.1	0.28 J	0.78 J	16.3	62.5
H4VSS01 (FD)	10/26/2007	8200	4 U	**8.4**	49	0.25	1 U	5.6	5.1	1000	15000	5.7	66	0.57	4 J	8	5.1	2 U	10 U	21	16
H4VSS02	10/26/2007	11300	0.77 J	**8.3**	83.1	0.39 J	0.51 U	10.3	8.3	1230	16700	5.3 J	96.9	0.34	---	10.7	3.9	0.16 J	1 J	25	23.6
H4VSS03	10/26/2007	6440	0.56 J	**6**	31.5	0.25 J	0.54 U	4.4	8.3	643	9160	6.7 J	86.3	0.56	---	7.2	3.3 UJ	1.1 U	0.54 J	10.8	11.2
H4VSS04	10/26/2007	11600	0.75 J	**11.5**	46.7	0.49 J	0.55 U	9.5	19.1	1620	27500	6.4 J	181	0.63	---	12.5	5.6	1.1 U	1.3 J	15	20.8
H4VSS05	10/26/2007	8690	0.93 J	**13.9**	90.4	0.3 J	0.51 U	4.5	4.8 UJ	824	18200	6.5 J	52	0.093 J	---	5.7	4.7	0.12 J	1 J	22.4	15.9
H4VSS06	10/26/2007	7260	0.95 J	**8.7**	47.3	0.23 J	0.52 U	3.7	6.1	703	11900	4.5 J	58.4	0.52	---	6.2	4.5	0.17 J	0.75 J	18.1	10.8
H4VSS07	10/26/2007	10700	0.43 J	**9.1**	68	0.5 J	0.53 U	5.6	15.1	896	16400	5.8 J	153	0.22	---	12.3	4.7	1.1 U	1 J	18	26.2
H4VSS08	10/26/2007	8230	0.47 J	**7.8**	74.8	0.46 J	0.51 U	6.4	19.4	2840	13000	3.8 J	155	0.04 J	---	12.7	3.8	0.27 J	0.77 J	27	14
H4VSS09	10/26/2007	6970	0.52 J	**8.1**	75.8	0.22 J	0.53 U	2.8	4.9 UJ	559	17200	7 J	69.1	0.3	---	5.8	5.7	0.25 J	1.2 J	17.9	16.8
H4VSS10	10/26/2007	27100	1.2 J	**13.6**	71.9	2.6	0.73 U	24.2	69	6920	61100	23.3 J	825	0.41	---	41.2	5.3	1.5 U	2.5 J	9.7	72.6
VLT SOIL: Surface Discrete																					
CAPSS01	10/29/2007	4910	1.3 J	**4.7 J**	37.7	0.25 J	0.5 U	3 J	24.6 J	10600	15100	4	81.2	0.45	---	10.9	6.6 J	0.79 J	0.86 J	10.2	20.5
CAPSS02	10/26/2007	6280	3.6 J	**119 J**	283	0.2 J	0.96	12.7 J	21 J	1250	27900	48.5	29.5	20.2	---	49.4	83.3 J	1.1	6.6	21.7	108
CAPSS03	10/29/2007	1970	1.5 J	**13.1 J**	104	0.06 J	0.52 U	2.8 J	2 J	6260	30000	271	20	0.81	---	1.1 J	13.8 J	1.9	2 J	8.5	13.2
CAPSS04	10/29/2007	7500	0.81 J	**29.3 J**	58.8	0.36 J	0.51 U	15.6 J	4.8 J	22100	20500	39.1	65.1	0.68	---	16	9.2 J	0.69 J	1.2 J	17.9	11.1

Comparison of Maximum Concentration to Cancer and Non-Cancer PRG

	Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Copper	Iron	Lead	Manganese	Mercury	Molybdenum	Nickel	Selenium	Silver	Thallium	Vanadium	Zinc	
Maximum Concentration	27100	NA	119	283	3	1	24	69	22100	61100	271	825	20	NA	49	6	2	7	27	108	
																					Total Cancer Risk
Cancer Risk (Maximum ÷ PRG (ca) x 1E-06)	NA	NA	7.4E-05	NA	1.2E-09	3.2E-10	NA	3.6E-08	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	**7.4E-05**
																					Total Hazard Index
Hazard Quotient (Maximum ÷ PRG (nc))	0.03	NA	0.46	0.004	0.001	0.002	NA	0.01	0.54	0.20	NA	0.04	0.07	NA	0.002	0.001	0.0004	0.1	0.03	0.0003	**1.5**

Bolded values exceed Industrial PRG
Depth 0.25-0.75 feet below ground surface
mg/Kg - milligrams per kilogram
J - Estimated result
U - Not detected at reporting limit
FD - Field Duplicate
PRG - Preliminary Remediation Goal (EPA, 2004)
-- - no PRG available
(ca) - Cancer PRG
(nc) - Non-cancer PRG
NA - Not applicable

Figures

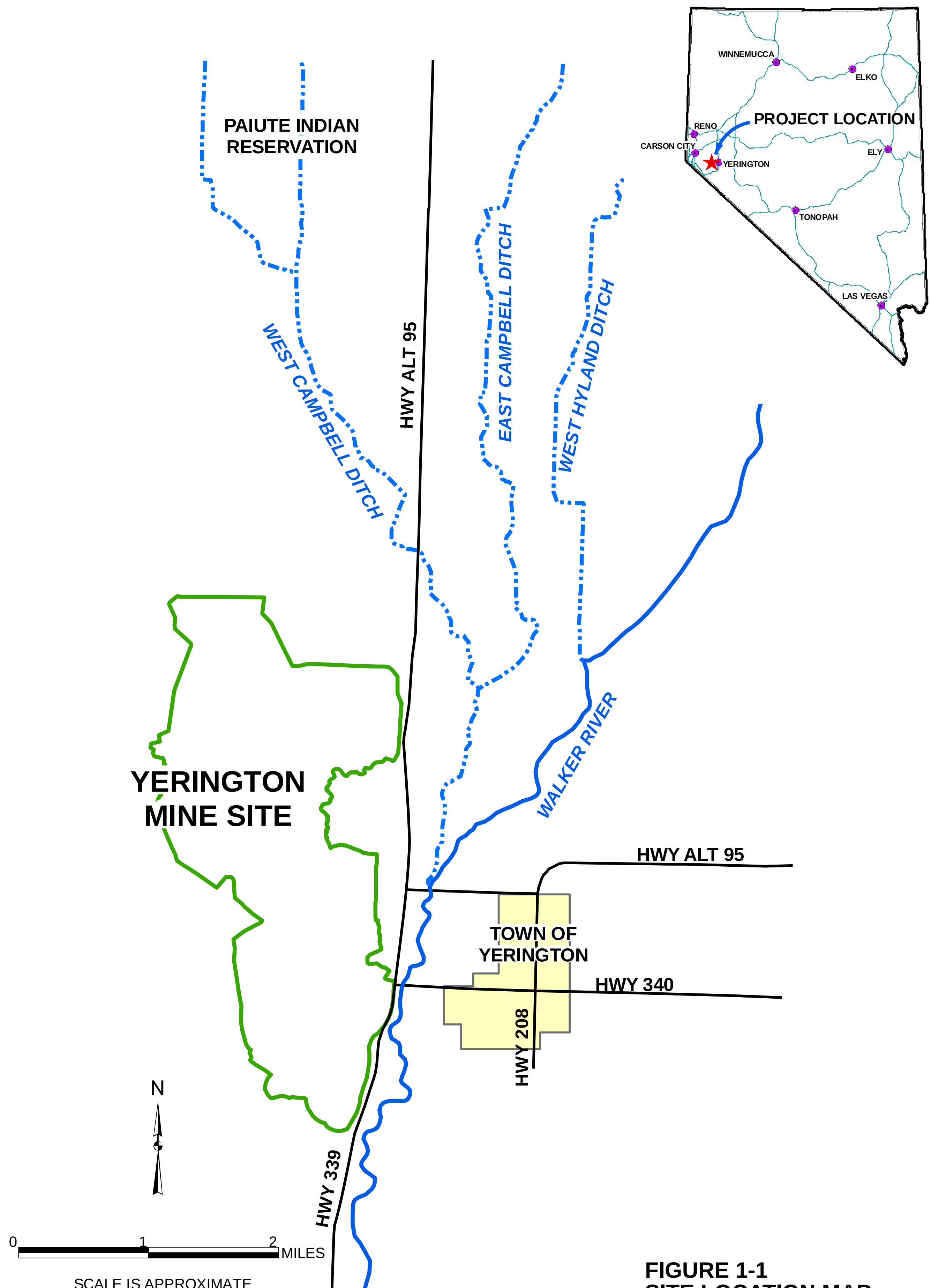


FIGURE 1-1
SITE LOCATION MAP
ANACONDA COPPER YERINGTON MINE

ES052008022RDD_1-1 (7/18/08)

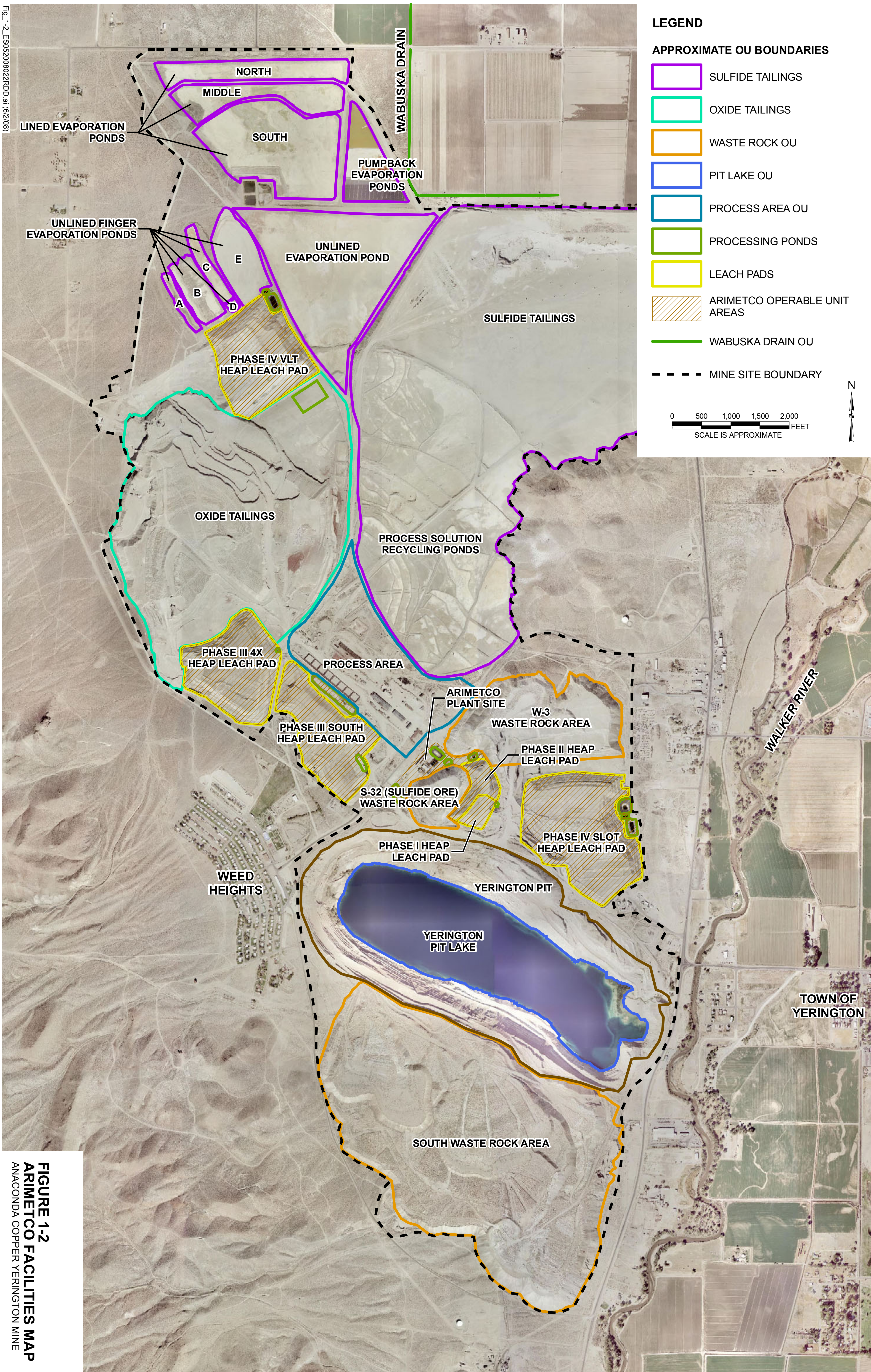
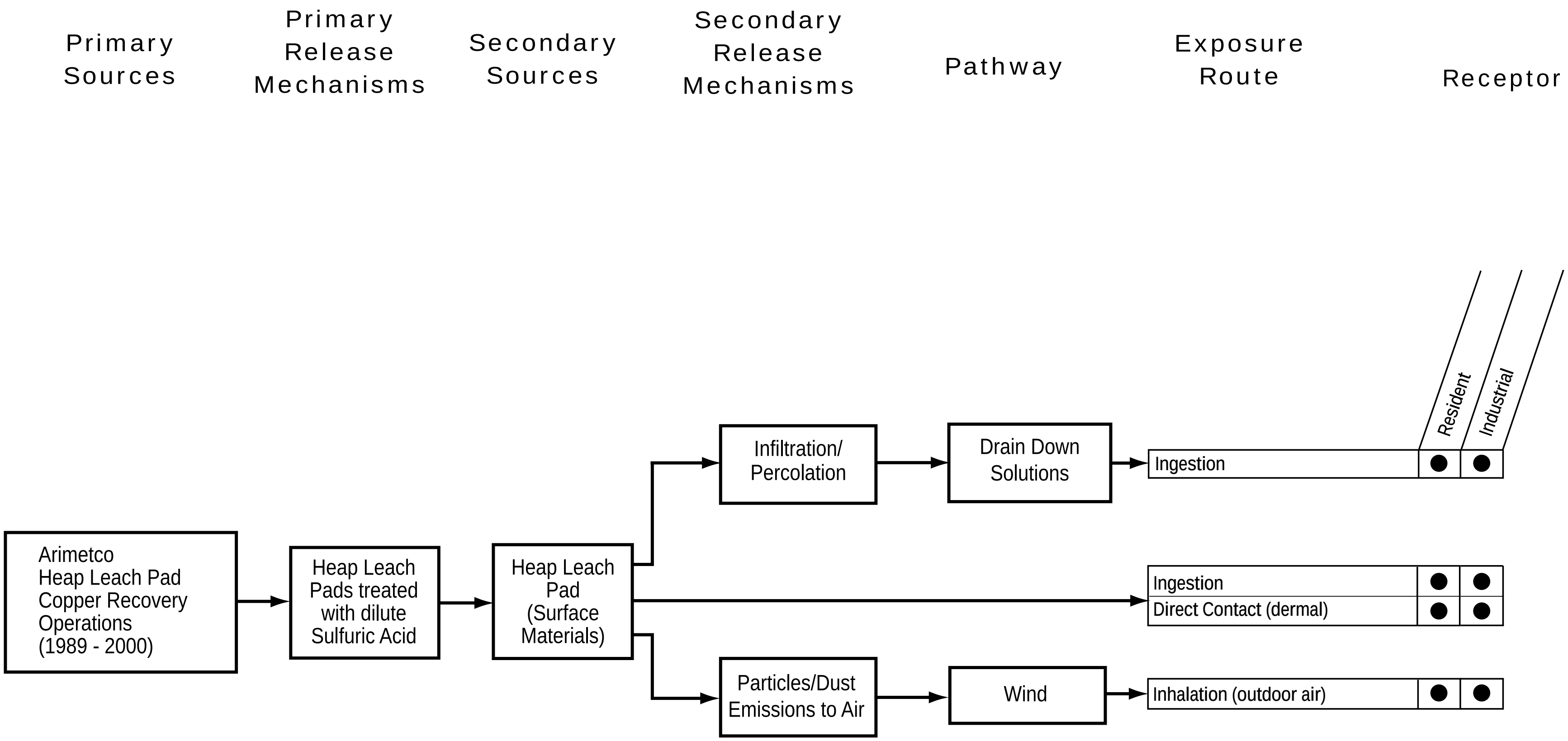


Fig_1-2_ES052008022RDD.ai (6/2/08)

FIGURE 1-2
ARIMETCO FACILITIES MAP
ANACONDA COPPER YERINGTON MINE



LEGEND:

● = Potentially Complete Pathway Evaluated in Screening Level Human Health Risk Assessment

FIGURE 3-1
DRAFT HUMAN HEALTH CONCEPTUAL SITE MODEL DIAGRAM
ANACONDA COPPER YERINGTON MINE

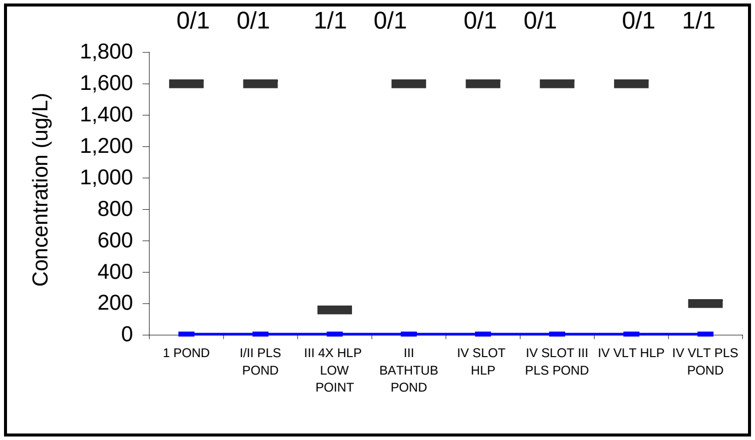
ES052008022RDD_3-1 (7/18/2008)

Appendices

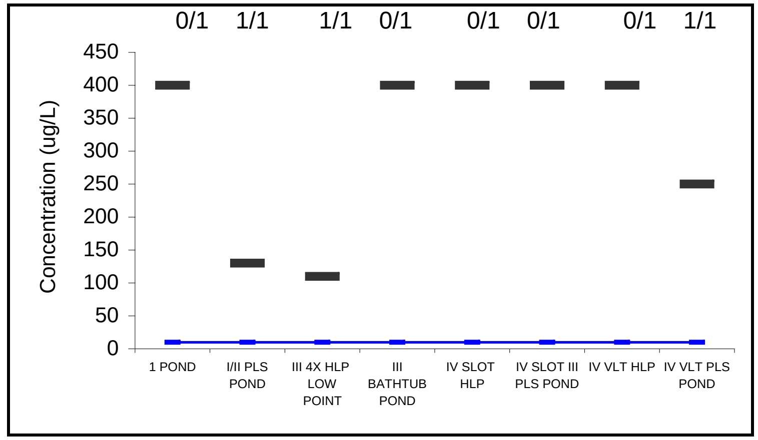
Box and Whisker Plots Comparing Concentrations, Drain-down Samples

Box and Whisker Plots Comparing Concentrations Drain Down Samples

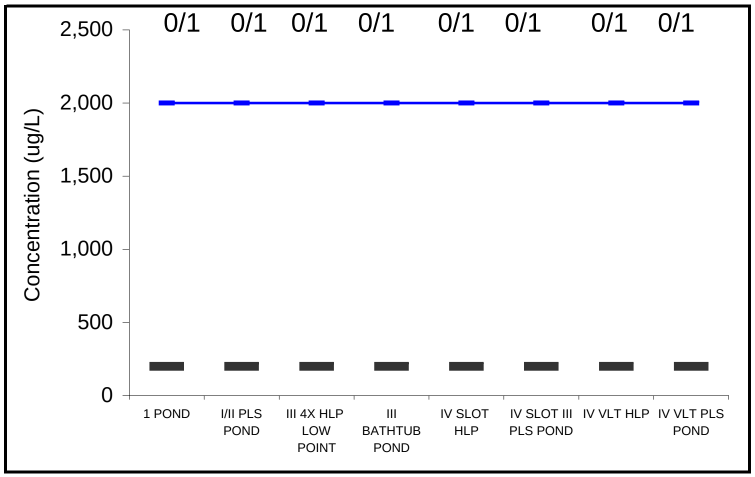
Antimony



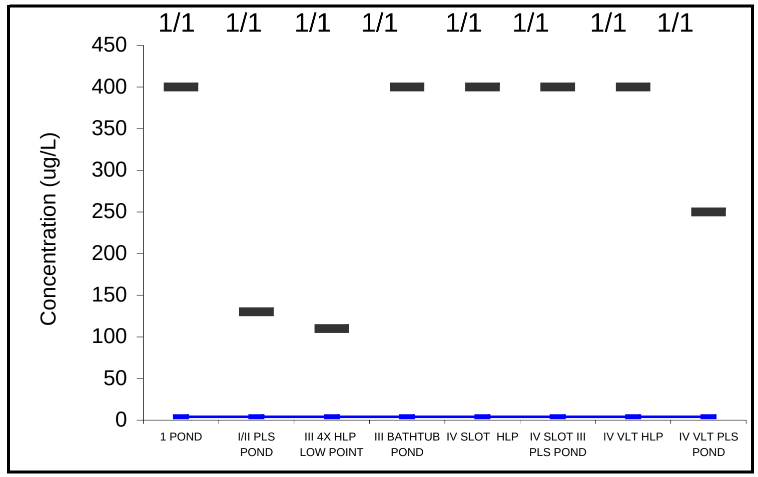
Arsenic



Barium



Beryllium

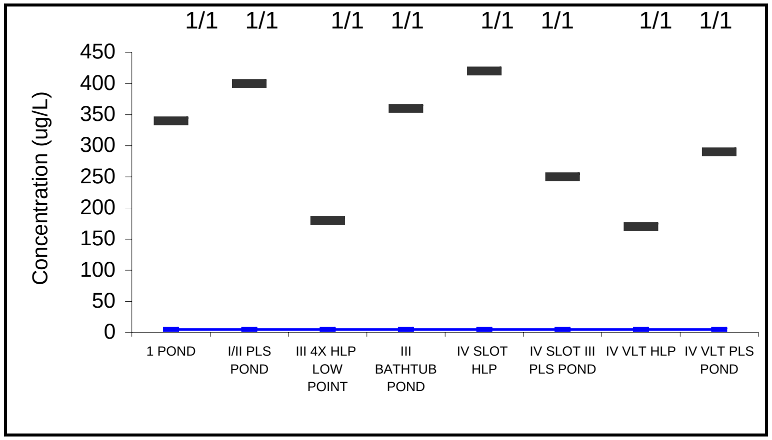


Primary MCL

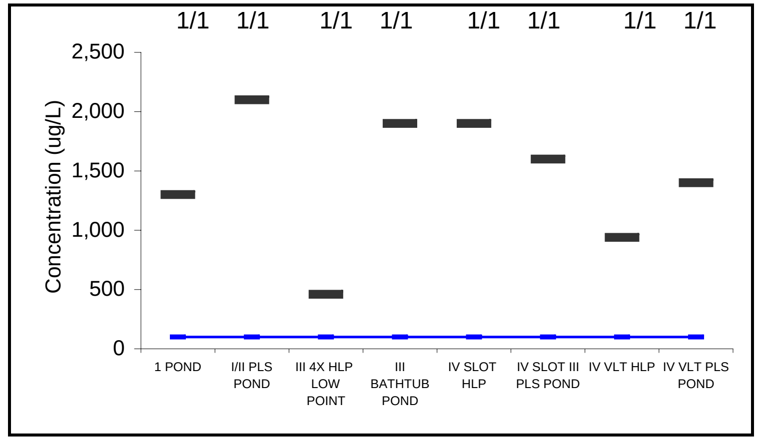
Frequency of Detection at Top of Each Plot

Box and Whisker Plots Comparing Concentrations Drain Down Samples

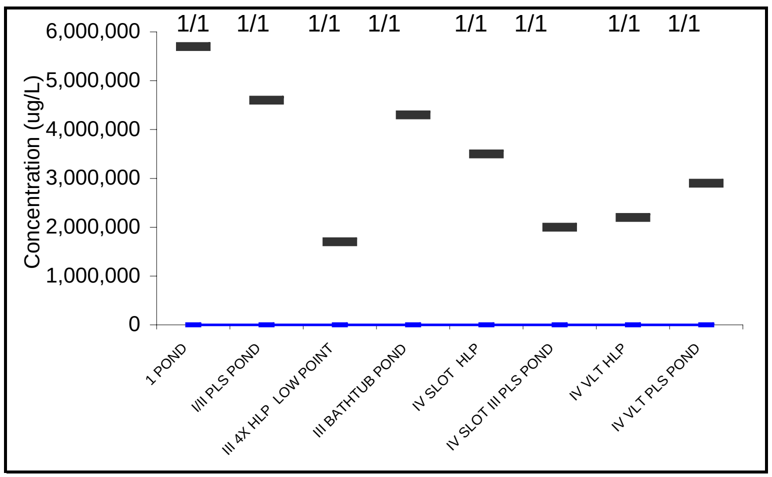
Cadmium



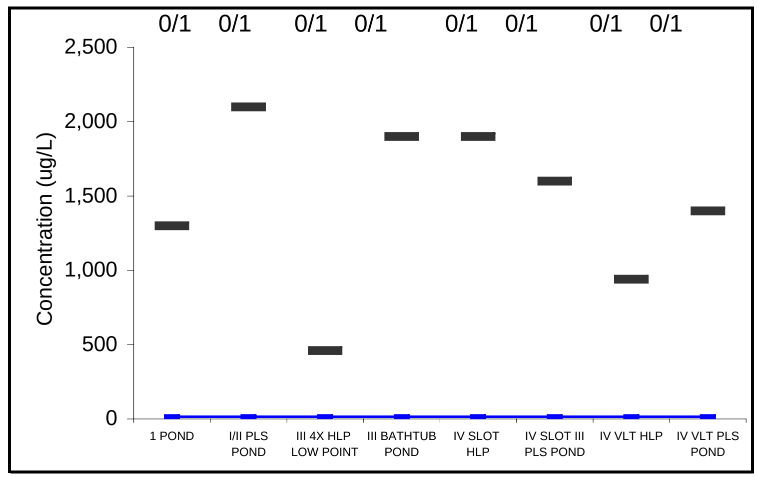
Chromium



Copper



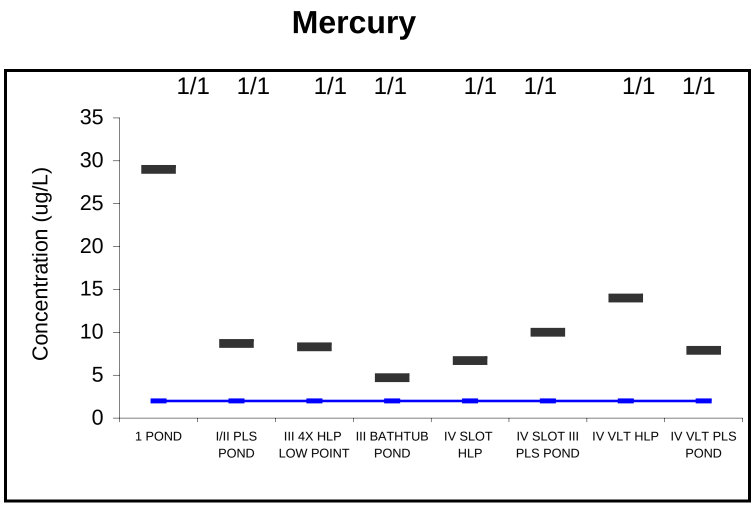
Lead

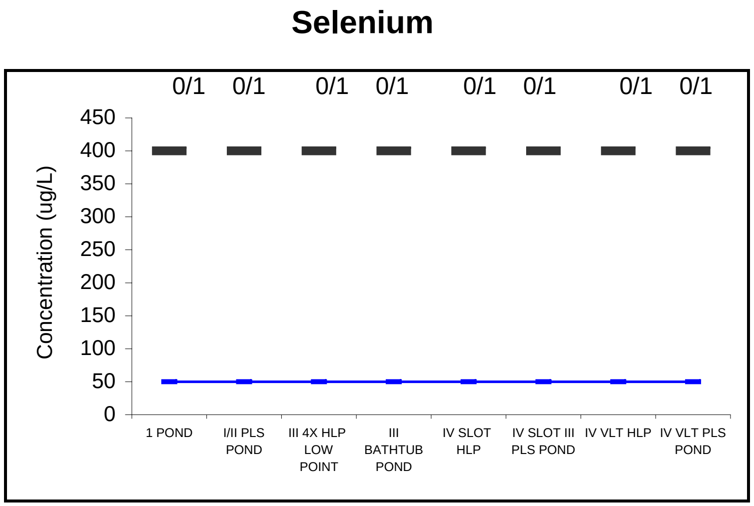


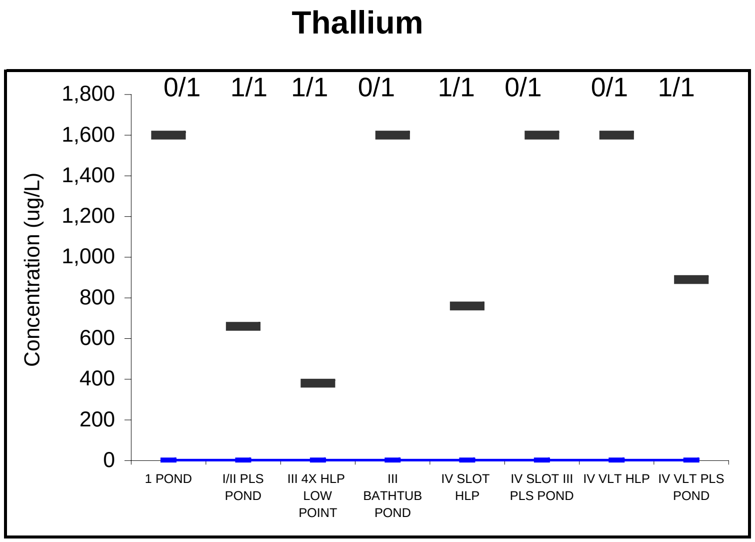
Primary MCL

Frequency of Detection at Top of Each Plot

Box and Whisker Plots Comparing Concentrations Drain Down Samples





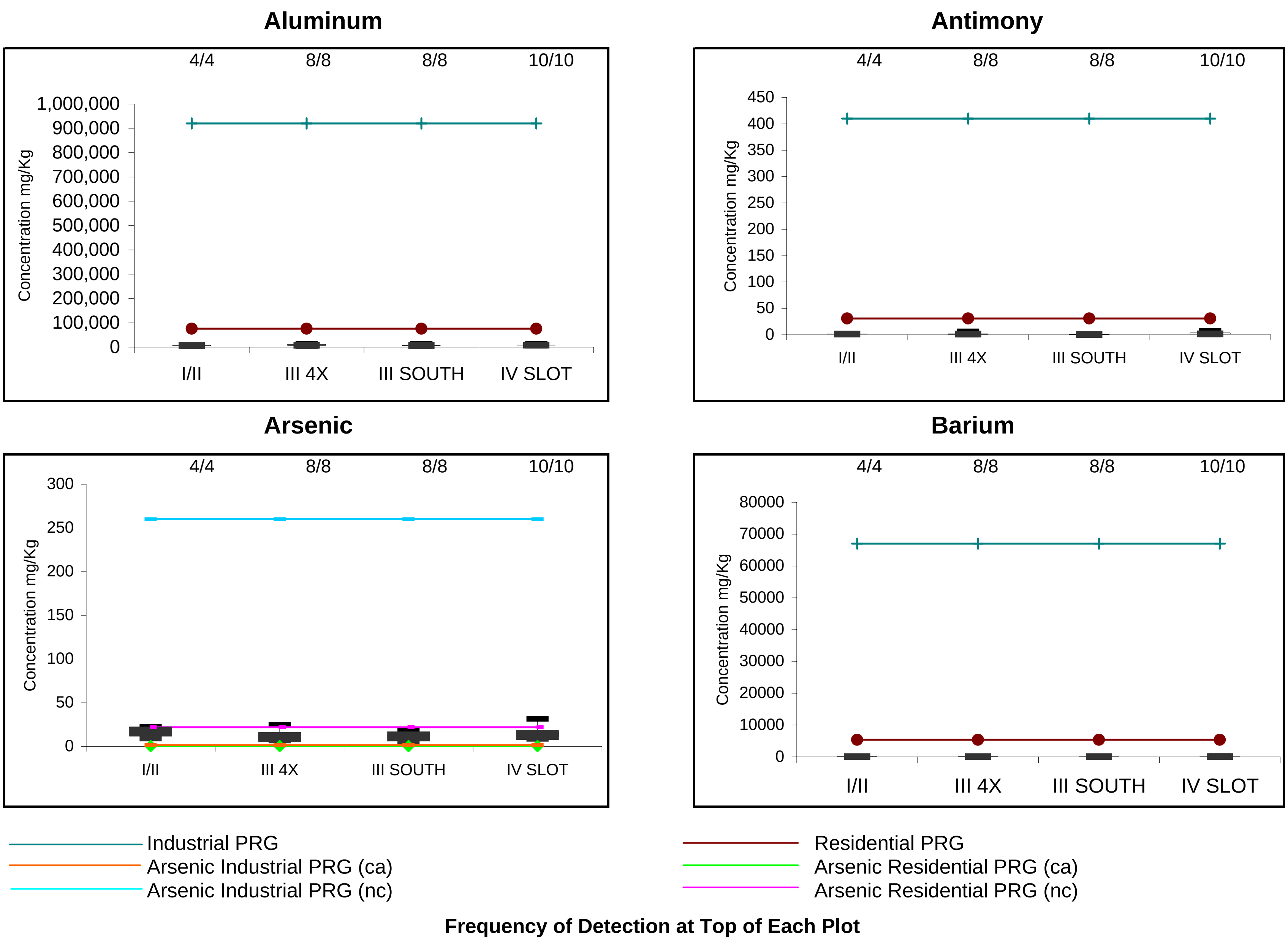


Primary MCL

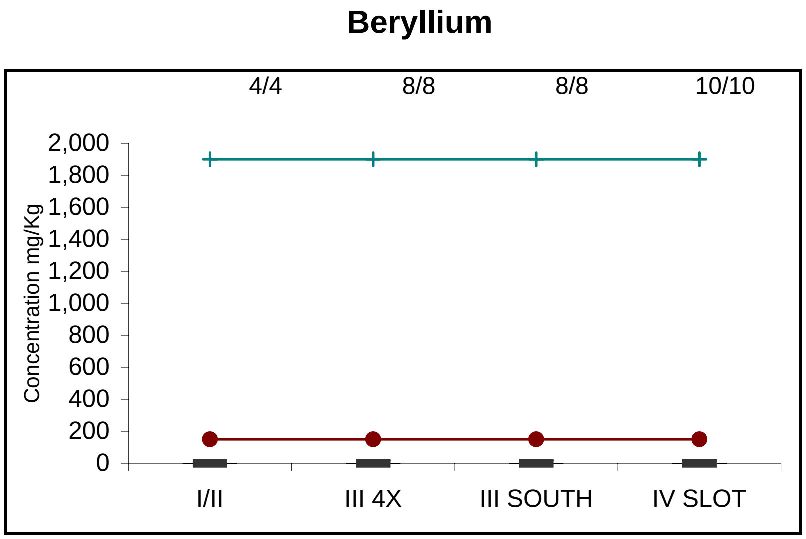
Frequency of Detection at Top of Each Plot

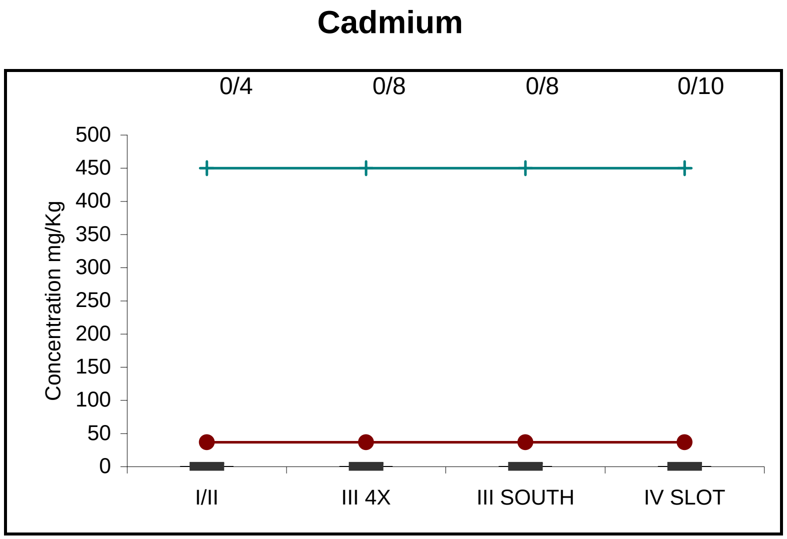
Box and Whisker Plots Comparing Concentrations from Four Leach Pads (Group A)

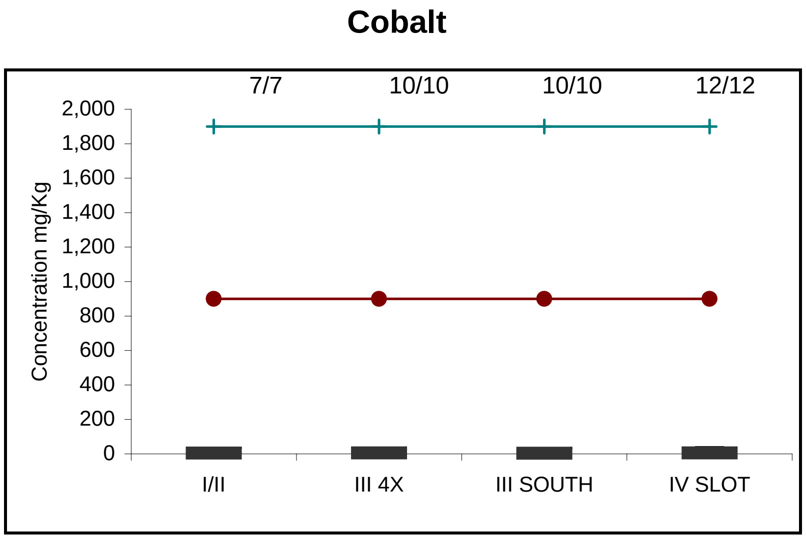
Box and Whisker Plots Comparing Concentrations from Four Heap Leach pads (Group A)

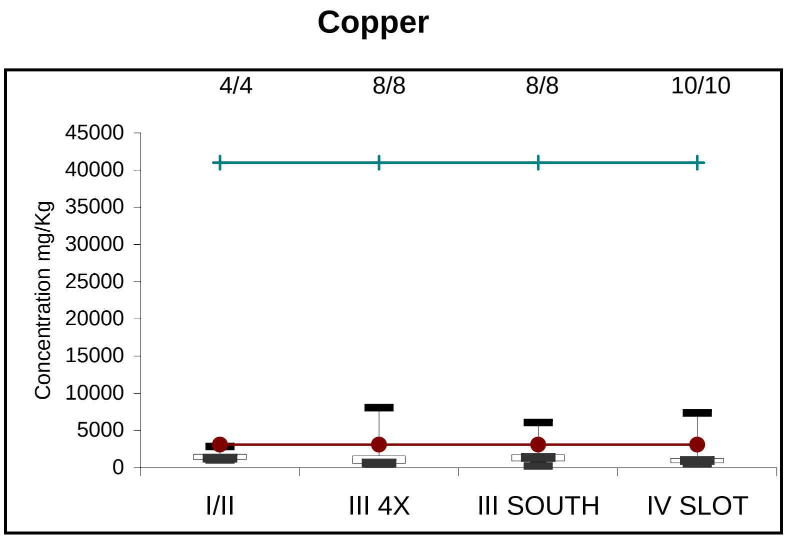


Box and Whisker Plots Comparing Concentrations from Four Heap Leach pads (Group A)









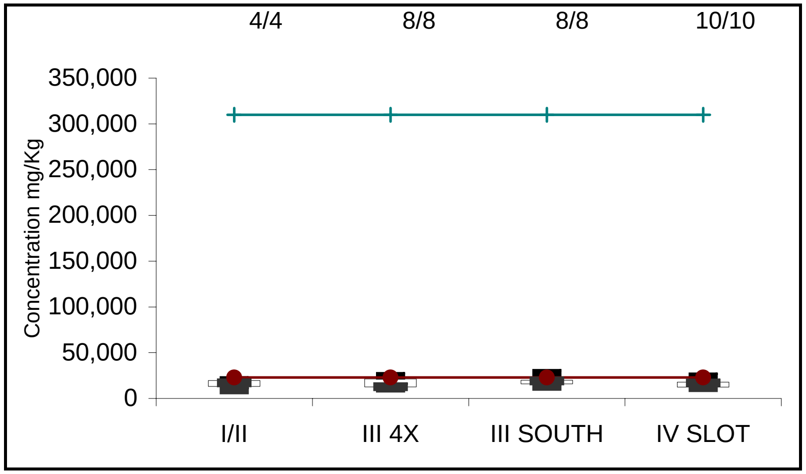
Industrial PRG

Residential PRG

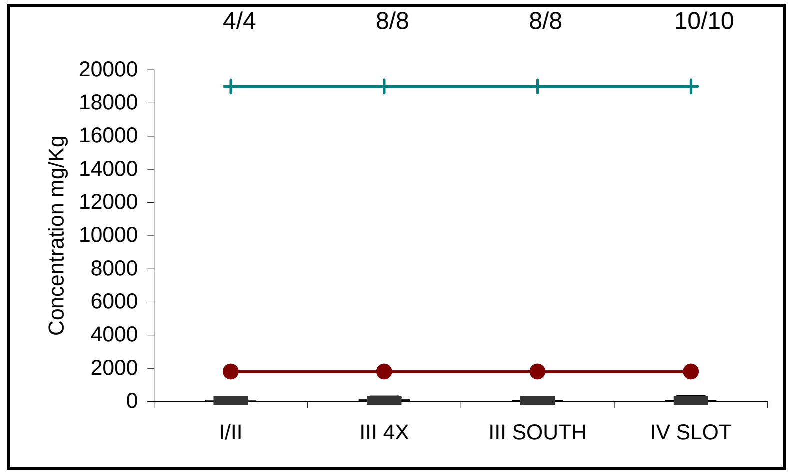
Frequency of Detection at Top of Each Plot

Box and Whisker Plots Comparing Concentrations from Four Heap Leach pads (Group A)

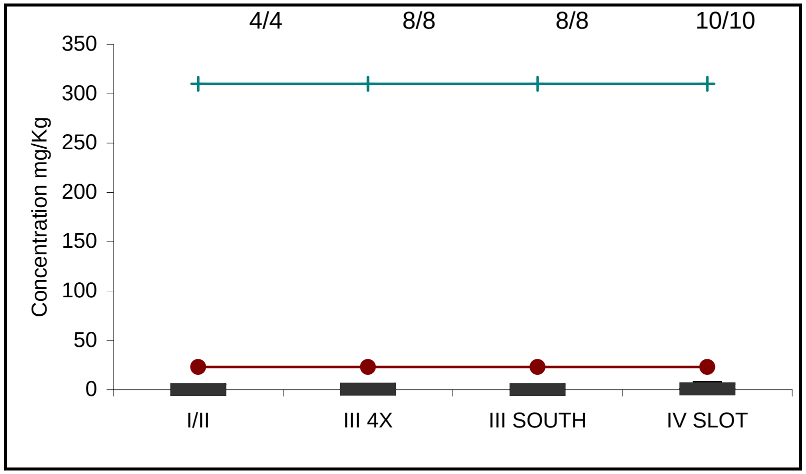
Iron



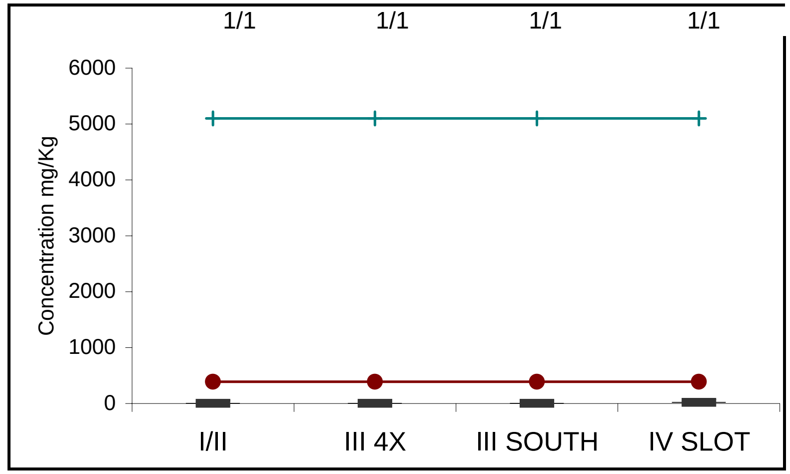
Manganese



Mercury



Molybdenum



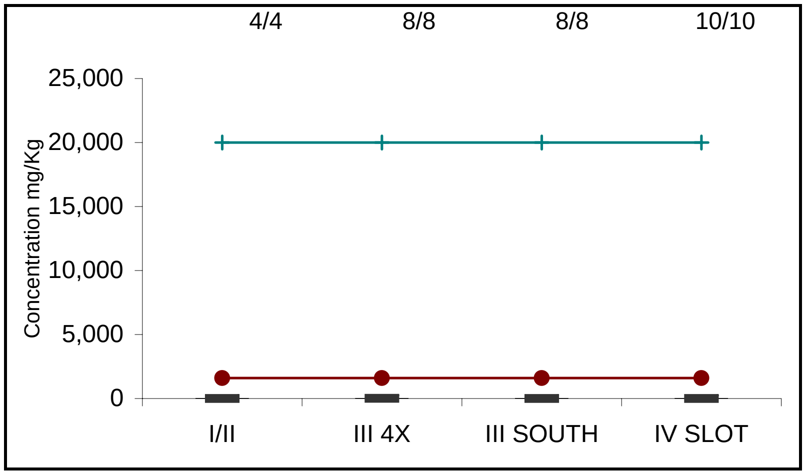
Industrial PRG

Residential PRG

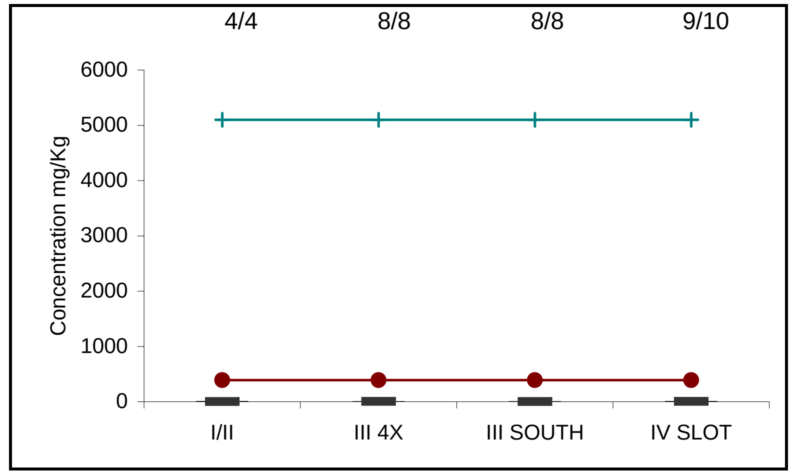
Frequency of Detection at Top of Each Plot

Box and Whisker Plots Comparing Concentrations from Four Heap Leach pads (Group A)

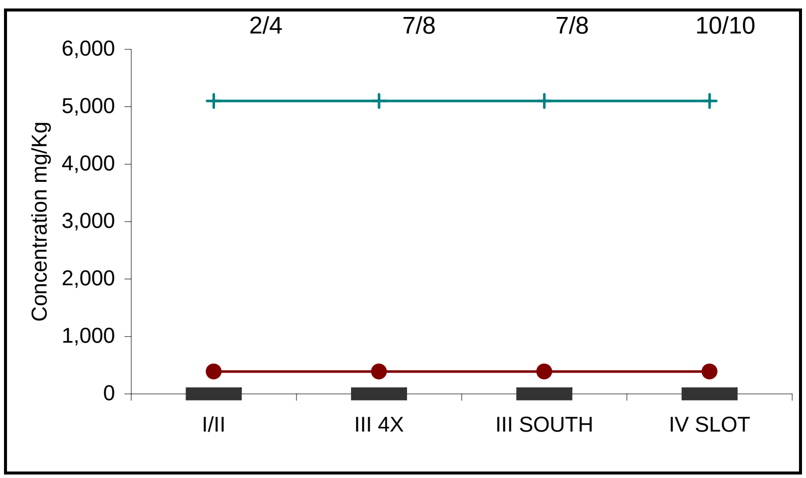
Nickel



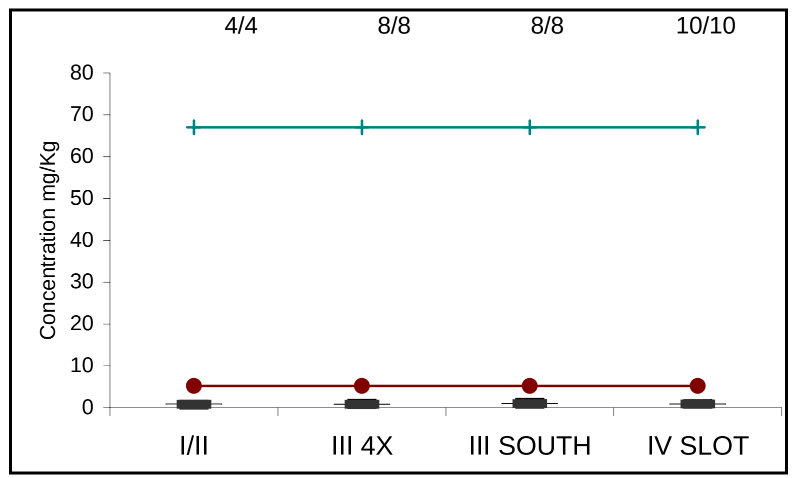
Selenium



Silver



Thallium

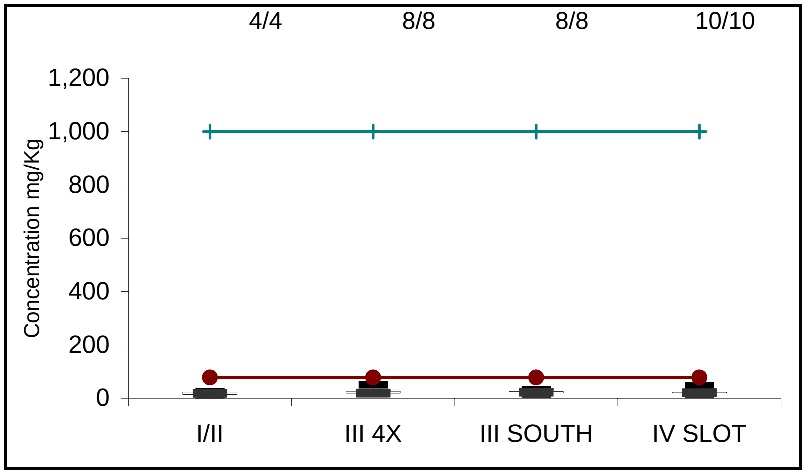


Industrial PRG   Residential PRG

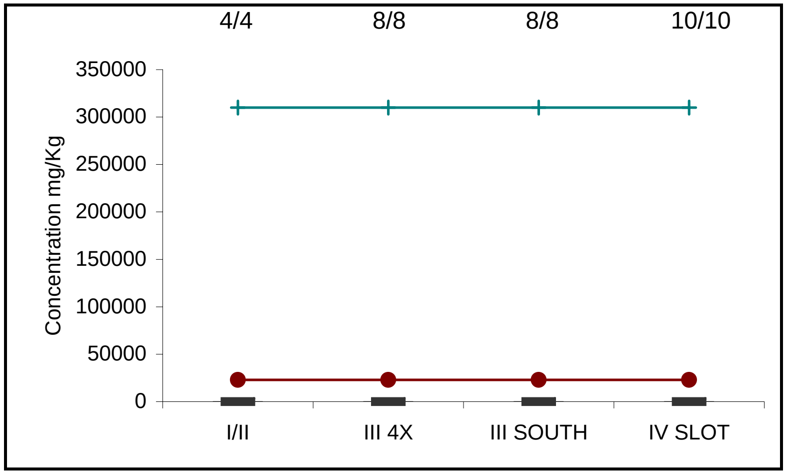
Frequency of Detection at Top of Each Plot

Box and Whisker Plots Comparing Concentrations from Four Heap Leach pads (Group A)

Vanadium



Zinc



Industrial PRG

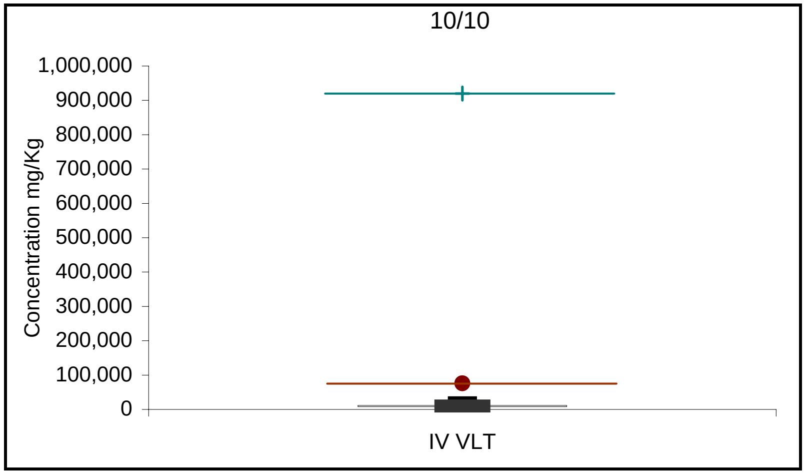
Residential PRG

Frequency of Detection at Top of Each Plot

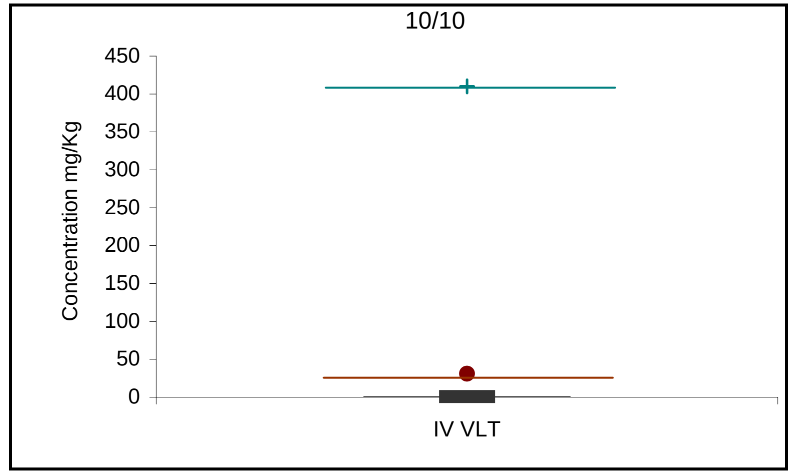
Box and Whisker Plots Comparing Concentrations from the Phase IV VLT Leap Leach Pad and Soil (Group B)

Box and Whisker Plots Comparing Concentrations from the Phase IV VLT Heap Leach Pad and Soil (Group B)

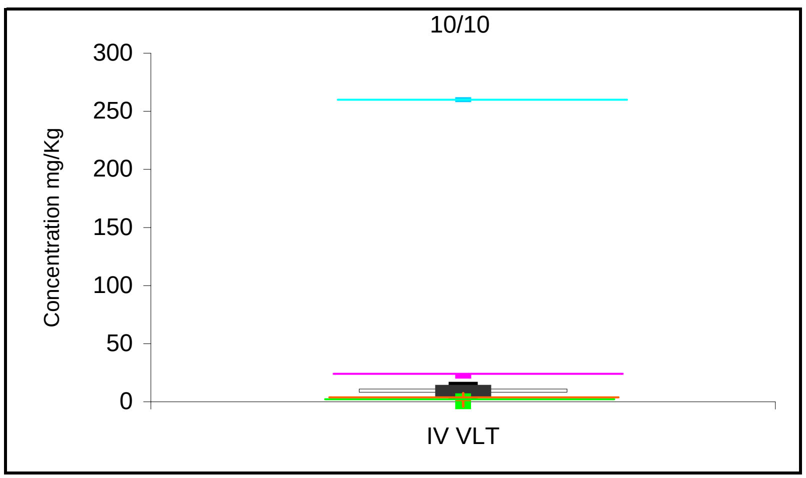
Aluminum



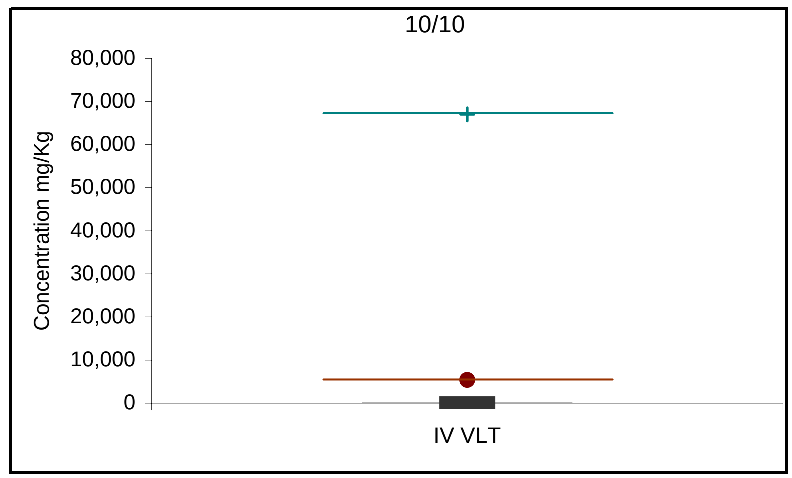
Antimony



Arsenic



Barium

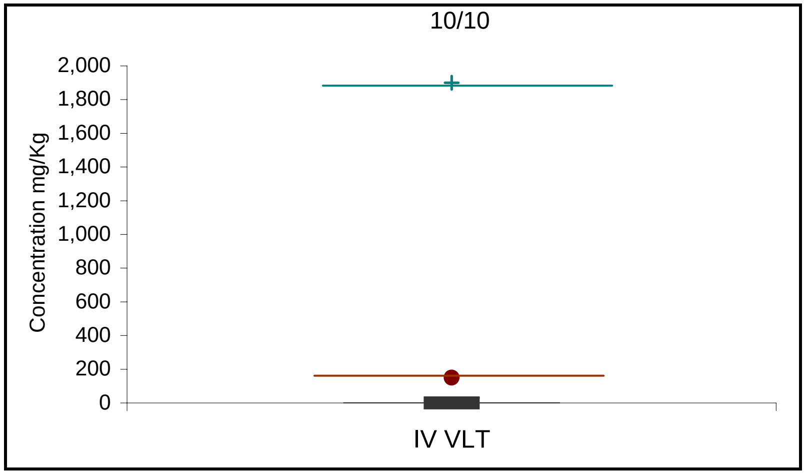


Industrial PRG
Arsenic Industrial PRG (ca)
Arsenic Industrial PRG (nc)
Residential PRG
Arsenic Residential PRG (ca)
Arsenic Residential PRG (nc)

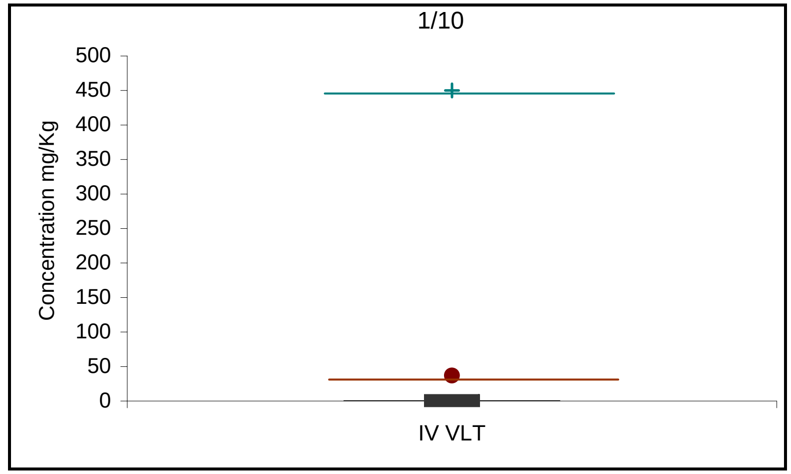
Frequency of Detection at Top of Each Plot

Box and Whisker Plots Comparing Concentrations from the Phase IV VLT Heap Leach Pad and Soil (Group B)

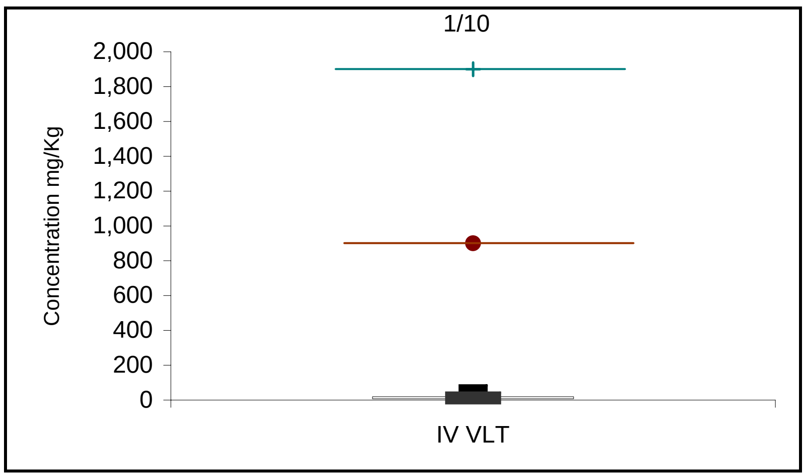
Beryllium



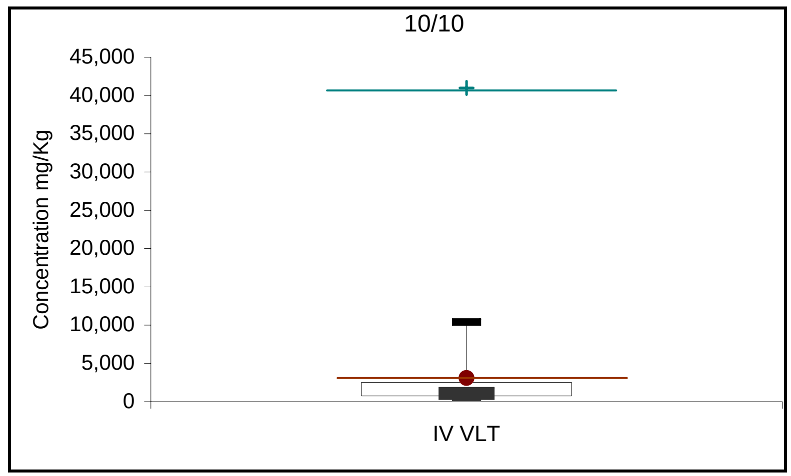
Cadmium



Cobalt



Copper



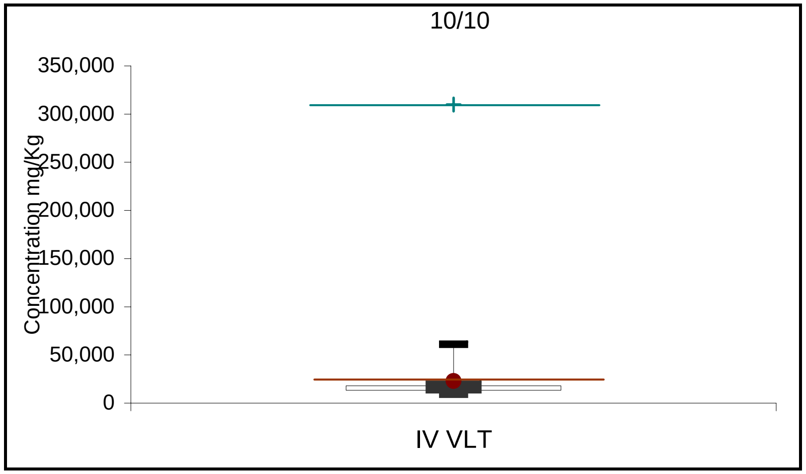
Industrial PRG

Residential PRG

Frequency of Detection at Top of Each Plot

Box and Whisker Plots Comparing Concentrations from the Phase IV VLT Heap Leach Pad and Soil (Group B)

Iron



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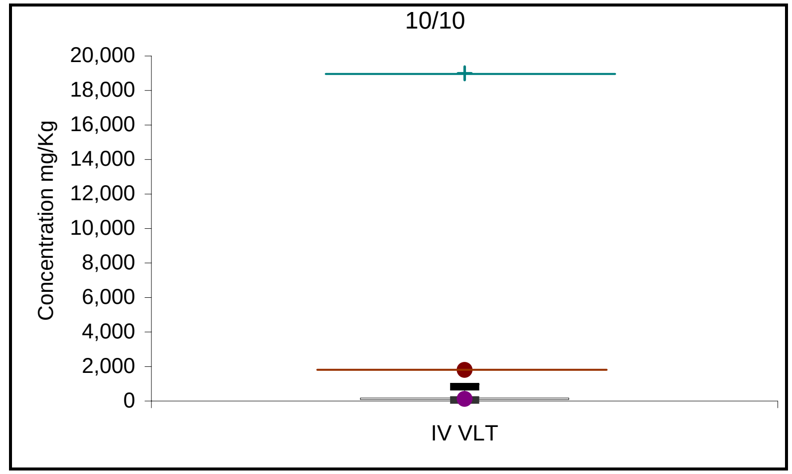
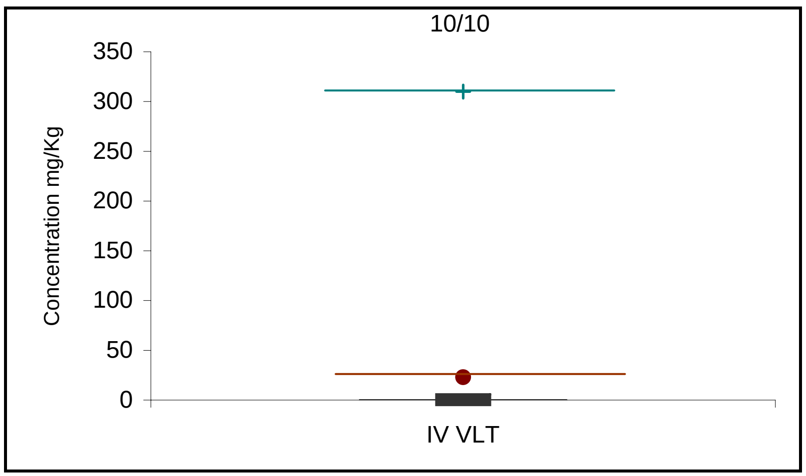
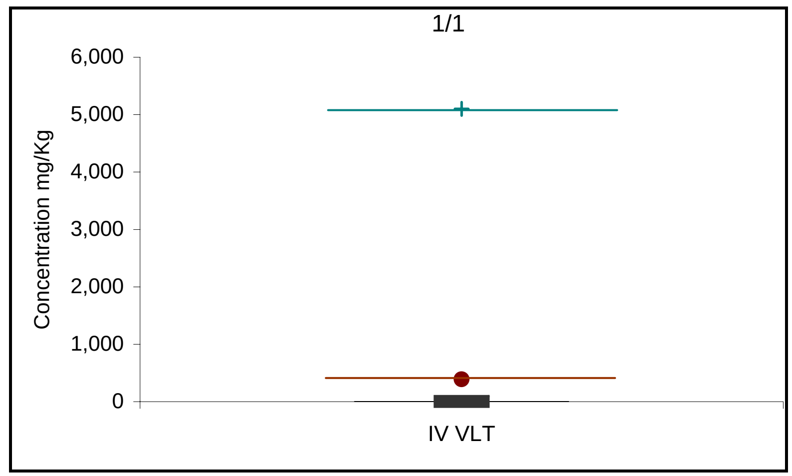


Mercury



Molybdenum

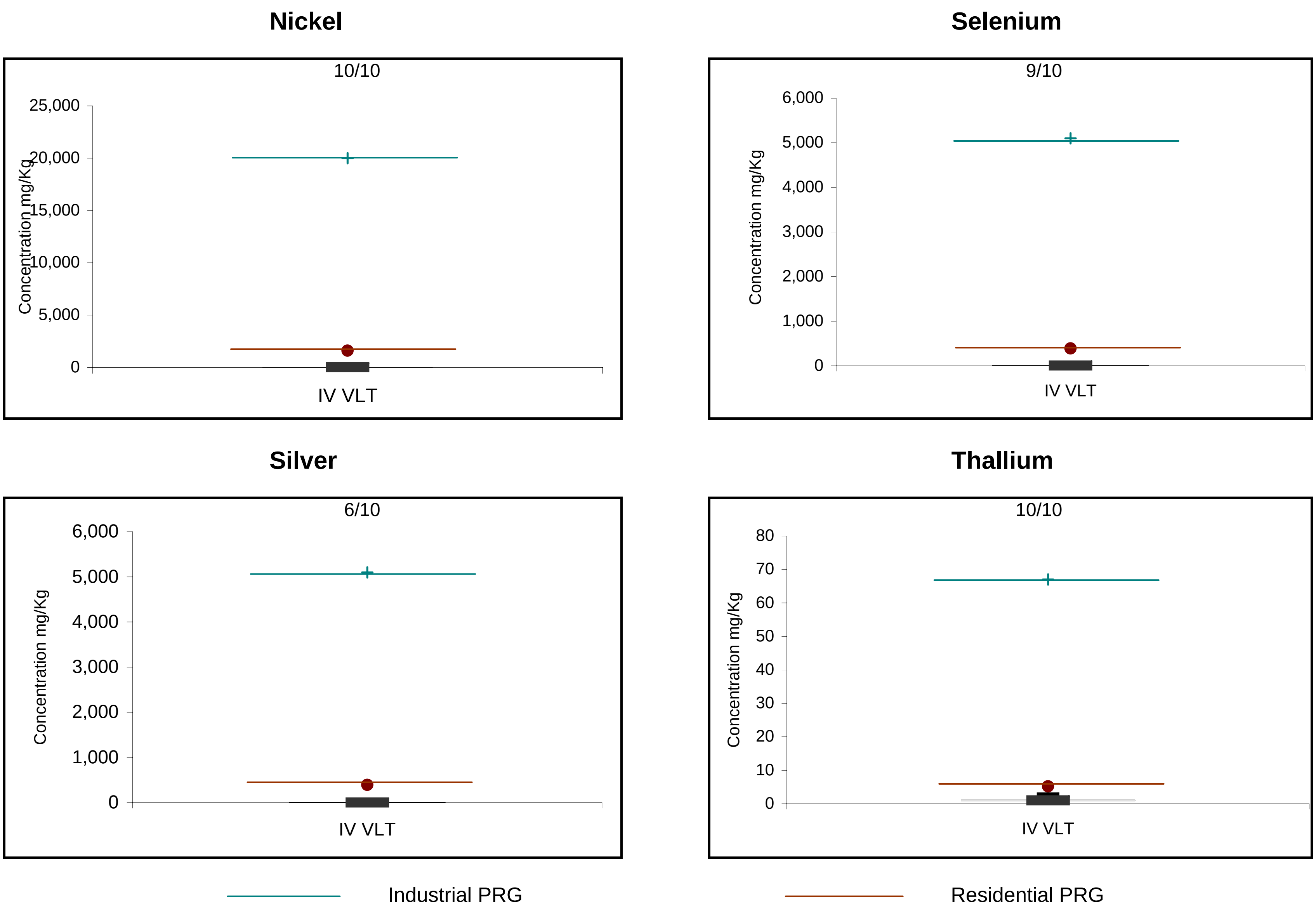


Industrial PRG

Residential PRG

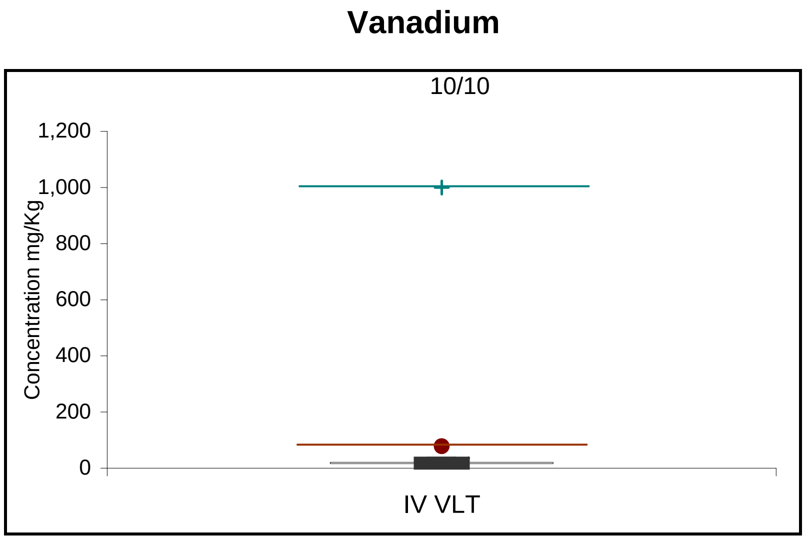
Frequency of Detection at Top of Each Plot

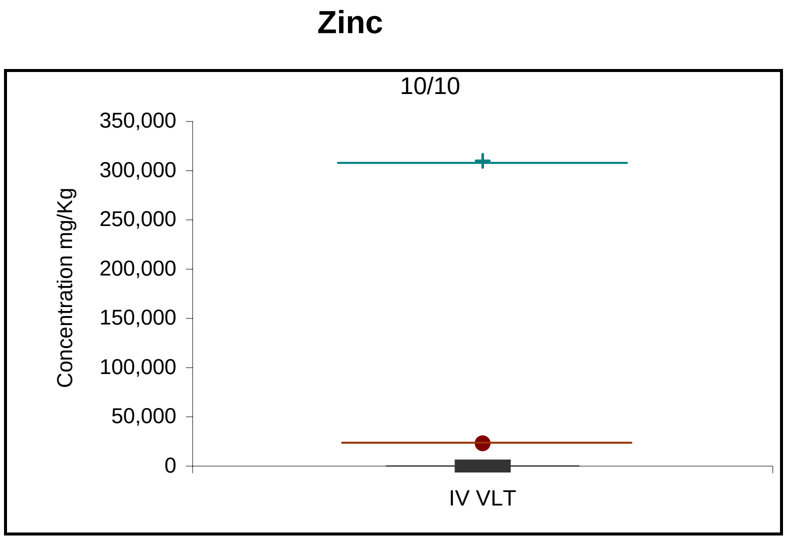
Box and Whisker Plots Comparing Concentrations from the Phase IV VLT Heap Leach Pad and Soil (Group B)



Frequency of Detection at Top of Each Plot

Box and Whisker Plots Comparing Concentrations from the Phase IV VLT Heap Leach Pad and Soil (Group B)





Industrial PRG

Residential PRG

Frequency of Detection at Top of Each Plot

Appendix I
Screening-level Ecological Risk Assessment

TECHNICAL MEMORANDUM
SCREENING-LEVEL ECOLOGICAL RISK ASSESSMENT

Arimetco Heap Leach Pads

Anaconda Copper Yerington Mine Site

EPA CONTRACT NO. 68-W-98-225
EPA WORK ASSIGNMENT NO. 273-RICO-09GU

Prepared for
U.S. Environmental Protection Agency
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April 2008

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Tables
(all tables are located at the end of the report)

Contents, Continued

Figures
(Figures are located at the end of the report.)

Acronyms and Abbreviations

µg/L	micrograms per liter
95UCL	95 percent upper confidence limit
ANOVA	Analysis of Variance
AUF	area use factor
BCG	Biota Concentration Guide
BERA	baseline ecological risk assessment
COPEC	constituent of potential ecological concern
CSM	conceptual site model
EcoSSL	Ecological Soil Screening Level
EPA	U.S. Environmental Protection Agency
EPC	exposure point concentration
ERA	ecological risk assessment
HLP	heap leach pad
HQ	Hazard Quotient
IAEA	International Atomic Energy Agency
ICRP	International Council for Radiological Protection
IRIS	Integrated Risk Information System
LD_{50}	A single dose that is lethal to 50 percent of exposed animals
LOAEL	lowest observed adverse effects level
LOEC	lowest observed effect concentration
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
NOAEL	no observed adverse effects levels
NOEC	no observed effects concentration
NPL	National Priorities List
ORNL	Oak Ridge National Laboratory
OU	Operable Unit

pCi/g	picocurie(s) per gram
pCi/L	picocurie(s) per liter
rad/d	radionuclide per day
RI	remedial investigation
SAMW	synthetic acid mine water
SL	screening-level
SLERA	Screening-level Ecological Risk Assessment
TM	technical memorandum
TRV	toxicity reference value
UCL	upper confidence limit of the mean
UNSCEAR	United Nations Scientific Committee on the Effects of Atomic Radiation
USACHPPM	U.S. Army Center for Health Promotion and Preventive Medicine
USDOE	U.S. Department of Energy
VLT	vat leach tailings

1.0 Introduction

CH2M HILL prepared this draft screening-level ecological risk assessment (SLERA) Technical Memorandum (TM) to support Remedial Investigation (RI) activities on behalf of the U. S. Environmental Protection Agency (EPA) Region 9 for the Arimetco Facilities Operable Unit (OU) of the Anaconda Copper/Yerington Mine site (Site). CH2M HILL prepared this TM as part of for Work Assignment (WA) No. 273-RICO-09GU with EPA Region 9.

This TM identifies the major constituent of concern; identifies and characterizes environmental exposure pathways; identifies potential receptors, indicator species, and endpoints; identifies preliminary toxicity benchmarks for the site's expected constituents of concern and receptors, and performs a SLERA based on the existing data. The SLERA was conducted in accordance with the first two steps of EPA's Ecological Risk Assessment Guidance (*Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments*, EPA 540-R-97-006, June 1997).

1.1 Background

The Site, which is almost 3,600 acres in size and located about two miles west of Yerington, in Lyon County, Nevada (see Figure 1-1) (all figures are located at the end of the report), includes an inactive open pit mine, waste rock piles, leached ore tailings piles, evaporation ponds and ore processing facilities; the latter include underground utilities, remnant foundations, tanks and buildings. Thirty (30) buildings have been identified within the Anaconda Process Areas. Comprising about 230 acres, the Process Areas (OU-3) include processing and ancillary support facilities located centrally at the Site. Buildings were used for various purposes relating to, but not limited to, ore processing, equipment maintenance, administration and mine-related operational activities.

When the mine was purchased by Arimetco in 1989, Anaconda's Process Facility was not used, but rather a new facility was constructed. This new facility, currently designated as the Arimetco Facilities OU, consists of four sets of heap leach pads (HLPs) and associated waste fluid and evaporation ponds: Phase I/II HLPs, Phase III HLPs, Phase IV Slot HLP, and Phase IV VLT HLP (see Figure 1-2). A brief discussion pertaining to each Arimetco-constructed HLP is presented below.

1.1.1 Phase I/II Heap Leach Pads

Phase I/II HLPs were constructed between 1989 and 1990, with initial leaching ending in 1996 and resuming for about five months in early 1997. A solution ditch was constructed in the northeast corner of the HLPs. The Phase I/II HLP occupies an area of about 14 acres and is comprised of an estimated 1,076,000 cubic yards of material. A sump is located west of the HLP and was initially used as a sediment control basin for the Phase I HLP, but now collects drain-down solutions from the south end of the Phase I/II HLP. The top deck of Phase I/II HLP occupies about 3 acres.

1.1.2 Phase III Heap Leach Pads

The southern part of Phase III South was constructed between 1990 and 1992, and Phase III 4X was constructed between 1992 and 1995. Historically, the solution ditch surrounding Phase III South drained either to the Bathtub Pond or the Mega Pond. Phase III South covers about 46 acres, is comprised of an estimated 5,453,000 cubic yards of material and the collection basin is to the southeast. The top deck of this HLP is generally flat and covers about 15 acres in two benches. Phase III 4X covers about 50 acres and is comprised of an estimated 5,215,000 cubic yards of material, with solutions collected in southeastern corner of the HLP being conveyed to the Mega Pond. The top deck is generally flat and covers about 22 acres in three benches. Historically, drain-down solution flowed either to the plant feed pond or to the Mega Pond.

1.1.3 Phase IV Slot Heap Leach Pad

The Phase IV Slot HLP was initially constructed by Arimetco in 20-foot lifts, covers about 86 acres and is comprised of an estimated 7,599,000 cubic yards of material. The HLP top deck is relatively flat and covers about 37 acres in five benches. Historically, drain-down solution flowed to one of two PLS Ponds east of the HLP. Because the northern PLS Pond has historically leaked, solution was primarily routed to the southern PLS Pond, and the northern pond was pumped dry when needed. In 2006, EPA relined the north pond and redirected solutions to the relined north pond. Solutions contained in the north pond are pumped to the EPA 4-acre evaporation pond.

1.1.4 Phase IV VLT Heap Leach Pad

The Phase IV VLT HLP was constructed on the southern portion of the former finger evaporation ponds and alluvium north of the existing VLT Tailings Area. The solution ditch drains to the northeast corner of the HLP and is routed to a single PLS Pond. The HLP was constructed in 20-foot lifts, covers about 54 acres and is comprised of an estimated 6,502,000 cubic yards of material. A generally flat top deck surface of about 29 acres exists in two benches. Currently, all drain-down solutions are routed to the EPA 4-acre evaporation pond.

1.2 Technical Approach

The technical approach for conducting the SLERA in this TM follows EPA guidance (EPA, 1997), which represents an eight-step process. The SLERA for the Arimetco HLPs is limited to the first two of these eight steps. It includes the screening-level problem formulation and ecological effects evaluation (Step 1), and the screening-level exposure estimate and risk calculation (Step 2). The problem formulation describes the environmental setting; identifies the major contaminants of concern; identifies and characterizes environmental exposure pathways; identifies potential receptors, indicator species, and endpoints; and identifies preliminary toxicity benchmarks for the site's expected contaminants of concern and receptors. These components are then used to perform a SLERA based on the existing data. The SLERA integrates conservative measures of exposure with conservative measures of effects to differentiate between analytes, receptors, and locations for which there are clearly no risks, and those for which further evaluation is necessary.

1.3 Guidance

The procedures followed for conducting the SLERA in this TM are consistent with those described in the following guidance provided by the EPA:

- Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments, Interim Final (EPA, 1997)
- ECO Updates, Volume 1, Numbers 1 through 5 (EPA, 1991a; EPA, 1991b; EPA, 1992b; EPA, 1992c; EPA, 1992d)
- ECO Updates, Volume 2, Numbers 1 through 4 (EPA, 1994a; EPA, 1994b; EPA, 1994c; EPA,, 1994d)
- ECO Updates, Volume 3, Numbers 1 and 2 (EPA 1996a; EPA, 1996b)
- Final Guidelines for Ecological Risk Assessment (EPA, 1998)
- Screening Level Ecological Risk Assessment Protocol for Hazardous Waste Combustion Facilities (EPA, 1999a)
- Ecological Risk Assessment and Risk Management Principles for Superfund Sites (EPA, 1999b)
- The Role of Screening-Level Risk Assessments and Refining Contaminants of Concern in Baseline Ecological Risk Assessments (EPA, 2001a)

In accordance with these guidance documents, this assessment serves as a SLERA. The primary guidance utilized in completing the SLERA was the Ecological Risk Assessment Guidance for Superfund (EPA, 1997) and the Final Guidelines for Ecological Risk Assessment (EPA, 1998).

1.4 Report Organization

This report is organized following the ERA framework established by EPA (EPA, 1992a) and includes the following sections:

- Section 1: Introduction
- Section 2: Screening-level Problem Formulation and Ecological Effects Evaluation
- Section 3: Screening-level Exposure Estimates
- Section 4: Screening-level Risk Calculation
- Section 5: Screening-level Risk Summary and Conclusions
- Section 6: References

2.0 Screening-level Problem Formulation and Ecological Effects Evaluation

This section presents the screening-level problem formulation and ecological effects evaluation, Step 1 of EPA's Ecological Risk Assessment Guidance (EPA, 1997). This step integrates available information (environmental setting; contaminant sources, transport and fate, and ecotoxicity; and receptors) and serves to provide focus to the ERA.

2.1 Screening-level Problem Formulation

The screening level problem formulation includes a description of the site setting, identification of constituents of potential ecological concern (COPEC), identification of the important aspects of the site to be protected (referred to as "assessment endpoints"), the means by which the assessment endpoints were evaluated (measures of exposure and effects), and previous site investigations. The end product of the problem formulation is a conceptual site model (CSM) that describes the contaminant sources and transport mechanisms, evaluates potential exposure pathways, and identifies the representative species that were used to assess potential ecological risk to those and other similar species.

2.1.1 Physical and Ecological Setting

Physical Setting

The physical setting of the Site is within the Basin and Range physiographic province, which is part of the Great Basin sagebrush-steppe ecosystem. Mason Valley occupies a structural graben (i.e., down-dropped faulted basin) immediately east of the Singatse Range, an uplifted mountain block. Vegetative communities in the area vary from relatively dense associations along the Walker River immediately east of the Site to sparse brush found on the alluvial fans derived from Singatse Range, immediately west of the Site. Mining and ore processing activities at the Site have resulted in modifications to the natural, pre-mining topography, including a large open pit (occupied by a pit lake), waste rock and leached ore piles, and evaporation and tailings ponds.

The Arimetco Facilities OU portion of the Site consists of four sets of HLPs (Phase I/II, Phase III, Phase IV Slot, and Phase IV VLT) and associated waste fluid and evaporation ponds. The HLPs vary in size from 14 to 86 acres and contain an estimated 1,076,000 to 7,599,000 cubic yards of material per HLP.

The climate at the Site is arid, with average monthly temperatures ranging from the low 30s°F in December to the mid 70s°F in July. Annual average rainfall for the town of Yerington is only 5.3 inches per year, with lowest rainfall occurring between July and September (WRCC 2007a). Sporadic thunderstorms may occur throughout the year and past storms have resulted in rain events of up to about 2 inches in a single day (WRCC, 2007b). Wind speed and direction at the Site are variable due, in part, to the heterogeneous natural topography and the localized effects of surface mining operations.

Ecological Setting

In general, the terrestrial ecosystem in the vicinity of the Site is characterized by an arid sagebrush-steppe vegetative community that is dominated by sagebrush and other low-lying woody vegetation, interspersed with a variety of forbs and grasses. Both livestock and wildlife preference for grasses contributes to the domination of vegetation in this system by sagebrush and other shrubs (Anonymous, 2001; Ricketts et al., 1999). Limited riparian and aquatic habitat is associated with the nearby Walker River.

Habitat value within the Arimetco Facilities OU is very limited. Terrestrial habitat is dominated by barren ground consisting of heaped ore and tailings and sparse vegetation. Although aquatic habitat per se is absent, the multiple leachate collection and evaporation ponds contain waste water and are therefore attractive to birds, mammals, and other wildlife.

2.1.2 Identification of Constituents of Potential Ecological Concern

COPECs are those constituents present at the Site (or Site vicinity from constituents that may have migrated from the Site) in concentrations that may exceed toxicity thresholds for ecological receptors. These constituents are identified in historical samples collected to characterize the site. Known Site practices directed the analytical suites collected as part of these historical characterization studies.

Based on the results of previous investigations summarized by ARC (2002), and as presented in Section 2.5 of the FSP (CH2M HILL, 2007), primary COPECs expected in drain-down fluids include low pH, arsenic, cadmium, chromium, copper, iron, and radionuclides (radium, thorium, and uranium). Other potential COPECs likely present in the HLPs include aluminum, beryllium, boron, chloride, lead, manganese, mercury, selenium, sulfate, and zinc.

2.1.3 Conceptual Site Model

The CSM is a written and visual presentation of predicted relationships among stressors, exposure pathways, and assessment endpoints. It includes a description of the complete exposure pathways and outlines the potential routes of exposure for each assessment endpoint. A CSM diagram for ecological exposures was developed for the Site and is presented in Figure 2-1.

The primary source is the heaped ore, waste rock and vat leached materials. Primary release mechanisms include wind and water erosion, as well as water-mediated leaching through the heaped metals-bearing materials. Secondary sources of potential contaminants are soils and other surficial materials, and drain-down fluids and leachate. Secondary release mechanisms include re-suspension of and bioaccumulation from soil/surficial material, plus direct ingestion/accumulation of soil or drain-down fluids.

Complete exposure pathways from contaminated media to ecological receptors exist at the Site. Birds and mammals may be exposed through food-web transfer of chemicals from lower trophic levels[1] (e.g., plants to herbivores, prey animals to carnivores). All receptors

[1] Note that although mallards are included as a receptor in the CSM, due to the absence of suitable habitat, the leachate ponds are the only exposure pathways considered complete.

may experience both internal and external exposure to radionuclides. Plants may be exposed to contaminants in soil/surficial material, as may birds or mammals through incidental ingestion of this material. Birds and mammals may also be exposed directly to contaminants in surface water through ingestion, and to a lesser extent through dermal contact. Inhalation of airborne dust and dermal contact with soil are considered complete but insignificant pathways.

2.1.4 Assessment Endpoints

Assessment endpoints are an expression of the important ecological values that should be protected at a site (Suter, 1990; Suter, 1993; EPA, 1998; Suter et al., 2000). Assessment endpoints are developed based on known information concerning the contaminants present, the study area, the ecological CSM, and risk hypotheses. There are three components to each assessment endpoint: an *entity* (e.g., migratory birds), an *attribute* of that entity (e.g., individual survival), and a *measure* (e.g., a measurable value, such as an effect level). Measures are described following the general description of assessment endpoints (EPA, 1998; Suter et al., 2000).

The assessment endpoint entities for the Site were selected based on the following principal criteria:

- Ecological relevance
- Societal relevance
- Susceptibility (or high exposure) to known or potential stressors at the Site

The attributes selected for each entity consisted of growth, reproduction, or survival. Maximum acceptable adverse effect levels generally selected for all receptors at a screening level are no observed effect concentrations (NOEC) or no observed adverse effects levels (NOAEL). Higher levels of effect are suitable only for later assessment tiers (i.e., baseline ecological risk assessments or [BERA]).

Assessment endpoints for the Site include terrestrial plants, soil invertebrates, and birds and mammals. No federal- or state-listed special status species (e.g., endangered or threatened species) are known to occur at or near the Site. Consequently, species-status species are not included as assessment endpoints. Additionally, reptiles, although considered important ecosystem components, are not included as assessment endpoints. This is due to the absence of both exposure and effects data to evaluate risks to this group. Risks to reptiles are, therefore, an uncertainty.

Where appropriate, representative ecological receptors (i.e., particular species) were selected to fulfill as many of the following criteria as possible:

- Species that are known to occur or are likely to occur at the Site
- Species that relate to the assessment endpoints selected
- Species that are likely to be maximally exposed to the site-related COPECs
- Sedentary species or species with a small home range
- Species with low reproductive rates

- Species that are known to play an integral role in the ecological community structure at the Site
- Species that are known or likely to be especially sensitive to the Site-related COPECs, and thus are an indication of ecological change
- Species that are representative of the foraging guild (i.e., a group of species with similar ecological resource requirements and foraging strategies and, therefore, similar roles in the ecosystem) or that serve as food items for higher trophic levels.

Bird and mammal receptors include species representative of trophic levels and foraging guilds (e.g., herbivores, invertivores, and carnivores). The representative receptors included chukar, killdeer, mallard (only for leachate ponds), and American kestrel for birds, and pocket gopher, Merriam's shrew, and kit fox for mammals. The assessment endpoints are listed and described in Table 2-1 (all tables are located at the end of the report).

2.1.5 Measures of Exposure and Effects

Measures (formerly referred to as measurement endpoints) are measurable attributes used to evaluate the risk hypotheses and are predictive of effects on the assessment endpoints (EPA, 1998). The three categories of measures include the following.

- Measures of exposure—used to evaluate levels at which exposures may be occurring.
- Measures of effect—used to evaluate the response of the assessment endpoints when exposed to the stressors.
- Measures of ecosystem and receptor characteristics—used to evaluate the ecosystem characteristics that influence the assessment endpoints, the distribution of stressors, and the characteristics of the assessment endpoints that may affect exposure or response to the stressor.

For this assessment, only measures of exposure and effects were used.

Measures of Exposure

Measures of exposure can be an exposure point concentration (EPC) of a chemical in an environmental medium or food item, or a related dose estimate. In the initial screening assessment, maximum detected or non-detected (if all samples were non-detects) concentrations were used as the EPC, for all receptors. If a refined screening assessment is determined to be necessary, a point-by-point evaluation of all analytes retained from this initial screen would be conducted as the next step for receptors with exposure expressed as a media concentration (e.g., terrestrial plants and soil invertebrates). For mobile receptors (i.e., birds and mammals), the EPC would be represented by the maximum media concentrations in the initial screen, with the 95 percent upper confidence limit of the mean (95 UCL) for each retained analyte to be used as the EPC if a refined assessment is completed. Additionally, bird and mammal receptors, which were assumed to forage exclusively onsite in the initial screening evaluation, would have more biologically realistic exposure assumptions employed in a refined assessment.

Measures of Effects

Measures of effects include media-specific ecotoxicity-based benchmarks and toxicity reference values (TRV). As previously indicated, benchmarks and TRVs in the initial screen were represented by literature-based chronic screening benchmarks, NOECs, or NOAELs. In the refined screen, chronic NOECs and NOAELs, as well as chronic lowest observed effect concentrations (LOEC) and lowest observed adverse effects levels (LOAEL) would be used.

Only literature-based single-chemical toxicity data were used. Ecological Soil Screening Levels (EcoSSL) developed by EPA (EPA, 2007a) were used as available, as were other published screening data for plants and soil invertebrates (e.g., Efroymson et al., 1997a; Efroymson et al., 1997b). Avian and mammalian chronic toxicity values were extracted from EFA West (1998), Sample et al., (1996), and published literature, as appropriate.

In addition to effects due to chronic exposures, observations of dead wildlife in the leach ponds suggest that acute effects may be occurring. To evaluate acute effects, single-chemical LD_{50} values (single doses that are lethal to 50 percent of exposed animals) for birds and mammals were extracted from published literature.

The measures of exposure and effects are provided, along with the assessment endpoints, in Table 2-1.

2.2 Ecological Effects Evaluation

The ecological effects evaluation summarizes available toxicity or other effects information that can be used to evaluate the exposures to COPECs and adverse effects in ecological receptors. Data that can be used include literature-derived or site-specific single-chemical toxicity data, site-specific ambient-media toxicity tests, and site-specific field surveys (Suter et al., 2000). For the Site, single-chemical toxicity data from literature sources were the primary effects data.

2.2.1 Chemical Effects in Terrestrial Plants and Soil Invertebrates

Single-chemical screening-level toxicity values for terrestrial plants and soil invertebrates have been developed for a limited number of analytes as part of the EPA EcoSSLs (EPA, 2007a). For analytes lacking EcoSSLs, additional data for terrestrial plants and soil invertebrates were obtained from the ORNL benchmark reports (Efroymson et al., 1997a; Efroymson et al., 1997b). Soil screening values for terrestrial plants and soil invertebrates are presented in Table 2-2.

2.2.2 Chemical Effects in Birds and Mammals

Wildlife EcoSSLs

Wildlife EcoSSLs, which represent chronic exposures to contaminants, were used for all analytes for which they were available. Wildlife EcoSSLs are presented in Table 2-2.

Chronic Oral Toxicity Data

Single-chemical chronic toxicity data for birds and mammals consist of NOAEL and LOAEL TRVs. These data were identified only for those chemicals lacking EcoSSLs, specifically aluminum, mercury, molybdenum, and thallium. NOAELs for these analytes were used in the initial screening evaluation, and LOAELs would be used in the refined screening, as necessary. Appropriate toxicity studies were selected from published literature based on several criteria:

- Studies were of chronic exposures or exposures during a critical stage of life (e.g., reproduction).
- Exposure was oral through food to ensure data were representative of oral exposures expected for wildlife in the field.
- Emphasis was placed on studies of reproductive impacts to ensure relevancy to population-level effects.
- Studies presented adequate information to evaluate and determine the magnitude of exposure and effects (or no-effects concentrations).

Specifically, toxicity studies were selected to serve as the TRV if exposure was chronic or during reproduction (a critical lifestage), the dosing regime was sufficient to identify both an NOAEL and an LOAEL, and the study considered ecologically relevant effects (e.g., growth, reproduction, or survival). If multiple studies for a given COPEC meet these criteria, the study generating the lowest reliable toxicity value was selected to be the TRV. The bird and mammal TRVs are presented in Table 2-3.

Acute Oral Toxicity Data

Acute oral LD_{50} values for birds and mammals were extracted from the literature to facilitate evaluation of acute exposures at the leachate ponds. LD_{50}s for mammals and birds are presented in Table 2-4.

2.2.3 Radionuclide Effects in Plants and Animals

Two radionuclide effect thresholds, as determined by consensus of international radiation regulatory agencies, form the basis for the multiple radionuclide-specific Biota Concentration Guides (BCG) available for aquatic, riparian, and terrestrial animals, and for terrestrial plants.

General guidance from the International Council for Radiological Protection (ICRP, 1991), the International Atomic Energy Agency (IAEA, 1992), and United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR, 1996) concluded that radiological doses to aquatic animals (including vertebrates and invertebrates) and to terrestrial plants and terrestrial animals (invertebrates and vertebrates) should not exceed 1 and 0.1 rad/d, respectively. Provided that radiation exposure does not exceed these levels, the consensus opinion of the international radiological organizations is that ecological populations will be protected. The U.S. Department of Energy (USDOE) has adopted these effect thresholds and integrated them into the Graded Approach (USDOE, 2002). The BCGs presented in USDOE, (2002) represent radionuclide concentrations in soil, water, or sediment that would produce a dose equal to the 1 or 0.1 rad/d threshold (depending on the type of biota). The BCGs for aquatic, riparian, and terrestrial animals and for terrestrial plants exposed to radionuclides in water, sediment, or soil are summarized in Table 2-5.

3.0 Screening-level Exposure Estimates

This section presents the screening-level exposure estimates, the first part of Step 2 of EPA's Ecological Risk Assessment Guidance (EPA, 1997). The exposure estimates provide a description and quantification of the nature and magnitude of the interaction between COPECs in surface water, sediment, soil, or groundwater and ecological receptors. This section first summarizes the available chemical and radionuclide concentration data, and then estimates the level of exposure for plants, invertebrates, birds, and mammals.

3.1 Available Data

Available data consist of measurements of metals, general chemistry, and radionuclides in drain-down fluids from the leachate ponds (Tables 3-1, 3-2, and 3-3) and materials from the HLPs (Tables 3-4, 3-5, and 3-6). Metals and general chemistry data from the HLPs were restricted to near-surface samples (0.25-0.75 ft). Because near-surface measurements were lacking for radionuclides, data from soil borings (surface to >100 ft) evaluated. Analytical results for individual samples are presented in Tables 3-1 through 3-6, along with simple summary statistics (i.e., number of samples, frequency of detects, minimum, median, and maximum concentrations).

3.2 Exposure Estimation

3.2.1 Chemical Exposures of Terrestrial Plants and Soil Invertebrates

Terrestrial plants and soil invertebrates experience exposure primarily through the soil in which they live. This exposure occurs as a consequence of living in a contaminated medium (i.e., receptors are directly exposed to COPECs). Although other exposure pathways (e.g., dietary exposure for invertebrates or foliar uptake) may contribute to total exposure for these receptors, exposure through the soil predominates. Consequently, estimates of exposure for terrestrial plants and soil invertebrates may be represented by the concentration of COPECs in the soil (mg/kg, pCi/g, or µg/kg).

As previously indicated, the EPCs for the initial screening were the maximum measured concentration (detected or non-detected) of the COPEC in soil (see Tables 3-4 through 3-6). COPECs that fail the initial screening assessment would be evaluated on a point-by-point basis, should a refined screen be performed.

3.2.2 Chemical Exposures of Birds and Mammals

Wildlife EcoSSLs developed by the EPA were used for all analytes for which they were available. Wildlife EcoSSLs represent soil concentrations that would result in dietary doses that do not exceed a NOAEL. Conservative assumptions (e.g., 100 percent bioavailability, 100 percent diet composition, and 100 percent site use) are used for the dietary dose calculations integrated into the EcoSSLs.

Because EcoSSLs were not available for aluminum, mercury, molybdenum, or thallium, it was necessary to calculate exposures for some wildlife receptors. Birds and mammals experience exposure through multiple pathways, including ingestion of abiotic media (surface water and sediment/soil) and biotic media (food), as well as inhalation and dermal contact. To address this multiple pathway exposure, modeling is required. The end product, or exposure estimate, for birds and mammals is a dosage (amount of chemical in milligrams per kilogram receptor body weight per day [mg/kg/day]) rather than a media concentration, as is the case for the other receptors. This is a function of both the multiple pathway approach and the typical methods used in toxicity testing for birds and mammals.

The general form of the model used to estimate exposure of birds and mammals to COPECs in surface water, sediment/soil, and food items is as follows (Suter et al., 2000):

$$E_t = E_o + E_d + E_i \tag{1}$$

Where:

E_t = the total chemical exposure experienced by wildlife

E_o, E_d, and E_i = oral, dermal, and inhalation exposure, respectively

Oral exposure occurs through the consumption of contaminated food, water, or sediment/soil. Dermal exposure occurs when contaminants are absorbed directly through the skin and inhalation exposure occurs when volatile compounds or fine particulates are inhaled into the lungs. Although methods are available for assessing dermal exposure to humans (EPA, 1992e), data necessary to estimate dermal exposure generally are not available for wildlife (EPA, 1993). Similarly, methods and data necessary to estimate wildlife inhalation exposures are poorly developed (EPA, 1993) or limited (i.e., some data are available through the EPA Integrated Risk Information System [IRIS] database). Additionally, a wildlife receptor's exposure to contaminants by inhalation and dermal contact usually contributes little to its overall exposure. Dermal exposure also is likely to be low, even in burrow-dwelling animals, because of the presence of protective dermal layers (e.g., feathers, fur, or scales). Therefore, for the purposes of this assessment, both dermal and inhalation exposure were assumed to be negligible.

Because dermal and inhalation exposures are excluded, total chemical exposure experienced by wildlife (E_t) is equal to oral exposure (E_o). By replacing E_o with a generalized exposure model modified from Suter et al., (2000), the previous equation was rewritten as follows:

$$E_t = \left[\left[\sum_{i=1}^{n} B_{ij} \times P_i \times FIR \right] + \left[Soil_j \times P_s \times FIR \right] + \left[Water_j \times WIR \right] \right] x\, AUF \tag{2}$$

Where:

E_t = total exposure (mg/kg/d)

$Soil_j$ = chemical concentration in sediment/soil (mg/kg dry weight)

P_s = sediment/soil ingestion rate as proportion of diet (unitless)

FIR = food ingestion rate (kg food/kg body weight/d)

B_{ij} = chemical concentration in biota type (i) (mg/kg wet weight)

P_i = proportion of biota type (i) in diet (unitless)

$Water_j$ = chemical concentration in water (mg/L)

WIR = water ingestion rate (L water/kg body weight/d)

AUF = area use factor (area of site/home range of receptor) (unitless)

Model Parameterization

To apply the exposure model, appropriate model parameters must be defined. These model parameters are outlined as follows.

Exposure Point Concentrations. For the initial screen, the maximum media concentration (detected or non-detected) of each COPEC was used for the EPC. COPECs that fail the initial screening assessment would be evaluated based on 95UCLs, should a refined screen be performed. This is because wildlife are mobile, traveling and experiencing exposure over the range of habitats they occupy, so their exposure is best described by mean chemical concentrations in areas they inhabit (Suter et al., 2000). Therefore, 95UCLs provide a conservative measure of the mean.

Life History Parameters. The specific life history parameters required to estimate exposure of each receptor to COPECs include body weight, ingestion rates of food and water, dietary components and percentage of the overall diet represented by each major food type, and approximate amount of soil and/or sediment that may be incidentally ingested based on feeding habits. These parameters, as well as foraging or home range information, were obtained from the literature and are presented in Table 3-7.

Many wildlife species are highly mobile, covering large areas in search of food, water, and shelter. The exposure that individuals experience depends on the amount of time they spend at a contaminated site. Site use depends on the size of the site relative to the receptor's home range. As a conservative assumption, wildlife receptors initially were assumed to forage onsite 100 percent of the time. In the refined screening, home range size would generally be considered in the exposure estimate by application of an area use factor (AUF).

Bioaccumulation Models. Measurements of concentrations of COPECs in wildlife foods (e.g., aquatic invertebrates, fish, plants, soil invertebrates, and small mammals) are a critical component for the estimation of oral exposure of birds and mammals. However, these site-specific measured data are generally not available or used in a screening-level assessment. Instead, bioaccumulation models derived from the literature are applied to develop risk estimates. The literature-based bioaccumulation models that describe uptake from soil-to-plants, soil-to-soil invertebrates, and soil-to–small-mammals are presented in Tables 3-8, 3-9, and 3-10, respectively.

3.2.3 Radionuclide Exposure

Exposure to radionuclides was evaluated based on maximum concentrations of radionuclides in water, sediment, or soil. Consistent with the USDOE Graded Approach (USDOE, 2002), maximum concentrations were compared to radionuclide-specific BCGs.

The BCGs represent the radionuclide concentration in water, sediment, or soil (in pCi/L or pCi/g) that corresponds to a conservatively calculated radiation dose to exposed biota that is equal to the radiation effect threshold appropriate for the given receptor.

Briefly, regardless of whether they are plants or animals, aquatic or terrestrial, biota receive exposure to radionuclides through a combination of both internal and external pathways. Internal exposure is a function of radiation emitted from radionuclides and then retained in tissues. External exposure is due to radiation from radionuclides in soil, sediment, and water with which biota come into contact (or come near). No radionuclide exposure modeling specific to the Site was conducted. Rather radionuclide exposure was estimated based on the internal and external radiation exposure models integrated into the BCGs (USDOE, 2002). Guidance for the BCGs (USDOE, 2002) contains detailed descriptions of these radionuclide exposure models, including how they were developed and the nature of the assumptions employed. The initial BCGs use conservative assumptions for internal and external exposure. External exposure assumptions include:

- The source medium is infinite in extent and contains uniform concentrations of radionuclides (i.e., there are no "hot spots")
- The exposed organism is very small; consequently 100 percent of the radionuclide energies are absorbed.
- Organisms exposed to soil or water are uniformly surrounded by the source medium.
- Organisms exposed to sediment reside on top of and in contact with the surface sediment.

Internal exposure assumptions include:

- The exposed organism is very large, such that all radionuclide decay energies are retained in tissue (100 percent of energies absorbed).
- Exposure for a given radionuclide includes all decay-chain progeny.
- All radionuclides are uniformly distributed such that all target tissues may be affected.

3.2.4 Acute Exposure to Drain-Down Fluids

Observations of dead birds associated with leachate ponds near the HLPs suggest acute exposures and mortality. This pathway was evaluated by calculating drinking water concentrations equivalent to the acutely lethal dose (LD_{50}), similar to the water benchmarks from Sample et al., (1996):

$$C_w = \frac{LD_{50}}{IR_w}. \qquad (3)$$

Where:

C_w = water concentration equal to the LD_{50} (mg/L)
LD_{50} = ingested dose resulting in 50 percent mortality (mg chemical/kg BW)
IR_w = water consumption rate (L/kg BW/day)

Values for C_w were calculated for kit fox and mallard ducks as representative mammalian and avian receptors. These values are presented in Table 2-4.

4.0 Screening-level Risk Characterization

This section presents the screening-level risk characterization, the second part of Step 2 of EPA's Ecological Risk Assessment Guidance (EPA, 1997). For the screening-level risk characterization, exposure data (from Section 2) and effects data (from Section 3) are integrated to draw conclusions concerning the presence, nature, and magnitude of effects that may exist at the Site. This section outlines the process by which exposure and effects data were integrated to estimate risk in the screening-level risk characterization and presents the results of the initial screening assessment.

Risks at the Site were evaluated based on the ratio of exposure concentrations or doses to TRVs, resulting in Hazard Quotients (HQ), and are described by the following equation:

$$HQ = C/TRV_{SL} \text{ or } ED/TRV_{NOAEL} \quad (4)$$

Where:

HQ = Ecological hazard quotient (unitless)

C = media concentration (µg/L or pCi/L for water and mg/kg or pCi/g) for sediment/soil)

ED = Estimated chemical intake (dose) by wildlife receptor (mg/kg-day)

TRV_{SL} = Screening-level (SL) Toxicity Reference Value (µg/L, mg/kg, pCi/L, pCi/g)

TRV_{NOAEL} = NOAEL-based Toxicity Reference Value (mg/kg-day)

SL-based or NOAEL HQ values less than 1.0 indicate that adverse effects associated with exposure to a given analyte are unlikely (EPA, 1997). These analytes were not considered to present unacceptable risk and can be excluded from further evaluation. When the estimated exposure for any COPEC exceeds the TRV_{SL} or TRV_{NOAEL}, an HQ greater than 1.0 is obtained. An HQ equal to or greater than 1.0 indicates data are insufficient to exclude the potential for risk, but does not necessarily indicate that risks are actually present. COPECs with HQs equal to or greater than 1.0 were retained and are recommended for a more detailed evaluation in the refinement stage of the SLERA. COPECS for which appropriate toxicity data were unavailable or for which detection limits were insufficient were not further evaluated, but were retained as uncertainties.

The outcome of the initial screening is a list of COPECs for each media-receptor combination that were: (1) determined to present no unacceptable risk, (2) retained for further evaluation in the refined screen, or (3) retained as an uncertainty.

Note that calcium, iron, magnesium, potassium, and sodium were considered macronutrients and are not expected to adversely affect ecological receptors. Accordingly, these COPECs were dropped from further consideration.

Bioavailability and therefore risks from aluminum in soil are pH dependent. Above a pH of 5.5, aluminum is not bioavailable and thus has limited toxicity (EPA, 2003a). Because the median pH in HLP material was 3.57 (range 2.66-7.89; Table 3-5), aluminum may be bio-available and was therefore retained for evaluation.

4.1 Terrestrial Plants

Maximum concentrations of COPECs in HLP surficial material were compared to either plant EcoSSLs (EPA, 2007a) or, if a plant EcoSSL was not available, plant soil screening benchmarks (Efroymson et al., 1997a) (see Table 4-1). Radionuclides measured in HLP boring composite samples were compared to terrestrial plant BCGs.

Screening values for plants were available for all metals and six of seven radionuclides measured in HLP materials (no BCG was available for thorium-227). Concentrations over all HLPs did not exceed screening values for eight metals (antimony, barium, beryllium, cadmium, manganese, nickel, silver, and zinc; Table 4-1), and summed exposures from maximum concentrations of the six measured radionuclides for which BCGs were available did not exceed the radionuclide screening threshold (i.e., the summed HQs<1). Maximum concentrations of 11 metals (aluminum, arsenic, total chromium, cobalt, copper, lead, mercury, molybdenum, selenium, thallium, and vanadium) exceeded plant screening values.

Point-by-point evaluation of all HLP material samples indicated that all samples (49 of 49) exceeded plant screening values for aluminum, total chromium, copper, mercury, molybdenum, selenium, and vanadium (see Table 4-2). The remaining analytes for which maximum concentrations exceeded the plant screening value had exceedance frequencies ranging from 2 percent (1 of 49 samples) for lead, to 22 percent (11 of 49 samples) for arsenic.

4.2 Soil Invertebrates

Maximum concentrations of COPECs in soil were compared to either invertebrate EcoSSLs (EPA, 2007a) or, if an invertebrate EcoSSL was not available, invertebrate soil screening benchmarks (Efroymson et al., 1997b) (see Table 4-1). Radionuclides measured in HLP boring composite samples were compared to terrestrial animal BCGs.

Soil invertebrate screening values were not available for aluminum, cobalt, molybdenum, silver, thallium, thorium-227, and vanadium, so these analytes were retained as uncertainties.

Among analytes for which screening values were available, concentrations over all HLPs did not exceed screening values for eight metals (antimony, barium, beryllium, cadmium, lead, manganese, nickel, and zinc; Table 4-1). In addition, summed exposures from maximum concentrations of the six measured radionuclide for which BCGs were available did not exceed the radionuclide screening threshold (i.e., the summed HQs<1). Maximum concentrations of 5 metals (arsenic, total chromium, copper, mercury, and selenium) exceeded invertebrate screening values.

Point-by-point evaluation of all HLP material samples indicated that all 49 samples exceeded invertebrate screening values for total chromium, copper, and mercury (see

Table 4-3). Arsenic and selenium had exceedance frequencies ranging from 2 percent (1 of 49 samples) for arsenic, to 61 percent (31 of 49 samples) for selenium.

4.3 Birds and Mammals

Both birds and mammals were evaluated to determine the potential for risk as a result of exposure to surficial media in the HLPs and to drain-down liquids in associated leachate ponds. Risks specific to birds and mammals were screened by comparing the maximum soil concentration to the bird and mammals EcoSSLs, or the terrestrial animal BCGs (see Table 4-1). Radionuclides measured in HLP boring composite samples were compared to terrestrial animal BCGs in the section above (see Section 4.2) and those results are not repeated here. Point-by-point comparisons to bird and mammal EcoSSLs were performed for all analytes where maximum values resulted in exceedances (see Tables 4-4 and 4-5). For chemical contaminants lacking EcoSSLs (aluminum, mercury, molybdenum and thallium), site-specific exposure modeling, as described in Section 3.2.2, was conducted using the maximum detected soil concentrations in each area (see Table 4-6). To evaluate potential acute effects to birds and mammals from consuming water from the leachate ponds, maximum surface water concentrations were compared to the acute drinking water values described in Section 2.2.2 and 3.2.4.

4.3.1 Terrestrial Exposures

EcoSSLs were available for 12 metals for birds and 16 metals for mammals (see Table 4-1). Among analytes for which EcoSSLs for birds were available, concentrations over all HLPs did not exceed screening values for five metals (chromium [as +3], cobalt, manganese, nickel, and silver). For mammals, maximum concentrations of nine metals (the same five as for birds, plus barium, beryllium, chromium [as +6], and vanadium) did not exceed EcoSSLs.

Maximum concentrations of arsenic, cadmium, copper, lead, selenium, and zinc exceeded both bird and mammal EcoSSLs. In addition, antimony exceeded for mammals, and vanadium exceeded for birds. Note that avian toxicity data for antimony, barium, beryllium, and chromium +6 are lacking, so these analytes were retained as uncertainties for birds.

Point-by-point evaluations indicated 100 percent frequency of exceedance for copper, selenium, and vanadium for birds (see Table 4-4), and copper and selenium for mammals (see Table 4-5). Antimony and cadmium had exceedance frequencies of 96 percent (47 of 49 samples) and 98 percent (48 of 49 samples) for mammals. Other retained analytes (arsenic, cadmium, lead, and zinc for birds; arsenic, lead, and zinc for mammals) had frequencies of exceedance of 14 percent or less.

Although modeled exposures to maximum concentrations of aluminum, mercury, and molybdenum exceeded NOAELs for almost all avian and mammalian receptors, thallium did not (see Table 4-6). Exposure estimates based on the minimum concentrations for aluminum, mercury, and molybdenum also exceeded NOAELs for all mammalian receptors; for birds, minimum exposures to only mercury and molybdenum exceeded NOAELs. Observations of exceedances by both maximum and minimum concentrations indicate that all samples could produce exposures greater than the NOAEL.

4.3.2 Acute Exposure at Leachate Ponds

Mallard and kit fox were used as representative species to evaluate potential effects of exposure to contaminants in drain-down water in leachate ponds. Although kit foxes generally obtain all necessary water from their diet (see Table 3-7), they were assumed to drink surface water for the purposes of this evaluation. Maximum concentrations of analytes measured in drain-down fluids were compared to drinking water LD_{50} equivalents (see Table 2-4) and BCGs for water (see Table 2-5). The results of these comparisons are presented in Table 4-7.

Maximum concentrations of aluminum and copper in drain-down fluids exceeded avian and mammalian LD_{50}s, and the minimum pH of drain-down fluids (1.9) approached levels associated with mortality in birds (1.5; see Table 4-7). In addition, summed radionuclide exposure for riparian animals exceeded the chronic effect threshold.

Low pH is known to potentiate metals toxicity. For example, when pH is reduced, aluminum becomes mobilized and species changes occur (Sparling, 1995). Above a pH of 6.0, aluminum solubility is low and most precipitates onto sediment. Aluminum solubility increases below a pH of 5.5 and it is more likely to be in inorganic forms that are more toxic to aquatic organisms than organically bound forms of aluminum. Other metals may also be mobilized and become more toxic with reduced pH. These include cadmium, lead, and mercury. Generally, pH in surface waters is not low enough to have a direct toxic effect on birds. However, toxicity to aquatic birds from aluminum in waters with low pH is possible (Sparling, 1995).

Research has recently been conducted evaluating acute exposures of birds to acid mine waters. In a series of experiments, Hooper et al., (2007) exposed mallards to drinking water formulated to contain metals and have a pH comparable to that observed in mine tailing ponds in which bird mortality had been observed. Seven of nine birds (78 percent) exposed to this synthetic acid mine water (SAMW) died, with mortality occurring 98 to 660 minutes following exposure. No mortality in control birds was observed. Although the SAMW contained multiple metals, Hooper et al., (2007) identified copper as one of the metals driving observed toxicity.

The composition of SAMW tested by Hooper et al., (2007) was compared to drain-down fluids from the Arimetco leachate ponds (see Figure 4-1). The pH of SAMW (2.0) was within the range of Arimetco drain-down fluids (1.9 to 2.8). Concentrations of metals were also generally comparable, with most analytes in the SAMW being similar to or lower than that observed in the Arimetco drain-down fluid samples. Copper was somewhat elevated in SAMW water relative to Arimetco drain-down fluids (5900 mg/L vs 5700 mg/L [maximum]), but aluminum was greatly elevated in Arimetco drain-down fluids (9000 to 27,000 mg/L) relative to SAMW (3700 mg/L).

The combination of low pH along with elevated aluminum and copper concentrations in Arimetco drain-down fluids, exceedances of literature-based drinking water LD_{50} equivalents for birds and mammals for both aluminum and copper, and the similarity in composition of Arimetco drain-down fluids to the SAMW that caused 78 percent mortality in exposed mallards suggests that acute risks are present for both birds and mammals at the Arimetco leachate ponds.

Radiation risks are considered unlikely because the USDOE BCGs are based on chronic exposures and they assume animals reside and forage exclusively at the site of exposure. The absence of attractive habitats and potential food at the Arimetco leachate ponds suggests that little likelihood that these locations will sustain sufficient use to realistically provide a radiation exposure sufficient to produce adverse effects.

5.0 Screening-level Summary and Conclusions

This section provides a summary and conclusions for the SLERA that was developed to support RI activities for the Arimetco HLPs. The SLERA was performed in accordance with EPA guidance to evaluate the potential for adverse effects to resident biota due to exposure to COPECs (metals and radionuclides) in leachate water and surficial HLP material at and adjacent to the Site. Conservative exposure and effects assumptions (i.e., maximum concentrations and no-effect levels) were used to evaluate potential risks to terrestrial plants, soil invertebrates, terrestrial birds and mammals.

Concentrations of multiple metals in surficial HLP materials and in drain-down fluid are sufficiently elevated to potentially produce adverse effects to plants, invertebrates, birds and/or mammals that may be exposed (see Table 5-1). In surficial HLP materials, six metals (aluminum, arsenic, copper, mercury, molybdenum, and selenium) failed the screen for virtually all receptor groups. In many instances, 100 percent of samples exceeded screening values. Lead concentrations exceeded screening values for all receptors but soil invertebrates. Antimony, cadmium, and zinc exceeded only for upper trophic level receptors (i.e., birds and mammals). In contrast, total chromium and cobalt exceeded only for lower trophic levels (i.e., plants and soil invertebrates). Five metals (barium, beryllium, manganese, nickel, and silver) did not exceed any of the available screening thresholds for any of the receptor groups. These analytes therefore are considered to present no unacceptable risks. Unlike metals, no soil-based radionuclide screening values (BCG) were exceeded. Consequently, adverse effects due to exposure to radionuclides in surficial HLP material are unlikely.

Although the screening evaluation for surficial HLP materials suggested risks to terrestrial receptors, multiple significant uncertainties exist. Implicit in the risk evaluation for plants and soil invertebrates was the assumption that the HLP material was comparable to soil and therefore could be evaluated using soil screening benchmarks. Given that the HLP material is essentially mined and processed rock to which acid solutions have been added to extract metals, this assumption is not likely to be valid. Therefore, risks to plants and soil invertebrates may be overestimated. Similarly, the risk evaluation for birds and mammals assumes that the HLP materials can produce prey (in the form of plants, soil invertebrates, and small mammals) and cover such that receptors will reside at and forage at the sites, thereby becoming exposed. Because these assumptions are also unlikely, risks to wildlife from HLP materials are likely to be overestimated. However, should the surfaces of the HLPs be modified or improved such that plants and other biota might become established, potential exposure and adverse effects to plants, soil invertebrates, and wildlife may result due to the highly elevated levels of metals in the HLP materials.

In contrast to the potential overestimation of risks to ecological receptors that may be exposed to surficial HLP materials, anecdotal evidence suggests that the drain-down fluids in the leachate collection ponds is adversely affecting birds. Comparison of concentrations of metals and pH from the ponds to acute toxicity values from the literature suggests that pH, aluminum, and copper are at levels acutely lethal to both birds and mammals. This is supported by recent research by Hooper et al., (2007) observing 78 percent mortality among mallards acutely exposed to a synthetic acid mine water that had a composition comparable to that present in the Arimetco leachate ponds. The mortality observed by Hooper et al., (2007) was attributed to copper toxicity.

Finally, uranium-234 and uranium-238 concentrations in drain-down fluids were elevated such that summed BCGs exceeded the chronic effects threshold. However, because habitat and food resources are lacking at the leachate ponds, actual effects due to exposure to radiation from these ponds are considered unlikely.

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Tables

TABLE 2-1

Assessment Endpoints and Measures of Exposure and Effects

Screening-Level Ecological Risk Assessment

Arimetco Facilities OU, Yerington, Nevada

Assessment Endpoint								
Entity	**Attribute**	**Effect Level**	**Conceptual Model Group**	**Representative Receptor**	**Assessment Level**	**Measures of Exposure**	**Available Lines of Evidence**	**Measures of Effect**
Terrestrial Plants	Growth, reproduction, or survival	NOECs (or equivalent) for initial screen LOECs for refined screen (if necessary)	Soil Biota	NA	Community	Maximum measured detected or non-detected soil concentrations in the initial screen	Single-chemical toxicity data	Benchmark values for toxic effects that could affect growth, reproduction, or survival
Soil Invertebrates	Growth, reproduction, or survival	NOECs (or equivalent) for initial screen LOECs for refined screen (if necessary)	Soil Biota	NA	Community	Maximum measured detected or non-detected soil concentrations in the initial screen	Single-chemical toxicity data	Benchmark values for toxic effects that could affect growth, reproduction, or survival
Birds	Growth, reproduction, or survival	NOAELs for initial screen LOAELs for refined screen	Herbivore	Chukar	Population	Exposure estimates based on maximum measured detected or non-detected surface water and soil concentrations and biota concentrations estimated using literature-based bioaccumulation models for initial screen	Single-chemical toxicity data	Benchmark values (NOAELs) for toxic effects that could affect growth, reproduction, or survival
	Growth, reproduction, or survival	NOAELs for initial screen LOAELs for refined screen	Insectivore	Killdeer	Population	Exposure estimates based on maximum measured detected or non-detected surface water and soil concentrations and biota concentrations estimated using literature-based bioaccumulation models for initial screen	Single-chemical toxicity data	Benchmark values (NOAELs) for toxic effects that could affect growth, reproduction, or survival
	Growth, reproduction, or survival	NOAELs for initial screen LOAELs for refined screen	Omnivore	Mallard	Population	Exposure estimates based on maximum measured detected or non-detected surface water and sediment concentrations and biota concentrations estimated using literature-based bioaccumulation models for initial screen	Single-chemical toxicity data	Benchmark values (NOAELs) for toxic effects that could affect growth, reproduction, or survival
	Growth, reproduction, or survival	NOAELs for initial screen LOAELs for refined screen	Carnivore	American Kestrel	Population	Exposure estimates based on maximum measured detected or non-detected surface water and soil concentrations and biota concentrations estimated using literature-based bioaccumulation models for initial screen	Single-chemical toxicity data	Benchmark values (NOAELs for initial screening and LOAELs for refinement) for toxic effects that could affect growth, reproduction, or survival
Mammals	Growth, reproduction, or survival	NOAELs for initial screen LOAELs for refined screen	Herbivore	Pocket Gopher	Population	Exposure estimates based on maximum measured detected or non-detected surface water and soil concentrations and biota concentrations estimated using literature-based bioaccumulation models for initial screen	Single-chemical toxicity data	Benchmark values (NOAELs) for toxic effects that could affect growth, reproduction, or survival
	Growth, reproduction, or survival	NOAELs for initial screen LOAELs for refined screen	Insectivore	Merriam's Shrew	Population	Exposure estimates based on maximum measured detected or non-detected surface water and soil concentrations and biota concentrations estimated using literature-based bioaccumulation models for initial screen	Single-chemical toxicity data	Benchmark values (NOAELs) for toxic effects that could affect growth, reproduction, or survival
	Growth, reproduction, or survival	NOAELs for initial screen LOAELs for refined screen	Carnivore	Kit Fox	Population	Exposure estimates based on maximum measured detected or non-detected surface water and soil concentrations and biota concentrations estimated using literature-based bioaccumulation models for initial screen	Single-chemical toxicity data	Benchmark values (NOAELs) for toxic effects that could affect growth, reproduction, or survival

Notes:

95UCL = 95 percent upper confidence limit of the arithmetic mean

COPEC = Constituent Of Potential Ecological Concern

NOAEL = No Observed Adverse Effect Level

NOEC = No Observed Effects Concentration

LOAEL = No Observed Adverse Effect Level

LOEC = Lowest Observed Effects Concentration

NA = Not applicable

Table 2-2
Screening-level Ecological Benchmarks for Chemical Contamination
Screening-level Ecological Risk Assessment
Arimetco Facilities OU, Yerington, Nevada

	Soil (mg/kg) EcoSSLs (unless stated otherwise)			
	Plant	**Invert**	**Bird**	**Mammal**
Aluminum	50a	--	--	--
Antimony	5a	78	--	0.27
Arsenic	18	60b	43	46
Barium	500a	330	--	2000
Beryllium	10a	40	--	21
Cadmium	32	140	0.77	0.36
Calcium				
Chromium III	--	--	26	34
Chromium VI	--	--	--	81
Chromium (Total)	1a	0.4b	--	--
Cobalt	13	--	120	230
Copper	70	80	28	49
Iron				
Lead	120	1700	11	56
Magnesium	--	--	--	--
Manganese	220	450	4300	4000
Mercury	0.3a	0.1b		
Molybdenum	2a			
Nickel	38	280	210	130
Potassium				
Silver	560	--	4.2	14
Selenium	0.52	4.1	1.2	0.63
Sodium				
Thallium	1a			
Vanadium	2a	--	7.8	280
Zinc	160	120	46	79

Notes:
a from Efroymson et al. 1997a
b from Efroymson et al. 1997b

Table 2-3
Toxicity Reference Values for Birds and Mammals
Screening-Level Ecological Risk Assessment
Arimetco Facilities OU, Yerington, Nevada

Analyte	Form/Surrogate Analyte	Primary Study	Test Species	Test Species Body Weight (kg)	Duration	Exposure Route	General Effect Endpoint	Specific Effect Endpoint	Uncertainty Factors Applied	Uncertainty Factor Type	NOAEL (mg/kg/d)	LOAEL (mg/kg/d)	Secondary Source
Birds													
Aluminum	$Al_2(SO_4)_3$	Carriere et al. 1986	ringed dove	0.155	4 months	oral in diet	reproduction				109.7		Sample et al. 1996
Mercury	Methyl mercury	Heinz and Hoffman 1998; Heinz 1976	mallard	1	2.5 months to two generations	oral in diet	reproduction				0.068	0.37	
Molybdenum	Sodium molybdate	Lepore and Miller 1965	chicken	1.5	21 days through reproduction	oral in diet	reproduction	embryonic viability	0.1	LOAEL-NOAEL	3.53	35.3	Sample et al. 1996
Thallium	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Mammals													
Aluminum	$AlCl_3$	Ondreicka et al. 1966	mouse	0.03	three generations	oral in water	reproduction		0.1	LOAEL-NOAEL	1.93	19.3	Sample et al. 1996
Mercury	Methylmercury chloride	Verschuuren et al. 1976	rat	0.35	three generations	oral in diet	reproduction	pup viability			0.032	0.16	Sample et al. 1996
Molybdenum	Molybdate (MoO_4)	Schroeder and Mitchener 1971	mouse	0.03	three generations	oral in water	reproduction	reproductive success, number of runts	0.1	LOAEL-NOAEL	0.26	2.6	Sample et al. 1996
Thallium	Thalleous acetate	Downs et al. 1960	rat	0.35	15 weeks	oral	growth	body weight			0.48	1.43	EFA West (1998)

Notes:
Uncertainty factors were used to adjust all measured effect concentrations to chronic NOAELS and chronic LOAELs as follows:
NOAEL to LOAEL = 0.1
kg = kilogram
mg/kg/d = milligram analyte per kilogram body weight per day
LOAEL = lowest observed adverse effect level
NA = not available
NOAEL = no observed adverse effect level

TABLE 2-4
Oral LD50 Values and Drinking Water Equivalents for Birds and Mammals
Screening-Level Ecological Risk Assessment
Arimetco Facilities OU, Yerington, Nevada

		Oral LD50 values									
Group	**Analyte**	**Test Species**	**Analyte Form**	**Value (mg/kg)**	**Reference**	**Receptor Species**	**Body Weight (kg)**	**Water ingestion Rate (L/kg/d)**	**mg/L LD50 Equivalent**	**Secondary Source**	**Comments**
Birds	pH	ducks, coots, grebes		<1.5	Read 1999	mallard	1	0.059	<1.5		these types of birds made up most of the deaths observed in acidic tailings ponds in South Australia
	Flouride	European starling (day old)	flouride	50	Fleming et al. 1987	mallard	1	0.059	847	WHO 2002	estimated 24-hr LD50, 17 mg/kg is 16-day LD50
	Chloride					mallard	1	0.059	0		
	Sulfate					mallard	1	0.059	0		
	(NO3 + NO2) as N					mallard	1	0.059	0		
	Aluminum	chicken	Al Cl3	5000	Storer and Nelsen 1968	mallard	1	0.059	84746		3 wk 100% mort)
	Aluminum	black duck		1000	Sparling 1990, 1991	mallard	1	0.059	16949		in diet under acidic conditions where Ca and P are low, found >60% mortality
	Arsenic	ring-necked pheasant	sodium arsenite	300	Eisler 2000	mallard	1	0.059	5085		
	Barium					mallard	1	0.059	0		
	Beryllium					mallard	1	0.059	0		
	Cadmium	chicken	chloride	177.5		mallard	1	0.059	3008		
	Chromium	chicken	Cr+6	1.7	Eisler 2000	mallard	1	0.059	29		
	Cobalt					mallard	1	0.059	0		
	Copper	chicken	sulfate	300	Pullar 1940	mallard	1	0.059	5085		
	Manganese					mallard	1	0.059	0		
	Molybdenum	chicken		8000	Friberg et al. 1975	mallard	1	0.059	135593	Eisler 2000	4 wk 61% mort
	Nickel					mallard	1	0.059	0		
	Selenium	chicken	Na2SeO3	50	El-Begearmi and Combs 1982	mallard	1	0.059	847		2 wk 47% mort
	Selenium	chicken	selenite	40	Jensen 1975	mallard	1	0.059	678	El-Begearmi and Combs 1982	2 weeks 40% mort
	Uranium					mallard	1	0.059	0		
	Vanadium	chicken	ammonium meta vanadate	100	Hafez and Kratzer 1976	mallard	1	0.059	1695		4 wk 80% mort
	Zinc	mallard	zinc carbonate	3000	Gasaway and Buss 1972	mallard	1	0.059	50847		60 d 67% mort
Mammals	pH					kit fox	2.4	0.0907	0		
	Fluoride	rat	sodium fluoride	31	ATSDR 2001a	kit fox	2.4	0.0907	342		
	Chloride					kit fox	2.4	0.0907	0		
	Sulfate					kit fox	2.4	0.0907	0		
	(NO3 + NO2) as N					kit fox	2.4	0.0907	0		
	Aluminum	rat	bromide	162	ATSDR 1999a	kit fox	2.4	0.0907	1786		
	Arsenic	rabbit	As+3	15	ATSDR 2000a	kit fox	2.4	0.0907	165		
	Barium	rat	chloride	132	ATSDR 1992a	kit fox	2.4	0.0907	1455		
	Beryllium	rat	sulfate	120	ATSDR 2002a	kit fox	2.4	0.0907	1323		
	Cadmium	rat	chloride	29	ATSDR 1999b	kit fox	2.4	0.0907	320		
	Chromium	rat	Cr+6	13	ATSDR 2000b	kit fox	2.4	0.0907	143		
	Cobalt	rat	chloride	42.4	ATSDR 2001b	kit fox	2.4	0.0907	467		
	Copper	rat	sulfate	31	ATSDR 2002b	kit fox	2.4	0.0907	342		
	Manganese	rat	chloride	275	ATSDR 2000c	kit fox	2.4	0.0907	3032		
	Molybdenum	rat	molybdenum trioxide	125	Luckey et al. 1975	kit fox	2.4	0.0907	1378		
	Nickel	rat	sulfate	39	ATSDR 1997	kit fox	2.4	0.0907	430		
	Selenium	rabbit	sodium selenite	1	ATSDR 2001c	kit fox	2.4	0.0907	11		
	Uranium	rat	uranyl nitrate	114	ATSDR 1999c	kit fox	2.4	0.0907	1257		
	Vanadium	mouse	sodium metavanadate	31	ATSDR 1992b	kit fox	2.4	0.0907	342		
	Zinc	rat	acetate	86	ATSDR 1994	kit fox	2.4	0.0907	948		

Table 2-5

Summary of Media Screening Values (Biota Concentration Guides) for Radionuclides

Screening-Level Ecological Risk Assessment

Arimetco Facilities OU, Yerington, Nevada

	Soil BCGs (pCi/g)		Water BCGs (pCi/L)				Sediment BCGs (pCi/g)	
Analyte	**Terrestrial Plant**	**Terrestrial Animal**	**Aquatic Animal**	**Riparian Animal**	**Terrestrial Plant**	**Terrestrial Animal**	**Aquatic Animal**	**Riparian Animal**
Th-228	6420	530	374	2040	16400000	63300	16400	805
Th-230	175000	9980	2570	13900	2740000000	452000	2740000	10400
Th-232	23500	1510	304	1680	3290000000	53600	3290000	1300
U-234	51600	5130	202	683	3080000000	404000	3080000	5270
U-235	27400	2770	217	736	105000000	419000	105000	3730
U-238	15700	1580	223	756	42800000	406000	42800	2490

Note:

All values extracted from USDOE (2002) or USDOE (2006)

Table 3-1
Summary of Drain-down Water Analytical Results for Metals
Arimetco Facilities OU, Yerington, Nevada

		Parameter:	Silica (SiO2)	Aluminum	Antimony	Arsenic	Barium	Beryllium	Boron	Cadmium	Calcium	Chromium	Cobalt	Copper	Iron	Lead	Lithium	Magnesium	Manganese	Mercury	Molybdenum
		Units:	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
Pond	Sample ID	SampleDate										Analytical Results									
PHASE 1 POND	H12DD01	9/13/2007	230000	19000000	**1,600**	**400**	**200**	1200	2500	340	600000	1300	45000	5700000	650000	**1,600**	13000	17000000	460000	29	**400**
PHASE I/II PLS POND	H12DD02	9/13/2007	250000	27000000	**1,600**	130	**200**	1500	1800	400	450000	2100	66000	4600000	460000	**1,600**	15000	23000000	700000	8.7	**400**
PHASE III 4X HEAP LEACH PAD - LOW	H3XDD01	9/12/2007	120000	11000000	160	110	**200**	640	1100	180	480000	460	29000	1700000	210000	**1,600**	7500	9600000	280000	8.3	**400**
PHASE III BATHTUB POND	H3SDD01	9/13/2007	190000	23000000	**1,600**	**400**	**200**	1300	1800	360	490000	1900	47000	4300000	1100000	**1,600**	14000	21000000	500000	4.7	**400**
PHASE IV SLOT HEAP LEACH PAD	H4SDD01	9/13/2007	220000	27000000	**1,600**	**400**	**200**	1500	1900	420	420000	1900	70000	3500000	420000	**1,600**	17000	23000000	740000	6.7	**400**
PHASE IV SLOT III PLS POND	H4SDD02	9/13/2007	160000	15000000	**1,600**	**400**	**200**	890	1400	250	600000	1600	41000	2000000	470000	**1,600**	11000	13000000	410000	10	**400**
PHASE IV SLOT III PLS POND	H4SDD02 (FD)	9/13/2007	160000	15000000	**1,600**	**400**	**200**	890	1400	250	600000	1600	41000	2000000	470000	**1,600**	11000	13000000	410000	11	**400**
PHASE IV VLT HEAP LEACH PAD	H4VDD02	9/12/2007	100000	9000000	**1,600**	**400**	**200**	550	1500	170	480000	940	28000	2200000	250000	**1,600**	6900	8600000	270000	14	**400**
PHASE IV VLT PLS POND	H4VDD01	9/12/2007	140000	17000000	200	250	**200**	960	1700	290	600000	1400	49000	2900000	650000	**1,600**	12000	15000000	460000	7.9	**400**
PHASE IV VLT PLS POND	H4VDD01 (FD)	9/12/2007	140000	17000000	**1,600**	280	**200**	970	1800	300	600000	1500	50000	2900000	640000	**1,600**	12000	15000000	470000	7.6	**400**
		Number of detects	10	10	2	4	0	10	10	10	10	10	10	10	10	0	10	10	10	10	0
		Number of samples	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
		Minimum	100,000	9,000,000	160	110	200	550	1,100	170	420,000	460	28,000	1,700,000	210,000	1,600	6,900	8,600,000	270,000	5	400
		Median	160,000	17,000,000	1,600	400	200	965	1,750	295	545,000	1,550	46,000	2,900,000	470,000	1,600	12,000	15,000,000	460,000	9	400
		Maximum	250,000	27,000,000	1,600	400	200	1,500	2,500	420	600,000	2,100	70,000	5,700,000	1,100,000	1,600	17,000	23,000,000	740,000	29	400

Notes:
Results in bold are non-detects

Table 3-1
Summary of Drain-down Water Analytical Results for Metals
Arimetco Facilities OU, Yerington, Nevada

		Parameter:	**Nickel**	**Potassium**	**Selenium**	**Silver**	**Sodium**	**Strontium**	**Thallium**	**Tin**	**Titanium**	**Vanadium**	**Zinc**
		Units:	**ug/L**	**ug/L**	**ug/L**	**ug/L**	**ug/L**	**ug/L**	**ug/L**	**ug/L**	**ug/L**	**ug/L**	**ug/L**
Pond	Sample ID	SampleDate									**Analytical Results**		
PHASE 1 POND	H12DD01	9/13/2007	26000	120000	**400**	**200**	1900000	15000	**1,600**	**20,000**	1000	230	47000
PHASE I/II PLS POND	H12DD02	9/13/2007	36000	75000	**400**	**200**	2200000	3700	660	**40,000**	410	300	63000
PHASE III 4X HEAP LEACH PAD - LOW	H3XDD01	9/12/2007	17000	93000	**400**	**200**	1100000	4500	380	**8,000**	180	70	26000
PHASE III BATHTUB POND	H3SDD01	9/13/2007	30000	40,000	**400**	50	2100000	140	**1,600**	**20,000**	900	1100	60000
PHASE IV SLOT HEAP LEACH PAD	H4SDD01	9/13/2007	41000	86000	**400**	**200**	2400000	2500	760	**40,000**	330	370	67000
PHASE IV SLOT III PLS POND	H4SDD02	9/13/2007	24000	100000	**400**	**200**	1500000	6800	**1,600**	**20,000**	310	86	39000
PHASE IV SLOT III PLS POND	H4SDD02 (FD)	9/13/2007	24000	99000	**400**	**200**	1500000	6800	**1,600**	**20,000**	300	81	39000
PHASE IV VLT HEAP LEACH PAD	H4VDD02	9/12/2007	17000	66000	**400**	**200**	970000	3800	**1,600**	**8,000**	300	65	26000
PHASE IV VLT PLS POND	H4VDD01	9/12/2007	30000	140000	**400**	**200**	1700000	7600	890	**20,000**	1100	100	46000
PHASE IV VLT PLS POND	H4VDD01 (FD)	9/12/2007	30000	140000	**400**	**200**	1700000	7700	**1,600**	**20,000**	1100	100	46000
		Number of detects	10	9	0	1	10	10	4	0	10	10	10
		Number of samples	10	10	10	10	10	10	10	10	10	10	10
		Minimum	17,000	40,000	400	50	970,000	140	380	8,000	180	65	26,000
		Median	28,000	96,000	400	200	1,700,000	5,650	1,600	20,000	370	100	46,000
		Maximum	41,000	140,000	400	200	2,400,000	15,000	1,600	40,000	1,100	1,100	67,000

Notes:
Results in bold are non-detects

Table 3-2
Summary of Drain-down Analytical Results for General Chemistry and TPH
Arimetco Facilities OU, Yerington, Nevada

Parameter:			**pH**	**Bicarbonate Alkalinity**	**Carbonate Alkalinity**	**Hydroxide Alkalinity**	**Total Alkalinity**	**Chloride**	**Fluoride**	**Nitrate + Nitrite as N**	**Phosphorus, Total**	**Silica (SiO2)**	**Specific Conductance**	**Sulfate**	**TPH, as diesel**	**TPH, as kerosene**
Units:			**pH units**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**ug/L**	**umhos/cm**	**mg/L**	**ug/L**	**ug/L**
	Location	SampleDate										**Analytical Results**				
PHASE 1 POND	H12DD01	9/13/2007	2.2	**20**	**20**	**20**	**20**	220	2600	16	160	230000	45000	200000	2000	2100
PHASE I/II PLS POND	H12DD02	9/13/2007	1.9	**20**	**20**	**20**	**20**	170	2100	21	360	250000	45000	170000	1,700	**1,700**
PHASE III 4X HEAP LEACH PAD - LOW POINT	H3XDD01	9/12/2007	2.43	**20**	**20**	**20**	**20**	115	1600	8.2	110	120000	44000	140000	750	**1,580**
PHASE III BATHTUB POND	H3SDD01	9/13/2007	2	**20**	**20**	**20**	**20**	330	3300	7	320	190000	39000	280000	1600	**3,200**
PHASE IV SLOT HEAP LEACH PAD	H4SDD01	9/13/2007	2	**20**	**20**	**20**	**20**	360	3100	18	270	220000	42000	250000	2100	**4,400**
PHASE IV SLOT III PLS POND	H4SDD02	9/13/2007	2.4	**20**	**20**	**20**	**20**	190	2100	14	170	160000	45000	170000	1300	**2,800**
PHASE IV SLOT III PLS POND	H4SDD02 (FD)	9/13/2007	2.4	**20**	**20**	**20**	**20**	310	3900	14	170	160000	31000	340000	1600	1700
PHASE IV VLT HEAP LEACH PAD	H4VDD02	9/12/2007	2.8	**20**	**20**	**20**	**20**	210	1200	9.4	210	100000	38000	93000	1500	1500
PHASE IV VLT PLS POND	H4VDD01	9/12/2007	2.6	**20**	**20**	**20**	**20**	190	2400	16	380	140000	44000	180000	1300	**2,600**
PHASE IV VLT PLS POND	H4VDD01 (FD)	9/12/2007	2.5	**20**	**20**	**20**	**20**	190	2400	16	400	140000	44000	190000	1200	**2,600**
		Number of detects	10	0	0	0	0	10	10	10	10	10	10	10	10	3
		Number of samples	10	10	10	10	10	10	10	10	10	10	10	10	10	10
		Minimum	2	20	20	20	20	115	1,200	7	110	100,000	31,000	93,000	750	1,500
		Median	2	20	20	20	20	200	2,400	15	240	160,000	44,000	185,000	1,550	2,350
		Maximum	3	20	20	20	20	360	3,900	21	400	250,000	45,000	340,000	2,100	4,400

Notes:
Results in bold are non-detects

Table 3-3
Summary of Drain-down Water Analytical Results for Radionuclides
Arimetco Facilities OU, Yerington, Nevada

		Parameter:	**Thorium 227**	**Thorium 228**	**Thorium 230**	**Thorium 232**	**Uranium 234**	**Uranium 235**	**Uranium 238**
		Units:	**pCi/L**	**pCi/L**	**pCi/L**	**pCi/L**	**pCi/L**	**pCi/L**	**pCi/L**
Pond	Sample ID	SampleDate							
PHASE 1 POND	H12DD01	9/13/2007	**-11**	641	196	**35.6**	6860	500	5280
PHASE I/II PLS POND	H12DD02	9/13/2007	**11.1**	**54.2**	72.3	46.9	8390	377	7010
PHASE III 4X HEAP LEACH PAD - LOW POINT	H3XDD01	9/12/2007	**20.9**	**175**	73.5	**56.4**	5660	217	4440
PHASE III BATHTUB POND	H3SDD01	9/13/2007	**21.8**	79.6	182	54.6	9950	336	7990
PHASE IV SLOT HEAP LEACH PAD	H4SDD01	9/13/2007	**-15**	**53.6**	57.1	**8.14**	11000	433	8870
PHASE IV SLOT III PLS POND	H4SDD02	9/13/2007	**37**	155	83.1	36.8	6120	291	5360
PHASE IV SLOT III PLS POND	H4SDD02 (FD)	9/13/2007	**-9.28**	140	67.7	21.3	6020	400	4870
PHASE IV VLT HEAP LEACH PAD	H4VDD02	9/12/2007	**-2.27**	132	51.5	**17.1**	3210	109	2470
PHASE IV VLT PLS POND	H4VDD01	9/12/2007	**13.3**	268	156	42	6590	289	5420
PHASE IV VLT PLS POND	H4VDD01 (FD)	9/12/2007	**16.7**	274	114	75.7	6230	368	5330
		Number of detects	0	7	10	6	10	10	10
		Number of samples	10	10	10	10	10	10	10
		Minimum	-15	54	52	8	3,210	109	2,470
		Median	12	148	78	39	6,410	352	5,345
		Maximum	37	641	196	76	11,000	500	8,870

Notes:
Results in bold are non-detects

Table 3-4
Summary of HLP Near-surface Material Analytical Results for Metals
Arimetco Facilities OU, Yerington, Nevada

Location	Sample ID	Sample Date	Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Calcium	Chromium	Cobalt	Copper	Iron	Lead	Magnesium	Manganese	Mercury	Molybdenum	Nickel	Potassium
PHASE I/II HLP	H12SS01	23-Oct-07	7860	1.3	22.6	68.3	0.36	**0.52**	3720	2.8	5.8	2,830	19400	6.1	7860	1.3	22.6	68.3	0.36	**0.52**
PHASE I/II HLP	H12SS01 (FD)	23-Oct-07	11000	1	26	81	0.39	**1**	6700	5	4.7	2100	24000	5.8	11000	1	26	81	0.39	**1**
PHASE I/II HLP	H12SS02	23-Oct-07	7760	1.1	21.4	74.7	0.35	**0.53**	5430	2.5	7.3	1,450	14400	3.9	7760	1.1	21.4	74.7	0.35	**0.53**
PHASE I/II HLP	H12SS03	23-Oct-07	5440	1.5	9.1	60.6	0.27	**0.51**	6670	3.3	3.2	1,100	8510	4.2	5440	1.5	9.1	60.6	0.27	**0.51**
PHASE I/II HLP	H12SS04	23-Oct-07	5770	0.36	12.5	73	0.28	**0.54**	5540	2.1	2.9	1,040	20100	7	5770	0.36	12.5	73	0.28	**0.54**
PHASE III 4X HLP	H3XSS01	25-Oct-07	11800	0.28	12	81.4	0.49	**0.51**	11200	19.1	12.3	3,090	20600	3.4	11800	0.28	12	81.4	0.49	**0.51**
PHASE III 4X HLP	H3XSS02	25-Oct-07	11500	6.2	24.8	105	0.55	**0.51**	16800	5.1	9.1	8,060	23800	6	11500	6.2	24.8	105	0.55	**0.51**
PHASE III 4X HLP	H3XSS03	25-Oct-07	7600	1	7.8	60.4	0.25	**0.52**	5160	7.7	5.2	520	12400	5.5	7600	1	7.8	60.4	0.25	**0.52**
PHASE III 4X HLP	H3XSS04	25-Oct-07	5850	0.48	6.8	44.1	0.19	**0.51**	3270	3.9	3.5	540	10500	6.5	5850	0.48	6.8	44.1	0.19	**0.51**
PHASE III 4X HLP	H3XSS05	25-Oct-07	4950	2.7	13	65.7	0.23	**0.52**	10200	4.5	4	655	12400	6.7	4950	2.7	13	65.7	0.23	**0.52**
PHASE III 4X HLP	H3XSS06	25-Oct-07	13700	1.5	19.4	110	0.52	**0.67**	48300	11	13.3	1,080	24700	53.2	13700	1.5	19.4	110	0.52	**0.67**
PHASE III 4X HLP	H3XSS07	25-Oct-07	6810	1.2	9.3	70.8	0.23	**0.52**	4520	4.9	4.6	539	12200	7.9	6810	1.2	9.3	70.8	0.23	**0.52**
PHASE III 4X HLP	H3XSS08	25-Oct-07	7690	0.53	7.7	60.4	0.2	**0.53**	1990	4.5	5.1	585	13000	4.9	7690	0.53	7.7	60.4	0.2	**0.53**
PHASE III 4X HLP	H3XSS08 (FD)	25-Oct-07	8800	**4**	8.5	58	0.22	**1**	2600	6	4.2	480	16000	4.5	8800	**4**	8.5	58	0.22	**1**
PHASE III SOUTH HLP	H3SSS01	24-Oct-07	7680	0.96	9.8	71.5	0.34	**0.53**	6770	3.9	6.2	1,420	18500	4.6	7680	0.96	9.8	71.5	0.34	**0.53**
PHASE III SOUTH HLP	H3SSS02	25-Oct-07	7390	1.2	18.4	76.9	0.38	**0.55**	4660	4.8	5.5	1,670	19800	5.5	7390	1.2	18.4	76.9	0.38	**0.55**
PHASE III SOUTH HLP	H3SSS03	25-Oct-07	12700	0.93	14.8	57.3	0.44	**0.51**	7000	2.7	9.3	6,060	20600	4.3	12700	0.93	14.8	57.3	0.44	**0.51**
PHASE III SOUTH HLP	H3SSS04	25-Oct-07	3890	0.26	2.6	40.5	0.08	**0.5**	1730	5.3	2.6	207	12500	1.8	3890	0.26	2.6	40.5	0.08	**0.5**
PHASE III SOUTH HLP	H3SSS04 (FD)	25-Oct-07	4500	**2**	2.4	39	0.09	**1**	3700	7.1	2.3	200	16000	1.7	4500	**2**	2.4	39	0.09	**1**
PHASE III SOUTH HLP	H3SSS05	24-Oct-07	6960	0.29	11.3	52.7	0.19	**0.55**	1540	5.3	2.6	990	19700	5.7	6960	0.29	11.3	52.7	0.19	**0.55**
PHASE III SOUTH HLP	H3SSS06	25-Oct-07	5580	0.55	11.4	72.3	0.21	**0.52**	7530	3.5	2.6	518	12500	6.7	5580	0.55	11.4	72.3	0.21	**0.52**
PHASE III SOUTH HLP	H3SSS07	24-Oct-07	8640	0.42	10.6	45.2	0.31	**0.53**	4000	2.4	8	1,960	16800	5.7	8640	0.42	10.6	45.2	0.31	**0.53**
PHASE III SOUTH HLP	H3SSS08	24-Oct-07	7080	0.25	11.6	124	0.21	**0.51**	4810	3.3	1.9	1,300	28000	3.2	7080	0.25	11.6	124	0.21	**0.51**
PHASE IV SLOT HLP	H4SSS01	24-Oct-07	6920	1.5	8.7	47.1	0.15	**0.53**	1810	4.6	**3.6**	543	11600	3.6	6920	1.5	8.7	47.1	0.15	**0.53**
PHASE IV SLOT HLP	H4SSS02	23-Oct-07	8560	0.57	10.2	62.8	0.34	**0.53**	3450	4.9	6.9	973	16300	5.8	8560	0.57	10.2	62.8	0.34	**0.53**
PHASE IV SLOT HLP	H4SSS03	23-Oct-07	7990	2.1	9.1	47.1	0.25	**0.52**	5480	6.2	6.2	594	11100	8.1	7990	2.1	9.1	47.1	0.25	**0.52**
PHASE IV SLOT HLP	H4SSS04	23-Oct-07	7750	7.2	15.3	45.6	0.31	**0.53**	4600	5.5	6.1	1030	11500	16.4	7750	7.2	15.3	45.6	0.31	**0.53**
PHASE IV SLOT HLP	H4SSS05	23-Oct-07	5990	0.78	12	54.3	0.25	**0.54**	8080	2.3	**2.8**	668	14100	20.4	5990	0.78	12	54.3	0.25	**0.54**
PHASE IV SLOT HLP	H4SSS06	24-Oct-07	12500	4.6	31.6	106	0.73	**0.52**	8320	7.6	5.6	3690	24100	8.2	12500	4.6	31.6	106	0.73	**0.52**
PHASE IV SLOT HLP	H4SSS06 (FD)	24-Oct-07	14000	6.9	28	120	0.74	**1**	7500	9.7	5.9	3600	27000	7.6	14000	6.9	28	120	0.74	**1**
PHASE IV SLOT HLP	H4SSS07	24-Oct-07	8480	1.8	12.8	87.9	0.4	**0.52**	4820	4.2	**4.4**	1320	18000	7.1	8480	1.8	12.8	87.9	0.4	**0.52**
PHASE IV SLOT HLP	H4SSS08	24-Oct-07	7430	0.87	17.1	72.6	0.27	**0.52**	7690	2.9	**4.7**	909	17300	9.3	7430	0.87	17.1	72.6	0.27	**0.52**
PHASE IV SLOT HLP	H4SSS09	24-Oct-07	7410	0.95	13.5	86.2	0.36	**0.54**	4540	6.6	**4.5**	614	17400	6.2	7410	0.95	13.5	86.2	0.36	**0.54**
PHASE IV SLOT HLP	H4SSS10	24-Oct-07	11100	4.1	22.5	221	0.69	**0.51**	13800	3.9	23.2	7360	17900	5	11100	4.1	22.5	221	0.69	**0.51**
PHASE IV VLT HLP	H4VSS01	26-Oct-07	13700	0.75	9.4	39.7	0.69	0.03	3810	5.1	51.6	10400	13400	5.5	13700	0.75	9.4	39.7	0.69	0.03
PHASE IV VLT HLP	H4VSS01 (FD)	26-Oct-07	8200	**4**	8.4	49	0.25	**1**	4400	5.6	5.1	1000	15000	5.7	8200	**4**	8.4	49	0.25	**1**
PHASE IV VLT HLP	H4VSS02	26-Oct-07	11300	0.77	8.3	83.1	0.39	**0.51**	7250	10.3	8.3	1230	16700	5.3	11300	0.77	8.3	83.1	0.39	**0.51**
PHASE IV VLT HLP	H4VSS03	26-Oct-07	6440	0.56	6	31.5	0.25	**0.54**	11200	4.4	8.3	643	9160	6.7	6440	0.56	6	31.5	0.25	**0.54**
PHASE IV VLT HLP	H4VSS04	26-Oct-07	11600	0.75	11.5	46.7	0.49	**0.55**	18200	9.5	19.1	1620	27500	6.4	11600	0.75	11.5	46.7	0.49	**0.55**
PHASE IV VLT HLP	H4VSS05	26-Oct-07	8690	0.93	13.9	90.4	0.3	**0.51**	2690	4.5	**4.8**	824	18200	6.5	8690	0.93	13.9	90.4	0.3	**0.51**
PHASE IV VLT HLP	H4VSS06	26-Oct-07	7260	0.95	8.7	47.3	0.23	**0.52**	5690	3.7	6.1	703	11900	4.5	7260	0.95	8.7	47.3	0.23	**0.52**
PHASE IV VLT HLP	H4VSS07	26-Oct-07	10700	0.43	9.1	68	0.5	**0.53**	7560	5.6	15.1	896	16400	5.8	10700	0.43	9.1	68	0.5	**0.53**
PHASE IV VLT HLP	H4VSS08	26-Oct-07	8230	0.47	7.8	74.8	0.46	**0.51**	6080	6.4	19.4	2840	13000	3.8	8230	0.47	7.8	74.8	0.46	**0.51**
PHASE IV VLT HLP	H4VSS09	26-Oct-07	6970	0.52	8.1	75.8	0.22	**0.53**	5590	2.8	**4.9**	559	17200	7	6970	0.52	8.1	75.8	0.22	**0.53**
PHASE IV VLT HLP	H4VSS10	26-Oct-07	27100	1.2	13.6	71.9	2.6	**0.73**	60700	24.2	69	6920	61100	23.3	27100	1.2	13.6	71.9	2.6	**0.73**
VLT SOIL	CAPSS01	29-Oct-07	4910	1.3	4.7	37.7	0.25	**0.5**	15300	3	24.6	10600	15100	4	4910	1.3	4.7	37.7	0.25	**0.5**
VLT SOIL	CAPSS02	26-Oct-07	6280	3.6	119	283	0.2	0.96	3950	12.7	21	1250	27900	48.5	6280	3.6	119	283	0.2	0.96
VLT SOIL	CAPSS03	29-Oct-07	1970	1.5	13.1	104	0.06	**0.52**	2570	2.8	2	6260	30000	271	1970	1.5	13.1	104	0.06	**0.52**
VLT SOIL	CAPSS04	29-Oct-07	7500	0.81	29.3	58.8	0.36	**0.51**	6140	15.6	4.8	22100	20500	39.1	7500	0.81	29.3	58.8	0.36	**0.51**
		Number of detects	49	46	49	49	49	2	49	49	42	49	49	49	49	48	49	49	49	2
		Number of samples	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49
		Minimum	1,970	0.43	4.7	37.7	0.06	0.50	2,570	2.8	2.0	559	11,900	3.8	1,970	0.43	4.7	38	0.06	0.50
		Median	7,380	0.94	11.1	73.4	0.28	0.52	5,885	5.1	10.6	2,045	17,700	6.8	7,380	0.94	11.1	73	0.28	0.52
		Maximum	27,100	3.60	119.0	283.0	2.60	0.96	60,700	24.2	69.0	22,100	61,100	271.0	27,100	3.60	119.0	283	2.60	0.96

Notes:

Near surface = 0.25 to 0.75 foot

Results in bold are non-detect

Measurements are in milligrams per kilogram

FD - field duplicate

Table 3-4
Summary of HLP Near-surface Material Analytical Results for Metals
Arimetco Facilities OU, Yerington, Nevada

Location	Sample ID	Sample Date	Selenium	Silver	Sodium	Thallium	Vanadium	Zinc
PHASE I/II HLP	H12SS01	23-Oct-07	3.8	0.17	206	0.99	23.8	13.5
PHASE I/II HLP	H12SS01 (FD)	23-Oct-07	3.6	2	210	**10**	30	12
PHASE I/II HLP	H12SS02	23-Oct-07	3.7	1.1	346	0.7	14.1	13
PHASE I/II HLP	H12SS03	23-Oct-07	3.8	1	117	0.43	12.1	7.3
PHASE I/II HLP	H12SS04	23-Oct-07	4.1	0.18	154	0.92	23.2	8.7
PHASE III 4X HLP	H3XSS01	25-Oct-07	3.5	0.09	337	0.52	50.3	12.2
PHASE III 4X HLP	H3XSS02	25-Oct-07	5.2	0.56	102	1	38.1	24.2
PHASE III 4X HLP	H3XSS03	25-Oct-07	3.1	1	262	0.82	18.9	13.2
PHASE III 4X HLP	H3XSS04	25-Oct-07	5.5	0.13	135	0.7	19.1	9.3
PHASE III 4X HLP	H3XSS05	25-Oct-07	2.9	0.12	321	0.74	18.5	8.3
PHASE III 4X HLP	H3XSS06	25-Oct-07	9.5	0.38	795	1.2	18.8	23.5
PHASE III 4X HLP	H3XSS07	25-Oct-07	3.9	0.2	194	0.75	17.6	12.2
PHASE III 4X HLP	H3XSS08	25-Oct-07	6.1	0.23	99.5	0.82	22.7	14.5
PHASE III 4X HLP	H3XSS08 (FD)	25-Oct-07	5.4	2	91	**10**	30	14
PHASE III SOUTH HLP	H3SSS01	24-Oct-07	4.3	0.25	410	0.99	20.8	14.6
PHASE III SOUTH HLP	H3SSS02	25-Oct-07	3.5	0.12	283	0.99	27.4	13.4
PHASE III SOUTH HLP	H3SSS03	25-Oct-07	3.7	0.29	143	0.89	32	10.6
PHASE III SOUTH HLP	H3SSS04	25-Oct-07	1.6	0.13	277	0.81	25.5	11.4
PHASE III SOUTH HLP	H3SSS04 (FD)	25-Oct-07	1.3	2	270	**10**	27	11
PHASE III SOUTH HLP	H3SSS05	24-Oct-07	4.6	0.2	175	1.2	19.9	10.8
PHASE III SOUTH HLP	H3SSS06	25-Oct-07	2.3	1	100	0.62	18	13.1
PHASE III SOUTH HLP	H3SSS07	24-Oct-07	3.4	0.11	415	0.91	15.2	21.2
PHASE III SOUTH HLP	H3SSS08	24-Oct-07	6.3	0.41	194	1.4	24.3	10.9
PHASE IV SLOT HLP	H4SSS01	24-Oct-07	5.2	0.15	64.2	0.68	18.9	9.3
PHASE IV SLOT HLP	H4SSS02	23-Oct-07	4.9	0.12	433	0.9	17.8	13.4
PHASE IV SLOT HLP	H4SSS03	23-Oct-07	4.9	0.11	233	0.68	19.8	7.7
PHASE IV SLOT HLP	H4SSS04	23-Oct-07	6.9	0.22	174	0.6	20.7	7.2
PHASE IV SLOT HLP	H4SSS05	23-Oct-07	4.8	0.15	131	0.76	13.1	8.6
PHASE IV SLOT HLP	H4SSS06	24-Oct-07	5	0.22	298	1.1	46.8	22.4
PHASE IV SLOT HLP	H4SSS06 (FD)	24-Oct-07	4.6	**2**	290	**10**	53	22
PHASE IV SLOT HLP	H4SSS07	24-Oct-07	4.6	0.11	93.8	1	21.1	13.5
PHASE IV SLOT HLP	H4SSS08	24-Oct-07	5.2	0.1	171	0.97	23.6	10.6
PHASE IV SLOT HLP	H4SSS09	24-Oct-07	3.9	0.13	181	0.95	19.7	12.2
PHASE IV SLOT HLP	H4SSS10	24-Oct-07	**2.2**	0.32	338	0.85	33.9	18.2
PHASE IV VLT HLP	H4VSS01	26-Oct-07	6.1	0.28	990	0.78	16.3	62.5
PHASE IV VLT HLP	H4VSS01 (FD)	26-Oct-07	5.1	**2**	130	**10**	21	16
PHASE IV VLT HLP	H4VSS02	26-Oct-07	3.9	0.16	440	1	25	23.6
PHASE IV VLT HLP	H4VSS03	26-Oct-07	**3.3**	**1.1**	290	0.54	10.8	11.2
PHASE IV VLT HLP	H4VSS04	26-Oct-07	5.6	**1.1**	822	1.3	15	20.8
PHASE IV VLT HLP	H4VSS05	26-Oct-07	4.7	0.12	424	1	22.4	15.9
PHASE IV VLT HLP	H4VSS06	26-Oct-07	4.5	0.17	155	0.75	18.1	10.8
PHASE IV VLT HLP	H4VSS07	26-Oct-07	4.7	**1.1**	614	1	18	26.2
PHASE IV VLT HLP	H4VSS08	26-Oct-07	3.8	0.27	358	0.77	27	14
PHASE IV VLT HLP	H4VSS09	26-Oct-07	5.7	0.25	343	1.2	17.9	16.8
PHASE IV VLT HLP	H4VSS10	26-Oct-07	5.3	**1.5**	3410	2.5	9.7	72.6
VLT SOIL	CAPSS01	29-Oct-07	6.6	0.79	207	0.86	10.2	20.5
VLT SOIL	CAPSS02	26-Oct-07	83.3	1.1	133	6.6	21.7	108
VLT SOIL	CAPSS03	29-Oct-07	13.8	1.9	1020	2	8.5	13.2
VLT SOIL	CAPSS04	29-Oct-07	9.2	0.69	125	1.2	17.9	11.1
		Number of detects	47	42	49	44	49	49
		Number of samples	49	49	49	49	49	49
		Minimum	3.8	0.12	125	0.75	8.5	11
		Median	5.5	0.74	351	1.10	18.0	16
		Maximum	83.3	1.90	3,410	6.60	27.0	108

Notes:
Near surface = 0.25 to 0.75 foot
Results in bold are non-detect
Measurements are in milligrams per kilogram
FD - field duplicate

Table 3-5

Summary of HLP Near-surface Material Analytical Results for General Chemistry

Arimetco Facilities OU, Yerington, Nevada

Location	Sample ID	Sample Date	pH	Alkalinity, Bicarbonate (as CaCO3)	Alkalinity, Carbonate (as CaCO3)	Alkalinity, Hydroxide (as CaCO3)	Alkalinity, Total (as CaCO3)	Chloride	Moisture	Nitrogen, Kjeldahl Total	Phosphorus, Total (as P)	Sodium Absorption Ratio	Total Nitrogen	Total Oxidizable Nitrogen	Boron	Calcium	Magnesium	Potassium	Sodium
			pH units	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	%	mg/Kg	mg/Kg	NA	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg
PHASE I/II HLP	H12SS01	23-Oct-07	3.58	**0.88**	**0.88**	**0.88**	**0.88**	43	3.6	250	849	0.041	250	3.6	18.2	3460	5630	592	173
PHASE I/II HLP	H12SS01 (FD1)	23-Oct-07	3.64	**0.88**	**0.88**	**0.88**	**0.88**	38	3.7	180	730	0.046	180	2.3	18	3970	5500	648	202
PHASE I/II HLP	H12SS02	23-Oct-07	3.46	**0.89**	**0.89**	**0.89**	**0.89**	57	4.9	92	529	0.075	94	1.9	15.5	5850	6310	457	348
PHASE I/II HLP	H12SS02 (FD1)	23-Oct-07	3.84	**0.89**	**0.89**	**0.89**	**0.89**	80	4.3	220	534	0.083	220	1.6	15.9	5870	6200	517	387
PHASE I/II HLP	H12SS03	23-Oct-07	3.41	**0.88**	**0.88**	**0.88**	**0.88**	13	2.9	110	519	0.032	110	0.74	10.1	8920	4400	908	146
PHASE I/II HLP	H12SS03 (FD1)	23-Oct-07	3.8	**0.87**	**0.87**	**0.87**	**0.87**	13	2.4	110	300	0.021	110	**0.66**	8.8	7270	4080	543	93.1
PHASE III 4X HLP	H3XSS06	25-Oct-07	3.28	**1.1**	**1.1**	**1.1**	**1.1**	98	22.7	390	719	0.11	400	2	26.9	33500	10500	2550	1030
PHASE III 4X HLP	H3XSS06 (FD1)	25-Oct-07	3.29	**1.1**	**1.1**	**1.1**	**1.1**	98	22.6	420	798	0.1	420	2.4	31.3	57900	11700	3050	1210
PHASE III 4X HLP	H3XSS08	25-Oct-07	3.7	**0.9**	**0.9**	**0.9**	**0.9**	15	5.2	120	392	0.025	120	**0.68**	12.8	1590	6310	1190	107
PHASE III SOUTH HLP	H3SSS04	25-Oct-07	3.76	**0.85**	**0.85**	**0.85**	**0.85**	21	**2**	120	409	0.089	130	4.9	10.7	3800	3220	1470	322
PHASE III SOUTH HLP	H3SSS04 (FD1)	25-Oct-07	3.81	**0.85**	**0.85**	**0.85**	**0.85**	14	**2**	1500	416	0.098	1400	**0.64**	10.7	4580	3240	1460	373
PHASE III SOUTH HLP	H3SSS05	24-Oct-07	3.44	**0.92**	**0.92**	**0.92**	**0.92**	18	7.8	250	1370	0.063	250	**0.69**	23.1	2110	4520	1380	242
PHASE III SOUTH HLP	H3SSS05 (FD1)	24-Oct-07	3.44	**0.92**	**0.92**	**0.92**	**0.92**	18	8.1	81	1320	0.062	81	0.94	20.6	2130	3820	1180	215
PHASE IV SLOT HLP	H4SSS03	23-Oct-07	3.63	**0.89**	**0.89**	**0.89**	**0.89**	17	4.9	180	269	0.048	180	**0.67**	9.3	6470	4680	508	215
PHASE IV SLOT HLP	H4SSS05	23-Oct-07	3.51	**0.92**	**0.92**	**0.92**	**0.92**	19	7.5	160	441	0.029	150	**0.69**	8.5	3760	2300	480	98.7
PHASE IV VLT HLP	H4VSS02	26-Oct-07	3.57	**0.87**	**0.87**	**0.87**	**0.87**	34	2.8	130	848	0.071	130	**0.66**	13	5900	7190	1600	349
PHASE IV VLT HLP	H4VSS04	26-Oct-07	3.25	**0.95**	**0.95**	**0.95**	**0.95**	120	10.7	110	900	0.089	120	2.8	18.6	14200	7180	3490	578
PHASE IV VLT HLP	H4VSS04 (FD1)	26-Oct-07	3.26	**0.98**	**0.98**	**0.98**	**0.98**	120	12.9	130	1260	0.11	130	2.4	25.4	16000	6700	4990	719
VLT SOIL	CAPSS01	29-Oct-07	5.9	1200	**0.85**	**0.85**	1200	37	**2**	120	374	0.05	120	2.8	11	11000	4400	1030	252
VLT SOIL	CAPSS01 (FD1)	29-Oct-07	7.89	1700	**0.85**	**0.85**	1700	37	**2**	130	559	0.038	130	2	14	13900	4860	1060	207
VLT SOIL	CAPSS02	26-Oct-07	4.04	**0.85**	**0.85**	**0.85**	**0.85**	15	**2**	110	430	0.015	110	2.2	26	5420	5830	1420	67.4
VLT SOIL	CAPSS03	29-Oct-07	2.7	**0.9**	**0.9**	**0.9**	**0.9**	32	5.3	300	305	0.41	300	**0.68**	28.3	2180	674	1690	913
VLT SOIL	CAPSS03 (FD1)	29-Oct-07	2.66	**0.89**	**0.89**	**0.89**	**0.89**	24	5	270	303	0.27	270	**0.67**	28.3	2630	1070	1590	674
		Number of detects	23	2	0	0	2	23	18	23	23	23	23	14	23	23	23	23	23
		Number of sample	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23
		Minimum	2.66	0.85	0.85	0.85	0.85	13	2.00	81	269	0.02	81	0.64	9	1,590	674	457	67
		Median	3.57	0.89	0.89	0.89	0.89	32	4.90	130	529	0.06	130	1.60	16	5,850	4,860	1,190	252
		Maximum	7.89	1,700	1.10	1.10	1,700	120	22.70	1,500	1,370	0.41	1,400	4.90	31	57,900	11,700	4,990	1,210

Notes:

Near surface = 0.25 to 0.75 foot

Results in bold are non-detects

Measurements are in milligrams per kilogram

% - percent

P - phosphorus

FD1 - Sample was not originally designated as a field duplicate, but laboratory analyzed more analytes than requested on chain of custody

Table 3-6
Summary of Boring Composites of HLP Material for Radionuclides
Arimetco Facilities OU, Yerington, Nevada

Location	Sample ID	Sample Date	Depth[a]	Thorium 227	Thorium 228	Thorium 230	Thorium 232	Uranium 234	Uranium 235	Uranium 238
PHASE I/II HLP	H12SU01	11-Oct-07	0-50	ND	1.28	1.38	0.884	0.996	0.0642	0.874
PHASE I/II HLP	H12SU02	10-Oct-07	50-77	0.15	1.54	1.46	1.31	0.849	0.0816	0.727
PHASE III 4X HLP	H3XSU01	16-Oct-07	50-67	0.171	1.41	0.986	1	1.28	0.0471	1.24
PHASE III 4X HLP	H3XSU02	16-Oct-07	0-50	ND	1.22	1.8	0.809	1.68	0.0623	1.21
PHASE III 4X HLP	H3XSU03	17-Oct-07	50-67	0.174	1.9	**3.67**	1.45	2.5	0.154	2.04
PHASE III SOUTH HLP	H3SSU01	25-Sep-07	20-97	0.191	1.35	1.57	1.03	1.63	ND	1.46
PHASE III SOUTH HLP	H3SSU01	07-Oct-07	0-50	ND	1.41	1.6	1.04	1.28	0.0923	1.33
PHASE III SOUTH HLP	H3SSU03	06-Oct-07	50-100	0.136	1.04	1.46	0.858	1.27	0.0625	1.23
PHASE III SOUTH HLP	H3SSU04	26-Sep-07	0-50	ND	1.24	1.94	1.03	1.5	0.134	1.38
PHASE IV SLOT HLP	H4SSU01	08-Oct-07	0-50	0.268	1.68	3.18	1.26	1.81	0.0876	1.68
PHASE IV SLOT HLP	H4SSU02	09-Oct-07	0-50	0.234	1.33	2.68	0.957	2	0.102	1.6
PHASE IV SLOT HLP	H4SSU03	09-Oct-07	50-77	0.354	1.58	1.79	1.4	1.55	0.0756	1.51
PHASE IV SLOT HLP	H4SSU04	09-Oct-07	0-50	0.162	1.72	1.47	1.13	1.37	ND	1.32
PHASE IV VLT HLP	H4VSU01	27-Sep-07	0-50	0.236	1.28	2.25	0.8	1.97	0.132	1.63
PHASE IV VLT HLP	H4VSU02	05-Oct-07	50-107	ND	1.77	1.82	1.96	2.22	0.0651	1.77
PHASE IV VLT HLP	H4VSU03	06-Oct-07	0-50	ND	1.15	2.64	0.953	1.68	0.132	1.49
			Number of detects	10	16	16	16	16	14	16
			Number of samples	16	16	16	16	16	16	16
			Minimum	0.14	1.04	0.99	0.80	0.85	0.05	0.73
			Median	0.24	1.37	1.88	1.04	1.62	0.09	1.50
			Maximum	0.35	1.77	3.18	1.96	2.22	0.13	1.77

Notes:
Measurements are in picocuries per gram
Results in bold are non-detects
[a] - depth in feet below ground surface
pCI/g - picocuries per gram
ND - Not detected at MDC
MDC - Minimum Detectable Concentration

Table 3-7
Exposure Parameters for Wildlife Receptors
Screening-Level Ecological Risk Assessment
Arimetco Facilities OU, Yerington, Nevada

	Exposure Factors									Feeding Habits and Foraging Range						
	Body Weight			Ingestion rate - food dry wt.			Ingestion rate - water			Biotic Dietary Items (% Diet)				Abiotic Media Ingestion (% diet)		
Species	Mean (kg)	Notes	Reference	Mean (kg/kg BW-d)	Notes	Reference	L/kg bw -d	Notes	Reference	Plants	Terrestrial Invertebrates	Mammals	Reference	Soil	Notes	Reference
Birds																
Chukar	Male: 0.619 Female: 0.537 Mean: 0.578	Values for female birds from New Mexico	Dunning 1993	0.04	Estimated using allometric estimation for galliforms and a body weight of 0.578 kg.	Nagy 2001	0.07	Estimated using allometric equation for birds and a body weight of 0.578 kg	Calder and Braun 1983	100	0	0	Assumed	9.3	Data not available for chukar. Value represents wild turkey.	Beyer et al. 1994
Killdeer	Male: 0.092 Female: 0.101 Mean: 0.097	Values for birds from Great Plains, USA	Dunning 1993	0.18	Estimated using allometric estimation for charadriiforms and a body weight of 0.097 kg.	Nagy 2001	0.13	Estimated using allometric equation for birds and a body weight of 0.097 kg	Calder and Braun 1983	0	100	0	Assumed	16.5	Data not available for killdeer. Value represents mean for five other charadriiform birds.	Beyer et al. 1994
Mallard	Both: 1.082	Values for birds from Britain	Dunning 1993	0.05	Estimated using allometric estimation for omnivorous birds and a body weight of 1.082 kg.	Nagy 2001	0.22	estimated using allometric equation for birds and a body weight of 0.0187 kg	Calder and Braun 1984	50	50	0	Assumed	3.3		Beyer et al. 1994
American Kestrel	Male: 0.111 Female: 0.120 Mean: 0.116	Values for birds from California	Dunning 1993	0.17	Estimated using allometric estimation for carnivorous birds and a body weight of 0.116 kg.	Nagy 2001	0.12	estimated using allometric equation for birds and a body weight of 0.116kg	Calder and Braun 1983	0	0	100	Assumed	2	Minimum soil ingestion assumed.	adapted from Beyer et al. 1994
Mammals																
Pocket Gopher	Male: 0.162 Female: 0.136 Mean: 0.149	Values reported for New Mexico	USACHPPM 2004	0.13	measured for free-ranging gophers in summer	CHPPM 2004	0.00	All water obtained from diet	CHPPM 2004	100	0	0	Assumed	5.2	Data not available for pocket gopher. Assumed to be similar to black-tailed (7.7%) and white-tailed (2.7%) prairie dogs.	adapted from Beyer et al. 1994
Merriam's Shrew	Both: 0.0059		Armstrong and Jones 1971	0.19	Estimated using allometric estimation for insectivorous mammals and a body weight of 0.0059 kg.	Nagy 2001	0.17	estimated using allometric equation for mammals and a body weight of 0.0059 kg	Calder and Braun 1984	0	100	0	Assumed	3	Data not available for Merriam's shrew. Assumed to be similar to short-tailed shrew. This is the 90th percentile value.	EPA 2007a (EcoSSLs)
Kit Fox	Male: 2.4 Female: 2.1 Mean: 2.25	Values reported for California	USACHPPM 2004	0.09	Measured for captive foxes	CHPPM 2004	0.00	All water obtained from diet	CHPPM 2004	0	0	100	Assumed	2.8	Data not available for kit fox. Assumed to be similar to red fox.	adapted from Beyer et al. 1994

Table 3-8

Summary of Bioaccumulation Models for Uptake from Soil to Plants

Screening-Level Ecological Risk Assessment

Arimetco Facilities OU, Yerington, Nevada

	Regression Models [a]				Bioaccumulation Factors		
Analyte	**B0**	**B1**	**Source**	**Notes**	**Plant BAF**	**Source**	**Notes**
Aluminum					**0.005**	Bechtel-Jacobs 1998	90th percentile - Table D-1 validation data
Mercury	**-0.996**	**0.544**	Bechtel Jacobs 1998	Single variable regression			
Molybdenum					**4.4177**	USACHPPM 2004	90th percentile - Table 4-6 leaf tissue
Thallium					**0.004**	ORNL RAIS 2005	

Notes:

[a] Regression models are in the form of LN(plant concentration) = B0 + B1(LN (soil concentration))

BAF = Bioaccumulation Factor

Table 3-9

Summary of Bioaccumulation Models for Uptake from Soil to Terrestrial Invertebrates

Screening-Level Ecological Risk Assessment

Arimetco Facilities OU, Yerington, Nevada

	Regression Models [a]				Bioaccumulation Factors		
Analyte	**B0**	**B1**	**Invertebrate Regression Reference**	**Notes**	**Invertebrate BAF**	**Source**	**Notes**
Aluminum					**0.118**	Sample et al. 1998a	90th percentile - Table C.1
Mercury	**0.0781**	**0.3369**	Sample et al. 1998a	General regression, not including validation data	2	USACHPPM 2004	90th percentile - Table 4-5 (Insecta)
Molybdenum					**2.091**	Sample et al. 1998a	90th percentile - Table C.1
Thallium					**0.256**	USACHPPM 2004	90th percentile - Table 4-5 (Insecta)

Notes:

[a] Regression models are in the form of LN(invertebrate concentration) = B0 + B1(LN (soil concentration))

BAF = Bioaccumulation Factor

Table 3-10

Summary of Bioaccumulation Models for Uptake from Soil to Small Mammals

Screening-level Ecological Risk Assessment

Arimetco Facilities OU, Yerington, Nevada

	Bioaccumulation Factors		
Analyte	**Mammal BAF**	**Source**	**Notes**
Aluminum	**0.0732**	Sample et al. 1998b	90th percentile (general) - Table C.1
Mercury	**0.1920**	Sample et al. 1998b	90th percentile (general) - Table C.1
Molybdenum	**1**	Default value	
Thallium	**0.1227**	Sample et al. 1998b	90th percentile general

Notes

BAF = Bioaccumulation Factor

Table 4-1
Ecological Screening Results for Metals and Radionuclides in HLP Materials
Arimetco Facilities OU, Yerington, Nevada

						Soil Screening Levels (mg/kg)				Soil BCGs (pCi/g)		Screening-level Hazard Quotients					
Analyte	Number of detects	Number of samples	Minimum	Median	Maximum	Plant	Invert	Bird	Mammal	Terrestrial Plant	Terrestrial Animal	Plants	Invert	Bird	Mammal	Terrestrial Plant	Terrestrial Animal
Metals (mg/kg)																	
Aluminum	49	49	1970	7380	27100	50						542.00					
Antimony	46	49	0.43	0.94	3.6	5	78		0.27			0.72	0.05		13.33		
Arsenic	49	49	4.7	11.1	119	18	60	43	46			6.61	1.98	2.77	2.59		
Barium	49	49	37.7	73.35	283	500	330		2000			0.57	0.86		0.14		
Beryllium	49	49	0.06	0.275	2.6	10	40		21			0.26	0.07		0.12		
Cadmium	2	49	0.5	0.52	0.96	32	140	0.77	0.36			0.03	0.01	1.25	2.67		
Chromium (assumed 3+)	49	49	2.8	5.05	24.2			26	34					0.93	0.71		
Chromium (assumed 6+)	49	49	2.8	5.05	24.2				81						0.30		
Chromium (total)	49	49	2.8	5.05	24.2	1	0.4					24.20	60.50				
Cobalt	42	49	2	10.6	69	13		120	230			5.31		0.58	0.30		
Copper	49	49	559	2045	22100	70	80	28	49			315.71	276.25	789.29	451.02		
Lead	49	49	3.8	6.75	271	120	1700	11	56			2.26	0.16	24.64	4.84		
Manganese	48	49	0.43	0.94	3.6	220	450	4300	4000			0.02	0.01	0.00	0.00		
Mercury	49	49	4.7	11.1	119	0.3	0.1					396.67	1190.00				
Molybdenum	49	49	37.7	73.35	283	2						141.50					
Nickel	49	49	0.06	0.275	2.6	38	280	210	130			0.07	0.01	0.01	0.02		
Selenium	47	49	3.8	5.5	83.3	0.52	4.1	1.2	0.63			160.19	20.32	69.42	132.22		
Silver	42	49	0.12	0.74	1.9	560		4.2	14			0.00		0.45	0.14		
Thallium	44	49	0.75	1.1	6.6	1						6.60					
Vanadium	49	49	8.5	17.95	27	2		7.8	280			13.50		3.46	0.10		
Zinc	49	49	10.8	16.35	108	160	120	46	79			0.68	0.90	2.35	1.37		
Radionuclides (pCi/g)																	
Thorium 227	10	16	0.136	0.235	0.354												
Thorium 228	16	16	1.04	1.37	1.77					6420	530					2.8E-04	3.3E-03
Thorium 230	16	16	0.986	1.88	3.18					175000	9980					1.8E-05	3.2E-04
Thorium 232	16	16	0.8	1.035	1.96					23500	1510					8.3E-05	1.3E-03
Uranium 234	16	16	0.849	1.615	2.22					51600	5130					4.3E-05	4.3E-04
Uranium 235	14	16	0.0471	0.0923	0.134					27400	2770					4.9E-06	4.8E-05
Uranium 238	16	16	0.727	1.5	1.77					15700	1580					1.1E-04	1.1E-03
															Sum	0.00053793	0.00655765

Notes:

Shaded cells indicate HQ≥1

Table 4-2

Summary of Screening-level Point-by-Point Evaluation of HLP Near-surface Material for Plants

Arimetco Facilities OU, Yerington, Nevada

Concentrations (mg/kg) of Analytes Retained for Plants

Location	Sample ID	Sample Date	Aluminum	Arsenic	Chromium	Cobalt	Copper	Lead	Mercury	Molybdenum	Selenium	Thallium	Vanadium
Plant Screening Values			50	18	1	13	70	120	0.3	2	0.52	1	2
PHASE I/II HLP	H12SS01	23-Oct-07	7860	22.6	2.8	5.8	2,830	6.1	22.6	68.3	3.8	0.99	23.8
PHASE I/II HLP	H12SS01 (FD)	23-Oct-07	11000	26	5	4.7	2100	5.8	26	81	3.6	**10**	30
PHASE I/II HLP	H12SS02	23-Oct-07	7760	21.4	2.5	7.3	1,450	3.9	21.4	74.7	3.7	0.7	14.1
PHASE I/II HLP	H12SS03	23-Oct-07	5440	9.1	3.3	3.2	1,100	4.2	9.1	60.6	3.8	0.43	12.1
PHASE I/II HLP	H12SS04	23-Oct-07	5770	12.5	2.1	2.9	1,040	7	12.5	73	4.1	0.92	23.2
PHASE III 4X HLP	H3XSS01	25-Oct-07	11800	12	19.1	12.3	3,090	3.4	12	81.4	3.5	0.52	50.3
PHASE III 4X HLP	H3XSS02	25-Oct-07	11500	24.8	5.1	9.1	8,060	6	24.8	105	5.2	1	38.1
PHASE III 4X HLP	H3XSS03	25-Oct-07	7600	7.8	7.7	5.2	520	5.5	7.8	60.4	3.1	0.82	18.9
PHASE III 4X HLP	H3XSS04	25-Oct-07	5850	6.8	3.9	3.5	540	6.5	6.8	44.1	5.5	0.7	19.1
PHASE III 4X HLP	H3XSS05	25-Oct-07	4950	13	4.5	4	655	6.7	13	65.7	2.9	0.74	18.5
PHASE III 4X HLP	H3XSS06	25-Oct-07	13700	19.4	11	13.3	1,080	53.2	19.4	110	9.5	1.2	18.8
PHASE III 4X HLP	H3XSS07	25-Oct-07	6810	9.3	4.9	4.6	539	7.9	9.3	70.8	3.9	0.75	17.6
PHASE III 4X HLP	H3XSS08	25-Oct-07	7690	7.7	4.5	5.1	585	4.9	7.7	60.4	6.1	0.82	22.7
PHASE III 4X HLP	H3XSS08 (FD)	25-Oct-07	8800	8.5	6	4.2	480	4.5	8.5	58	5.4	**10**	30
PHASE III SOUTH HLP	H3SSS01	24-Oct-07	7680	9.8	3.9	6.2	1,420	4.6	9.8	71.5	4.3	0.99	20.8
PHASE III SOUTH HLP	H3SSS02	25-Oct-07	7390	18.4	4.8	5.5	1,670	5.5	18.4	76.9	3.5	0.99	27.4
PHASE III SOUTH HLP	H3SSS03	25-Oct-07	12700	14.8	2.7	9.3	6,060	4.3	14.8	57.3	3.7	0.89	32
PHASE III SOUTH HLP	H3SSS04	25-Oct-07	3890	2.6	5.3	2.6	207	1.8	2.6	40.5	1.6	0.81	25.5
PHASE III SOUTH HLP	H3SSS04 (FD)	25-Oct-07	4500	2.4	7.1	2.3	200	1.7	2.4	39	1.3	**10**	27
PHASE III SOUTH HLP	H3SSS05	24-Oct-07	6960	11.3	5.3	2.6	990	5.7	11.3	52.7	4.6	1.2	19.9
PHASE III SOUTH HLP	H3SSS06	25-Oct-07	5580	11.4	3.5	2.6	518	6.7	11.4	72.3	2.3	0.62	18
PHASE III SOUTH HLP	H3SSS07	24-Oct-07	8640	10.6	2.4	8	1,960	5.7	10.6	45.2	3.4	0.91	15.2
PHASE III SOUTH HLP	H3SSS08	24-Oct-07	7080	11.6	3.3	1.9	1,300	3.2	11.6	124	6.3	1.4	24.3
PHASE IV SLOT HLP	H4SSS01	24-Oct-07	6920	8.7	4.6	**3.6**	543	3.6	8.7	47.1	5.2	0.68	18.9
PHASE IV SLOT HLP	H4SSS02	23-Oct-07	8560	10.2	4.9	6.9	973	5.8	10.2	62.8	4.9	0.9	17.8
PHASE IV SLOT HLP	H4SSS03	23-Oct-07	7990	9.1	6.2	6.2	594	8.1	9.1	47.1	4.9	0.68	19.8
PHASE IV SLOT HLP	H4SSS04	23-Oct-07	7750	15.3	5.5	6.1	1030	16.4	15.3	45.6	6.9	0.6	20.7
PHASE IV SLOT HLP	H4SSS05	23-Oct-07	5990	12	2.3	**2.8**	668	20.4	12	54.3	4.8	0.76	13.1
PHASE IV SLOT HLP	H4SSS06	24-Oct-07	12500	31.6	7.6	5.6	3690	8.2	31.6	106	5	1.1	46.8
PHASE IV SLOT HLP	H4SSS06 (FD)	24-Oct-07	14000	28	9.7	5.9	3600	7.6	28	120	4.6	**10**	53
PHASE IV SLOT HLP	H4SSS07	24-Oct-07	8480	12.8	4.2	**4.4**	1320	7.1	12.8	87.9	4.6	1	21.1
PHASE IV SLOT HLP	H4SSS08	24-Oct-07	7430	17.1	2.9	**4.7**	909	9.3	17.1	72.6	5.2	0.97	23.6
PHASE IV SLOT HLP	H4SSS09	24-Oct-07	7410	13.5	6.6	**4.5**	614	6.2	13.5	86.2	3.9	0.95	19.7
PHASE IV SLOT HLP	H4SSS10	24-Oct-07	11100	22.5	3.9	23.2	7360	5	22.5	221	**2.2**	0.85	33.9
PHASE IV VLT HLP	H4VSS01	26-Oct-07	13700	9.4	5.1	51.6	10400	5.5	9.4	39.7	6.1	0.78	16.3
PHASE IV VLT HLP	H4VSS01 (FD)	26-Oct-07	8200	8.4	5.6	5.1	1000	5.7	8.4	49	5.1	**10**	21
PHASE IV VLT HLP	H4VSS02	26-Oct-07	11300	8.3	10.3	8.3	1230	5.3	8.3	83.1	3.9	1	25
PHASE IV VLT HLP	H4VSS03	26-Oct-07	6440	6	4.4	8.3	643	6.7	6	31.5	**3.3**	0.54	10.8
PHASE IV VLT HLP	H4VSS04	26-Oct-07	11600	11.5	9.5	19.1	1620	6.4	11.5	46.7	5.6	1.3	15
PHASE IV VLT HLP	H4VSS05	26-Oct-07	8690	13.9	4.5	**4.8**	824	6.5	13.9	90.4	4.7	1	22.4
PHASE IV VLT HLP	H4VSS06	26-Oct-07	7260	8.7	3.7	6.1	703	4.5	8.7	47.3	4.5	0.75	18.1
PHASE IV VLT HLP	H4VSS07	26-Oct-07	10700	9.1	5.6	15.1	896	5.8	9.1	68	4.7	1	18
PHASE IV VLT HLP	H4VSS08	26-Oct-07	8230	7.8	6.4	19.4	2840	3.8	7.8	74.8	3.8	0.77	27
PHASE IV VLT HLP	H4VSS09	26-Oct-07	6970	8.1	2.8	**4.9**	559	7	8.1	75.8	5.7	1.2	17.9
PHASE IV VLT HLP	H4VSS10	26-Oct-07	27100	13.6	24.2	69	6920	23.3	13.6	71.9	5.3	2.5	9.7
VLT SOIL	CAPSS01	29-Oct-07	4910	4.7	3	24.6	10600	4	4.7	37.7	6.6	0.86	10.2
VLT SOIL	CAPSS02	26-Oct-07	6280	119	12.7	21	1250	48.5	119	283	83.3	6.6	21.7
VLT SOIL	CAPSS03	29-Oct-07	1970	13.1	2.8	2	6260	271	13.1	104	13.8	2	8.5
VLT SOIL	CAPSS04	29-Oct-07	7500	29.3	15.6	4.8	22100	39.1	29.3	58.8	9.2	1.2	17.9

HQs for Analytes Retained for Plants

Location	Sample ID	Aluminum	Arsenic	Chromium	Cobalt	Copper	Lead	Mercury	Molybdenum	Selenium	Thallium	Vanadium
PHASE I/II HLP	H12SS01	157.20	1.26	2.80	0.45	40.43	0.05	75.33	34.15	7.31	0.99	11.90
PHASE I/II HLP	H12SS01 (FD)	220.00	1.44	5.00	0.36	30.00	0.05	86.67	40.50	6.92	10.00	15.00
PHASE I/II HLP	H12SS02	155.20	1.19	2.50	0.56	20.71	0.03	71.33	37.35	7.12	0.70	7.05
PHASE I/II HLP	H12SS03	108.80	0.51	3.30	0.25	15.71	0.04	30.33	30.30	7.31	0.43	6.05
PHASE I/II HLP	H12SS04	115.40	0.69	2.10	0.22	14.86	0.06	41.67	36.50	7.88	0.92	11.60
PHASE III 4X HLP	H3XSS01	236.00	0.67	19.10	0.95	44.14	0.03	40.00	40.70	6.73	0.52	25.15
PHASE III 4X HLP	H3XSS02	230.00	1.38	5.10	0.70	115.14	0.05	82.67	52.50	10.00	1.00	19.05
PHASE III 4X HLP	H3XSS03	152.00	0.43	7.70	0.40	7.43	0.05	26.00	30.20	5.96	0.82	9.45
PHASE III 4X HLP	H3XSS04	117.00	0.38	3.90	0.27	7.71	0.05	22.67	22.05	10.58	0.70	9.55
PHASE III 4X HLP	H3XSS05	99.00	0.72	4.50	0.31	9.36	0.06	43.33	32.85	5.58	0.74	9.25
PHASE III 4X HLP	H3XSS06	274.00	1.08	11.00	1.02	15.43	0.44	64.67	55.00	18.27	1.20	9.40
PHASE III 4X HLP	H3XSS07	136.20	0.52	4.90	0.35	7.70	0.07	31.00	35.40	7.50	0.75	8.80
PHASE III 4X HLP	H3XSS08	153.80	0.43	4.50	0.39	8.36	0.04	25.67	30.20	11.73	0.82	11.35
PHASE III 4X HLP	H3XSS08 (FD)	176.00	0.47	6.00	0.32	6.86	0.04	28.33	29.00	10.38	10.00	15.00
PHASE III SOUTH HLP	H3SSS01	153.60	0.54	3.90	0.48	20.29	0.04	32.67	35.75	8.27	0.99	10.40
PHASE III SOUTH HLP	H3SSS02	147.80	1.02	4.80	0.42	23.86	0.05	61.33	38.45	6.73	0.99	13.70
PHASE III SOUTH HLP	H3SSS03	254.00	0.82	2.70	0.72	86.57	0.04	49.33	28.65	7.12	0.89	16.00
PHASE III SOUTH HLP	H3SSS04	77.80	0.14	5.30	0.20	2.96	0.02	8.67	20.25	3.08	0.81	12.75
PHASE III SOUTH HLP	H3SSS04 (FD)	90.00	0.13	7.10	0.18	2.86	0.01	8.00	19.50	2.50	10.00	13.50
PHASE III SOUTH HLP	H3SSS05	139.20	0.63	5.30	0.20	14.14	0.05	37.67	26.35	8.85	1.20	9.95
PHASE III SOUTH HLP	H3SSS06	111.60	0.63	3.50	0.20	7.40	0.06	38.00	36.15	4.42	0.62	9.00
PHASE III SOUTH HLP	H3SSS07	172.80	0.59	2.40	0.62	28.00	0.05	35.33	22.60	6.54	0.91	7.60
PHASE III SOUTH HLP	H3SSS08	141.60	0.64	3.30	0.15	18.57	0.03	38.67	62.00	12.12	1.40	12.15
PHASE IV SLOT HLP	H4SSS01	138.40	0.48	4.60	0.28	7.76	0.03	29.00	23.55	10.00	0.68	9.45
PHASE IV SLOT HLP	H4SSS02	171.20	0.57	4.90	0.53	13.90	0.05	34.00	31.40	9.42	0.90	8.90
PHASE IV SLOT HLP	H4SSS03	159.80	0.51	6.20	0.48	8.49	0.07	30.33	23.55	9.42	0.68	9.90
PHASE IV SLOT HLP	H4SSS04	155.00	0.85	5.50	0.47	14.71	0.14	51.00	22.80	13.27	0.60	10.35
PHASE IV SLOT HLP	H4SSS05	119.80	0.67	2.30	0.22	9.54	0.17	40.00	27.15	9.23	0.76	6.55
PHASE IV SLOT HLP	H4SSS06	250.00	1.76	7.60	0.43	52.71	0.07	105.33	53.00	9.62	1.10	23.40
PHASE IV SLOT HLP	H4SSS06 (FD)	280.00	1.56	9.70	0.45	51.43	0.06	93.33	60.00	8.85	10.00	26.50
PHASE IV SLOT HLP	H4SSS07	169.60	0.71	4.20	0.34	18.86	0.06	42.67	43.95	8.85	1.00	10.55
PHASE IV SLOT HLP	H4SSS08	148.60	0.95	2.90	0.36	12.99	0.08	57.00	36.30	10.00	0.97	11.80
PHASE IV SLOT HLP	H4SSS09	148.20	0.75	6.60	0.35	8.77	0.05	45.00	43.10	7.50	0.95	9.85
PHASE IV SLOT HLP	H4SSS10	222.00	1.25	3.90	1.78	105.14	0.04	75.00	110.50	4.23	0.85	16.95
PHASE IV VLT HLP	H4VSS01	274.00	0.52	5.10	3.97	148.57	0.05	31.33	19.85	11.73	0.78	8.15
PHASE IV VLT HLP	H4VSS01 (FD)	164.00	0.47	5.60	0.39	14.29	0.05	28.00	24.50	9.81	10.00	10.50
PHASE IV VLT HLP	H4VSS02	226.00	0.46	10.30	0.64	17.57	0.04	27.67	41.55	7.50	1.00	12.50
PHASE IV VLT HLP	H4VSS03	128.80	0.33	4.40	0.64	9.19	0.06	20.00	15.75	6.35	0.54	5.40
PHASE IV VLT HLP	H4VSS04	232.00	0.64	9.50	1.47	23.14	0.05	38.33	23.35	10.77	1.30	7.50
PHASE IV VLT HLP	H4VSS05	173.80	0.77	4.50	0.37	11.77	0.05	46.33	45.20	9.04	1.00	11.20
PHASE IV VLT HLP	H4VSS06	145.20	0.48	3.70	0.47	10.04	0.04	29.00	23.65	8.65	0.75	9.05
PHASE IV VLT HLP	H4VSS07	214.00	0.51	5.60	1.16	12.80	0.05	30.33	34.00	9.04	1.00	9.00
PHASE IV VLT HLP	H4VSS08	164.60	0.43	6.40	1.49	40.57	0.03	26.00	37.40	7.31	0.77	13.50
PHASE IV VLT HLP	H4VSS09	139.40	0.45	2.80	0.38	7.99	0.06	27.00	37.90	10.96	1.20	8.95
PHASE IV VLT HLP	H4VSS10	542.00	0.76	24.20	5.31	98.86	0.19	45.33	35.95	10.19	2.50	4.85
VLT SOIL	CAPSS01	98.20	0.26	3.00	1.89	151.43	0.03	15.67	18.85	12.69	0.86	5.10
VLT SOIL	CAPSS02	125.60	6.61	12.70	1.62	17.86	0.40	396.67	141.50	160.19	6.60	10.85
VLT SOIL	CAPSS03	39.40	0.73	2.80	0.15	89.43	2.26	43.67	52.00	26.54	2.00	4.25
VLT SOIL	CAPSS04	150.00	1.63	15.60	0.37	315.71	0.33	97.67	29.40	17.69	1.20	8.95
Number of exceedances		49	11	49	9	49	1	49	49	49	20	49
Percent exceedances		100%	22%	100%	18%	100%	2%	100%	100%	100%	41%	100%
Max HQ		542.00	6.61	24.20	5.31	315.71	2.26	396.67	141.50	160.19	10.00	26.50

Notes:

Near surface = 0.25-0.75 foot

Shaded cells indicate exceedance of screening value

mg/kg - milligrams per kilogram

FD - Field Duplicate

Table 4-3
Summary of Screening-level Point-by-Point Evaluation of HLP Near-surface Material for Soil Invertebrates

Arimetco Facilities OU, Yerington, Nevada

Location	Sample ID	Sample Date	Concentrations (mg/kg) of Analytes Retained for Soil Invertebrates					Screening-level HQs for Analytes Retained for Soil Invertebrates				
			Arsenic	Chromium	Copper	Mercury	Selenium	Arsenic	Chromium	Copper	Mercury	Selenium
Invertebrate Screening Values			60	0.4	80	0.1	4.1					
PHASE I/II HLP	H12SS01	23-Oct-07	22.6	2.8	2,830	22.6	3.8	0.38	7.00	35.38	226.00	0.93
PHASE I/II HLP	H12SS01 (FD)	23-Oct-07	26	5	2100	26	3.6	0.43	12.50	26.25	260.00	0.88
PHASE I/II HLP	H12SS02	23-Oct-07	21.4	2.5	1,450	21.4	3.7	0.36	6.25	18.13	214.00	0.90
PHASE I/II HLP	H12SS03	23-Oct-07	9.1	3.3	1,100	9.1	3.8	0.15	8.25	13.75	91.00	0.93
PHASE I/II HLP	H12SS04	23-Oct-07	12.5	2.1	1,040	12.5	4.1	0.21	5.25	13.00	125.00	1.00
PHASE III 4X HLP	H3XSS01	25-Oct-07	12	19.1	3,090	12	3.5	0.20	47.75	38.63	120.00	0.85
PHASE III 4X HLP	H3XSS02	25-Oct-07	24.8	5.1	8,060	24.8	5.2	0.41	12.75	100.75	248.00	1.27
PHASE III 4X HLP	H3XSS03	25-Oct-07	7.8	7.7	520	7.8	3.1	0.13	19.25	6.50	78.00	0.76
PHASE III 4X HLP	H3XSS04	25-Oct-07	6.8	3.9	540	6.8	5.5	0.11	9.75	6.75	68.00	1.34
PHASE III 4X HLP	H3XSS05	25-Oct-07	13	4.5	655	13	2.9	0.22	11.25	8.19	130.00	0.71
PHASE III 4X HLP	H3XSS06	25-Oct-07	19.4	11	1,080	19.4	9.5	0.32	27.50	13.50	194.00	2.32
PHASE III 4X HLP	H3XSS07	25-Oct-07	9.3	4.9	539	9.3	3.9	0.16	12.25	6.74	93.00	0.95
PHASE III 4X HLP	H3XSS08	25-Oct-07	7.7	4.5	585	7.7	6.1	0.13	11.25	7.31	77.00	1.49
PHASE III 4X HLP	H3XSS08 (FD)	25-Oct-07	8.5	6	480	8.5	5.4	0.14	15.00	6.00	85.00	1.32
PHASE III SOUTH HLP	H3SSS01	24-Oct-07	9.8	3.9	1,420	9.8	4.3	0.16	9.75	17.75	98.00	1.05
PHASE III SOUTH HLP	H3SSS02	25-Oct-07	18.4	4.8	1,670	18.4	3.5	0.31	12.00	20.88	184.00	0.85
PHASE III SOUTH HLP	H3SSS03	25-Oct-07	14.8	2.7	6,060	14.8	3.7	0.25	6.75	75.75	148.00	0.90
PHASE III SOUTH HLP	H3SSS04	25-Oct-07	2.6	5.3	207	2.6	1.6	0.04	13.25	2.59	26.00	0.39
PHASE III SOUTH HLP	H3SSS04 (FD)	25-Oct-07	2.4	7.1	200	2.4	1.3	0.04	17.75	2.50	24.00	0.32
PHASE III SOUTH HLP	H3SSS05	24-Oct-07	11.3	5.3	990	11.3	4.6	0.19	13.25	12.38	113.00	1.12
PHASE III SOUTH HLP	H3SSS06	25-Oct-07	11.4	3.5	518	11.4	2.3	0.19	8.75	6.48	114.00	0.56
PHASE III SOUTH HLP	H3SSS07	24-Oct-07	10.6	2.4	1,960	10.6	3.4	0.18	6.00	24.50	106.00	0.83
PHASE III SOUTH HLP	H3SSS08	24-Oct-07	11.6	3.3	1,300	11.6	6.3	0.19	8.25	16.25	116.00	1.54
PHASE IV SLOT HLP	H4SSS01	24-Oct-07	8.7	4.6	543	8.7	5.2	0.15	11.50	6.79	87.00	1.27
PHASE IV SLOT HLP	H4SSS02	23-Oct-07	10.2	4.9	973	10.2	4.9	0.17	12.25	12.16	102.00	1.20
PHASE IV SLOT HLP	H4SSS03	23-Oct-07	9.1	6.2	594	9.1	4.9	0.15	15.50	7.43	91.00	1.20
PHASE IV SLOT HLP	H4SSS04	23-Oct-07	15.3	5.5	1030	15.3	6.9	0.26	13.75	12.88	153.00	1.68
PHASE IV SLOT HLP	H4SSS05	23-Oct-07	12	2.3	668	12	4.8	0.20	5.75	8.35	120.00	1.17
PHASE IV SLOT HLP	H4SSS06	24-Oct-07	31.6	7.6	3690	31.6	5	0.53	19.00	46.13	316.00	1.22
PHASE IV SLOT HLP	H4SSS06 (FD)	24-Oct-07	28	9.7	3600	28	4.6	0.47	24.25	45.00	280.00	1.12
PHASE IV SLOT HLP	H4SSS07	24-Oct-07	12.8	4.2	1320	12.8	4.6	0.21	10.50	16.50	128.00	1.12
PHASE IV SLOT HLP	H4SSS08	24-Oct-07	17.1	2.9	909	17.1	5.2	0.29	7.25	11.36	171.00	1.27
PHASE IV SLOT HLP	H4SSS09	24-Oct-07	13.5	6.6	614	13.5	3.9	0.23	16.50	7.68	135.00	0.95
PHASE IV SLOT HLP	H4SSS10	24-Oct-07	22.5	3.9	7360	22.5	**2.2**	0.38	9.75	92.00	225.00	0.54
PHASE IV VLT HLP	H4VSS01	26-Oct-07	9.4	5.1	10400	9.4	6.1	0.16	12.75	130.00	94.00	1.49
PHASE IV VLT HLP	H4VSS01 (FD)	26-Oct-07	8.4	5.6	1000	8.4	5.1	0.14	14.00	12.50	84.00	1.24
PHASE IV VLT HLP	H4VSS02	26-Oct-07	8.3	10.3	1230	8.3	3.9	0.14	25.75	15.38	83.00	0.95
PHASE IV VLT HLP	H4VSS03	26-Oct-07	6	4.4	643	6	**3.3**	0.10	11.00	8.04	60.00	0.80
PHASE IV VLT HLP	H4VSS04	26-Oct-07	11.5	9.5	1620	11.5	5.6	0.19	23.75	20.25	115.00	1.37
PHASE IV VLT HLP	H4VSS05	26-Oct-07	13.9	4.5	824	13.9	4.7	0.23	11.25	10.30	139.00	1.15
PHASE IV VLT HLP	H4VSS06	26-Oct-07	8.7	3.7	703	8.7	4.5	0.15	9.25	8.79	87.00	1.10
PHASE IV VLT HLP	H4VSS07	26-Oct-07	9.1	5.6	896	9.1	4.7	0.15	14.00	11.20	91.00	1.15
PHASE IV VLT HLP	H4VSS08	26-Oct-07	7.8	6.4	2840	7.8	3.8	0.13	16.00	35.50	78.00	0.93
PHASE IV VLT HLP	H4VSS09	26-Oct-07	8.1	2.8	559	8.1	5.7	0.14	7.00	6.99	81.00	1.39
PHASE IV VLT HLP	H4VSS10	26-Oct-07	13.6	24.2	6920	13.6	5.3	0.23	60.50	86.50	136.00	1.29
VLT SOIL	CAPSS01	29-Oct-07	4.7	3	10600	4.7	6.6	0.08	7.50	132.50	47.00	1.61
VLT SOIL	CAPSS02	26-Oct-07	119	12.7	1250	119	83.3	1.98	31.75	15.63	1190.00	20.32
VLT SOIL	CAPSS03	29-Oct-07	13.1	2.8	6260	13.1	13.8	0.22	7.00	78.25	131.00	3.37
VLT SOIL	CAPSS04	29-Oct-07	29.3	15.6	22100	29.3	9.2	0.49	39.00	276.25	293.00	2.24
					Number of exceedances			1	49	49	49	30
					Frequency of exceedances			2%	100%	100%	100%	61%
					max HQ			1.98	60.50	276.25	1190.00	20.32

Notes:
Near surface = 0.25-0.75 foot
Shaded cells indicate exceedance of screening value
mg/kg - milligrams per kilogram
FD - Field Duplicate

Table 4-4

Summary of Screening-level Point-by-Point Evaluation of HLP Near-surface Material for Birds

Arimetco Facilities OU, Yerington, Nevada

Location	Sample ID	Sample Date	Concentrations (mg/kg) of Analytes Retained for Birds							Screening-level HQs for Analytes Retained for Birds						
			Arsenic	Cadmium	Copper	Lead	Selenium	Vanadium	Zinc	Arsenic	Cadmium	Copper	Lead	Selenium	Vanadium	Zinc
Avian Screening Values			**43**	**0.77**	**28**	**11**	**1.2**	**7.8**	**46**							
PHASE I/II HLP	H12SS01	23-Oct-07	22.6	**0.52**	2,830	6.1	3.8	23.8	13.5	0.53	0.68	101.07	0.55	3.17	3.05	0.29
PHASE I/II HLP	H12SS01 (FD)	23-Oct-07	26	**1**	2100	5.8	3.6	30	12	0.60	1.30	75.00	0.53	3.00	3.85	0.26
PHASE I/II HLP	H12SS02	23-Oct-07	21.4	**0.53**	1,450	3.9	3.7	14.1	13	0.50	0.69	51.79	0.35	3.08	1.81	0.28
PHASE I/II HLP	H12SS03	23-Oct-07	9.1	**0.51**	1,100	4.2	3.8	12.1	7.3	0.21	0.66	39.29	0.38	3.17	1.55	0.16
PHASE I/II HLP	H12SS04	23-Oct-07	12.5	**0.54**	1,040	7	4.1	23.2	8.7	0.29	0.70	37.14	0.64	3.42	2.97	0.19
PHASE III 4X HLP	H3XSS01	25-Oct-07	12	**0.51**	3,090	3.4	3.5	50.3	12.2	0.28	0.66	110.36	0.31	2.92	6.45	0.27
PHASE III 4X HLP	H3XSS02	25-Oct-07	24.8	**0.51**	8,060	6	5.2	38.1	24.2	0.58	0.66	287.86	0.55	4.33	4.88	0.53
PHASE III 4X HLP	H3XSS03	25-Oct-07	7.8	**0.52**	520	5.5	3.1	18.9	13.2	0.18	0.68	18.57	0.50	2.58	2.42	0.29
PHASE III 4X HLP	H3XSS04	25-Oct-07	6.8	**0.51**	540	6.5	5.5	19.1	9.3	0.16	0.66	19.29	0.59	4.58	2.45	0.20
PHASE III 4X HLP	H3XSS05	25-Oct-07	13	**0.52**	655	6.7	2.9	18.5	8.3	0.30	0.68	23.39	0.61	2.42	2.37	0.18
PHASE III 4X HLP	H3XSS06	25-Oct-07	19.4	**0.67**	1,080	53.2	9.5	18.8	23.5	0.45	0.87	38.57	4.84	7.92	2.41	0.51
PHASE III 4X HLP	H3XSS07	25-Oct-07	9.3	**0.52**	539	7.9	3.9	17.6	12.2	0.22	0.68	19.25	0.72	3.25	2.26	0.27
PHASE III 4X HLP	H3XSS08	25-Oct-07	7.7	**0.53**	585	4.9	6.1	22.7	14.5	0.18	0.69	20.89	0.45	5.08	2.91	0.32
PHASE III 4X HLP	H3XSS08 (FD)	25-Oct-07	8.5	**1**	480	4.5	5.4	30	14	0.20	1.30	17.14	0.41	4.50	3.85	0.30
PHASE III SOUTH HLP	H3SSS01	24-Oct-07	9.8	**0.53**	1,420	4.6	4.3	20.8	14.6	0.23	0.69	50.71	0.42	3.58	2.67	0.32
PHASE III SOUTH HLP	H3SSS02	25-Oct-07	18.4	**0.55**	1,670	5.5	3.5	27.4	13.4	0.43	0.71	59.64	0.50	2.92	3.51	0.29
PHASE III SOUTH HLP	H3SSS03	25-Oct-07	14.8	**0.51**	6,060	4.3	3.7	32	10.6	0.34	0.66	216.43	0.39	3.08	4.10	0.23
PHASE III SOUTH HLP	H3SSS04	25-Oct-07	2.6	**0.5**	207	1.8	1.6	25.5	11.4	0.06	0.65	7.39	0.16	1.33	3.27	0.25
PHASE III SOUTH HLP	H3SSS04 (FD)	25-Oct-07	2.4	**1**	200	1.7	1.3	27	11	0.06	1.30	7.14	0.15	1.08	3.46	0.24
PHASE III SOUTH HLP	H3SSS05	24-Oct-07	11.3	**0.55**	990	5.7	4.6	19.9	10.8	0.26	0.71	35.36	0.52	3.83	2.55	0.23
PHASE III SOUTH HLP	H3SSS06	25-Oct-07	11.4	**0.52**	518	6.7	2.3	18	13.1	0.27	0.68	18.50	0.61	1.92	2.31	0.28
PHASE III SOUTH HLP	H3SSS07	24-Oct-07	10.6	**0.53**	1,960	5.7	3.4	15.2	21.2	0.25	0.69	70.00	0.52	2.83	1.95	0.46
PHASE III SOUTH HLP	H3SSS08	24-Oct-07	11.6	**0.51**	1,300	3.2	6.3	24.3	10.9	0.27	0.66	46.43	0.29	5.25	3.12	0.24
PHASE IV SLOT HLP	H4SSS01	24-Oct-07	8.7	**0.53**	543	3.6	5.2	18.9	9.3	0.20	0.69	19.39	0.33	4.33	2.42	0.20
PHASE IV SLOT HLP	H4SSS02	23-Oct-07	10.2	**0.53**	973	5.8	4.9	17.8	13.4	0.24	0.69	34.75	0.53	4.08	2.28	0.29
PHASE IV SLOT HLP	H4SSS03	23-Oct-07	9.1	**0.52**	594	8.1	4.9	19.8	7.7	0.21	0.68	21.21	0.74	4.08	2.54	0.17
PHASE IV SLOT HLP	H4SSS04	23-Oct-07	15.3	**0.53**	1030	16.4	6.9	20.7	7.2	0.36	0.69	36.79	1.49	5.75	2.65	0.16
PHASE IV SLOT HLP	H4SSS05	23-Oct-07	12	**0.54**	668	20.4	4.8	13.1	8.6	0.28	0.70	23.86	1.85	4.00	1.68	0.19
PHASE IV SLOT HLP	H4SSS06	24-Oct-07	31.6	**0.52**	3690	8.2	5	46.8	22.4	0.73	0.68	131.79	0.75	4.17	6.00	0.49
PHASE IV SLOT HLP	H4SSS06 (FD)	24-Oct-07	28	**1**	3600	7.6	4.6	53	22	0.65	1.30	128.57	0.69	3.83	6.79	0.48
PHASE IV SLOT HLP	H4SSS07	24-Oct-07	12.8	**0.52**	1320	7.1	4.6	21.1	13.5	0.30	0.68	47.14	0.65	3.83	2.71	0.29
PHASE IV SLOT HLP	H4SSS08	24-Oct-07	17.1	**0.52**	909	9.3	5.2	23.6	10.6	0.40	0.68	32.46	0.85	4.33	3.03	0.23
PHASE IV SLOT HLP	H4SSS09	24-Oct-07	13.5	**0.54**	614	6.2	3.9	19.7	12.2	0.31	0.70	21.93	0.56	3.25	2.53	0.27
PHASE IV SLOT HLP	H4SSS10	24-Oct-07	22.5	**0.51**	7360	5	**2.2**	33.9	18.2	0.52	0.66	262.86	0.45	1.83	4.35	0.40
PHASE IV VLT HLP	H4VSS01	26-Oct-07	9.4	0.03	10400	5.5	6.1	16.3	62.5	0.22	0.04	371.43	0.50	5.08	2.09	1.36
PHASE IV VLT HLP	H4VSS01 (FD)	26-Oct-07	8.4	**1**	1000	5.7	5.1	21	16	0.20	1.30	35.71	0.52	4.25	2.69	0.35
PHASE IV VLT HLP	H4VSS02	26-Oct-07	8.3	**0.51**	1230	5.3	3.9	25	23.6	0.19	0.66	43.93	0.48	3.25	3.21	0.51
PHASE IV VLT HLP	H4VSS03	26-Oct-07	6	**0.54**	643	6.7	**3.3**	10.8	11.2	0.14	0.70	22.96	0.61	2.75	1.38	0.24
PHASE IV VLT HLP	H4VSS04	26-Oct-07	11.5	**0.55**	1620	6.4	5.6	15	20.8	0.27	0.71	57.86	0.58	4.67	1.92	0.45
PHASE IV VLT HLP	H4VSS05	26-Oct-07	13.9	**0.51**	824	6.5	4.7	22.4	15.9	0.32	0.66	29.43	0.59	3.92	2.87	0.35
PHASE IV VLT HLP	H4VSS06	26-Oct-07	8.7	**0.52**	703	4.5	4.5	18.1	10.8	0.20	0.68	25.11	0.41	3.75	2.32	0.23
PHASE IV VLT HLP	H4VSS07	26-Oct-07	9.1	**0.53**	896	5.8	4.7	18	26.2	0.21	0.69	32.00	0.53	3.92	2.31	0.57
PHASE IV VLT HLP	H4VSS08	26-Oct-07	7.8	**0.51**	2840	3.8	3.8	27	14	0.18	0.66	101.43	0.35	3.17	3.46	0.30
PHASE IV VLT HLP	H4VSS09	26-Oct-07	8.1	**0.53**	559	7	5.7	17.9	16.8	0.19	0.69	19.96	0.64	4.75	2.29	0.37
PHASE IV VLT HLP	H4VSS10	26-Oct-07	13.6	**0.73**	6920	23.3	5.3	9.7	72.6	0.32	0.95	247.14	2.12	4.42	1.24	1.58
VLT SOIL	CAPSS01	29-Oct-07	4.7	**0.5**	10600	4	6.6	10.2	20.5	0.11	0.65	378.57	0.36	5.50	1.31	0.45
VLT SOIL	CAPSS02	26-Oct-07	119	0.96	1250	48.5	83.3	21.7	108	2.77	1.25	44.64	4.41	69.42	2.78	2.35
VLT SOIL	CAPSS03	29-Oct-07	13.1	**0.52**	6260	271	13.8	8.5	13.2	0.30	0.68	223.57	24.64	11.50	1.09	0.29
VLT SOIL	CAPSS04	29-Oct-07	29.3	**0.51**	22100	39.1	9.2	17.9	11.1	0.68	0.66	789.29	3.55	7.67	2.29	0.24
									Number of exceedances	1	6	49	7	49	49	3
									Frequency of exceedances	2%	12%	100%	14%	100%	100%	6%
									max HQ	2.77	1.30	789.29	24.64	69.42	6.79	2.35

Notes:

Shaded cells indicate exceedance of screening value

Results in bold are non-detects

mg/kg - milligrams per kilogram

FD - Field Duplicate

Near surface = 0.25-0.75 foot

Table 4-5

Summary of Screening-level Point-by-Point Evaluation of HLP Near-surface Material for Mammals

Arimetco Facilities OU, Yerington, Nevada

Location	Sample ID	Sample Date	Concentrations (mg/kg) of Analytes Retained for Mammals							Screening-level HQs for Analytes Retained for Mammals						
			Antimony	Arsenic	Cadmium	Copper	Lead	Selenium	Zinc	Antimony	Arsenic	Cadmium	Copper	Lead	Selenium	Zinc
Mammalian Screening Values			**0.27**	**46**	**0.36**	**49**	**56**	**0.63**	**79**							
PHASE I/II HLP	H12SS01	23-Oct-07	1.3	22.6	**0.52**	2,830	6.1	3.8	13.5	4.81	0.49	1.44	57.76	0.11	6.03	0.17
PHASE I/II HLP	H12SS01 (FD)	23-Oct-07	1	26	**1**	2100	5.8	3.6	12	3.70	0.57	2.78	42.86	0.10	5.71	0.15
PHASE I/II HLP	H12SS02	23-Oct-07	1.1	21.4	**0.53**	1,450	3.9	3.7	13	4.07	0.47	1.47	29.59	0.07	5.87	0.16
PHASE I/II HLP	H12SS03	23-Oct-07	1.5	9.1	**0.51**	1,100	4.2	3.8	7.3	5.56	0.20	1.42	22.45	0.08	6.03	0.09
PHASE I/II HLP	H12SS04	23-Oct-07	0.36	12.5	**0.54**	1,040	7	4.1	8.7	1.33	0.27	1.50	21.22	0.13	6.51	0.11
PHASE III 4X HLP	H3XSS01	25-Oct-07	0.28	12	**0.51**	3,090	3.4	3.5	12.2	1.04	0.26	1.42	63.06	0.06	5.56	0.15
PHASE III 4X HLP	H3XSS02	25-Oct-07	6.2	24.8	**0.51**	8,060	6	5.2	24.2	22.96	0.54	1.42	164.49	0.11	8.25	0.31
PHASE III 4X HLP	H3XSS03	25-Oct-07	1	7.8	**0.52**	520	5.5	3.1	13.2	3.70	0.17	1.44	10.61	0.10	4.92	0.17
PHASE III 4X HLP	H3XSS04	25-Oct-07	0.48	6.8	**0.51**	540	6.5	5.5	9.3	1.78	0.15	1.42	11.02	0.12	8.73	0.12
PHASE III 4X HLP	H3XSS05	25-Oct-07	2.7	13	**0.52**	655	6.7	2.9	8.3	10.00	0.28	1.44	13.37	0.12	4.60	0.11
PHASE III 4X HLP	H3XSS06	25-Oct-07	1.5	19.4	**0.67**	1,080	53.2	9.5	23.5	5.56	0.42	1.86	22.04	0.95	15.08	0.30
PHASE III 4X HLP	H3XSS07	25-Oct-07	1.2	9.3	**0.52**	539	7.9	3.9	12.2	4.44	0.20	1.44	11.00	0.14	6.19	0.15
PHASE III 4X HLP	H3XSS08	25-Oct-07	0.53	7.7	**0.53**	585	4.9	6.1	14.5	1.96	0.17	1.47	11.94	0.09	9.68	0.18
PHASE III 4X HLP	H3XSS08 (FD)	25-Oct-07	**4**	8.5	**1**	480	4.5	5.4	14	14.81	0.18	2.78	9.80	0.08	8.57	0.18
PHASE III SOUTH HLP	H3SSS01	24-Oct-07	0.96	9.8	**0.53**	1,420	4.6	4.3	14.6	3.56	0.21	1.47	28.98	0.08	6.83	0.18
PHASE III SOUTH HLP	H3SSS02	25-Oct-07	1.2	18.4	**0.55**	1,670	5.5	3.5	13.4	4.44	0.40	1.53	34.08	0.10	5.56	0.17
PHASE III SOUTH HLP	H3SSS03	25-Oct-07	0.93	14.8	**0.51**	6,060	4.3	3.7	10.6	3.44	0.32	1.42	123.67	0.08	5.87	0.13
PHASE III SOUTH HLP	H3SSS04	25-Oct-07	0.26	2.6	**0.5**	207	1.8	1.6	11.4	0.96	0.06	1.39	4.22	0.03	2.54	0.14
PHASE III SOUTH HLP	H3SSS04 (FD)	25-Oct-07	**2**	2.4	**1**	200	1.7	1.3	11	7.41	0.05	2.78	4.08	0.03	2.06	0.14
PHASE III SOUTH HLP	H3SSS05	24-Oct-07	0.29	11.3	**0.55**	990	5.7	4.6	10.8	1.07	0.25	1.53	20.20	0.10	7.30	0.14
PHASE III SOUTH HLP	H3SSS06	25-Oct-07	0.55	11.4	**0.52**	518	6.7	2.3	13.1	2.04	0.25	1.44	10.57	0.12	3.65	0.17
PHASE III SOUTH HLP	H3SSS07	24-Oct-07	0.42	10.6	**0.53**	1,960	5.7	3.4	21.2	1.56	0.23	1.47	40.00	0.10	5.40	0.27
PHASE III SOUTH HLP	H3SSS08	24-Oct-07	0.25	11.6	**0.51**	1,300	3.2	6.3	10.9	0.93	0.25	1.42	26.53	0.06	10.00	0.14
PHASE IV SLOT HLP	H4SSS01	24-Oct-07	1.5	8.7	**0.53**	543	3.6	5.2	9.3	5.56	0.19	1.47	11.08	0.06	8.25	0.12
PHASE IV SLOT HLP	H4SSS02	23-Oct-07	0.57	10.2	**0.53**	973	5.8	4.9	13.4	2.11	0.22	1.47	19.86	0.10	7.78	0.17
PHASE IV SLOT HLP	H4SSS03	23-Oct-07	2.1	9.1	**0.52**	594	8.1	4.9	7.7	7.78	0.20	1.44	12.12	0.14	7.78	0.10
PHASE IV SLOT HLP	H4SSS04	23-Oct-07	7.2	15.3	**0.53**	1030	16.4	6.9	7.2	26.67	0.33	1.47	21.02	0.29	10.95	0.09
PHASE IV SLOT HLP	H4SSS05	23-Oct-07	0.78	12	**0.54**	668	20.4	4.8	8.6	2.89	0.26	1.50	13.63	0.36	7.62	0.11
PHASE IV SLOT HLP	H4SSS06	24-Oct-07	4.6	31.6	**0.52**	3690	8.2	5	22.4	17.04	0.69	1.44	75.31	0.15	7.94	0.28
PHASE IV SLOT HLP	H4SSS06 (FD)	24-Oct-07	6.9	28	**1**	3600	7.6	4.6	22	25.56	0.61	2.78	73.47	0.14	7.30	0.28
PHASE IV SLOT HLP	H4SSS07	24-Oct-07	1.8	12.8	**0.52**	1320	7.1	4.6	13.5	6.67	0.28	1.44	26.94	0.13	7.30	0.17
PHASE IV SLOT HLP	H4SSS08	24-Oct-07	0.87	17.1	**0.52**	909	9.3	5.2	10.6	3.22	0.37	1.44	18.55	0.17	8.25	0.13
PHASE IV SLOT HLP	H4SSS09	24-Oct-07	0.95	13.5	**0.54**	614	6.2	3.9	12.2	3.52	0.29	1.50	12.53	0.11	6.19	0.15
PHASE IV SLOT HLP	H4SSS10	24-Oct-07	4.1	22.5	**0.51**	7360	5	**2.2**	18.2	15.19	0.49	1.42	150.20	0.09	3.49	0.23
PHASE IV VLT HLP	H4VSS01	26-Oct-07	0.75	9.4	0.03	10400	5.5	6.1	62.5	2.78	0.20	0.08	212.24	0.10	9.68	0.79
PHASE IV VLT HLP	H4VSS01 (FD)	26-Oct-07	**4**	8.4	**1**	1000	5.7	5.1	16	14.81	0.18	2.78	20.41	0.10	8.10	0.20
PHASE IV VLT HLP	H4VSS02	26-Oct-07	0.77	8.3	**0.51**	1230	5.3	3.9	23.6	2.85	0.18	1.42	25.10	0.09	6.19	0.30
PHASE IV VLT HLP	H4VSS03	26-Oct-07	0.56	6	**0.54**	643	6.7	**3.3**	11.2	2.07	0.13	1.50	13.12	0.12	5.24	0.14
PHASE IV VLT HLP	H4VSS04	26-Oct-07	0.75	11.5	**0.55**	1620	6.4	5.6	20.8	2.78	0.25	1.53	33.06	0.11	8.89	0.26
PHASE IV VLT HLP	H4VSS05	26-Oct-07	0.93	13.9	**0.51**	824	6.5	4.7	15.9	3.44	0.30	1.42	16.82	0.12	7.46	0.20
PHASE IV VLT HLP	H4VSS06	26-Oct-07	0.95	8.7	**0.52**	703	4.5	4.5	10.8	3.52	0.19	1.44	14.35	0.08	7.14	0.14
PHASE IV VLT HLP	H4VSS07	26-Oct-07	0.43	9.1	**0.53**	896	5.8	4.7	26.2	1.59	0.20	1.47	18.29	0.10	7.46	0.33
PHASE IV VLT HLP	H4VSS08	26-Oct-07	0.47	7.8	**0.51**	2840	3.8	3.8	14	1.74	0.17	1.42	57.96	0.07	6.03	0.18
PHASE IV VLT HLP	H4VSS09	26-Oct-07	0.52	8.1	**0.53**	559	7	5.7	16.8	1.93	0.18	1.47	11.41	0.13	9.05	0.21
PHASE IV VLT HLP	H4VSS10	26-Oct-07	1.2	13.6	**0.73**	6920	23.3	5.3	72.6	4.44	0.30	2.03	141.22	0.42	8.41	0.92
VLT SOIL	CAPSS01	29-Oct-07	1.3	4.7	**0.5**	10600	4	6.6	20.5	4.81	0.10	1.39	216.33	0.07	10.48	0.26
VLT SOIL	CAPSS02	26-Oct-07	3.6	119	0.96	1250	48.5	83.3	108	13.33	2.59	2.67	25.51	0.87	132.22	1.37
VLT SOIL	CAPSS03	29-Oct-07	1.5	13.1	**0.52**	6260	271	13.8	13.2	5.56	0.28	1.44	127.76	4.84	21.90	0.17
VLT SOIL	CAPSS04	29-Oct-07	0.81	29.3	**0.51**	22100	39.1	9.2	11.1	3.00	0.64	1.42	451.02	0.70	14.60	0.14
									Number of exceedances	47	1	48	49	1	49	1
									Frequency of exceedances	96%	2%	98%	100%	2%	100%	2%
									max HQ	26.67	2.59	2.78	451.02	4.84	132.22	1.37

Notes:

Shaded cells indicate exceedance of screening value

Results in bold are non-detects

mg/kg - milligrams per kilogram

FD - field duplicate

Near surface = 0.25-0.75 foot

Table 4-6
Screening-level Dietary Exposure Estimates for Birds and Mammals for Analytes lacking EcoSSLs
Arimetco Facilities OU, Yerington, Nevada

Analyte	Maximum Soil Concentration (mg/kg)	Plant Bioaccumulation Model: Intercept	Plant Bioaccumulation Model: Slope	Plant Bioaccumulation Model: BAF	Invertebrate Bioaccumulation: Intercept	Invertebrate Bioaccumulation: Slope	Invertebrate Bioaccumulation: BAF	Small Mammal BAF	Estimated Concentrations (mg/kg DW): Plant	Estimated Concentrations (mg/kg DW): Soil Invertebrate	Estimated Concentrations (mg/kg DW): Small Mammal	Receptor	Food Ingestion Rate (kg/kg/d)	Soil Ingestion Rate (prp of FIR)	Diet Composition (proportion): Plant	Diet Composition (proportion): Soil Invertebrate	Diet Composition (proportion): Small Mammal	Estimated Exposure (mg/kg/d): Plant	Estimated Exposure (mg/kg/d): Soil Invertebrate	Estimated Exposure (mg/kg/d): Small Mammal	Estimated Exposure (mg/kg/d): Soil	Estimated Exposure (mg/kg/d): Total	NOAEL (mg/kg/d)	NOAEL HQ
Aluminum	27100			0.005			0.118	0.0732	135.50	3197.80	1983.72	Chukar	0.04	0.093	1	0	0	5.42	0	0	100.81	106.23	109.7	0.97
Mercury	119	-0.996	0.544		0.0781	0.3369		0.192	4.97	5.41	22.848	Chukar	0.04	0.093	1	0	0	0.20	0	0	0.44	0.64	0.068	9.43
Molybdenum	283			4.4177			2.091	1	1250.21	591.75	283	Chukar	0.04	0.093	1	0	0	50.01	0	0	1.05	51.06	3.53	14.46
Thallium	6.6			0.004			0.256	0.1227	0.03	1.69	0.80982	Chukar	0.04	0.093	1	0	0	0.001	0	0	0.02	0.03		
Aluminum	27100			0.005			0.118	0.0732	135.50	3197.80	1983.72	Killdeer	0.18	0.165	0	1	0	0	575.60	0	804.87	1380.47	109.7	12.58
Mercury	119	-0.996	0.544		0.0781	0.3369		0.192	4.97	5.41	22.848	Killdeer	0.18	0.165	0	1	0	0	0.97	0	3.53	4.51	0.068	66.29
Molybdenum	283			4.4177			2.091	1	1250.21	591.75	283	Killdeer	0.18	0.165	0	1	0	0	106.52	0	8.41	114.92	3.53	32.56
Thallium	6.6			0.004			0.256	0.1227	0.03	1.69	0.80982	Killdeer	0.18	0.165	0	1	0	0	0.30	0	0.20	0.50		
Aluminum	27100			0.005			0.118	0.0732	135.50	3197.80	1983.72	American Kestrel	0.17	0.02	0	0	1	0	0	337.23	92.14	429.37	109.7	3.91
Mercury	119	-0.996	0.544		0.0781	0.3369		0.192	4.97	5.41	22.848	American Kestrel	0.17	0.02	0	0	1	0	0	3.88	0.40	4.29	0.068	63.07
Molybdenum	283			4.4177			2.091	1	1250.21	591.75	283	American Kestrel	0.17	0.02	0	0	1	0	0	48.11	0.96	49.07	3.53	13.90
Thallium	6.6			0.004			0.256	0.1227	0.03	1.69	0.80982	American Kestrel	0.17	0.02	0	0	1	0	0	0.14	0.02	0.16		
Aluminum	27100			0.005			0.118	0.0732	135.50	3197.80	1983.72	Pocket Gopher	0.13	0.052	1	0	0	17.62	0	0	183.20	200.81	1.93	104.05
Mercury	119	-0.996	0.544		0.0781	0.3369		0.192	4.97	5.41	22.848	Pocket Gopher	0.13	0.052	1	0	0	0.65	0	0	0.80	1.45	0.032	45.34
Molybdenum	283			4.4177			2.091	1	1250.21	591.75	283	Pocket Gopher	0.13	0.052	1	0	0	162.53	0	0	1.91	164.44	0.26	632.46
Thallium	6.6			0.004			0.256	0.1227	0.03	1.69	0.80982	Pocket Gopher	0.13	0.052	1	0	0	0.003	0	0	0.04	0.05	0.48	0.10
Aluminum	27100			0.005			0.118	0.0732	135.50	3197.80	1983.72	Merriam's Shrew	0.19	0.03	0	1	0	0	607.58	0	154.47	762.05	1.93	394.85
Mercury	119	-0.996	0.544		0.0781	0.3369		0.192	4.97	5.41	22.848	Merriam's Shrew	0.19	0.03	0	1	0	0	1.03	0	0.68	1.71	0.032	53.32
Molybdenum	283			4.4177			2.091	1	1250.21	591.75	283	Merriam's Shrew	0.19	0.03	0	1	0	0	112.43	0	1.61	114.05	0.26	438.64
Thallium	6.6			0.004			0.256	0.1227	0.03	1.69	0.80982	Merriam's Shrew	0.19	0.03	0	1	0	0	0.32	0	0.04	0.36	0.48	0.75
Aluminum	27100			0.005			0.118	0.0732	135.50	3197.80	1983.72	Kit Fox	0.09	0.028	0	0	1	0	0	178.53	68.29	246.83	1.93	127.89
Mercury	119	-0.996	0.544		0.0781	0.3369		0.192	4.97	5.41	22.848	Kit Fox	0.09	0.028	0	0	1	0	0	2.06	0.30	2.36	0.032	73.63
Molybdenum	283			4.4177			2.091	1	1250.21	591.75	283	Kit Fox	0.09	0.028	0	0	1	0	0	25.47	0.71	26.18	0.26	100.70
Thallium	6.6			0.004			0.256	0.1227	0.03	1.69	0.80982	Kit Fox	0.09	0.028	0	0	1	0	0	0.07	0.02	0.09	0.48	0.19
	Minimum Concentrations (mg/kg)																							
Aluminum	1970			0.005			0.118	0.0732	9.85	232.46	144.204	Chukar	0.04	0.093	1	0	0	0.39	0	0	7.33	7.72	109.7	0.07
Mercury	4.7	-0.996	0.544		0.0781	0.3369		0.192	0.86	1.82	0.9024	Chukar	0.04	0.093	1	0	0	0.03	0	0	0.02	0.05	0.068	0.76
Molybdenum	37.7			4.4177			2.091	1	166.55	78.83	37.7	Chukar	0.04	0.093	1	0	0	6.66	0	0	0.14	6.80	3.53	1.93
Aluminum	1970			0.005			0.118	0.0732	9.85	232.46	144.204	Killdeer	0.18	0.165	0	1	0	0	41.84	0	58.51	100.35	109.7	0.91
Mercury	4.7	-0.996	0.544		0.0781	0.3369		0.192	0.86	1.82	0.9024	Killdeer	0.18	0.165	0	1	0	0	0.33	0	0.14	0.47	0.068	6.87
Molybdenum	37.7			4.4177			2.091	1	166.55	78.83	37.7	Killdeer	0.18	0.165	0	1	0	0	14.19	0	1.12	15.31	3.53	4.34
Aluminum	1970			0.005			0.118	0.0732	9.85	232.46	144.204	American Kestrel	0.17	0.02	0	0	1	0	0	24.51	6.70	31.21	109.7	0.28
Mercury	4.7	-0.996	0.544		0.0781	0.3369		0.192	0.86	1.82	0.9024	American Kestrel	0.17	0.02	0	0	1	0	0	0.15	0.02	0.17	0.068	2.49
Molybdenum	37.7			4.4177			2.091	1	166.55	78.83	37.7	American Kestrel	0.17	0.02	0	0	1	0	0	6.41	0.13	6.54	3.53	1.85
Aluminum	1970			0.005			0.118	0.0732	9.85	232.46	144.204	Pocket Gopher	0.13	0.052	1	0	0	1.28	0	0	13.32	14.60	1.93	7.56
Mercury	4.7	-0.996	0.544		0.0781	0.3369		0.192	0.86	1.82	0.9024	Pocket Gopher	0.13	0.052	1	0	0	0.11	0	0	0.03	0.14	0.032	4.48
Molybdenum	37.7			4.4177			2.091	1	166.55	78.83	37.7	Pocket Gopher	0.13	0.052	1	0	0	21.65	0	0	0.25	21.91	0.26	84.25
Aluminum	1970			0.005			0.118	0.0732	9.85	232.46	144.204	Merriam's Shrew	0.19	0.03	0	1	0	0	44.17	0	11.23	55.40	1.93	28.70
Mercury	4.7	-0.996	0.544		0.0781	0.3369		0.192	0.86	1.82	0.9024	Merriam's Shrew	0.19	0.03	0	1	0	0	0.35	0	0.03	0.37	0.032	11.65
Molybdenum	37.7			4.4177			2.091	1	166.55	78.83	37.7	Merriam's Shrew	0.19	0.03	0	1	0	0	14.98	0	0.21	15.19	0.26	58.43
Aluminum	1970			0.005			0.118	0.0732	9.85	232.46	144.204	Kit Fox	0.09	0.028	0	0	1	0	0	12.98	4.96	17.94	1.93	9.30
Mercury	4.7	-0.996	0.544		0.0781	0.3369		0.192	0.86	1.82	0.9024	Kit Fox	0.09	0.028	0	0	1	0	0	0.08	0.01	0.09	0.032	2.91
Molybdenum	37.7			4.4177			2.091	1	166.55	78.83	37.7	Kit Fox	0.09	0.028	0	0	1	0	0	3.39	0.10	3.49	0.26	13.42

Note:

Shaded cells indicate HQ>1

Table 4-7

Comparison of Drain-down Water Concentrations to Acute Bird and Mammal Screening Thesholds

Arimetco Facilites OU, Yerington, Nevada

			Concentrations (mg/L)			LD50 Equivalent (mg/L)		Maximum HQ		
Analytes	**Number of detects**	**Number of samples**	**Minimum**	**Median**	**Maximum**	**Bird (mallard)**	**Mammal (kit fox)**	**Bird**	**Mammal**	**Concentrations (mg/L) in SAMW[a] from Hooper et al. (2007)**
Silica (SiO2)	10	10	100	160	250					
Aluminum	10	10	9000	17000	27000	85000	1786	0.32	15.12	3718
Aluminum						17000		1.59		
Antimony	2	10	0.16	1.6	1.6					
Arsenic	4	10	0.11	0.4	0.4	5000	165	0.00	0.00	0.344
Barium	0	10	0.2	0.2	0.2		1455		0.00	
Beryllium	10	10	0.55	0.965	1.5		1323		0.00	
Boron	10	10	1.1	1.75	2.5					
Cadmium	10	10	0.17	0.295	0.42	3000	320	0.00	0.00	22.2
Calcium	10	10	420	545	600					493
Chromium	10	10	0.46	1.55	2.1	29	143	0.07	0.01	4.8
Cobalt	10	10	28	46	70		467		0.15	21.8
Copper	10	10	1700	2900	5700	5000	342	1.14	16.68	5943
Iron	10	10	210	470	1100					1351
Lead	0	10	1.6	1.6	1.6					
Lithium	10	10	6.9	12	17					
Magnesium	10	10	8600	15000	23000					1596
Manganese	10	10	270	460	740		3032		0.24	746
Mercury	10	10	0.0047	0.0085	0.029					
Molybdenum	0	10	0.4	0.4	0.4	135000	1378	0.00	0.00	
Nickel	10	10	17	28	41		430		0.10	10.8
Potassium	9	10	40	96	140					
Selenium	0	10	0.4	0.4	0.4	850	11	0.00	0.04	0.639
Selenium						680		0.00		
Silver	1	10	0.05	0.2	0.2					
Sodium	10	10	970	1700	2400					17.3
Strontium	10	10	0.14	5.65	15					
Thallium	4	10	0.38	1.6	1.6					
Tin	0	10	8	20	40					
Titanium	10	10	0.18	0.37	1.1					
Vanadium	10	10	0.065	0.1	1.1	1700	342	0.00	0.00	0.352
Zinc	10	10	26	46	67	51000	948	0.00	0.07	2071
pH	10	10	1.9	2.4	2.8	<1.5				2 to 2.03
Chloride	10	10	0.115	0.2	0.36					
Fluoride	10	10	1.2	2.4	3.9	850	342	0.00	0.01	
Radionuclides						**Terrestrial Animal**	**Riparian Animal**	**Terrestrial Animal**	**Riparian Animal**	
Thorium 227	0	10	-15	12.2	37					
Thorium 228	7	10	53.6	147.5	641	63300	2040	0.01	0.31	
Thorium 230	10	10	51.5	78.3	196	452000	13900	0.00	0.01	
Thorium 232	6	10	8.14	39.4	75.7	53600	1680	0.00	0.05	
Uranium 234	10	10	3210	6410	11000	404000	683	0.03	16.11	
Uranium 235	10	10	109	352	500	419000	736	0.00	0.68	
Uranium 238	10	10	2470	5345	8870	406000	756	0.02	11.73	
Notes:							Sum	0.06	28.89	

Table 5-1
Summary of Ecological Screening Results for HLP Materials and Drain-down Fluids
Arimetco Facilities OU, Yerington, Nevada

	Risks from Soil				Risks from Drain-down Water	
Analyte	**Plants**	**Soil Invertebrates**	**Birds**	**Mammals**	**Birds**	**Mammals**
Metals						
Aluminum	X-100%	--	X	X-100%	X	X
Antimony	NR	NR	--	X	--	--
Arsenic	X	X	X	X	NR	NR
Barium	NR	NR	--	NR	--	NR
Beryllium	NR	NR	--	NR	--	NR
Cadmium	NR	NR	X	X	NR	NR
Chromium (assumed 3+)	--	--	NR	NR	--	--
Chromium (assumed 6+)	--	--	--	NR	--	--
Chromium (total)	X-100%	X-100%	--	--	NR	NR
Cobalt	X	--	NR	NR	--	NR
Copper	X	X-100%	X-100%	X-100%	X	X
Lead	X	NR	X	X	--	--
Manganese	NR	NR	NR	NR	--	NR
Mercury	X-100%	X-100%	X-100%	X-100%	--	--
Molybdenum	X-100%	--	X-100%	X-100%	NR	NR
Nickel	NR	NR	NR	NR	--	NR
Selenium	X-100%	X	X-100%	X-100%	NR	NR
Silver	NR	--	NR	NR	--	--
Thallium	X	--	--	X	--	--
Vanadium	X-100%	--	X-100%	NR	NR	NR
Zinc	NR	NR	X	X	NR	NR
Radionuclides						
Thorium 227	NR	NR	NR	NR	NR	NR
Thorium 228	NR	NR	NR	NR	NR	NR
Thorium 230	NR	NR	NR	NR	NR	NR
Thorium 232	NR	NR	NR	NR	NR	NR
Uranium 234	NR	NR	NR	NR	X	X
Uranium 235	NR	NR	NR	NR	NR	NR
Uranium 238	NR	NR	NR	NR	X	X

Notes:
NR - No Unacceptable Risk
-- - No screening value; not evaluated
X - Maximum exceeded screening value
X-100% - all samples exceeded screening value

Figures

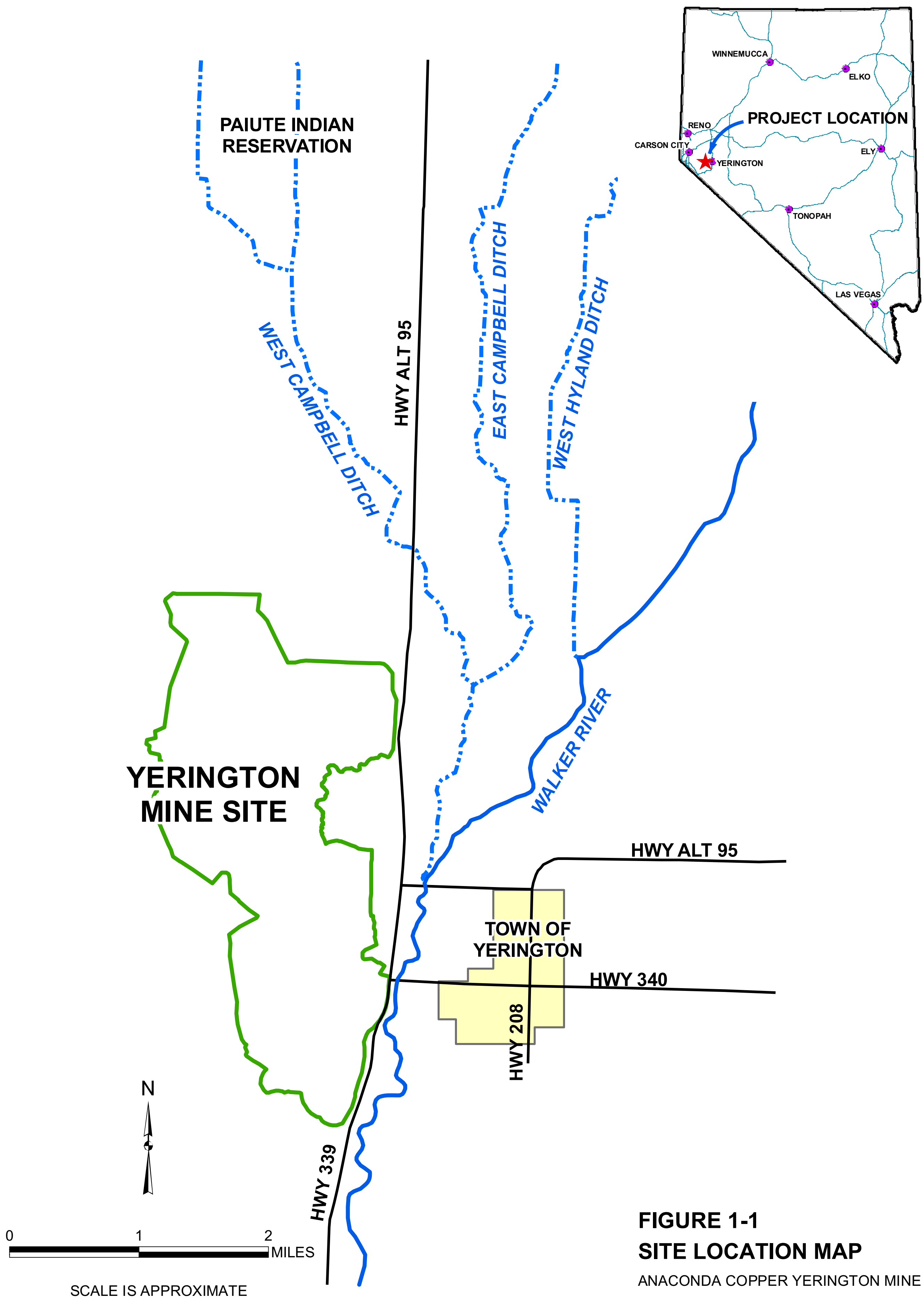

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FIGURE 1-1
SITE LOCATION MAP
ANACONDA COPPER YERINGTON MINE

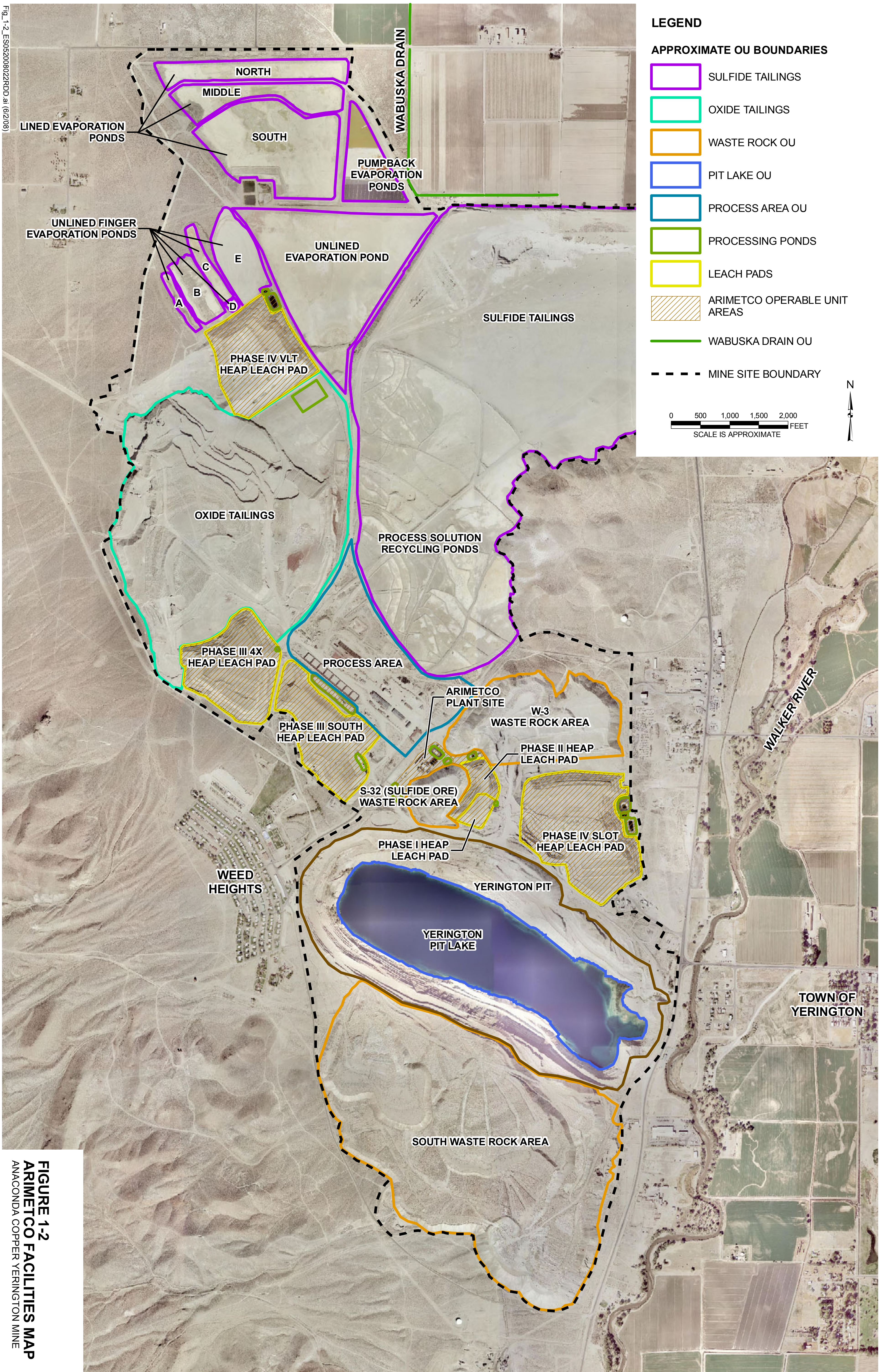
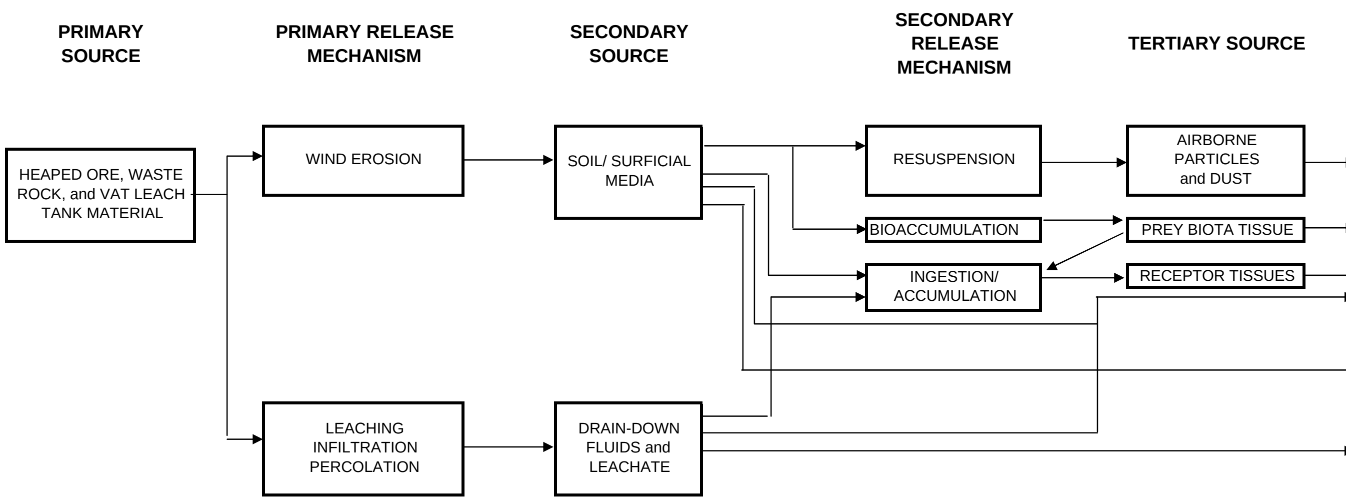


FIGURE 1-2
ARIMETCO FACILITIES MAP
ANACONDA COPPER YERINGTON MINE



EXPOSURE ROUTE	Terrestrial Plants	Terrestrial Invertebrates	Chukar	Killdeer	Mallard	American Kestrel	Pocket Gopher	Merriam's Shrew	Kit Kox
Inhalation (dust)	--	--	Ci	Ci	Ci	Ci	Ci	Ci	Ci
Foliar Uptake	Ci	--	--	--	--	--	--	--	--
Ingestion	--	Ci	C	C	Ci	C	C	C	C
Internal Radiation Dose	C	C	C	C	C	C	C	C	C
External Radiation Dose	C	C	C	C	C	C	C	C	C
Root Contact	C	--	--	--	--	--	--	--	--
Dermal Contact	--	C	Ci	Ci	Ci	Ci	Ci	Ci	Ci
Ingestion	--	C	C	C	Ci	C	C	C	C
Dermal Contact	--	I	Ci	Ci	Ci	Ci	Ci	Ci	Ci
Ingestion	--	I	C	C	C	C	C	C	C

(Ecological Receptors)

Legend

- C — Pathway considered complete and significant (quantitatively evaluated)
- Ci — Pathway considered complete but insignificant (not quantitatively evaluated)
- I — Pathway considered incomplete
- -- — Pathways not applicable

Figure 2-1 Arimetco Heap Leach Pad OU
Conceptual Site Model of Ecological Exposures

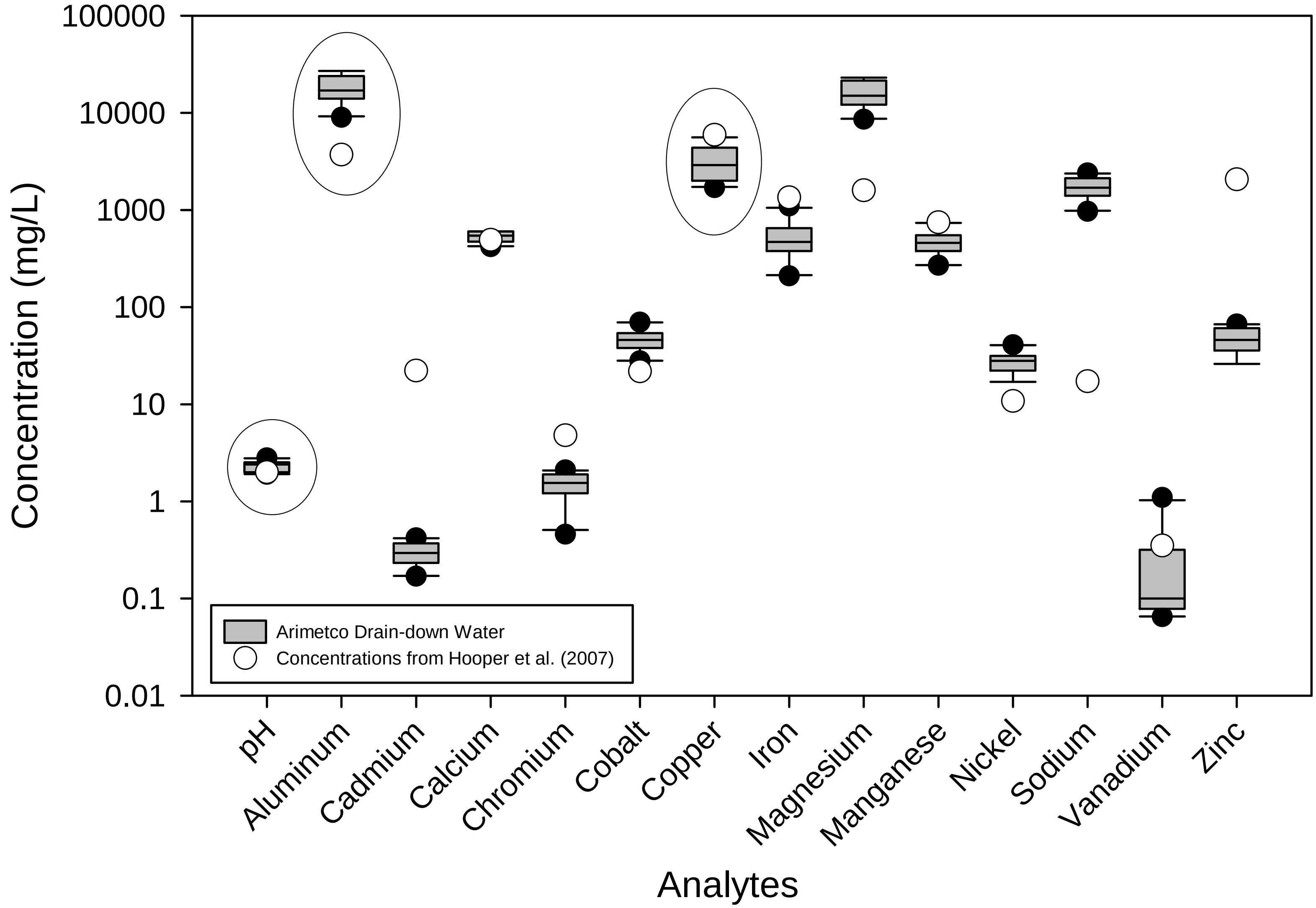


Figure 4-1. Comparison of analyte concentrations in drain-down water from Arimetco heap leach pads and synthetic acid-mine water used by Hooper et al. (2007) to evaluate acute toxicity to mallard ducks.