Historical Summary Report
Anaconda-Yerington Mine Site
Yerington, Nevada

Prepared for:
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U.S. Environmental Protection Agency
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Acronyms and Abbreviations

µg/L	micrograms per liter
°C	degree Celsius
°F	degree Fahrenheit
amsl	above mean sea level
Anaconda	Anaconda Mining Company
Arimetco	Arizona Metals Company
ARC	Atlantic Richfield Company
BLM	U.S. Bureau of Land Management
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CERCLIS	Comprehensive Environmental Response, Compensation, and Liability Information System
Cu	copper
E & E	Ecology and Environment
EPA	U.S. Environmental Protection Agency
EW	electrowinning
Fe	iron
Fe^{3+}	ferric iron
FOV	Finding of Violation
g/L	grams per liter
gpm	gallons per minute
H	horizontal
H_2SO_4	sulfuric acid
HDPE	high-density polyethylene
HLP	heap leach pad
HSR	historical summary report
lb	pound(s)

mg/L	milligrams per liter
MOU	Memorandum of Understanding
NDEP	Nevada Division of Environmental Protection
NPL	National Priorities List
OU	operable unit
PCB	polychlorinated biphenyl
PLS	pregnant leach solution
Site	Anaconda Copper Mine Site in Yerington, Nevada
SO_2	sulfur dioxide
SO_3	sulfur trioxide
SX	solvent extraction
TDS	total dissolved solids
TENORM	technologically enhanced naturally occurring radioactive materials
TGI	Trans Global Industries
USGS	U.S. Geological Survey
V	vertical
VLT	vat leach tailings
WRA	Waste Rock Area

SECTION 1

Introduction

1.1 Purpose

The purpose of this historical summary report (HSR) is to summarize the operational history of the former Anaconda Copper Mine Site in Yerington, Nevada (Site), and to make available for discussion a listing of known and reported spills and chemicals used at the Site. As part of this HSR, the summary of historical operations, as captured by Brown and Caldwell in the *Draft Process Areas (Operable Unit 3) Remedial Investigation Work Plan* (2007a) to the Atlantic Richfield Company (ARC), has been updated. Additionally, numerous letters, documents, maps, and other information obtained from the Site administrative building in 2006 were reviewed and analyzed to develop the historical summaries and spill information contained in the following sections. This document groups the use of chemicals and known spills by operable unit (OU) and reiterates only the specific information and data that are contained in the reviewed files. This document and the information contained herein are based on information and records that were discovered and reviewed but do not likely represent a complete history of spill and chemical information, and, in general, the accuracy of the reported information could not be verified.

This HSR summarizes the operations and history of various owners and operators at the Site—including Anaconda Mining Company (Anaconda), Don Tibbals/Copper Tek, and Arizona Metals Company (Arimetco)—and assesses the quantity and type of materials spilled and released. Individual spills and releases of the indicated chemicals are further discussed by OU and process area in the following sections.

1.2 Site Chronology

This section presents a description of the operational history and the individual physical features (i.e., ore processing components) at the Site. Much of this section's descriptions of the Anaconda operations and processing history was taken from the *Draft Process Areas (Operable Unit 3) Remedial Investigation Work Plan* prepared by Brown and Caldwell for ARC (Brown and Caldwell, 2007a).

The Site is located in Mason Valley, 1 mile west of the city of Yerington, on the west side of the Walker River in Lyon County, Nevada (Figure 1-1) (figures are located at the end of the section in which they are first referenced). Copper in the Yerington district was initially discovered in the 1860s, with large-scale exploration of the porphyry copper system occurring in the early 1900s when the area was organized into a mining district by Nevada-Empire Copper Mining and Smelting Company. Anaconda became involved in the Site when it entered into a lease agreement with option on the property in 1941 and conducted an extensive exploration program from 1942 to 1945 (U.S. Bureau of Mines, 1958). Anaconda purchased the property in 1951. The Weed Heights community was constructed to house mining personnel, and the mine began producing copper in 1953 (Appendix A, Photograph A-1) producing approximately 1.7 billion pounds of copper during its operations. Anaconda was purchased by ARC in 1977, and ARC divested itself of the Site on June 30, 1978. Subsequent operators and lessees used some of the buildings within the Process Area for operational support, storage, and various light industrial activities; however, the Anaconda-constructed processing components remained inactive after this period. The following timeline summarizes significant operational and regulatory milestones:

1907 Empire-Nevada Copper Mining and Smelting Company discover Yerington deposit and operates at Yerington Site from 1918 to 1920.

1941 Anaconda Mining Company acquired the property.

1951 Weed Heights housing community constructed.

1952 The Process Areas and Acid Plant constructed at the Yerington Mine Site.

1952 Mining activities began with stripping of overburden.

1953 First copper oxide ore delivered to the leaching plant.

1961 Concentrator for processing sulfide ore and sulfide tailings dam constructed.

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

1967 Sulfide ore concentrator expanded to double capacity.

1973 Nevada Bureau of Mines and Geology reported on radioactivity at Site (Bulletin 81).

1976 U.S. Geological Survey (USGS) performed a study (report published in 1982) to investigate possible groundwater impact of tailings and brine disposal at the Anaconda Copper Mine Site.

1976 Kilborn/NUS Inc. issued a report to Wyoming Mineral Corporation evaluating the feasibility of a proposed uranium processing facility at the Yerington Site.

1977 ARC purchased Anaconda Minerals, including the Site.

1978 ARC shut down all mining and processing operations.

1979 Unison leased building space in the Process Areas for the purpose of dismantling transformers for disposal.

1979 Anaconda Copper Mine was entered into the Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS) database.

1982 The Nevada Division of Environmental Protection (NDEP) issued a Finding of Violation (FOV) to ARC for alleged "unauthorized discharge of pollutants to waters of the state."

1982 Site, including community of Weed Heights, purchased by Don Tibbals of Tibbals Construction (December 29, 1982).

1983 NDEP personnel and Lyon County Commissioners met to discuss the investigation of groundwater and surface water contamination.

1985 Under an Administrative Order issued by NDEP, ARC constructed the pumpback well system, including five pumpback wells (PW-1 through PW-5) and the associated approximate 23-acre pumpback evaporation pond.

1986 Copper Tek leaching operations were shut down by NDEP. An FOV and Administrative Order were issued to Tibbals in December.

1989 Don Tibbals and Copper Tek sold the Site to Arimetco, effective August 7, 1989, with the exception of the community of Weed Heights and a portion of the oxide tailings area. Copper Tek continued to operate the Yerington Project as an operating subsidiary of Arimetco.

1989 Arimetco began heap leaching and processing operations.

1990 The U.S. Environmental Protection Agency (EPA) conducted a Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) evaluation of the Site.

1991 Unison ended lease agreement and ceased transformer dismantling operations at the former Yerington Mine Site.

1992 Canonie Environmental signed a contract with Arimetco No. 84112-01.001 on June 26 to continue operations and maintenance of the pumpback well system and evaporation ponds, monthly water monitoring, and semiannual water quality sampling.

1993 Arimetco expanded onsite operations and posts a reclamation bond/corporate guarantee totaling $3.5 million as part of its financial assurance for reclamation.

1994 EPA conducted CERCLA prioritization and determined that the Anaconda Copper Mine was eligible for listing on the National Priorities List (NPL) as a Superfund site.

1997 Arimetco filed for bankruptcy protection but continued to operate the mine until January 2000.

1998 The U.S. Bureau of Land Management (BLM) was notified of NDEP concerns of offsite contamination, and NDEP requested BLM to consider the Site as a potential threat to groundwater and expedite steps for remediation.

1998 ARC installed six additional pumpback wells (PW-6 through PW-11) and modified the evaporation pond by partitioning the pond into three cells and adding clay liners.

1998 On December 17, NDEP issued Arimetco a Notice of Noncompliance and Order requiring them to reduce levels of operation down to a care and maintenance level and cease adding new ore and makeup water to the heap leach pads.

1999 ARC completed construction of the upgrades to the pumpback system. The system consists of six pumpback wells, one new monitoring well, and an evaporation pond divided into three cells.

2000 Arimetco abandoned operations at the Site, leaving four operational heap leach pads (HLP) with approximately 90 million gallons of pregnant leach solution (PLS) still in the system. The Site comes under NDEP Emergency Management.

2000 In September, NDEP capped a partially excavated, planned Arimetco Fluids Pond, north of the vat leach tailings (VLT) HLP, with VLT material, to mitigate "red dust" exposed during early construction. The newly scoped VLT pond was not completed.

2000 In October, EPA conducted an expanded Site Inspection, which included collecting groundwater samples from monitoring wells on and around the Site and standing water from a belowground cellar, PLS, tailings, and leachate salts.

2000 ARC upgraded the liner systems in the middle and south Pumpback Well System (PWS) evaporation ponds by installing 60-mil high-density polyethylene (HDPE) over the top of the existing clay liners. The north cell remains lined with the clay liner installed in 1998.

2000 In December, EPA requested Nevada's position on listing the Site on the NPL.

2001 In January, Nevada responded to EPA's letter regarding NPL listing and did not support listing.

2001 In March, NDEP capped three areas with VLT material, including (1) an area of calcines that were removed from the solution storage tanks and placed on top of the oxide tailings, (2) areas within the former calcine ditch, and (3) one of the strong fluids storage tanks to mitigate fugitive "red dust" generated on the Site.

2002 In March, NDEP completed capping of the Thumb Pond (the largest of the finger ponds) with VLT material to mitigate "red dust."

2002 On March 28, a Memorandum of Understanding (MOU) was signed between NDEP, EPA, and BLM regarding coordination and oversight of assessment, characterization, and response activities at the Site. NDEP will coordinate all work to be performed under the October 24 Administrative Order on Consent, consistent with the requirements of the MOU. As parties to the MOU, BLM, and EPA will participate in the review of activities and requirements under this order.

2002 On September 23, NDEP issued an alleged FOV and order to Arimetco requiring that it generate a work plan and schedule for removing and disposing of remaining materials onsite. On October 23, NDEP issued a notice of the failure to comply and took over removal actions.

2003 In January, as part of the Site cleanup and removal action, NDEP arranged for collection and analysis of 400 drums and fluids remaining in the Arimetco solvent extraction (SX) and electrowinning (EW) facilities. The drum and EW removal projects were funded by the State of Nevada, were conducted through SRK Consulting, and have since been reimbursed by ARC.

2004 EPA assumed regulatory control of the Site.

2005 In March, EPA issued ARC a Unilateral Administrative Order Docket No. 9-2005-0011 to continue initial response actions.

2005 In October, EPA personnel conducted a removal assessment to determine issues that should be addressed short term. EPA determined two necessary activities:

(1) ridding the Site of polychlorinated biphenyls (PCB) and (2) controlling mine waste containing dust from blowing off the Site.

2006 EPA removed approximately 170 transformers, switches, and containers at the Site that potentially contained unacceptable levels of PCBs.

2006 Using VLT material, EPA capped portions of the sulfide tailings area not previously capped and applied a sealant to other areas on the Site that were determined to be contributing to fugitive dust emissions.

2006 EPA constructed a 4-acre evaporation pond to contain excess drain-down fluids from the Arimetco heap leach fluids management system.

2007 In January, EPA issued ARC a Unilateral Administrative Order Docket No. 9-2007-0005 to begin the Site wide remedial investigation and feasibility study process.

2007 EPA conducted a removal action to address fluid management issues associated with the Bathtub Pond. Removal actions included removing sediments and liner from the pond, backfilling and grading the pond, and constructing an interceptor trench along the shoulder of the pond.

2008 EPA removed the Mega Pond, two Raffinate Ponds, and the PLS Pond. Removal actions included removing sediments and liner from the ponds and backfilling and grading the ponds.

2008 EPA removed two organic traps (Vaults A and B), excavated kerosene-contaminated soils, and constructed the bioremediation cells on top of the Phase IV Slot HLPs.

2008 EPA approved a minimum 1-year shutdown of the PWS to evaluate its effectiveness and to investigate the shallow and intermediate hydraulic zones underlying northern areas of the Site.

2009 EPA issued ARC an Administrative Order on Consent Docket No. 09-2009-0010 for removal actions and settlement on past EPA response costs.

2010 EPA performed several removal actions, including removing the former Mine Site Administrative Building with asbestos-containing material, removing the tire pile located east of the Process Area, and improving existing security perimeter fencing.

2010 EPA completed a Draft Supplemental Remedial Investigation and Human Health Risk Assessment on the Arimetco HLPs and Fluids.

1.3 Processing Operations

Processing operations, including volumes and concentrations of materials, changed over time throughout the Site's mine life. Copper was initially discovered in Mason Valley, the Yerington district, in 1865. The earliest known mine property, the Nevada-Empire Mine, included 15 claims (spanning 250 acres), a millsite, and a local smelter. Early processing included a 25-ton leaching plant, constructed to use the Midland ferric chloride process; however, Nevada-Empire modified processing in 1920, to leaching with precipitation onto scrap iron (Weed, 1920). Anaconda purchased the former Nevada-Empire Mine property in 1941. General descriptions of Anaconda's mining and processing activities are provided in this section, but the values and tonnages provided are approximate.

Anaconda conducted mining in the main Yerington Pit between 1953 and 1978 (Figure 1-3). Categories of material removed from the pit included oxide ore, sulfide ore, low-grade dump-leach oxide ore, low-grade sulfide ore, and waste-rock overburden. Mining was conducted using electric and diesel shovels, bulldozers, scrapers, and 25-ton haul trucks (U.S. Bureau of Mines, 1958). By 1972, approximately 70,000 tons of ore were mined per day, including 28,000 tons of oxide and sulfide ore, 28,000 tons of low-grade dump-leach ore, and 14,000 tons of overburden and waste rock. Mined ore characteristics in 1972 were also described in the *Skillings Mining Review* (Skillings, 1972) as follows:

- Copper oxide ore containing greater than 0.3 percent copper was delivered to the primary and secondary crusher to reduce ore to less than 0.5-inch, to be later used for copper processing.
- 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 copper was delivered to the W-3 dump leach, located just south of Burch Drive, where it was operated as a heap-leach system beginning in 1965.
- Low-grade sulfide ore was stockpiled in the S-23 Area, southeast of the Burch Drive Bridge, for possible future treatment.

1.3.1 Ore Mineralization and Geologic Processes

Copper mineralization of the mine ore can be divided into three distinct zones: the upper zone, the second or central zone (or the zone of secondary enrichment), and the lower zone. The upper zone is the oxidized ore, where the most predominant copper mineral is chrysocolla ($CuSiO_3 \cdot 2H_2O$). In the second or central zone, the sulfide copper minerals begin to appear, and the upper zone abruptly terminates. The sulfide minerals are primarily a combination of chalcocite (Cu_2S) and chalcopyrite ($CuFeS_2$), with chalcocite dominating. The formation of the chalcocite mineral is believed to have occurred by precipitation from copper-laden fluids that seeped down from the oxide zone. This secondary enrichment zone is the highest grade part of the mine. The lower zone is the primary sulfide zone, where the principal copper mineral is chalcopyrite. This zone contained the greatest portion of sulfide ore.

Several processes were required at the Site for removal of copper from the ore. Chrysocolla, being easily dissolved by dilute sulfuric acid, allowed the oxide ore to be leached. Chalcocite and chalcopyrite, however, will not dissolve in sulfuric acid and therefore required the alternative process, concentration/flotation, for copper extraction in the sulfide minerals (Jacky, 1958).

1.3.2 General Processing Operations

The open pit was mined in 25-foot benches with a 45-degree pit wall slope. Final dimensions of the mined 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, and deep wells were installed along the eastern perimeter of the pit to dewater the fractured bedrock as the depth of the pit increased. Water was pumped from these wells at a rate of approximately 900 gallons per minute (gpm) and was used for Weed Heights housing and plant operations (U.S. Bureau of Mines, 1958).

The overlying alluvium (or overburden) was excavated and transported to the southern margin of the pit lake, now referred to as the south Waste Rock Area (WRA). Low-grade oxide ore was excavated and placed onto what is now referred to as the W-3 WRA, while low-grade sulfide ore was removed and stored at the S-23 WRA. The higher grade oxide and sulfide ore was removed and transported to the Site for further processing.

All oxide and sulfide ore was crushed prior to leaching or processing in the various plant facilities. Crushing was a two-step process for the oxide ore and a three-step process for sulfide ore (Figure 1-4). All ore underwent coarse crushing in the primary crusher, a 54-inch gyratory crusher that reduced the ore to 5 inches or less. Coarse ore exited the crusher onto the No. 1 conveyor and was stored in the oxide and sulfide coarse ore storage.

Ore was delivered to the primary crusher in 25-ton end-dump trucks. Water sprays, controlled by the dump attendant, were installed at either end and immediately behind the bumper block to spray the ore stream as it dropped into the dumping pocket. The ore was dumped over an inclined grizzly made of 12-inch manganese-steel bars set with 3-inch openings between them. The oversized material fed directly into a gyratory crusher set at 5 inches, while undersized material from the grizzly and the crushed material dropped into a 150-ton receiving bin below the crusher. No manual feeding of the crusher was required, and the crusher was capable of crushing a 35-ton load in 45 seconds. The less-than-5-inch material was delivered to 48-inch conveyor belt No. 1 by four 48-inch pan feeders, two of which operated simultaneously. Following a series of screening processes, the ore was delivered to the leaching vats.

From the receiving bin below the crusher, a 48-inch conveyor belt fed by a 60-inch pan feeder conveyed the less-than-5-inch rock to a storage pile with a live-storage capacity of 9,000 to 11,000 tons, plus 6,000 to 7,000 tons of dead storage. The storage pile also acted as a blending pile, as the different grades of ore from the pit were well mixed by the piling and subsequent drawing off from the bottom (U.S. Bureau of Mines, 1958).

For secondary crushing, ore from the coarse-ore storage pile was delivered to 5-foot by 12-foot double-deck screens. Coarse ore was transported to the secondary crusher by the No. 2 conveyor and was further reduced in size to 7/16-inch using standard and short-head cone crushers. Fine-oxide ore exited the secondary crusher through an underground conveyor (No. 6 conveyor) to the sample tower, where a sample was collected for assay. The methodology used at the Yerington Mine to prevent segregation, channeling, or blanketing of fines was to agglomerate the fines by increasing the moisture content to between 5 and 6 percent. This was accomplished by wetting each layer of crushed ore as it entered onto the No. 6 conveyer by spraying with water to ensure agglomeration of the fines (U.S. Bureau of Mines, 1958).

Sulfide ore underwent additional crushing at the sulfide ore crushing and stockpile area located at the north end of the vat leach tanks. Fine grinding of the sulfide ore to a grain size between 20- and 200-mesh particle size was necessary for use in the floatation process and was accomplished using several rod and ball mills in sequence (Skillings, 1972).

1.3.3 Oxide Ore Processing

1.3.3.1 Crushing and Leaching

Oxide ore was crushed in the primary and secondary crushers (Figure 1-4; Appendix A, Photograph A-17) to less than 0.5 inch and stored for use at the ore storage bin (Appendix A, Photograph A-2) and loaded into the vat leach tanks (Figure 1-5; Appendix A, Photographs A-3, A-4, A-5, A-23, A-24, and A-42) by conveyor and overhead loading bridge with the agglomerated ore from the secondary crusher (Figure 1-4). The ore was bedded into a vat leach tank to prevent segregation and allow uninhibited circulation of leach solutions within the tank. Each tank had the capacity to hold approximately 12,000 dry tons of ore and 800,000 gallons of solution when filled to within 6 inches from 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, and 24 hours required to excavate and refill. The entire cycle required approximately 8 days; therefore, eight leach vats (Figure 2-3 [P]) were installed and used to maximize efficiency (U.S. Bureau of Mines, 1958).

After the ore was bedded into the tanks, sulfuric acid leach solution was added to cover the ore. The initial concentration of acid during this conditioning period was 20 to 30 grams per liter (g/L), which was recirculated through the tanks for 3 or more hours by drawing it off the bottom and air-lifting it to the top of the tank until the acid content dropped to less than or equal to 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 solutions. Solutions were recirculated and pumped at a rate of 2,000 gpm. The pregnant solution from the conditioning leach was pumped off to one of the two 286,000-gallon solution storage tanks (Figure 2-3 [DD]) while new solution was transferred from the previous vat as acid was added to bring it up to the desired leaching strength of 40 to 60 g/L**.** This solution was recirculated and then transferred to the next vat. This cycle continued for four or five leaching periods.

Following the leaching process, the ore underwent three wash cycles. The first wash cycle used solution advanced from the preceding tank. The water used for the second comes from three sources (1) discharge water from the Peabody Scrubber in the acid plant (see Section 1.3.4), (2) a portion of the final drain from the leaching circuit, and (3) fresh water obtained from water supply wells. The third wash source water is the same as the second wash cycle (Anaconda, 1954). Depending on the leaching schedule (i.e., 96-hour or 120-hour schedule), wash solution is recirculated until the start of the copper solution withdrawal and put into one of the three open storage tanks simultaneously with the enriched copper solution. Approximately 1.4 million gallons of water were used per day for leach wash water.

Spent ore, known as oxide tailings or VLT, was excavated from the VLTs by a clamshell digger mounted on a rolling overhead gantry crane that could position over any of the eight tanks. The digger would drop the leached ore into a hopper, under which 25-ton end-dump trucks would drive, receive a load, and then haul the waste material to the oxide tailings or

VLT pile. The average time to excavate one tank was 16 hours at a rate of 40 truckloads per hour.

In February 1965, Anaconda began dump leaching of the W-3 Waste Rock Area (WRA), suspected to contain low-grade oxide ore. The dump leaching increased Anaconda's processing by over 800 gpm (Appendix A, Photographs A-32, A-33, A-34, A-35, A-36, and A-37). The following is a summation of results of the dump leaching operation between 1965 and 1968:

- Copper contained in dumps leached: 61,933,180 pounds
- Copper produced to date: 11,715,414 pounds
- Extraction (percent of total): 18.92 percent
- Acid consumed (total): 79,812 tons
- Acid consumed: 13.63 pounds sulfuric acid per pound copper
- Average production cost: 20.36¢ per pound copper

Table 1-1 presents the results from each of the 11 areas of the W-3 dump that have been leached.

TABLE 1-1
Summary of Dump Leaching Operations at Weed Heights, 1965–1968
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Panel Number	Height of Dump (feet)	Leaching Period (days)	Estimated Grade (percent Cu)	Acid Consumed (lb H_2SO_4/lb Cu)	Extraction Percent of Total
1	160	263	0.30	19.55	14.37
3	160	66	0.30	14.53	7.15
4	160	138	0.30	13.23	19.05
5	160	129	0.30	13.55	21.09
6	160	364	0.30	13.38	27.30
7A	32	53	0.27	9.68	40.40
8A	28	39	0.25	12.19	22.90
9A	23	31	0.31	7.75	20.84
10A	20	55	0.26	12.79	18.62
11A	22	48	0.29	11.62	20.18
12A	25	36	0.27	10.29	20.18

Source: Anaconda, 1968

Notes:

Cu = copper
H_2SO_4 = sulfuric acid
lb = pound(s)

Panels 1 through 6 were areas on the original low-grade dump that were built to a height of about 160 feet. It contained mostly low-grade oxide ore. Panels 7A through 12A were areas on the new dump that were built in 25-foot lifts and contained both low-grade oxide and sulfide ores. Except for Panel No. 3, the leaching period of each panel was determined by its production rate. When the pregnant solution from a panel would drop to 0.30 to 0.40 g/L copper from its peak of 0.80 to 1.00 g/L copper, the panel was abandoned, and a new panel started. Panel No. 2 was to commence leaching following the Anaconda memoranda dated May 13, 1968.

Copper was extracted from the ore in the W-3 dump with disappointing results. Low extraction volumes were attributed to poor solution to ore contact. According to Anaconda, there were large quantities of ore that never came into contact with the acid-bearing solution. In a trench that was dug through the entire depth of Panel No. 8A following leaching activities, it appeared that 30 to 40 percent of the ore exposed on the walls of the trench had never been in contact with the acid. Acid consumption in dump leaching oxide ores was estimated to be two to three times greater than that of vat leaching. To leach 0.30 percent copper ore in the vats required about 6 pounds of sulfuric acid per pound Extracted, whereas dump leaching consumed and average of 13.63 pounds of sulfuric acid per pound copper. Fluids generated at the W-3 WRA were pumped back and stored in the Dump Leach Surge Pond (Appendix A, Photographs A-30 and A-31) before being transported to the Iron Launders and recirculated through the Process Area solution recycling tank (Appendix A, Photograph A-38).

1.3.3.2 Cementation

The Mining Congress Journal reported the Precipitation of Copper on Iron at the Yerington Mine Site (Monninger, 1963). According to Frank Monninger, General Plant Foreman, copper was recovered from the leach solution by precipitating (i.e., cementing) the copper using scrap iron. Precipitation of copper onto iron was the means by which copper was extracted from solution. In the cementation facilities, the pregnant solution from leaching was processed for the removal or "precipitation" of the copper from solution. The operation is divided into the following five steps:

- Charging the metallic iron to the concrete precipitation launders by means of a magnet-equipped gantry crane
- Introducing the pregnant copper-bearing solution to the metallic iron, where the actual precipitation of the copper takes place and is allowed to proceed until near-total consumption of the iron
- Removing the precipitated copper from the launders by excavation with a clamshell
- Washing and screening the precipitated copper through a trommel screen for removal of soluble salts, foreign solids, and any unconsumed iron
- Drying the copper precipitates to allow for shipping

The type of precipitant used at the Site was burned, de-tinned, partially shredded, and crumpled tin cans. This processed material was supplied principally by the Los Angeles By Products Company and was made up of the cans salvaged from garbage collections together with tin plate scrap from can manufacturers. This material possessed the following characteristics that made it ideal and efficient as the precipitation agent:

- The material was clean. That is, it was relatively free of rust, paint, paper, or other residue of a nonferrous nature.
- It was composed of light-gauge, uniform stock.
- The partially shredded and crumpled material offered an ideal balance between exposed surface area and porosity.
- The material was easily handled and available at costs consistent with other scrap iron.

The clean irons not only assisted in maintaining a high-purity product but also provided a clean, active surface area for a more rapid and complete reaction between the iron and copper solution, allowing the high-speed conversion of iron to copper. More than 95 percent of the original charge of iron was consumed and converted to copper, leaving only a small percentage of unconsumed iron to be recycled.

The cementation plant (Appendix A, Photographs A-6, A-7, A-8, A-9, and A-39) comprised 20 parallel launders (Figure 2-3 [EE]), each divided into two sections by a concrete wall butted at one end to the common (west) wall and extending to within 6 feet of the opposing wall, allowing solution to flow from one section to another within each launder. Each section is 10 feet wide by 58 feet long; 4 feet 3 inches deep at one end; and 5 feet 6 inches deep at the other set, at a 1.25 percent slope to promote flow from one launder to the next. The iron launders were further divided into the following four separate banks: primary, secondary, stripping/settling, and scavenger (Figure 1-6). In 1965, when leaching operations began, an additional dump leach bank was added. These banks were operated in the following ways (Jacky, 1967; Anaconda, 1954):

- **Primary bank.** This bank consisted of four sections, three of which received solution at any given time, the fourth being out of circuit for washing, removing copper, and cleaning. Nearly 1 million gallons of pregnant solution were sent to the iron launders each day (U.S. Bureau of Mines, 1958). A new or cleaned section is loaded with 85,000 to 90,000 pounds of scrap iron prior to copper solution being introduced. Pregnant solution, with a concentration of 15 to 25 g/L copper and 5.8 g/L sulfuric acid was pumped through an 8-inch lead pipe into the concrete bottoms of the launder tanks. Solution making up the feed for the primary bank consisted of 700 to 730 gpm of new solution and 800 to 900 gpm of recirculated solution. The bulk of the solution feeding these sections is introduced through weep holes in the distribution launder, percolating upward through the iron, overflowing the adjustable-level weir box at the east end of each section, and discharging into the recirculation launder. Each section in the primary bank was excavated on a 4-day schedule, yielding approximately 140,000 pounds of copper (Anaconda, 1954).
- **Secondary bank.** This bank consisted of four sections: two received solution at any given time; the third was out of circuit for washing, removing copper, and cleaning; and the fourth was maintained for a spare. Like the primary bank, a new or cleaned section is first loaded with 85,000 to 90,000 pounds of scrap iron. Solution making up the feed for the secondary bank was recirculated solution flowing at a rate of 900 to 1,000 gpm. The solution overflowing the adjustable-level weir box at the east end of each section was directed into a sump supplying the intermediate pump, which supplied 700 to 730 gpm to the stripping bank, while the excess discharged from the secondary bank

into the recirculated solution. The average time each section is under solution is approximately 6 3/4 days, producing approximately 100,000 pounds of copper (Anaconda, 1954).

- **Stripping/settling.** This bank consisted of five sections operating as pairs of tanks where the stripping bank contained iron and the settling banks did not. Solution feeding the stripping/settling bank is made up entirely of solution being discharged from the secondary bank at a rate equal to that of the influent solution coming into the primary bank (700 to 730 gpm). On average, 15 days are required to fill the sections, yielding nearly 70,000 pounds of copper. The unused iron removed from the precipitates is returned to the primary bank for additional consumption. Final solutions from this area were sent to a 30,000-gallon spent solution sump and pumped to the acid plant for use as a slurry agent to wash the calcines and dust residues from the acid plant to the evaporation ponds (Anaconda, 1954; U.S. Bureau of Mines, 1958).
- **Scavenger.** This bank consisted of one and a half sections. The purpose of the scavenger bank was to consume unused iron that was removed from the other precipitation banks after washing and separation in a trammel. These sections were excavated once a week and produced approximately 90,000 pounds of copper. Typically, the residual iron put into the scavenger sections was much finer, resulting in the precipitates forming a dense mass that was often difficult to excavate and wash in the trommel.
- **Dump-leach primary and secondary.** Initiated in 1965, the W-3 dump-leach precipitation operated similarly to the vat-leach operation, generating copper sulfate solution. These solutions were recirculated from the dump-leach primary to the dump-leach secondary through a separate dump leach recirculation sump. Spent solutions were stored in the dump leach surge pond, located east of the iron launders, and were available for reuse in the plant. Areas of reuse have not been identified.

Following the cementation steps previously described, all copper cement product was washed in place at a rate of approximately 300 gpm for 8 to 12 hours, amounting to the equivalent of approximately five times the volume of the copper solution drained. The copper precipitates were then excavated by overhead gantry crane with a clamshell digger and dropped into the trommel hopper at the southeast end of the precipitation tanks, where it was further washed and the unused scrap iron separated from the copper cement. The copper cement was loaded onto hotplates for drying prior to shipment. The hotplates were large, flat drying surfaces that were heated underneath by propane gas to dry the material to approximately 12 percent moisture. The copper cement product averaged 83 percent copper, which was hauled by trucks to the Wabuska rail spur for railroad transportation to the Washoe Smelter in Anaconda, Montana, for final smelting to a pure copper product (Skillings, 1972). Table 1-2 provides the average assay values of the solutions at various points in the cementation circuit.

TABLE 1-2
Average Assay Values of Solutions at the Various Stages in the Cementation Circuit
Historical Summary Report, Anaconda-Yerington Mine Site

	Flow (gpm)	Cu (g/L)	H_2SO_4 (g/L)	Fe (g/L)	Fe^{3+} (g/L)
Primary and Scavenger Launders					
New Solution	700	20.0	5.8	7.2	5.4
Recirculated Solution	900	3.5	2.4	23.6	0.5[a]
Total Feed	1,600	10.7	3.8	16.4	2.6
Discharge	1,600	3.8	2.5	23.2	Trace
Secondary Launders					
Recirculated Solution (feed)	900	3.5	2.4	23.6	0.5
Discharge	900	1.0	2.1	26.4	[b]
Stripping/Settling Launders					
Feed	700	1.0	2.1	26.4	--
Discharge	700	0.5	2.0	28.1	--

[a] The recirculated solution in the primary and scavenger launders is the same strength as the recirculated solution in the secondary launders.

[b] The discharge solution in the secondary launder is the same strength as the feed solution to the stripping bank.

Source: U.S. Bureau of Mines, 1958

Notes:
Cu = copper
H_2SO_4 = sulfuric acid
Fe = iron
Fe^{3+} = ferric iron

1.3.4 Sulfide Ore Processing

The minerals rich in the sulfide zone were not dissolvable in dilute sulfuric acid, requiring a change in process treatment for the sulfide-rich copper ore. The new treatment was concentration by flotation (Figure 1-7). A froth flotation system was constructed beginning in 1958 and began operating September 25, 1961, to process sulfide ore from the Yerington Pit. Flotation separation was accomplished by mixing very finely ground ore (pulp) with water and a chemical (typically xanthates and aerofloats) to make the sulfide mineral hydrophobic and then sparging air and a surfactant chemical (typically pine oil) through the mixture to create froth. Xanthates are made from a combination of sodium hydroxide, carbon disulphide, and alcohol, whereas the aerofloat is a dithiophosphate made from alcohol, sodium hydroxide, and phosphorus pentosulphide. The sulfide minerals in the pulp attached to the air bubbles in the froth mixture, which collected on the surface of the aeration tank in the rougher floatation circuit and were skimmed off as concentrate. The concentrator (Figure 2-3 [HH]) was designed to take this initial concentrate, separate the solids in a 75-foot-diameter thickener, and regrind the thickened solids to an even finer pulp size of minus 325 mesh (approximately 44 microns). This reground material was sent through a scavenger flotation circuit, a cleaner circuit, and a recleaning circuit (Figure 1-7). The final concentrate was thickened in 50-foot-diameter thickeners; the thickened concentrate was dewatered using a vacuum filter and then dried in a 24-foot rotary dryer. The finished concentrate averaged 28 percent copper, which was hauled by trucks to the Wabuska rail spur and loaded onto rail cars for transportation to the Washoe smelter in Anaconda, Montana, for final smelting to a pure copper product (Skillings, 1972).

Excess pulp after the flotation separation was disposed of in the sulfide tailings as a slurry mixture of solids and water. Operation of the concentrator required approximately 3,000 gpm of water, which was obtained from groundwater production wells and recycled water from decanting the sulfide tailings and other plant operations (Skillings, 1972).

1.3.5 Acid Plant

Sulfuric acid was produced at the Site in the fluosolids and acid plant from 1952 to 1978 (Appendix A, Photographs A-10, A-11 and A-20) (Figure 2-3 [SS]). Raw sulfur ore was hauled by truck to the Site from the Leviathan Mine located in Alpine County, California, until 1962. The production of sulfuric acid from sulfur ore included the following five steps: (1) crushing, (2) grinding, (3) roasting, (4) dust precipitation, and (5) contact acid plant. The final product was 93 percent sulfuric acid that was used in the tank leach and the dump leach of the oxide ore. The following is a summary of the steps used in acid production (Anaconda, 1954; U.S. Bureau of Mines, 1958):

1. Crushing. Two-stage crushing was completed using a jaw crusher and short-head crusher to reduce the sulfur ore to minus 1 inch.
2. Grinding. Rod mills were used to further reduce the ore to minus 10 mesh (less than 2 millimeter) for feed to the fluosolids roaster.
3. Roasting. Fluosolid roasters were used to roast the sulfur ore and drive sulfur dioxide (SO_2) gas from the ore, which would then be converted to sulfuric acid in the subsequent steps. The ore was bedded into an 18-foot-wide by 25-foot-high reactor lined with insulating and fire brick. The bed of material was maintained at 5 feet, and fluidizing air heated by propane was circulated to heat the ore to a temperature of 1,100 degrees Fahrenheit (°F) to oxidize the sulfur. The burned ore or "calcines" were removed from the bottom of the reactor and disposed of in the evaporation ponds conveyed in the Calcine Ditch (Figure 2-3 [WW]) using spent solution pumped from cementation/iron launders to sluice the solids to the ponds. The Calcine Ditch discharged into the easternmost Finger Evaporation Pond (Finger Pond E on Figure 1-2). During operations, the discharge covered a much larger area than the current pond footprint (Appendix A, 1967 Aerial Photograph).
4. Dust precipitation. The dust precipitation system comprises a spray cooler, transfer chamber, three banks of Buell cyclones, a Peabody Scrubber, and, although not normally used for this purpose, four mist cottrells in parallel. About 50 percent of the available calcine passes into the dust system entrained in the SO_2 gas and amounts to about 150 tons per day. Of this amount, all is precipitated in the system except about 16 pounds per day that pass to the acid plant converters. Gases leaving the reactor contained 10 to 12 percent SO_2 and were cooled and sent through the Peabody scrubber and Cottrell electrostatic precipitator to remove dust. Precipitates were collected at a rate of about 800 pounds per day and contained 30 to 40 percent selenium with silica. Water from the scrubber was recycled and used as wash water in the leaching vats (U.S. Bureau of Mines, 1958). Selenium precipitates were sold and shipped offsite several times per year (Owen, 1957a; Owen 1957b, Fritsoe, 1958).
5. Contact acid plant. The SO_2 gas entered the contact acid plant by going through a primary and secondary converter, where the SO_2 was converted to sulfur trioxide (SO_3).

> The SO_3 gas then went through two heat exchangers and entered into the adsorption tower containing 98 percent H_2SO_4, where it combined with the 2 percent water to form acid. The acid is diluted to 93 percent sulfuric acid and pumped to two 2,500-ton storage tanks. The acid is pumped from the storage tanks through two 250-gallon measuring tanks to the leaching vats at a rate of approximately 400 tons per day (U.S. Bureau of Mines, 1958).

The sulfuric acid plant was discontinued in 1978 and dismantled by Arimetco in 1992; however, details on the dismantling and demolition of the sulfuric acid plant have not been located. The area has been subsequently buried under the Phase III South Arimetco heap leaching pad (see Section 1.3.7).

1.3.6 Post-Anaconda Operations

In 1982, following 25 years of mining and milling, the Site was sold to Don Tibbals, a local resident and contractor, 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, a company that salvaged drained electrical transformers for metals such as copper and brass (Ecology and Environment, Inc., 2000). From 1982 to 1989, Copper Tek Corp., operated under Tibbals' ownership, reprocessed oxide ore vat leach tailings and low-grade oxide ore within the W-3 waste rock, previously mined by Anaconda, using heap leaching and SX/EW processes in the area to the south of the historic mill buildings, at what is now referred to as the Phase I HLP. Copper Tek executed copper extraction at a small SX/EW plant on the south side of Burch Drive where the current abandoned Arimetco process area is located. Mr. Tibbals also renovated approximately 130 of the 200 homes in Weed Heights, located adjacent to the western boundary of the Site.

In 1988, an option agreement to purchase oxide tailings was made between Don Tibbals and Trans Global Industries (TGI), a Utah Corporation for the option to purchase 70 million tons of the tailings and lease the Property and the Processing Site upon terms and conditions set forth by both parties. Tibbals had previously sold 10 million tons of oxide tailings to Rainbow Group and executed a bill of sale transferring the same to TGI (Bible et al., 1988). Tibbals, who maintains ownership of 80 acres of land on the western margin of the oxide tailings, has distributed an undisclosed quantity of tailings for use across Mason Valley.

Mr. Tibbals sold Copper Tek holdings to Arimetco in 1989, which operated a closed-system copper-extraction operation using the tailings piles left behind by Anaconda, whereby ore was crushed and heaped on lined pads and leached with dilute sulfuric acid of approximately 12 to 15 g/L concentration. The PLS is processed through a SX/EW plant to recover cathode copper. In this type of process (SX/EW), all solutions are reused in a closed circuit, minimizing generated mine waste.

1.3.7 Arimetco

When the mine was purchased by Arimetco in 1989, the Copper Tek process facility was not used; instead, a new facility was constructed. The copper was primarily processed from the dump ores left behind by Anaconda using the conventional heap leaching and SX/EW technology. Approximately 40,000 tons of copper ore per day were hauled to the leach pad areas and end-dumped into lifts 20 feet high, with each lift to be leached for 30 to 40 days.

Arimetco-constructed HLPs consist of five spatially distinct units constructed in four phases (Figures 1-8 and 1-9), covering nearly 250 acres. Phase I is located immediately north of the open pit and southeast of the SX/EW facility. Phase II is contiguous with Phase I and extends to the northwest. Phase III consists of two separate lined heaps, with Phase III South and Phase III 4X both located north of the access road and west of the Process Areas. Note that the Phase III south heap was constructed on top of Anaconda's historical sulfuric acid production facility. Phase IV also consists of two separate HLPs with the slot heap bordering the eastern property boundary and including a portion of Anaconda's W-3 WRA and the VLT heap, the northernmost HLP.

During Arimetco's operations, approximately 40,000 tons of ore per day were hauled and end-dumped into lifts approximately 20 feet high, with each lift to be leached 30 to 40 days. According to Arimetco operating procedures, ore was not placed within 15 feet of perimeter berms forming heap containment. Subsequently higher lifts made on heaps featuring solution collection were set back 8 feet from the edge of the preceding lift and configured an overall slope of 2.4H:1V. Heap height typically reached 120 feet above the liner (Arimetco, 1993a). A summary of the Arimetco HLP construction details is provided in Table 1-3.

1.3.7.1 Phase I/II Heap Leach Pad

The Phase I/II HLP was constructed by Arimetco beginning in 1989 to leach low-grade oxide ore from the original Anaconda W-3 dump. The pad was constructed on a single 40-mil HDPE liner over compacted alluvium and other fill materials. A solution ditch surrounding the Phase I area drained to a low point in the northeast corner of the pad. The Phase I HLP originally covered approximately 6 acres and had an estimated height of 100 feet. The Phase II HLP expanded northwest from Phase I and covered an additional 8 acres. Leaching of the Phase I/II HLP permanently ended in 1997 (Brown and Caldwell, 2007a). The Phase I/II HLP occupies approximately 14 lined acres. A sump exists on the west side of the heap and was probably a sediment control basin for the original Phase I HLP. Currently, the sump collects minor drain-down from the south end of the Phase I/II HLP. A large collection pond is located at the north end of the Phase I/II HLP that collects the drain-down solution from the perimeter ditches.

1.3.7.2 Phase III South Heap Leach Pad

The Phase III south HLP covers approximately 46 acres, including the site of the former Anaconda sulfuric acid plant, and was constructed between 1990 and 1992 to leach low-grade oxide ore from the W-3 Waste Rock dump, some VLT material, and mined material from the MacArthur Pit. This HLP includes a secondary liner of compacted, naturally occurring clayey material. Single 40-mil HDPE liners were constructed for solution recovery, and a drainage ditch surrounding the Phase III South HLP was constructed with a polynet leak-detection system over a second 40-mil HDPE membrane. The solution ditch drained to a collection pond (known as the Bathtub Pond that was closed by EPA in 2007) and to the Mega Pond. In 2006 and 2007, EPA installed interceptor trenches and french drains to divert the drain-down solution to the new 4-acre evaporation pond rather than the original Bathtub and Mega Ponds. Leaching of the Phase III South HLP originally ended in early 1997 but resumed for several months in 1998 (Brown and Caldwell, 2003a).

TABLE 1-3
Summary of Arimetco Heap Leach Pad Construction Details
Historical Summary Report, Anaconda-Yerington Mine Site

	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 – 1996 (plus five months in 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 in 1997	400 to 500 gpm in 1998	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]	100 feet	120 feet	120 feet	100 feet	120 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.
Design Slopes[a]	Unknown	Unknown	Unknown	2.4H:1V	2.4H:1V

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

[b]Brown and Caldwell, 2003a.

Notes:

H = horizontal
V = vertical

1.3.7.3 Phase III 4X Heap Leach Pad

The Phase III 4X HLP covers approximately 50 acres and was constructed between 1992 and 1995 to leach low-grade oxide ore from the W-3 Waste Rock dump, some VLT material, and mined material from the MacArthur Pit. Solution from the Phase III 4X Heap solution ditch drains to a low point near the southeast corner of the pad. A variable 2- to 10-foot "blanket" of VLT material was placed on the liner surface to act as drain rock and to protect the liner from the more irregular and angular mine material to be leached. Leaching of the Phase III 4X HLP ended in 1999 (Brown and Caldwell, 2003a).

1.3.7.4 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 various directions over a 25-year period and eventually formed one contiguous dump known as the W-3 dump or W-3 WRA. The original W-3 area encompassed nearly 170 acres and was more than 100 feet high. In 1965, Anaconda began leaching copper on portions of the W-3 dump and in the late 1970s began mining a portion of the W-3 dump to augment the vat leach operation. Their incursion into the dump became known as the Slot. Arimetco later resumed mining in the Slot, expanding it north by excavating further into the W-3 waste rock. The Slot was eventually mined down by Arimetco to the original topography and prepared for a 1,000,000-square-foot starter pad area for the Phase IV Slot HLP. This pad expanded a large portion of the remaining W-3 dump area, and, between 1993 and 1996, Arimetco continually mined the W-3 dump ore back onto the growing Phase IV Slot HLP. Between 1993 and 1998, Arimetco also transported some of the W-3 oxide ore to the Phase III HLPs.

The Phase IV Slot HLP included both a primary 40-mil HDPE liner and a secondary compact lean-clay liner. The solution ditch surrounding the Phase IV Slot HLP drains to the eastern side of the HLP and is currently routed to the northernmost of two PLS ponds. The Phase IV Slot HLP covers approximately 86 acres and was constructed in 20-foot lifts. The majority of this HLP was constructed on public land, with portions of the west and south slopes on private land.

1.3.7.5 Phase IV Vat Leach Tailings Heap Leach Pad

The Phase IV VLT HLP covers an area of approximately 54 acres and was constructed on the southern portion of the previously operated Finger Ponds. Arimetco constructed the Phase IV VLT Pad in 20-foot lifts between 1995 and 1998 and included a primary 40-mil HDPE liner and a secondary liner of compacted naturally occurring, gray, lean clay. A solution ditch surrounding the Phase IV VLT HLP drains to the northeast corner and is routed through a large sediment control basin to an adjacent PLS Pond (Brown and Caldwell, 2003a).

The Phase IV VLT HLP consists primarily of VLT oxide tailings with some run-of-mine and crushed ore from the MacArthur Pit. Arimetco ceased adding makeup water and acid to the Phase IV VLT HLP in November 1998. Solution drain-down has decreased over time from 3,300 gpm during peak operation to a recent rate of approximately 35 gpm. This rate was measured before late 2006 when drain-down solutions began being diverted to the new

4-acre evaporation pond rather than being pumped back to the top of the Phase IV VLT HLP.

1.3.8 Summary of Arimetco Operations

Copper heap leaching involved the application of an acidic water-based solution over the heaped ore's surface using irrigation apparatus configured to provide a coverage rate of about 0.0025 gpm per square foot. The applied solution (raffinate) contained about 12 to 15 grams of sulfuric acid per 1,000 grams of water (1.2 to 1.5 percent sulfuric acid). The solution then percolated through the heap, solubilizing the copper oxides. The resultant PLS emerged at the toe of the heap, concentrated in elemental copper and reduced in sulfuric acid to less than 4 g/L (0.4 percent), and was pumped to a sunken reservoir known as the PLS Pond, located on the westernmost margin of the Arimetco SX/EW process area. This location allowed for PLS to be gravity-fed into the plant area.

The leaching reaction created copper sulfate and water, which was then conveyed in flows exceeding 5,000 gpm to the SX plant as feed solution. The SX process consisted of two stages, using three cycling fluids that were alternately mixed and separated. In the first stage, extraction was accomplished by mingling the water-based PLS feed with a reagent carried by a fluid organic (in this case kerosene). The PLS and the organic were thoroughly mixed together before entering a large settling tank, where they were slowly separated as immiscible fluids. During the time of contact, the reagent carried by the organic would exchange hydrogen ions for copper ions in the PLS. Through ion exchange, the PLS was relieved of its copper and became raffinate, which was re-acidified and recycled to the heaps to repeat the process.

The copper-laden organic advanced to the second stage called stripping, where the organic solution was thoroughly mixed with another water-based solution called an electrolyte, which was recycled from the EW tank house. During contact, the exchange of hydrogen ions for copper ions was reversed and a copper sulfate produced. The resulting copper-rich electrolyte was settled from the organic and advanced to the EW tank house for plating, while the organic was recycled to the extraction stage. The final stage was the EW of ionic copper from the electrolyte solution using electrical currents to sheet-plate copper onto an arrangement of stainless steel cathodes. Electrolysis separated pure copper from the other dissolved metals and impurities using sheets of insoluble lead anodes that were alternately placed opposite the sheets of cathodes immersed in the conductive electrolyte bath. Copper was slowly deposited on the immersed cathode sheet, while oxygen was liberated at the anode. Sulfuric acid was regenerated to the electrolyte bath at a ratio of about 1.5 pounds per pound of plated copper (Figure 1-10).

PLS collection ditches are located around the perimeters of all HLPs. The ditch lining typically comprised two layers of 40-mil HDPE plastic liners and one roll width of HDPE poly-net sandwiched between them, allowing any leakage in the top liner to flow laterally between the two liners and collect in a downstream leak-detection sump.

At leach-detection sumps, the poly-net routed any leakage to a 2-inch PVC collector pipe lying across the bottom of the ditch and between the plastic liners. This pipe was perforated but only where it lies between the liners. The collector pipe was booted through the bottom secondary liner and ran below ground to a sump located in the adjacent berm.

Nevada mining regulation pertaining to collection pond design requires that (1) in the event of a process plant shutdown or pump failure, a process pond must contain the leach pad drain-down solution for up to 24 hours; (2) in the event of a 25-year, 24-hour storm, a process pond must contain 100 percent of direct rainfall and leach pad storm runoff; and (3) total process pond capacity must provide for a pond freeboard of not less than 2 feet from below its overflow crest. In the course of leaching operations, raffinate volumes delivered to a pad area may vary highly; however, pond design capacities should focus on the maximum raffinate flow to be expected for each pad drainage system.

Fluid management and site maintenance currently involves the following activities:

- Several pumps are operated intermittently to direct the drain-down effluent or leakage from primary containment ponds/sumps to the new 4-acre evaporation pond installed by EPA in 2006 for evaporation. In addition, in several locations, fluids drain by gravity flow to the new 4-acre evaporation pond.
- Collection system pipes are visually inspected for leakage or failure on a routine basis.
- Solution drainage rates are measured at weirs on the Site, including the Slot pad, Phase III 4X pad, and VLT pad solution ditches. Leak detection systems are monitored, and records of leakage are maintained onsite.

Arimetco filed for bankruptcy in 1997 and ceased mining minerals and adding acid to the HLPs in November 1998 prior to the December 1998 NDEP Notice of noncompliance and Order (NDEP, 1998). Arimetco ceased processing operations in November 1999. Arimetco failed to make payroll and was unable to staff the Site in January 2000.

Following the abandonment of the Site by Arimetco, the State of Nevada took over the Site cleanup activities and fluids system management on January 27, 2000. Following cessation of mining activities, an estimated 90 million gallons of PLS were present in the HLPs. Mr. Joe Sawyer of NDEP indicated that the flow rate in the system when the State took over in January 2000 was approximately 1,200 gpm (Ecology and Environment, Inc., 2000); the current flow rate is less than 50 gpm.

1.4 Mine Site Water

1.4.1 Pit Lake

During pit mining operations from 1951 to 1978 (Appendix A, Photographs A-13, A-14, A-15, A-22, A-27, A-28, A-44, and A-56), nearly 360 million tons of materials were removed from the mine pit, most of which remains as tailings or heap leach piles within the mine boundary. In 1978, the mine pit measured 6,400 feet long, 2,800 feet wide, and 800 feet deep on the west end of the pit and 225 feet deep at the extreme east end of the pit. The open pit was mined in 25-foot benches with a 45-degree pit wall slope, rather than the typical 50-foot benches used in open pit mining, because of the heterogeneity of the ore.

Groundwater was encountered during the initial mining phase at approximately 100 feet below ground surface, equivalent to 4,350 feet above mean sea level (amsl). To remove the groundwater and continue with mining operations, seven dewatering wells were installed along the eastern perimeter of the pit as shown in Table 1-4. The depth to groundwater in the dewatering wells ranged between 80 and 90 feet below ground surface.

TABLE 1-4
Historical Pit Lake Dewatering Wells
Historical Summary Report, Anaconda-Yerington Mine Site

Pit Lake Well Number	Well Location	Water Rights Application Number	Certificate Record Number	Water Appropriation (ft^3/sec)	Date of Appropriation	Well Construction Specifications
No. 1 Well	T13N R25E and bears N 54º 34' 32" W., 3,113.36 feet	14109 Changed to 58527	4392	1.10	03-12-1952	Well originally 349.5 feet deep, cased with 337.7 feet of 14-inch casing; equipped with a three-stage turbine pump driven by a 60-hp motor and conveyed through various length pipe to mine town-site and ore beneficiation plant. Depth to water if not pumped is 71 feet. Excess water is discharged into the Walker River. Deepened at a later date to 545 feet.
No. 2 Well	T13N R25E and bears N 64º 13' 28" W., 4,149.92 feet	14110	4393	1.10	03-12-1952	Well originally 321 feet deep, cased with 14-inch casing; equipped with a nine-stage turbine pump driven by a 75-hp motor and conveyed through various length pipe to mine town-site and ore beneficiation plant. Depth to water if not pumped is 100 feet. Excess water is discharged into the Walker River. Deepened at a later date to 545 feet.
No. 3 Well	T13N R25E and bears N 80º 48' 36" W., 3,785.61 feet	14111	4394	1.67	03-12-1952	Well originally 249.0 feet deep, cased with 244 feet of 14-inch casing; equipped with a three-stage turbine pump driven by a 60-hp motor and conveyed through various length pipe to mine town-site and ore beneficiation plant.
No. 4 Well	T13N R25E and bears N 89º 55' 16" W., 3,307.02 feet	14112	4395	2.22	03-12-1952	Well originally 314 feet deep, cased with 180 feet of 14-inch casing and 286 feet of 12-inch casing; equipped with a 12-stage turbine pump driven by an 85-hp motor and conveyed through various length pipe to mine town-site and ore beneficiation plant. Depth to water if not pumped is 71 feet. Excess water is discharged into the Walker River. Deepened at a later date to 545 feet.
No. 5 Well	T13N R25E and bears S 77º 43' 38" W., 2,801.3 feet	14113	4396	1.10	03-12-1952	Well originally 350 feet deep, cased with 281 feet of 18-inch casing; equipped with a nine-stage turbine pump driven by a 125-hp motor and conveyed through various length pipe to mine town-site and ore beneficiation plant. Excess water is discharged into the Walker River.
No. 6 Well	T13N R25E and bears S 62º 02' 03" W., 2,173.31 feet	15425	4398	1.0	12-03-1953	Well Construction Specifications for this location are not known.
No. 7 Well	T13N R25E and bears N 62º 35' 15" W., 2,182.03 feet	15424	4397	1.20	12-03-1953	Well originally 600 feet deep, cased with 400 feet of 18-inch casing and 560 feet of 14-inch casing; equipped with a 12-stage submersible pump driven by a 85-hp motor and conveyed through various length pipe to mine town-site and ore beneficiation plant.

Notes:

ft^3/sec = cubic feet per second
hp = horsepower

As mining operations continued, additional dewatering wells were drilled within the pit boundary, and the seven outer wells were deepened. Historical records indicate that the average pump rate for the dewatering wells was approximately 3,400 acre-feet per year, equivalent to approximately 2,400 gpm on a continuous basis as summarized in Table 1-5. The water removed from dewatering was used onsite to support ore processing, mining, and milling operations and as a potable drinking water supply for Weed Heights, the housing community west of the Site (Brown and Caldwell, 2007b).

TABLE 1-5
Average Pumping Rates for Pit Lake Wells
Historical Summary Report, Anaconda-Yerington Mine Site

Pit Lake Well Number	Gallons per Day	Gallons per Minute
1	622,060	432
2	285,120	198
3	493,920	343
5	1,159,200	805
6	403,200	280
7	570,240	396
Total Average Daily Pump Rates	**3,533,760**	**2,454**

Source: Nesbitt, 1955a

Since 1978, the pit has been refilling with groundwater inflows. The Pit Lake is currently just over 400 feet deep at the west end and totals approximately 40,000 acre-feet of water. The Pit Lake continues to refill 30 years after mining and pit dewatering operations ended.

On January 4, 1997, an unprecedented flood occurred in Mason Valley, which originated in the northern Sierra Nevada Mountains and inflicted widespread damage in western Nevada. The extent of the damage was observed in the Truckee, Carson, and Walker River basins. Because of the floodwater pathways surrounding Yerington, sections of western and central Yerington were spared from significant flooding. The severity of flooding in Yerington may also have been alleviated when the city constructed a floodwater diversion ditch at SR 339. The ditch was constructed by ripping a swath across the highway, thereby channeling the floodwaters westward from the Walker River to the east end of the Pit Lake and diverting nearly 1,000 acre-feet of floodwater (Rigby et al., 1998). The impacts of the diversion ditch can still be seen today, as Walker River water continues to seep into this eastern boundary of the Pit Lake.

The Pit Lake surface is still below the potentiometric surface in the surrounding bedrock flow system and a cone of depression continues to exist around the pit. The conceptual model for the recovery of groundwater into the Pit Lake includes the bedrock flow system as the dominant recharge source that is ultimately sourced from the Walker River.

A recent Pit Lake elevation of 4,221.92 feet amsl was measured on July 8, 2010 (Brown and Caldwell, 2010). The lowest elevation of the pit floor is 3,800 feet amsl. The rate of the rise in lake level is starting to flatten with time. As Pit Lake begins to approach that of the surrounding potentiometric surface, which may or may not be as high as the pre-mining surface, the lake may evolve into a flow-through phase. The Pit Lake water is neutral to slightly alkaline (Brown and Caldwell, 2007a). Laboratory analysis performed on the

Pit Lake water show that it contains a number of constituents in elevated concentrations, including selenium and copper.

1.4.2 Groundwater Impacts

Although water quality data prior to 1989 are limited, there are some data available supporting groundwater degradation as a result of the historical mining operations. Several studies were performed at the Yerington Site between 1974 and 1979. In 1974, when Anaconda was still operating at the Site, four samples were collected from wells north of the tailings impoundment (WW-12C, WW-22, WW-26, and WW-35). These results indicated that pH ranged from 7.18 to 8.05, total dissolved solids (TDS) concentrations ranged from 268 to 1,412 milligrams per liter (mg/L), and copper concentrations ranged from 9 to 15 micrograms per liter (µg/L). Even in 1974, some of today's drinking water quality standards were exceeded in the deep aquifer downgradient from the tailings ponds, including arsenic, sulfate, and lead. At the request of the NDEP, the USGS initiated a groundwater study in 1976 to determine the groundwater impacts below and surrounding the Site. Studies were performed to determine, if present, the nature and the extent of groundwater contamination associated with the mining and milling waste fluids discharged on the northern margin of the Site. Initial studies performed by H.R. Seitz included the installation of 17 shallow test wells immediately downgradient from the evaporation ponds used for the disposal of the iron sulfate brine and tailings slurry. Chemical analysis indicated that shallow groundwater in the vicinity of the ponds was contaminated. Additionally, chemical analysis of water from industrial-supply wells in the same area indicates that deeper groundwater deteriorated in quality during heavy pumping that began in the 1960s and that the observed chemical changes may be due to contamination by percolating acid brine, tailings fluid, or both (Seitz et al., 1982).

In 1979, following site closure, wells WW-12C, WW-22, WW-26, and WW-35 were again sampled, but analyzed for fewer constituents. The 1979 results showed that the sulfate concentrations had increased since the 1974 sampling event, and that WW-26, which had not yielded concentrations above drinking water standards in 1974, returned elevated sulfate concentrations in 1979. The 1974 to 1979 analytical results and studies performed north of the Site, though not conclusive, are suggestive of degradation of water quality in the deep aquifer (Dalton, 1998).

In 1983, Anaconda representatives met with officials from the NDEP in response to an FOV and order concerning the evaporation and tailings ponds and performed additional analysis of the groundwater north of the Site. Analysis showed elevated levels of sulfate, iron, manganese, and copper, along with a visible sludge of red iron precipitates. In August 1983, Anaconda proposed a groundwater investigation program consisting of exploratory drilling, completing additional monitoring wells, protecting existing monitoring wells, and routine water quality monitoring (Anaconda, 1984a). Routine groundwater monitoring was considered to be the best technique to project levels of contaminants in excess of drinking water or irrigation standards. Historical routine monitoring results show strong evidence to suggest that pumping of subsurface groundwater to dewater the open pit and to meet the water requirements of the Anaconda mining and milling operation resulted in the creation of a drawdown cone, which influenced historical groundwater levels. Since operations ceased at the Site in 1978, there has been a significant rise noted in the groundwater elevations in monitoring wells, primarily in wells north of the Site (Applied Hydrology Associates, 1983). The notable rise in groundwater elevation is supported by the USGS study that sampled and evaluated groundwater quality downgradient from the tailings ponds. Historical water levels are summarized in Table 1-6. Recent monitoring results, it indicate that groundwater pumping for agriculture use and an ongoing drought that has spanned the last decade has affected current water levels north of the Site. Routine quarterly groundwater monitoring, as well as phased drilling programs continue sitewide.

TABLE 1-6
Well Records for USGS Test Wells (1978) and Anaconda Wells proximal to Tailings Impoundment(s)
Historical Summary Report, Anaconda-Yerington Mine Site

Well ID	Well Depth (feet bgs)	Casing Diameter (inches)	Water Level (feet)	Date	Use of Well
USGS Test Wells					
1A	28.6	2	9.70	01-09-1978	X
			4.16	09-04-1980	
1B	29.0	2	9.83	01-09-1978	X
			4.27	09-04-1980	
2A	29.3	2	1.00	01-06-1978	X
			1.21	09-04-1980	
2B	29.7	2	1.54	01-09-1978	X
			1.94	09-04-1980	
3	29.6	2	8.13	01-11-1978	X
			3.68	09-04-1980	
4A	27.0	2	5.30	01-10-1978	X
			4.11	09-04-1980	
4B	29.5	2	5.34	01-09-1978	X
			3.96	09-04-1980	
5A	29.1	2	4.92	09-04-1980	X
5B	29.1	2	11.88	01-06-1978	X
			4.83	09-04-1980	
6	30.0	2	10.78	01-07-1978	X
			5.22	09-04-1980	
7	25.3	2	7.20	01-11-1978	X
			3.07	09-04-1980	
8	29.2	2	7.91	01-25-1978	X
			5.02	09-04-1980	
9	40.0	2	14.08	01-06-1978	X
			9.01	09-04-1980	
10	28.2	2	6.89	01-11-1978	X
			3.21	09-04-1980	
11	29.6	2	7.00	01-05-1978	X
			3.25	09-04-1980	
12	28.0	2	11.60	01-09-1978	X
			4.25	09-04-1980	
13	29.2	2	8.49	01-05-1978	X
			4.66	09-04-1980	

TABLE 1-6
Well Records for USGS Test Wells (1978) and Anaconda Wells proximal to Tailings Impoundment(s)
Historical Summary Report, Anaconda-Yerington Mine Site

Well ID	Well Depth (feet bgs)	Casing Diameter (inches)	Water Level (feet)	Date	Use of Well
Anaconda Wells					
12C	465	16	6.0[a]	1-26-1965	U (I)
			22.99	03-15-1966	
			3.3	09-04-1980	
22	440	18	20.0[a]	09-08-1967	U (I)
			3.77	09-04-1980	
26	322	18	15.0[a]	07-01-1968	U (I)
			5.63	09-04-0980	
29	337	16	38.52	05-11-1976	U (I)
			5.55	09-04-1980	
35	420	16	15.0	11-28-1972	U (I)
			7.07	09-04-1980	
I	373	14	18.84	03-15-1966	Ir (I)
			8.5	09-04-1980	
S	42	6	9.60	03-15-1966	U (D)
			9.26	05-20-1976	
			11.96	12-08-1976	
			5.97	09-04-1980	
U	151	14	24.0[a]	05-24-1961	U (Ir)
			18.16	12-08-1976	
			16.03	01-26-1978	
			11.40	09-04-1980	

[a]Water level measurements reported by driller.

Notes:

Information in table extrapolated from USGS Open File Report 80-1217 (Seitz et al., 1982).

bgs = below ground surface
D = domestic
I = industrial (mining, milling, and other uses)
ID = identifier
Ir = irrigation
U = unused
X = test well placed during USGS study

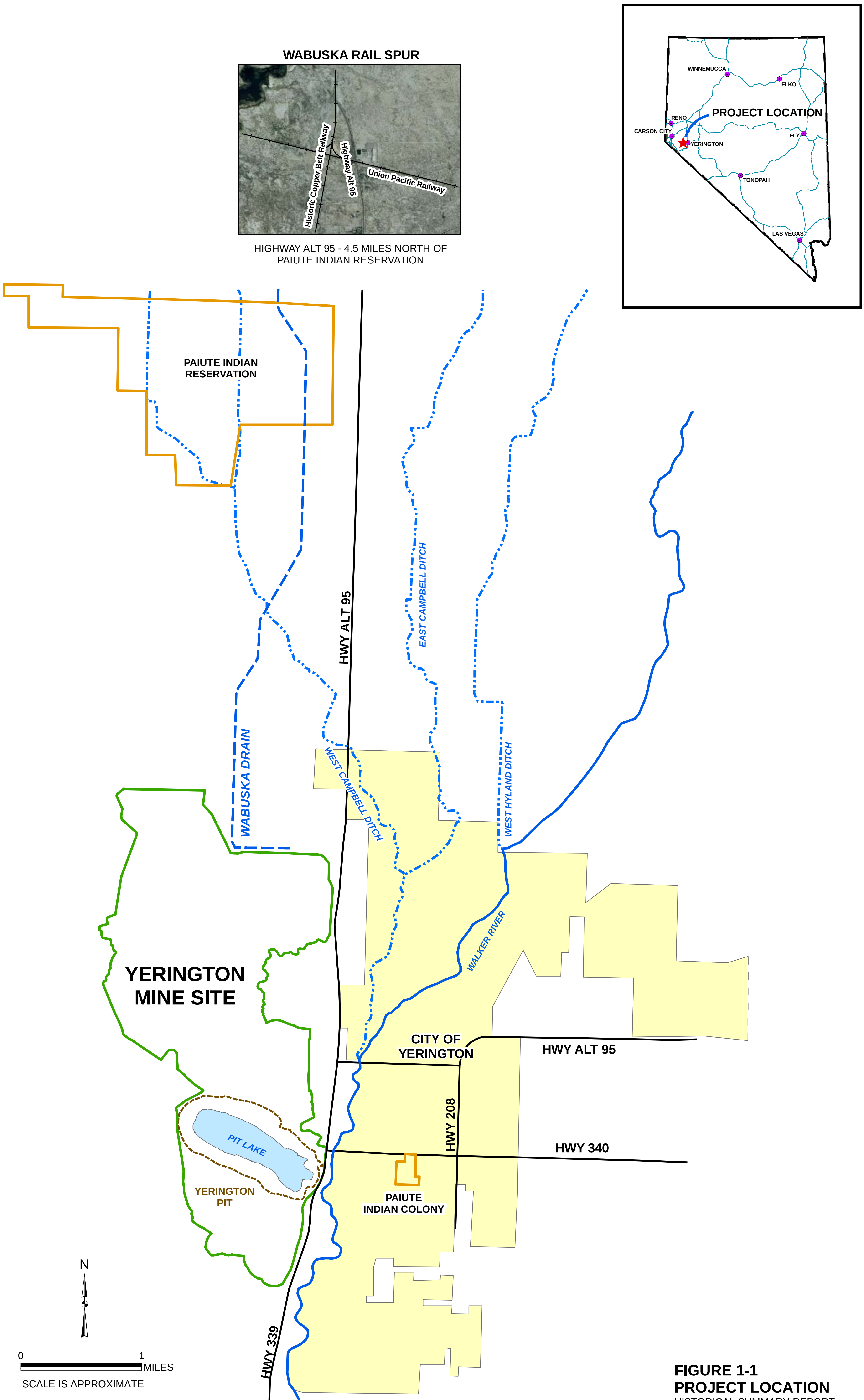


FIGURE 1-1
PROJECT LOCATION
HISTORICAL SUMMARY REPORT
ANACONDA-YERINGTON MINE SITE

\\BALDUR\PROJ\ANACONDA_COPPER_354946\MAPFILES\HIST_SUMM\FIG1-1_PROJ_LOC_HSR.MXD MSCHROCK 2/4/2010 22:44:07

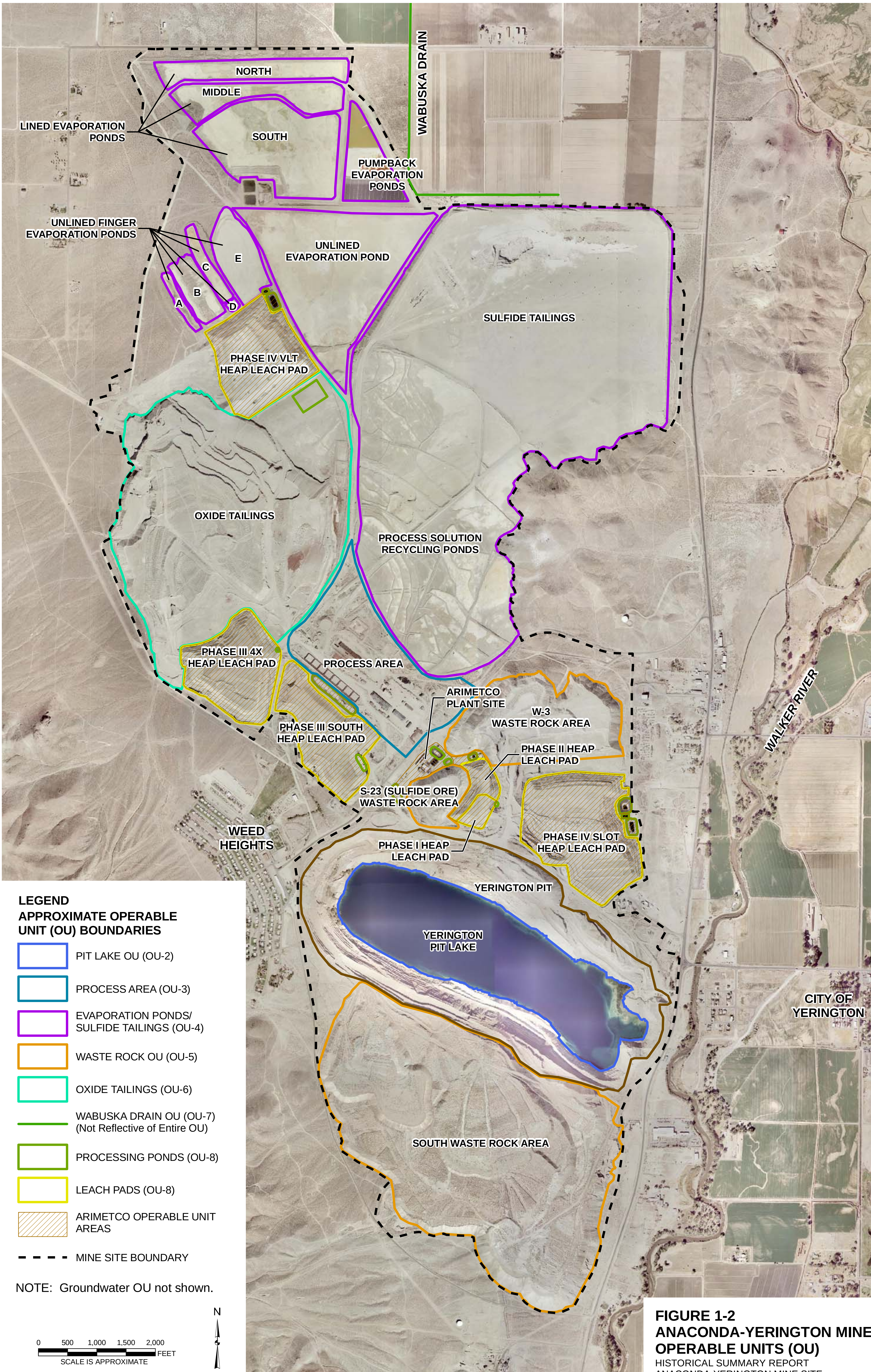


FIGURE 1-2
ANACONDA-YERINGTON MINE OPERABLE UNITS (OU)
HISTORICAL SUMMARY REPORT
ANACONDA-YERINGTON MINE SITE

\\BALDUR\PROJ\ANACONDA_COPPER_354946\MAPFILES\HIST_SUMM\FIG1-2_OP_UNIT_HSR.MXD MSCHROCK 2/4/2010 22:14:59

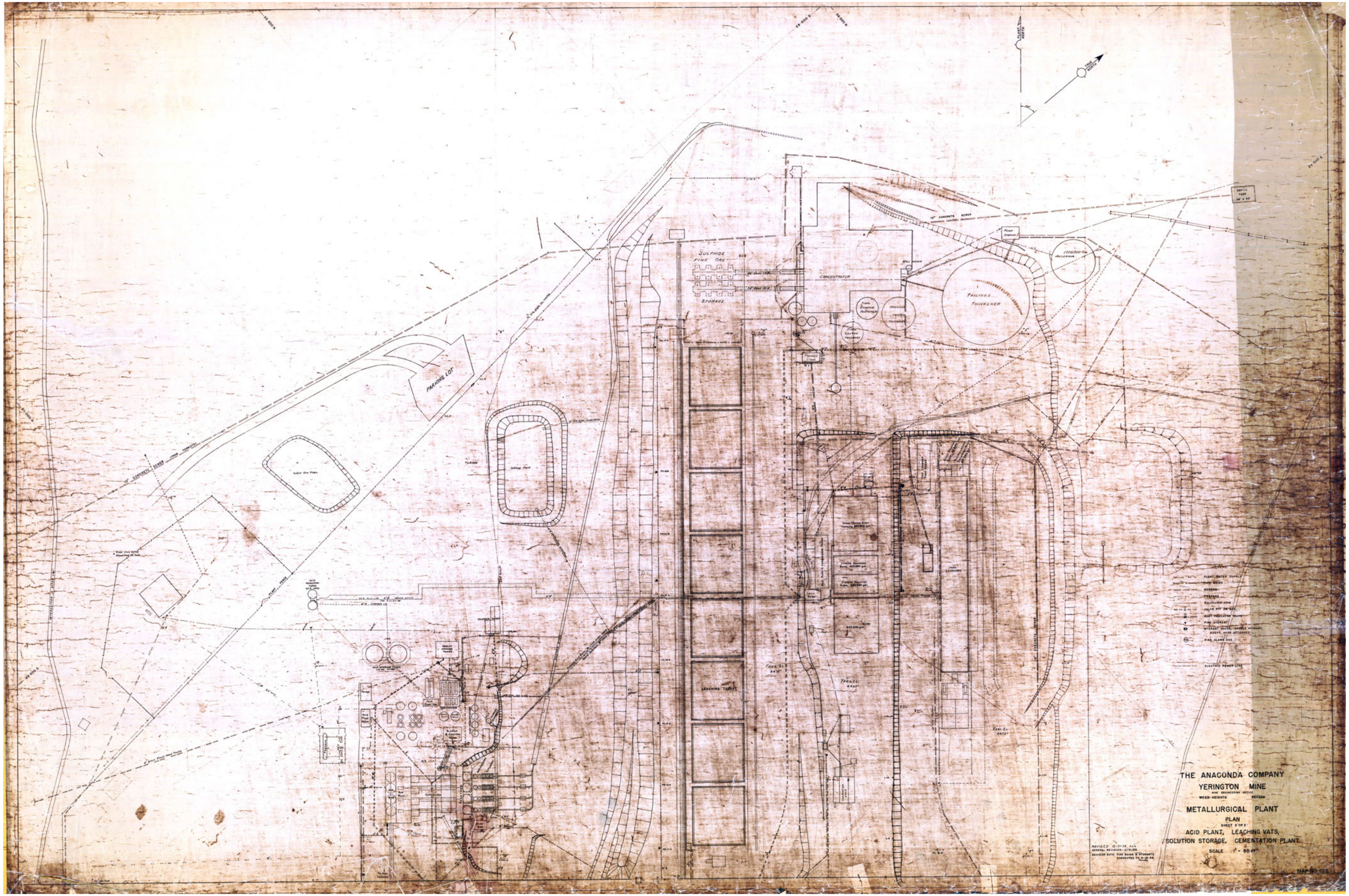


FIGURE 1-3
1954 YERINGTON MINE METALLURGICAL PLANT
HISTORICAL SUMMARY REPORT
ANACONDA-YERINGTON MINE

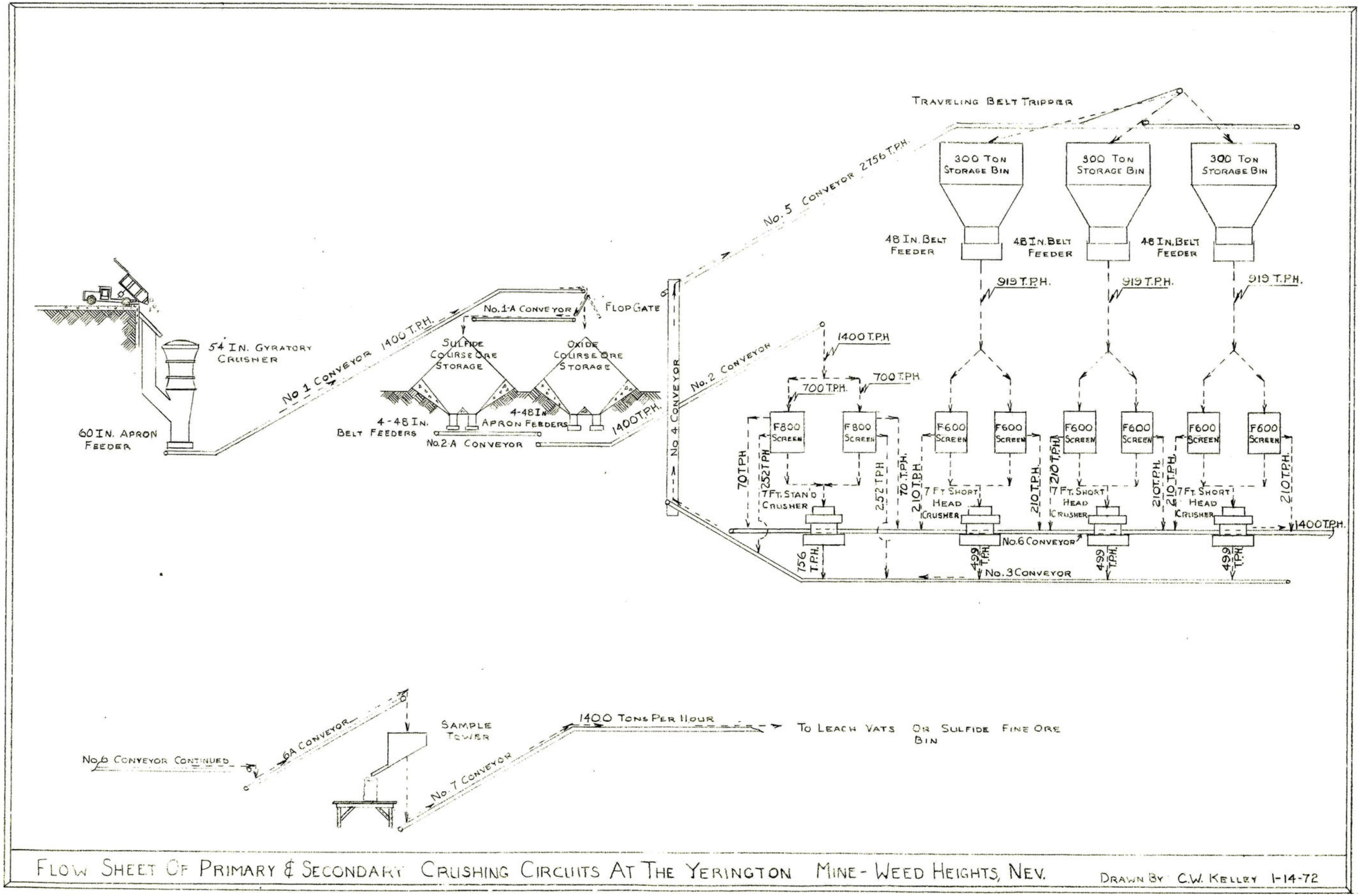


FIGURE 1-4
CRUSHER FLOW DIAGRAM
HISTORICAL SUMMARY REPORT
ANACONDA-YERINGTON MINE

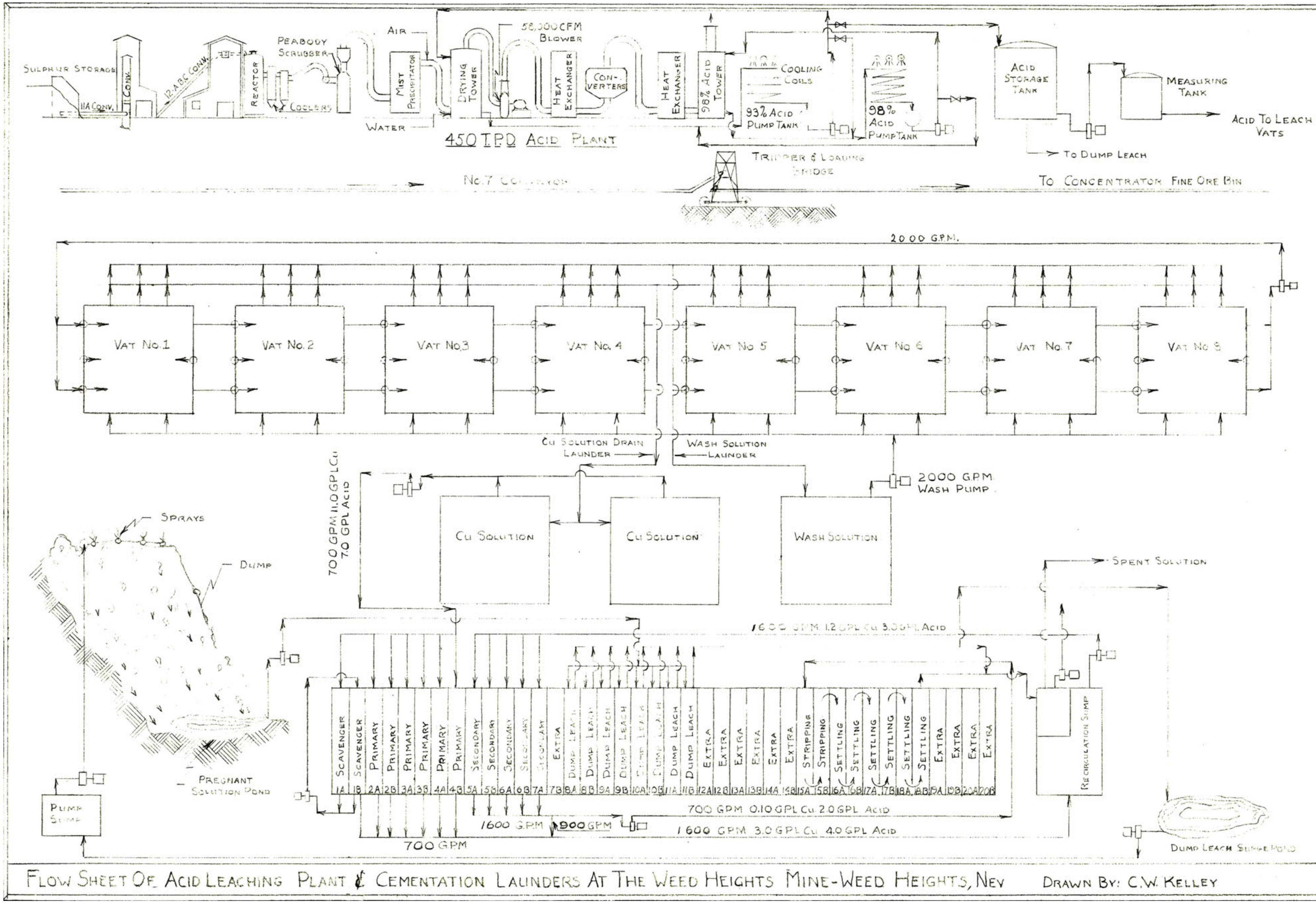
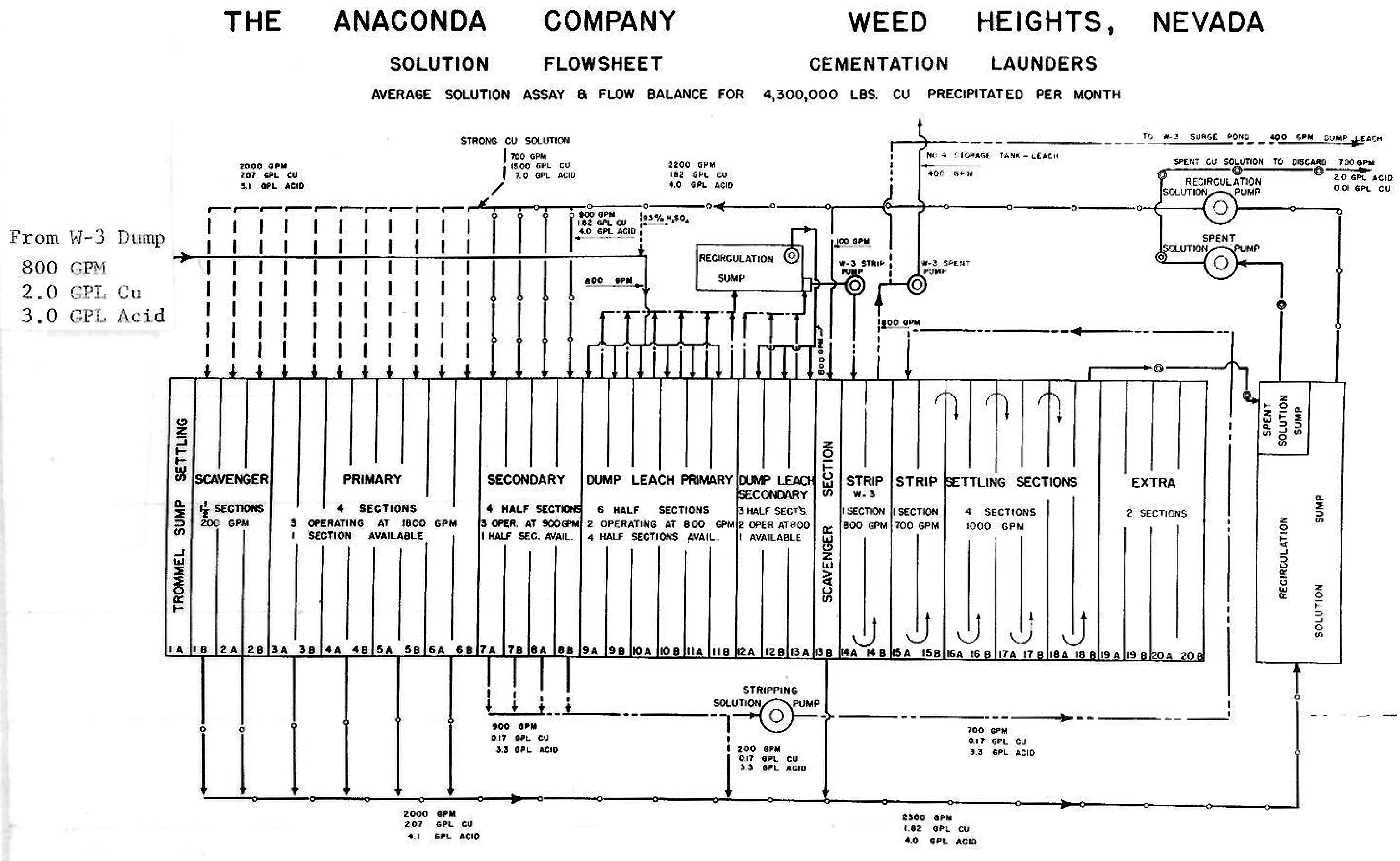


FIGURE 1-5
ACID PLANT AND CEMENTATION FLOW DIAGRAMS
HISTORICAL SUMMARY REPORT
ANACONDA-YERINGTON MINE

ES092209222513RDD_1-5 (9/22/09)



SOURCE: HISTORICAL ANACONDA FILES

ES092209222513RDD_1-7 (9/22/09)

FIGURE 1-6
SOLUTION ASSAY
FLOW BALANCE DIAGRAM
HISTORICAL SUMMARY REPORT
ANACONDA-YERINGTON MINE

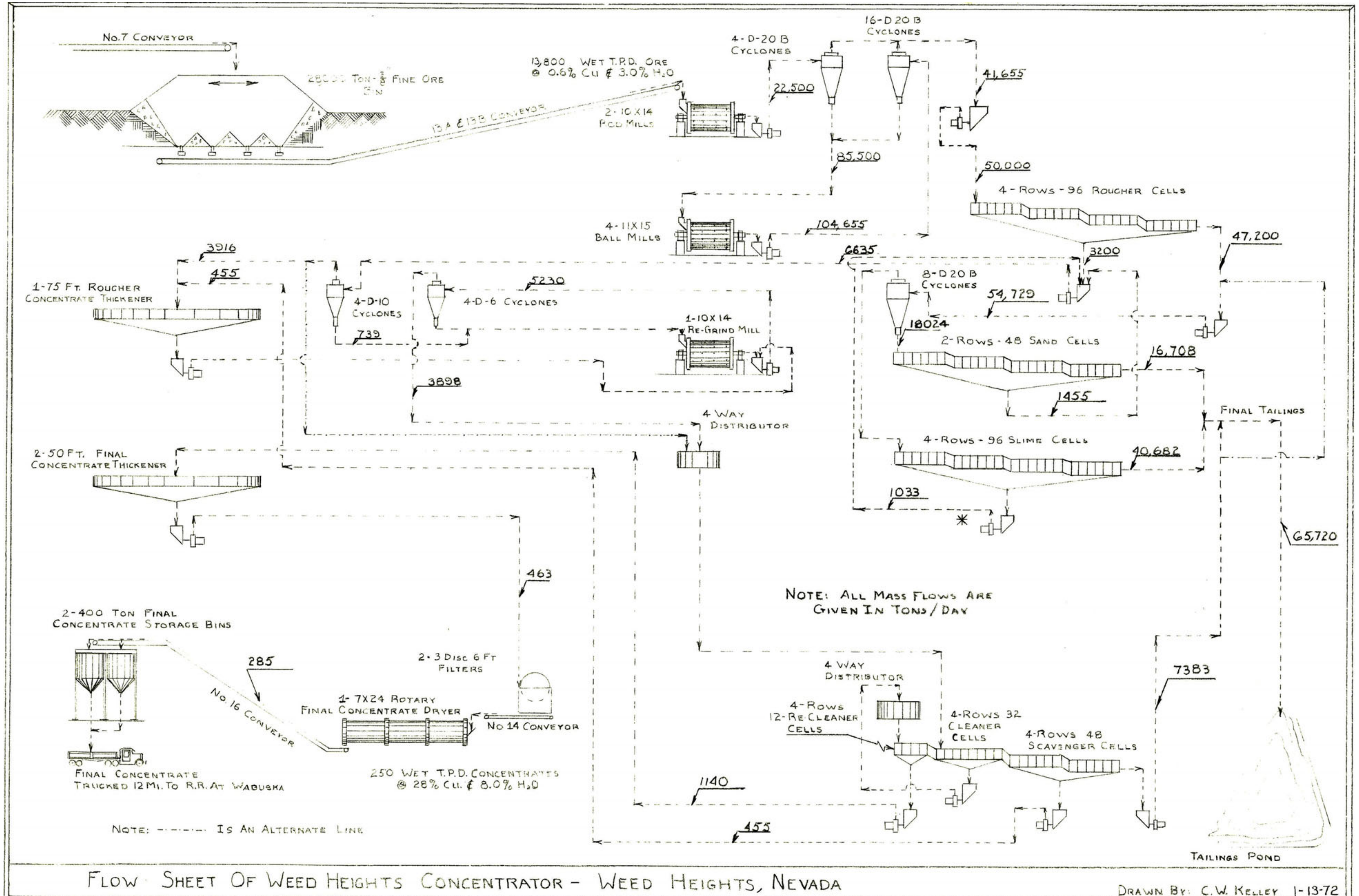


FIGURE 1-7
CONCENTRATOR FLOW DIAGRAMS
HISTORICAL SUMMARY REPORT
ANACONDA-YERINGTON MINE

ES092209222513RDD_1-8

FIGURE 1-8
ARIMETCO PHASE I/II, PHASE III 4X, PHASE III SOUTH, AND PHASE IV SLOT HEAP LEACH PADS
HISTORICAL SUMMARY REPORT
ANACONDA-YERINGTON MINE SITE

FIGURE 1-9
ARIMETCO PHASE IV VLT HEAP LEACH PAD
HISTORICAL SUMMARY REPORT
ANACONDA-YERINGTON MINE SITE

ES092209222513RDD_1-9

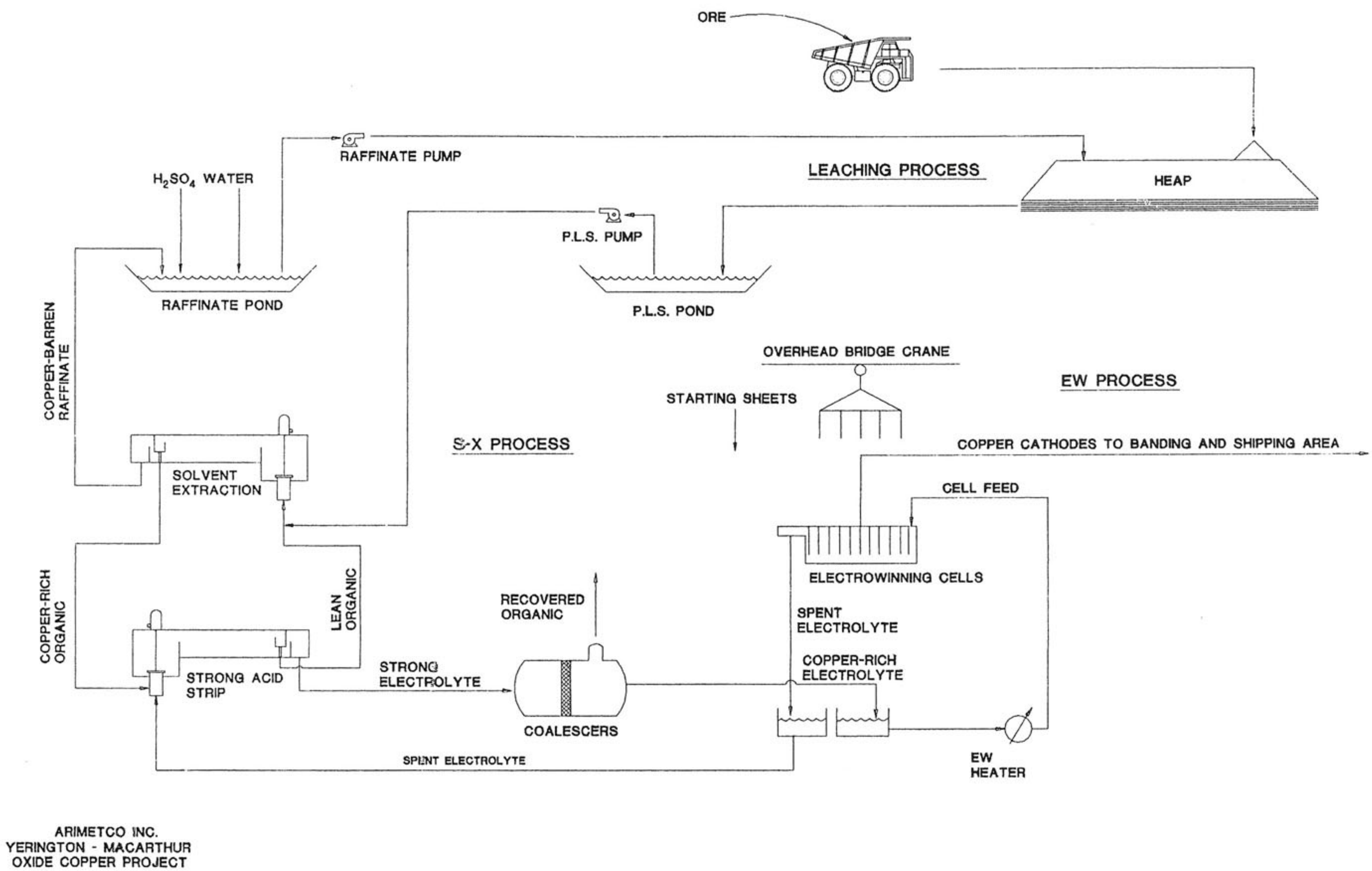


FIGURE 1-10
ARIMETCO PROCESS SCHEMATIC
HISTORICAL SUMMARY REPORT
ANACONDA-YERINGTON MINE

ES092209222513RDD_1-10 (9/22/09)

SECTION 2

Known Uses, Spills, and Disposal of Chemicals

This section incorporates available information on chemical usage, potential leaks and releases, and known spills that occurred during the operational history of the Site.

Very little data were found in the historical records documenting spill information from when the Anaconda was operating the mine. At that time, there was less regulatory oversight by agencies enforcing mine operators, and almost no records exist of specific spills into localized soils and groundwater. Although there are not specific records of spills or releases during Anaconda operations, the company was using tremendous quantities of liquids as part of the processing operations, resulting in large quantities of spent fluids and tailings slurries being disposed of directly onto the ground surface in primarily unlined (and some lined) evaporation and recycling ponds. Also, because of the mineralogical characteristics of the ore and waste rock mined at the Site from the Yerington Pit, naturally occurring radioactive minerals have been concentrated in portions of the Process Areas, tailings areas, and evaporation ponds and now occur as technologically enhanced naturally occurring radioactive materials (TENORM). Figure 2-1 presents an overall general release pathway flow diagram generated for each of the historical Site operational units, the mode of transport, the affected matrix, and the locations of the supporting evidence within this historical summary report.

EPA divided the Site into OUs (Figure 1-2) to better manage implementation of the remedial studies. With the exception of the sitewide groundwater OU-1, the following sections describe known spills and chemical usage associated with facilities and components of each of the following OUs:

- Pit Lake OU-2
- Process Areas OU-3
- Evaporation Ponds and Sulfide Tailings OU-4
- WRAs OU-5
- Oxide Tailings OU-6
- Wabuska Drain OU-7
- Arimetco OU-8

Characterization studies have confirmed that more than 3,000 acres of tailings and waste rock with concentrations of metals remain at the Site and that process fluids emanating from the ponds have low pH and contain elevated concentrations of arsenic, cadmium, chromium, copper, and iron. Also present are radionuclides, including uranium, thorium, and radium. Analysis confirmed elevated concentrations of contaminants above regulatory limits of arsenic, beryllium, cadmium, chromium, lead, and selenium. EPA concluded that heavy metals existing in source materials at the Site have contaminated groundwater.

2.1 Process Areas Operable Unit

During the 25-year operational history of Anaconda, nearly 360 million tons of ore and debris were removed from the open pit mine. The mined ore contained copper oxides and copper sulfides. In the onsite process area (Appendix A, Photographs A-16, A-19, and A-29), a copper precipitate was produced from the oxide ore, and a copper concentrate was produced from the sulfide ore. Both concentrates were shipped to Montana for smelting.

Byproducts of the milling operation were wet gangue from the sulfide ore and 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 throughout the Site. Some of the ponds were equipped with asphalt liners, while other ponds were unlined. Historical photographs indicate that the ponds occupied nearly 1,377 acres. Both the brine and tailings fluid are potential contaminants.

The following facilities are associated with the Process Areas OU:

- Buildings (22 various types of buildings)
- Primary and secondary crushers—Area 2 (CC and OO)
- Acid plant (SS; now located below the Phase III South HLP)
- Leach vats—Area 3 (P)
- Precipitation plant—Area 5 (EE)
- Sulfide plant—Area 6 (GG and HH)
- Petroleum fuel filling stations and storage tanks (U, W, X, and Z)
- Acid tanks (PP)
- Water tank (BB)
- Storage areas (chemicals, used oil, transformers)
- Conveyance piping and ditches (WW, DDD, EEE, and FFF)
- Discharge ponds and dry wells (XX, BBB, and CCC)

2.1.1 Buildings

Approximately 30 buildings have been identified within the Process Areas (Figures 2-2 and 2-3). The buildings were used for various purposes relating but not limited to ore processing, mining maintenance, and administrative and operational activities. The following table summarizes the buildings and ancillary features located within the Process Areas (Table 2-1) (Brown and Caldwell, 2007a).

Most of the Site structures were constructed on concrete slabs and are sheet-metal sided and roofed. Other historical structures onsite were constructed of asbestos roofing or insulation, common construction materials used at the time. Historical use of several of the Process Areas facilities suggests that there may be concern for potential contamination and environmental impact. Process Areas facilities that may be of concern may include but are not limited to buildings including the Administrative Building (A), the Lead Shop (O), the Warehouse and Assay Laboratory (F), the Filling Stations (U, W, X, and Z), Truck Wash and Paint Shop (M), and the Equipment Wash (C).

The *Draft Process Areas (Operable Unit 3) Remedial Investigation Work Plan* (Brown and Caldwell, 2007a) contains descriptions of chemical usage and potential releases from Process Areas buildings and associated features. An excerpt from the work plan is included as

Appendix F. This draft work plan has been reviewed by EPA and resubmitted to ARC with comments, which are currently being addressed by ARC.

TABLE 2-1
Process Area Buildings and Ancillary Features
Historical Summary Report, Anaconda-Yerington Mine Site

Facility Name	ID	Facility Name	ID	Facility Name	ID
Administration Building	A	Core Building	AA	Concrete Pump Tank	AAA
Tire Pile	B	Water Tank	BB	Upper Truck Sludge Pond	BBB
Equipment Wash	C	Primary Crusher	CC	Lower Truck Sludge Pond	CCC
Change House	D	Solution Tanks	DD	Truck Sludge Pond Ditch	DDD
School House	E	Precipitation Plant	EE	East Solution Ditch	EEE
Warehouse and Assay Laboratory	F	Solution Tanks Electrical Building and Pumphouse	FF	Solution Overflow Ditch	FFF
Large Warehouse Annex	G	Sulfide Plant Office	GG	North Low Area	HHH
Small Warehouse Annex	H	Sulfide Plant	HH	Coarse Ore Storage	III
Fire Engine Storage/Tire Shop	I	Concrete Ramps	II		
Grease Shop #1	J	Low Area #1	JJ		
Truck Shop	K	Dump Leach Surge Pond	KK		
Equipment Garage	L	Tar Drum Storage	LL		
Truck Wash and Paint Shop	M	Drain Outlet	MM		
Carpenter Shop	N	Stacker Area	NN		
Lead Shop	O	Secondary Crusher	OO		
Leach Vats	P	Arimetco Acid Tanks	PP		
Quonset Hut	Q	Arimetco Crusher/Hopper	QQ		
Emergency Shed	R	Arimetco Stacker Area	RR		
Sheet Metal Shop	S	Acid Plant	SS		
Plumber’s Shop	T	Motor Cargo Building	TT		
Filling Station #1	U	Old Crusher Site	UU		
Grease Shop #2	V	Tailings Pump Houses	VV		
Filling Station #2	W	Calcine Ditch	WW		
Filling Station #3	X	Acid Plant Pond	XX		
Electrical Shop	Y	Sulfide Ore Crusher and Stockpile	YY		
Filling Station #4	Z	Surface Pumps Foundation	ZZ		

Source: Brown and Caldwell, 2007a

2.1.2 Primary and Secondary Crushers

Both copper ore, excavated from the Pit, and sulfur ore, transported from Leviathan Mine, were crushed at the Site. Copper ore was delivered to the primary crusher (Figure 2-3 [CC]) in 25-ton, end-dump trucks and crushed to minus 5-inch. Once crushed, ore was stored in the coarse ore storage bin until collected for secondary crushing (Figure 2-3, [OO]). Sulfur ore also underwent primary and secondary crushing and was stored onsite until used at the plant to generate acid. Dust, generated from both the copper ore and sulfur ore crushing processes, was of constant concern for mine operators.

In August 1957, a confidential study was performed by John W. Warren. The survey was concerned only with the environment within the crushing plants and the effluence from the discharge stacks of the dust retention equipment. On the basis of field observations performed during the 1957 survey, the particle size analyses of the sulfur primary and sulfur secondary discharge stack indicated that the major portion of the effluence is airborne for appreciable distances. Emanations from the crushing operations at the Site were a direct function of the moisture content of the rock stream and the percentage of new rock surface. The survey concluded that the "existing problems at both the primary and secondary crushers were that the effluences from several stacks of the dust collection systems within the crushing plants are unsightly, are a nuisance, and can be of pathological consequence. The total volume of polluted effluence is of considerable magnitude, and considerable expenditure is required to clean these air flows" (Warren, 1957). The polluted volumes are listed in Table 2-2.

TABLE 2-2
Polluted Volumes Discharged from Primary and Secondary Crushers
Historical Summary Report, Anaconda-Yerington Mine Site

Location	Section	Number of Stacks	Volume per Stack (ft^3/min)	Total Volume (ft^3/min)	Grand Total (ft^3/min)
Sulfur Crushing Plant	Primary	1	4,800	4,800	
	Secondary	1	2,100	2,100	
	Ball Mill	4	1,200	4,800	11,700
Copper Crushing Plant	Primary	1	18,000	18,000	
	Transfer Tower	1	3,000	3,000	
	Secondary	4	15,000	60,000	81,000
TOTAL					92,700

Source: Warren, 1957

Note:

ft^3/min = cubic feet per minute

2.1.3 Acid Plant

Anaconda was faced with the problem of supplying its own acid because sulfur was in short supply under government allocation. The need to process low-grade sulfur ore into sulfuric acid led to the purchase and development of the Leviathan Mine in Alpine County, California. Leviathan Mine is located approximately 60 miles west of the Site. The ore body at the Leviathan Mine ran about 28 percent elemental sulfur with minor amounts of sulfides and sulfates. The sulfur ore was mined by open pit during a 7-month period each year, generating enough stockpiled material, stored at the Site, northwest of the acid plant, to operate the Yerington Mine during the winter months (Explosives Engineer, 1955). The Dorrco Fluosolids system in conjunction with a contact sulfuric acid plant (Figure 2-3 [SS]) was adopted as the method for producing sulfuric acid (Nesbitt, 1957).

The Dorrco Fluosolids system burned the sulfur ore to supply sulfide dioxide gas to the sulfuric acid plant, which was designed to produce 450 tons of sulfuric acid daily in the form of commercial-grade acid, 93 percent strength (Appendix A, Photographs A-10 and A-11).

Byproducts such as selenium were generated during the production of sulfuric acid. Over a 2-year period, analysis of the selenium content in the Leviathan sulfur ore indicated it to be present in concentrations ranging from 0.007 to 0.02 percent. In the reactors, the sulfide ore was burned in the presence of oxygen with a bed temperature maintained at 1,110 to 1,200°F. At this stage, some of the selenium was vaporized and portions burned to form selenium dioxide. Complete condensation of the vaporous selenium was brought about when the gas temperature dropped from 600 to 100°F in the Peabody Scrubber. These solids were found to average 17 to 20 percent elemental selenium. Average soluble selenium content in the effluent has been found to be approximately 2 milligrams selenium per 1 liter effluent. Selenium concentrates settled out in the 18 inches of water in the mist precipitators. These precipitators were periodically drained and washed from the bottom into two small settling ponds. By the addition of small amount of Separan 1260 during the draining period, the fine sludge was flocculated and settled completely in a 24-hour period, after which the free water was siphoned off (Zundel, 1955).

Experimental work was performed during early mining/milling operations to determine possible economic methods of recovery of elemental selenium from the solids collected inside the mist precipitators and the soluble concentrations collected from the effluent; the soluble selenium was extracted with metallic copper and the insoluble fraction by screening, dissolution and reduction from acid solutions by SO_2 and sublimation (Zundel, 1955).

As early as 1955, the selenium concentrates from the mist precipitators were dried, sacked, and shipped (Zundel, 1955). Correspondence in 1957 indicates that dry selenium concentrate, weighing 60 pounds per cubic foot, was being shipped to the International Smelting and Refining Company Raritan Copper Works in Perth Amboy, New Jersey. No information has been found on the total volume of selenium shipped offsite.

Vanadium pentoxide (V_2O_5) was used in the manufacture of sulfuric acid, and serves as the catalyzing agent for the mildly exothermic oxidation of SO_2 to SO_3 by air. This reaction, for which vanadium pentoxide is the most effective catalyst, allowed sulfuric acid to be produced in a cost-effective process. The reaction is performed between 400 and 620 degrees Celsius (°C); below 400°C, the vanadium pentoxide is inactive as a catalyst, and above 620°C, it begins to break down. Because of its effectiveness in converting SO_2 into SO_3, and thereby sulfuric acid, special care must be taken with the operating temperatures and placement when firing sulfur-containing fuels. Internal correspondences on April 27, and April 28, 1965 (Gray, 1965 and Burch, 1965) (Appendix E), concerns were raised on the need to “clean” the vanadium pentoxide (V_2O_5) catalyst in the converter section of the acid plant.

In a 36-month period from 1954 to 1956, over 507,600 tons of 93.19 percent acid were produced from approximately 587,800 tons of ore assaying 29.75 percent sulfur (Nesbitt, 1957). Table 2-3 indicates the quantity of sulfur at various points in the process, the percent weight, and the equivalent tons of 93.19 percent acid.

The dusts from the gas produced in the manufacture of sulfuric acid were removed by wet scrubbers, mist precipitators, and cyclones. The resulting wet slurry was directed to four calcine launders. From the launders, the slurry was sent along with the calcines from the acid plant reactors to the "evaporation area" along the calcine ditch, using the spent solution from the precipitation launders as a conveyance medium (U.S. Bureau of Mines, 1958).

TABLE 2-3
Quantity of Sulfur in Sulfur Ore to Sulfuric Acid Process
Historical Summary Report, Anaconda-Yerington Mine Site

Location	Tons of Sulfur	% Weight	Tons of Sulfuric Acid
Quantity of Sulfur			
In Ore	174,866.54	100.00	574,681.40
In Calcine	3,885.58	2.22	12,769.57
Total to Peabody Scrubber	170,980.96	97.78	561,911.83
Total in Acid Produced	154,455.51	88.33	507,602.60
Total Estimated Losses	16,525.45	9.45	54,309.23
Source of Estimated Losses			
Peabody Scrubber	5,471.60	3.13	17,981.87
Mist Precipitator	1,262.35	0.72	4,148.58
Drying Tower and Leaks	5,021.10	2.87	16,501.34
Stack	4,770.40	2.73	15,677.44
Estimated Losses	16,525.45	9.45	54,309.23

Source: Nesbitt, 1957

Historical documentation indicates that in 1954 the calcines discarded from the reactors increased from 25 percent of the available calcine to nearly 50 percent. The calcine was discarded from the coolers and cyclones through star valves with cooled bearings and flapper valves, respectively.

The hot calcines dropped from the dust valves into covered concrete launders set on a slope of 0.5 inch to the foot and were quenched and sluiced away with spent solution pumped from cementation in an unlined ditch (Figure 2-3 [WW]). Rerouting the calcine ditch from the acid plant (Appendix A, Photographs A-19, A-24, A-26, A-44, and A-45) to the north fence to obtain a grade of 2.5 percent solved the problem of material settling in the ditch encountered early in the mining operation. Table 2-4 contains a tabulated distribution of calcine throughout the system, including sulfur content and sieve analyses.

TABLE 2-4
Distribution of Calcine throughout the System
Historical Summary Report, Anaconda-Yerington Mine Site

	Reactor	Spray Cooler	Transfer Chamber	1st Cyclone	2nd Cyclone	3rd Cyclone	Peabody Scrubber	Mist Cottrells and Loss	Total Dust System	Total Calcine
% Weight of Total Calcine	50	6	6	30.0	3.0	1.0	3.8	.2	50	100
Tons Calcine per Day	150	18	18	90	9	3	11.6	0.4	150	300
% Sulfur in Calcine	0.76	0.70	0.67	1.01	2.06	2.32	1.75	1.75	1.082	0.921
Tons Sulfur per Day	1.140	0.126	0.121	0.909	0.187	0.070	0.203	0.007	1.623	2.763
Screen Analysis % 10 mesh	10.4	0.3	0.3						0.08	5.24
Screen Analysis % 14 mesh	10.8	1.9	1.9						0.48	5.64
Screen Analysis % 20 mesh	15.6	2.0	2.0						0.48	5.64
Screen Analysis % 28 mesh	14.3	2.0	2.0						0.48	7.39
Screen Analysis % 35 mesh	16.3	2.4	2.4						0.56	8.34
Screen Analysis % 48 mesh	14.1	2.8	2.8	0.1					0.74	7.42
Screen Analysis % 65 mesh	11.5	7.0	7.0	1.3					2.46	6.98
Screen Analysis % 100 mesh	5.3	25.6	25.6	22.8					19.84	12.57
Screen Analysis % 150 mesh	1.1	23.2	23.2	19.2					17.08	9.09
Screen Analysis % 200 mesh	0.1	10.6	10.6	17.2	10.0	10.0	5.0		13.94	7.02
Screen Analysis % -200 mesh	0.5	22.2	22.2	39.4	90.0	90.0	95.0	100.0	43.86	22.18

Source: Anaconda, 1954

In 1962, Anaconda ceased mining sulfur ore from the Leviathan Mine in Alpine County, California, for the purpose of generating acid. Following closure of Leviathan Mine, acquiring sulfur from outside sources was required. Historical correspondence indicate that liquid sulfur was being purchased from several suppliers, transported by railcar to Wabuska station, and hauled to the Site, where Anaconda then continued generating acid at the plant. Although the oxide ore had been depleted and the need for acid was minimized, leaching activities that commenced at the W-3 WRA required acid to extract any remaining copper in the WRA. The acid plant was dismantled and removed by Arimetco in June 1992. The area where the acid plant was once located was prepared for lining and ready for ore placement in July 1992. Currently, Arimetco's Phase III South HLP is above the historical acid plant, sulfuric stockpile, and portions of the calcine ditch.

2.1.4 Leach Vats

At the Site, the 8-day cycle of bedding the ore, leaching, draining, and excavation of residue was carried out in sequence in eight vat leach tanks (Figure 2-2 [P]) (Appendix A, Photographs A-3, A-4, A-5, A-23, A-24, and A-26). Each leach vat measured 120 by 135 feet, and a 16-inch filter bottom and an allowance for freeboard at the top made the available depth of each vat 18.8 feet. Each tank held approximately 12,000 tons of ore and 800,000 gallons of solution (U.S. Bureau of Mines, 1958).

The leach vats were built of reinforced concrete with a wall thickness of 1 foot at the top widening to a wall thickness of 3 feet at the base. To protect the concrete from the corrosive action of sulfuric acid, mastic lining was used. The lining consisted of 30 percent asphalt and 70 percent sand, reinforced with two layers of 6-inch-square mesh and No. 2-gage welded wire. The filter bottom on the vats was built with three layers of timber stringers and two layers of cocoa matting. The bottom layer is made up of timbers spaced on 16-inch centers, leaving a 2-inch space on the ends, and allowing the solution to drain to three transverse and two longitudinal drain channels into the subsequent vat.

Aggregate remaining in the leach vats following the leaching and washing process was dug from the vats with an 8-ton clamshell bucket and discharged into two 50-ton hoppers mounted on a traveling unloading bridge. The aggregate or tailings were then hauled to the oxide (or VLT) tailings waste dumps (U.S. Bureau of Mines, 1958).

In April 1954, questions were raised by F.F. Frick, Research Engineer, to A.E. Miller, Anaconda General Manager (Frick, 1954) (Appendix E), regarding the integrity of the "Insul-Mastic coating" used in the construction of the leach vats. Questions included the following:

1. Were the coatings at Yerington put on by representatives of the Insul-Mastic Company?
2. A concern was raised that "blisters" had developed in the mastic lining (Appendix A, Photograph A-4) because of pin holes and that the "blisters" were drained and dressed back into place. Was this the case?
3. Directions indicate that the lining needs to "cure" from 35 to 45 days to allow for complete evaporation of the solvent. Were the original coatings at Yerington cured for 35 days or more? Have any patches been made? If so, how was the surface prepared? Were the coatings aged properly prior to use?
4. As General Manager, are you satisfied with the Insul-Mastic coatings?

A memorandum was prepared in response to the concerns raised and indicated the following:

1. Insul-Mastic coatings were applied by California Coatings, Inc., of Sacramento.
2. "Blisters" appeared on the east, north, and west inner walls as well as the floor in a matter of hours following application. It was suggested that the "blisters" formed as a result of high atmospheric temperatures and low humidity, causing rapid evaporation

of the solvents at the outer surface of the coating. Blisters were all punctured and repaired with glass fabric and additional Insul-Mastic. The "blistering" was very prevalent when the total coating thickness over the glass fabric was sprayed in one application and eliminated when the coating was made in separate applications over a period of 4 days.

3. Because of climatic conditions, it was stated that Yerington Mine was advised that the 35- to 45-day cure was not necessary. "We did not cure the coatings for this period before putting them to use, nor have we made any repairs to the coating as yet."
4. It is early to determine if the Insul-Mastic coating is satisfactory. There are, however, "blisters" showing up now that the daytime temperatures have increased. Causes behind these blisters have not been determined.

The integrity of the Insul-Mastic lining on the leach vats was not addressed again until 1962 in a series of memorandums within Anaconda where the Asphalt Institute addressed concerns raised by the Chief Engineer at Yerington. In May 1962, the Insul-Mastic Lining in Vats No. 3 and 4 was repaired. A memorandum to the Yerington Mine Plant Superintendent summarizes the work completed in repairing the mastic wall lining with an account of the contributing factors necessitating the repair work (Gadkowski, 1962; Monninger, 1962).

2.1.5 Solution Storage Tanks

There are four solution storage tanks, also referred to as solution sumps, located between the leach vats and the precipitation plant (Figure 2-2 [DD]). Three of the four solution storage tanks were used for storing strong copper solution exiting the leach vats with a total storage capacity of approximately 1.4 million gallons. One additional storage tank, referred to as the wash water sump, offered space for 845,000 gallons of wash water from the leaching circuit, which included slurry from the Peabody scrubber in the sulfuric acid plant. Recent documents (Daily Logs for the W-3 Dump Leach) indicate that excess wash water was pumped to a nearby well (WW-10) used as a dump sump. The total number of gallons of wash water discharged into the well is not known; however, laboratory analysis performed in 1992 on water collected from the well indicated that arsenic concentrations exceeded 3.0 mg/L.

2.1.6 Precipitation Plant

The precipitation plant, more commonly called the "cementation operation" (Figure 2-3 [EE]), consists of precipitation launders, solution sumps, an adjacent launder pump station, scrap iron storage, and trommel screens. The precipitation plant consisted of 20 parallel launders that were filled with light-gauge scrap iron used to precipitate copper from the sulfuric acid leach solution pumped out of the leach vats and temporarily stored in the solution tanks, as described in Section 1.3.3. A solution-distribution launder is built along the full width of the ends of the launders (U.S. Bureau of Mines, 1958). The waste product from the cementation plant was a ferrous sulfate solution that was conveyed to the evaporation ponds. Pregnant copper solution from dump leaching activities was also sent to the precipitation plant but was kept separate from the vat leach solution (Brown and Caldwell, 2007a).

New PLS was pumped in 8-inch lead pipes from the storage reservoir, at the rate of approximately 700 gpm, to the weir box at the head of the distribution launder, where it was joined by 900 gpm of recirculated solution. The solution percolated upward through the primary launders (Appendix A, Photographs A-6, A-7, A-8, and A-9), which were three-quarters of the way full with new scrap iron (Appendix A, Photographs A-6 and A-7), and overflowed into the recirculation launder at a rate of 1,600 gpm. The discharge from the stripping launders flowed to a 30,000-gallon waste sump, from where it was pumped to the acid plant to sluice the calcines and dust residues to the evaporation area (U.S. Bureau of Mines, 1958).

Each primary launder was kept in the cementation circuit approximately 4.75 days, each secondary launder approximately 6.75 days, and each stripping launder approximately 15 days. The launder was then taken out of circuit and washed 8 to 12 hours, using a volume of five times as much water as cement copper and drained. The cement copper was excavated with a crane and ultimately dumped into trammels, where the copper was washed through the openings and into a 36- by 36- by 7-foot settling basin. Discharge from the end of the trammel consisted of washed scrap-iron, which fell into another pit from which it was recharged to scavenger launders. At Wabuska, the cement copper was loaded into railroad cars and shipped for smelter at Anaconda, Montana (U.S. Bureau of Mines, 1958).

2.1.7 Petroleum Fuel-filling Stations and Aboveground Storage Tanks

Included on historical Anaconda electrical substation maps (Figure 2-6) and on Copper Tek plans dated May 1989, a fast-fuel system was located west-northwest of the SX/EW facility. Plans submitted in October 1990 do not address or indicate that the fast-fuel system remains; however, aboveground features, such as a historical pump station, asphalt foundations, and abandoned fuel lines, indicate that the remnants of this fast-fuel stop still exist. Additional documentation provided by Brown and Caldwell indicates that several aboveground storage tanks are present onsite. These are listed in Table 2-5.

TABLE 2-5
Aboveground Petroleum Storage Tank Inventory
Historical Summary Report, Anaconda-Yerington Mine Site

Location	Capacity (gallons)	Contents	Secondary Containment	Volume
Filling Station 1	10,000	Diesel	Yes	None
Filling Station 1	1,000	Gasoline	No	None
Truck Shop (inside)	500	Used Oil	Unknown	None
North of Truck Shop (outside)	1,800	Used Oil	Yes	None
North End of Truck Shop	~5,000	Oil	Yes	None
North End of Truck Shop	~5,000	Oil	Yes	None
North End of Truck Shop	3,000	Oil	Yes	None

2.1.8 Acid Tanks

A former aboveground acid tank is located south of the solvent extraction plant, adjacent to the tank farm in the former Arimetco SX/EW facility. Although no acid remains in this former acid tank, heavy staining does exist within a secondary containment area.

The acid tank area (Figure 2-2 [PP]) is located approximately 1 mile northwest of the main Anaconda process facility. Currently four aboveground acid tanks are located approximately 1,400 feet southwest of the Phase IV VLT HLP (Table 2-6).

TABLE 2-6
Aboveground Acid Tank Inventory
Historical Summary Report, Anaconda-Yerington Mine Site

Location	Capacity (gallons)	Contents	Secondary Containment	Volume Remaining
Acid Tank	5,000	Sulfuric Acid	Yes	Unknown
Acid Tank	5,000	Sulfuric Acid	Yes	Unknown
Acid Tank	50,000	Sulfuric Acid	Yes	Unknown
Acid Tank	10,000	Sulfuric Acid	No	Unknown

The 50,000-gallon metal sulfuric acid tank is confined within an earth-bermed, plastic-lined secondary containment area, the contents of which have been drained, although the volume of residual acid is unknown. Approximately 30 feet outside the 50,000-gallon tank containment area is an approximately 10,000-gallon acid tank lying on its side with chocks to prevent rolling. Two additional metal sulfuric acid tanks with 5,000-gallon capacities are located approximately 70 feet northwest of the large tank and are also within an earth-bermed, plastic-lined secondary containment. Soil is yellow within the secondary containment and at the end of an outlet pipe outside the containment (Brown and Caldwell, 2003a).

2.1.9 Water Tanks

A water tank is located on the southwest slope of the Phase III South HLP. The water tank was used to supply the water for both the mine and for the Weed Heights residents and is currently not in operation. The capacity and volume of water remaining in the tank is unknown (Brown and Caldwell, 2003a).

In 1964, a site evaluation was performed by K.W. Humphreys, Anaconda Personnel Director, on the domestic water supply in Weed Heights, which is supplied by the onsite production (dewatering) wells surrounding the Pit Lake, and pumped to the water storage tank, which remains standing adjacent to the current Phase III South Heap Leach Pad. Several residents complained of “the taste of oil in the water,” and several additional homes were deemed “not safe” according to analytical results. The specific date of the complaint and location of the complainant are specified in a July 31, 1964, Humphreys memorandum (Appendix E). The town-site head tanks were chlorinated with high-test hypochlorite in an effort to clear the water on July 29, 1964. On July 30, confirmation samples were taken from all three head tanks, one plant head tank, and three residential homes. On that same day, concerns were expressed about the “situation” and stated that if it was not “cleared,” the Company should consider a permanent chlorinating system (Humphreys, 1964).

Historical records indicate that a Site visit was performed on March 17, 1976, and that the town-site water tanks were checked visually by removing manhole covers, indicating additional water tanks were used for the town water supply. Locations of these tanks are not known. Nothing could be seen floating on the water in the tank, but there was a “film” of some type in the tank. The top and ladder framework was badly pitted with rust and a completely open vent on each tank was noted. One tank appeared to have an access hole that allowed rainwater and dirt into the tank (Bailey, 1976).

Recommendations following the inspection of the town-site water tanks included flushing each tank as it was drawn down and increasing the amount of chlorine put into the system at the mine.

2.2 Evaporation Ponds/Sulfide Tailings Operable Unit

Discarded solutions from the vat-leaching operations were conveyed by open ditch and disposed of by solar evaporation in the northern portion of the Site (Appendix A, Figure A-6). This area was developed during mining operations into nine evaporation ponds that cover an area of approximately 500 acres (Appendix A, Photographs A-12, A-14, A-15, A-26, A-45, A-46, A-47, A-50, A-55, and A-56). The ponds were unlined, sealed by a compacted clay surface, or sealed by application of asphalt to a prepared surface (i.e., lined). When the ponds completely dried, following cessation of mining operations in 1978, several thousand tons of salts rich in iron sulfates remained (Anaconda Company, 1978).

2.2.1 Unlined and Lined Evaporation Ponds

PLS from the vat-leaching process was used in copper cementation to recover the dissolved copper. This process involved the replacement of iron by copper ions. The spent solution was bled off when the iron content in the solution reached a saturation level that resulted in inefficient ion exchange and copper recovery. The bleed solution was pumped into an unlined ditch that channeled it into evaporation ponds in the northern portion of the Site, west of the sulfide tailings impoundment (Seitz et al., 1982). An estimated 700-gpm or 1,100 acre-feet of solution per year were pumped to the unlined Iron Bleed Pond, also known as the unlined evaporation pond (Figure 1-2 and Photograph A-2). Between 1971 and 1978, an adjoining evaporation pond to the north was constructed. This pond was lined with asphalt (the lined evaporation pond) and was used to evaporate the “bleed” solution (Dalton, 1998).

In 1955, the flow rate to the drainage area averaged approximately 2,000,000 gallons per day, or 1,385 gpm. Despite the high-flow rate, water levels receded steadily, and water characteristics from samples taken immediately behind the tailings dam showed a free acid concentration of 1.0 g/L, total soluble salts concentration of 171 g/L, and total iron concentration of 37.5 g/L. This implied that spent process solution from the mining process was infiltrating into the subsurface (Nesbitt, 1955a; Dalton, 1998).

The ponds, lined and unlined, were used by Anaconda for the disposal of spent solution from copper cementation processing, the acid plant’s Peabody scrubber (Nesbitt, 1955b), and additional solution from other process components. In 1976, the USGS performed a study investigating the possible groundwater impacts of tailings and brine disposal at the Site. Observed findings indicate some chemical similarity between the tailings fluids and shallow groundwater near the tailing recycling ditch (located north of the unlined evaporation pond) and seepage to the Wabuska Drain located north of the unlined tailings pond.

Just west of the large, triangular, unlined evaporations pond (also called the Iron Bleed Pond), there are five additional unlined ponds referred to as the "Finger Ponds" (Figure 1-2). The unlined Finger Ponds were partially buried by construction of the Phase IV VLT HLP. The Finger Ponds were already partially filled prior to Arimetco's start of operations in 1989. The area of the Finger Ponds included approximately 13 acres of exposed "red tailings," the southeast corner of which Arimetco excavated during VLT heap construction (Brown and Caldwell, 2003b). Although the Finger Ponds were originally unlined, Arimetco documentation indicates that a thin layer (1 to 4 inches) of sulfate precipitate overlayed an asphalt liner, which in turn overlayed soil. The integrity of the asphalt liner was uncertain (Waltz, 1994). As described previously, lined evaporation ponds were constructed north of the large, unlined evaporation pond. The lined ponds have been identified as the north, south, and middle lined evaporation ponds. These ponds were constructed and placed into operation between 1971 and 1978 and were used to evaporate process water.

The Anaconda facility was identified as a potential hazardous waste site, and entered into CERCLIS on October 1, 1979, 1 year following Site closure. Several characterization and investigative actions involving the migration of fluids emanating from the evaporation ponds occurred following the Site listing. In 1985, the NDEP issued an order to ARC requiring that groundwater conditions along the northern boundary of the Site be addressed. Following the publication of groundwater conditions north of the Site (Seitz et al., 1982; Anaconda, 1984b), the NDEP issued an Administrative Order requiring ARC to install pumpback wells and an associated evaporation pond and initiate pumpback well system operations. The pumpback evaporation pond was initially a single unlined triangular evaporation pond, constructed to evaporate groundwater extracted from the pumpback system; the PWS is located east of the lined evaporation ponds and north of the unlined evaporation ponds.

In 1985, Canonie Engineers and Environmental Services Corp., an agent for ARC and later for Arimetco performing operations and maintenance of the pumpback well system, reported, "The contaminants apparently originated as leachate from the evaporation ponds. Brines and sludges from the processing of copper oxide ore were deposited in these ponds during the 25-year active life of the tailings site. The liquid waste seeped into the ground water and now acts as a constant source of contaminants for migration offsite. The contaminants appear to be migrating northwest of the site at a rate of up to 25 feet per year."

In 1998, ARC installed six additional pumpback wells and modified the PWS evaporation pond by partitioning the pond into three cells and adding clay liners. In 2000, ARC upgraded the liner systems in the middle and south PWS by installing 60-mil HDPE over the existing clay liners. The north cell of the PWS evaporation pond remains lined with the clay liner, which was installed in 1998. ARC continues to operate the PWS and the tree lined pumpback evaporation ponds at the northernmost region of the Site pursuant to the NDEP Administrative Order and subsequent EPA orders.

In 1999, at the request of the Yerington Paiute Tribe, EPA began evaluating the former Anaconda-Yerington Copper Mine Site and the effectiveness of the existing pumpback system in preventing offsite migration of contaminated groundwater. EPA sought to determine if domestic wells had been impacted by the Site (Superfund Technical Assessment and Response Team, 2000).

2.2.2 Sulfide Tailings Area

The sulfide tailings area is the depositional area for the dewatered slurry from the sulfide ore benefaction process that operated between January 1961 and June 1978 (Appendix A, Figure A-13). The sulfide ore process involved recovering the copper by fine crushing and chemical flotation, where lime was added to maintain basic pH. Tailings were deposited as slurry in designated pond areas (Appendix A, Photographs A-12, A-18, A-21, A-26, A-27, A-46, A-49, A-50, A-54, and A-56), from which decanted water was pumped back to the process circuit via water recycling ponds, which were present on the southern margin of the sulfide tailings area. Seepage from the northernmost portion of the sulfide tailings area was collected in a peripheral ditch and recycled along with the process water. The tailings ponds dried soon after mining ceased in 1978; however, it is likely that the lowermost portions of the sulfide tailings remained saturated, preventing any heavy construction (Anaconda Company, 1978). The sulfide tailings area, including the water recycling ponds, occupies the northeast corner of the Site and is the largest surface mine unit on the Site (Brown and Caldwell, 2003b).

The depositional area for the sulfide ore tailings was contained by a dam (Appendix A, Photographs A-18, A-21, A-26, A-45, and A-46) that was constructed of VLT material, "on relatively flat land" beginning in 1958. The dam was to be constructed to accommodate the estimated 21 million tons of sulfide ore. At the time of construction, the oxide tailings used to build the dam contained approximately 11 percent moisture and required dry time to allow loaders to deposit the VLT without sinking. The VLT were hauled by dump truck to the dam area and spread out using bulldozers. There was one pond, the area of which was approximately 20 acres. The dams were raised using the VLT in approximately 3-foot lifts and then backfilled with the sulfide tailings.

The dam was constructed to an elevation of 4,425 feet. A "tower" was constructed on the eastern flank of the dam, so that a ditch could be cut at an elevation of 4,375 feet on the natural ground and carry any flow in the ditch through the dam itself at a point where the dam meets the natural ground at the east side at the same elevation of 4,375 feet. The tailings line was carried on the top of the dam at an elevation of 4,425 feet, and discharge pipes were placed at regular intervals at the north face of the dam, allowing tailings to discharge in that area. By discharging the tailings here, the fines were expected to "seal off" the face of the dam and also the surface of the ground and "eventually" prevent seepage. Recovery of any water from the tailings pond area would not be possible in the early stages; however, recovery would be considered at a later date.

When the mine began disposing of the tailings, there were downspouts from the pipeline on top of the dam to the bottom of the dam so that the sulfide "concentrator tailings" could be deposited around the dam, be constructed from the VLTs, and generate a seal to prevent wash out. Following years of operation using the downspouts, sulfide plant tailings were quite above the water level around the dam initiating the dumping of tailings directly from the 10-inch-diameter pipeline on top of the dam for a period of 2 to 3 months until moving to another area and continuing this process.

In 1964, the mine was disposing of nearly 6,900 tons of material a day and using nearly 1.5 million gallons of water in the disposal process. "The water, of course, returned to the plant from the dam" (Anaconda, 1954).

The tailings were pumped from the concentrator to the tailings dam in a 10-inch-diameter pipeline. The pumps did not have sufficient capacity to handle the entire amount of tailings, so a portion of it was bypassed through a concentrate pipe sewer and discharged at the high end of the dam (Anaconda, 1964).

The sulfide tailings (also known as concentrator tailings) comprise rock that was ground to less than 65 mesh and deposited over an area of approximately 600 acres. When the sulfide tailings were dry and exposed to wind, they generated an extreme dust hazard (Anaconda Company, 1978). To address this dust hazard, Anaconda covered the sulfide tailings with VLT. When Anaconda operations ceased in 1978, approximately 95 percent of the surface of the sulfide tailings was covered with VLT. The remaining 5 percent was considered too unstable to cover at the time of closure because of the grain size and moisture content. As part of a removal action conducted in 2006 to address dust concerns, EPA covered most of the remaining exposed sulfide tailings with VLT.

2.3 Waste Rock Operable Unit

Waste Rock Areas from mining at the Site are located both north and south of the Yerington Pit. These areas have been divided into the following three distinct regions: (1) the South WRA; (2) the W-3 WRA; and (3) the S-23 WRA. The WRAs consist primarily of alluvium and weakly mineralized quartz monzonite bedrock.

Historical data indicate that other WRAs existed during earlier mining stages; however, they have since merged or been renamed into these three regions. The WRAs have not been in use since 1978, except for the excavation Arimetco performed in the W-3 WRA to generate heap leach materials.

2.3.1 South Waste Rock Area

The South WRA is the largest and oldest of the three areas and occupies most of the disturbed land south of the open pit. It is almost entirely on land controlled by BLM, an area estimated to cover approximately 388 acres, and contains most of the 90 million tons of alluvial gravel removed above the ore bodies and another 25 million tons of rock waste that occurred with the ore. Its elevation ranges from 4,600 feet amsl to 4,750 feet amsl, and the side slopes are generally sloped 1.4 horizontal (H):1 vertical (V) and have a maximum height of approximately 160 feet (Brown and Caldwell, 2003c). This area may include minor amounts of alluvium removed during exploration or lode mining as early as the late nineteenth century. Historical Anaconda documents suggest that some of the rock may be low-grade copper ore.

This waste rock has been excavated for construction materials for both onsite and offsite use, including but not limited to state highway construction, country road construction, fill for public and private buildings, rip-rap for the Walker River, irrigation and drainage canals, and decorative rocks (Anaconda Company, 1978).

2.3.2 W-3 Waste Rock Area

The W-3 WRA is located north of the open pit and originally encompassed the area now occupied by the Phase IV Slot HLP. The W-3 WRA is almost entirely on land controlled by

BLM. Following excavation to supply leach materials for the Phase IV Slot heap, the area covers approximately 80 acres, and its elevation ranges from 4,404 to 4,646 feet amsl. The side slopes are generally 1.4H:1V and have a maximum height of about 210 feet. Materials consist of quartz monzonite with varying degrees of oxide staining and with particles ranging from 8 inches to silt sized (Brown and Caldwell, 2003c).

2.3.3 S-23 Waste Rock Area

The S-23 WRA generally consists of low-grade material stockpiled west of the Phase I/II HLP and south of the Arimetco SX/EW plant. It was originally constructed by Anaconda and has been identified on historical maps as “Sulfide Tailings,” “Low-grade Sulfide Ore,” or “S-23 Waste Rock.” The area is located entirely on private land and covers approximately 19 acres. It ranges in elevation from 4,468 to 4,494 feet amsl. A 100-foot-wide haul road provides access to the top surface of the waste rock pile. The side slopes are generally 1.4H:1V and have a maximum height of approximately 110 feet (Brown and Caldwell, 2003c). Historical records indicate that this WRA is referred to as the S-23 WRA as opposed to the S-32 WRA, as indicated in the documents prepared by Brown and Caldwell, suggesting that the numbers were at some time transposed in early reports.

2.4 Oxide Tailings Operable Unit

Oxide tailings or VLT are the leached products of Anaconda’s vat leach copper extraction process. The oxide tailings dumps, located north of the Process Areas, contain the crushed rock and the red sludge at the base of the leach vats that remained following the extraction of copper in the vat-leaching process. The vat-leach process involved crushing ore into a uniform minus 0.5-inch size, and loading it into one of eight large concrete leach vats where weak sulfuric acid was circulated over an 8-day period. Pregnant leach water exiting the vats was conveyed to the precipitation vats, where cement copper was precipitated onto iron and de-tinned cans. Barren water was then passed to iron launders, where excess iron was removed and the water recycled to the leach vats (see Section 1.3.3). Following the 8-day cycle, the spent ore was removed from the vats and transferred to haul trucks for conveyance to the oxide tailings area. The rate of delivery of oxide tailings is estimated at about 10,000 tons per day, beginning in 1953 (Dalton, 1998). The sulfate- and iron-rich water that resulted from this process was discharged to the unlined and lined evaporation ponds (see Section 1.3.3).

The oxide tailings area covers approximately 500 acres, with an average height exceeding 100 feet. The top surfaces are composed of multiple benches and VLT mounds and have been channeled to prevent storm runoff and erosion. In planning for the Phase IV VLT HLP project, Arimetco estimated that nearly 70 million tons of material remained in the oxide tailings area (Brown and Caldwell, 2003b). The VLT material is characterized as a homogeneous quartz monzonite.

It should be noted that the oxide tails also harbor an acid storage tank at the north end of the tails, a hopper at the northwest end of the tailings, and many of the tin cans used in the iron precipitators “cementation.” The additional uses of the oxide tails should be noted, as these facilitate a different contaminant signature than that of the homogenous quartz monzonite, or raw ore.

The VLT material has been widely used in Mason Valley in asphalt and concrete, as engineered fill, and as surfacing material for highway shoulders, country, and private roads, driveways, yards, and other applications (Nesbitt, 1978). The material has also been used extensively onsite as capping material, including over Finger Pond E, that contained the calcine slurry or “red dust” and much of the sulfide tailings pile as noted previously. Don Tibbals currently owns 80 acres of property overlain by VLT, on the west side of the oxide tails OU, adjacent to the Site boundary. The property is primarily used for storage of various industrial equipment and sale of aggregate.

2.5 Wabuska Drain Operable Unit

The Wabuska Drain is an agricultural return-flow ditch, constructed sometime in the 1940s (Biaggi, 1983; Appendix B). Historical maps indicate that the Wabuska drain was constructed parallel to the historic Nevada Copper Belt Railway and terminated where the current north, middle, and south evaporation ponds were later constructed. The Wabuska Drain was originally constructed to drain groundwater for the Southern Pacific Railroad. The Wabuska Drain is approximately 14 miles in length and, although realigned several times based on mining activities, currently originates adjacent to the evaporation ponds at the northern edge of the Site.

The Wabuska Drain is one of many return-flow ditches encompassed in a network of irrigation drains used to manage Walker River water for agricultural uses across Mason Valley (Figures 2-4 and 2-5). The Wabuska Drain is aligned to the north where it bisects the West Campbell Irrigation Ditch and continues northward through the Paiute Indian Reservation before crossing Highway 95A, approximately 1 mile south of Wabuska, where it is aligned to the east-northeast until it intersects with the Walker River north of the Mason Valley Wildlife Management Area (Brown and Caldwell, 2003d). The Wabuska Drain continues to operate by collecting return flows from crop irrigation In addition to direct runoff from local irrigated fields, runoff from precipitation on local roads also contributes to flows within the drain.

The hydraulic grade of the Wabuska Drain between the Site and the southern margin of the Yerington Paiute Indian Colony is approximately 0.148 percent over 4.1 miles. The grade increases slightly to about 0.160 percent through its 1.1-mile length within the reservation. From the northern margin of the reservation to its intersection with the Walker River, the average hydraulic grade was calculated at 0.042 percent (Brown and Caldwell, 2003d).

The drain was originally designed, prior to mining operations, as a V-shaped to trapezoidal-shaped conveyance channel, where dimensions increase in the downgradient direction. The Walker River Irrigation District maintains the ditch by clearing brush and providing routine culvert maintenance where vegetation has become established. Historically, it has been documented that the drain intercepts shallow mining-related groundwater and sediment originating from the Site. Historical data indicate that the alignment of the drain has shifted over time in the area immediately north of the mine and that other portions of the drain have been built on (Figure 2-4).

Historical mining documents indicate that both the Walker River Irrigation District and Nevada Fish and Game Commission expressed concerns over the Wabuska Drain and main

Walker River (Trelease, 1958). It has been noted that discoloration was present at the confluence of the ditch and the Walker River. In 1958, Nevada Fish and Game performed a flyover and noted that a "bright orange material" was flowing in large quantities from the drain immediately below the "retaining" ponds, through the entire length of the drain into the Walker River (Trelease, 1958). From ground investigations performed at that same time, material was entering the drain as "spring-like flows" directly adjacent to the ponds. Additionally, staff from the Anaconda Mine was taken on a flyover of the drain from its source to its terminus at the Walker River and from the Walker River to Weber Reservoir. It was pointed out to Anaconda staff during this flight that the discoloration extended from the confluence of Wabuska Drain and Walker River downstream to Weber Reservoir and that no discoloration was noticeable in the Walker River above its confluence with the Wabuska Drain (Trelease, 1958).

Animal studies on both fish and rats indicate that there may be deleterious effects on test subjects when consuming undiluted water from the Wabuska Drain adjacent to the evaporation ponds. Results from a University of Nevada Reno study observing the effects of evaporation pond water, drainage ditch water, and White River Irrigation District (Wabuska Drain) water on the growth of rats indicate that young, growing rats will not consume undiluted test waters but will die of thirst if no other water is available (Dunn, 1956). Rats would not consume bar ditch water (water taken from behind evaporation pond dam) and Wabuska Drain water unless it was diluted to 25 percent with distilled water (Weeth, 1956; Appendix B).

Various parties have collected sporadic surface water and sediment samples from the Wabuska Drain north of the mine between 1983 and 2003. Some of the samples have contained elevated concentrations of inorganic constituents and reduced pH levels. In 1982, NDEP issued an FOV to ARC for alleged "unauthorized discharge of pollutants to waters of the state." NDEP directed ARC to begin the monitoring program, propose plans for sampling and analysis procedures, determine the extent of contaminated soils, and eliminate or mitigate the seepage of pollutants. The FOV alleges that pollution of the Wabuska Drain and the underlying groundwater had occurred in the area north of the evaporation and tailings ponds previously used by Anaconda for disposal of tailings and wastewater from the leaching process.

Based on studies performed by ARC in 1983, the source of the contaminants in the "surface drain" is the very high concentration of iron in shallow groundwater adjacent to the "ditch" along the irrigated agriculture fields. The ditch at this location is within 200 feet of the seepage return ditch below the unlined evaporation pond. The eastern extremity of this seepage return ditch is reported to be connected with the main section of the ditch by a pipe extending through the embankment, permitting movement of iron-rich waters (Anaconda, 1984b).

2.6 Radiological Concerns

In addition to concerns regarding soil, sediment, atmospheric, and groundwater contamination caused as a result of historical mining processes, radiological issues continue to be a concern at the Site. In a USGS bulletin published in 1954, the Yerington Property was highlighted as an area with elevated concentrations of naturally occurring uranium. A sample collected from one of the dumps indicated a 0.03 percent triuranium octoxide. Geiger counts ranged from background to nearly four times the background, with an average slightly exceeding background levels (King and Roberts, 1954; Garside, 1973). When the ore was processed for the copper, it produced TENORM, in which radioactive minerals were either concentrated above natural levels or moved from their natural location, potentially causing an increased risk for exposure and offsite migration. TENORM has been identified within the process area including materials with elevated levels of radium-226, radium-228, thorium-230, thorium-232, and uranium-238 (Brown and Caldwell, 2005).

In 1976, Kilborn/NUS Inc. issued a report to Wyoming Mineral Corporation evaluating the feasibility of a proposed uranium processing facility at the Yerington Site. The proposed uranium processing facility would be sufficient to produce approximately 50,000 pounds of triuranium octoxide as yellow cake uranium from 700 gpm of Yerington copper leach liquors.

In April 1979, a radiological survey was conducted by Anaconda personnel from Grants, New Mexico. The study included a radiological survey (gamma emission) of the mine dumps, open pit, stockpiles, and tailings areas. Soil, water, and vegetation samples were also collected at select locations for radiological analysis. The gamma survey was conducted from a pickup truck using a PRM-7 Micro R Meter. All dumps, stockpiles, and tailings ponds were surveyed as access and time permitted. Readings were recorded every 20 to 40 meters. The instrument operated continuously between recording points to check for anomalies. Results indicated that the Finger Ponds 3, 4, and 5 all displayed high gamma readings, particularly at Pond 5 (which corresponds to the finger thumb pond) (Anaconda Company, 1979a). Although the analytical results for soil, groundwater, and vegetation have not been located, it appeared that the residue in the evaporation ponds is a problem because of radiological contamination (Anaconda, 1979b).

Initial studies have been performed to determine if local residents are being exposed to radiation from TENORM that has been transported offsite through windblown fugitive dust and use of oxide tailings. Doses calculated from data collected from the 2005–2008 Air Quality Monitoring Programs evaluating exposure to fugitive dusts have been found to be within relevant air quality monitoring standards (Brown and Caldwell, 2009). An EPA scanner van survey, conducted in 2006, did not detect significant elevated levels of radiation in the community areas.

2.7 Arimetco Operable Unit

The method used by Arimetco to extract copper from the oxide ore involved leaching with 1 percent sulfuric acid and pumping the leachate to SX tanks to be mixed with a kerosene solution, containing 5 percent Acorga (greater than 99 percent alkyd hydroxyl) to extract the copper from the weak acid solution into the kerosene solution. A 10 percent sulfuric acid was applied to the copper-rich kerosene solution to leach out the copper; the copper concentrated solution was then pumped to the EW plant and plated out on stainless steel sheets. The acid solution that remained following the copper extraction was recirculated to the HLPs to be used again. Chemicals used in the mining and milling process included sulfuric acid, Acorga, and kerosene. Cobalt sulfate, sodium thiosulfate, and potassium iodide were used in the onsite lab for analytical purposes, while acetylene gas, nitrogen gas, oxygen gas, liquid nitrogen, unleaded gasoline, and diesel fuel were used for vehicle maintenance and refueling (Ecology and Environment, 2000).

After filing for Chapter 11 bankruptcy in 1997, Arimetco continued its copper recovery operations through 1999, only to abandon the Site in 2000 and leave the five operational leach pads with approximately 90 million gallons of PLS remaining in the system.

The Arimetco OU has the following three components:

- HLPs
- SX and EW plant
- Fluids management system

After Arimetco left the Site, NDEP implemented an emergency removal action to operate and maintain the fluids management system and then later initiated a cleanup effort of the Arimetco SX/EW plant. Chemicals of all types, including solutions, sludges, and precipitates, were removed from the plant; all solution conveyance pipes were drained and inspected; and all of the anodes and cathodes in the EW circuit were cleaned. The approximate quantities of materials removed from the SX/EW Plant by NDEP (NDEP, 2003) (Appendix C) included the following:

- Electrolyte fluid: 233,000 gallons
- Organic fluid: 19,000 gallons
- Waste oil: 4,500 gallons
- Copper sulfate: 72 cubic yards
- Crushed drums: 40 cubic yards
- Miscellaneous, nonhazardous liquid wastes: 34,000 gallons
- Miscellaneous solid wastes: 200 cubic yards
- Hazardous waste (lead): 70 cubic yards
- Hazardous waste (other): 1,800 pounds

2.7.1 Recorded Arimetco Spills

Arimetco spill records were obtained from the historical files transferred from the administrative building at the mine. The spill records indicate dates and times of both major and minor spills. Table 2-9 provides a summary of the spills. Tables 2-8 and 2-9 provide the date, time, source, contaminant, and quantity of each spill. All spill records are included in Appendix D.

TABLE 2-7
Recorded Arimetco Spills Summary
Historical Summary Report, Anaconda-Yerington Mine Site

Date	Contaminant	Approximate Reported Quantity (gallons)	Notes
1990 to 1993	H_2SO_4	415,188	
1997	H_2SO_4	Geysers flowing 2 to 5 hours per day; quantity unknown/unreported	Citizen complaints
1997	Fugitive Dust		Citizen complaints
1997 to 1998	H_2SO_4	362,215	

Note:
H_2SO_4 = sulfuric acid

TABLE 2-8
Spill Report Information for 1990 to 1993, under Operation of Arimetco, Inc.
Historical Summary Report, Anaconda-Yerington Mine Site

Date	Time of Spill	Material Spilled	Quantity and Concentration of Spill	Location of Spill	Reason for Spill	Material Contaminated	Remedial Actions Taken in Response to Spill	Date Remedial Action Completed	Name of Person Responsible for Spill Remediation	Position	Date Closed	Report Number	Comments
8/30/1990[a]	Graveyard	1.1 g/L $CuSO_4$ at less than 1 percent H_2SO_4	Approximately 1,000 gallons; additional reports suggest up to 2,000 gallons	NE side of leach pad on road (exact location of spill unknown)	Wind flapping liner; seam tore at solution level.	Stockpiled ore	Liner added to existing line and berm raised. Area drained back onto liner. Area dug out, neutralized with lime and water, and then refilled. Samples taken following remedial action.	9/1/1990	Gary Snyder	SX/EW Superintendent	9/2/1990	H900831A	Evidence shows that there is conflicting information as to the quantity of the spill. A summary provided by Arimetco/Copper Tek indicates "a total of about 2,000 gallons of 0.23% acid with 1.1 g/L copper poured into the low spot for 2 days while repairs were underway, resulting in the spill of about 5 gallons of pure acid."
1/13/1991[b]	Unknown	PLS	400,000 gallons of 0.72 g/L copper in dilute H_2SO_4 concentration of 6 g/L	North end of ore heaps at PLS pond	Pipeline rupture during pumping, probably during ambient temperature variance. Valves not open during restart of plant caused pressure to rupture pipe. Shutdown of system resulted in PLS pond overflow.	Ore stockpile	Plant shut down. PLS and raffinate lines were repaired; restart of system to stop overflow; samples taken of contaminated ore; excavation and removal of same material to leach pad; samples retaken. Ten to15 tons of lime used to treat contaminated area to penetrate and neutralize.	1/14/1991	Gary Snyder	Project Manager	1/14/1991	DEM H910114D National Emergency Response Center Case No. 54956	There are several accounts on file from staff present when the spill occurred. A more detailed account of the spill is available for review in Section 2.2.1.
3/29/1991[b]	Unknown	PLS	100 gallons PLS, 1.3-g/L Cu, 8 g/L H_2SO_4	Organic trap	Coupling leak caused by coupling was hit with a backhoe bucket.	Tailings used as fill around organic trap	Material was excavated. This required a plant shutdown to replace the coupling and excavate the material to the leach pad.	3/30/1991	M.H. Shipes	General Manager	3/30/1991		
12/31/1991[b]	Unknown	93 percent H_2SO_4	3 gallons 93 percent H_2SO_4	New tank farm	Discharge valve on acid truck was not closed tightly; leak on tailings fill.	Tailings used to backfill around tank farm	Tailings were excavated to the pad and replaced.	1/3/1992	M.H. Shipes	General Manager	1/3/1992		
3/8/1992[c]	Unknown	PLS	400 gallons 1.2 g/L Cu, 4 g/L H_2SO_4	Leach pad	Heap toe washed down into solution ditch with a very small (3–4 gpm) stream topping the berm. The area had been checked 1 hour and 45 minutes earlier.	Ore pile rock	Washout caused by a plug that popped out of a leach line. This section of pipe was replaced. The ore that was contaminated was shoveled onto the pad.	3/9/1992	M.H. Shipes	General Manager	3/9/1992		
4/3/1992[c]	Unknown	Raffinate	400 gallons of 0.1 g/L Cu, 18 g/L H_2SO_4	SE corner of PIII-X leach pad	Line split, spraying solution over berm edge.	Soil near pad	Soil was excavated to pad.	4/3/1992	Ron Quisenberry	Mine Foreman	3/10/1992		
6/20/1992[c]	Unknown	Organic (SX-1 kerosene) (Acorga reagent)	20 gallons	W stripper SX plant	Leak in 2-inch temporary line for a sump pump.	Tailings around plant	Organic picked up with vacuum cleaner, and contaminated dirt moved to leach dump area. New tailings brought in.	6/20/1992	Bill McCombs	SX/EW Superintendent	6/20/1992	H900831A	
06/29/1992[c]	03:25	98 percent H_2SO_4	30 gallons		Operator inattentiveness: truck overflowed.	Soil	Loader excavated contaminated soil and then placed it onto HLPs.	6/29/1992	Rick Havenstrite	Project Manager	6/29/1992		
10/1/1992[c]	Graveyard	Diesel fuel	Approximately 15 gallons	Diesel storage tank	Overflow of fuel truck.	Parking lot dirt	Contaminated area scooped and hauled away. Fresh dirt replaced.	10/6/1992	Rick Havenstrite	Project Manager	10/6/1992		

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Spill Report Information for 1990 to 1993, under Operation of Arimetco, Inc.
Historical Summary Report, Anaconda-Yerington Mine Site

Date	Time of Spill	Material Spilled	Quantity and Concentration of Spill	Location of Spill	Reason for Spill	Material Contaminated	Remedial Actions Taken in Response to Spill	Date Remedial Action Completed	Name of Person Responsible for Spill Remediation	Position	Date Closed	Report Number	Comments
10/10/1992[c]	Unknown	93 percent H_2SO_4	200–250 gallons 93 percent H_2SO_4	Acid storage tank	Acid tank discharge line ruptured at fitting.	Ground near acid storage tank	The spill took place in an unlined, but contained, area immediately adjacent to the acid storage tank. Any significant drainage in this area was diverted to the #1 Leach Pad, but there was not enough quantity for this spill to reach the pad. The area was dug out to dry ground, and the contaminated soil was moved to the leach pad area. New soil was hauled in to the spill area.	10/10/1992	Rick Havenstrite	Project Manager	10/12/1992		
1/7/1993[d]	7:00	PLS	8,000–12,000 gallons 4 g/L H_2SO_4	Channel from pregnant pond	Channel capacity reduced by accumula-tion of ice and snow in channel, causing pregnant solution to top channel bank.	Ground at foot of pad	Channel cleared of ice and snow buildup. Spillage returned to pond. Area was "cleaned up." Contaminated area dug out to dry ground and hauled to the leach pad (inside containment).	1/7/1993	Rick Havenstrite	General Manager		DEM H930108B	Spill was reported to the Bureau of Mining. Informed Staff D. Tecca. Report taken by Q. Aninao. Report NV930108-02.
7/1993[e]	Graveyard	Unknown	Unknown	Flooded tank farm	Power interruption caused by a blown fuse, which kicked out two main oil circuit breakers in middle of night.	Flooded Tank Farm	Power restart	7/1993					A blown fuse caused two oil circuit breakers to kick out resulting in a flooded tank farm and wiping out two sump pumps. Problem not found until next day. Plant lost time was approximately 17 hours.

[a]Source: Arimetco, 1990a
[b]Source: Arimetco, 1991
[c]Source: Arimetco, 1992
[d]Source: Arimetco, 1993b
[e]Source: Arimetco, 1993c

Notes:

Cu = copper
$CuSO_4$ = copper sulfate
NE = northeast
H_2SO_4 = sulfuric acid

TABLE 2-9
Spill Report Information for 1997 to 1998, under Operation of Arimetco, Inc.
Historical Summary Report, Anaconda-Yerington Mine Site

Date	Time of Spill	Material Spilled	Quantity and Concentration of Spill	Location of Spill	Reason for Spill	Material Contaminated	Remedial Actions Taken in Response to Spill	Date Remedial Action Completed	Name of Person Responsible for Spill Remediation	Position	Date Closed	Report Number	Comments
2/03/1997[a]	6:30 p.m.	PLS	40,000 gallons	Feed pond	Operator error.	Soil	Unknown.	--	--	--	--	--	
3/30/1997[a]		Acid solution	73,000	#4 leach pad – unknown	Sample ongoing, pumped out, pipeline split – over containment berm.	Soil	Excavated soil and returned to HLP.	--	Travis Cantwell	--	--	--	
11/12/1997[a]	4:30	Raffinate and PLS	~300–400 gallons	West end of crusher serge pad	Heavy rains caused PLS to overflow out of containment. Washed sediments into containment ditch causing pipe to become clogged.	Surrounding soils	A collection sump was dug to contain PLS saturated ore fines/silts. Standing solution was pumped back into containment. The pad drain was unplugged to allow for PLS to drain to VLT pad containment. Additional work may be required to reduce chance of future release occurrences.	Anticipated to be completed 11/24/1997	Joe Sawyer and Paul Davis	Mine superintendent and crusher foreman, respectively.	--	--	
11/15/1997[a]	16:30	PLS	~650–750 gallons; $CuSO_4$ containing <4 g/L H_2SO_4	North end of Pad I	Ore material sluffed off the pad causing the conveyance ditch to fill. PLS overflowed berm.	Soils	Pad I leach solution was shut off. Sluffed ore was channeled to allow PLS to drain into its respective pond. Standing solution was pumped into Pad I PLS pond. Soils excavated and hauled to lined pad.	Anticipated to be completed 11/24/1997	Robert Schrieder	Construction/lead foreman	--	--	
11/17/1997[a]	10:55	Acid solution	Unknown	"Leach fields"	--	--	Unknown.	--	--	--	--	--	Citizen Complaint: Phoned in to report "geysers of sulfuric acid" running 2 to 5 hours per day.
11/20/1997[a]		PLS	~800 gallons of PLS, $CuSO_4$ containing <4 g/L H_2SO_4	North of check valves (near northern most anaconda vat) PLS pipe	Plant intake and plant feed pond intake plugged with debris. To unplug intake, the PLS feed pipe had to be cut and diverted to the Mega Pond. The cut PLS pipe back-drained PLS out of containment.	Soils and old Anaconda vat leach tails	Standing PLS solution soaked up with VLT material.	Anticipated 11/28/1997	--	--	--	--	
11/22/1997[a]	19:00	PLS	~800 gallons of PLS, $CuSO_4$ containing <4 g/L H_2SO_4	North end of PLS plant feed pond	A new HDPE pipe extension was fastened to the PLS discharge pipe that discharges into the PLS plant feed pond. A leak developed in the pipe and caused PLS to overspray out of containment. The PLS flowed down to the main Weed Heights access road. The spill was reported by a Weed Heights resident.	Soils	Leak was stopped and repaired. Solution was soaked up with earth material. This material was then hauled to a lined HLP.	11/23/1997	John Williams	Shift mine foreman	--	--	
11/24/1997[a]	11:40	Acid	Unknown	Loading dock 95A Wabuska	Tanker leaked to soil at the loading dock in Wabuska.	Soil	Unknown.	11/11/1997	Bill Sifford	--	--	--	Unknown caller reported spill
1/15/1998[b]	Unknown	Oil and water emulsion	>50 gallons	East of small plant	Treatment tank overflow.	Tailings	Removed treatment tank and mined out material.	2/1/1998	Larry Houglad	SX Foreman	2/5/1998	--	
1/15/1998[b]	--	Raffinate	>50 gallons	SM SX plant	Tank overflow.	--	Removed contaminated material to VLT pad.	--	--	--	--	--	Duration of spill ~2 min.
1/17/1998[b]	--	Raffinate	>50 gallons	East of recirculation tank	Power outage.	--	Removed contaminated material to VLT pad.	--	--	--	--	--	Duration of spill ~10 min.
1/17/1998[b]	--	Raffinate	>50 gallons	East of RF-1 pond	Packing on pump leaked.	--	Removed contaminated material to VLT pad.	--	--	--	--	--	Duration of spill ~10 min.

TABLE 2-9
Spill Report Information for 1997 to 1998, under Operation of Arimetco, Inc.
Historical Summary Report, Anaconda-Yerington Mine Site

Date	Time of Spill	Material Spilled	Quantity and Concentration of Spill	Location of Spill	Reason for Spill	Material Contaminated	Remedial Actions Taken in Response to Spill	Date Remedial Action Completed	Name of Person Responsible for Spill Remediation	Position	Date Closed	Report Number	Comments
1/30/1998[b]	--	H_2SO_4	50 gallons	East of SX acid tank	Welding truck hit pipe.	--	Removed contaminated material to VLT pad.	--	--	--	--	--	Duration of spill ~5 min.
2/2/1998[b]	--	Raffinate	>50 gallons	Small SX plant	Grader blade hit 8-inch pipe.	--	Removed contaminated material to VLT pad.	--	--	--	--	--	Duration of spill ~2 min.
2/15/1998[b]	--	Raffinate	500 gallons	VLT leach pad	Washout.	--	Removed contaminated Material to VLT pad.	--	--	--	--	--	Duration of spill ~20 min.
2/19/1998[b]	16:50	Tailings – Sodium Cyanide	~4,000 square feet ~100 gallons	Winners Corner	Tractor/scraper spreading “tailings” 3 to 4 inches deep behind convenient store at Winners Corner.	--	None.	--	--	--	--	--	
2/20/1998[b]	--	Raffinate	100 gallons	VLT ditch and pad	Weld on 16-inch raffinate line.	--	Removed contaminated material to VLT pad.	--	--	--	--	--	Duration of spill ~20 min.
2/21/1998[b]	--	Raffinate	Exceeded 240,000 gallons	Former Weed Heights Sewage lagoon area	Weld on 16-inch raffinate line.	--	Removed contaminated material to VLT pad.	--	--	--	--	--	Duration of spill ~20 to 30 min.
03/06/1998[b]	Unknown	Raffinate	800–1,000 gallons	Mine Road- Specific location not indicated	Hose failure – release to dirt road.	--	Cleaned up by mine personnel.	--	Gary Robertson	--	--	DEM#98030 9-2693	
3/6/1998[b]	--	Raffinate	>50 gallons	Road VLT south end	Weld on 16-inch raffinate line.	--	Removed contaminated material to VLT pad.	--	--	--	--	--	Duration of spill ~15 min.
7/4/1998[b]	--	Raffinate	250 gallons 1 percent H_2SO_4	4X flow meter area	Weld point – small leak.	--	Repaired and cleaned up.	--	--	--	--	--	
8/4/1998[b]	--	Raffinate	50–60 gallons 1 percent H_2SO_4	VLT pond area	Rupture in pipe.	--	Repaired and cleaned up.	--	--	--	--	--	
9/7/1998[b]	--	Raffinate	5,000 gallons 1 percent H_2SO_4 (pH 2)	Burch Drive office and north	Weld failed.	--	Pumped ponded solution and dug out contaminated soil.	--	--	--	--	--	
9/20/1998[b]	20:00	Raffinate	80 gallons	VLT ditch at Pad #11	Weld failed.	--	Called in crew to repair and replace line.	Turned line back on at 11:00 p.m.	Bill Gasler	Plant Supervisor	9/21/1998	--	
11/4/1998[b]	--	PLS	~10 gallons	--	Pulled pipe from ditch with solution inside.	--	Removed soil to leach pad.	Immediate	Joe Sawyer	--	--	--	
11/5/1998[b]	--	Raffinate	~15 gallons	VLT	Wrap around on 16-inch line was leaking.	Tailings	Dug out and put on leach pad.	11/5/1998	Dustin Aoman	Leadman	11/5/1998	--	
10/5/1999[c]	10:30	Organic reagent kerosene	~5 gallons	Organic trap	Transferring organic from extractor while cleaning overflowed organic trap.	Soil adjacent to trap	Soil was shoveled into buckets and placed on lined impoundment.	10/6/1999	Joe Sawyer	Project Manager	10/7/1999	--	
10/29/1999[c]	04:00	Electrolyte	~20 gallons	North of EW building	Broken supply line to EW Plant.	Soil adjacent to plant	Contaminated soil was shoveled into pickup truck and hauled to “4FX” leach pad for disposal.	11/01/1999	Joe Sawyer	Project Manager	11/01/1999	--	
12/23/1999[c]	10:00	Dilute raffinate	~50 gallons	Between VLT ditch and pond on SE corner of pad	A 16-inch gasket began leaking. Allowed solution to spray into air for about 1 hour.	Soil in roadway between VLT pad and pond	Damp soil in roadway was scraped up with backhoe and hauled onto the VLT pad for disposal.	12/23/1999	Joe Sawyer	Project Manager	12/23/1999	--	

Sources:
[a]Arimetco, 1990b
[b]Arimetco, 1991
[c]Arimetco, 1992

Notes:
min. = minutes
H_2SO_4 = sulfuric acid
SE = southeast
-- = not available

Several of the spills documented between 1991 and 1998 were reportedly greater than 5,000 gallons. For these larger spills, a detailed summary of what occurred and the steps taken to remediate the spill and to prevent additional contamination is provided below.

2.7.1.1 August 31, 1990

On August 31, 1990, before dawn, leach solution began leaking through a tear in the edge of the liner into a low spot in the road adjacent to the pad. The tear was reportedly caused by wind flapping the liner and tearing the seam at the solution level. A total of approximately 2,000 gallons of 0.23 percent acid with 1.1 g/L copper poured into the low spot during the next 2 days while repairs were underway. The volume of the spill was determined by volumetric measurement.

Remedial action began immediately on the morning of August 31. The pool in the road was bailed with buckets before noon. The solution liner was inspected, and the tear was found. Six inches of VLT and the top 6 inches of clay liner in the roadbed were removed. All of the excavated soil was placed on the adjacent leach pad.

NDEP shows notations on the spill summary provided by Arimetco/Copper Tek under "Description of Spill" Paragraph I: Line 8. "The volume of the spill was determined by the volumetric measurement, length multiplied by width times depth divided by 7.48 gallons per cubic foot." NDEP indicates that this value should have been multiplied, *not divided*; therefore, the spill is estimated to be 50,000 to 100,000 gallons rather than the 1,000 to 2,000 gallons reported. Causes and prevention of recurrence: Paragraph III: Line 1, "The spill was caused by a tear in the liner as a result of high winds and allowed solution to escape." NDEP notes a verbal report indicating that a truck ran into the berm and tore the liner (NDEP, 2003) (Appendix D).

2.7.1.2 January 13, 1991

At approximately 9:30 a.m. on January 13, 1991, an unplanned discharge of PLS occurred at the Arimetco Yerington Mine Process Area, when the PLS pond overflowed. The discharge occurred in the NW ¼ section of Section 16 Township 13N, Range 25E. Solution was entering the pond from the Phases I and II leach pads at a rate of approximately 420 gpm, and overflowed at that rate from approximately 6:00 p.m. on January 13, 1991, until approximately 9:00 a.m. on January 14, 1991. The total discharge was estimated at approximately 380,000 gallons. Solution was sampled and found to contain 0.72 g/L of copper and 0.33 percent sulfuric acid; the pH of the solution was 1.9.

According to employee statements, a new pad was to be excavated behind the plant to provide a containment area for a concentrated acid storage tank, being relocated from the existing tank farm. The excavated area was to be approximately a 30- by 30-foot level pad 20 to 25 feet away from the wall. A loader was used to excavate the area; however, it could not gain traction because of icy and snowy conditions. The dirt being removed was used to build a bridge over the temporary Driscoll line so the trucks could cross to be loaded. The operator made several passes and sunk in over the 6-inch PLS line, causing it to rupture. The plant was quickly shut down, minimizing the initial spill to an estimated 500 gallons. The pipeline was excavated, repaired, and operable at 3:30 p.m. According to Arimetco staff, the plant was then restarted and solution was pumped from the full PLS pond to the raffinate pond. At 4:30 p.m., the plant operator restarted the raffinate pump, which supplies the leach solution to the HLP. The pipeline ruptured about 30 feet from the pump upon startup, and the system was immediately shut down for a second time. The second failure occurred at a thrust block on a section of pipe that was covered by approximately 12 inches of fill. After completing repairs and allowing adequate dry time, the raffinate pumps were successfully restarted and operated a total of 30 minutes when the third rupture occurred. The discharge from the initial two failures of this pipe was estimated at 1,000 gallons. This solution was approximately 0.85 percent sulfuric acid and contained 0.05 g/L copper. After working through the night, repairs were completed and the system was restarted.

The PLS pond overflowed from 6:00 p.m. Sunday until approximately 9:00 a.m. Monday, when repairs were complete. The discharge of solution followed the local topography, which included a small depression between the sedimentation pond and the ore stockpile north and east. The soil in this area has high clay content and was frozen to a depth of 2 feet. The area covered at this depth would have an approximate volume of 15,000 gallons. Because the solution never rose above this level, the path of least resistance was to enter the toe of the ore stockpile and follow the topography of the ground beneath the stockpile.

Excavation began on the contaminated soil as soon as the discharge was stopped. The soil was placed on the Phase II HLP. The material was removed to a depth of 5 feet as close to the stockpile and ponds as safety would allow. Typical pH readings prior to excavation varied between pH 2.0 and pH 5.0. Following excavation, the bottom of the cut showed pH readings between pH 6.0 and pH 7.0. The sides continued to have readings between pH 2.0 and pH 5.0. On Wednesday, January 15, 1991, the side of the cut was heavily spread with lime, followed by an overspray of water. Continuous addition of lime and water overspray occurred until complete neutralization was achieved.

An investigation following the spill revealed the following:

- Employees were instructed to excavate a pad behind the tank farm without knowing or checking for the presence of any buried lines.
- The raffinate pump was started without first checking that all valves were open. This is a result of inattention to duties and improper or incomplete training.
- Cleanup of spilled solution did not begin until approximately 4 hours after repairs were completed, allowing a larger area to be contaminated.

2.7.1.3 January 7, 1993

On the morning of January 7, 1993, approximately 8,000 to 12,000 gallons of PLS were released from containment at the Site. The spill was apparently caused by the accumulation of ice and snow in a ditch that carries the PLS solution adjacent to one of the HLPs (specific pad is unknown). The water crested the top of the HDPE liner, eventually eroding a cut into the berm that created the containment. Solution was discovered on an adjacent haul road within minutes of the breach and quickly addressed. According to mine records, temporary repairs were completed within an hour.

2.7.1.4 February 3, 1997

On the evening of February 3, 1997, at approximately 6:30 p.m., the PLS feed pond overflowed, releasing approximately 40,000 gallons of PLS. The overflow occurred due to an operator error. Flow to the feed pond had been building up because of increased drain-down from the leach pads generated by heavy rainfall during January 1997. The usual method for controlling solution buildup in the pond is to recirculate excess solution back to the heaps. The operator on duty failed to check the pond level, although it had been rising. The feed pond overtopped along the western end. The overflow was spotted by the security guard, who notified the operator, and the PLS feed lines were shut off at 7:10 p.m.

As the spill occurred, PLS flowed out of the pond and northward between the SX/EW plant and the administrative buildings. None of the solution entered any body of water, waterway, or drainage. The solution followed along the path of an onsite roadway, crossing it at two locations and ponding across it at a third low region. The flow traversed a distance of approximately 2,300 feet. The maximum width of the affected area reached 250 feet but averaged approximately 150 feet. No PLS was reported outside of Arimetco property.

Cleanup was performed by front-end loaders and bulldozers digging up the contaminated soil and loading it onto a 95-ton haul truck. The haul truck transported the contaminated material to the lined heaps for disposal. Lime and water were applied to the excavated areas to further dilute and neutralize any residual acid.

2.7.1.5 March 30, 1997

On March 30, 1997, approximately 73,000 gallons of an "acid solution" flowed over a containment berm at the "#4 Leach Pad" (exact location is unknown). The reason for the spill is a "split in the pipeline." The contaminated soil was excavated and placed back on the HLP. No additional reference information exists in the mine records or in the records at the NDEP office.

2.7.1.6 February 21, 1998

In the early afternoon of February 21, 1998, a weld point directly uphill of two sewage lagoons failed, causing an estimated 240,000 gallons or more of raffinate solution with a pH of 2.3 to leach onto Arimetco property in the area of the former Weed Heights sewage lagoons. The weld is thought to have broken as a result of cold weather; however, the exact cause was reported as unknown.

The area contaminated was reportedly two clay-lined sewage ponds, and the remediation efforts began promptly. The line was shut down immediately, and 1,000 feet of 4-inch Driscoll pipe was placed from the sewage ponds to the permitted VLT pad area. The raffinate solution was pumped from the sewage ponds to the VLT pond. According to 1998 spill records, leak detectors located at the sewage lagoons remained dry throughout the remedial actions, and all lost raffinate solution was pumped back to the lined VLT. Photographs of the spill are included in Appendix D.

2.7.1.7 September 7, 1998

A spill of approximately 5,000 gallons of dilute sulfuric acid occurred sometime in the morning of September 7, 1998. The reason for the spill was because of a weld failure on a 12-inch Driscoll line. The area impacted by this spill was the south end of the SX/EW parking lot, west of the guard shack on Burch Drive. White film was observed on the road, and bulldozers excavated soil in the area of the spill. The line was repaired, and excess solution that puddled next to the roadway was pumped to a contained area.

2.7.2 Record of Communications

In addition to the spills recorded, various correspondences between citizens of Lyon County and the NDEP beginning in 1984 exist. All records located in the NDEP record of communications files are documented as follows.

A record of communication dated March 28, 1984, exists between John Worlun and Verne Rosse describing the meeting with Warren Schofield and a "friend" regarding the Site. Schofield expressed that he wanted a status report on the dealings with Anaconda, including the summary of Anaconda's "report" and the meeting with them on March 14. Mr. Schofield additionally expressed concern over the Garaud family on Silverado Road, who had experienced "skin burning" when exposed to Wabuska Drain Water. Also, the Garaud family stated that they had high iron in their water, and it was staining the household fixtures. There was additional discussion of a proposed PCB operation at Weed Heights (Appendix C).

A record of communication dated February 6, 1990, exists between NDEP employee J. Dennison and Mike Lacey. A phone conversation recorded at 2:00 p.m. alleges sulfuric acid spills at Copper Tek. The summary indicates that "frequent spills in excess of 20,000 to 30,000 gallons of sulfuric acid occurred onsite" and that tanks located by the crusher leak. This was reported by a former employee who states that there are witnesses that can corroborate these allegations (Appendix C).

A record of communication dated March 30, 1990, between "Kathy" and Jim Rigsby documents a 4:00 p.m. phone conversation. The caller alleges the following releases of sulfuric acid at the Copper Tek site in Yerington:

- On the east and south edge of the heap pad: The pad has been loaded to the edge, and, although there was a small berm, the heap sloughed off and covered the berm, allowing solution to run onto the surrounding ground. This has occurred continually over 5 to 6 months.
- During startup (5 or 6 months ago), no berm had been constructed, so solution was able to flow off the pad directly onto the ground. A berm was finally constructed but only after the thousands of gallons of acid had soaked into the ground.
- A sulfuric acid storage tank has leaked continuously over the past 5 to 6 months.
- Outside of the recovery room, the thickener tanks leak, and there is no containment berm.
- The filters used in processing are sometimes drained directly onto the ground and the solution runs down the road to the guard shack.

NDEP records indicate that these reports "will be investigated" (Appendix C).

There is a record of communication dated October 12, 1990, of a 2:30 p.m. phone conversation between Paul Liebendorfer and Scott Gibson of Arimetco's Tucson office. The topic of discussion was an exceedance of the permitted leakage rate. "Scott was evaluating permit monitoring data and found they had exceeded both the quarterly rate and annual rate limits for the PIP monitoring point (leak detection for pad sump). Leakage was occurring during a site visit on August 31, 1990, at which time Ray Birch, Arimetco Vice President, was told that the existing leakage rate would cause a violation of permit limits within 24 hours. He said that this would be fixed right away" (the inspection noted other deficiencies, and a report is in the file). The permit requires that NDEP be notified within 24 hours of an exceedance of permit conditions. Arimetco has not responded until more than 1 month after discovery. They also failed to notify NDEP of exceedances of both quarterly and annual leakage rates within the required time periods and did not provide required written reports. Leakage continued for 11 days prior to being corrected. Mr. Gibson indicated that Arimetco was having management problems that resulted in the notification delay. The people at the Site apparently are not aware of the permit limits and the reporting requirements. NDEP plans to review data from the required quarterly permit submittal and then conduct another site inspection. The first site inspection noted a number of other permit deficiencies. Paul recommends preparing a notice of violation and issuing an order after the next site inspection, as it will better document NDEP's other concerns over and above the reporting violations (Appendix C).

There is a record of communication dated November 11, 1990, between Paul and Mike Fielding. Mike was employed at the Site as a plumber. The report discusses the acid tank farm area. Piping continually leaked, and sump piping completely deteriorated, causing settlement and cracking. Large quantities of acid had leaked, and the piping was so badly damaged that it could not be repaired. Arimetco continually spilled material and covered it up without adding neutralization chemicals. The liner is not seamed properly, and the seams pull apart (NDEP also noted this condition in their last inspection as well as seepage and spillage off liner). Mike is willing to testify as to the conditions and practices at the Site (Appendix C).

A record of communication exists for a phone conversation between Doug Z. and Dale Johnson from Lyon County Building Department at 10:45 a.m. on October 9, 1991. Dale received a report from Don Tibbals that the floor in the process building is so badly deteriorated from acid that washdown solutions or spills pass through cracks into the ground underlying the building. The solutions are supposed to go into a sump and be pumped back onto the leach pad. New construction is ongoing and has not included sumps as specified in the plans. A site inspection on either October 10 or 11 by "Bob" and "Dave" of NDEP will be done as a follow-up (Appendix C).

On August 8, 1995, Matt McAuliffe from the State of Nevada Bureau of Waste Management performed a compliance evaluation inspection and noted the following items of concern:

- Heavy staining was discovered around an underground storage tank located north of Arimetco's vehicle maintenance shop. The tank reportedly contained used oil and spent solvent. The extent of contamination was considered to be significant considering the age of the tank and the waste management practices at the Site. Two photographs of this area are available for viewing in a file located in the office of the Bureau of Waste Management (McAuliffe, 1995a).

- An underground storage tank reportedly containing used oil and solvent from the parts washers was discovered. It is not known whether the tank was registered. Hydrocarbon staining around the tank was noted. The Bureau of Waste Management has available for viewing a file containing the inspection report, warning letter, and photographs of the tank in question (McAuliffe, 1995b).

- A synthetically lined pond was discovered that has not been noted in previous inspections. The pond contained sludge that flows from SX cells. The solids would accumulate as the liquid portion evaporated. It was stated that the pond did not have a leak detection system and that the solids would be addressed at closure. The pond is located approximately 200 yards east of the SX cells (McAuliffe, 1995c).
- Located west of the main office near “compressor pump house #1” was a concrete pond containing what looked to be hydrocarbon-contaminated soil. When questioned, mine personnel could not identify the material (McAuliffe, 1995c).

A record of communication dated December 7, 2000, documents a conversation between Benjamin Castellana of Ecology and Environment (E & E), who is on EPA’s Superfund Technical Assessment and Response Team, and Joe Sawyer. E & E asked Mr. Sawyer when Arimetco stopped mining operations at the Site. Mr. Sawyer replied that Arimetco stopped adding acid and mining minerals in November 1998. E & E asked Mr. Sawyer when Arimetco stopped processing copper at the Site. Mr. Sawyer replied that Arimetco stopped processing in November 1999. E & E asked Mr. Sawyer when Arimetco abandoned the Site, and Mr. Sawyer replied that Arimetco failed to make payroll and was unable to man the Site in January 2000. The State of Nevada took over the Site on January 27, 2000. E & E asked Mr. Sawyer what volume of pregnant solution was present in the leach pads at the time of abandonment. Mr. Sawyer replied that there was an estimated 90 million gallons of PLS present in January 2000. Mr. Sawyer added that the flow rate in the pumping system when the state took over in January 2000 was approximately 1,200 gpm, and the current flow rate was less than 300 gpm.

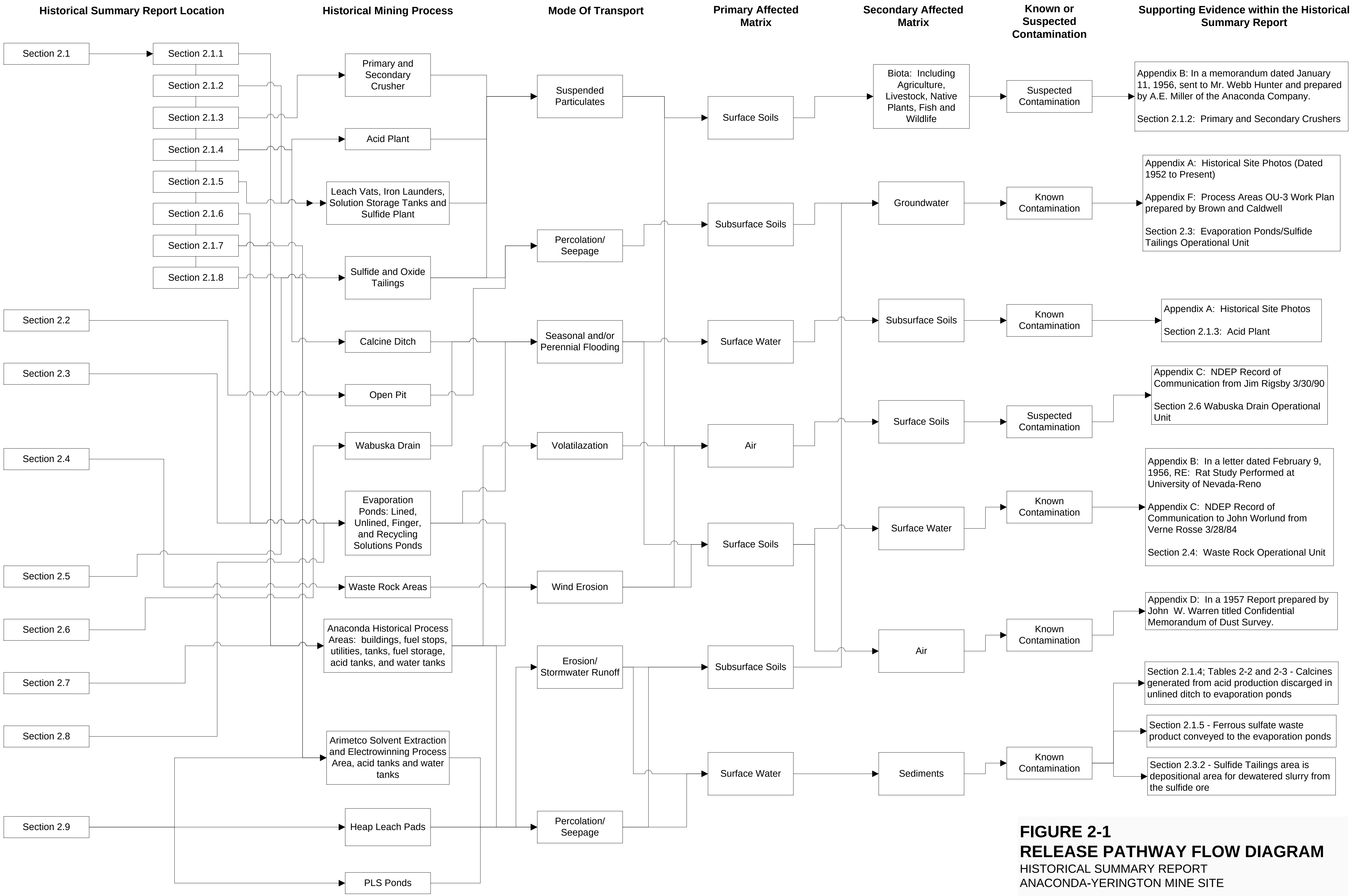


FIGURE 2-1
RELEASE PATHWAY FLOW DIAGRAM
HISTORICAL SUMMARY REPORT
ANACONDA-YERINGTON MINE SITE

NOTES:
1.)PROJECTION: NEVADA STATE PLANE, WEST ZONE 1927 NORTH AMERICAN DATUM(FEET)
2.)BASE PHOTO TAKEN OCTOBER 3, 2001
3.)LAND STATUS OBTAINED FROM BLM 2002

LEGEND

- MINE SITE BOUNDARY
- MINE UNIT
- BLM - PRIVATE LAND BOUNDARY

N W E S

1,000 500 0 1,000 2,000 Feet

SOURCE: BROWN AND CALDWELL, 2007

FIGURE 2-2
PROCESS SUB-AREA 12
HISTORICAL SUMMARY REPORT
ANACONDA-YERINGTON MINE

ES092209222513RDD_2-2 (2/5/10)

NOTES:
1.) PROJECTION: NEVADA STATE PLANE, WEST ZONE 1927 NORTH AMERICAN DATUM (FEET)
2.) BASE PHOTO TAKEN OCTOBER 3, 2001

LEGEND

Area Boundary
Process Area Boundary

Area 1, Area 2, Area 3, Area 4, Area 5, Area 6, Area 7, Area 8, Area 9, Area 10, Area 11

150 75 0 150 300 Feet

SOURCE: BROWN AND CALDWELL, 2007

ES092209222513RDD_2-3 (2/5/10)

FIGURE 2-3
PROCESS SUB-AREAS
1 THROUGH 11
HISTORICAL SUMMARY REPORT
ANACONDA-YERINGTON MINE

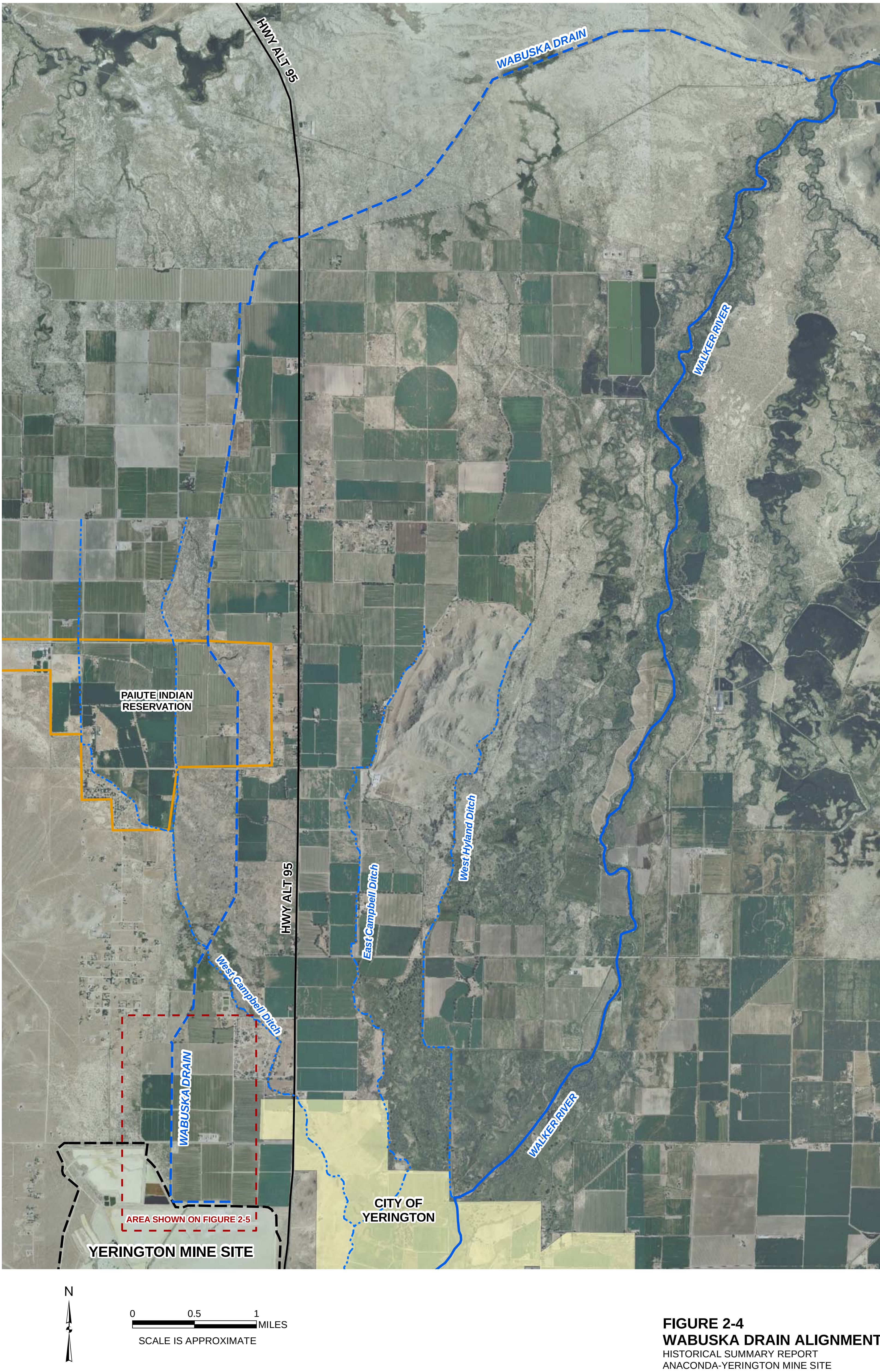
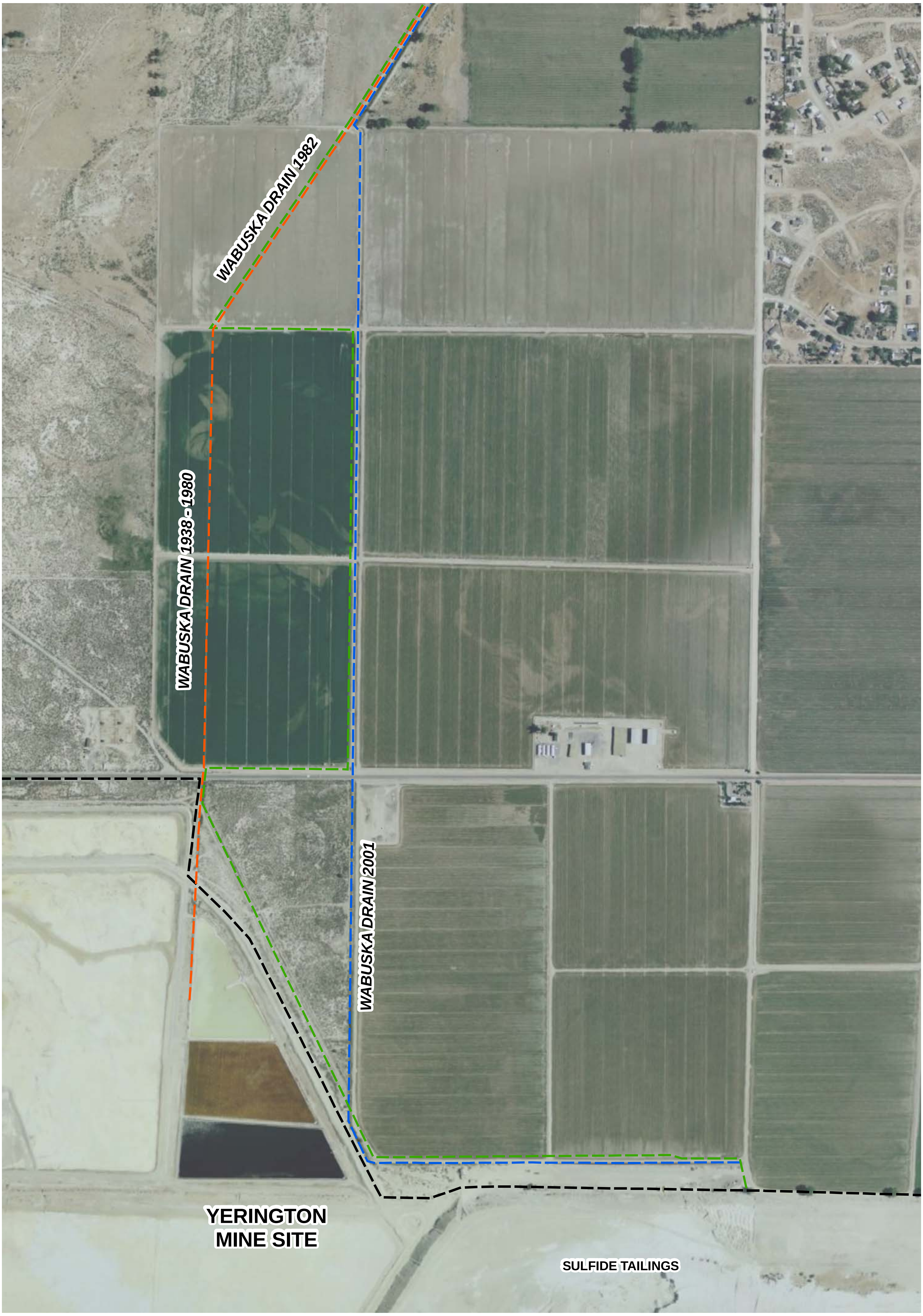


FIGURE 2-4
WABUSKA DRAIN ALIGNMENT
HISTORICAL SUMMARY REPORT
ANACONDA-YERINGTON MINE SITE

\\BALDUR\PROJ\ANACONDA_COPPER_354946\MAPFILES\HIST_SUMM\FIG2-4_WABUSKA_DRAIN_HSR.MXD MSCHROCK 2/5/2010 16:31:57



LEGEND

WABUSKA DRAIN ALIGNMENT 1938-1980

WABUSKA DRAIN ALIGNMENT 1982

WABUSKA DRAIN ALIGNMENT 2001

MINE SITE BOUNDARY

N

0 300 600 FEET

SCALE IS APPROXIMATE

FIGURE 2-5
HISTORICAL WABUSKA DRAIN ALIGNMENTS

HISTORICAL SUMMARY REPORT
ANACONDA-YERINGTON MINE SITE

\\BALDUR\PROJ\ANACONDA_COPPER_354946\MAPFILES\HIST_SUMM\FIG2-5_HIST_WABUSKA_DRAIN_HSR.MXD MSCHROCK 2/5/2010 16:41:03

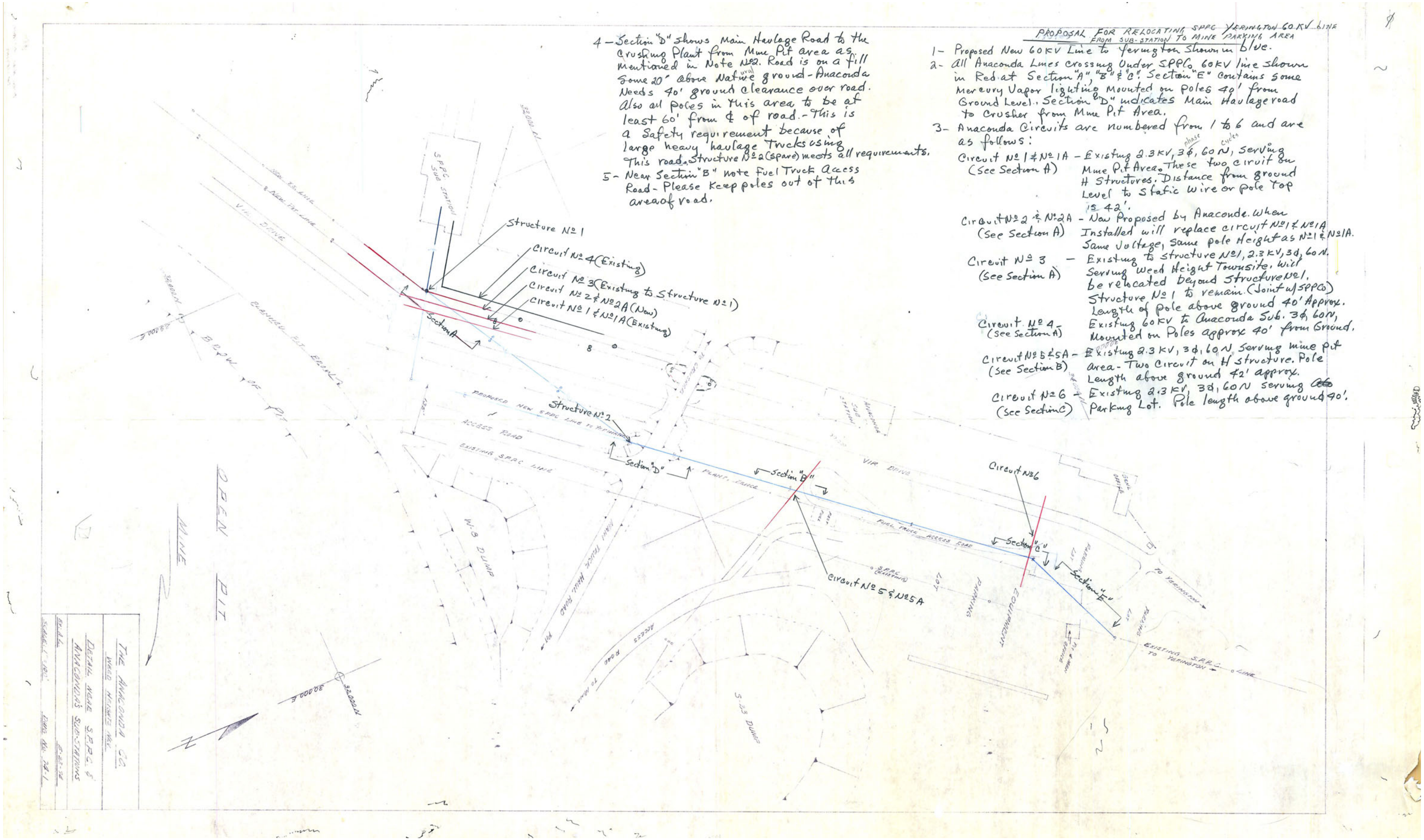


FIGURE 2-6
ANACONDA SUB-STATIONS
HISTORICAL SUMMARY REPORT
ANACONDA-YERINGTON MINE

ES092209222513RDD_2-6 (1/29/10)

SECTION 3

Current Site Status

Since mining and copper reclamation operations at the Site ceased in 2000, extensive Site characterization and remedial investigations have been accomplished. EPA has performed several removal actions, including the following:

- Mitigating fugitive dust
- Addressing fluid management issues associated with the Arimetco HLPs
- Removing or relining ponds that have shown signs of deterioration due to exposure to the elements
- Implementing a groundwater monitoring program associated with the Arimetco OU
- Removed kerosene contaminated soils within the Arimetco Process Areas to the recently constructed bioremediation cells on top of the Phase IV Slot HLP
- Razing the former Administrative Building and disposing of asbestos-containing material
- Removing the tire pile and reducing the risk of fires associated with old stored tires

Continued efforts by EPA are underway to determine the influence of releases of fluids from each of the aforementioned operational processes, used by Anaconda, Copper Tek, and Arimetco, at the Site and to determine the nature and extent of contamination present at each of the Site OUs, the mode of transport, and the affected matrix. Previous sections of this historical summary report discuss the known uses, spills, and disposal of chemicals at the Site and recommendations for additional review.

Because the mining and copper reclamation operations at the Site ceased in 2000, the Process Areas are no longer active and little remains of the historical mining facility. Current activity that exists at the mine includes fluid management associated with the Arimetco heap leach process components and the pumpback well system established in 1986. These systems are currently maintained by ARC's environmental contractor, Brown and Caldwell, and were previously maintained by Applied Hydrology Associates, Inc., from 1986 to 2009.

In addition, EPA has conducted several removal actions from 2006 to 2009 to repair Arimetco fluid collection ponds currently receiving drain-down fluids or to divert fluids to a newly constructed 4-acre evaporation pond, as well as closure of inactive ponds. EPA also removed transformers, capped a portion of the sulfide tails with oxide tailing/VLT material, performed asbestos abatement/removal actions, and removed potential fire hazards associated with an on Site tire pile.

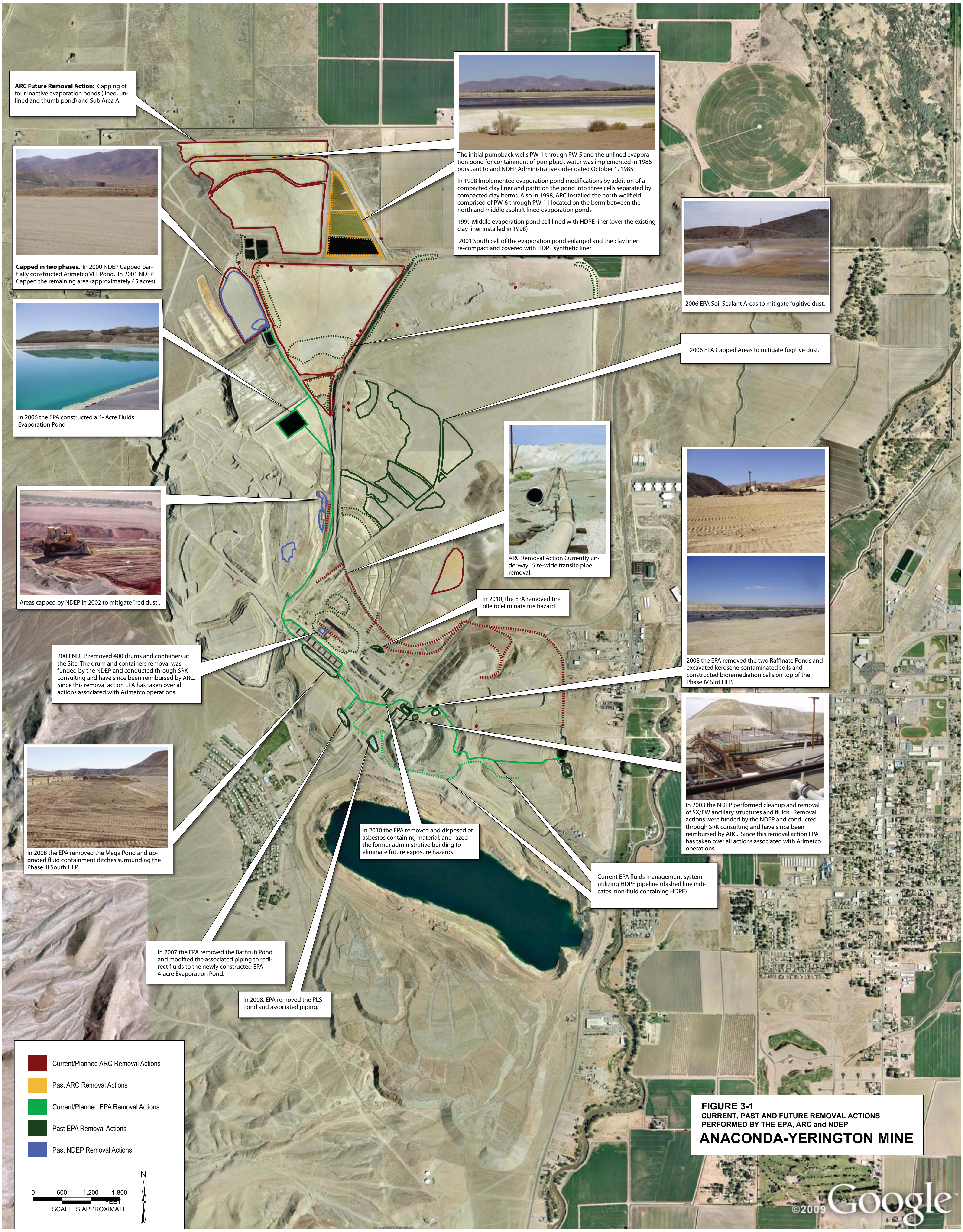
Both EPA and ARC are involved in ongoing studies and investigations at the Site; EPA is leading remedial investigation/feasibility study activities at Arimetco, and ARC is planning to conduct removal actions and investigations at the remainder of the Site under two EPA orders and one consent agreement. Current, past, and future removal actions performed by EPA, ARC, and NDEP are shown on Figure 3-1.

Studies have been conducted by ARC, under the supervision of EPA, to fully characterize the nature and extent of contamination within each of the OUs associated with the Anaconda mining and milling operations, characterize the evaporation ponds, and evaluate the effectiveness of the PWS. In 2008, EPA approved a shutdown of the Anaconda PWS to investigate the shallow and intermediate hydraulic zones in the northern areas of the Site, and, in March 2009, the PWS was taken offline to carry out these investigations.

Upcoming investigations to be performed by ARC include the following:

- Expanding the domestic well monitoring program for wells north of the Site,
- Capping the lined and unlined evaporation ponds,
- Installing additional monitoring wells within the historical Anaconda Process Areas,
- Removing the historical transite pipe fluid conveyance lines across the Site, and
- Excavating radiological areas of concern within the former Anaconda Process Area

Most recently, a subsidiary of Quaterra Resources Inc. has been given an option to purchase the Site by the Arimetco bankruptcy court, including mineral and water rights, private land, and Arimetco holdings excluding the SX/EW plant equipment and documents. The process is still in the technical evaluation phase, and as of September 2010, no decision has been made.



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MODIFIED IMAGE: Anaconda_Yerington_Mine_Removal_Map_4.ai 10-25-2010 sbm
Aerial courtesy of Google™ Earth, 2010. Images: ©2010 DigitalGlobe, USDA Farm Service Agency.

SECTION 4

Recommendations for Additional Review

Numerous letters, documents, maps, and other information obtained from the Site administrative building in 2006 were reviewed and analyzed to develop the historical summaries and spill information contained in this report. Work plans prepared by Brown and Caldwell for ARC were reviewed to provide additional historical information on selected portions of the Site. NDEP files on the Site were reviewed to gather additional information on spills or other releases to the environment. This report reiterates only the specific information and data that were contained in the reviewed files and documents but cannot represent operational, release/spill, or chemical usage information that was inaccurately recorded or that is missing.

In preparing this HSR, several other information sources came to light that may provide additional historical information on the Site but could not be reviewed at this time. These include the following:

- Historical aerial photographs available at the Nevada Bureau of Mines and Geology to further investigate outward expansion of the Yerington Mine and the Wabuska Drain. Initial investigations performed at the Bureau show that quadrangle maps of the Yerington District are available from 1915 to present day. Aerial photographs of the mine area are available from 1938 to present day.
- Inquire with Union Pacific Railroad about dismantling of the Nevada Copper Belt Rail Road that historically ran through the area of the unlined evaporation ponds in the northern portion of the Site and extended south through the Process Area and then west of the Walker River.
- Determine if additional information is present at the University of Wyoming data storage facility where the majority of Anaconda records are stored.
- Research additional studies performed by the State of Nevada Fish and Game Commission (now referred to as the Department of Wildlife Conservation) regarding potential impacts of mine discharges to the Wabuska Drain.
- Research documents that may be available at the Walker River Irrigation District regarding history of the Wabuska Drain.
- Complete interviews with both Don H. Tibbals and Roy H. Shipes to provide better insight to the mining and milling operations of Copper Tek and Arimetco.

In addition, there remains a considerable portion of the historical mine files and documents previously retrieved from the Site that has only undergone a cursory review. More detailed reviews may provide additional details on historical operation and potential environmental impacts.

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SECTION 6

Glossary

The terms below were excerpted from the Economical Recovery of By-Products in the Mining Industry prepared by the Oak Ridge National Laboratory, published in November 2001.

Activator—**a.** In flotation, a chemical added to the pulp (a mixture of ground ore and water) to increase the floatability of a mineral in a froth or to refloat a depressed (sunk) mineral. Also called an activating reagent. **b.** A reagent that affects the surface of minerals in such a way that it is easy for the collector atoms to become attached. It has the opposite effect of a depressor.

Baghouse—A chamber in which exit gases from roasting, smelting, melting, or calcining are filtered through membranes (bags) that arrest solids such as fine particulates.

Ball mill—A rotating horizontal cylinder with a diameter almost equal to the length supported by a frame or shaft, in which nonmetallic materials are ground using various types of grinding media such as quartz pebbles and porcelain balls.

Beneficiation—**a.** The dressing or processing of ores for the purpose of (1) regulating the size of a desired product, (2) removing unwanted constituents, and (3) improving the quality, purity, or assay grade of a desired product. **b.** Concentration or other preparation of ore for smelting by drying, flotation, or separation.

Blast furnace—A shaft furnace in which solid fuel is burned with an air blast to smelt ore in a continuous operation.

Calcine—**a.** Ore or concentrate after treatment by calcination or roasting and ready for smelting. **b.** To expel, by heating, volatile matter as carbon dioxide, water, or sulfur, with or without oxidation; to roast; to burn. (See *Calcination*, *Calcining*, *Calciner*, and *Roasting*.)

Calcination—**a.** Heating ores, concentrates, precipitates, or residues to decompose carbonates, hydrates, or other compounds. **b.** Heating metals at high temperatures to convert them into their oxides.

Cementation—The precipitation of a more noble metal from solution by the introduction of a less noble metal.

Chalcophile—Said of an element tending to concentrate in sulfide minerals and ores. Such elements have intermediate electrode potentials and are soluble in iron monosulfide. (Compare *Lithophile*.)

Classifier—**a.** A machine or device for separating the constituents of a material according to relative sizes and densities, thus facilitating concentration and treatment. The term classifier is used in particular where an upward current of water is used to remove fine particles from coarser material. **b.** In mineral beneficiation, the classifier is a device that takes the ball mill discharge and separates it into two portions—the finished product, which is ground as fine as desired, and oversized material. (See *Ball mill* and *Beneficiation*.)

Collector—A compound containing a hydrogen-carbon group and an ionized group, chosen for ability to adsorb selectively in a froth flotation process and render adsorbing surfaces relatively hydrophobic.

Cone crusher—A machine for reducing the size of materials by means of a truncated cone revolving on its vertical axis within an outer chamber, the annular space between the outer chamber and cone being tapered. (See also *Gyratory crusher*.)

Depressor—A substance (usually inorganic) that inhibits flotation of the mineral. (See *Activator*.)

Electrolyte—A nonmetallic electric conductor (as a solution, liquid, or fused solid) in which current is carried by the movement of ions instead of electrons with the liberation of matter at the electrodes; a liquid ionic conductor.

Electrostatic separation—A method of separating materials by dropping feed material between two electrodes, positive and negative, rotating in opposite directions. Non-repelled materials drop in a vertical plane; susceptible materials are deposited in a forward position somewhat removed from the vertical plane.

Electrowinning—An electrochemical process in which a metal dissolved within an electrolyte is plated onto an electrode. Used to recover metals such as cobalt, copper, gold, and nickel from solution in the leaching of ores, concentrates, and precipitates (See *Electrolyte*.)

Flotation—A process for separating suspended particles using their relative density in a liquid. Usually, the term is now used to mean froth flotation. (See *Froth* and *Froth flotation*.)

Froth—In the flotation process, a collection of bubbles resulting from agitation, the bubbles being the agent for raising (floating) the particles of ore to the surface of the cell. (See *Froth flotation*.)

Froth flotation—**a.** A flotation process in which the minerals floated gather in and on the surface of bubbles of air or gas driven into or generated in the liquid in some convenient manner. **b.** The separating of finely crushed minerals from one another by causing some to float in a froth and others to remain in suspension in the pulp. Oils and various chemicals are used to activate, make floatable, or depress the minerals. **c.** A process for cleaning fine coal, copper, lead, zinc, phosphate, kaolin, etc. with the aid of a reagent; the minerals become attached to air bubbles in a liquid medium and float as a froth. (See *Flotation* and *Froth*.)

Gyratory crusher—A primary crusher consisting of a vertical spindle, the foot of which is mounted in an eccentric bearing within a conical shell. The top carries a conical crushing head revolving eccentrically in a conical maw.

Hydrocyclone—A cyclone separator in which a spray of water is used. (A cyclone separator is a funnel-shaped device for removing material from an airstream by centrifugal force.)

Jaw crusher—A primary crusher designed to reduce large rocks or ores to sizes capable of being handled by any of the secondary crushers. It consists of a moving jaw, hinged at one end, which swings toward and away from a stationary jaw in a regular oscillatory cycle.

Leachate—A solution obtained by leaching, which is the extraction of soluble metals or salts from an ore by means of slowly percolating solutions such as water or acids.

Lixiviant—A liquid medium that selectively extracts the desired metal from the ore or material to be leached rapidly and completely, and from which the desired metal can then be recovered in a concentrated form.

Raffinate—The aqueous solution remaining after a metal has been extracted by a solvent. (See *Solvent extraction*.)

Roasting—**a.** Heating an ore to effect a chemical change that will facilitate smelting. (See *Smelting*.) **b.** The operation of heating sulfide ores in air to convert to oxide or sulfate. **c.** Calcination, usually with oxidation. "Good," "dead," or "sweet" roasting is complete roasting; that is, it is carried on until sulfurous and arsenious fumes cease to be given off. Kernel roasting is a process of treating poor sulfide copper ores, by roasting in lumps, whereby copper and nickel are concentrated in the interior of the lumps. (See *Calcination*.) **d.** The heating of solids, frequently to promote a reaction with a gaseous constituent in the furnace atmosphere.

Rod mill—A mill for fine grinding, somewhat similar to a ball mill but employing long steel rods instead of balls to effect the grinding. (See *Ball mill*.)

Sintering—**a.** A heat treatment for agglomerating small particles to form larger particles, cakes, or masses; in the case of ores and concentrates, it is accomplished by fusion of certain constituents. **b.** To heat a mass of fine particles for a prolonged time below the melting point, usually to cause agglomeration.

Sludge—A semi fluid, slushy, murky mass of sediment resulting from treatment of water, sewage, or industrial and mining wastes, such as those from a coal-washing facility.

Smelter—A furnace in which raw materials or ores are melted.

Solvent extraction—A method of separating one or more substances from a mixture by treating a solution of the mixture with a solvent that will dissolve the required substances, leaving the others.

Tailings—**a.** Any refuse material resulting from the washing, concentration, or treatment of ores. **b.** Those portions of ore or minerals that are regarded as too poor to be treated further. **c.** The reject from froth flotation cells. (See *Froth flotation*.)

Venturi scrubber—Venturi scrubbers are used to collect extremely fine particulate matter from industrial emission sources. They are commonly used to remove particulate matter from exhaust gas streams which are corrosive, flammable, or which contain difficult-to-handle solids. The particulate collection efficiency of a venturi scrubber is comparable to that of an electrostatic precipitator or a fabric filter baghouse. The scrubbers mix particles and liquid, and then use a high-velocity air or gas stream to cause the liquid to become a mist that separates from the heavier solid particles.