Versar INC.

SITE INVESTIGATION OF SELECTED MINE SITES NEAR JUNEAU, ALASKA

Prepared for:

City and Borough of Juneau
155 South Seward Street
Juneau, Alaska 99801

Alaska Electric Light and Power
134 Franklin Street
Juneau, Alaska 99801

Prepared by:

Versar Inc. - Sacramento
5330 Primrose Drive, Suite 228
Fair Oaks, California 95628

Versar Job No. 6147.1

January 4, 1989

Versar INC.

DISCLAIMER

The purpose of this investigation and report is only to inform the client of the environmental conditions as they currently exist at the subject sites. Versar Inc. does not assume responsibility for the discovery and elimination of hazards that could possibly cause accidents, injuries, or damage. Compliance with submitted recommendations and/or suggestions in no way assures elimination of hazards or the fulfillment of a client's obligation under any local, state, or federal laws or any modifications or changes thereto. In many cases, federal, state, or local codes require the prompt reporting to relevant authorities if a release occurs. It is the responsibility of the client to comply with requirements to notify authorities of any conditions that are in violation of the current legal standards.

Factual information regarding operations, conditions, and test data were obtained, in part, from the client and have been assumed by Versar to be correct and complete. Since the facts stated in this report are subject to professional interpretation, they could result in differing conclusions. In addition, the findings and conclusions contained in this report are based on various quantitative and qualitative factors as they existed on or near the date of the investigation. Therefore, if the recommendations made in this report are not implemented within a reasonable period of time, there can be no assurances that intervening factors will not arise that will affect the conclusions reached herein.

Versar makes no warranty and assumes no liability with respect to the use of information contained in this report. No changes to its form or content may be made without Versar's express written approval.

This report reflects conditions, operations, and practices as observed during the investigation. Changes or modifications to procedures and/or facilities made after the site visit are not included.

Versar INC.

FOREWORD

This report was prepared by Versar Inc. of Sacramento, California, for the City and Borough of Juneau and Alaska Electric Light and Power under a contract dated December 14, 1987. Mr. Clarence Johnson, Senior Geohydrologist, prepared this report. Mr. Michael A. Neely, Manager, Versar West Coast Risk Management Services, reviewed this report.

Approved for Release:

Michael A. Neely, Manager
West Coast Risk Management Services

Versar INC.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

1.0 INTRODUCTION

Several historical mine sites in the Juneau, Alaska, area have recently been evaluated by the Alaska Department of Environmental Conservation (ADEC) and the United States Environmental Protection Agency (EPA). These investigations have included sites owned by the City and Borough of Juneau (CBJ) and Alaska Electric Light and Power Company (AEL&P). The results of sampling in Silver Bow Basin have indicated that heavy metals may be present in concentrations above background levels in the area of the Perseverance mill and Ebner Falls (Tryck, Nyman, and Hayes, 1987). Because the CBJ and AEL&P are concerned about the possibility of the suspected contamination causing environmental impairment, Versar was authorized to conduct an investigation of the Silver Bow Basin, the tailings deposited at and near tidewater along Douglas Island, the Alaska Juneau Mine (AJ) rock dump, and the Treadwell cyanide mill and tailing sites. The goal of the investigation was to determine if metals are present in high enough concentrations to raise concerns about environmental impairment, and to determine if special management practices are necessary.

2.0 ENVIRONMENTAL SETTING

2.1 Site Location and Demographics

The sites to be investigated are in or near the City of Juneau, Alaska. Access to Juneau is by boat or airplane. The population of Juneau is approximately 27,000. The locations of the study areas are shown in Figure 2-1.

The Perseverance site and Ebner Falls are located in Silver Bow Basin, an undeveloped recreational area approximately two miles east of downtown Juneau. Steep, forested mountains surround the basin and the Juneau Ice Field covers the top of the mountains to the east. Gold

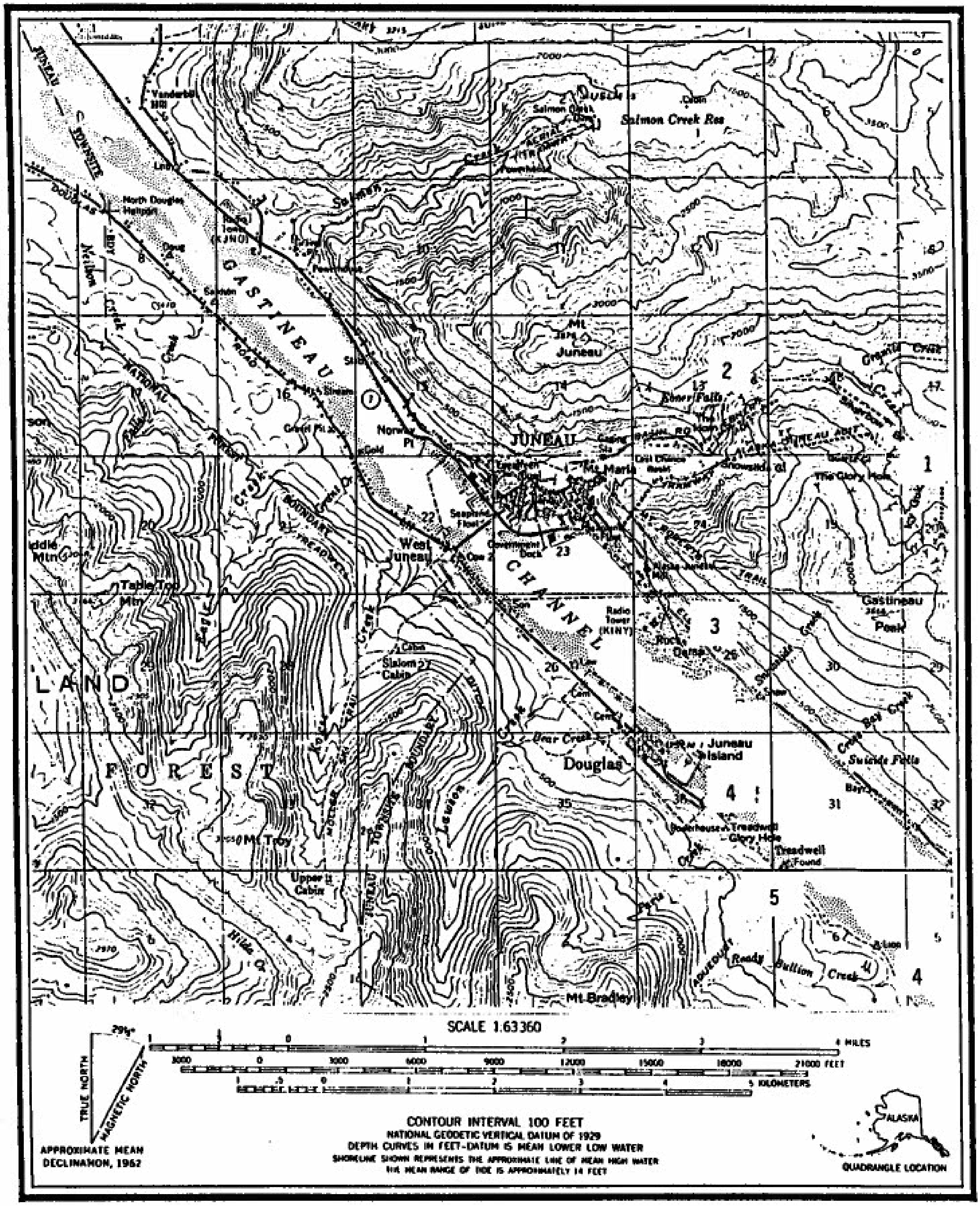


Figure 2-1. Map Showing the Locations of the Perseverance Area (1), Upper Ebner Falls (2), the AJ Rock Dump (3), the Douglas Island Tailings (4), and the Treadwell Cyanide Mill (5)

Creek flows to the west through the center of the basin and discharges over Ebner Falls, a narrow gap at the western end of the basin, to Last Chance Basin. The Perseverance Mine is near the east end of the basin. The only developed access is a hiking trail, which originates in Last Chance Basin west of Silver Bow Basin. The Alaska Juneau glory hole, a large open pit mine, is located to the west of the Perseverance mill site. The Webster mill site is located approximately 500 feet upstream from Ebner Falls.

The AJ rock dump begins one-half mile southeast of downtown Juneau and extends 2,800 feet to the southeast at tidewater in Gastineau Channel. The rock dump includes both unprocessed waste rock from the mine, and tailings from the gold extraction process. The only structures on the rock dump are communications satellite dishes, a Union Oil tank farm located on the northwest end of the rock dump, and the Juneau wastewater treatment plant located at the southeast end. Because the mountains border the channel so closely, the area adjacent to the rock dump has not been developed.

The tailings located along Gastineau Channel on Douglas Island, are from the operations of the Treadwell Group mines. The Sandy Beach area, on the northwest end of the tailings, has been developed as a recreational area and includes softball fields, a soccer field, tennis courts, and a picnic area. Residences are located to the west, uphill from Sandy Beach. Tailings from the Treadwell Group mining operations extend virtually continuously in a southeast direction from Sandy Beach to the Ready Bullion Mine, a distance of approximately 8,000 feet. Included in this area are the Treadwell cyanide mill tailings, which were deposited at tidewater approximately 4,000 feet southeast of Sandy Beach at tidewater, and also at the mill site, which is 500 feet inland from the channel. Most of the tailings on Douglas Island are located along a steep, forested, undeveloped area, which is used primarily as a recreational area for day trips by hikers.

2.2 Climate

The climate in the Juneau area is characterized by high precipitation, frequent cloudiness, and moderate temperatures due to the maritime influences which prevail along the coast of southeastern Alaska. The rugged, mountainous terrain surrounding Juneau produces large variations in local climatic conditions. The mean annual temperature is 40.2 degrees Fahrenheit (^{o} F). Temperatures range from 44^{o} F to 64^{o} F during June, July, and August, to between 17^{o} F and 38^{o} F during the November through February winter season. Occasional periods of severe cold occur when winds originating in northwestern Canada, known as "Taku Winds," flow into the area over the mountain passes and the Juneau Ice Fields. Juneau lies within the path of most storms crossing the Gulf of Alaska and experiences high precipitation. The mean annual precipitation is 53.17 inches, including 102.9 inches of snowfall. Approximately 68 percent of the snowfall occurs during December, January, and February. Monthly precipitation ranges from less than three inches in April, to an average of 7.74 inches in September.

2.3 Surface Water

The nearest surface water to the Perseverance mill site is Gold Creek, which is located approximately 50 feet to the north. According to a University of Alaska publication cited in a previous study of the Perseverance area (Tryck, Nyman, and Hayes, 1987), the stream has an average flow rate of 110 cubic feet per second. The actual flow rate of the stream varies widely during the year. A tributary to Gold Creek, Lurvey Creek, is located 500 feet southeast of the site. Gold Creek flows into the Gastineau Channel approximately 4.5 miles downstream from the mill site. Gold Creek serves as a recharge source for the water supply of the City and Borough of Juneau. The CBJ water supply wells are located approximately 3.5 miles downstream from the Perseverance site.

2.4 Geology

The geology of Southeastern Alaska is dominated by a series of northwest trending synclinoriums and anticlinoriums, and high angle strike-slip faults. These structures have been developed by several periods of folding and in excess of 150 miles of right lateral movement along the faults. Juneau is on the eastern edge of a synclinorium which is part of the Juneau-Mitkoff-Gravina structural low. This structural unit is bounded on the east by the Coast Crystalline Belt, which underlies the mainland, and extends to the west into the Insular Belt, which underlies the islands of the Alexander Archipelago. The Coast Crystalline Belt is comprised of a core of igneous rocks flanked by detrital and volcanic sedimentary rocks. The igneous rocks are part of the Coast Range Batholith, a complex composite pluton from Jurassic to Tertiary in age. These rocks are primarily granitic in composition, but mafic and ultramafic rocks are commonly found as dikes and sills in adjacent rocks, and as magmatic segregations within the batholith. The sedimentary rocks which flank the Coast Range Batholith are Paleozoic to Mesozoic in age, and have been regionally and contact metamorphosed into gneiss, schist, slate, and greenstone. The igneous dikes and sills enclosed in the sedimentary rocks have been, in places, similarly metamorphosed. The degree of metamorphism decreases toward the west, away from the batholith.

The rocks underlying Juneau and Douglas Island are part of the Juneau Gold Belt, a local subdivision of the Coast Crystalline Belt. The rocks hosting the gold deposits are slate, schist, metagabbro, and greenstone. Mineralization associated with the gold throughout the belt includes galena, pyrite, sphalerite, pyrrhotite, arsenopyrite, chalcopyrite, and tetrahedrite. The deposits toward the western side of the belt also include molybdenite, magnetite, scheelite, native arsenic, realgar, and orpiment (Berg and Cobb, 1966). The highest concentrations of gold are found in quartz veins in slate and metagabbro near Juneau, and in quartz veins in albite diorite dikes on Douglas Island. Lower concentrations of gold are found in the rocks hosting the veins.

2.5 Geohydrology

Ground water is used by CBJ to supply the municipal water system, and also by private well owners in the Juneau area for domestic supplies. All of the ground water pumped for the municipal supply system is reported to be of excellent quality.

The geohydrology of Last Chance Basin, which is west of Silver Bow Basin, has most recently been studied by James M. Montgomery, Consulting Engineers, Inc. (JMMCE). The geohydrologic conditions described in the JMMCE 1985 report are consistent with those generally recognized in steep-walled, glaciated alpine valleys. The sediments consist of unconsolidated fluvial, alluvial, landslide, and glacial deposits. Three aquifers were defined in the basin, two deep, confined aquifers, and a shallow unconfined aquifer. The upper deep aquifer is the principal aquifer exploited by CBJ for the municipal water supply. The shallow unconfined aquifer recharges the deeper aquifers. Tests conducted by JMMCE reported a transmissivity of 145,000 gallons per day per foot (gpd/ft) for the upper deep aquifer, a transmissivity of 62,500 gpd/ft for the shallow, unconfined aquifer, and total basin underflow of 4.3 million gallons per day (mgd). Underflow exclusive of the contribution of Gold Creek was estimated to be at least 2.0 mgd. This large underflow indicates that Last Chance Basin is hydraulically connected to Silver Bow Basin. It is also reasonable to expect that the subsurface environments are similar in the two basins. The principal difference may be the depth to bedrock. Wells in the Last Chance Basin are capable of sustained yields in excess of 1,000 gallons per minute. This yield is believed to be typical for valley bottom aquifers throughout the Juneau area (USGS, 1974, Siegel, 1988).

Although no studies have been undertaken to specifically define ground water flow through the soils developed on the mountainsides in the Juneau area, some empirical observations have been made in the Thane area, which is located approximately three miles southeast of Juneau. The aquifers in the soils developed on the mountainsides in the Thane area have lower transmissivities than those in Last Chance Basin and in valley bottom reservoirs in the Juneau area. The wells in Thane, which must typically be completed to depths of greater that 100 feet, show substantial drawdown at pumping rates of less than 50 gallons per minute. The ground water flow in the Thane area is expected to be typical for the mountain slopes in Silver Bow Basin and on Douglas Island.

3.0 PREVIOUS WORK

The only previous work reported for the areas of concern are two studies near the Perseverance Mine. The first was conducted for ADEC by Tetra Tech, Inc. Two soil samples from the area of the Perseverance mill were analyzed for total lead and leachable lead using the Extraction Procedure Toxicity Test (EPTT) (Tetra Tech, 1984). Sample Number 83100411 contained 2,600 milligrams per kilogram (mg/kg) of total lead. The leachate generated in the EPTT contained 5.2 milligrams per liter (mg/l) of lead. Sample 84050704 contained 5,000 mg/kg of total lead, and the EPTT leachate contained 0.12 mg/l of lead.

Because the Perseverance mill is included on the EPA's list of suspected hazardous waste sites, and is located upstream from the CBJ water intake system, ADEC retained Tryck, Nyman and Hayes (TNH) and Science Applications International Corporation (SAIC) to evaluate the site to determine if releases of hazardous wastes from the site present an imminent or substantial danger to public health, welfare, or the environment. The results of the investigation, which are summarized below, were presented in a report titled "Suspected Uncontrolled Hazardous Waste Site Inspections, Perseverance Mill, Juneau, Alaska," dated September, 1987. In July, 1986, the TNH/SAIC project staff traveled to Juneau, Alaska, to review pertinent files and interview people familiar with the Perseverance mill. The staff reviewed regional and state ADEC files, EPA Region X CERCLIS files, United States Geological Survey well inventory data, and United States Bureau of Mines Records. A review of the CBJ monitoring data showed the water supplies from Gold Creek sources to be of excellent quality, and within federal and state drinking water standards. Project staff also interviewed ADEC personnel and private citizens who were familiar with the site. Based on their interpretation of the available information, TNH/SAIC concluded that the mill site might be contaminated with heavy metals and cyanide, and represented a potential source of contamination for Juneau's water supplies. It was recommended that a site visit and field sampling should be conducted to further evaluate the potential hazards of the area.

A site inspection of the Perseverance mill was conducted on November 12, 1986. The inspection included visual observation of the site, and collection of soil, stream sediment, surface water, and ground water samples. Poor weather conditions and snowfall forced the project staff to modify their original sampling and site observation plans. A total of six soil samples were collected (including one replicate sample); the depth of sampling was limited to between two and six inches because the ground was frozen. Three samples of stream sediments were collected from Gold Creek, including one sample taken two miles downstream from the mill site. No information was provided on the size fraction of the sediments which were analyzed. Four of six soil sample locations and two of the three sediment samples were reported to have elevated concentrations of lead, mercury, arsenic, and zinc. The two samples which contained the highest concentrations of heavy metals were selected for the EPTT. The leachate from sample DA3 was found to contain 5.6 mg/l of lead, and the leachate from sample S1 was found to contain 5.2 mg/l of lead. Both of these samples slightly exceed the proposed federal TCLP limits of 5.0 mg/l of lead. No other metals exceeded the TCLP limits. None of the samples analyzed contained cyanide. A summary of the soil and stream sediments sample analyses is presented in Table 3-1. Some of the samples underwent field tests to measure pH. The pH measurements ranged from 3.96, in soil believed to contain mine tailings, to 8.14 in stream sediments two miles downstream from the Perseverance mill. Background soil samples had a pH of 5.2.

Four surface and two ground water samples were collected during the site visit. Ground water samples were collected from seeps, and may have also contained some surface water. Analyses did not indicate significant levels of heavy metal contamination. Zinc, the only metal measured above detection limits, was present at levels of less than one percent of the drinking water standard of 5.0 mg/l. The specific conductance of the two ground water samples, as measured in the field, was 680 and 3,200 micromhos per square centimeter.

Based on the results of the analyses of the samples, site observations, and background research, the following recommendations which are pertinent to this work plan were made: a minimum of 21 soil borings, six within the unvegetated area and 15 at other locations near the Perseverance mill, should be drilled to collect soil samples from three, nine, and 15 feet for chemical analysis for lead, zinc, arsenic, and mercury; the hazardous characteristics of soil samples with significant concentrations of heavy metals should be quantified using the EPTT; an unspecified number of stream sediment samples should be collected along the course of Gold Creek from the head of Silver Bow Basin to the CBJ water intake for analysis for lead, zinc, arsenic, and

Table 3-1. Summary of the Results of the Chemical Analyses of Soil and Stream Sediment Samples[1]

Total Metals

Sample No.	Lead (ug/g)	Zinc (ug/g)	Arsenic (ug/g)	Mercury (ug/g)
MDL[2]	4.0	0.75	10.0	0.02
U1	10.9	133	12.5	BDL[3]
U2	11.2	119	12.2	BDL
S1	3,160	519	974	347
DA1	2,640	747	1,260	8.99
DA2	3,310	275	1,130	14.8
DA3	5,950	657	1,580	16.2
DA3R	4,200	313	742	29.7
UEFS	404	177	45.8	12.8
MD1	654	312	121	0.38

Extraction Procedure Toxicity Test

	Lead (mg/l)	Zinc (mg/l)	Arsenic (mg/l)	Mercury (mg/l)
TCLP limits	5.0	NE[4]	5.0	0.2
S1	5.2	0.05	0.005	<0.001
NA3/NA3R	5.6	0.12	0.007	<0.001

[1]Source: TNH/SAIC, 1987

[2]MDL: method detection limit

[3]BDL: below detection limits

[4]NE: not established

mercury; water samples should be collected from site runoff, Gold Creek, and within the mine for analysis for lead, zinc, arsenic, and mercury; and a determination of the depth to ground water and the relationship of the aquifers in Silver Bow and Last Chance Basins should be made.

In addition to the work discussed above, the site was scored using the EPA Hazard Ranking System. The results of the scoring have not been made available to Versar.

An investigation of the Thane Mine dump site was conducted by Environment and Ecology (EE) for the United State Environmental Protection Agency. The report of the study was released in May, 1988. Although the study did not cover the same area as the Versar investigation, the environmental setting, the deposit mined, the mining and milling methods used, and the tailings produced are similar, and the results provide additional data which can be used to facilitate the interpretation of the results of this study. Of primary interest in the EE report, are the results of the analyses of tailings for total metals and analysis by EPTT. The lead in the tailings ranged from 4.8 mg/kg to 193 mg/kg, the zinc ranged from 44 mg/kg to 366 mg/kg, and the arsenic ranged from 7.4 mg/kg to 62 mg/kg. The samples with the lowest concentrations of metals were collected in an area where stream sediments have mixed with the tailings, and, in some locations, constitute the largest part of the sample. The concentrations of all of the metals detected in the EPTT were at least two orders of magnitude below the maximum allowable concentration.

4.0 SAMPLING PROCEDURES

A work plan for the collection and analysis of samples in the study areas was given to ADEC for review prior to beginning the work. Mr. Steve Haavig and Mr. Jeff Hock of ADEC reviewed the plan and written comments were sent to Mr. David Stone of AEL&P on June 22, 1988. In response to the comments, the procedures to be used were described in greater detail and the comments were incorporated into the plan where appropriate.

The soil samples were collected from holes made with a hand auger. The auger holes were examined for soil stratification, and the samples were collected from the side of the hole after cleaning the hole to prevent cross contamination of samples obtained from discreet layers. After completing the sampling at each location, the auger was cleaned with a stiff-bristled brush and clean water, followed by cleaning in an Alconox solution and rinsing in distilled, deionized water. The spatulas and knives used to collect the samples were similarly cleaned after each sample. All of the samples collected were placed in precleaned glass jars and placed in ice chests.

Stream sediment samples were collected by taking sediments from several spots at each sample location to form a composite sample. To gain the most representative sample, sediments were collected which would pass through an 80-mesh screen. The samples were placed in precleaned glass jars and stored in an ice chest.

Water samples for metals were collected by allowing the water to flow directly into precleaned plastic one-liter jars. The mouths of the jars were pointed upstream to prevent contamination of the sample. Nitric acid was added to acidify the sample to a pH of less than 2.0. Water samples for cyanide were tested with potassium iodide starch paper for the presence of sulfides, and sodium hydroxide was used to raise the pH to greater than 12.0, if necessary. The pH, temperature, and specific conductivity were recorded for all water samples. After collection, the water samples were placed in ice chests.

Chain of custody forms were filled out for all samples (see Appendix B). Two copies of the chain of custody forms were placed in each ice chest with the securely packed samples, and the ice chests were taped closed and sealed. The samples were then sent to the Versar laboratory in Springfield, Virginia, via overnight courier.

Splits of all the samples, with the exception of the cyanide samples, were collected for the ADEC. These samples were delivered following the proper chain of custody procedures to the ADEC laboratory in Juneau (see Appendix B).

5.0 WORK ACCOMPLISHED

5.1 Perseverance Mine

5.1.1 Background

The tailings from the Perseverance Mill were removed during the mid-1930s for processing in the Alaska-Juneau Mill (D. Stone, personal communication, 1987). A thin layer of tailings, which were not removed, have formed an unvegetated red soil. It is estimated that less than 800 tons of tailings are left at the site. To verify the results obtained during the TNH/SAIC study, and to further determine the possible hazardous characteristics of the tailings, samples were collected along north-south and east-west transects in the tailings disposal area. Samples were also collected along the trail leading to the tailings area, the mill site, and from the soil between the mill site and the tailings. To determine whether the tailings may have impacted the water in Gold Creek, two water samples were collected downstream from the tailings area. Sediment samples were collected at the locations where water samples were taken, and also upstream of the Perserverance Mine and Webster mill (above Ebner Falls) areas.

5.1.2 Tailings Disposal Area Soil Samples

The tailings disposal area has maximum dimensions of 145 feet in length, and 82 feet in width (see Figure 5-1). The area was apparently prepared for deposition of the tailings by scraping dirt from the center of the area towards the outside to form a berm four to five feet high.

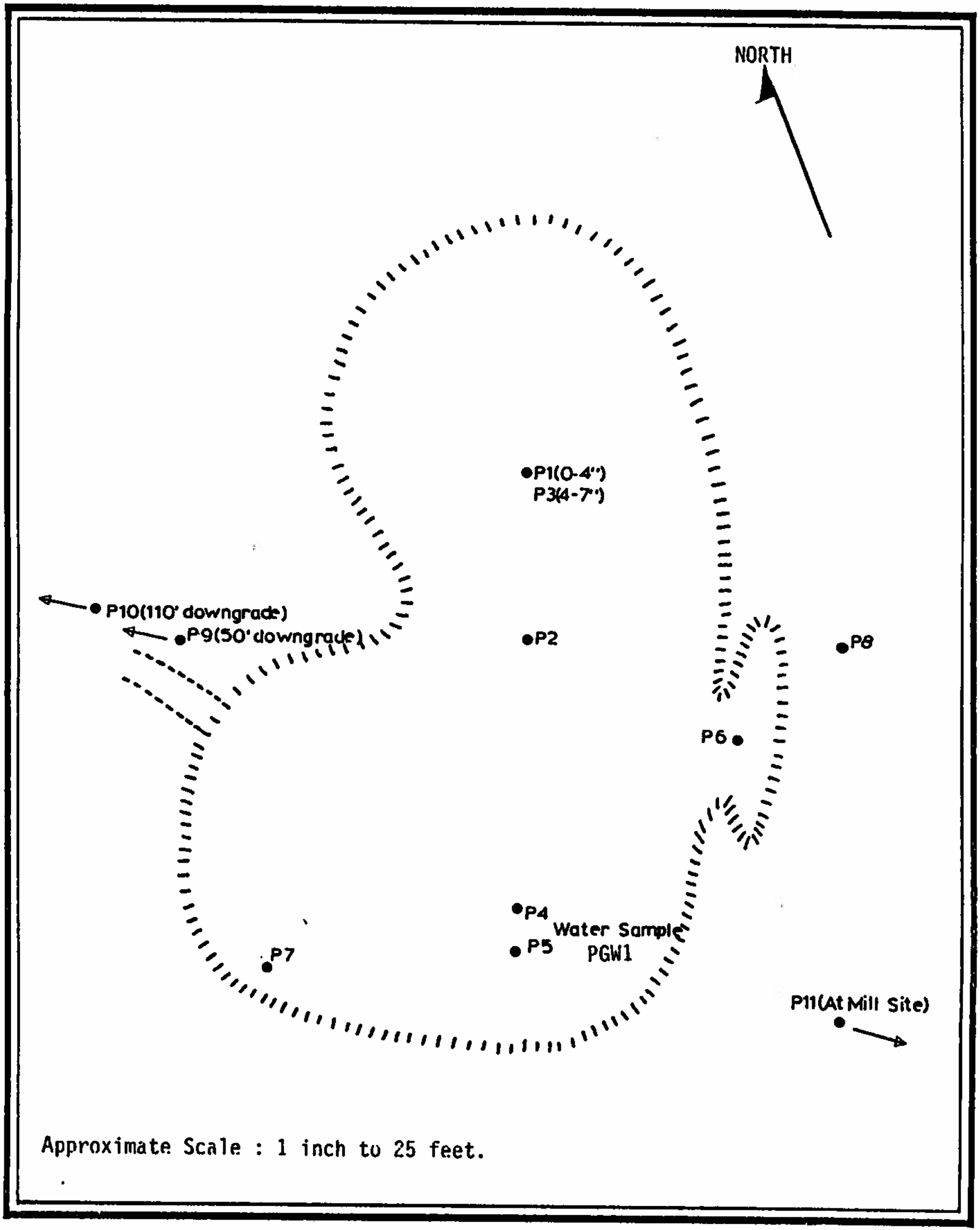


Figure 5-1. Locations of the Tailings, Soil, and Water Samples Collected Near the Perseverance Mine

Part of the berm on the east side may be formed by a natural bank. The surface of the entire area is covered by a thin layer of tailings which have been oxidized to a rust color. The thickness of the tailings varies from less than six inches to approximately four feet in the berms. The average thickness appears to be less than 1.5 feet. The tailings are not able to support vegetation; however, a few patches of grass and some shrubs appear to be growing where the tailings layer is very thin (see Photos 1 and 2, Appendix A). The edge of the tailings disposal area is sharply delineated by vegetation, which starts on the top of the berm, and consists of alder, willow, and other plant species which are found throughout Last Chance and Silver Bow Basins.

Ten soil samples were collected from the tailings area along north-south and east-west transects (see Figure 5-1). The upper four to 12 inches of the soil at the locations sampled consists of rust-colored, fine-grained, oxidized tailings. This layer is underlain by a fine-grained layer of grey tailings approximately four to 18 inches thick. The tailings appear to be composed primarily of quartz, feldspar, and pyroxene. The tailings are underlain by a brown, clayey, sandy silt with gravel, which appears to be typical of the soil which occurs throughout the valley, or by a layer of fractured bedrock. The tailings layer is thicker on the inner slope of the surrounding berm, and may be as thick as the four foot height of the berm at the margins. Standing water from rain fall was seen only in the lowest part of the tailings area. Water was found in the holes augered for soil samples only in the lowest part of the tailings area also. Eight samples were taken of the tailings, one sample was taken of a tailings and soil mixture, and one sample was taken of the brown soil. Seven of these samples were submitted for analysis for lead, zinc, arsenic, and mercury, and three samples were submitted for analysis for lead, arsenic, mercury, silver, cadmium, selenium, barium, and chromium using the Extraction Procedure Toxicity Test (EPTT). The pH of the soil was estimated by mixing equal volumes of soil and deionized water with a pH of 7, and testing the resulting liquid with a pH meter.

5.1.3 Other Soil Samples

Soil samples were also collected from the Perseverance Mill site, the area between the Perseverance Mill and the tailings disposal area, and the trail approaching the tailings disposal area from the west. The Perseverance Mill site and the area between the mill and tailings disposal area were sampled to determine if metals are present in the soil at elevated concentrations as a result of the milling operations. The sample locations were heavily vegetated, and showed no impairment as resulting from mining or milling activities was noted near the mill on the area between the mill and the tailings site. The two samples collected along the trail leading to the disposal area were sampled because tailings were observed to have been carried down the trail by storm water, and it appeared that samples from the trail could give an indication of the maximum potential for the tailings to cause contamination of the soil to the west of the disposal area. Although tailings could be observed in the trail samples, the soil in general appeared to be typical for the Silver Bow Basin.

5.1.4 Water and Sediment Samples

Stream water samples and stream sediment samples were collected at locations upstream and downstream from the tailings disposal area (see Figure 5-2). The water samples were clear and free of sediments. Care was taken to ensure that the samples were representative of the stream sediments, and were not bank samples. Based on an examination of the coarser fraction of the sediments collected, the principal minerals present are quartz, feldspar, pyroxene, amphibole, and mica, along with rock fragments of slate.

One water sample was taken from standing water which collected in the auger hole bored for soil sample P-5 (see Figure 5-1). To limit

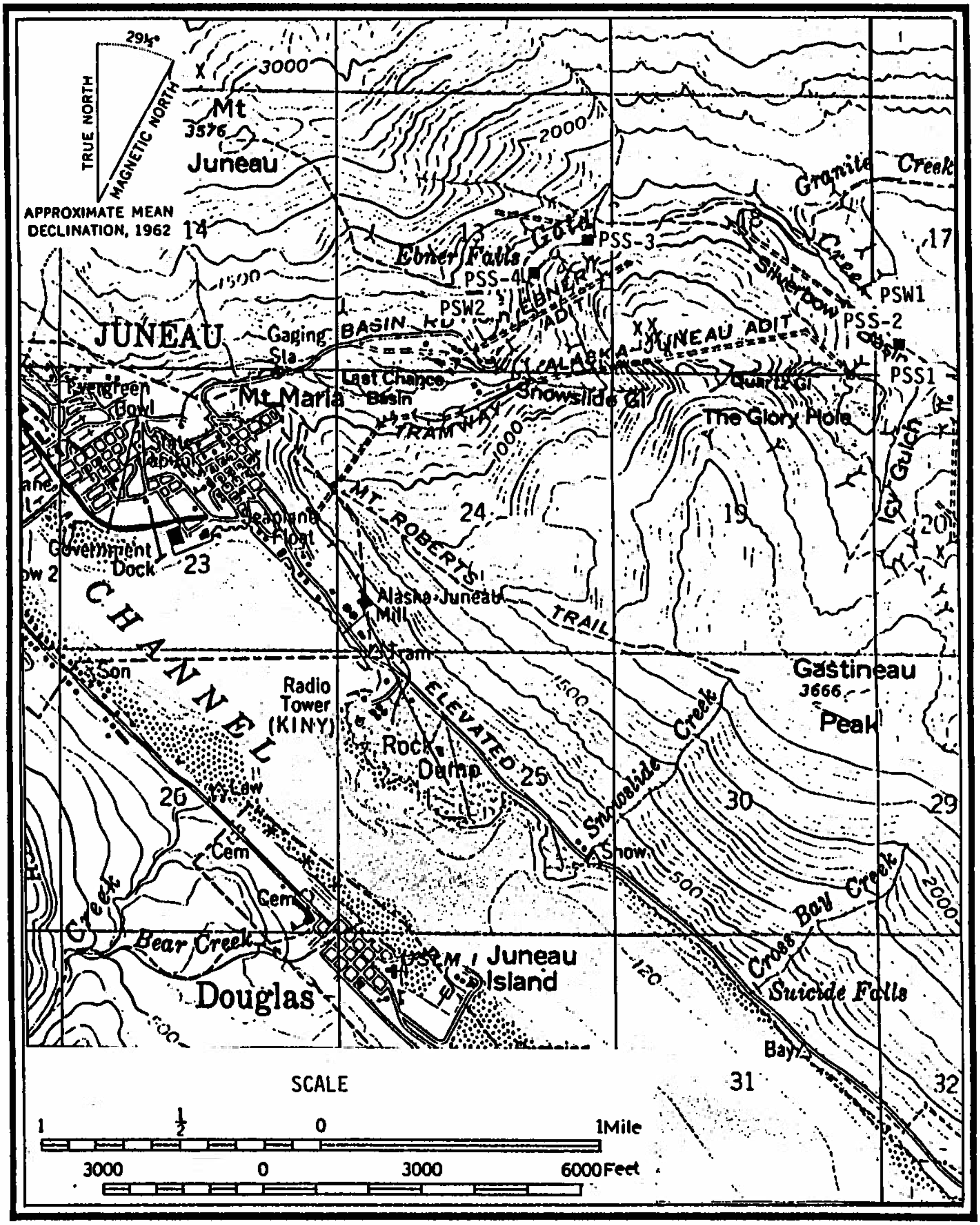


Figure 5-2. Locations of the Sediment and Stream Water Samples Taken From Gold Creek

possible dilution by rain water, the standing water was removed from the hole, the hole covered, and a sample collected after the hole had refilled with water. The water sample was cloudy, and was filtered at the ADEC laboratory the morning after it was collected.

5.2 Ebner Falls

5.2.1 Background

Ebner Falls was the location of the Webster mill (Berg and Cobb, 1966). Although the TNH/SAIC report attributes the presence of heavy metals in the stream sediments taken near Ebner Falls to transport of the Perseverance tailings by Gold Creek, it is more probable that the operations at the Webster mill have contributed the heavy metals found in the sediments. To help determine the source of the metals and to determine the threat to the environment posed by their presence, stream water and sediment samples were collected both above and below the location of the Webster mill (see Figure 5-2).

5.2.2 Stream Water and Sediment Sampling

Near the Webster mill, Gold Creek flows through a steep-walled valley. The creek is constricted at the falls, and the flow is extremely rapid. Although minus 80 mesh sediments were difficult to find, particularly immediately above the falls, sufficient sediment was obtained for analysis. Stream sediment samples were collected upstream and downstream from the location of the Webster mill and a water sample was collected downstream. The composition of the sediments is similar to the stream sediments collected near the Perseverance Mine. An examination of the area did not find evidence of any tailings piles which could be sources of contamination.

5.3 Douglas Island Tailings

5.3.1 Background

Although there has been no indication that the Treadwell cyanide mill tailings are hazardous, they were selected for investigation to assess the potential for environmental impairment because of the general concerns associated with mine tailings. In addition, these tailings are unique because they are derived from the only ore processed with cyanide in the Juneau area (Stone and Stone, 1983), and they consist primarily of sulfides. Three soil samples and one water sample were collected from the cyanide mill area. Tailings samples were also collected from the beach along Gastineau Channel at Sandy Beach (see Photo 3, Appendix A), from near the Ready Bullion Mine (see Photo 4, Appendix A), and from the beach 1,000 feet northwest of the Treadwell cyanide mill sulfide tailings (see Photo 5, Appendix A). The sample locations are shown in Figure 5-3. Samples were collected from the Ready Bullion and Sandy Beach area because they represent the northwest and southeast boundaries of the mining areas, and the Sandy Beach area has the greatest amount of human contact with the tailings. The third location along the beach was selected because of the presence of rusted and broken pieces of old mining and milling equipment, which could indicate that the area was used as a waste disposal site.

5.3.2 Treadwell Cyanide Mill Samples

The Treadwell cyanide mill tailings are located both at tidewater (see Photo 6, Appendix A), and approximately 500 feet inland from Gastineau Channel (see Photo 7, Appendix A). The tailings consist primarily of fine-grained iron sulfides which appear to be dark grey, but on close inspection can be seen to have a yellow color. The lower tailings pile, located at tidewater, is 70 feet long and 40 feet wide. The thickness of the pile varies from six feet to greater than 10 feet. The upper tailings pile is 140 feet long and 65 feet wide. The pile

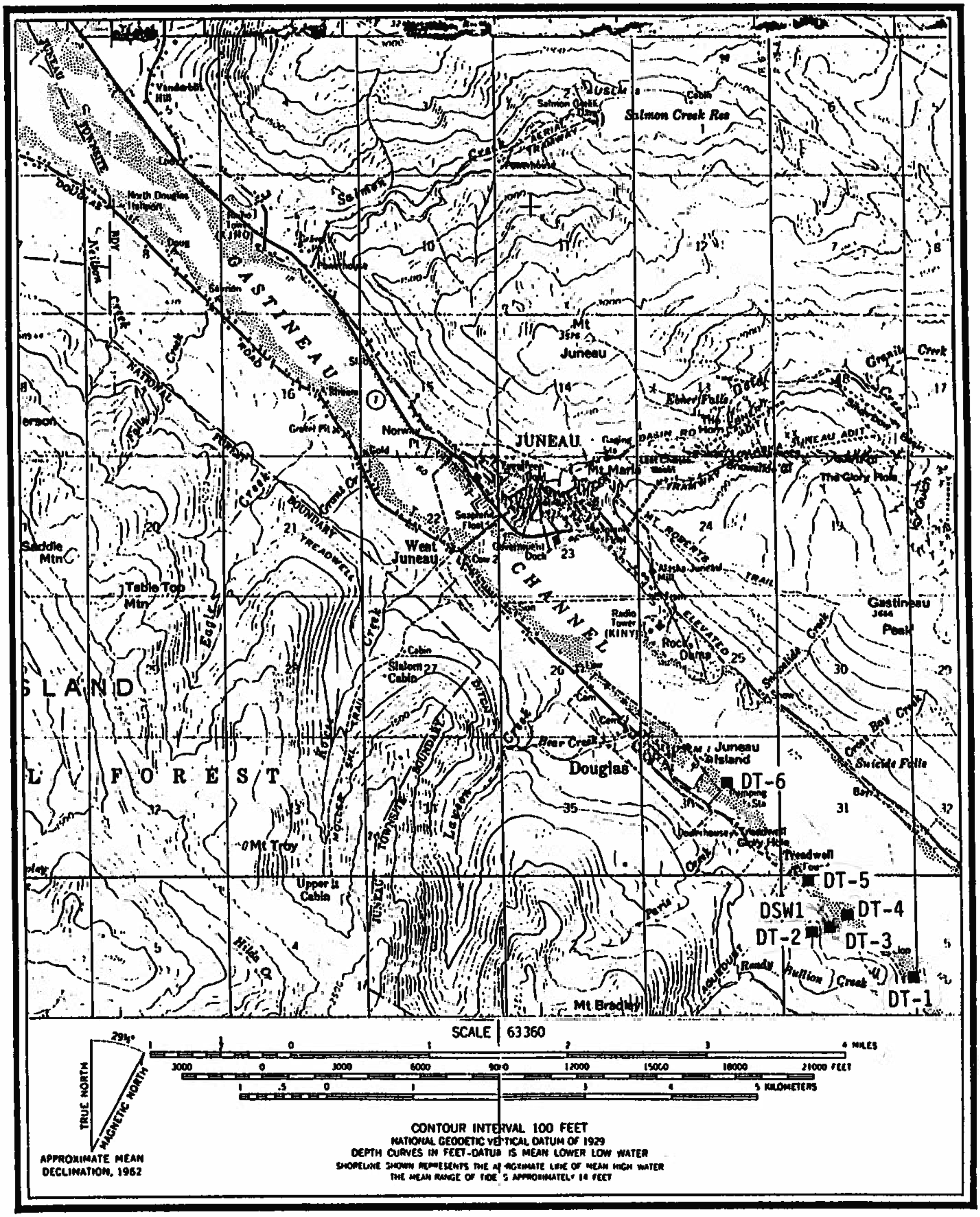


Figure 5-3. Locations of the Tailings, Soil, and Water Samples Collected on Douglas Island

appears to be six to 12 feet thick, but the true thickness is difficult to judge because the underlying topography is unknown. A discontinuous red layer one to two inches thick is present four inches below the surface in the upper tailings pile. The perimeter of the upper pile, and the southwest side of the lower pile, were bounded by vegetation. Soil containing greater than 50 per cent tailings was found in holes augered to a depth of three feet approximately 25 feet downslope from the upper tailings pile. This mixture of soil and tailings was covered with vegetation, even where tailings were predominant in the upper surface.

Samples were collected from both piles and from the soil between the piles for analysis for lead, zinc, mercury, arsenic, and cyanide, and one sample was collected from the upper pile for EPTT (see Photo 8, Appendix A). One water sample was collected from a small, slow moving stream which flowed over the top of the inland pile. The sample location was approximately 60 feet downstream from the tailings. The water sample was analyzed for lead, zinc, mercury, arsenic, cyanide, pH, and specific conductivity. Water from the stream was also analyzed for pH and specific conductivity upstream from the upper tailings pile, in the tailings pile, and below the site where the water sample was collected.

5.3.3 Gastineau Channel Beach Tailings

The tailings samples collected from Sandy Beach, the Ready Bullion Mine, and the beach northwest of the Treadwell cyanide mill tailings are composed of sand- and silt-sized quartz, feldspar, pyroxene, and amphiboles. There was no visual evidence of sulfides or other minerals which would normally contain lead, zinc, mercury, or arsenic.

5.4 Alaska Juneau Mine Dump

5.4.1 Background

The AJ rock dump contains both gangue, or waste rock, and mill tailings from the AJ mill. Samples were collected from the northwest and southeast ends of the dump (see Figure 5-4). Although the work plan called for a sample from the middle of the dump, the rock in the dump appeared to be so homogeneous that a third sample did not appear to be warranted. Structures located on the rock dump include satellite communications antennas, a Union Oil tank farm at the northwest end of the dump, and the Juneau municipal wastewater treatment plant at the southeast end.

5.4.2 Rock Dump Samples

The gangue is found primarily at the western end of the dump and is composed of sand, gravel, cobbles, and boulders ranging up to 24 inches in diameter (see Photo 9, Appendix A). The principal components are rock fragments of gabbro, metagabbro, and slate. The eastern end of the dump contains a greater percentage of mill tailings, which are finer (predominantly sand) and are composed of gabbro, metagabbro, slate, and individual grains of quartz, feldspar, and pyroxene. The sample from the southeast end was taken from a 10-foot high cut which exposed a number of layers (see Photo 10, Appendix A). The sample consists of a composite of the layers exposed.

6.0 RESULTS

The laboratory reports of the chemical analyses are included in Appendix C for the tailings, soil, and sediment samples, Appendix D for the water samples, and Appendix E for the EPTT.

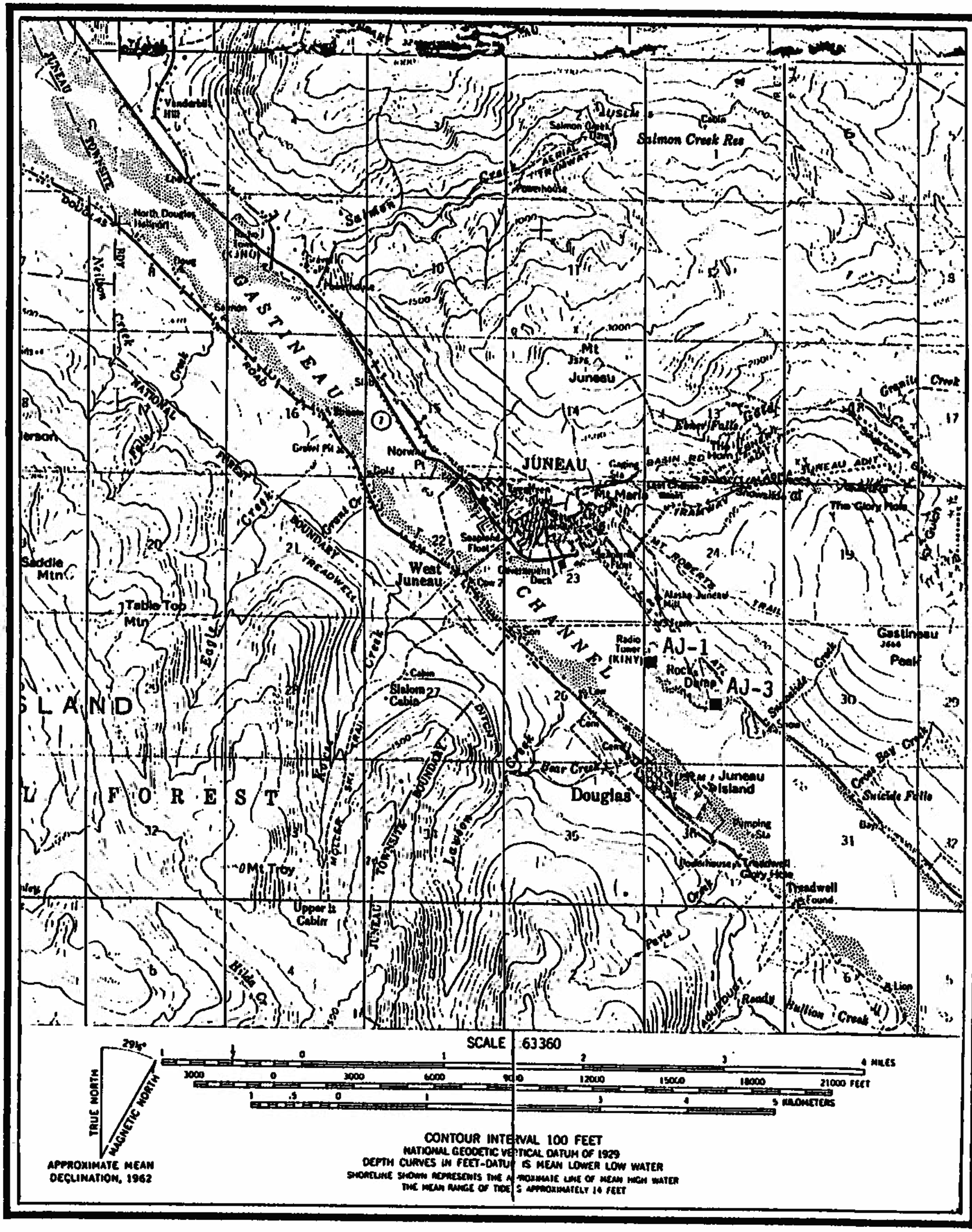


Figure 5-4. Locations of the Tailings Samples Collected at the Alaska Juneau Rock Dump

6.1 Perseverance Mine and Ebner Falls

6.1.1 Soil Samples

The results of the chemical analyses of the soil samples from the Perseverance Mine area are given in Table 6-1. The results show that the samples of tailings contain relatively high levels of lead (between 1,310 and 12,500 mg/kg), moderate to high levels of mercury (between 1.4 and 33 mg/kg) and arsenic (between 102 and 2,240 mg/kg), and moderate levels of zinc (between 105 and 505 mg/kg). The soil beneath the tailings and samples taken to the east of the tailings disposal area and at the base of the mill have generally lower levels of lead (between 700 and 1,540 mg/kg), zinc (between 95 and 379 mg/kg), arsenic (between 34 and 576 mg/kg), and mercury (between 0.14 and 13 mg/kg). The soil samples collected 50 feet and 100 feet to the west, along the trail leading to the site, have the lowest concentrations of metals. One hundred feet down the trail, the levels decrease to 72 mg/kg of lead, 108 mg/kg of zinc, 21 mg/kg of arsenic, and 0.45 mg/kg of mercury. The pH of the soil samples ranged from 3.48 to 5.31 in the tailings disposal area, and from 4.71 to 6.22 outside the tailings disposal area.

Of the three samples submitted for the EPTT, only one sample returned a result which exceeded the limits for the test (see Table 6-2). Sample P12, taken from the grey tailings layer, had lead in the leachate at a concentration of 5.64 mg/l, which is above the limit of 5.0 mg/l.

6.1.2 Sediment Samples

Two sediment samples were collected from the Perseverance Mine area, and two were collected from the Ebner Falls area. The results of the chemical analyses are given in Table 6-1. Sample PSS1 was collected upstream from the tailings area to serve as a background sample. Lead increases from 13 mg/kg upstream from the tailings disposal site to a

Table 6-1. Results of Analyses of Tailings, Soil, and Stream Sediment Samples

Sample No.	Lead	Zinc	Arsenic	Mercury	Cyanide
	All values are reported in milligrams per kilogram				
			Soil Samples		
Perseverance Mine Area					
P1	2,440	505	1,670	17	NA[1]
P2	8,880	408	2,240	25	NA
P3	924	340	576	13	NA
P4	1,470	136	166	8.2	NA
P5	1,560	95	188	0.14	NA
P6	1,310	105	102	1.4	NA
P7	12,500	197	404	33	NA
P8	700	379	34	2.2	NA
P9	293	107	40	4.0	NA
P10	72	108	21	0.45	NA
P11	749	122	394	11	NA
Douglas Tailings Area					
DT1	8.6	49	4.5	0.33	<0.53
DT2	316	649	191	57	19.9
DT3	60	38	64	0.22	<0.79
DT4	511	147	350	10	49.1
DT5	119	84	75	1.1	1.28
DT6	13	34	<3.8	0.36	<0.59
Alaska Juneau Rock Dump					
AJ1	86	232	44	<0.11	NA
AJ2	163	444	36	<0.11	
			Sediment Samples		
Perseverance Mine Area					
PSS1	13	92	23	<0.12	NA
PSS2	14	124	33	<0.13	NA
Upper Ebner Falls					
PSS3	40	96	30	<0.13	NA
PSS4	24	117	27	0.26	NA

[1]Not analyzed for this parameter

Table 6-2. Results of the Extraction Procedure Toxicity Tests

Sample No.	Silver	Arsenic	Barium	Cadmium	Chromium	Lead	Selenium	Mercury
	All values are reported in milligrams per liter							
<u>Perseverance Mine Area</u>								
P12	0.001	0.041	0.051	0.034	<0.005	5.64	<0.005	<0.002
P13	<0.001	<0.02	0.155	<0.003	<0.005	0.443	<0.005	<0.002
P14	<0.003	0.02	0.757	<0.003	0.0051	0.672	<0.005	<0.002
<u>Douglas Tailings Area</u>								
DEPT 2	0.001	<0.02	0.09	0.05	0.005	0.39	<0.005	<0.002
<u>Maximum Allowable Concentration</u>								
	5	5	100	1	5	5	1	0.2

maximum of 40 mg/kg in the sediment sample taken from the creek above the Webster mill near Ebner Falls. The lead content of the sample taken downstream from the Webster mill fell to 24 mg/kg. The concentration of zinc in the samples shows little variation, with levels between 92 mg/kg and 124 mg/kg. Arsenic concentrations increase immediately downstream from the background sample, but decrease by Ebner Falls. Mercury is below the reporting limit of 0.13 mg/kg except in the sediment collected downstream from the Webster mill, which had a concentration of 0.26 mg/kg.

6.1.3 Water Samples

The two water samples collected from Gold Creek, one downstream from the tailings area and one downstream from the Webster mill, did not contain lead, arsenic, or mercury at the reporting limits of 0.005 mg/l, 0.010 mg/l, and 0.0002 mg/l, respectively (see Table 6-3). Zinc was found to be present at 0.0084 mg/l in PSW1 and 0.0087 mg/l in PSW2. The pH of the stream water was 7.2, and the conductivity was approximately 16 microsiemens (ms). The sample of water taken from the auger hole at the tailings area has 2.8 mg/l of lead, 1.55 mg/l of zinc, 0.022 mg/l of arsenic, and no mercury at a reporting limit of 0.0002 mg/l. The pH of the water was 3.42 and the conductivity was 700 ms.

6.2 Douglas Island Tailings

Tailings samples collected at Sandy Beach (DT6) and the beach near the Ready Bullion Mine (DT1) have low levels of lead, zinc, and arsenic. These samples have nondetectable levels of cyanide at reporting limits of 0.53 mg/kg and 0.59 mg/kg, and trace amounts of mercury at 0.33 mg/kg and 0.36 mg/kg, respectively. The samples collected from the upper (DT2) and lower (DT4) tailings piles at the Treadwell cyanide mill contain 316 mg/kg and 511 mg/kg of lead, 649 mg/kg and 147 mg/kg of

Table 6-3. Results of the Analyses of Water Samples

Sample No.	Lead	Zinc	Arsenic	Mercury	Cyanide
All values reported in milligrams per liter					
Perseverance Mine Area					
PSW1	<0.005	0.0084	<0.01	<0.0002	NA[1]
PGW1	2.8	1.55	0.022	<0.0002	NA
Upper Ebner Falls					
PSW2	<0.005	0.0087	<0.01	<0.0002	NA
Douglas Tailings Area					
DSW1	0.017	0.199	<0.01	0.00036	<0.01
Trip Blank					
	<0.005	0.0061	<0.01	<0.0002	<0.01

[1]Not analyzed for this parameter

zinc, 191 mg/kg and 350 mg/kg of arsenic, 57 mg/kg and 10 mg/kg of mercury, and 19.9 mg/kg and 49.1 mg/kg of cyanide, respectively. A soil sample collected on the hillside between the two tailings piles contains 60 mg/kg of lead, 38 mg/kg of zinc, 64 mg/kg of arsenic, 0.22 mg/kg of mercury, and cyanide was nondetectable at a reporting limit of 0.79 mg/kg. The final soil sample, taken on the beach northwest of the lower tailings pile, has 119 mg/kg of lead, 84 mg/kg of zinc, 75 mg/kg of arsenic, 1.1 mg/kg of mercury, and 1.28 mg/kg of cyanide.

One sample from the upper tailings pile was submitted for the EPTT. None of the metals exceeded the allowable concentration in the leachate (see Table 6-2).

One water sample was collected from a stream which flows over the upper tailings pile. The sample, which was collected 60 feet downslope from the tailings pile, contains 0.017 mg/l of lead, 0.199 mg/l of zinc, and 0.00036 mg/l of mercury. Arsenic and cyanide were not detected at the reporting limit of 0.01 mg/l (see Table 6-3). The pH of the water was 6.71 above the upper tailings pile and the conductivity was 650 ms. Immediately below the tailings pile, the pH was 2.67 and the conductivity was 3,400 ms. At the location where the water sample was taken, the pH was 2.8 and the conductivity was 1740 ms. Near the beach, the stream water had a pH of 2.8, and a conductivity of 1390 ms.

6.3 Alaska Juneau Rock Dump

Two samples were submitted for analyses from the Alaska Juneau rock dump. The metal concentrations of sample AJ1, from the northwest end of the dump, and AJ3, from the southeast end of the dump, were 86 mg/kg and 163 mg/kg of lead, 232 mg/kg and 444 mg/kg of zinc, and 44 and 36 mg/kg of arsenic, respectively (see Table 6-1). Mercury was not detected at a reporting limit of 0.11 mg/kg.

7.0 DISCUSSION

7.1 Mobility of Lead, Zinc, Arsenic, Mercury, and Cyanide

The solubility of naturally occurring lead minerals is low. However, once lead is in solution, the sorption process is more efficient at scavenging lead than is precipitation (Hem, 1976). The sorption process is enhanced by the presence of naturally occurring organic materials such as humic and fulvic acids which, in general, increases the sorptive affinity of lead for clays (Guy and Chakrabarti, 1976). Low pH solutions will tend to cause a slight increase in the solubility of lead compounds, although the organic complexes are not affected by low pH to the same extent as inorganic compounds. The low pH within the tailings would tend to slightly increase the solubility of the organic lead compounds. However, the organic matter in the soil would promote the sorption of the lead on clay particles, thereby increasing the mobility of lead.

Zinc is one of the more soluble base metals. Once in solution, precipitation is effective in controlling the mobility of zinc only in highly reducing solutions (Holmes et al., 1974). Under oxidizing conditions, precipitation is only important where high concentrations of zinc are found. Zinc will form complexes with inorganic ligands and organic acids which are stable at low pH. This may effect their removal from the aquatic environment through the formation of colloids (Long and Angino, 1977). Coprecipitation with or adsorption on hydrous iron oxides also removes zinc from the aqueous environment. In the tailings, conditions do not favor precipitation of zinc in solution. However, the mobility of zinc can be reduced by the formation of colloids at the low pH in the tailings, and through adsorption by organic material and clay in the soil.

Because arsenic tends to form relatively soluble compounds and has multiple oxidation states, its geochemistry is intricate. Arsenic is extremely mobile in the aquatic environment and cycles through the water and sediments. Waslenchuk and Windom (1978) found that arsenic complexed with organic matter was difficult to precipitate. However, Waslenchuk (1979) later demonstrated that once arsenic becomes associated with particulates, it remains bound and tends to accumulate with sediments and soils. Arsenic also tends to coprecipitate with or adsorb on hydrous iron oxides (La Pientre, 1954). Coprecipitation and adsorption are the most important methods of removing arsenic from solution in aerobic, acidic, fresh water (Gupta and Chen, 1978). The concentration of arsenic solution does not appear to be high enough permit precipitation. However, the iron content may be high enough, particularly in the iron sulfide rich tailings pile on Douglas Island, to permit coprecipitation with iron oxides in the soil as the pH increases. Adsorption may be effective in removing arsenic from solution in soils with high clay content.

Mercury has a low solubility and shows a strong affinity for adsorption onto particulates. In aqueous systems, this is followed by settling to the bed sediments. The overwhelming majority of any dissolved mercury is removed in this manner within a relatively short time, generally near the source (Loring, 1975). The sorption of mercury is increased by the presence of organics, and is greater on clays than on sand (Reimers and Krenkel, 1974). The mercury associated with the tailings appears to behave as predicted by its low solubility and strong affinity for adsorption.

The cyanide ion can react with many metals to form compounds which are insoluble. However, if the cyanide ion is present in excess, soluble metallocyanide complexes can be formed which can be transported in solution. In natural waters at a pH of less than 7, greater than 99 per cent of the free cyanide is present as hydrogen cyanide (Towill et al., 1978). Hydrogen cyanide has been shown to volatilize very quickly, with half of the free cyanide being lost to the atmosphere in as little as 10 hours in quiescent systems (Raef et al., 1977). Although cyanide is relatively mobile in soil, cyanide mobility is at a minimum in soils with low pH, a high percentage of clay, and high levels of iron oxides (Alesii and Fuller, 1976). It is probable that only a negligible amount of free cyanide is present in the tailings or water. In addition to the volatility of free cyanide and the low concentration of total organic cyanide, the low pH, the amount of clay in the soil, and the iron oxides present as a result of the weathering of the iron sulfides will all act to reduce the mobility of cyanide in and near the tailings.

7.2 Perseverance Area

The results of the analyses of the soil, sediment, and stream water samples were in general agreement with the results of the earlier studies. The concentration of the metals in the tailings disposal area is highly variable, although the lead content appears to increase towards the west side. Positive correlations of the relative concentrations of the metals exist only between lead and mercury (correlation coefficient of r=0.89), and between zinc and arsenic (correlation coefficient of r=0.74). The metal content of the samples does not appear to vary with the thickness of the tailings. For example, samples P6 and P7, taken from the thickest part of the tailings on the inner slope of the berm, have lead concentrations of 12,500 and 1,310 mg/kg, respectively. Sample P2, taken from the center of the tailings area, where the tailings layer is thinnest, has a lead concentration of 8,880 mg/kg. The milling and tailings disposal activities have contaminated the soil between the two operational areas, but the contamination does not appear to have affected the vegetation outside the tailings disposal area proper. It would appear that the inhibiting factor is the low pH in the tailings disposal area, rather than the metal content of the soil.

The soil contamination to the west of the tailings disposal area is of a lower magnitude, both in areal extent and in metal concentrations. Tailings were observed to have been carried down the trail which leads to the disposal site. The principal means of transport of the tailings is believed to be stormwater washing tailings down the trail from the berm surrounding the disposal site. In spite of the presence of tailings along the trail, the metal content of the soil samples had returned to near background levels, as defined by the TNH/SAIC study, 100 feet to the west of the site.

The results of the EPTT conducted during this and previous studies show that the amount of leachable metal is not directly correlative with the total metal content. Therefore, other factors, such as the degree of weathering, must control the leachability of the metals. The tests also show that lead is the only metal which is leachable in large enough quantities to exceed the limits for the test in some samples. Further, in those samples where lead is present in the leachate above the allowable concentration, the limit is only marginally exceeded.

While the sediment samples collected from Gold Creek show a moderate increase downstream for lead, zinc, and arsenic, none of the concentrations of metals in the sediments are atypical for mineralized areas (Boyle, 1979), and would not be considered anomalous in many metallogenic terranes. The low relative metal content of the sediments is underscored by comparison to the concentrations of metals found in the tailings in the Perseverance Mine disposal site and to the samples from the Alaska Juneau rock dump. However, mercury is present in sample PSS4, collected below the Webster mill, but was not detected in any other sediment samples. It is presumed that this mercury is present as a result of treating ore to recover gold at the Webster mill.

The results of the analyses of water samples from Gold Creek collected during this study, and the continuing analyses of water from

Gold Creek conducted by the City and Borough of Juneau, have found no evidence that the mercury is contaminating the water in the creek. The analyses also show that, of the metals associated with the mining in Silver Bow Basin, only zinc is detectable in the water, and only in low concentrations. The actual concentration of zinc in the water may be less than reported because zinc was found in the trip blank at a concentration of 0.0061 mg/l. The sample of ground water taken from the tailings disposal area did have detectable amounts of lead, zinc, and arsenic, but at levels below the EPTT limits in spite of the low pH of the water and the tailings, which would tend to increase leaching of the metals. The water samples from Gold Creek demonstrate that the ground water from the tailings area has no measurable affect on the creek water.

7.3 Douglas Island Tailings

The metals in the Treadwell cyanide mill tailings do not appear to be mobile for four reasons: (1) the leachate generated during the EPTT contained only small amounts of metals; (2) the soil sample (DT3) downslope from the upper tailings pile contain concentrations of lead, zinc, and arsenic which drop sharply when compared to the tailings, approaching background levels, (3) the mercury concentration in sample DT3 is much lower than in the tailings; and (4) the stream flowing through the upper tailings pile leached only small amounts of metals out of the tailings, even though the very low pH generated by the iron sulfides would tend to encourage leaching.

The samples from the Sandy Beach and Ready Bullion areas have lead, zinc, and arsenic concentrations at or below the background established for the Juneau area by soil and sediment samples in the TNH/SAIC study and in the EE study of the Thane area. No cyanide was detected, but trace amounts of mercury were found. The mercury is present in much lower quantities than in either the Douglas tailings or the Perseverance tailings. The leachate from the EPTT on the tailings did not contain detectable amounts of mercury at a reporting limit of 0.002 mg/l. It is therefore likely that the mercury in the beach tailings is present in an immobile form. If the constant weathering to which the tailings are exposed has not removed the mercury, it is unlikely that the mercury will be released in large enough quantities to impact the environment.

It is also likely that the cyanide is present in an immobile form. Free cyanide is volatile in natural waters, particularly in water with a low pH. Over 65 years have passed since cyanide was used at the site, and free cyanide would have long since volatilized or formed a stable metal complex. Therefore, the residual cyanide appears to be present as insoluble metal compounds. The abundance of clay and the low pH in the soil surrounding the tailings pile are also conditions which favor less mobile cyanide compounds.

7.4 Alaska Juneau Rock Dump

The results of the analyses of the samples from the rock dump show that metals are present in concentrations which are moderately above background levels. However, the rocks have a very similar mineralogy to the tailings in the Thane area which were mined from the same ore body. The EPTT on the Thane tailings show that no metals are present in the leachate above the acceptable levels. There is no reason to expect that the Alaska Juneau rock dump poses any greater threat than the Thane tailings.

8.0 CONCLUSIONS

8.1 Mobility of Metals and Cyanide

The metals and cyanide appear to be relatively immobile. Because of the length of time since the tailings were deposited, it is probable that all of the easily soluble or volatile species present have been removed from the system. The remaining species are either relatively insoluble compounds or are tightly bound in the soil and and sediments.

Therefore, any environmental impact of the metals and cyanide will occur at the location in which they are deposited.

8.2 Perseverance Mine Area

Although metals from the mining and milling operations can be detected in the entire area between the mill and the tailings disposal area, a noticeable environmental impact can be seen only in the tailings disposal area. The level of contamination appears to drop off rapidly to the west of the tailings disposal site, and the results of the chemical analyses show that Gold Creek has not been impacted by the presence of the tailings. Although lead was found to marginally exceed the limit for the EPTT, there is no evidence, with the exception of the lack of vegetation in the tailings disposal area, that any environmental impairment has occurred. The greatest concern is that hikers could be adversely affected by contact with the metals in the tailings disposal area.

There are three management alternatives for the wastes: monitor the wastes to ensure that changing conditions do not create environmental hazards; cap the wastes; or remove the wastes. The monitoring program would consist of an evaluation of the results of the regular sampling and analysis of the municipal water supply conducted by the CBJ, semi-annual analysis of water samples collected downstream from the tailings disposal area, and maintenance of the sign at the site which warns of potential hazards as a result of the presence of the tailings. The main advantage of this method is the low cost. The main disadvantage is that it permits contact with the tailings if hikers choose to ignore the sign. Capping the wastes would consist of covering the tailings with an soil or talus from the area around the site. In addition, an impermeable, synthetic liner could be laid over the tailings underneath the natural cover. The advantages of this alternative are that it limits contact with the tailings and decreases the infiltration of storm water which could leach metals from the tailings. The disadvantages are the cost, and the excavation of material to cap the tailings could lead to erosion and transportation of sediment to Gold Creek. The third alternative would require the excavation and transportation of the wastes to another site. The advantage to this alternative is that it removes the tailings from the area. The disadvantages are that it merely moves the tailings to another area, but does not provide for treating the tailings to decrease their inherent potential for environmental impairment; the cost; and the possibility that disturbing the tailings could increase the short term potential to contaminate Gold Creek by increasing the release of metals to the ground water, or by spills of the tailings into the creek during the removal operations. Because the impact of the contamination is limited to the tailings disposal area, human contact with the tailings is limited, no problems have been documented as a result of human contact, and the benefits, if any, to be gained by selecting the second or third alternatives are marginal compared to the cost of implementing them, the first alternative should be selected for management of the tailings.

8.3 Ebner Falls

The mercury in the sediments below the Webster mill does not pose a threat of environmental impairment. Neither the water sample collected immediately downstream from the sediment sample location nor the regular sampling by the CBJ have detected mercury in the water in Gold Creek. Because mercury has a very low solubility and dissolved mercury tends to adsorb tightly onto sediments near the source, it is recommended that the only action to be taken is to examine the results of the regular CBJ municipal water analyses for the presence of mercury.

8.4 Douglas Island Tailings

The results of the analyses of the samples from Douglas Island show that there are no materials present which could be classified as hazardous waste. Although the tailings on Sandy Beach have trace amounts of mercury, the results of the EPTT demonstrate that the mercury is tightly bound to the beach sediments.

The data suggest that all of the metals and the cyanide in the tailings and soil at the Treadwell cyanide mill are relatively immobile. Therefore, the Treadwell cyanide mill tailings do not appear to pose a threat to the environment. No further action is recommended for the Douglas tailings.

8.5 Alaska Juneau Rock Dump

No material has been identified as hazardous waste at this site. No further action is recommended for the rock dump.

9.0 RECOMMENDATION

To reduce the risk of environmental impairment at the sites examined, the CBJ and AEL&P should address the following recommendation.

- 88-11-1: A monitoring program consisting of evaluations of the results of the regular sampling and analysis of the municipal water supply conducted by the CBJ, semi-annual analysis of water samples collected downstream from the tailings disposal area, and maintenance of the sign at the site warning of potential hazards as a result of the presence of the tailings should be implemented immediately. The monitoring program should be formalized with written procedures. Written results of each monitoring episode should be maintained. The monitoring program should include an examination of the results of the analyses for indications that mercury is being released from the Ebner Falls site.

10.0 APPENDICES

Appendices A through E comprise the technical appendix to this report. The contents of the appendix are listed below.

Appendix A. Site Visit Photographs

Appendix B. Chain of Custody Forms

Appendix C. Laboratory Report of the Chemical Analyses of the Tailings, Soil, and Sediment Samples

Appendix D. Laboratory Report of the Chemical Analyses of the Water Samples

Appendix E. Laboratory Report of the Extraction Procedure Toxicity Tests

Versar INC.

REFERENCES CITED

Alesii, B.A. and W.H. Fuller. 1976. The mobility of three cyanide forms in soils. pp. 213-223. in Residual Management by Land Disposal. W.H. Fuller (ed.). Environmental Protection Agency, Cincinnati, Ohio. PB 256768 268p.

Berg, H.C., and Cobb, E.H. 1966. Metaliferous Lode Deposits of Alaska. pp. 154-164 U.S.G.S. Bulletin 1246.

Boyle, R.W. 1979. The Geochemistry of Gold and Its Deposits. Canada Geological Survey Bulletin 280. pp. 9-88.

Environment and Ecology. 1988. Site Investigation Report for Thane Mine Dump Site Juneau, Alaska. Environmental Protection Agency, Seattle, Washington. TDD F10-8712-02.

Gupta, S. and K.Y. Chen. 1978. Arsenic removal by adsorption. Juneau Water Pollution Control Federation. 50(3):493-506.

Guy, R.D. and C.L. Chakrabarti. 1976. Studies of metal-organic interactions in model systems pertaining to natural waters. Can. J. Chem. 54:2600-2611.

Hem, J.D. 1976. Inorganic chemistry of lead in water. pp.5-11. in Lead in the environment. T.G. Lovering (ed.). U.S. Geological Survey Professional Paper 957, Washington, D.C. 90p.

Holmes, C.W., E.A. Slade, and C.J. McLerram. 1974. Migration and redistribution of zinc and cadmium in a marine estuarine ecosystem. Environ. Sci. Technol. 8(3):255-259.

James M. Montgomery Consulting Engineers, Inc. (1985) Last Chance Basin Groundwater Supply Assessment, City and Borough of Juneau, Alaska. 47p. Prepared for Quadra Engineering, Inc.

La Peintre, M. 1954. Solubilization par les eaux naturelles de l'aresenic lie' au fer dans les roches sedimentaries. Comt. Rend. Acad. Sci. (France) 239:359-360.

Long, D.T. and E.E. Angino. 1977. Chemical speciation of Cd, Cu, Pb, and Zn in mixed freshwater, seawater, and brine solutions. Geochem. Cosmochim. Acta. 41:1183-1191.

Loring, D.H. 1975. Mecury in the sediments of the Gulf of St. Lawrence. Can. J. Earth Sci. 12:1219-1237.

Raef, S.F., W.G. Characklis, M.A. Kossich, and C.H. Ward. 1977a. Fate of cyanide and related compounds in aerobic microbial systems. I. Chemical reaction with substrate and physical removal. Water Res. 11:477-483.

Raef, S.F., W.G. Characklis, M.A. Kossich, and C.H. Ward. 1977b. Fate of cyanide and related compounds in aerobic microbial systems. II. Microbial degradation. Water Res. 11:485-492.

Reimers, R.S. and P.A. Krenkel. 1974. Kinetics of mercury adsorption and desorption in sediments. Jour. Water Poll. Control Fed. 46(2):352-365.

Siegel, D.I. 1988. The Recharge-Discharge Function of Wetlands Near Juneau, Alaska: Part I. Hydrogeological Investigations. Ground Water 26:427-434.

Siegel, D.I. 1988. The Recharge-Discharge Function of Wetlands Near Juneau, Alaska: Part II. Geochemical Investigations 26:580-586.

Stone, David, and Brenda Stone. 1983. Hard Rock Gold. Vangard Press, Inc., Seattle, Washington.

Tetra Tech, Inc. (1984) Site Investigation Reports: Perseverance Mill. prepared for the Alaska Department of Environmental Conservation. Juneau, Alaska.

Towill, L.E., J.S. Drury, B.L. Whitfield, E.B. Lewis, E.L. Galyan, and A.S. Hammons. 1978. Reviews of the environmental effects of pollutants. V. Cyanide. pp. 11-33. Oak Ridge National Laboratory, Oak Ridge, Tenn. PB 289 920. 190p.

Trick, Nyman and Hayes. 1987. Suspected Uncontrolled Hazardous Waste Site Inspections, Perserverance Mill, Juneau, Alaska. 45p. Prepared for the Alaska Department of Environmental Conservation, Juneau, Alaska.

U.S. Geological Service. 1971. Water Resources Data for the City and Borough of Juneau, Alaska.

Waslenchuk, D.G. 1979. The geochemical controls on arsenic concentrations in southeastern United State rivers. Chem. Geol. 24:315-325.

Waslenchuk, D.G. and H.L. Windom, 1978. Factors controlling the estuarine chemistry of arsenic. Estuarine Coastal Mar. Sci. 7:455-464.

Versar INC.

APPENDIX

SITE INVESTIGATION OF SELECTED MINE SITES NEAR JUNEAU, ALASKA

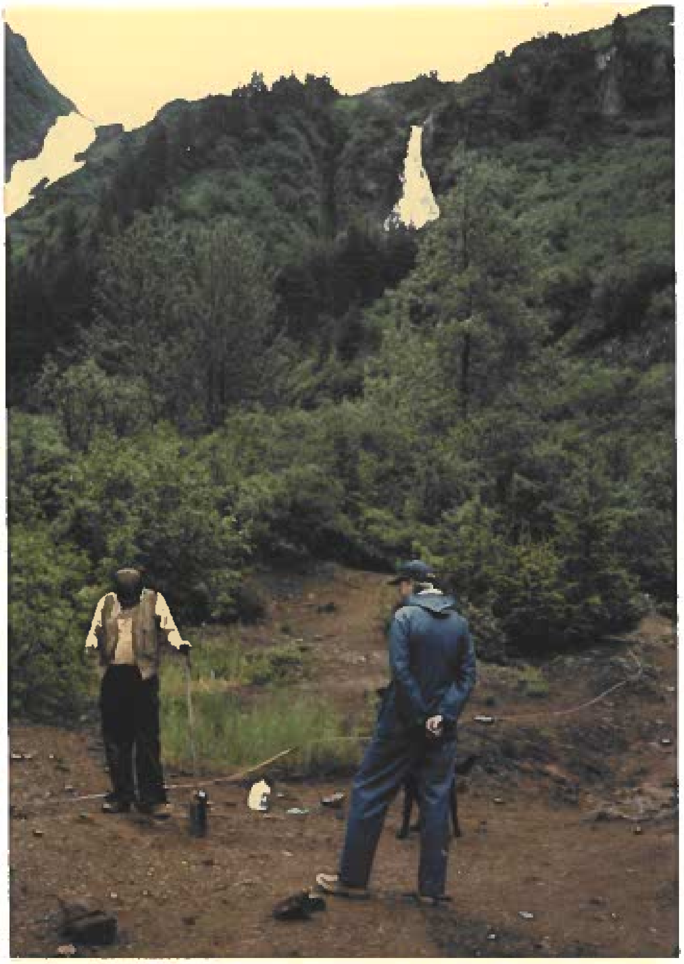
Versar INC.

APPENDIX A

Site Visit Photographs

Photograph 1. Perseverance Tailings Disposal Area

Photograph 2. Perseverance Tailings Disposal Area



Photograph 3. Sandy Beach Area

Photograph 4. Beach Near the Ready Bullion Mine

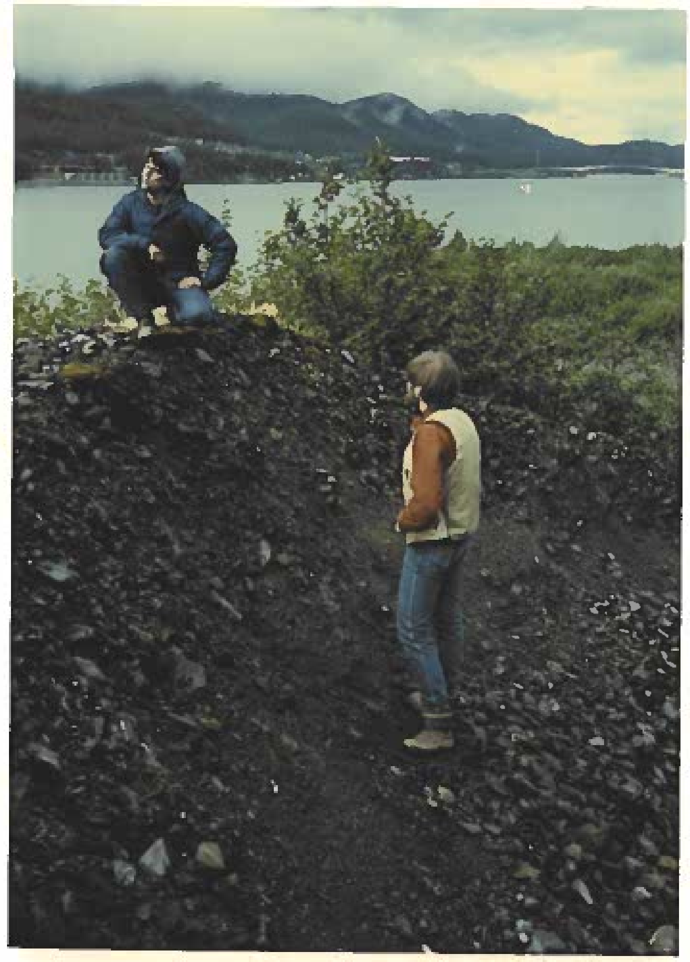
Photograph 5. Possible Mill Waste Disposal Site Northwest of the Treadwell Cyanide Mill

Photograph 6. Treadwell Cyanide Mill Lower Tailings Pile

Versar INC.

Photograph 7. Treadwell Cyanide Mill Upper Tailings Pile

Photograph 8. Collecting Tailing Samples at the Treadwell Cyanide Mill Upper Tailings Piles



Photograph 9. Northwest End of the AJ Rock Dump

Photograph 10. Stratified Tailings at the Southeast End of the AJ Rock Dump

Versar INC.

APPENDIX B

Chain of Custody Forms

Versar INC.

CHAIN OF CUSTODY RECORD

PROJECT NO.	PROJECT NAME	INDUSTRIAL HYGIENE SAMPLE
6147.1	City and Burough of Juneau	Y / (N)

SAMPLERS: *(Signature)* J.R. Frantes (Printed) J. R. Frantes

PARAMETERS

FIELD SAMPLE NUMBER	DATE	TIME	COMP.	GRAB	STATION LOCATION	NO. OF CONTAINERS	Pb, Zn, Hg, As							REMARKS
P-1	7/20/88	1315		✓		1	X							
P-2	7/20/88	1300	✓			1	X							
P-3	7/20/88	1315		✓		1	X							
P-4	7/20/88	1536	✓			1	X							
P-5	7/20/88	1345		✓		1	X							
P-6	7/20/88	1430	✓			1	X							
P-7	7/20/88	1450	✓			1	X							
P-8	7/20/88	1430	✓			1	X							
P-9	7/20/88	1500	✓			1	X							
P-10	7/20/88	1530	✓			1	X							
P-11	7/20/88	1600	✓			1	X							
P-12	7/20	1530	✓			1								HOLD For instructions

Relinquished by: *(Signature)*	Date / Time	Received by: *(Signature)*	Relinquished by: *(Signature)*	Date / Time	Received by: *(Signature)*
J.R. Frantes	7/22/88 1630				
(Printed) J. R. Frantes		(Printed)	(Printed)		(Printed)

Relinquished by: *(Signature)*	Date / Time	Received for Laboratory by: *(Signature)*	Date / Time	Remarks
(Printed)		(Printed)		

Distribution: Original Plus One Accompanies Shipment (white and yellow); Copy to Coordinator Field Files (pink).

Versar INC.

CHAIN OF CUSTODY RECORD

PROJECT NO. 6147.1

PROJECT NAME City and Bureau of Juneau

INDUSTRIAL HYGIENE SAMPLE Y / N (N circled)

SAMPLERS: *(Signature)* J.R. Frantes — *(Printed)* J. R. Frantes

PARAMETERS: Pb, Zn, Hg, As

FIELD SAMPLE NUMBER	DATE	TIME	COMP.	GRAB	STATION LOCATION	NO. OF CONTAINERS	Pb, Zn, Hg, As	REMARKS
P-13	7/20/88	1600	✓			1		HOLD For instruction
P-14	7/20/88	1600		✓		1		HOLD For instruction.
PSS-1	7/20/88	1356	✓			1	X	
PSS-2	7/20/88	1411	✓			1	X	
PSS-3	7/20/88	1745	✓			1	X	
PSS-4	7/20/88	1731	✓			1	X	
PSW-1	7/20/88	1401		✓		1	X	
PSW-2	7/20/88	1745		✓		1	X	
PGW-1	7/20/89	1556		✓		1	X	

Relinquished by: *(Signature)*	Date / Time	Received by: *(Signature)*	Relinquished by: *(Signature)*	Date / Time	Received by: *(Signature)*
J.R. Frantes	7/22/88 1630				
(Printed) J.R. Frantes		*(Printed)*	*(Printed)*		*(Printed)*

Relinquished by: *(Signature)*	Date / Time	Received for Laboratory by: *(Signature)*	Date / Time	Remarks
(Printed)		*(Printed)*		

Distribution: Original Plus One Accompanies Shipment (white and yellow); Copy to Coordinator Field Files (pink).

Versar INC.

CHAIN OF CUSTODY RECORD

PROJECT NO. 6147.1

PROJECT NAME: City and Borough Juneau

INDUSTRIAL HYGIENE SAMPLE: Y / N (N circled)

SAMPLERS: (Signature) [signature]

(Printed) James R. Franter

FIELD SAMPLE NUMBER	DATE	TIME	COMP.	GRAB	STATION LOCATION	NO. OF CONTAINERS	Pb, Zn, Hg, As	Cyanide	~~Ext. Proc. Tox~~					REMARKS
D-T-1	7/21/88	1037	✓		Tailings Red Bullion	1	X	X						
D-T-2	7/21/88	1153		✓	Tailings Upper Treadwell	1	X	X	~~X~~	} /10				
D-T-3	7/21/88	1211	✓		Soil	1	X	X						
D-T-4	7/21/88	1320		✓	Tailings lower Treadwell	1	X	X	~~X~~					
D-T-5	7/21/88	1407		✓	Tailings central beach	1	X	X						
D-T-6	7/21/88	1455	✓		Tailings Sandy Beach	1	X	X						
D-EPT-2	7/21/88	1154		✓		1								HOLD for instructions
D-EPT-6	7/21/88	1449	✓			1								HOLD for instructions
D-SW-1	7/21/88	1322		✓	Creek	2	X	X						one bottle for each

Relinquished by: (Signature)	Date / Time	Received by: (Signature)	Relinquished by: (Signature)	Date / Time	Received by: (Signature)
[signature]	7/22/88 1630				
(Printed) J.R. Frantz		(Printed)	(Printed)		(Printed)

Relinquished by: (Signature)	Date / Time	Received for Laboratory by: (Signature)	Date / Time	Remarks
(Printed)		(Printed)		

Distribution: Original Plus One Accompanies Shipment (white and yellow); Copy to Coordinator Field Files (pink).

Versar INC.

CHAIN OF CUSTODY RECORD

PROJECT NO.: 6147.1

PROJECT NAME: City and Burgert Juneau

INDUSTRIAL HYGIENE SAMPLE: Y / N

SAMPLERS: (Signature) J Frantz

(Printed) J Frantz

FIELD SAMPLE NUMBER	DATE	TIME	COMP.	GRAB	STATION LOCATION	NO. OF CONTAINERS	Pb, Zn, Hg, As							REMARKS
AJ-1	7/22/88	0950		✓	Northern Rock Dump	1	X							
AJ-2	7/22/88	0950		✓	Northern Rock Dump	1								Hold for instruction
AJ-3	7/22/88	1022	✓		Southern Rock Dump	1	X							
AJ-4	7/22/88	1022	✓		Southern Rock Dump	1								Hold for instruction

Relinquished by: (Signature)	Date / Time	Received by: (Signature)	Relinquished by: (Signature)	Date / Time	Received by: (Signature)
J.R. Frantz	7/22/88 1630				
(Printed) J.R. Frantz		(Printed)	(Printed)		(Printed)

Relinquished by: (Signature)	Date / Time	Received for Laboratory by: (Signature)	Date / Time	Remarks
(Printed)		(Printed)		

Distribution: Original Plus One Accompanies Shipment (white and yellow); Copy to Coordinator Field Files (pink).

Versar INC.

CHAIN OF CUSTODY RECORD

PROJECT NO. 88SER0005

PROJECT NAME: Versar Duplicates Perserverance

INDUSTRIAL HYGIENE SAMPLE: Y / N (N circled)

SAMPLERS: (Signature) [signatures]

(Printed) James R. Frantes, C. Johnson, Steve Haavig

FIELD SAMPLE NUMBER	DATE	TIME	COMP.	GRAB	STATION LOCATION	NO. OF CONTAINERS	Pb, Zn, Hg, As							REMARKS
P-1A	7/20/88	1315		✓	Tailings site	1	X							
P-2A	7/20/88	1300	✓		Tailings site	1	X							
P-3A	7/20/88	1315		✓	Tailings site	1	X							
P-4A	7/20/88	1530	✓		Tailings site	1	X							
P-5A	7/20/88	1345		✓	Tailings site	1	X							
P-6A	7/20/88	1430	✓		Tailings site/east bank	1	X							
P-7A	7/20/88	1450	✓		Tailing site/South west bank	1	X							
P-8A	7/20/88	1430	✓		Upslope 50'	1	X							
P-9A	7/20/88	1500	✓		Downslope 50'	1	X							
P-10A	7/20/88	1530	✓		Downslope 110'	1	X							
P-11A	7/20/88	1600	✓		Downslope of Mill Site	1	X							
[struck out]	[struck out]					11 (tally)								

Relinquished by: (Signature)	Date / Time	Received by: (Signature)	Relinquished by: (Signature)	Date / Time	Received by: (Signature)
James R Frantes	7/21/88 9:05				
(Printed) James R. Frantes		(Printed)	(Printed)		(Printed)

Relinquished by: (Signature)	Date / Time	Received for Laboratory by: (Signature)	Date / Time	Remarks
		[signature]	7/21/88 9:05	Please call Jay Benardi in Versar, Springfield, VA, @(703) 750-3000 to verify methods
(Printed)		(Printed)		

Distribution: Original Plus One Accompanies Shipment (white and yellow); Copy to Coordinator Field Files (pink).

Versar INC.

CHAIN OF CUSTODY RECORD

PROJECT NO. 88SER0005

PROJECT NAME Versar Duplicate- Perseverance

INDUSTRIAL HYGIENE SAMPLE Y / (N)

SAMPLERS: *(Signature)* C. Johnson, S Haavig, James R Frantes

(Printed) C Johnson, Steve Haavig, James Frantes

FIELD SAMPLE NUMBER	DATE	TIME	COMP.	GRAB	STATION LOCATION	NO. OF CONTAINERS	Pb, Zn, Hg, As							REMARKS
P-SS-1A	7/20/88	1356	✓		Above Perseverance	1	X							
P-SS-2A	7/20/88	1411	✓		Below Perseverance	1	X							
P-SS-3A	7/20/88	1745	✓		Above Webster	1	X							
P-SS-4A	7/20/88	1731	✓		Below Webster	1	X							
P-SW-1A	7/20/88	1359		✓	Below Perseverance	1	X							
P-SW-2A	7/20/88	1745		✓	Below Webster	1	X							
P-GW-1A	7/20/88	1356		✓	By soil sample P-SA	1	X							

Relinquished by: *(Signature)*	Date / Time	Received by: *(Signature)*	Relinquished by: *(Signature)*	Date / Time	Received by: *(Signature)*
James R Frantes	7/21/88 9:05				
(Printed) James R. Frantes		*(Printed)*	*(Printed)*		*(Printed)*

Relinquished by: *(Signature)*	Date / Time	Received for Laboratory by: *(Signature)*	Date / Time	Remarks
		[signature]	7/21/88 9:05	Please call Jay Benard @ Versar (703) 750-3000 to verify methods
(Printed)		*(Printed)*		

Distribution: Original Plus One Accompanies Shipment (white and yellow); Copy to Coordinator Field Files (pink).

Versar INC.

CHAIN OF CUSTODY RECORD

PROJECT NO.: 88SER0005

PROJECT NAME: Versar Duplicates—Douglas

INDUSTRIAL HYGIENE SAMPLE: Y / (N)

SAMPLERS: (Signature) J Frantes, C Johnson

(Printed) J. Frantes C. Johnson

FIELD SAMPLE NUMBER	DATE	TIME	COMP.	GRAB	STATION LOCATION	NO. OF CONTAINERS	Pb, Zn, Hg, As							REMARKS
D-T-1A	7/21/88	1037	✓		Tailings R.B. (south	1	X							
D-T-2A	7/21/88	1153		✓	Tailings upper Treadwell	1	X							
D-T-3A	7/21/88	1211	✓		Soil	1	X							
D-T-4A	7/21/88	1320		✓	Tailings lower Treadwell	1	X							
D-T-5A	7/21/88	1407		✓	Tailings Central Beach	1	X							
D-T-6A	7/21/88	1455	✓		Tailings Sandy Beach	1	X							
D-SW-1A	7/21/88	1322		✓	Creek	1	X							

Relinquished by: (Signature)	Date / Time	Received by: (Signature)	Relinquished by: (Signature)	Date / Time	Received by: (Signature)
J R Frantes	7/21/88 1600				
(Printed) James R Frantes		(Printed)	(Printed)		(Printed)

Relinquished by: (Signature)	Date / Time	Received for Laboratory by: (Signature)	Date / Time	Remarks
		[signature]	7.21.88 1600	Please call Jay Benardi at Versar Springfield, VA @ (703) 750-3000 to verify methods.
(Printed)		(Printed)		

Distribution: Original Plus One Accompanies Shipment (white and yellow); Copy to Coordinator Field Files (pink).

Versar INC.

CHAIN OF CUSTODY RECORD

PROJECT NO. 88SER0005

PROJECT NAME Versar Duplicates – A.J. Rock Dump

INDUSTRIAL HYGIENE SAMPLE Y / N (N circled)

SAMPLERS: *(Signature)* James Frantes

(Printed) James Frantes

FIELD SAMPLE NUMBER	DATE	TIME	COMP.	GRAB	STATION LOCATION	NO. OF CONTAINERS	Pb, Zn, Hg, As							REMARKS
AJ-1A	7/22/88	0950		✓	Northern	1	X							
AJ-3A	7/22/88	1022	✓		Southern	1	X							

Relinquished by: *(Signature)*	Date / Time	Received by: *(Signature)*	Relinquished by: *(Signature)*	Date / Time	Received by: *(Signature)*
James R. Frantes	7/22/88 1452				
(Printed) James R. Frantes		*(Printed)*	*(Printed)*		*(Printed)*

Relinquished by: *(Signature)*	Date / Time	Received for Laboratory by: *(Signature)*	Date / Time	Remarks
		Michelle Bonnet	7/22/88 1452	Please call Jay Benard at Versar in Springfield, VA (703) 750 3000 to verify methods
(Printed)		*(Printed)* Michelle Bonnet		

Distribution: Original Plus One Accompanies Shipment (white and yellow); Copy to Coordinator Field Files (pink).

APPENDIX C

Laboratory Report of the Chemical Analyses of the Tailings, Soil, and Sediment Samples

Versar INC.

ANALYSIS NARRATIVE

Project: 4600-464
Title: Versar Intercompany Bank Project
Client: Alaska
Date: August 22, 1988

This is a batch of twenty-three soils and five waters which were received by Versar, Inc. on July 25, 1988. The samples were digested between July 27 and August 3, 1988. All digestion and analysis procedures followed methods prescribed in Test Methods for Evaluating Solid Waste, SW-846, 3rd. Edition.

The digestates were quantitated by ICP on August 3 and August 17, 1988. All blanks were clean with the exception of zinc in both the soil and water digestion blanks. These levels were low and insignificant. Check standard recoveries were within 10% control windows. Duplicate precision was acceptable with the following exceptions. Zinc RPD was slightly above the 20% window for the water QC sample. The soil QC sample had an elevated RPD for lead as a result of digesting nonhomogeneous duplicate aliquots. Spike recoveries were within 25% control windows except for zinc in the soil spike at 64%. This may be the result of matrix interference.

Lead and arsenic were quantitated on the water digestates by HGA in order to obtain lower detection limits than would be possible by ICP. HGA analyses took place between July 29 and August 12, 1988. All blanks were clean and all check standard recoveries were within 20% windows. Duplicate precision was satisfactory for arsenic results but outside 20% windows for lead. Spike recoveries were within 25% windows.

Mercury was analyzed on the soils and waters by CVAA techniques on July 29 and August 5, 1988. The analyses followed same day digestions. Blanks were clean and check standard recoveries were within 20% windows. Duplicate precision was within limits as were spike recoveries.

Prepared by: Danette Drew
Danette Drew
Laboratory Operations

Reviewed by: Chris Pappas

6850 VERSAR CENTER • P.O. BOX 1549 • SPRINGFIELD, VIRGINIA 22151 • TELEPHONE: (703) 750-3000 • TELEX: 901125

4600-464

DATA PACKAGE - SOILS

DATE 8/15/88

COVER PAGE
INORGANIC ANALYSES DATA PACKAGE

QC REPORT: 464 SOILS

LAB NAME: VERSAR, INC.

REFERENCE: SW-846, 3rd ed.

PROJECT NO.: 4600.0000

SAMPLE NUMBERS

FIELD NO.	LAB ID NO.	FIELD NO.	LAB ID NO.
AJ1	52601		
AJ3	52602		
P1	52603	P2	52604
P3	52605	P4	52606
P5	52607	P6	52608
P7	52609	P8	52610
P9	52611	P10	52612
P11	52613	PSS1	52614
PSS2	52615	PSS3	52616
PSS4	52617	DT1	52618
DT2	52619	DT3	52620
DT4	52621	DT5	52622
DT6	52623		

COMMENTS:

ICP INTERELEMENT AND BACKGROUND CORRECTION APPLIED? YES.
CORRECTIONS APPLIED BEFORE GENERATION OF RAW DATA.

FOOTNOTES:

NR - NOT REQUIRED BY CONTRACT AT THIS TIME

FORM I:

DF - DILUTION FACTOR

FORM I

SAMPLE NO.
AJ1

INORGANIC ANALYSIS DATA SHEET

DATE 8/15/88

LAB NAME: VERSAR INC.

QC REPORT NO.:464 SOILS

REF.: SW-846 3RD ED.

MATRIX: SOIL

LAB SAMPLE ID. NO. 52601

BATCH: 464

PROJECT-TASK 4600.0000

ELEMENTS IDENTIFIED AND MEASURED

MG/KG (DRY WEIGHT)

1.	ARSENIC	44.
2.	LEAD	86.
3.	MERCURY	< 0.11
4.	ZINC	232.

PERCENT SOLIDS 87.4

COMMENTS:

FORM I

: SAMPLE NO. :
: AJ2 :

INORGANIC ANALYSIS DATA SHEET

DATE 8/15/88

LAB NAME: VERSAR INC.

QC REPORT NO.:464 SOILS

REF.: SW-846 3RD ED.

MATRIX: SOIL

LAB SAMPLE ID. NO. 52602

BATCH: 464

PROJECT-TASK 4600.0000

ELEMENTS IDENTIFIED AND MEASURED

MG/KG (DRY WEIGHT)

1.	ARSENIC	36.
2.	LEAD	163.
3.	MERCURY	< 0.11
4.	ZINC	444.

PERCENT SOLIDS 90.8

COMMENTS:

FORM I

SAMPLE NO.: P1

INORGANIC ANALYSIS DATA SHEET

DATE 8/15/88

LAB NAME: VERSAR INC.

QC REPORT NO.: 464 SOILS

REF.: SW-846 3RD ED.

MATRIX: SOIL

LAB SAMPLE ID. NO. 52603

BATCH: 464

PROJECT-TASK 4600.0000

ELEMENTS IDENTIFIED AND MEASURED

		MG/KG (DRY WEIGHT)
1.	ARSENIC	1670.
2.	LEAD	2440.
3.	MERCURY	17.
4.	ZINC	505.

PERCENT SOLIDS 61.0

COMMENTS: DF OF 10 FOR HG.

FORM I

SAMPLE NO.
P2

INORGANIC ANALYSIS DATA SHEET

DATE 8/15/88

LAB NAME: VERSAR INC.

QC REPORT NO.:464 SOILS

REF.: SW-846 3RD ED.

MATRIX: SOIL

LAB SAMPLE ID. NO. 52604

BATCH: 464

PROJECT-TASK 4600.0000

ELEMENTS IDENTIFIED AND MEASURED

MG/KG (DRY WEIGHT)

1.	ARSENIC	2240.
2.	LEAD	8880.
3.	MERCURY	25.
4.	ZINC	408.

PERCENT SOLIDS 67.0

COMMENTS: DF OF 10 FOR HG.

FORM I

SAMPLE NO.
P3

INORGANIC ANALYSIS DATA SHEET

DATE 8/15/88

LAB NAME: VERSAR INC.

QC REPORT NO.:464 SOILS

REF.: SW-846 3RD ED.

MATRIX: SOIL

LAB SAMPLE ID. NO. 52605

BATCH: 464

PROJECT-TASK 4600.0000

ELEMENTS IDENTIFIED AND MEASURED

MG/KG (DRY WEIGHT)

1.	ARSENIC	576.
2.	LEAD	924.
3.	MERCURY	13.
4.	ZINC	340.

PERCENT SOLIDS 70.4

COMMENTS: DF OF 10 FOR HG.

FORM I

SAMPLE NO.
P4

INORGANIC ANALYSIS DATA SHEET

DATE 8/15/88

LAB NAME: VERSAR INC.

QC REPORT NO.: 464 SOILS

REF.: SW-846 3RD ED.

MATRIX: SOIL

LAB SAMPLE ID. NO. 52606

BATCH: 464

PROJECT-TASK 4600.0000

ELEMENTS IDENTIFIED AND MEASURED

MG/KG (DRY WEIGHT)

1.	ARSENIC	166.
2.	LEAD	1470.
3.	MERCURY	8.2
4.	ZINC	136.

PERCENT SOLIDS 77.7

COMMENTS: DF OF 10 FOR HG.

FORM I

SAMPLE NO.
P5

INORGANIC ANALYSIS DATA SHEET

DATE 8/15/88

LAB NAME: VERSAR INC.

QC REPORT NO.:464 SOILS

REF.: SW-846 3RD ED.

MATRIX: SOIL

LAB SAMPLE ID. NO. 52607

BATCH: 464

PROJECT-TASK 4600.0000

ELEMENTS IDENTIFIED AND MEASURED

MG/KG (DRY WEIGHT)

1.	ARSENIC	188.
2.	LEAD	1560.
3.	MERCURY	0.14
4.	ZINC	95.

PERCENT SOLIDS 71.3

COMMENTS:

FORM I

SAMPLE NO.
P6

INORGANIC ANALYSIS DATA SHEET

DATE 8/15/88

LAB NAME: VERSAR INC.

QC REPORT NO.:464 SOILS

REF.: SW-846 3RD ED.

MATRIX: SOIL

LAB SAMPLE ID. NO. 52608

BATCH: 464

PROJECT-TASK 4600.0000

ELEMENTS IDENTIFIED AND MEASURED

MG/KG (DRY WEIGHT)

1.	ARSENIC	102.
2.	LEAD	1310.
3.	MERCURY	1.4
4.	ZINC	105.

PERCENT SOLIDS 78.3

COMMENTS:

FORM I

SAMPLE NO.
P7

INORGANIC ANALYSIS DATA SHEET

DATE 8/13/88

LAB NAME: VERSAR INC.

QC REPORT NO.: 464 SOILS

REF.: SW-846 3RD ED.

MATRIX: SOIL

LAB SAMPLE ID. NO. 52609

BATCH: 464

PROJECT-TASK 4600.0000

ELEMENTS IDENTIFIED AND MEASURED

MG/KG (DRY WEIGHT)

1.	ARSENIC	404.
2.	LEAD	12500.
3.	MERCURY	33.
4.	ZINC	197.

PERCENT SOLIDS 72.4

COMMENTS: DF OF 10 FOR HG.

FORM I

: SAMPLE NO. :
: P8 :

INORGANIC ANALYSIS DATA SHEET

DATE 8/15/88

LAB NAME: VERSAR INC.

QC REPORT NO.:464 SOILS

REF.: SW-846 3RD ED.

MATRIX: SOIL

LAB SAMPLE ID. NO. 52610

BATCH: 464

PROJECT-TASK 4600.0000

ELEMENTS IDENTIFIED AND MEASURED

MG/KG (DRY WEIGHT)

1.	ARSENIC	34.
2.	LEAD	700.
3.	MERCURY	2.2
4.	ZINC	379.

PERCENT SOLIDS 71.3

COMMENTS:

FORM I

SAMPLE NO.
P9

INORGANIC ANALYSIS DATA SHEET

DATE 8/15/88

LAB NAME: VERSAR INC.

QC REPORT NO.:464 SOILS

REF.: SW-846 3RD ED.

MATRIX: SOIL

LAB SAMPLE ID. NO. 52611

BATCH: 464

PROJECT-TASK 4600.0000

ELEMENTS IDENTIFIED AND MEASURED

MG/KG (DRY WEIGHT)

1.	ARSENIC	40.
2.	LEAD	293.
3.	MERCURY	4.0
4.	ZINC	107.

PERCENT SOLIDS 64.7

COMMENTS:

FORM I

SAMPLE NO.
P10

INORGANIC ANALYSIS DATA SHEET

DATE 8/15/88

LAB NAME: VERSAR INC.

QC REPORT NO.: 464 SOILS

REF.: SW-846 3RD ED.

MATRIX: SOIL

LAB SAMPLE ID. NO. 52612

BATCH: 464

PROJECT-TASK 4600.0000

ELEMENTS IDENTIFIED AND MEASURED

MG/KG (DRY WEIGHT)

1.	ARSENIC	21.
2.	LEAD	72.
3.	MERCURY	0.45
4.	ZINC	108.

PERCENT SOLIDS 76.0

COMMENTS:

FORM I

SAMPLE NO.
P11

INORGANIC ANALYSIS DATA SHEET

DATE 8/15/88

LAB NAME: VERSAR INC.

QC REPORT NO.:464 SOILS

REF.: SW-846 3RD ED.

MATRIX: SOIL

LAB SAMPLE ID. NO. 52613

BATCH: 464

PROJECT-TASK 4600.0000

ELEMENTS IDENTIFIED AND MEASURED

MG/KG (DRY WEIGHT)

1.	ARSENIC	394.
2.	LEAD	749.
3.	MERCURY	11.
4.	ZINC	122.

PERCENT SOLIDS 80.4

COMMENTS: DF OF 10 FOR HG.

FORM I

SAMPLE NO.
PSS1

INORGANIC ANALYSIS DATA SHEET

DATE 8/15/88

LAB NAME: VERSAR INC.

QC REPORT NO.:464 SOILS

REF.: SW-846 3RD ED.

MATRIX: SOIL

LAB SAMPLE ID. NO. 52614

BATCH: 464

PROJECT-TASK 4600.0000

ELEMENTS IDENTIFIED AND MEASURED

MG/KG (DRY WEIGHT)

1.	ARSENIC	23.
2.	LEAD	13.
3.	MERCURY	< 0.12
4.	ZINC	92.

PERCENT SOLIDS 79.9

COMMENTS:

FORM I

: SAMPLE NO. :
: PSS2 :

INORGANIC ANALYSIS DATA SHEET

DATE 8/15/88

LAB NAME: VERSAR INC.

QC REPORT NO.:464 SOILS

REF.: SW-846 3RD ED.

MATRIX: SOIL

LAB SAMPLE ID. NO. 52615

BATCH: 464

PROJECT-TASK 4600.0000

ELEMENTS IDENTIFIED AND MEASURED

MG/KG (DRY WEIGHT)

1.	ARSENIC	33.
2.	LEAD	14.
3.	MERCURY	< 0.13
4.	ZINC	124.

PERCENT SOLIDS 76.8

COMMENTS:

FORM I

INORGANIC ANALYSIS DATA SHEET

SAMPLE NO.	PSS3
DATE	8/15/88

LAB NAME: VERSAR INC.

REF.: SW-846 3RD ED.

LAB SAMPLE ID. NO. 52616

PROJECT-TASK 4600.0000

QC REPORT NO.:464 SOILS

MATRIX: SOIL

BATCH: 464

ELEMENTS IDENTIFIED AND MEASURED

MG/KG (DRY WEIGHT)

1.	ARSENIC	30.
2.	LEAD	40.
3.	MERCURY	< 0.13
4.	ZINC	96.

PERCENT SOLIDS 76.4

COMMENTS:

FORM I

INORGANIC ANALYSIS DATA SHEET

SAMPLE NO.
PSS4

DATE 8/15/88

LAB NAME: VERSAR INC.

QC REPORT NO.:464 SOILS

REF.: SW-846 3RD ED.

MATRIX: SOIL

LAB SAMPLE ID. NO. 52617

BATCH: 464

PROJECT-TASK 4600.0000

ELEMENTS IDENTIFIED AND MEASURED

MG/KG (DRY WEIGHT)

1.	ARSENIC	27.
2.	LEAD	24.
3.	MERCURY	0.26
4.	ZINC	117.

PERCENT SOLIDS 74.1

COMMENTS:

FORM I

SAMPLE NO.
DT1

INORGANIC ANALYSIS DATA SHEET

DATE 8/15/88

LAB NAME: VERSAR INC.

QC REPORT NO.:464 SOILS

REF.: SW-846 3RD ED.

MATRIX: SOIL

LAB SAMPLE ID. NO. 52618

BATCH: 464

PROJECT-TASK 4600.0000

ELEMENTS IDENTIFIED AND MEASURED

MG/KG (DRY WEIGHT)

1.	ARSENIC	4.5
2.	LEAD	8.6
3.	MERCURY	0.33
4.	ZINC	49.

PERCENT SOLIDS 94.3

COMMENTS:

FORM I

SAMPLE NO.
DT2

INORGANIC ANALYSIS DATA SHEET

DATE 8/15/88

LAB NAME: VERSAR INC.

QC REPORT NO.: 464 SOILS

REF.: SW-846 3RD ED.

MATRIX: SOIL

LAB SAMPLE ID. NO. 52619

BATCH: 464

PROJECT-TASK 4600.0000

ELEMENTS IDENTIFIED AND MEASURED

MG/KG (DRY WEIGHT)

1.	ARSENIC	191.
2.	LEAD	316.
3.	MERCURY	57.
4.	ZINC	649.

PERCENT SOLIDS 83.8

COMMENTS: DF OF 10 FOR HG.

FORM I

INORGANIC ANALYSIS DATA SHEET

SAMPLE NO.: DT3

DATE 8/15/88

LAB NAME: VERSAR INC.

QC REPORT NO.:464 SOILS

REF.: SW-846 3RD ED.

MATRIX: SOIL

LAB SAMPLE ID. NO. 52620

BATCH: 464

PROJECT-TASK 4600.0000

ELEMENTS IDENTIFIED AND MEASURED

MG/KG (DRY WEIGHT)

1.	ARSENIC	64.
2.	LEAD	60.
3.	MERCURY	0.22
4.	ZINC	38.

PERCENT SOLIDS 63.5

COMMENTS:

FORM I

: SAMPLE NO. :
: DT4 :

INORGANIC ANALYSIS DATA SHEET

DATE 8/15/88

LAB NAME: VERSAR INC.

QC REPORT NO.:464 SOILS

REF.: SW-846 3RD ED.

MATRIX: SOIL

LAB SAMPLE ID. NO. 52621

BATCH: 464

PROJECT-TASK 4600.0000

ELEMENTS IDENTIFIED AND MEASURED

MG/KG (DRY WEIGHT)

1.	ARSENIC	350.
2.	LEAD	511.
3.	MERCURY	10.
4.	ZINC	147.

PERCENT SOLIDS 82.2

COMMENTS: DF OF 10 FOR AS, PB, HG, ZN.

FORM I

SAMPLE NO.
DT5

INORGANIC ANALYSIS DATA SHEET

DATE 8/15/88

LAB NAME: VERSAR INC.

QC REPORT NO.:464 SOILS

REF.: SW-846 3RD ED.

MATRIX: SOIL

LAB SAMPLE ID. NO. 52622

BATCH: 464

PROJECT-TASK 4600.0000

ELEMENTS IDENTIFIED AND MEASURED

MG/KG (DRY WEIGHT)

1.	ARSENIC	75.
2.	LEAD	119.
3.	MERCURY	1.1
4.	ZINC	84.

PERCENT SOLIDS 85.7

COMMENTS:

FORM I

SAMPLE NO.
DT6

INORGANIC ANALYSIS DATA SHEET

DATE 8/15/88

LAB NAME: VERSAR INC.

QC REPORT NO.: 464 SOILS

REF.: SW-846 3RD ED.

MATRIX: SOIL

LAB SAMPLE ID. NO. 52623

BATCH: 464

PROJECT-TASK 4600.0000

ELEMENTS IDENTIFIED AND MEASURED

MG/KG (DRY WEIGHT)

1.	ARSENIC	< 3.8
2.	LEAD	13.
3.	MERCURY	0.36
4.	ZINC	34.

PERCENT SOLIDS 85.2

COMMENTS:

FORM II A Q.C. REPORT: 464 SOILS

INITIAL AND CONTINUING CALIBRATION VERIFICATION(3)

LAB NAME: VERSAR, INC.
DATE: 8/15/88 UNITS: UG/L

COMPOUND	INITIAL CALIB.(1)			CONTINUING CALIB.(2)				
	TRUE	FOUND	%R	TRUE	FOUND	%R	FOUND	%R
1. ARSENIC	500.	482.	96.	500.	458.	92.	472.	94.
2. LEAD	1000.	973.	97.	1000.	977.	98.	963.	96.
3. MERCURY	5.2	5.2	100.	5.06	5.0	99.	5.0	99.
4. ZINC	500.	503.	101.	500.	510.	102.	522.	104.

(1),(2) INITIAL, CONTINUING CALIBRATION SOURCE: EPA, VERSAR
(3) CONTROL LIMITS: MERCURY AND TIN 80-120; ALL OTHER COMPOUNDS 90-110

FORM II B Q.C. REPORT: 464 SOILS

INITIAL AND CONTINUING CALIBRATION VERIFICATION(3)

LAB NAME: VERSAR, INC.

DATE: 8/15/88 UNITS: UG/L

COMPOUND	INITIAL CALIB.(1)			CONTINUING CALIB.(2)				
	TRUE	FOUND	%R	TRUE	FOUND	%R	FOUND	%R
1. ARSENIC	500.			500.	470.	94.	494.	99.
2. LEAD	1000.			1000.	982.	98.	985.	98.
3. MERCURY				5.06	5.2	103.		
4. ZINC	500.			500.	519.	104.	527.	105.

(1),(2) INITIAL, CONTINUING CALIBRATION SOURCE: EPA, VERSAR

(3) CONTROL LIMITS: MERCURY AND TIN 80-120; ALL OTHER COMPOUNDS 90-110

FORM II C   Q.C. REPORT: 464 SOILS

INITIAL AND CONTINUING CALIBRATION VERIFICATION(3)

LAB NAME: VERSAR, INC.
DATE: 8/15/88   UNITS: UG/L

COMPOUND	INITIAL CALIB. (1)			CONTINUING CALIB. (2)				
	TRUE	FOUND	%R	TRUE	FOUND	%R	FOUND	%R
1. ARSENIC								
2. LEAD								
3. MERCURY	5.2	5.0	96.	5.06	4.8	95.	4.8	95.
4. ZINC	500.	508.	102.	500.	508.	102.		

(1), (2) INITIAL, CONTINUING CALIBRATION SOURCE: EPA, VERSAR
(3) CONTROL LIMITS: MERCURY AND TIN 80-120; ALL OTHER COMPOUNDS 90-110

FORM III A
BLANKS

Q.C.REPORT: 464 SOILS

LAB NAME: VERSAR, INC.
DATE 8/15/88

UNITS: UG/L

COMPOUND	INITIAL CALIB BLANK VALUE	MATRIX HOH CONTINUING CALIB BLANK VALUE 1	2	3	4	PREP SOIL	BLANK SOIL
1. ARSENIC	< 32.	< 32.	< 32.	< 32.	< 32.	< 32.	< 32.
2. LEAD	< 16.	< 16.	31.	< 16.	< 16.	< 16.	< 16.
3. MERCURY	< 0.2	< 0.2	< 0.2	< 0.2		< 0.2	< 0.2
4. ZINC	< 4.0	< 4.0	< 4.0	< 4.0	< 4.0	6.1	6.1

mult by
100
for MDL

FORM III B
BLANKS

Q.C. REPORT: 464 SOILS

LAB NAME: VERSAR, INC.
DATE 8/15/88

UNITS: UG/L

COMPOUND	INITIAL CALIB BLANK VALUE	MATRIX HOH CONTINUING CALIB BLANK VALUE 1	2	3	4	PREP SOIL	BLANK SOIL
1. ARSENIC							
2. LEAD							
3. MERCURY	< 0.2	< 0.2	< 0.2			< 0.2	
4. ZINC	< 4.0	< 4.0					

FORM IV A — Q.C. REPORT: 464 SOILS

ICP INTERFERENCE CHECK SAMPLE

LAB NAME: VERSAR, INC.
DATE: 8/15/88

CHECK SAMPLE I.D. : INTER
CHECK SAMPLE SOURCE: EPA
UNITS: UG/L

COMPOUND	CONTROL LIMITS(1) MEAN	2X STD. DEV.	TRUE (2)	INITIAL OBSERVED	%R	FINAL OBSERVED	%R
1. ARSENIC	100.	112.	0.0	< 32.	0.0	106.	0.0
2. LEAD	4480.	38.	4850.	4360.	90.	4460.	92.
3. MERCURY	---	---	---	---	---	---	---
4. ZINC	932.	9.	973.	874.	90.	913.	94.

(1) MEAN BASED ON N = 5 (2) TRUE VALUE OF INTERFERENCE CHECK SAMPLE

FORM IV B Q.C. REPORT: 464 SOILS

ICP INTERFERENCE CHECK SAMPLE

LAB NAME: VERSAR, INC.
DATE: 8/15/88

CHECK SAMPLE I.D.: INTER
CHECK SAMPLE SOURCE: EPA
UNITS: UG/L

COMPOUND	CONTROL LIMITS(1) MEAN	2X STD.DEV.	TRUE (2)	INITIAL OBSERVED	%R	FINAL OBSERVED	%R
1. ARSENIC	100.	112.	---	---	---	---	---
2. LEAD	4480.	38.	---	---	---	---	---
3. MERCURY	---	---	---	---	---	---	---
4. ZINC	932.	9.	973.	854.	88.	854.	88.

(1) MEAN BASED ON N = 5 (2) TRUE VALUE OF INTERFERENCE CHECK SAMPLE

FORM VI A
DUPLICATES

Q.C. REPORT: 464 SOILS

LAB NAME: VERSAR, INC.
DATE: 8/15/88

FIELD SAMPLE NO.:AJ1
LAB SAMPLE ID NO.52601
UNITS:MG/KG

MATRIX:SOIL

COMPOUND	CONTROL LIMITS (1)	SAMPLE(S)	DUPLICATE(D)	RPD(2)
1. ARSENIC		44.	48.	8.7
2. LEAD		86.	87.	1.2
3. MERCURY (3)		0.14	< 0.14	NC
4. ZINC		232.	208.	11.

(1) TO BE ADDED AT A LATER DATE
(2) RPD = [(S-D)/((S+D)/2)]X100
(3) FIELD # P5, LAB # 52607
NC - NON CALCULABLE RPD DUE TO VALUE(S) LESS THAN CRDL

FORM VI B
DUPLICATES

Q.C. REPORT: 464 SOILS

LAB NAME: VERSAR, INC.
DATE: 8/15/88

FIELD SAMPLE NO.:AJ3
LAB SAMPLE ID NO.52602
UNITS:MG/KG

MATRIX:SOIL

COMPOUND	CONTROL LIMITS (1)	SAMPLE(S)	DUPLICATE(D)	RPD(2)
1. ARSENIC		36.	30.	18.
2. LEAD		163.	90.	58.
3. MERCURY		< 0.11	< 0.11	NC
4. ZINC		444.	473.	6.3

(1) TO BE ADDED AT A LATER DATE
(2) RPD = [(S-D)/((S+D)/2)]X100
NC - NON CALCULABLE RPD DUE TO VALUE(S) LESS THAN CRDL

FORM V A

SPIKE SAMPLE RECOVERY

Q.C. REPORT: 464 SOILS

LAB NAME: VERSAR, INC.
DATE: 8/15/88

MATRIX: L. SOIL

CASE NO.: -0-
FIELD SAMPLE NO.: AJ1
LAB SAMPLE ID NO.: 52601
UNITS: MG/KG

COMPOUND	CONTROL LIMIT %R	SPIKED SAMPLE RESULT (SSR)	SAMPLE RESULT (SR)	SPIKED ADDED (SA)	%R (1)
1. ARSENIC	75-125	424.	44.	458.	83.
2. LEAD	75-125	439.	86.	458.	77.
3. MERCURY (2)	75-125	1.7	0.14	1.4	111.
4. ZINC	75-125	523.	232.	458.	64.

(1) %R = [(SSR-SR)/SA] X 100
(2) FIELD # P5, LAB # 52607

"NR" - NOT REQUIRED

FORM V B
SPIKE SAMPLE RECOVERY

Q.C. REPORT: 464 SOILS

LAB NAME: VERSAR, INC.
DATE: 8/15/88

MATRIX: L. SOIL

CASE NO.: -0-
FIELD SAMPLE NO.: AJ3
LAB SAMPLE ID NO.: 52602
UNITS: MG/KG

COMPOUND	CONTROL LIMIT %R	SPIKED SAMPLE RESULT (SSR)	SAMPLE RESULT (SR)	SPIKED ADDED (SA)	%R (1)
1. ARSENIC	75-125	475.	36.	440.	100.
2. LEAD	75-125	547.	163.	440.	87.
3. MERCURY	75-125	1.1	< 0.11	1.1	100.
4. ZINC	75-125	818.	444.	440.	85.

(1) %R = [(SSR-SR)/SA] X 100

"NR" - NOT REQUIRED

FORM IX A   Q.C. REPORT: 464 SOILS

ICP SERIAL DILUTION

LAB NAME: VERSAR, INC.
DATE: 8/15/88

MATRIX: L. SOIL

CASE NO. : -0-
FIELD SAMPLE NO.: AJ1
LAB SAMPLE ID NO.:52601
UNITS: UG/L

COMPOUND	INIT. SAMPLE CONC. (I)	SERIAL DIL. (S) (1)	% DIFFERENCE (2)	
1. ARSENIC	380.	347.	8.7	(3)
2. LEAD	754.	839.	11.	
3. MERCURY			NA	
4. ZINC	2030.	2080.	2.5	

(1) DILUTED SAMPLE CONCENTRATION CORRECTED FOR 1:4 DILUTION
(2) PERCENT DIFFERENCE =|I-S|/I*100
(3) SERIAL DILUTION IS LESS THAN 10 TIMES IDL; CONTROL LIMITS DO NOT APPLY
NR - NOT REQUIRED, INITIAL SAMPLE CONCENTRATION LESS THAN 10 TIMES IDL
NA - NOT APPLICABLE, ANALYTE NOT DETERMINED BY ICP

FORM IX B   Q.C. REPORT: 464 SOILS
ICP SERIAL DILUTION

LAB NAME: VERSAR, INC.
DATE: 8/15/88

MATRIX: L. SOIL

CASE NO. : -0-
FIELD SAMPLE NO.: AJ3
LAB SAMPLE ID NO.:52602
UNITS: UG/L

COMPOUND	INIT. SAMPLE CONC. (I)	SERIAL DIL. (S) (1)	% DIFFERENCE (2)	
1. ARSENIC	327.	514.	57.	(3)
2. LEAD	1480.	1680.	14.	
3. MERCURY			NA	
4. ZINC	4040.	4730.	17.	

(1) DILUTED SAMPLE CONCENTRATION CORRECTED FOR 1:4 DILUTION
(2) PERCENT DIFFERENCE =|I-S|/I*100
(3) SERIAL DILUTION IS LESS THAN 10 TIMES IDL; CONTROL LIMITS DO NOT APPLY
NR - NOT REQUIRED, INITIAL SAMPLE CONCENTRATION LESS THAN 10 TIMES IDL
NA - NOT APPLICABLE, ANALYTE NOT DETERMINED BY ICP

Versar INC.

GENERAL CHEMISTRY SECTION

ANALYSIS NARRATIVE

DATE: August 19, 1988
Project #: 4600-464
Project description: Juneau, Alacka

This project consisted of 6 soil and 2 water samples for the analysis of total cyanide. The CLP modified version of Method 335.2 from Methods for Chemical Analysis of Water and Wastes (MCAWW), 1983, was followed.

The soil data is reported on a dry weight basis. The percent total solids was calculated on a wet weight basis.

No analytical or quality assurance problems were encountered.

Christina Casillas
General Chemistry
Laboratory Operations

Versar INC.

GENERAL INORGANIC CHEMISTRY SECTION
ANALYSIS REPORT

PROJECT : 4600
BATCH : 464

DATE : 17-Aug-88
PAGE : 1

LAB #	SAMPLE ID	Total Cyanide (mg/kg)	Total Cyanide (ug/L)		
52618	D T 1	<0.53			
52619	D T 2	19.9			
52620	D T 3	<0.79			
52621	D T 4	49.1			
52622	D T 5	1.28			
52623	D T 6	<0.59			
52629	TRIP BLANK		<10.		
52630	D SW 1		<10.		

LABORATORY MANAGER

Versar INC.

GENERAL INORGANIC CHEMISTRY
QUALITY ASSURANCE REPORT

DATE: 17-Aug-88
PAGE: 1
OF SAMPLES: 6

PROJECT: 4600
BATCH: 464

PARAMETER: CN-T (ug/L)

I. INITIAL CALIBRATION VERIFICATION	REFERENCE STANDARD SOURCE Versar Std.	FOUND	90.7	
		TRUE	90.0	
		% RECOVERY	101%	
	BLANK VALUE	RESULTS	<10.0	
	PREP BLANK 1	RESULTS	<0.5	mg/kg
	PREP BLANK 2	RESULTS		
II. CONTINUING CALIBRATION VERIFICATION	STANDARD 1 SOURCE EPA 1182/179 #8	FOUND	600.	
		TRUE	561.	
		% RECOVERY	107%	
	STANDARD 2 SOURCE Versar Std.	FOUND	105.	
		TRUE	100.	
		% RECOVERY	105%	
III. DUPLICATE SAMPLE RESULTS	DUPLICATE 1 SAMPLE ID D T 3	SAMPLE RESULT	<0.79	mg/kg
		DUPLICATE RESULT	<0.79	mg/kg
		RPD %	NC*	
	DUPLICATE 2 SAMPLE ID	SAMPLE RESULT		
		DUPLICATE RESULT		
		RPD %		
IV. SPIKED SAMPLE RESULT	SPIKED SAMPLE ID D T 3	$\bar{X}$ SAMPLE RESULT	<0.79	mg/kg
		SPIKE RESULT	7.72	mg/kg
		SPIKE ADDED	7.92	mg/kg
		% RECOVERY	97%	

*NC = Not Calculable

Versar INC.

APPENDIX D

Laboratory Report of the Chemical Analyses of the Water Samples

Versar INC.

ANALYSIS NARRATIVE

Project: 4600-464
Title: Versar Intercompany Bank Project
Client: Alaska
Date: August 22, 1988

This is a batch of twenty-three soils and five waters which were received by Versar, Inc. on July 25, 1988. The samples were digested between July 27 and August 3, 1988. All digestion and analysis procedures followed methods prescribed in Test Methods for Evaluating Solid Waste, SW-846, 3rd. Edition.

The digestates were quantitated by ICP on August 3 and August 17, 1988. All blanks were clean with the exception of zinc in both the soil and water digestion blanks. These levels were low and insignificant. Check standard recoveries were within 10% control windows. Duplicate precision was acceptable with the following exceptions. Zinc RPD was slightly above the 20% window for the water QC sample. The soil QC sample had an elevated RPD for lead as a result of digesting nonhomogeneous duplicate aliquots. Spike recoveries were within 25% control windows except for zinc in the soil spike at 64%. This may be the result of matrix interference.

Lead and arsenic were quantitated on the water digestates by HGA in order to obtain lower detection limits than would be possible by ICP. HGA analyses took place between July 29 and August 12, 1988. All blanks were clean and all check standard recoveries were within 20% windows. Duplicate precision was satisfactory for arsenic results but outside 20% windows for lead. Spike recoveries were within 25% windows.

Mercury was analyzed on the soils and waters by CVAA techniques on July 29 and August 5, 1988. The analyses followed same day digestions. Blanks were clean and check standard recoveries were within 20% windows. Duplicate precision was within limits as were spike recoveries.

Prepared by: Danette Drew
Danette Drew
Laboratory Operations

Reviewed by: Chris T Pappas

4600-464

DATA PACKAGE - WATERS

DATE 8/22/88

COVER PAGE
INORGANIC ANALYSES DATA PACKAGE

LAB NAME: VERSAR, INC.
REFERENCE: SW-846, 3rd ed.

QC REPORT: 464 WATER
CASE NO. -0-
PROJECT NO.: 4600.0000

SAMPLE NUMBERS

FIELD NO.	LAB ID NO.	FIELD NO.	LAB ID NO.
TRIP BLANK	52624	PSW1	52625
PSW2	52626	PGW1	52627
DSW1	52628		

COMMENTS:

ICP INTERELEMENT AND BACKGROUND CORRECTION APPLIED? YES.
CORRECTIONS APPLIED BEFORE GENERATION OF RAW DATA.

FOOTNOTES:

NR - NOT REQUIRED BY CONTRACT AT THIS TIME
FORM I:

DF - DILUTION FACTOR

FORM I

: SAMPLE NO. :
: TRIP BLANK :

INORGANIC ANALYSIS DATA SHEET

DATE 8/22/88

LAB NAME: VERSAR INC.

QC REPORT NO.: 464 WATER

REF.: SW-846 3RD. ED.

MATRIX: WATER

LAB SAMPLE ID. NO.: 52624

BATCH: 464

PROJECT-TASK: 4600.0000

ELEMENTS IDENTIFIED AND MEASURED

UG/L

1.	ARSENIC	< 10.
2.	LEAD	< 5.0
3.	MERCURY	< 0.2
4.	ZINC	6.1

COMMENTS:

FORM I

SAMPLE NO.
PSW1

INORGANIC ANALYSIS DATA SHEET

DATE 8/22/88

LAB NAME: VERSAR INC.

QC REPORT NO.: 464 WATER

REF.: SW-846 3RD. ED.

MATRIX: WATER

LAB SAMPLE ID. NO.: 52625

BATCH: 464

PROJECT-TASK: 4600.0000

ELEMENTS IDENTIFIED AND MEASURED

UG/L

1.	ARSENIC	< 10.
2.	LEAD	< 5.0
3.	MERCURY	< 0.2
4.	ZINC	8.4

COMMENTS:

FORM I

: SAMPLE NO. :
: PSW2 :

INORGANIC ANALYSIS DATA SHEET

DATE 8/22/88

LAB NAME: VERSAR INC.

QC REPORT NO.: 464 WATER

REF.: SW-846 3RD. ED.

MATRIX: WATER

LAB SAMPLE ID. NO.: 52626

BATCH: 464

PROJECT-TASK: 4600.0000

ELEMENTS IDENTIFIED AND MEASURED

UG/L

1.	ARSENIC	< 10.
2.	LEAD	< 5.0
3.	MERCURY	< 0.2
4.	ZINC	8.7

COMMENTS:

FORM I

SAMPLE NO.
PGW1

INORGANIC ANALYSIS DATA SHEET

DATE 8/22/88

LAB NAME: VERSAR INC.

QC REPORT NO.: 464 WATER

REF.: SW-846 3RD. ED.

MATRIX: WATER

LAB SAMPLE ID. NO.: 52627

BATCH: 464

PROJECT-TASK: 4600.0000

ELEMENTS IDENTIFIED AND MEASURED

UG/L

1.	ARSENIC	22.
2.	LEAD	2800.
3.	MERCURY	< 0.2
4.	ZINC	1550.

COMMENTS: DF OF 250 FOR PB.

FORM I

SAMPLE NO.
DSW1

INORGANIC ANALYSIS DATA SHEET

DATE 8/22/88

LAB NAME: VERSAR INC.

QC REPORT NO.: 464 WATER

REF.: SW-846 3RD. ED.

MATRIX: WATER

LAB SAMPLE ID. NO.: 52628

BATCH: 464

PROJECT-TASK: 4600.0000

ELEMENTS IDENTIFIED AND MEASURED

UG/L

1.	ARSENIC	< 10.
2.	LEAD	17.
3.	MERCURY	0.36
4.	ZINC	199.

COMMENTS: DF OF 2 FOR PB.

FORM II A Q.C. REPORT: 464 WATER

INITIAL AND CONTINUING CALIBRATION VERIFICATION(3)

LAB NAME: VERSAR, INC.
DATE: 8/22/88

UNITS: UG/L

COMPOUND	INITIAL CALIB.(1)			CONTINUING CALIB.(2)				
	TRUE	FOUND	%R	TRUE	FOUND	%R	FOUND	%R
1. ARSENIC	100.	101.	101.	100.	99.	99.	100.	100.
2. LEAD	97.9	103.	105.	50.	50.	100.	50.	100.
3. MERCURY	5.2	5.2	100.	5.06	5.2	103.		
4. ZINC	500.	509.	102.	500.	503.	101.	513.	103.

(1),(2) INITIAL, CONTINUING CALIBRATION SOURCE: EPA, VERSAR
(3) CONTROL LIMITS: MERCURY AND HGA 80-120; ALL OTHER COMPOUNDS 90-110

FORM II B Q.C. REPORT: 464 WATER

INITIAL AND CONTINUING CALIBRATION VERIFICATION(3)

LAB NAME: VERSAR, INC.

DATE: 8/22/88 UNITS: UG/L

COMPOUND	INITIAL CALIB. (1)			CONTINUING CALIB. (2)				
	TRUE	FOUND	%R	TRUE	FOUND	%R	FOUND	%R
1. ARSENIC	100.	108.	108.	100.	98.	98.		
2. LEAD				50.	50.	100.	51.	102.
3. MERCURY								
4. ZINC								

(1),(2) INITIAL, CONTINUING CALIBRATION SOURCE: EPA, VERSAR

(3) CONTROL LIMITS: MERCURY AND HGA 80-120; ALL OTHER COMPOUNDS 90-110

FORM II C   Q.C. REPORT: 464 WATER

INITIAL AND CONTINUING CALIBRATION VERIFICATION(3)

LAB NAME: VERSAR, INC.
DATE: 8/22/88   UNITS: UG/L

COMPOUND	INITIAL CALIB.(1) TRUE	FOUND	%R	CONTINUING CALIB.(2) TRUE	FOUND	%R	FOUND	%R
1. ARSENIC								
2. LEAD				50.	48.	96.		
3. MERCURY								
4. ZINC								

(1),(2) INITIAL, CONTINUING CALIBRATION SOURCE: EPA, VERSAR
(3) CONTROL LIMITS: MERCURY AND HGA 80-120; ALL OTHER COMPOUNDS 90-110

FORM III A
BLANKS

Q.C. REPORT: 464 WATER

LAB NAME: VERSAR, INC.
DATE 3/22/88

UNITS: UG/L

COMPOUND	INITIAL CALIB BLANK VALUE	MATRIX CONTINUING CALIB BLANK VALUE 1	2	HOH 3	4	PREP HOH	BLANK 2.
1. ARSENIC	< 10.	< 10.	< 10.			< 10.	
2. LEAD	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	
3. MERCURY	< 0.2	< 0.2				< 0.2	
4. ZINC	< 2.0	< 2.0	< 2.0			2.9	

FORM III B
BLANKS

Q.C. REPORT: 464 WATER

LAB NAME: VERSAR, INC.
DATE 8/22/88

UNITS: UG/L

MATRIX HOH

COMPOUND	INITIAL CALIB BLANK VALUE	CONTINUING CALIB BLANK VALUE 1	2	3	4	PREP HOH	BLANK 2.
1. ARSENIC	< 10.	< 10.					
2. LEAD		< 5.0					
3. MERCURY							
4. ZINC							

FORM IV A   Q.C. REPORT: 464 WATER

ICP INTERFERENCE CHECK SAMPLE

LAB NAME: VERSAR, INC.

DATE: 8/22/88

CHECK SAMPLE I.D.: INTER

CHECK SAMPLE SOURCE: EPA

UNITS: UG/L

COMPOUND	CONTROL LIMITS(1) MEAN	2X STD.DEV.	TRUE (2)	INITIAL OBSERVED	%R	FINAL OBSERVED	%R
1. ARSENIC	100.	112.	---	---	---	---	---
2. LEAD	4480.	38.	---	---	---	---	---
3. MERCURY	---	---	---	---	---	---	---
4. ZINC	932.	9.	973.	921.	95.	930.	96.

(1) MEAN BASED ON N = 5   (2) TRUE VALUE OF INTERFERENCE CHECK SAMPLE

FORM V A

SPIKE SAMPLE RECOVERY

Q.C. REPORT: 464 WATER

LAB NAME: VERSAR, INC.

DATE 8/22/88

FIELD SAMPLE NO.:PSW1

LAB SAMPLE ID NO.52625

MATRIX: HOH

UNITS:UG/L

COMPOUND	CONTROL LIMIT %R	SPIKED SAMPLE RESULT (SSR)	SAMPLE RESULT (SR)	SPIKED ADDED (SA)	%R (1)
1. ARSENIC (2)	75-125	88.	< 10.	100.	88.
2. LEAD (2)	75-125	128.	17.	100.	111.
3. MERCURY	75-125	1.7	< 0.2	2.0	85.
4. ZINC	75-125	470.	8.4	500.	92.

(1) %R = [(SSR-SR)/SA] X 100

(2) Field no. DSW1, lab no. 52626

FORM VI A
DUPLICATES

Q.C. REPORT: 464 WATER

LAB NAME: VERSAR, INC.
DATE: 8/22/88

FIELD SAMPLE NO.:PSW1
LAB SAMPLE ID NO. 52625
UNITS:UG/L

MATRIX:HOH

COMPOUND	CONTROL LIMITS (1)	SAMPLE(S)	DUPLICATE(D)	RPD(2)
1. ARSENIC (3)		< 10.	< 10.	NC
2. LEAD (3)		17.	23.	30.
3. MERCURY		< 0.2	< 0.2	NC
4. ZINC		8.4	11.	27.

(1) TO BE ADDED AT A LATER DATE
(2) RPD = [(S-D)/((S+D)/2)]X100 (3) Field no. PSW1; lab no. 52626
NC - NON CALCULABLE RPD DUE TO VALUE(S) LESS THAN CRDL

FORM IX A Q.C. REPORT: 464 WATER
ICP SERIAL DILUTION

LAB NAME: VERSAR, INC.
DATE: 8/22/88

MATRIX: L. HOH

CASE NO. : -0-
FIELD SAMPLE NO.: PGW1
LAB SAMPLE ID NO.:52627
UNITS: UG/L

COMPOUND	INIT. SAMPLE CONC. (I)	SERIAL DIL. (S) (1)	% DIFFERENCE (2)
1. ARSENIC			NA
2. LEAD			NA
3. MERCURY			NA
4. ZINC	1550.	1610.	3.9

(1) DILUTED SAMPLE CONCENTRATION CORRECTED FOR 1:4 DILUTION
(2) PERCENT DIFFERENCE =|I-S|/I*100
(3) SERIAL DILUTION IS LESS THAN 10 TIMES IDL; CONTROL LIMITS DO NOT APPLY
NR - NOT REQUIRED, INITIAL SAMPLE CONCENTRATION LESS THAN 10 TIMES IDL
NA - NOT APPLICABLE, ANALYTE NOT DETERMINED BY ICP

Versar INC.

GENERAL CHEMISTRY SECTION

ANALYSIS NARRATIVE

DATE: August 19, 1988
Project #: 4600-464
Project description: Juneau, Alaska

This project consisted of 6 soil and 2 water samples for the analysis of total cyanide. The CLP modified version of Method 335.2 from Methods for Chemical Analysis of Water and Wastes (MCAWW), 1983, was followed.

The soil data is reported on a dry weight basis. The percent total solids was calculated on a wet weight basis.

No analytical or quality assurance problems were encountered.

Christina Casillas
General Chemistry
Laboratory Operations

Versar INC.

GENERAL INORGANIC CHEMISTRY SECTION
ANALYSIS REPORT

PROJECT : 4600
BATCH : 464

DATE : 17-Aug-88
PAGE : 1

LAB #	SAMPLE ID	Total Cyanide (mg/kg)	Total Cyanide (ug/L)		
52618	D T 1	<0.53			
52619	D T 2	19.9			
52620	D T 3	<0.79			
52621	D T 4	49.1			
52622	D T 5	1.28			
52623	D T 6	<0.59			
52629	TRIP BLANK		<10.		
52630	D SW 1		<10.		

LABORATORY MANAGER

Versar INC.

GENERAL INORGANIC CHEMISTRY
QUALITY ASSURANCE REPORT

DATE: 17-Aug-88
PAGE: 2
OF SAMPLES: 2

PROJECT: 4600
BATCH: 464

Section	Item		PARAMETER: CN-T (ug/L)
I. INITIAL CALIBRATION VERIFICATION	REFERENCE STANDARD SOURCE Versar Std.	FOUND	90.7
		TRUE	90.0
		% RECOVERY	101%
	BLANK VALUE	RESULTS	<10.0
II. CONTINUING CALIBRATION VERIFICATION	PREP BLANK 1	RESULTS	<10.0
	PREP BLANK 2	RESULTS	
	STANDARD 1 SOURCE EPA 1182/179 #8	FOUND	600.
		TRUE	561.
		% RECOVERY	107%
	STANDARD 2 SOURCE Versar Std.	FOUND	106.
		TRUE	100.
		% RECOVERY	106%
III. DUPLICATE SAMPLE RESULTS	DUPLICATE 1 SAMPLE ID D SW 1	SAMPLE RESULT	<10.0
		DUPLICATE RESULT	<10.0
		RPD %	NC*
	DUPLICATE 2 SAMPLE ID	SAMPLE RESULT	
		DUPLICATE RESULT	
		RPD %	
IV. SPIKED SAMPLE RESULT	SPIKED SAMPLE ID D SW 1	X SAMPLE RESULT	<10.0
		SPIKE RESULT	98.4
		SPIKE ADDED	100.
		% RECOVERY	98%

*NC = Not Calculable

Versar INC.

APPENDIX E

Laboratory Report of the Extraction Procedure Toxicity Tests

Versar INC.

ANALYSIS NARRATIVE

Project: 4600-519
Title: Versar Intercompany Bank Project
Site: Juneau
Date: September 28, 1988

This batch of four soils was received on July 25, 1988. The soils were extracted on September 19, 1988 by Extraction Procedure Toxicity Testing, method 1310, SW-846, 3rd Edition. The extracts were then digested for ICP and HGA analysis on September 21. All digestions and analyses followed SW-846, 3rd Edition methods.

ICP analytes were quantitated on September 21, 1988. Check standard recoveries were within 10% windows. Blanks were clean with the exception of barium, chromium, and lead, indicating a positive bias on the sample results for those analytes. Duplicate RPD's were within limits except for arsenic, barium, and cadmium. Elevated RPD's are most likely the result of extracting nonhomogenous duplicate aliquots. Spike recoveries were within 25% control windows except for lead. Although lead spike recovery was high, the spike level was exceeded by the level of lead in the sample by at least a factor of ten.

Selenium was quantitated by HGA on September 22, 1988. Blanks were clean and check standard recoveries were within 20% windows. Duplicate precision was satisfactory as was the spike recovery.

Mercury was quantitated on September 26, 1988 by CVAA following a same day digestion. Blanks were clean and check standard recoveries were within 20% windows. Duplicate precision was good. No matrix spike was performed as the samples were analyzed by Method of Standard Additions.

Prepared by: Danette Drew
Danette Drew
Laboratory Operations

Reviewed by: Chris T. Pappas

DATE 9/23/88

COVER PAGE
INORGANIC ANALYSES DATA PACKAGE

QC REPORT: 519
CASE NO. -0-
PROJECT NO.: 4600.0000

LAB NAME: VERSAR, INC.
REFERENCE: SW-846, 3rd ed.

SAMPLE NUMBERS

FIELD NO.	LAB ID NO.	FIELD NO.	LAB ID NO.
52633	56704	52634	56705
52635	56706	52636	56707

COMMENTS:

ICP INTERELEMENT AND BACKGROUND CORRECTION APPLIED? YES.
CORRECTIONS APPLIED BEFORE GENERATION OF RAW DATA.

FOOTNOTES:

NR - NOT REQUIRED BY CONTRACT AT THIS TIME

FORM I:

DF - DILUTION FACTOR

FORM I

SAMPLE NO.
52633

DATE: 9/23/88

INORGANIC ANALYSIS DATA SHEET

LAB NAME: VERSAR INC. QC REPORT NO.: 519

SOW NO.: SW-846 3RD ED.

LAB SAMPLE ID. NO.: 56704 MATRIX: EXTRACT

PROJECT-TASK: 4600.0000 BATCH: 519

ELEMENTS IDENTIFIED AND MEASURED

MG/L

1.	ARSENIC	0.041
2.	BARIUM	0.058
3.	CADMIUM	0.034
4.	CHROMIUM	< 0.004
5.	LEAD	5.64
6.	MERCURY	< 0.002
7.	SELENIUM	< 0.005
8.	SILVER	< 0.006

COMMENTS:

FORM I

SAMPLE NO.
52634

DATE: 9/23/88

INORGANIC ANALYSIS DATA SHEET

LAB NAME: VERSAR INC. QC REPORT NO.: 519

SOW NO.: SW-846 3RD ED.

LAB SAMPLE ID. NO.: 56705 MATRIX: EXTRACT

PROJECT-TASK: 4600.0000 BATCH: 519

ELEMENTS IDENTIFIED AND MEASURED

MG/L

1.	ARSENIC	< 0.021
2.	BARIUM	0.155
3.	CADMIUM	< 0.005
4.	CHROMIUM	< 0.004
5.	LEAD	0.443
6.	MERCURY	< 0.002
7.	SELENIUM	< 0.005
8.	SILVER	< 0.006

COMMENTS:

FORM I

SAMPLE NO.
52635

DATE: 9/23/88

INORGANIC ANALYSIS DATA SHEET

LAB NAME: VERSAR INC.

QC REPORT NO.: 519

SOW NO.: SW-846 3RD ED.

LAB SAMPLE ID. NO.: 56706

MATRIX: EXTRACT

PROJECT-TASK: 4600.0000

BATCH: 519

ELEMENTS IDENTIFIED AND MEASURED

MG/L

1.	ARSENIC	< 0.021
2.	BARIUM	0.757
3.	CADMIUM	< 0.005
4.	CHROMIUM	0.0051
5.	LEAD	0.672
6.	MERCURY	< 0.002
7.	SELENIUM	< 0.005
8.	SILVER	< 0.006

COMMENTS:

FORM I

SAMPLE NO.
52636

DATE: 9/23/88

INORGANIC ANALYSIS DATA SHEET

LAB NAME: VERSAR INC.

QC REPORT NO.: 519

SOW NO.: SW-846 3RD ED.

LAB SAMPLE ID. NO.: 56707

MATRIX: EXTRACT

PROJECT-TASK: 4600.0000

BATCH: 519

ELEMENTS IDENTIFIED AND MEASURED

MG/L

1.	ARSENIC	< 0.021
2.	BARIUM	0.090
3.	CADMIUM	0.050
4.	CHROMIUM	0.004
5.	LEAD	0.390
6.	MERCURY	< 0.002
7.	SELENIUM	< 0.025 *
8.	SILVER	< 0.006

COMMENTS: *DETECTION LIMIT CHANGED DUE TO DILUTION BECAUSE OF INTERFERENCE. DF OF 5 FOR SE.

FORM II A Q.C. REPORT: 519

INITIAL AND CONTINUING CALIBRATION VERIFICATION(3)

LAB NAME: VERSAR, INC.

DATE: 9/23/88 UNITS: UG/L

COMPOUND	INITIAL CALIB.(1) TRUE	FOUND	%R	CONTINUING CALIB.(2) TRUE	FOUND	%R	FOUND	%R
1. ARSENIC	500.	488.	98.	500.	478.	96.	497.	99.
2. BARIUM	500.	495.	99.	500.	491.	98.	491.	98.
3. CADMIUM	500.	510.	102.	500.	510.	102.	520.	104.
4. CHROMIUM	500.	504.	101.	500.	502.	100.	500.	100.
5. LEAD	1000.	1030.	103.	1000.	1060.	106.	1040.	104.
6. MERCURY	5.2	5.1	98.	5.06	5.7	113.	5.6	111.
7. SELENIUM	25.	23.	92.	50.	47.	94.	48.	96.
8. SILVER	500.	506.	101.	500.	502.	100.	503.	101.

(1),(2) INITIAL, CONTINUING CALIBRATION SOURCE: EPA, VERSAR

(3) CONTROL LIMITS: MERCURY AND SELENIUM 80-120; ALL OTHER COMPOUNDS 90-110

FORM II B Q.C. REPORT: 519

INITIAL AND CONTINUING CALIBRATION VERIFICATION(3)

LAB NAME: VERSAR, INC.

DATE: 9/23/88 UNITS: UG/L

COMPOUND	INITIAL CALIB.(1)			CONTINUING CALIB.(2)				
	TRUE	FOUND	%R	TRUE	FOUND	%R	FOUND	%R
1. ARSENIC								
2. BARIUM								
3. CADMIUM								
4. CHROMIUM								
5. LEAD								
6. MERCURY								
7. SELENIUM				50.	49.	98.		
8. SILVER								

(1),(2) INITIAL, CONTINUING CALIBRATION SOURCE: EPA, VERSAR

(3) CONTROL LIMITS: MERCURY AND SELENIUM 80-120; ALL OTHER COMPOUNDS 90-110

FORM III A
BLANKS

Q.C. REPORT: 519

LAB NAME: VERSAR, INC.
DATE 9/23/88

UNITS: UG/L

COMPOUND	INITIAL CALIB BLANK VALUE	MATRIX HOH CONTINUING CALIB BLANK VALUE 1	2	3	4	PREP HOH	BLANK EXT. BLK.
1. ARSENIC	< 21.	< 21.	< 21.			< 21.	< 21.
2. BARIUM	< 1.0	< 1.0	< 1.0			< 1.0	65.
3. CADMIUM	< 5.0	< 5.0	< 5.0			< 5.0	< 5.0
4. CHROMIUM	< 4.0	4.8	< 4.0			8.6	4.8
5. LEAD	< 38.	43.	< 38.			48.	47.
6. MERCURY	< 2.0	< 2.0	< 2.0			< 2.0	< 2.0
7. SELENIUM	< 5.0	< 5.0	< 5.0	< 5.0		< 5.0	< 5.0
8. SILVER	< 6.0	< 6.0	< 6.0			< 6.0	< 6.0

FORM IV A　　　Q.C. REPORT: 519

ICP INTERFERENCE CHECK SAMPLE

LAB NAME: VERSAR, INC.

DATE: 9/23/88

CHECK SAMPLE I.D. : INTER

CHECK SAMPLE SOURCE: EPA

UNITS: UG/L

COMPOUND	CONTROL LIMITS(1) MEAN	2X STD. DEV.	TRUE (2)	INITIAL OBSERVED	%R	FINAL OBSERVED	%R
1. ARSENIC	100.	112.	0.0	(21.	0.0	(21.	0.0
2. BARIUM	491.	9.	483.	483.	100.	483.	100.
3. CADMIUM	920.	5.	909.	966.	106.	978.	108.
4. CHROMIUM	910.	12.	513.	512.	100.	518.	101.
5. LEAD	4480.	38.	4850.	4850.	100.	4960.	102.
6. MERCURY	---	---	---	---	---	---	---
7. SELENIUM	---	---	---	---	---	---	---
8. SILVER	907.	6.	934.	992.	106.	999.	107.

(1) MEAN BASED ON N = 5　　(2) TRUE VALUE OF INTERFERENCE CHECK SAMPLE

FORM V A — Q.C. REPORT: 519

SPIKE SAMPLE RECOVERY

LAB NAME: VERSAR, INC.

DATE 9/23/88

FIELD SAMPLE NO.:52633

LAB SAMPLE ID NO.56704

MATRIX: HOH

UNITS:UG/L

COMPOUND	CONTROL LIMIT %R	SPIKED SAMPLE RESULT (SSR)	SAMPLE RESULT (SR)	SPIKED ADDED (SA)	%R (1)
1. ARSENIC	75-125	550.	41.	500.	102.
2. BARIUM	75-125	260.	58.	200.	101.
3. CADMIUM	75-125	235.	34.	200.	100.
4. CHROMIUM	75-125	587.	< 4.0	500.	117.
5. LEAD	75-125	6400.	5640.	500.	152.
6. MERCURY	75-125	NR	---	---	---
7. SELENIUM	75-125	98.	< 5.0	100.	98.
8. SILVER	75-125	200.	< 6.0	200.	100.

(1) %R = [(SSR-SR)/SA] X 100

FORM VI A Q.C. REPORT: 519
DUPLICATES

LAB NAME: VERSAR, INC.
DATE: 9/23/88

FIELD SAMPLE NO.:52633
LAB SAMPLE ID NO.56704
UNITS:UG/L

MATRIX:HOH

COMPOUND	CONTROL LIMITS (1)	SAMPLE(S)	DUPLICATE(D)	RPD(2)
1. ARSENIC		41.	30.	31.
2. BARIUM		58.	86.	39.
3. CADMIUM		34.	14.	83.
4. CHROMIUM		< 4.0	< 4.0	NC
5. LEAD		5640.	6260.	10.
6. MERCURY		< 2.0	< 2.0	NC
7. SELENIUM		< 5.0	< 5.0	NC
8. SILVER		< 6.0	< 6.0	NC

(1) TO BE ADDED AT A LATER DATE
(2) RPD = [(S-D)/((S+D)/2)]X100
NC - NON CALCULABLE RPD DUE TO VALUE(S) LESS THAN CRDL

FORM IX A Q.C. REPORT: 519

ICP SERIAL DILUTION

LAB NAME: VERSAR, INC.
DATE: 9/23/88

MATRIX: L. HOH

CASE NO. : -0-
FIELD SAMPLE NO.:52633
LAB SAMPLE ID NO.:56704
UNITS: UG/L

COMPOUND	INIT. SAMPLE CONC. (I)	SERIAL DIL. (S) (1)	% DIFFERENCE (2)
1. ARSENIC	41.	< 105.	NR
2. BARIUM	58.	58.	0.0
3. CADMIUM	34.	40.	NR
4. CHROMIUM	< 4.0	38.	NR
5. LEAD	5640.	5770.	2.3
6. MERCURY			NA
7. SELENIUM			NA
8. SILVER	< 6.0	< 30.	NR

(1) DILUTED SAMPLE CONCENTRATION CORRECTED FOR 1:4 DILUTION
(2) PERCENT DIFFERENCE =|I-S|/I*100
(3) SERIAL DILUTION IS LESS THAN 10 TIMES IDL; CONTROL LIMITS DO NOT APPLY
NR - NOT REQUIRED, INITIAL SAMPLE CONCENTRATION LESS THAN 10 TIMES IDL
NA - NOT APPLICABLE, ANALYTE NOT DETERMINED BY ICP

Standardization Rpt. Wed 09-21-88 08:46:00 PM page 1

Standard: STD1-Blank

Night Stdization BPT 9-21-88

Elem	Ag3280	Al3082	As1936	B_2497	Ba4934	Be3130	Ca3179
Avge	-.0011	-.0038	.0214	.0022	.0001	.0004	.0072
#1	.0002	-.0018	.0253	.0027	.0004	.0005	.0082
#2	-.0023	-.0058	.0174	.0018	-.0002	.0003	.0062

Elem	Cd2288	Co2286	Cr2677	Cu3247	Fe2599	Fe2714	K_7664
Avge	-.0002	-.0003	-.0008	.0001	.0025	-.0009	3.535
#1	-.0005	-.0003	.0002	.0004	.0044	.0003	3.559
#2	.0002	-.0004	-.0018	-.0001	.0007	-.0020	3.510

Elem	Li6707	Mg2795	Mn2576	Mo2023	Na5889	Ni2316	Pb2203
Avge	-.0002	.0034	.0000	-.0004	.0445	-.0033	-.0010
#1	.0000	.0037	.0002	-.0008	.0446	-.0027	-.0004
#2	-.0004	.0032	-.0002	-.0001	.0444	-.0039	-.0017

Elem	Sb2175	Se1960	Si2881	Sn1899	Sr4215	Ti3349	Tl1908
Avge	-.0034	.0060	.0018	.0029	.0000	.0002	-.0013
#1	-.0004	.0124	.0036	-.0072	.0000	.0009	[illegible]
#2	-.0065	-.0004	.0000	.0130	.0000	-.0004	-.0010

Elem	V_2924	Y_3710	Zn2138
Avge	-.0015	-.0002	.0005
#1	-.0001	.0000	.0006
#2	-.0029	-.0003	.0003

Standard: STD2

Elem	Ag3280	Al3082	As1936	B_2497	Ba4934	Be3130	Ca3179
Avge	.4904	-.0038	.0233	.0021	.0000	.0001	.2089
#1	.4906	-.0049	.0266	.0011	-.0001	.0001	.2077
#2	.4903	-.0026	.0200	.0031	.0001	.0002	.2102

Elem	Cd2288	Co2286	Cr2677	Cu3247	Fe2599	Fe2714	K_7664
Avge	.2896	.1409	-.0007	.0940	.0003	.0023	3.513
#1	.2908	.1408	-.0020	.0941	-.0018	.0010	3.513
#2	.2884	.1411	.0007	.0939	.0023	.0035	3.513

Elem	Li6707	Mg2795	Mn2576	Mo2023	Na5889	Ni2316	Pb2203
Avge	-.0003	.8568	.3092	.0000	.0442	.0011	-.0016
#1	-.0004	.8559	.3088	-.0003	.0434	.0014	-.0018
#2	-.0002	.8576	.3096	.0003	.0450	.0008	-.0014

Elem	Sb2175	Se1960	Si2881	Sn1899	Sr4215	Ti3349	Tl1908
Avge	-.0022	.0079	.0015	-.0025	.0000	.0001	.0014
#1	-.0022	.0171	.0017	-.0020	.0000	.0000	.0007
#2	[illegible]	-.0013	.0014	-.0030	.0000	.0002	.0022

Elem	Y_2234	Y_3710	Zn2138
Avge	-.0015	-.0001	.3509
#1	-.0022	-.0002	.3495
#2	-.0008	-.0001	.3523

Standard: STD3

Elem	Ag3280	Al3082	As1936	B_2497	Ba4934	Be3130	Ca3179
Avge	-.0010	.1003	.0278	.0100	.3575	.6836	.0087
#1	-.0004	.1005	.0218	.0097	.3565	.6810	.0086
#2	-.0016	.1001	.0338	.0103	.3584	.6861	.0088

Elem	Cd2288	Co2286	Cr2677	Cu3247	Fe2599	Fe2714	K_7664
Avge	.0013	.0002	-.0002	.0003	.6151	.0212	3.543
#1	.0017	.0004	.0006	.0003	.6126	.0210	3.520
#2	.0009	.0001	-.0010	.0002	.6175	.0214	3.566

Elem	Li6707	Mg2795	Mn2576	Mo2023	Na5889	Ni2316	Pb2203
Avge	.0919	.0044	.0002	.1441	.3432	.6623	.0000
#1	.0918	.0046	.0002	.1432	.3422	.6553	.0003
#2	.0920	.0042	.0002	.1451	.3442	.6694	-.0004

Elem	Sb2175	Se1960	Si2881	Sn1899	Sr4215	Ti3349	Tl1908
Avge	.1617	-.0036	.0048	.5167	.3823	.5281	.0006
#1	.1608	-.0006	.0044	.5154	.3809	.5266	-.0012
#2	.1625	-.0067	.0051	.5180	.3836	.5297	.0024

Elem	V_2924	Y_3710	Zn2138
Avge	-.0037	.0000	.0019
#1	-.0035	.0000	.0020
#2	-.0039	-.0001	.0017

Standardization Rpt.   Wed 09-21-88 08:52:50 PM   page 1

Standard: STD4

Elem	Ag3280	Al3082	As1936	B_2497	Ba4934	Be3130	Ca3179
Avge	-.0017	-.0037	.4199	.3310	.0003	.0005	.0068
#1	.0000	-.0025	.4240	.3303	.0003	.0007	.0075
#2	-.0034	-.0050	.4158	.3317	.0003	.0004	.0061

Elem	Cd2288	Co2286	Cr2677	Cu3247	Fe2599	Fe2714	K_7664
Avge	.0021	-.0002	.6136	-.0001	.0047	-.0007	3.523
#1	.0020	-.0001	.6093	.0001	.0050	-.0001	3.521
#2	.0021	-.0003	.6178	-.0004	.0045	-.0012	3.526

Elem	Li6707	Mg2795	Mn2576	Mo2023	Na5889	Ni2316	Pb2203
Avge	.0001	.0036	-.0001	.0001	.0445	.0005	-.0005
#1	.0002	.0037	-.0002	.0003	.0444	.0011	-.0006
#2	.0001	.0034	.0000	-.0001	.0446	-.0001	-.0003

Elem	Sb2175	Se1960	Si2881	Sn1899	Sr4215	Ti3349	Tl1908
Avge	-.0012	.2810	.0093	-.0035	.0000	.0004	-.0011
#1	.0011	.2909	.0094	-.0056	.0000	.0006	-.0002
#2	-.0034	.2712	.0091	-.0014	.0000	.0001	-.0020

Elem	V_2924	Y_3710	Zn2138
Avge	-.0030	-.0003	.0005
#1	-.0026	-.0002	.0007
#2	-.0033	-.0003	.0003

Standardization Rpt. Wed 09-21-88 08:54:53 PM

Standard: STD6

Elem	Ag3280	Al3082	As1936	B_2497	Ba4934	Be3130	Ca3179
Avge	-.0049	-.0035	-.0510	.0206	.0003	.0003	.0064
#1	-.0055	-.0039	-.0531	.0208	.0002	.0002	.0058
#2	-.0043	-.0031	-.0489	.0203	.0004	.0004	.0070

Elem	Cd2288	Co2286	Cr2677	Cu3247	Fe2599	Fe2714	K_7664
Avge	.0000	-.0004	.0000	-.0003	30.66	1.062	3.578
#1	-.0005	-.0005	-.0009	-.0004	30.59	1.059	3.571
#2	.0005	-.0004	.0009	-.0002	30.74	1.066	3.584

Elem	Li6707	Mg2795	Mn2576	Mo2023	Na5889	Ni2316	Pb2203
Avge	-.0002	.0037	-.0035	-.0139	.0455	-.0005	.0010
#1	-.0003	.0035	-.0038	-.0143	.0456	.0025	.0013
#2	.0000	.0038	-.0032	-.0136	.0454	-.0034	.0008

Elem	Sb2175	Se1960	Si2881	Sn1899	Sr4215	Ti3349	Tl1908
Avge	-.0847	-.1002	.0007	.0043	.0000	.0002	-.0065
#1	-.0874	-.1015	.0002	-.0006	.0000	.0001	-.0053
#2	-.0820	-.0990	.0011	.0092	.0000	.0003	-.0076

Elem	V_2924	Y_3710	Zn2138
Avge	.0014	.0000	.0017
#1	.0006	-.0001	.0016
#2	.0021	.0001	.0018

Standard: STD5

Elem	Ag3280	Al3082	As1936	B_2497	Ba4934	Be3130	Ca3179
Avge	-.0015	.0036	.0331	.0617	.0003	.0024	.0250
#1	-.0012	.0046	.0324	.0624	.0002	.0026	.0249
#2	-.0018	.0026	.0338	.0611	.0003	.0022	.0252

Elem	Cd2288	Co2286	Cr2677	Cu3247	Fe2599	Fe2714	K_7664
Avge	.0006	.0004	.0016	.0004	.0167	-.0018	7.614
#1	.0008	.0004	.0014	.0005	.0184	-.0015	7.629
#2	.0004	.0005	.0019	.0004	.0149	-.0021	7.598

Elem	Li6707	Mg2795	Mn2576	Mo2023	Na5889	Ni2316	Pb2203
Avge	.0000	.0040	.0002	-.0001	.0494	.0036	.0011
#1	-.0002	.0042	.0000	.0000	.0496	.0038	.0007
#2	.0001	.0038	.0004	-.0002	.0492	.0034	.0016

Elem	Sb2175	Se1960	Si2881	Sn1899	Sr4215	Ti3349	Tl1908
Avge	.0046	.0087	.0070	-.0009	.0000	.0019	.0008
#1	.0060	.0011	.0074	-.0024	.0000	.0019	-.0007
#2	.0031	.0162	.0065	.0006	.0000	.0018	.0022

Elem	V_2924	Y_3710	Zn2138
Avge	.6058	.1949	-.0005
#1	.6034	.1945	-.0005
#2	.6083	.1953	-.0005

Standardization Rpt. Wed 09-21-88 08:59:24 PM page 1

Standard: STD7

Elem	Ag3280	Al3082	As1936	B_2497	Ba4934	Be3130	Ca3179
Avge	-.0001	.0005	.0221	.0144	.0003	.0004	.0088
#1	-.0014	-.0003	.0220	.0150	.0002	.0002	.0078
#2	.0012	.0012	.0221	.0139	.0003	.0005	.0098

Elem	Cd2288	Co2286	Cr2677	Cu3247	Fe2599	Fe2714	K_7664
Avge	-.0003	-.0001	.0006	.0002	.0063	.0005	3.546
#1	-.0004	-.0006	-.0008	.0001	.0056	-.0003	3.528
#2	-.0002	.0004	.0020	.0004	.0070	.0014	3.565

Elem	Li6707	Mg2795	Mn2576	Mo2023	Na5889	Ni2316	Pb2203
Avge	.0001	.0058	.0002	.0000	.0457	.0026	.0457
#1	.0001	.0058	.0000	-.0001	.0454	.0050	.0451
#2	.0002	.0058	.0004	.0002	.0460	.0003	.0463

Elem	Sb2175	Se1960	Si2881	Sn1899	Sr4215	Ti3349	Tl1908
Avge	.0011	.0052	.0654	.0023	.0000	.0009	.0759
#1	.0005	-.0024	.0647	.0046	.0000	.0006	.0771
#2	.0017	.0128	.0661	.0000	.0000	.0012	.0746

Elem	V_2924	Y_3710	Zn2138
Avge	.0002	.0001	.0029
#1	-.0008	-.0002	.0031
#2	.0011	.0003	.0027

Method: C Sample Name: AR ,1.X Operator:
Run Time: 09/21/88 21:02:24
Comment: 4600-519 WATER/EXTRACT
Mode: CONC Corr. Factor: 1

4600-519
4600-510 Red:g
BPT 9-21-88
FN: 921881.OUT

Elem	Ag3280	Al3082	As1936	B_2497	Ba4934	Be3130	Ca3179
Avge	.0008	.0101	.0041	.0007	-.0001	.0002	.0042
#1	-.0021	-.0087	.0002	-.0029	-.0008	.0000	-.0010
#2	.0038	.0290	.0080	.0043	.0006	.0004	.0094

Elem	Cd2288	Co2286	Cr2677	Cu3247	Fe2599	Fe2714	K 7664
Avge	-.0014	.0021	.0009	-.0011	.0017	.0753	.1739
#1	-.0002	.0032	-.0018	-.0048	-.0007	.0258	-.1372
#2	-.0026	.0011	.0036	.0027	.0042	.1249	.4851

Elem	Li6707	Mg2795	Mn2576	Mo2023	Na5889	Ni2316	Pb2203
Avge	.0049	.0002	.0000	.0029	.0134	.0097	.0182
#1	.0033	-.0001	.0000	.0025	.0033	.0069	-.0139
#2	.0065	.0004	.0000	.0033	.0234	.0125	.0503

Elem	Sb2175	Se1960	Si2881	Sn1899	Sr4215	Ti3349	Tl1908
Avge	.0125	-.0120	.0149	.0051	.0000	.0000	.0349
#1	.0006	-.0343	.0094	.0041	.0000	-.0005	.0219
#2	.0243	.0104	.0204	.0061	.0000	.0005	.0478

Elem	V_2924	Y_3710	Zn2138
Avge	.0042	.0003	.0005
#1	.0026	.0003	-.0001
#2	.0058	.0003	.0012

Method: C   Sample Name: EPA   ,HCL   Operator:
Run Time: 09/21/88 21:04:50
Comment: 4600-519 WATER/EXTRACT
Mode: CONC   Corr. Factor: 1

Elem	Ag3280	Al3082	As1936	B_2497	Ba4934	Be3130	Ca3179
Avge	-.0047	.5271	.4875	.5011	.4948	.4968	20.44
#1	-.0049	.5179	.4946	.4977	.4962	.4976	20.47
#2	-.0045	.5363	.4805	.5044	.4934	.4960	20.41

Elem	Cd2288	Co2286	Cr2677	Cu3247	Fe2599	Fe2714	K 7664
Avge	.0015	.0004	.5044	.0036	.5027	.5396	20.20
#1	.0021	-.0010	.5027	.0052	.5025	.5421	20.54
#2	.0008	.0018	.5061	.0020	.5028	.5372	19.86

Elem	Li6707	Mg2795	Mn2576	Mo2023	Na5889	Ni2316	Pb2203
Avge	1.989	.4976	.0001	1.963	20.31	.0132	.0244
#1	1.990	.4991	-.0009	1.967	20.36	.0142	[illegible]
#2	1.988	.4961	.0011	1.959	20.26	.0121	[illegible]

Elem	Sb2175	Se1960	Si2881	Sn1899	Sr4215	Ti3349	Tl1908
Avge	.5195	-.0498	.0010	1.967	2.023	1.962	.0390
#1	.5213	-.0395	.0008	1.972	2.025	1.968	.0243
#2	.5176	-.0602	.0011	1.962	2.021	1.956	.0537

Elem	V_2924	Y_3710	Zn2138
Avge	.0036	1.962	.5161
#1	.0035	1.965	.5170
#2	.0038	1.959	.5153

Analysis Report [illegible]

Method: C Sample Name: EPA ,HNO3 Operator:
Run Time: 09/21/88 21:07:49
Comment: 4600-519 WATER/EXTRACT
Mode: CONC Corr. Factor: 1

Elem	Ag3280	Al3082	As1936	B_2497	Ba4934	Be3130	Ca3179
Avge	.5059	-.0018	-.0014	.0262	.0003	-.0005	.0161
#1	.5061	-.0043	-.0053	.0266	.0006	-.0003	.0203
#2	.5057	.0006	.0025	.0257	.0000	-.0006	.0119

Elem	Cd2288	Co2286	Cr2677	Cu3247	Fe2599	Fe2714	K_7664
Avge	.5099	.5176	.0038	.5172	.0144	-.0150	.1550
#1	.5134	.5155	.0048	.5183	.0159	-.0195	.2236
#2	.5065	.5197	.0028	.5162	.0128	-.0104	.0865

Elem	Li6707	Mg2795	Mn2576	Mo2023	Na5889	Ni2316	Pb2203
Avge	.0049	.0007	.5064	.0039	.0201	.4923	1.026
#1	.0065	.0007	.5071	.0059	.0167	.4938	1.039
#2	.0033	.0007	.5058	.0018	.0234	.4909	1.013

Elem	Sb2175	Se1960	Si2881	Sn1899	Sr4215	Ti3349	Tl1908
Avge	.0140	1.994	.0531	-.0097	.0000	.0004	1.965
#1	.0201	1.972	.0609	-.0118	.0000	.0010	1.988
#2	.0079	2.017	.0453	-.0076	.0000	-.0003	1.941

Elem	V_2924	Y_3710	Zn2138
Avge	.4877	.0008	.0007
#1	.4871	.0018	.0013
#2	.4883	-.0003	.0001

Method: C Sample Name: ICSAB , 1. X Operator:
Run Time: 09/21/88 21:10:47
Comment: 4600-519 WATER/EXTRACT
Mode: CONC Corr. Factor: 1

Elem	Ag3280	Al3082	As1936	B_2497	Ba4934	Be3130	Ca3179
Avge	.9919	535.2	-.1558	.0081	.4830	.4717	492.9
#1	.9875	534.5	-.1480	.0103	.4838	.4700	490.2
#2	.9962	535.8	-.1635	.0058	.4822	.4733	495.6

Elem	Cd2288	Co2286	Cr2677	Cu3247	Fe2599	Fe2714	K 7664
Avge	.9664	.4748	.5125	.5368	209.7	217.3	-.0005
#1	.9582	.4719	.5106	.5362	209.2	216.2	-.3737
#2	.9745	.4776	.5145	.5374	210.1	218.3	.3728

Elem	Li6707	Mg2795	Mn2576	Mo2023	Na5889	Ni2316	Pb2203
Avge	.0103	113.8	.4845	-.0318	.4486	.9052	4.849
#1	.0109	113.7	.4842	-.0347	.4386	.9065	4.834
#2	.0098	113.9	.4848	-.0289	.4587	.9039	4.864

Elem	Sb2175	Se1960	Si2881	Sn1899	Sr4215	Ti3349	Tl1908
Avge	.0499	-.0710	.0352	-.0220	.1167	-.0056	.6543
#1	.0426	-.0787	.0352	-.0164	.1167	-.0062	.6147
#2	.0572	-.0632	.0352	-.0276	.1166	-.0050	.6939

Elem	V_2924	Y_3710	Zn2138
Avge	.4568	.0000	.9659
#1	.4523	-.0003	.9604
#2	.4614	.0003	.9714

Method: C Sample Name: ICSAB ,/20. Operator:
Run Time: 09/21/88 21:13:06
Comment: 4600-519 WATER/EXTRACT
Mode: CONC Corr. Factor: 1

Elem	Ag3280	Al3082	As1936	B_2497	Ba4934	Be3130	Ca3179
Avge	.0525	27.46	-.0010	.0007	.0256	.0259	27.14
#1	.0493	27.43	-.0136	.0034	.0249	.0258	27.05
#2	.0557	27.49	.0115	-.0019	.0263	.0260	27.24

Elem	Cd2288	Co2286	Cr2677	Cu3247	Fe2599	Fe2714	K_7664
Avge	.0504	.0258	.0288	.0264	12.15	12.17	1.040
#1	.0501	.0223	.0274	.0227	12.13	12.07	.6746
#2	.0507	.0293	.0302	.0301	12.17	12.27	1.405

Elem	Li6707	Mg2795	Mn2576	Mo2023	Na5889	Ni2316	Pb2203
Avge	.0016	27.65	.0278	.0010	.0770	.0516	.2968
#1	.0011	27.60	.0271	-.0019	.0502	.0513	.2668
#2	.0022	27.70	.0285	.0040	.1038	.0519	.3268

Elem	Sb2175	Se1960	Si2881	Sn1899	Sr4215	Ti3349	Tl1908
Avge	.0068	-.0362	-.0045	-.0144	.0020	.0000	.0473
#1	.0090	-.0426	-.0076	-.0192	.0020	-.0012	.0504
#2	.0046	-.0298	-.0014	-.0095	.0020	.0012	.0442

Elem	V_2924	Y_3710	Zn2138
Avge	.0268	.0008	.0525
#1	.0252	.0008	.0518
#2	.0284	.0008	.0532

Method: C Sample Name: DBW ,1.X Operator:
Run Time: 09/21/88 21:16:45
Comment: 4600-519 WATER/EXTRACT
Mode: CONC Corr. Factor: 1

Elem	Ag3280	Al3082	As1936	B_2497	Ba4934	Be3130	Ca3179
Avge	.0054	.0440	.0178	.0229	.0004	-.0001	.0005
#1	.0044	.0396	.0219	.0223	.0000	.0002	-.0030
#2	.0065	.0483	.0136	.0235	.0008	-.0004	.0040

Elem	Cd2288	Co2286	Cr2677	Cu3247	Fe2599	Fe2714	K_7664
Avge	.0018	.0042	.0086	.0022	.0073	.1387	.0151
#1	.0004	-.0004	.0070	-.0005	.0061	.1297	-.1479
#2	.0032	.0088	H.0103	.0048	.0086	.1478	.1780

Elem	Li6707	Mg2795	Mn2576	Mo2023	Na5889	Ni2316	Pb2203
Avge	.0016	.0042	-.0006	.0051	-.0067	.0058	.0481
#1	.0033	.0053	-.0013	.0040	-.0167	.0032	.0417
#2	.0000	.0031	.0000	.0061	.0033	.0084	.0546

Elem	Sb2175	Se1960	Si2881	Sn1899	Sr4215	Ti3349	Tl1908
Avge	.0422	.0138	.3465	-.0031	.0000	.0438	.0334
#1	.0429	.0053	.3308	-.0006	.0000	.0433	.0211
#2	.0414	.0222	.3623	-.0056	.0000	.0442	.0457

Elem	V_2924	Y_3710	Zn2138
Avge	.0058	.0013	.0030
#1	.0049	.0008	.0027
#2	.0066	.0018	.0033

Analysis Report Wed 09-21-88 09:21:42 PM

Method: C Sample Name: EXBL ,1.X Operator:
Run Time: 09/21/88 21:19:49
Comment: 4600-519 WATER/EXTRACT
Mode: CONC Corr. Factor: 1

Elem	Ag3280	Al3082	As1936	B_2497	Ba4934	Be3130	Ca3179
Avge	.0002	.0353	.0061	.0515	.0649	.0000	.0424
#1	.0013	.0280	.0000	.0540	.0655	.0000	.0421
#2	-.0009	.0425	.0123	.0491	.0644	-.0001	.0426

Elem	Cd2288	Co2286	Cr2677	Cu3247	Fe2599	Fe2714	K_7664
Avge	.0029	.0038	.0048	.0006	.0120	.0421	.1891
#1	.0047	.0045	.0042	.0006	.0105	.0396	.1340
#2	.0012	.0031	.0054	.0006	.0135	.0447	.2442

Elem	Li6707	Mg2795	Mn2576	Mo2023	Na5889	Ni2316	Pb2203
Avge	.0022	.0060	.0003	.0035	.3850	.0068	.0471
#1	.0033	.0060	.0000	.0018	.3850	.0047	.0375
#2	.0011	.0060	.0007	.0053	.3850	.0089	.0566

Elem	Sb2175	Se1960	Si2881	Sn1899	Sr4215	Ti3349	Tl1908
Avge	.0223	-.0373	.3300	.0060	.0000	.0425	.0178
#1	.0118	-.0448	.3324	.0025	.0000	.0421	.0390
#2	.0328	-.0298	.3277	.0095	.0000	.0429	-.0034

Elem	V_2924	Y_3710	Zn2138
Avge	.0021	.0005	H.0375
#1	.0002	.0008	H.0373
#2	.0040	.0003	H.0376

Method: C Sample Name: 6704 .1.X Operator:
Run Time: 09/21/88 21:22:57
Comment: 4600-519 WATER/EXTRACT
Mode: CONC Corr. Factor: 1

Elem	Ag3280	Al3082	As1936	B_2497	Ba4934	Be3130	Ca3179
Avge	.0010	.7380	.0410	.0581	.0578	.0000	.4722
#1	.0019	.7399	.0351	.0569	.0576	.0002	.4749
#2	.0001	.7361	.0469	.0592	.0579	-.0002	.4694

Elem	Cd2288	Co2286	Cr2677	Cu3247	Fe2599	Fe2714	K 7664
Avge	.0337	.0363	.0031	.5019	26.98	26.87	-.1306
#1	.0349	.0356	.0050	.4981	26.84	26.78	.0498
#2	.0325	.0370	.0011	.5056	27.13	26.96	-.3110

Elem	Li6707	Mg2795	Mn2576	Mo2023	Na5889	Ni2316	Pb2203
Avge	.0033	.4063	.0164	-.0015	.5691	.0781	3.639
#1	.0033	.4046	.0161	-.0023	.5792	.0834	3.630
#2	.0033	.4081	.0168	-.0006	.5591	.0729	3.649

Elem	Sb2175	Se1960	Si2881	Sn1899	Sr4215	Ti3349	Tl1908
Avge	.0261	-.0220	1.204	-.0059	.0083	.0437	.0056
#1	.0259	-.0041	1.210	.0118	.0083	.0439	-.0510
#2	.0263	-.0398	1.199	-.0236	.0083	.0435	.0398

Elem	V_2924	Y_3710	Zn2138
Avge	.0001	.0013	1.641
#1	.0019	.0018	1.633
#2	-.0017	.0008	1.648

Method: C Sample Name: 6704DP, 1.X Operator:
Run Time: 09/21/88 21:27:23
Comment: 4600-519 WATER/EXTRACT
Mode: CONC Corr. Factor: 1

Elem	Ag3280	Al3082	As1936	B_2497	Ba4934	Be3130	Ca3179
Avge	.0026	.7027	.0299	.0469	.0865	.0001	.3905
#1	.0015	.6935	.0275	.0457	.0854	-.0001	.3898
#2	.0037	.7118	.0323	.0480	.0876	.0003	.3913

Elem	Cd2288	Co2286	Cr2677	Cu3247	Fe2599	Fe2714	K_7664
Avge	.0146	.0193	.0033	.2233	10.86	10.89	.6435
#1	.0180	.0200	.0037	.2222	10.78	10.82	.4991
#2	.0111	.0186	.0029	.2243	10.94	10.97	.7878

Elem	Li6707	Mg2795	Mn2576	Mo2023	Na5889	Ni2316	Pb2203
Avge	.0033	.4422	.0152	.0019	.5189	.0404	6.261
#1	.0022	.4391	.0158	.0007	.5189	.0384	6.236
#2	.0043	.4452	.0146	.0031	.5189	.0423	6.286

Elem	Sb2175	Se1960	Si2881	Sn1899	Sr4215	Ti3349	Ti1908
Avge	.0174	-.0358	1.304	-.0032	.0083	.0529	.0089
#1	.0141	-.0527	1.285	-.0084	.0083	.0518	-.0014
#2	.0208	-.0188	1.323	.0021	.0083	.0539	.0193

Elem	V_2924	Y_3710	Zn2138
Avge	.0027	.0008	1.152
#1	.0036	.0003	1.144
#2	.0019	.0013	1.159

Method: C   Sample Name: 6704SP,1.X   Operator:
Run Time: 09/21/88 21:31:37
Comment: 4600-519 WATER/EXTRACT
Mode: CONC   Corr. Factor: 1

Elem	Ag3280	Al3082	As1936	B_2497	Ba4934	Be3130	Ca3179
Avge	.1997	1.270	.5504	.2403	.2602	.1992	1.585
#1	.1982	1.273	.5380	.2397	.2619	.1994	1.585
#2	.2012	1.268	.5628	.2410	.2586	.1990	1.584

Elem	Cd2288	Co2286	Cr2677	Cu3247	Fe2599	Fe2714	K_7664
Avge	.2349	.5497	.5868	1.037	29.03	28.89	10.68
#1	.2379	.5494	.5862	1.038	29.05	28.94	10.80
#2	.2320	.5501	.5874	1.035	29.01	28.84	10.55

Elem	Li6707	Mg2795	Mn2576	Mo2023	Na5889	Ni2316	Pb2203
Avge	.5119	.9527	.2238	.5018	6.605	.6213	6.404
#1	.5114	.9535	.2231	.5036	6.612	.6144	6.385
#2	.5125	.9519	.2244	.5	6.599	.6282	6.422

Elem	Sb2175	Se1960	Si2881	Sn1899	Sr4215	Ti3349	Tl1908
Avge	.4440	.5438	1.133	.5308	.2151	.2482	.4905
#1	.4465	.5537	1.127	.5335	.2167	.2484	.4719
#2	.4414	.5340	1.138	.5280	.2135	.2481	.5091

Elem	V_2924	Y_3710	Zn2138
Avge	.2001	.2017	2.253
#1	.2010	.2007	2.255
#2	.1992	.2028	2.252

Method: C   Sample Name: 6705 ,1.λ   Operator:
Run Time: 09/21/88 21:34:49
Comment: 4600-519 WATER/EXTRACT
Mode: CONC   Corr. Factor: 1

Elem	Ag3280	Al3082	As1936	B_2497	Ba4934	Be3130	Ca3179
Avge	-.0011	.1657	-.0002	.0437	.1552	.0000	.4335
#1	-.0019	.1507	-.0003	.0445	.1548	.0000	.4332
#2	-.0003	.1806	-.0001	.0429	.1556	.0000	.4337

Elem	Cd2288	Co2286	Cr2677	Cu3247	Fe2599	Fe2714	K_7664
Avge	.0004	.0026	.0034	.0149	.0383	.0728	-.1136
#1	-.0015	.0044	.0052	.0154	.0388	.0444	-.0056
#2	.0022	.0009	.0016	.0144	.0378	.1012	-.2216

Elem	Li6707	Mg2795	Mn2576	Mo2023	Na5889	Ni2316	Pb2203
Avge	.0043	.2494	.0072	.0005	1.657	.0027	.4433
#1	.0022	.2484	.0065	-.0010	1.644	.0021	.4466
#2	.0065	.2505	.0078	.0019	1.671	.0033	.4401

Elem	Sb2175	Se1960	Si2881	Sn1899	Sr4215	Ti3349	Tl1908
Avge	.0182	-.0193	1.664	-.0039	.0041	.0340	.0287
#1	.0235	-.0113	1.655	.0006	.0041	.0340	.0351
#2	.0130	-.0272	1.674	-.0084	.0041	.0340	.0223

Elem	V_2924	Y_3710	Zn2138
Avge	.0020	.0008	.1120
#1	.0023	-.0003	.1108
#2	.0018	.0018	.1131

Method: C   Sample Name: 6706 ,1.X   Operator:
Run Time: 09/21/88 21:37:29
Comment: 4600-519 WATER/EXTRACT
Mode: CONC   Corr. Factor: 1

Elem	Ag3280	Al3082	As1936	B_2497	Ba4934	Be3130	Ca3179
Avge	.0030	.3755	.0149	.0284	.7567	.0000	.7819
#1	.0036	.3793	.0160	.0286	.7586	.0000	.7851
#2	.0024	.3716	.0138	.0283	.7547	.0000	.7787

Elem	Cd2288	Co2286	Cr2677	Cu3247	Fe2599	Fe2714	K_7664
Avge	.0001	.0056	.0051	.0165	.0515	.1337	1.665
#1	-.0009	.0060	.0053	.0165	.0505	.1242	1.650
#2	.0012	.0053	.0050	.0165	.0525	.1432	1.680

Elem	Li6707	Mg2795	Mn2576	Mo2023	Na5889	Ni2316	Pb2203
Avge	.0054	.6055	.1903	.0009	.9474	.0098	.6723
#1	.0054	.6080	.1902	.0006	.9675	.0127	.6659
#2	.0054	.6030	.1903	.0013	.9274	.0068	.6787

Elem	Sb2175	Se1960	Si2881	Sn1899	Sr4215	Ti3349	Tl1908
Avge	.0209	.0066	.4070	-.0003	.0082	.0610	.0360
#1	.0183	-.0107	.4180	.0021	.0082	.0607	.0363
#2	.0236	.0240	.3960	-.0026	.0082	.0613	.0356

Elem	V_2924	Y_3710	Zn2138
Avge	.0025	.0005	.1000
#1	.0021	.0008	.1007
#2	.0029	.0003	.0993

Method: C Sample Name: 6707 ,1.X Operator:
Run Time: 09/21/88 21:40:18
Comment: 4600-519 WATER/EXTRACT
Mode: CONC Corr. Factor: 1

Elem	Ag3280	Al3082	As1936	B_2497	Ba4934	Be3130	Ca3179
Avge	.0010	.375	.0011	.0203	.0895	.0000	H247.4
#1	-.0013	.3803	-.0026	.0189	.0893	-.0003	H247.2
#2	.0033	.3697	.0048	.0216	.0898	.0003	H247.6

Elem	Cd2288	Co2286	Cr2677	Cu3247	Fe2599	Fe2714	K 7664
Avge	.0504	.6593	.0040	.2794	.2413	.3041	4.272
#1	.0537	.6618	.0039	.2789	.2392	.2874	4.154
#2	.0471	.6568	.0041	.2800	.2435	.3208	4.390

Elem	Li6707	Mg2795	Mn2576	Mo2023	Na5889	Ni2316	Pb2203
Avge	.0027	36.85	5.566	.0012	.6662	.4539	.3900
#1	.0033	36.84	5.577	.0009	.6394	.4451	.3805
#2	.0022	36.86	5.555	.0016	.6930	.4628	.3995

Elem	Sb2175	Se1960	Si2881	Sn1899	Sr4215	Ti3349	Tl1908
Avge	.0129	.0159	2.972	-.0031	12.84	.0310	-.0073
#1	.0019	.0225	2.945	-.0057	12.83	.0306	-.0106
#2	.0240	.0093	2.999	-.0006	12.85	.0314	-.0041

Elem	V_2924	Y_3710	Zn2138
Avge	.0022	.0159	19.51
#1	.0017	.0161	19.50
#2	.0027	.0156	19.52

Method: C Sample Name: AR ,1.X Operator:
Run Time: 09/21/88 21:43:20
Comment: 4600-519 WATER/EXTRACT
Mode: CONC Corr. Factor: 1

Elem	Ag3280	Al3082	As1936	B_2497	Ba4934	Be3130	Ca3179
Avge	.0050	.0251	.0164	-.0007	.0004	.0002	.0273
#1	.0077	.0425	.0214	.0016	.0006	.0001	.0387
#2	.0023	.0077	.0113	-.0029	.0003	.0003	.0159

Elem	Cd2288	Co2286	Cr2677	Cu3247	Fe2599	Fe2714	K_7664
Avge	-.0014	.0039	.0048	-.0011	.0016	.0634	.7380
#1	-.0013	.0039	.0085	.0016	.0040	.1434	1.160
#2	-.0016	.0039	.0011	-.0037	-.0007	-.0166	.3165

Elem	Li6707	Mg2795	Mn2576	Mo2023	Na5889	Ni2316	Pb2203
Avge	.0027	.0029	.0010	.0029	.0536	.0086	.0428
#1	.0043	.0030	.0007	.0054	.0703	.0099	.0760
#2	.0011	.0029	.0013	.0003	.0368	.0072	.0097

Elem	Sb2175	Se1960	Si2881	Sn1899	Sr4215	Ti3349	Tl1908
Avge	.0321	.0219	.0071	-.0028	.0016	.0005	.0053
#1	.0466	.0411	.0157	.0019	.0031	.0020	-.0075
#2	.0177	.0028	-.0015	-.0075	.0000	-.0010	.0180

Elem	V_2924	Y_3710	Zn2138
Avge	.0047	.0010	.0017
#1	.0056	.0023	.0027
#2	.0038	-.0003	.0007

Method: C   Sample Name: EPA   ,HCL   Operator:
Run Time: 09/21/88 21:45:29
Comment: 4600-519 WATER/EXTRACT
Mode: CONC   Corr. Factor: 1

Elem	Ag3280	Al3082	As1936	B_2497	Ba4934	Be3130	Ca3179
Avge	-.0082	.5272	.4780	.4952	.4914	.4928	20.28
#1	-.0090	.5277	.4817	.4947	.4903	.4914	20.24
#2	-.0074	.5267	.4743	.4956	.4925	.4941	20.32

Elem	Cd2288	Co2286	Cr2677	Cu3247	Fe2599	Fe2714	K_7664
Avge	.0019	-.0013	.5023	.0014	.4962	.5351	20.27
#1	.0005	-.0010	.5007	.0030	.4942	.5139	19.97
#2	.0033	-.0017	.5038	-.0002	.4983	.5563	20.58

Elem	Li6707	Mg2795	Mn2576	Mo2023	Na5889	Ni2316	Pb2203
Avge	1.998	.5072	.0017	1.952	20.26	.0047	.0084
#1	1.990	.5064	.0023	1.952	20.26	.0030	-.0023
#2	2.005	.5079	.0011	1.952	20.27	.0064	.0191

Elem	Sb2175	Se1960	Si2881	Sn1899	Sr4215	Ti3349	Ti1908
Avge	.5134	-.0128	-.0144	1.971	2.114	1.947	-.0083
#1	.5166	-.0022	-.0174	1.945	2.108	1.943	-.0276
#2	.5101	-.0234	-.0113	1.998	2.120	1.951	.0111

Elem	V_2924	Y_3710	Zn2138
Avge	.0030	1.952	.5154
#1	.0029	1.945	.5159
#2	.0031	1.958	.5150

Method: C   Sample Name: EPA ,HNO3   Operator:
Run Time: 09/21/88 21:47:43
Comment: 4600-519 WATER/EXTRACT
Mode: CONC   Corr. Factor: 1

Elem	Ag3280	Al3082	As1936	B_2497	Ba4934	Be3130	Ca3179
Avge	.5018	.0228	.0177	.0207	.0004	-.0006	.0273
#1	.5027	.0257	.0108	.0214	.0000	-.0005	.0322
#2	.5010	.0199	.0246	.0199	.0008	-.0007	.0223

Elem	Cd2288	Co2286	Cr2677	Cu3247	Fe2599	Fe2714.	K_7664
Avge	.5100	.5165	.0089	.5119	.0178	.0414	.9779
#1	.5089	.5197	.0107	.5119	.0165	.0459	1.107
#2	.5112	.5134	.0072	.5119	.0190	.0368	.8488

Elem	Li6707	Mg2795	Mn2576	Mo2023	Na5889	Ni2316	Pb2203
Avge	.0043	.0010	.5032	.0043	.0670	.5060	1.059
#1	.0043	.0015	.5045	.0054	.0703	.5005	1.037
#2	.0043	.0006	.5019	.0033	.0636	.5115	1.08[illegible]

Elem	Sb2175	Se1960	Si2881	Sn1899	Sr4215	Ti3349	Tl1908
Avge	.0409	2.057	.0877	.0015	.0000	.0023	2.033
#1	.0406	2.053	.1002	.0093	.0000	.0027	2.009
#2	.0411	2.060	.0751	-.0063	.0000	.0018	2.058

Elem	V_2924	Y_3710	Zn2138
Avge	.4849	.0015	.0023
#1	.4868	.0018	.0029
#2	.4830	.0013	.0017

Method: C   Sample Name: 6704SD,/5.   Operator:
Run Time: 09/21/88 21:54:15
Comment: 4600-519 WATER/EXTRACT
Mode: CONC   Corr. Factor: 1

Elem	Ag3280	Al3082	As1936	B_2497	Ba4934	Be3130	Ca3179
Avge	-.0012	.1555	.0113	.0212	.0116	-.0001	.0970
#1	-.0020	.1497	.0195	.0191	.0118	.0000	.0987
#2	-.0003	.1613	.0030	.0234	.0115	-.0001	.0953

Elem	Cd2288	Co2286	Cr2677	Cu3247	Fe2599	Fe2714	K_7664
Avge	.0081	.0102	.0076	.1025	5.517	5.455	.2517
#1	.0094	.0088	.0064	.1052	5.538	5.443	.0441
#2	.0067	.0117	.0088	.0998	5.495	5.466	.4593

Elem	Li6707	Mg2795	Mn2576	Mo2023	Na5889	Ni2316	Pb2203
Avge	-.0005	.0817	.0034	.0041	.1105	.0218	1.154
#1	.0000	.0820	.0034	.0051	.1105	.0146	1.164
#2	-.0011	.0814	.0034	.0031	.1105	.0289	1.145

Elem	Sb2175	Se1960	Si2881	Sn1899	Sr4215	Ti3349	Tl1908
Avge	.0181	-.0202	.3151	-.0037	.0029	.0088	.0217
#1	.0083	.0075	.3143	.0041	.0031	.0086	.0018
#2	.0279	-.0479	.3159	-.0114	.0026	.0090	.0417

Elem	V_2924	Y_3710	Zn2138
Avge	.0017	.0010	.3446
#1	.0022	.0003	.3472
#2	.0012	.0018	.3420

Method: C   Sample Name: ICSAB ,1.X   Operator:
Run Time: 09/21/88 22:10:05
Comment: 4600-510 WATER/EXTRACT
Mode: CONC   Corr. Factor: 1

Elem	Ag3280	Al3082	As1936	B_2497	Ba4934	Be3130	Ca3179
Avge	.9994	537.1	-.1516	.0102	.4834	.4736	496.6
#1	.9976	535.7	-.1210	.0096	.4827	.4723	495.6
#2	1.001	538.4	-.1823	.0107	.4841	.4749	497.6

Elem	Cd2288	Co2286	Cr2677	Cu3247	Fe2599	Fe2714	K_7664
Avge	.9777	.4811	.5181	.5396	210.9	219.4	.9505
#1	.9781	.4826	.5184	.5385	210.7	219.1	.9688
#2	.9773	.4797	.5179	.5407	211.2	219.7	.9322

Elem	Li6707	Mg2795	Mn2576	Mo2023	Na5889	Ni2316	Pb2203
Avge	.0103	114.4	.4885	-.0297	.4720	.9065	4.958
#1	.0087	114.4	.4870	-.0275	.4653	.9165	4.956
#2	.0119	114.4	.4899	-.0319	.4787	.8965	4.960

Elem	Sb2175	Se1960	Si2881	Sn1899	Sr4215	Ti3349	Tl1908
Avge	.0433	-.1042	.0478	.0007	.1210	-.0053	.7785
#1	.0682	-.0231	.0478	.0051	.1210	-.0050	.7923
#2	.0184	-.1852	.0478	-.0036	.1210	-.0056	.7647

Elem	V_2924	Y_3710	Zn2138
Avge	.4631	.0010	.9854
#1	.4649	.0013	.9847
#2	.4612	.0008	.9862

Method: C Sample Name: ICSAB ,/20. Operator:
Run Time: 09/21/88 22:12:52
Comment: 4600-510 WATER/EXTRACT
Mode: CONC Corr. Factor: 1

Elem	Ag3280	Al3082	As1936	B_2497	Ba4934	Be3130	Ca3179
Avge	.0553	27.56	.0163	.0035	.0263	.0260	27.36
#1	.0524	27.51	.0165	.0029	.0257	.0261	27.28
#2	.0582	27.61	.0161	.0040	.0269	.0260	27.45

Elem	Cd2288	Co2286	Cr2677	Cu3247	Fe2599	Fe2714	K_7664
Avge	.0504	.0304	.0319	.0291	12.21	12.35	2.008
#1	.0487	.0279	.0285	.0269	12.18	12.26	2.117
#2	.0521	.0329	.0352	.0312	12.25	12.44	1.899

Elem	Li6707	Mg2795	Mn2576	Mo2023	Na5889	Ni2316	Pb2203
Avge	.0005	28.06	.0279	.0041	.1105	.0551	.3227
#1	-.0022	28.01	.0272	.0012	.1105	.0604	.2992
#2	.0033	28.11	.0286	.0070	.1105	.0497	.3463

Elem	Sb2175	Se1960	Si2881	Sn1899	Sr4215	Ti3349	Tl1908
Avge	.0055	-.0339	.0167	-.0132	.0019	.0004	.0635
#1	-.0043	-.0397	.0002	-.0212	.0019	-.0005	.0376
#2	.0154	-.0282	.0332	-.0052	.0019	.0012	.0894

Elem	V_2924	Y_3710	Zn2138
Avge	.0293	.0008	.0531
#1	.0267	.0008	.0515
#2	.0320	.0008	.0547

Method: C   Sample Name: AR   ,1.X   Operator:
Run Time: 09/21/88 22:16:48
Comment: 4600-519 WATER/EXTRACT
Mode: CONC   Corr. Factor: 1

Elem	Ag3280	Al3082	As1936	B_2497	Ba4934	Be3130	Ca3179
Avge	-.0006	.0082	.0034	-.0003	.0000	.0001	.0062
#1	-.0005	.0174	.0076	-.0011	.0000	.0001	.0084
#2	-.0007	-.0010	-.0007	.0004	.0000	.0000	.0040

Elem	Cd2288	Co2286	Cr2677	Cu3247	Fe2599	Fe2714	K_7664
Avge	.0015	.0014	.0005	-.0016	.0038	.0398	.8130
#1	.0029	.0018	.0010	-.0016	.0055	.0445	.7134
#2	.0002	.0011	.0000	-.0016	.0022	.0351	.9126

Elem	Li6707	Mg2795	Mn2576	Mo2023	Na5889	Ni2316	Pb2203
Avge	.0005	.0058	-.0003	.0032	.0435	.0064	.0235
#1	.0000	.0069	-.0006	.0032	.0502	.0021	.0395
#2	.0011	.0047	.0000	.0032	.0368	.0107	.0075

Elem	Sb2175	Se1960	Si2881	Sn1899	Sr4215	Ti3349	Tl1908
Avge	.0208	-.0152	-.0126	.0038	.0000	-.0002	-.0270
#1	.0194	-.0186	-.0063	.0026	.0000	-.0003	-.0437
#2	.0223	-.0117	-.0189	.0049	.0000	-.0001	-.0103

Elem	V_2924	Y_3710	Zn2138
Avge	.0000	.0005	-.0007
#1	.0004	.0008	-.0001
#2	-.0003	.0003	-.0013

Method: C Sample Name: EPA ,HCL Operator:
Run Time: 09/21/88 22:20:06
Comment: 4600-519 WATER/EXTRACT
Mode: CONC Corr. Factor: 1

Elem	Ag3280	Al3082	As1936	B_2497	Ba4934	Be3130	Ca3179
Avge	-.0054	.5193	.4970	.4988	.4911	.4954	20.41
#1	-.0060	.5064	.4938	.5014	.4892	.4945	20.37
#2	-.0047	.5322	.5001	.4962	.4931	.4963	20.45

Elem	Cd2288	Co2286	Cr2677	Cu3247	Fe2599	Fe2714	K_7664
Avge	.0025	-.0002	.5006	.0004	.4982	.5277	20.48
#1	.0025	-.0010	.4957	-.0002	.4978	.5136	20.60
#2	.0025	.0005	.5055	.0009	.4986	.5418	20.36

Elem	Li6707	Mg2795	Mn2576	Mo2023	Na5889	Ni2316	Pb2203
Avge	1.987	.5157	.0001	1.976	20.23	.0056	.0039
#1	1.988	.5147	-.0002	1.963	20.22	.0061	-.0110
#2	1.986	.5166	.0004	1.990	20.25	.0051	.0188

Elem	Sb2175	Se1960	Si2881	Sn1899	Sr4215	Ti3349	Tl1908
Avge	.5091	-.0197	-.0232	2.005	2.098	1.948	.0048
#1	.5040	-.0386	-.0222	2.012	2.091	1.942	.0098
#2	.5143	-.0009	-.0242	1.997	2.104	1.955	-.000[illegible]

Elem	V_2924	Y_3710	Zn2138
Avge	.0013	1.957	.5212
#1	-.0003	1.953	.5193
#2	.0030	1.962	.5230

Method: C Sample Name: EPA ,HNO3 Operator:
Run Time: 09/21/88 22:22:35
Comment: 4600-519 WATER/EXTRACT
Mode: CONC Corr. Factor: 1

Elem	Ag3280	Al3082	As1936	B_2497	Ba4934	Be3130	Ca3179
Avge	.5034	-.0081	.0047	.0203	-.0008	-.0006	.0099
#1	.5002	-.0120	.0082	.0209	.0000	-.0006	.0109
#2	.5065	-.0042	.0011	.0196	-.0017	-.0006	.0089

Elem	Cd2288	Co2286	Cr2677	Cu3247	Fe2599	Fe2714	K 7664
Avge	.5195	.5197	.0019	.5151	.0115	-.0387	.7310
#1	.5175	.5190	.0023	.5119	.0123	-.0341	1.055
#2	.5216	.5204	.0015	.5183	.0107	-.0434	.4070

Elem	Li6707	Mg2795	Mn2576	Mo2023	Na5889	Ni2316	Pb2203
Avge	.0016	.0008	.5084	.0028	.0435	.4893	1.045
#1	.0022	.0008	.5064	.0052	.0435	.4834	1.043
#2	.0011	.0008	.5103	.0004	.0435	.4951	1.046

Elem	Sb2175	Se1960	Si2881	Sn1899	Sr4215	Ti3349	Tl1908
Avge	.0006	2.060	.0484	-.0056	.0000	-.0008	1.987
#1	.0169	2.049	.0421	-.0068	.0000	-.0005	2.016
#2	-.0157	2.070	.0547	-.0045	.0000	-.0010	1.957

Elem	V_2924	Y_3710	Zn2138
Avge	.4866	.0003	.0007
#1	.4855	.0003	.0004
#2	.4878	.0003	.0010

Versar inc

VERSAR INC.
TRACE METALS SECTION
FLAMELESS AAS ANALYSIS LOG SHEET

ELEMENT: Se DATE: 9-22-88
PROJECT-BATCH: 4600-519 TRAY NO.: 1
EP TOX

INSTRUMENT: #5
WAVELENGTH: 196.0 nm SLIT: 2.0 L
LIGHT SOURCE: ✓ EDL ____ HCl
CURRENT/POWER: 5.5 watts
BACKGROUND CORRECTION: Zeeman
STANDARD PREP. DATE: 9-22-88
SPIKE = 100 ppb

Matrix Modifier Added Y ✓ N ____

TUBE: L.V.P. (Pt) REP: 2
PURGE: 0 Ar ____ N_2
PIPET VOL: 25 µl

Step	1	2	3	4	5
Temp °C	110	1100	2100	2500	20
Ramp (s)	5	5	0	1	2
Hold (s)	30	15	5	3	8
Boc (s)		14			
Rec (s)		15			

CUP	LAB #	AVG. ABS.	UNADJ. CONC.	D.F.	CONC. µg/l	CONC. mg/kg ____ wt.	COMMENTS
1.	CB	-3					r= 1.0
2.	10 ppb	36					
3.	20	76					
4.	50	194					
5.	EPA WP 386	87	22.5		23.		[25.] 92% rec
6.	CB	1	1.04		<5.0		
7.	DBW +0	0	<1.0		<5.0		
8.	+10	36	9.92				(99)
9.	EXT BLK +0	-3	<1.0		<5.0		
10.	+10	41	11.2				(112)
11.	MS	44	24.6	4	98.		98% rec
12.	56704 +0	6	2.31		<5.0		
13.	+10	39	10.7				(84)
14.	56704 DP +0	-1	<1.0		<5.0		RPD=NC
15.	+10	37	10.2				(102)

E = Interference
( ) = % Rec. of MSA spike

INITIALS [initials]

Versar inc

VERSAR INC.
TRACE METALS SECTION
FLAMELESS AAS ANALYSIS LOG SHEET

ELEMENT: Se DATE: 9-22-88
PROJECT-BATCH: 4600-519 TRAY NO.: 1

CUP	LAB #	AVG. ABS.	UNADJ. CONC.	D.F.	CONC. µg/l	CONC. mg/kg ___wt.	COMMENTS
16.	CB	-1	<1.0		<5.0		
17.	50 ppb	184	47.4		47.		94% rec
18.	50 ml SP TB	35	9.82	/10	98.		r=0.9964
19.	+10	78					98% rec
20.	+20	110					
21.	56705 TB	0	<1.0		<5.0		
22.	+10	41	11.2				(112)
23.	56706 TB	1	1.04		<5.0		
24.	+10	38	10.4				(94)
25.	56707 TB	17	5.10		–		Rerun ~~3~~ 1/5
26.	+10	31	8.65				(36)
27.	CB	-1	<1.0		<5.0		
28.	50 ppb	188	48.5		48.		96% rec
29.	56707 TB	3	1.55	/5	<25.		
30.	+10	~~4~~ 45	13.2				(106)
31.	CB ~~+20~~	-5	<1.0		<5.0		
32.	50 ppb	190	49.0		49.		98% rec
33.							
34.							
35.							

INITIALS ___

Versar inc.

VERSAR INC.
TRACE METALS SECTION
AAS PRINTER TAPES

ELEMENT: Se DATE: 9-22-88 (A)

PROJECT-BATCH: 4600-519

4600-519
* 9-22-88
Se

Sample	Value	Code
	-0.02[illegible]	
	-0.0[illegible]1	
	-0.0[illegible]9	AV
	7.1[illegible]	CV
	0.000	AZ
	0.1[illegible]	
	-0.0[illegible]	
1	-0.0[illegible]	AV
	06	ER
	0.0[illegible]	
	0.036	
2	[illegible]	AV
	[illegible]	CV
	0.0[illegible]	
	0.0[illegible]	
3	0.0[illegible]	AV
	[illegible]	CV
	0.1[illegible]	
	0.1[illegible]	
4	0.1[illegible]	AV
	2.[illegible]	CV
	0.0[illegible]	
	0.0[illegible]	
5	[illegible]	AV
	0.[illegible]1	CV
	[illegible]	
	[illegible]	
6	[illegible]	AV
	06	ER
	0.0[illegible]	
	-0.0[illegible]	
7	-0.0[illegible]	AV
	06	ER
	0.[illegible]	
	0.[illegible]	
8	[illegible]	AV
	3.[illegible]	CV
	-0.0[illegible]	
	-0.0[illegible]	
9	-0.0[illegible]	AV
	06	ER
	0.0[illegible]	
	0.0[illegible]	
10	0.[illegible]41	AV
	1[illegible]	CV
	0.0[illegible]	
	0.0[illegible]	
11	[illegible]	AV
	[illegible].7[illegible]	CV
	0.0[illegible]	
	0.0[illegible]	
12	0.0[illegible]	AV
	54.[illegible]	CV
	0.041	
	0.037	
13	0.0[illegible]	AV
	7.[illegible]	CV
	0.0[illegible]	
	-0.0[illegible]	
14	-0.0[illegible]	AV
	06	ER
	0.0[illegible]	
	0.0[illegible]	
15	0.0[illegible]	AV
	24.[illegible]	CV
	0.0[illegible]	
	-0.0[illegible]	
16	-0.0[illegible]	AV
	06	ER
	0.14[illegible]	
	0.187	
17	0.1[illegible]	AV
	2.7[illegible]	CV
	0.035	
	0.034	
18	0.035	AV
	2.05	CV
	0.075	
	0.081	
19	0.078	AV
	5.44	CV
	0.113	
	0.1[illegible]6	
20	0.11[illegible]	AV
	4.32	CV
	0.002	
	-0.002	
21	-0.00[illegible]	AV
	06	ER
	0.042	
	0.039	
22	0.041	AV
	5.24	CV
	-0.002	
	0.004	
23	0.001	AV
	06	ER
	0.037	
	0.039	
24	0.038	AV
	3.72	CV
	0.020	
	0.015	
25	0.017	AV
	20.20	CV
	0.036	
	0.027	
26	0.031	AV
	20.20	CV
	0.001	
	-0.002	
27	-0.001	AV
	06	ER
	0.185	
	0.192	
28	0.188	AV
	2.53	CV
	0.001	
	0.004	
29	0.003	AV
	20.8[illegible]	CV
	0.039	
	0.042	
30	0.045	AV
	10.5[illegible]	CV
	-0.0[illegible]	
	-0.0[illegible]	
31	-0.0[illegible]	AV
	5[illegible].57	CV
	0.189	
	0.192	
32	0.1[illegible]	AV
	1.11	CV

[initials]

VERSAR, INC.
METALS LABORATORY
COLD VAPOR Hg ANALYSIS SHEET

Page 1 of 1

Test/Batch: 4600-519 Date: 9/26/98

Sample No.: 56704 - 56707, EXT BLK

Instrument: #1 Light Source: EDL ✓

Wavelength: 254 nm. Slit: 0.7 Current Power: 6 MAS

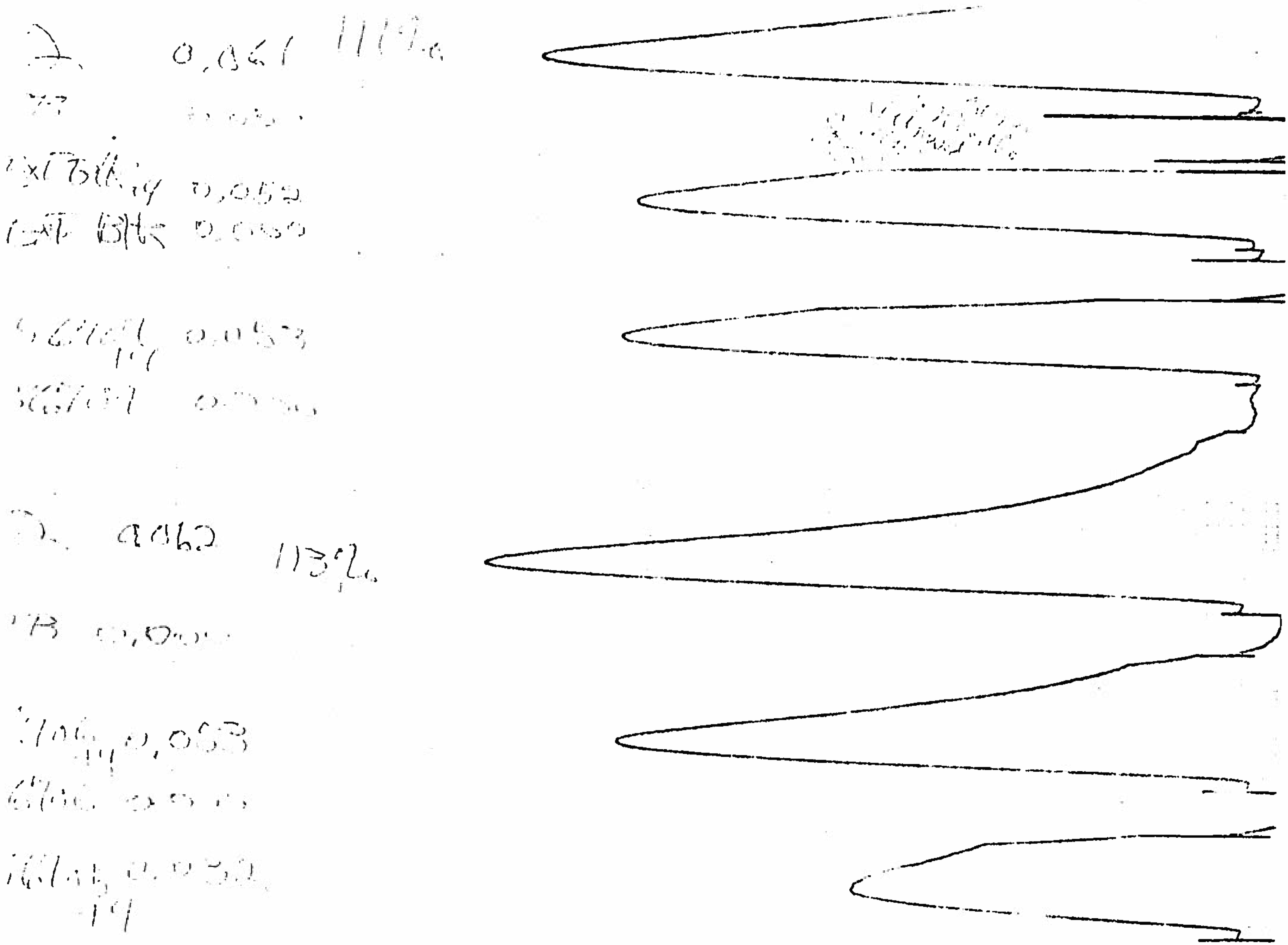
Background Correction: —— Gas Flow: 3.0

Spike = 2 ug/l mg/kg

	Sample/EPA ID No.	Abs.	Unadj. Conc.	D.F.	Conc. ug/l	Conc. mg/kg wt.	Comments
1.	CB	0.000					R=0.9983
2.	0.5 ppb	0.005					
3.	2	0.022					
4.	5	0.059					
5.	10	0.166					
6.	ICB/DB	0.000	<0.2		~~<0.2~~ <2.0		
	ICV	0.056	5.14		5.1		98% [5.2]
	56704	0.000	<0.2		<2.0		
9.	+4	0.037	3.37		~~3.4~~		(85%) ~~[4 ppb]~~
10.	56704Dp	0.000	<0.2		<2.0		
11.	+4	0.052	4.77				(120)
12.	~~56704Sp~~	~~.014~~	~~1.23~~		~~12~~		~~(60%) 2 ppb~~
13.	~~+4~~	~~0.052~~	~~4.77~~				~~(80)~~
14.	56705	0.000	<0.2		<2.0		
15.	+4	0.032	2.90				(73)
16.	56706	0.000	<0.2		<2.0		
17.	+4	0.053	4.86				(122)
18.	CCB	0.000	<0.2		~~<0.2~~ <2.0		
19.	CCV	0.062	5.70		5.7		113% [5.06]
20.	56707	0.000	<0.2		<2.0		
21.	+4	0.053	4.86				(122)
22.	EXT BLK	0.000	<0.2		<2.0		
23.	+4	0.052	4.77		~~<2.0~~		(120)
24.	CCB	0.000	<0.2		~~<0.2~~ <2.0		
	CCV	0.061	5.61		5.6		111% [5.06]

ICV = #5 ICV = 5.2 ug/L CCV = Alfa = 5.06 ug/L

Analyst: JeB


0,061
111%
0,062
113%
0,053

0,000

116 0,053
-14

116 0,000

105 0,032
-14

105 0,000

104/Dp 0,052
-14

104/Dp 0,014

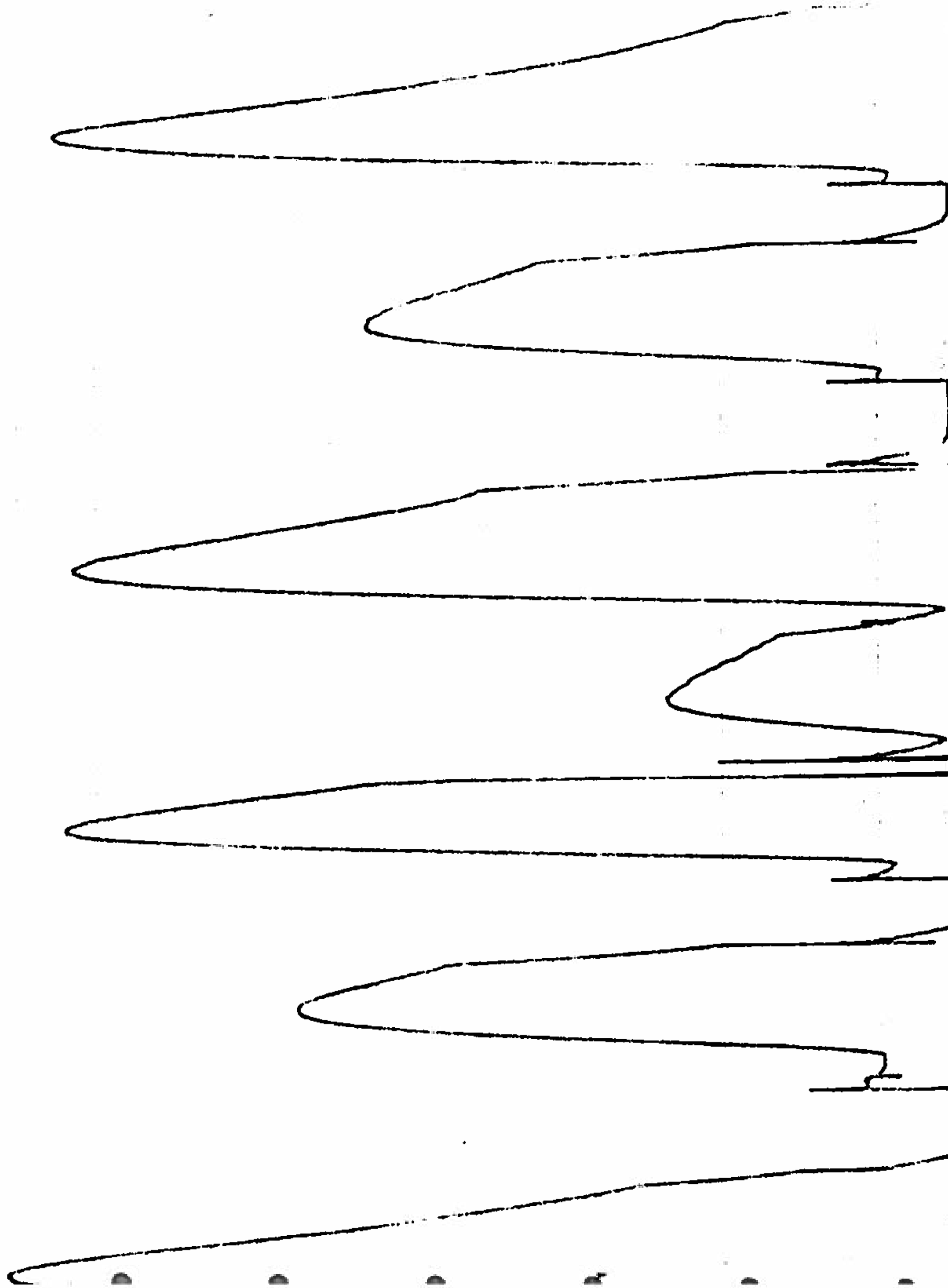
104 Dp -14 0,052

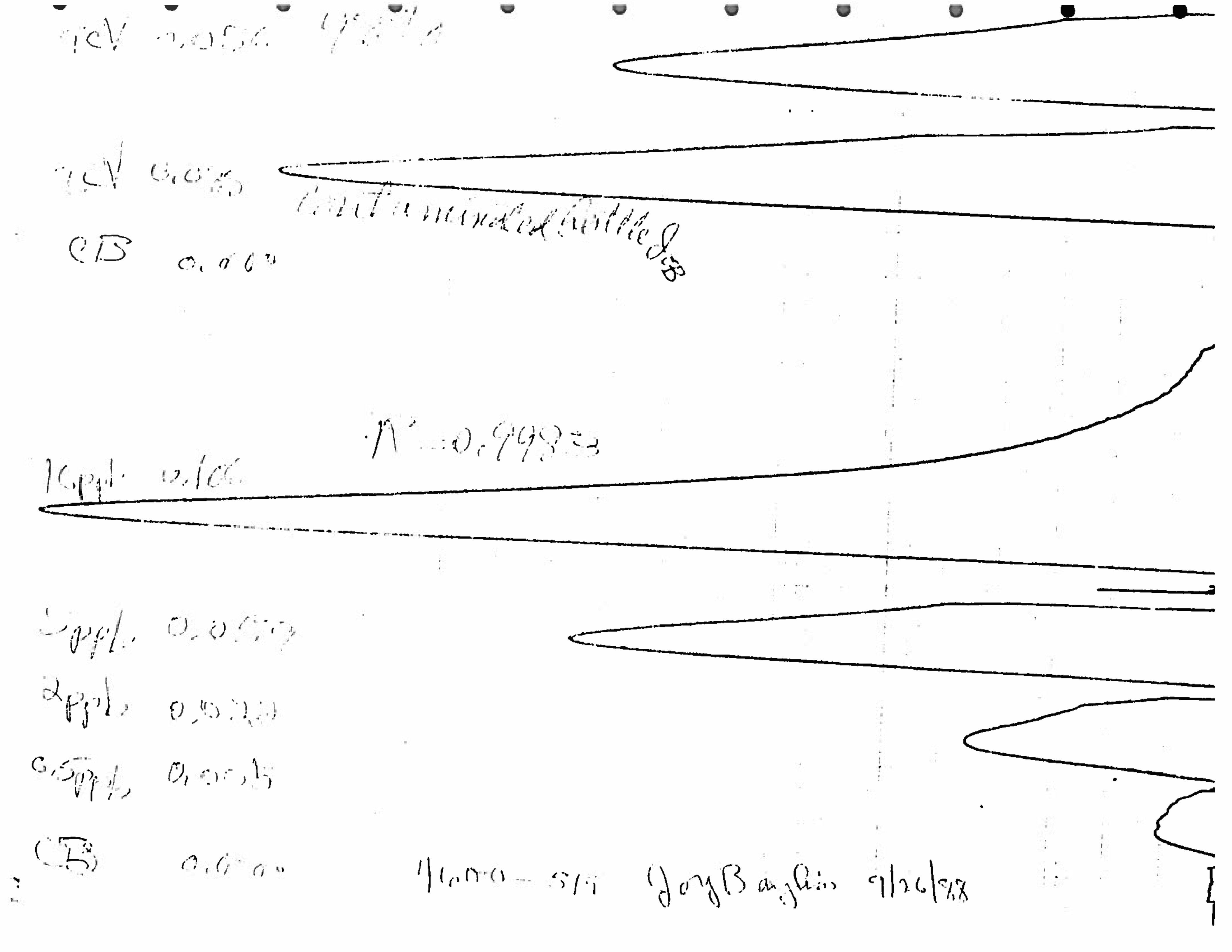
104 Dp 0,000

104/14 0,037

104 0,000

V 0,056




ICV
ICV
contaminated bottle
CB
R² = 0.998
1ppb 0.100
CB
Joy Baglin 9/26/98

Versar INC
LABORATORY OPERATIONS
TRACE METALS SECTION

Pg. No. ~~2~~ 1/3 cj

E.P. TOXICITY TEST
pH ADJUSTMENTS

Project: 4600

Batch: 519

Date: 9/19/88

	SAMPLE NUMBERS						
	Blk	56704	56704 Dup	56705	56706	56707	
TIME BETWEEN ADJUSTMENTS	pH/ml acid	pH/ml acid	pH/ml acid	pH/ml acid	pH/ml acid	pH/ml acid	pH/ml acid
15min	4.89 / 0ml	3.36 / 0ml	3.45 / 0ml	3.37 / 0	4.26 / 0	5.63 / 5ml	
15min	4.89 / 0ml	3.35 / 0ml	3.35 / 0ml	3.35 / 0ml	4.16 / 0	4.88 / 0	
15min	4.85 / 0ml	3.31 / 0ml	3.35 / 0ml	3.34 / 0ml	4.17 / 0ml	5.10 / 0ml	
15min	4.45 / 0ml	3.22 / 0ml	3.32 / 0ml	3.35 / 0ml	4.15 / 0ml	5.32 / 5ml	
30min	4.79 / 0ml	3.23 / 0ml	3.31 / 0ml	3.32 / 0ml	4.16 / 0ml	4.93 / 0ml	
30min	4.84 / 0ml	3.22 / 0ml	3.31 / 0ml	3.30 / 0ml	4.30 / 0ml	5.12 / 0ml	
1hr	4.84 / 0ml	3.22 / 0ml	3.25 / 0ml	3.32 / 0ml	4.17 / 0ml	5.45 / 15ml	
1hr	4.84 / 0ml	3.20 / 0ml	3.29 / 0ml	3.32 / 0ml	4.2[illegible] / 0ml	4.34 / 0ml	
1hr	4.77 / 0ml	3.15 / 0ml	3.27 / 0ml	3.30 / 0ml	4.22 / 0ml	4.3[illegible] / 0ml	
1hr	4.02 / 0ml	2.96 / 0ml	3.01 / 0ml	3.10 / 0ml	3.92 / 0ml	4.94 / 14ml	
1hr ~~[illegible]~~ cj	5.62 / 400ml	3.00 / 0ml	3.08 / 0ml	3.30 / 0ml	3.52 / 0ml	5.29 / 15ml	
1hr	—	—	—	—	— cj	4.33 / 0ml	
1hr	—	—	—	—	— cj	4.78 / 0ml	

pH Meter Calibration:
pH sol. 7 pH sol. 4

Preparer: cj

cj

Versar INC
LABORATORY OPERATIONS
TRACE METALS SECTION

Pg. No. 3 of 2/3

E.P. TOXICITY TEST
pH ADJUSTMENTS

Project: 4600

Batch: 519

Date: 9/19/88

	SAMPLE NUMBERS						
	56707						
TIME BETWEEN ADJUSTMENTS	pH/ml acid	pH/ml acid	pH/ml acid	pH/ml acid	pH/ml acid	pH/ml acid	pH/ml acid
1hr	4.78 / 0ml						
1hr	4.78 / 0ml						

CJ

pH Meter Calibration:
pH sol. 4 pH sol. 7

Preparer: CJ

Versar INC
LABORATORY OPERATIONS
TRACE METALS SECTION

E.P. TOXICITY TEST
FINAL VOLUME ADJUSTMENTS

Project: ~~58~~ 4600

Batch: 519

Date: 9/20/88

Lab no.	Sample Wt. (grams) Filtrate/Solid	DI HOH Added Initially. (Samp. Wt.x16)	Total ml. 0.5N Acetic Acid Added	Final Vol. Adj. (Sample Wt.x20-[Samp. Wt.x16+A])
Blk	cf 100ml	1600	400ml	
56709	100.11 g	1601.8	0 ml	~~398.2~~ 400.4
56704 D	100.06 g	1601 ~~1600~~ cf	0 ml	~~399.0~~ 400.2
56705	100.13 g	1602.1	0 ml	~~397.9~~ 400.5
56706	100.15 g	1602.4	0 ml	~~397.6~~ 400.6
56707	100.10 g	1601.6	54 ml	~~398.4~~ 400.4 cf

Preparer: cf

VERSAR, INC.
METALS LABORATORY
ICP WATER DIGESTION LOG

Project-Batch: 4600 -519
Digestion Type: ICP Method: 3010
Reference: SW-846 3rd Edition

Date: 9-21-95
No. of Samples: 4
No. of Blanks: 1

Sample No.	Matrix	Initial Wt./Vol.	Final Vol.	Description	pH	Comments
Ext.Blank	extracts	100mls	100mls	clear, colorless	<2.0	
56704						
56704ext.DP						
56704SP						
56705						
56706						
56707						
DBW	HOH					
MS						

LOW LEVEL SPIKE

SPIKE= 10 ml × Sol'n #1-*10ppm Ca,*5ppm Co,Cu,Li,
Mg,Mo,Ni,Pb,Se,Si,Tl,Zn
*2ppm Be,Cd,Mn,Sr,Ti,V,Y
*8.2ppm Na

10 ml × Sol'n #2-*100ppm K *50ppm Na *10ppm Fe
* 5ppm Al,As,Cr,Sb,Sn *2ppm B,Ba

10 ml × Sol'n #3-*2ppm Ag

Description: Color
Clarity - Clear, Cloudy or Opaque

Preparer: [illegible]

VERSAR, INC.
METALS LABORATORY
MERCURY DIGESTION LOG

Project-Batch: 4600-519

Page ___ of ___

Reference: SW846 3rd Edition; Method: 7470

Date: 4/26/88

No. of Samples: 1

No. of Blanks: 1

Sample No.	Matrix	Initial Wt./Vol.	Description	pH	Comments
56104	Water	100mls	See ICP & HG-Digestion Sheet	<2.0	
+4					
56105 EDP					
+4					
56104S (Jct IND FB)					
+4					
56105					
+4					
56106					
+4					
56107					
+4					
EXT BLK					
+4					

SPIKE = 2 ml x 0.1 ppm Hg / 100 ml = 2 ppb

ALFA = 0.5 ml x 1.013 ppm Hg / 100 ml = 5.06 ppb

EPA/LCS = 1ml of # 5IV - 5.2 ppb

STANDARDS: 0.5 ppb = 5 ml x 0.01 ppm / 100 ml
2.0 ppb = 2 ml x 0.1 ppm / 100 ml
5.0 ppb = 5 ml x 0.1 ppm / 100 ml
10. ppb = 10 ml x 0.1 ppm / 100 ml

Descriptions: Color
Clarity - Clear, Cloudy or Opaque
Texture - Fine, Med, Coarse
Artifacts

Preparer: JCB

VERSAR INC.
METALS LABORATORY
HGA DIGESTION LOG

Project-Batch: 4600 - 519
Digestion Type: HGA Method: 7060/7740
Reference: SW-846 3rd Edition

Date: 9-21-88
No. of Samples: 7
No. of Blanks: 1

Sample No.	Matrix	Initial Wt./Vol.	Final Vol.	Description	pH	Comments
ext. blank	extract	100 mls	100 mls	clear, colorless	<2.0	
56704	↓	↓	↓	↓	↓	
56704 amp DP						
56704 SP						
56705						
56706						
56707	↓					
DBW	H2O					
MS	↓	↓	↓	↓	↓	

SPIKE = 1 mls x 10 ppm As, Se, Tl.

Description: Color
Clarity - Clear, Cloudy or Opaque
Texture - Fine, Med., Coarse
Artifacts

Preparer: [illegible]