Wild Foods Investigation
Public Review Draft Report
Northwest Alaska

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Prepared for:

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DEC
Alaska Department of Environmental Conservation

E & E
Ecology and Environment, Inc.

Port
DeLong Mountain Transportation System Port Site

NPS
National Park Service

Haul Road
DeLong Mountain Transportation System

DHSS
Alaska Department of Health and Social Services

The **Alaska Department of Environmental Conservation** (DEC) tasked **Ecology and Environment, Inc.,** (E & E) to assist with a study of subsistence foods near the **DeLong Mountain Transportation System Port Site** (Port), which serves Red Dog Mine located in northwest Alaska.

The origin of this investigation is a report released by the **National Park Service** (NPS) in May 2001. The report (NPS 2001) detailed heavy metal concentrations in mosses and soil near the **DeLong Mountain Transportation System** (Haul Road). The results for cadmium, lead, and zinc raised concern among local people and regulators. The report brought attention to the potential environmental impact of the Haul Road and the Port, where zinc and lead concentrates from Red Dog Mine are stockpiled for shipment to smelters.

In August 2001, Northwest Alaskans asked the DEC to investigate the subsistence foods that village residents would be harvesting at areas potentially affected by fugitive dust. DEC initiated this investigation to determine the metals content of subsistence foods near the Port and Haul Road. The **Alaska Department of Health and Social Services** (DHSS) was asked to include the results from this study into their evaluation of the risks to human health from the consumption of potentially contaminated subsistence foods.

On August 13, 2001, DEC tasked E & E to develop the work plan for collecting subsistence food samples and analyzing the data. E & E (2001) submitted *Work Plan Documents for Berry and Plant Sampling Investigation* (Appendix A) on August 15, 2001. On August 20, 2001, DEC and E & E personnel were in Kivalina, preparing for sample collection. Point Hope was added to the investigation in September 2001, when DEC received a request from the Tribal Council of Point Hope to include the village in this study. Because of the short season and harvest time for the target species identified by the Native Village of Kivalina, the planning stage for this study was compressed.

The initial focus of this investigation was to determine whether local subsistence foods are contaminated by heavy metals resulting from the

operations of the Port and Haul Road. However, during the sampling, it became clear that a quantitative analysis of the potential sources of heavy metals could not be accomplished through this study. The results only define the relative concentrations of heavy metals in the subsistence foods. Interpretation of the collected data is limited because of the following facts that surfaced during the study.

- No available baseline data for metal concentrations in subsistence foods near the Haul Road, the Port, Noatak, and Point Hope;
- Absence of data for metal concentrations in subsistence foods elsewhere in the American Arctic;
- Lack of an adequate statistical control site for comparison of metal concentrations in sample data sets. Noatak was originally targeted as the statistical control, but potential differences in geologic conditions and plant compositions between the coastal regions of the Port and the inland, riverine area of Noatak prohibit an equal comparison;
- Uncertainty of whether dust from operations at the Haul Road and Port actually are depositing on subsistence foods in the area;
- Unknown uptake factors for metals in the subsistence foods that were analyzed; and
- Unknown bioavailability factors for metals in the subsistence foods that were analyzed.

In summary, this investigation was not designed to determine whether dust from Port and Haul Road operations is affecting and accumulating on nearby subsistence foods. In addition, this investigation does not present a statistical comparison of sample data sets near the Port to a control data set because an appropriate control site could not be found in the compressed planning stage.

This study, however, does detail the similarities and differences in metal concentrations between the sample data sets collected at and near the Port, Noatak, and Point Hope. In addition, data collected for this investigation serve as a baseline for future comparisons of subsistence foods. These data, in a frame work of future studies and investigations, are valuable to environmental and health professionals in determining the impact of Haul Road and Port operations on the environment and human health.

GPS
Global Positioning System

This document includes background information (Section 2), sampling and analytical procedures (Section 3), data analysis (Section 4), analytical results (Section 5), conclusions (Section 6), and references (Section 7). The project sampling plan, project photographs, **Global Positioning System** (GPS) coordinates for sample locations, laboratory data reports, data validation summaries, and statistical procedures are included as appendices.

2

Project Background

Red Dog Mine is located in the DeLong Mountains of northwest Alaska. The mine produces lead and zinc concentrates. The entire operation consists of the mine, the Port, and the 52-mile Haul Road that connects the mine and Port. Figure 2-1 shows the location of the mine in northwest Alaska. Figure 2-2 details the mine, Haul Road, and the Port.

The mining process includes crushing, grinding, floating, and dewatering the ore. The results are lead and zinc concentrates in powder form. Until recently, the concentrates had been loaded in open-top containers on tandem tractor-trailer trucks and transported on the Haul Road as a covered load to the Port. At the Port, the ore was dumped into hoppers by tilting and vibrating the entire tractor-trailer. In September 2001, **Teck Cominco Alaska, Inc.**, (Cominco) the operator of Red Dog Mine, replaced the old trucks with new ones that have hydraulically sealed covers and a side dumping feature to minimize the loss of concentrate. Along with the new sealed-top trucks, Cominco also has installed washing stations for the trucks at the mine and Port to curtail the loss of concentrate from dust emissions. Washing ceased on September 28, 2001, with the onset of freezing conditions. Cominco (2001) is developing alternative strategies to focus on source control and to prevent contamination.

Cominco
Teck Cominco Alaska Incorporated

At the Port, ore concentrates are stored in two storage buildings. The concentrates are kept there until they are moved by conveyor belts to barges. The barges transport the concentrates to bulk ocean-going vessels anchored offshore. Pack ice around the Port limits the transport of concentrates to approximately 100 days per year. All smelting of the ore concentrates occurs outside Alaska (Werniuk 2001).

2.1 Previous Investigations

Many investigations have been conducted at Red Dog Mine, but only two have focused on dust emissions. NPS initiated a study in 1999, and DHSS issued a public health evaluation in October 2001. These two investigations are described below. In addition, a Canada subsistence study is mentioned briefly.

2.1.1 National Park Service

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In 2001, NPS (2001) published a report entitled, *Heavy Metals in Mosses and Soils on Six Transects Along the Red Dog Mine Haul Road, Alaska*. NPS investigated atmospheric deposition of cadmium, lead, and zinc within 1,600 meters (one mile) of the Haul Road. The species of focus was the moss *Hylocomium splendens*, an effective indicator species for metal deposition because the plant has a primitive vascular system that limits uptake of metals from soil. The study utilized a measurement tool known as *enrichment factors*. An enrichment factor is a ratio of target elements (lead, zinc, and cadmium for this project) to an abundant, mostly benign element (generally aluminum) in plants to the .same ratio in local soils. Enrichment factors less than 10 generally represent local lithology and reflect expected uptake by plants under natural conditions. However, enrichment factors greater than 10 are indicators that extraneous factors, such as atmospheric deposition, likely are influencing the elemental composition of the plants. The equation below shows an enrichment factor ratio:

$$\frac{\frac{P(t)}{P(a)}}{\frac{S(t)}{S(a)}}$$

where P(t) is the concentration of a target element in the plant; P(a) is the concentration of an abundant element in the plant; S(t) is the concentration of the same target element in local soil; and S(a) is the concentration of the same abundant element in local soil.

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The NPS study found that enrichment factors for lead, zinc, and cadmium were greater than 10 as far as one mile from the Haul Road. In addition, enrichment factors greater than 10 for all three metals occurred at all three locations investigated: 250 meters, 1,000 meters, and 1,600 meters from the Haul Road. The enrichment factors for cadmium and zinc actually showed an increase from 250 meters to 1,000 meters and then appeared to be decreasing at 1,600 meters. However, lead appeared to have more consistent enrichment factors regardless of the distance from the Haul Road, which possibly suggests that lead is dispersing farther and more uniformly than cadmium and zinc.

NPS conducted additional fieldwork in 2001. Results and conclusions will be subject to peer review in 2002.

2.1.2 Alaska Department of Health and Social Services

DHSS (2001) issued an interim report entitled, *Public Health Evaluation of Exposure of Kivalina and Noatak Residents to Heavy Metals from Red Dog Mine,* in October 2001. Due to time constraints and longer than anticipated analysis time for the subsistence food samples, the DHSS

included only data from 10 salmonberry samples collected around the Port Site as part of this investigation. The locations of these ten samples are depicted as salmonberry samples 1-5 and 6-10 in Figure 3-1. In the report issued in October 2001, which also included bioavailability data, blood lead testing for residents and workers, and soil, water, fish, caribou metal concentration data, DHSS concluded that no identified exposure pathway exists from Red Dog Mine to the residents of Kivalina and Noatak. DHSS observed that average concentrations of metals in the salmonberries were below risk-based screening concentrations for ingestion. The final report will incorporate all of the sampling results from this report.

2.1.3 Canada Subsistence Study

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In May 1998, the Centre for Indigenous Peoples' Nutrition and Environment at McGill University in Ste-Anne-de-Bellevue in Quebec City, Quebec, issued *Yukon First Nations' Assessment of Dietary Benefit/Risk* (Receveur et al. 1998). The report details consumption of 107 traditional foods in 10 indigenous communities in the Yukon Territory. The study collected samples of the 107 foods for analysis. Of these 107 foods, one sample of blackberries was collected and analyzed. No salmonberry or sour dock samples were collected. Because the Canada report focuses mainly on the dietary properties of other subsistence foods, it offers little comparison to this investigation.

2.2 Environmental Setting

Red Dog Mine is located 55 miles east of the Chukchi Sea, in the De-Long Mountains at the western end of the Brooks Range. The western portion of the Brooks Range is a highly mineralized area, containing many zinc, lead, and silver deposits. These deposits consist of layers rich in sulfide minerals and are dispersed in black shale and chert. The dominant minerals are sphalerite (zinc sulfide), silver-rich galena (lead sulfide), pyrite (iron sulfide), and marcasite (iron sulfide) (**United States Geological Survey** [USGS] 1995).

USGS
United States Geological Survey

The mine itself is located in a formation characterized by black carbonaceous shale with subordinate interbedded black chert. This formation contains the Red Dog deposit of lead and zinc (USGS 1990). This mineral-rich zone at the mine contrasts with the varied soils of the Port Site, Point Hope, and Noatak. These areas are marked by a mixture of beach deposits (except for Noatak) and Quaternary undivided surficial deposits caused by the submersion of soils over time. The deposits are a general mixture of pebbly sand and gravel, while the surficial deposits are unconsolidated clay, silt, sand, and gravel mixed with tundra, lacustrine, alluvial, colluvial, and glacial deposits (USGS 1987, 1977).

Cominco has instituted an environmental monitoring program at the Port. Soil, water, air, and subsistence food samples have been collected over the past decade. Between 1990 and 1996, 116 soil samples were

ppm
parts per million

collected from two locations known as "Control Sites." One "Control Site" was located approximately 1.5 miles north of the Port, and the other was located approximately 2.25 miles southeast of the Port. The median concentration of lead in the soil samples ranged from 5 **parts per million** (ppm) to 26 ppm between 1990 and 1996. The median concentration of zinc in the soil samples ranged from 40 ppm to 68 ppm between 1990 and 1996 (RWJ Consulting 1997). These concentrations of lead and zinc are consistent with ranges found in soils elsewhere in northwest Alaska. Data from a USGS study indicates that concentrations ranged from 10 ppm to 21 ppm for lead and 50 ppm to 80 ppm for zinc in the coastal regions between Cape Krusenstern National Monument and Kivalina. In addition, a soil sample near Noatak had a lead concentration of 12 ppm and a zinc concentration of 60 ppm (Gough et al. 1988). These data points from USGS, combined with Cominco's monitoring program, do not indicate significant variations in soil compositions along the coastal regions and near Noatak.

This comparison of data, however, is limited. In general, there is a lack of knowledge regarding the varying mineral content of the soils along the coast and inland at Noatak. In addition, various soil structures may allow for various uptake factors in the subsistence food species. Therefore, an adequate relationship between the Port Site, Point Hope, and Noatak is not known because a lithologic survey of the soils and an accompanying botanical investigation of the plant species in the study areas have not been conducted.

3

Sampling and Analytical Procedures

This section summarizes the fieldwork implemented during the project. The work was performed under the guidelines of E & E's *Work Plan Documents for Berry and Plant Sampling Investigation* (Appendix A).

The subsistence food species in this study were selected by DEC in consultation with representatives from Kivalina and Noatak. Three species of subsistence foods were chosen based on their abundance during August and September. Table 3-1 presents the target subsistence foods.

Table 3-1 Target Subsistence Foods

Common Name	Scientific Name	Inupiat Name
Sour Dock	*Rumex arcticus*	Quaguq
Salmonberry	*Rubus chamaemorus*	Aqpik
Blackberry	*Empetrum nigrum*	Asiaq

The metals analyzed during this project are those identified in the **United States Environmental Protection Agency's** (EPA's) **Toxic Release Inventory** (TRI) reports for Red Dog Mine (cadmium, chromium, cobalt, copper, lead, manganese, nickel, and zinc), plus selenium.

Subsistence food samples were collected from four areas during this study. The first area is the land immediately south of the Port, next to the Port's tank farm. This area is referred to as *Terminal* in this report. Salmonberries were collected as part of the Terminal data set. The locations of the Terminal samples are not included in a figure because no GPS data were gathered for these samples.

The second sample area is associated with the traditional harvest lands for Kivalina (Figure 3-1). These lands include the regions north and south of the Port. This area is referred to as *Port Site* in this report.

EPA
United States Environmental Protection Agency

TRI
Toxic Release Inventory

Salmonberries, sour dock, and blackberries were collected as part of the Port Site data set.

The third sample area is associated with the traditional harvest lands for Noatak (Figure 3-1). These lands include the regions northwest of the village and upriver of the village. This area is referred to as *Noatak* in this report. Salmonberries, sour dock, and blackberries were collected as part of the Noatak data set.

The last area is associated with the traditional harvest lands for Point Hope (Figure 3-2). These lands include the region west of the village. This area is referred to as *Point Hope* in this report. Salmonberries were collected as part of the Point Hope data set.

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3.1 Sample Procedures for Subsistence Foods

The first step in collecting subsistence food samples was identifying areas that had sufficient quantities of the target species. Residents of Kivalina, Noatak, and Point Hope assisted by showing DEC and E & E personnel the location of traditional harvest lands. When a location that had an adequate volume of the target species was identified, project personnel and the residents assisted in sample collection.

All samplers wore disposable latex gloves, which were changed for each new sample to minimize potential cross-contamination of samples. Two or more individuals constituted a sample team. If sufficient volume of the sample species was present, the goal was to collect two samples: a washed sample and an unwashed sample. The unwashed samples represented the species as it exists. They were collected by filling a precleaned 8-ounce jar with the species. The other samples were washed before containerization. However, before the washing occurred, the sample material was gathered into a plastic colander. When at least 50 grams of the species was gathered into the colander, the sample team washed the sample material.

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The intention of rinsing the samples was to determine whether metals that had settled on the surface of subsistence foods from atmospheric deposition could be removed from the foods. If effective, sample analysis would indicate the metals that are contained only within the subsistence foods. Then, these data could be compared to the data from unwashed samples to qualify and possibly quantify atmospheric deposition of metals on the subsistence foods.

Two washing methods were used. The first method was to pour or spray Type II reagent-grade water on the sample material in the colander while the other team member stirred the sample material so that the water rinsed all of the material. The second method involved placing the sample material in the sample jar and then pouring water into the jar and flushing the sample material. After the sample was washed by one of the

two methods, both sample containers were labeled with the sample number and date and time of collection.

The planned method for washing samples involved rinsing the sample material in colanders. However, the sample teams sometimes were handicapped in the amount of water that could be mobilized because of the space limits of the helicopter that transported them. Therefore, it was necessary to develop an alternative method that used less water. The alternative method involved rinsing the sample material in the sample jar.

In many instances, only one sample was collected at a sampling location because of insufficient sample material. When this occurred, the unwashed sample always was collected, instead of the washed sample. Table 3-2 shows which samples had a washed sample co-collected with the unwashed sample.

After all samples were collected from a sampling location and containerized, the sample team began to collect the next sample following the same guidelines. The colanders were decontaminated using Type II reagent-grade water, and the samplers changed gloves between sample locations to minimize cross-contamination. The sample teams ensured sample independence by collecting each sample from unique areas, so that no overlap in samples occurred.

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3.2 Sample Locations for Subsistence Foods

The following sections detail the sample locations. All samples were collected during three sampling events: August 20 to 22, 2001; September 7, 2001; and September 19 and 20, 2001. Table 3-2 presents a summary of all samples collected during the project. Table 3-3 is a summary of the sections below.

DEC and E & E personnel used a portable GPS unit to record the locations of samples. The GPS coordinates of each sample were used to develop Figures 3-1 and 3-2. Exponent, Inc., a consulting firm under contract to Cominco, produced the figures. E & E supplied Exponent, Inc., with the data points. Appendix B contains a complete list of GPS coordinates for the sample locations.

3.2.1 Salmonberry and Sour Dock Collection of the Port Site Data Set

Enoch Shiedt of Maniilaq Association; Austin Swan and Jerry Norton of Kivalina; Gerry Guay and Barbara Trost of DEC; Liz Maiers of Exponent, Inc.; and Ben Martich of E & E traveled by helicopter from Kivalina on August 20, 2001, to collect salmonberries from the Port Site area. Austin Swan and Jerry Norton directed the sample team to locations where Kivalina residents have traditionally gathered salmonberries. Ten sets of washed and unwashed salmonberry samples were collected.

On August 21, 2001, Enoch Shiedt of Maniilaq Association, Austin Swan and Jerry Norton and Nelda Swan and Millie Hawley of Kivalina, Gerry Guay and Barbara Trost of DEC, and Ben Martich of E & E re-mobilized by helicopter from Kivalina to the Port Site for the collection of sour dock samples. Ten sets of washed and unwashed sour dock samples were collected.

3.2.2 Salmonberry and Sour Dock Collection of the Noatak Data Set

Enoch Shiedt of Maniilaq Association, Dwight Arnold and Roland Booth of Noatak, Gerry Guay and Barbara Trost of DEC, and Ben Martich of E & E traveled by helicopter from Noatak on August 22, 2001, to collect salmonberry and sour dock samples. Dwight Arnold and Roland Booth directed the sample team to locations where residents of Noatak have traditionally gathered subsistence foods. Ten sets of washed and unwashed salmonberry and sour dock samples were collected.

3.2.3 Salmonberry Collection of the Terminal Data Set

On September 7, 2001, Walt Sandel of DEC collected four unwashed salmonberry samples from the area around the Port. These samples were collected on the south side of the facility, near the tank farm. Walt Sandel was at the Port on other DEC business and collected these samples to eliminate remobilization by DEC and E & E. Only four unwashed samples were collected because insufficient quantities existed for more samples. Sour dock and blackberries were not collected as part of the Terminal data set because these species were not identified.

3.2.4 Salmonberry Collection of the Point Hope Data Set

ATV
all-terrain vehicle

On September 19, 2001, Jakie Koonuk of Point Hope and Barbara Trost of DEC used an **all-terrain vehicle** (ATV) to travel from Point Hope to an area west of the village where Point Hope residents have traditionally gathered salmonberries. Low quantities of ripe salmonberries allowed the collection of only 10 unwashed samples. Sour dock and blackberries were not collected at Point Hope because these species were not ripe on September 19, 2001.

3.2.5 Blackberry Collection of the Port Site Data Set

Janet Mitchell, Marilyn Booth, and Bob Mitchell of Kivalina and Ben Martich of E & E collected blackberry samples at the Port Site on September 19, 2001. The sample team traveled from Kivalina by ATV. Janet Mitchell, Marilyn Booth, and Bob Mitchell directed the sample team to the locations where residents of Kivalina have traditionally gath-

ered blackberries. Ten sets of washed and unwashed blackberry samples were collected.

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3.2.6 Blackberry Collection of the Noatak Data Set

On September 20, 2001, Gretchen Booth, Gladys Mitchell, and Stanley Norton of Noatak and Ben Martich of E & E collected blackberry samples as part of the Noatak data set. The sample team traveled by boat on the Noatak River to identify locations where blackberries were prevalent. Eight unwashed samples of blackberries were collected. Additional samples and washed samples were not collected because of insufficient quantities of ripe blackberries.

3.3 Water Samples

Two water samples were collected during the investigation. One sample was collected from New Hart Creek, a drinking water source for subsistence hunters and gatherers. The creek is located approximately 2.5 miles north of the Port (Figure 3-1). Ben Martich of E & E collected this sample on August 21, 2001. The other water sample came from the Wulik River where Kivalina's surface water intake is located. Gerry Guay of DEC collected this sample on August 21, 2001.

Each sample was collected by dipping a dedicated, precleaned, 1-liter polyethylene bottle in the surface water source. The water from this polyethylene bottle then was transferred to another precleaned, 1-liter polyethylene bottle that was pre-preserved with nitric acid. After the sample container was filled, a label displaying the sample number and date and time of collection was affixed to the sample container.

3.4 Sample Handling

During the three sampling events, the samples were kept with the sample team until all of the samples were collected. The sample team labeled, packaged, and iced the samples in the field. Chains-of-custody also were completed. The samples were shipped to Anchorage when the sample team demobilized from the sampling event. In Anchorage, the samples were re-iced and sent for next-day delivery to **Battelle Marine Sciences Laboratory** (Battelle) in Sequim, Washington. Battelle completed the analysis for all samples.

Battelle
Battelle Marine Sciences Laboratory

IDW
investigation-derived waste

3.5 Investigation-Derived Waste

Disposable sampling equipment and personal protective equipment were used during the field event. The **investigation-derived waste** (IDW) included latex gloves, sample boxes, and plastic water jugs. All IDW was bagged in the field and transported to Anchorage with the other sampling equipment. The IDW was disposed of at the Anchorage Landfill.

3.6 Quality Assurance Summary

Battelle conducted analyses for all of the samples collected during this project. Subsistence food and water samples were analyzed by inductively coupled plasma mass spectrometry, EPA Method 6020, for a select list of metals: cadmium, chromium, cobalt, copper, lead, manganese, nickel, selenium, and zinc. The subsistence food samples were analyzed using wet weight and dry weight of the samples. *Wet weight analysis* means that the samples were analyzed as they arrived at the laboratory. Conversely, *dry weight analysis* means that the sample material was dried before analysis. In this case, the samples were freeze-dried. This was done to remove the water content of the sample material. The reason is that varying water content of each sample would add variability (error) to the concentrations of metals in the sample matrix. The removal of water would minimize the variability of metals content in the analysis caused by water, so that only the natural variability in the sample material would remain.

This report presents the analytical results from the freeze-dried samples only. The freeze-dried results are preferred and more accurate for statistical analysis of data because of the reduced variability in the sample matrix as described in the previous paragraph. Wet weight analysis typically is used for health evaluations. The results of the wet weight analysis are presented in Attachment C.

Battelle submitted a laboratory narrative regarding **quality control** (QC) with the analytical results. An E & E chemist conducted a **quality assurance** (QA) review of Battelle's reports. Battelle's analytical reports and E & E's QA review are presented in Appendix C. The significant changes highlighted in the QA review include the following:

QC
quality control

QA
quality assurance

- The results for chromium are reported as non-detect values because chromium was detected in laboratory blank samples; and
- Most of the results for selenium are biased high or low because QC recoveries were either above or below standards.

In addition, QC samples were collected during the field events. Matrix spike/matrix spike duplicate samples were collected every 20 samples for each subsistence food sample. No field duplicate samples for subsistence foods were collected because only composite samples were collected. Laboratory/method QC data were used to support the two water samples collected. Lastly, two samples of the rinse water were collected to verify the metals content of the water. Again, Appendix C presents the laboratory analytical reports and E & E's validation report. Analytical results are in Section 5.

4

Data Analysis

During this investigation, three subsistence food species were collected from three major sample locations: the traditional harvest areas near the Port and the villages of Noatak and Point Hope. Battelle analyzed the samples for metals identified in EPA's TRI report for Red Dog Mine. These metals are cadmium, chromium, cobalt, copper, lead, manganese, nickel, and zinc. The samples also were analyzed for selenium.

This study focuses on the results for lead, zinc, and cadmium because elevated concentrations of these metals along the Haul Road were documented in the NPS study. Tables 5-1 and 5-2 present the complete data set for all metals, unwashed and washed, respectively.

During the planning phase of the investigation, the harvest areas of Noatak were designated as a "Control Site" (or background) for statistical comparison to the other data sets. However, during the sampling part of this investigation, it became apparent that the samples from Noatak were not suitable as a statistical control. In addition, time constraints did not permit the search of a more appropriate "Control Site." Therefore, this study has no background or control data set for comparison. Instead, data sets from each sample location are compared to determine which data sets show statistical differences from the others.

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For the statistical comparison, the following descriptive statistics were calculated: number of samples within the sample set, mean, standard deviation, minimum, maximum, and the lower and upper 95% confidence limits. A meaningful comparison between data sets could be performed only if both sample sets showed similar distribution; therefore, each data set was tested for normality of distribution. To determine whether the calculated means of the data sets truly represent different populations of the subsistence food species (i.e., different concentrations of a metal in the subsistence food species), t-tests were performed between data sets. A detailed discussion of the statistical analysis tools is included in Appendix D.

Chapter 5 presents the results of a three-tiered approach for the comparison of the sample sets. First, individual metals in different data sets were compared. The mean concentrations of lead, zinc, and cadmium were compared individually across all data sets. These comparisons are

depicted visually in bar graphs and box plots. This technique allows for a general understanding of metal concentrations by food species and location.

Second, a spatial analysis of the analytical results is presented by showing the mean concentrations of data sets and the distance in miles from the Port where each data set was collected. Furthermore, some of the data sets are split to allow for a more detailed analysis. Each subset is treated as its own data set with mean and standard deviation, thereby increasing the data points under investigation. Washed and unwashed sample sets are included in this analysis.

The final method of data analysis focused on the differences in the mean concentrations of a single metal among all subsistence foods collected in the Port Site and Terminal data sets. This approach includes all unwashed samples collected within 6.1 miles of the Port. The analysis allows for an assessment of concentrations between the subsistence food types.

Although the focus of this study was on lead, zinc, and cadmium, an analysis of other significant metals in different sample species is included in the comparison of the three major sample locations. The results are presented in Section 5.2.

5 Results

This section presents the results of data analysis as described in Section 4. All laboratory results presented in this section are based on dry weight analysis.

The complete laboratory analysis for all nine metals is displayed in Tables 5-1 and 5-2 for unwashed and washed samples, respectively. A descriptive statistical summary is presented in Tables 5-3 and 5-4 for the unwashed and washed data sets, respectively. The descriptive statistics include the following information regarding the data sets: number of samples, mean, standard deviation, minimum values, maximum values, and upper and lower 95% confidence intervals for the mean.

Tables 5-3 and 5-4 provide an "eyeball" review of the data sets. The reader can compare means between data sets and see how the ranges of data sets overlap by comparing minimum and maximum values and confidence intervals. For Tables 5-3 and 5-4, non-detect values in the data sets have been adjusted arbitrarily to one-half the detection limit for calculating means, standard deviations, and confidence intervals. Although this is a standard method, it should be noted that this 'correction' biases the results high.

All subsistence food samples were analyzed for the eight metals, plus selenium, identified in EPA's TRI report for Red Dog Mine. However, the discussion of results focuses on lead, zinc, and cadmium in the following sections. These three metals were selected because lead and zinc are the main ores extracted from Red Dog Mine and cadmium usually co-occurs with zinc. In addition, the three metals were the focus of the NPS (2001) study. Lastly, comparison and discussion of all nine metals would make the report cumbersome and add minimal value.

5.1 Washed Samples

Approximately two-thirds of the unwashed subsistence food samples also had a matching washed sample. One of the assumptions of this study was that atmospheric deposition is contributing to increased concentrations of metals in subsistence foods. By washing samples, it was hoped that the dust of atmospheric deposition would be removed from

the sample material, thereby decreasing the concentrations of metals in the subsistence food samples.

Table 5-5 shows a comparison of the mean concentration of metals for the matching washed/unwashed data sets. Of the 44 data sets for which washed samples were collected, 21 of the washed data sets have a mean concentration of a metal greater than the mean concentration of the metal in the corresponding unwashed data set. This statistic is almost random, meaning that there is an equal chance of the washed or unwashed sample set having a greater mean.

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The sample team collected two samples of the rinse water to determine the concentrations of metals in the water that was poured on the samples. Table 5-6 presents the results from the two samples. The water sample results are reported in micrograms per liter or parts per billion, while the subsistence food results are in milligrams per kilogram or ppm. In general, the detections in the water are at concentrations that are three orders of magnitude below the concentrations found in the subsistence foods. It is unlikely that the rinse water caused any spike in the analytical results of the subsistence foods.

The different rinsing methods used in this study were not tested as to their effectiveness before the field events. However, it should be noted that no standard practice exists for washing food samples for environmental/health evaluations. Thus, without further testing, the conclusion is that rinsing the samples was most likely ineffective in reducing the concentrations of metals or washing away any metal-laden dust that may have settled on the subsistence foods.

5.2 Comparison of Metal Concentrations in Port Site, Noatak, and Point Hope Data Sets

Click Here For:

Graph 1

Graph 2

Graph 3

Graph 4

Graph 5

Graph 6

Graph 7

Graph 8

Graphs 1 through 3 compare the mean concentrations of lead, zinc, and cadmium individually in subsistence food samples from the Port Site, Noatak, and Point Hope. Only salmonberries were collected at Point Hope. The different-colored bars in the graphs represent the three different plant species. Only unwashed samples are compared.

Graphs 4 through 8 offer a more detailed analysis between data sets. In these graphs, the mean concentration and standard deviation of a single metal in a single subsistence food are compared between two or more data sets. Data for washed samples are included with data for unwashed samples where applicable. Graphs 4 through 6 present a comparison of the lead concentrations in all three subsistence food species. Graph 7 shows the difference in zinc concentrations in blackberries between Noatak and the Port Site. In Graph 8, cadmium concentrations in sour dock sample sets are compared between Noatak and the Port Site.

In summary, the graphs indicate that:

- Lead exhibits greater concentrations in all subsistence foods from Port Site sample sets when compared to either the Noatak or Point Hope data sets;
- The Noatak data set appears to have a greater concentration of cadmium in sour dock samples than the Port Site data set;
- The Noatak data set appears to have a greater concentration of zinc in blackberry samples than the Port Site data set; and
- The remaining combinations appear to share similar concentrations of metals in subsistence foods.

These graphical comparisons suggest only potential differences in mean concentrations of data sets. In order to draw conclusions with confidence, hypothesis-based statistics should be employed. Appendix D describes the process for utilizing a t-test to determine whether the mean concentration of a metal in a data set is statistically different from the mean concentration of the same metal in another data set.

Only the results of the t-tests are presented here. All metals are included in this analysis because a description of the process is not included.

click here

For the Port Site data set, with 95% confidence:

- Lead has a greater concentration in salmonberries than in salmonberries from the Noatak data set;
- Selenium and lead have greater concentrations in sour dock samples than in sour dock samples from the Noatak data set;
- Lead has a greater concentration in blackberries than in blackberries from the Noatak data set; and
- Lead, nickel, and zinc have greater concentrations in salmonberries than in salmonberries from the Point Hope data set.

For the Noatak data set, with 95% confidence:

- Copper has a greater concentration in salmonberries than in salmonberries from the Port Site data set;
- Manganese, nickel, and cadmium have greater concentrations in sour dock samples than in sour dock samples from the Port Site data set;
- Copper and zinc have greater concentrations in blackberries than in blackberries from the Port Site data set; and
- Cobalt, manganese, and selenium have greater concentrations in salmonberries than in salmonberries from the Point Hope data set.

For the Point Hope data set, with 95% confidence:

- Cobalt, copper, manganese, and selenium have greater concentrations in salmonberries than in salmonberries from the Port Site data set; and

- Cobalt, selenium, and manganese have greater concentrations in salmonberries than in salmonberries from the Noatak data set.

5.3 Comparison of Metal Concentrations by Subsistence Food Type

This analytical approach involves comparing the concentrations of a single metal in a single subsistence food across all data sets. Included in the analysis is the Terminal data set, which comprises four salmonberry samples. GPS data were not gathered for this data set; therefore, the distance in the following graphs is set at zero.

Graphs 9 through 16 present the comparisons. The graphs are box and whisker plots. If a box does not contain whiskers, then the confidence interval falls within one standard deviation of the mean.

From Graphs 9 through 11, the following observations regarding salmonberry sample sets are made:

Click Here For:

Graph 9

Graph 10

Graph 11

- The greatest concentrations of lead, zinc, and cadmium in salmonberry samples occur in the Terminal data set. However, the percentage difference of the means in the Terminal data set to the means of the other data sets is not equal. Lead has a difference of approximately 8 times greater in the Terminal data set, cadmium has a difference of approximately 2.25 times greater, and zinc has a difference of approximately 1.5 times greater;
- The data set located 1.6 miles south of the Port has lower concentrations of zinc and cadmium than the data set collected 2.6 miles north of the Port;
- The concentrations of lead follow a decreasing trend as the distance from the Port increases. This occurrence repeatedly happens in the analyses below, and the point is discussed further in Section 6; and
- The concentrations for lead, zinc, and cadmium are similar between the Noatak and Point Hope data sets.

From Graphs 12 through 14, the following observations regarding sour dock sample sets are made:

Click Here For:

Graph 12

Graph 13

Graph 14

- The data set located 1.9 miles from the Port has greater concentrations of lead and cadmium than the data set located 5.4 miles from the Port;
- The greatest concentration of cadmium occurs in the Noatak data set; and
- The results for lead again follow a decreasing trend as the distance of each data set from the Port increases.

From Graphs 15 and 16, the following observations regarding blackberry sample sets are made:

Click Here For:

Graph 15

Graph 16

- Again, lead appears to follow a decreasing trend in concentration as the distance from the Port increases. Furthermore, the washed and unwashed data sets support this observation; and
- The greatest concentrations of zinc appear to occur in Noatak samples.

Most of the results for cadmium are non-detect values, indicating that cadmium concentrations in blackberries are generally less than 0.01 milligrams per kilogram (the detection limit). Therefore, a graph of cadmium concentrations in blackberry sample sets was not generated.

5.4 Comparison of Metal Concentrations in Different Subsistence Foods

This method of data analysis focuses on the differences in the mean concentrations of a single metal among all subsistence foods collected in the Port Site and Terminal data sets.

Graphs 17 through 19 compare the means of lead, zinc, and cadmium in the unwashed sample sets from the Terminal and Port Site data sets. The following observations are made from the graphs:

Click Here For:

Graph 17

Graph 18

Graph 19

- The greatest concentrations of lead and zinc appear to occur in sour dock samples collected 1.9 miles north of the Port. Sour dock samples collected near salmonberry samples in the Port Site data set show almost a ten-fold greater concentration of lead and almost double the concentration of lead in salmonberry samples from the Terminal data set;
- Zinc concentrations in sour dock samples collected near salmonberry samples in the Port Site data set are almost twice the concentration of zinc in those nearby salmonberry samples;
- Lead and zinc concentrations in sour dock samples collected 5.4 miles from the Port show levels similar to those of the salmonberries from the Terminal data set;
- The greatest concentration of cadmium appears to occur in salmonberry samples from the Terminal data set; and
- The results for blackberries exhibit the least variability of all three subsistence foods. However, blackberries also were collected farthest from the Port. Either the blackberries are least affected by the Port and Haul Road activities or samples were not collected close enough to the Port to affect the results, or a combination of the two.

5.5 Water Samples

Two surface water samples were collected during the project. Table 5-7 presents the analytical results and DEC drinking water standards for the nine metals under investigation. Although all nine metals were detected in the water samples, all of the metals were well below the State's regulatory standards for drinking water as promulgated in 18 Alaska Administrative Code 80.

6 Conclusions

This report presents the findings of subsistence food samples collected because of concerns raised by local citizens that subsistence foods are affected by the operations of the Port and Haul Road. Three subsistence foods were collected: salmonberries, sour dock, and blackberries. They were collected from the lands around the Port, Noatak, and Point Hope. The samples were analyzed for the metals discussed in EPA's TRI for Red Dog Mine: cadmium, chromium, cobalt, copper, lead, manganese, nickel, selenium, and zinc.

The analytical data are compared in Section 5 to determine whether any trends exist in the data. Data analysis focused on the results of lead, zinc, and cadmium because lead and zinc are the main metals extracted from Red Dog Mine and cadmium usually co-occurs with zinc. In addition, the three metals were the focus of the NPS (2001) study (Section 2.1). The following bullets summarize the findings:

- The analysis of the subsistence food samples provided mostly usable data. Most of the results were above detection limits. For results that were below the detection limit, one-half the detection limit was selected arbitrarily for calculating statistical parameters. The chromium results could not be used because chromium was present in the laboratory's method blank analysis. This altered the detection limit, thereby affecting the reported results;

- Because no control data set was available for comparison, the data presented in this report were not compared to background levels. Instead, a comparison of the data from the three main sample locations is presented;

- Washing samples in the field appeared to have no effect on the concentrations of metals. The washing process likely was ineffective at removing particulate matter from the surfaces of the subsistence foods. A more thorough and controlled washing process may have proven more effective. However, the washed-sample results were useful because they indicated that a simple rinse of subsistence foods will not lower exposure of metals to subsistence users;

- Lead concentrations in subsistence food samples from near the Port were generally greater than lead concentrations in samples from Noatak and Point Hope;

- Zinc concentrations in the subsistence foods were generally similar for all three sample locations;

- For each subsistence food, the concentration of lead showed a decreasing trend with increased distance from the Port. If these lead levels are to be attributed mainly to atmospheric deposition, this inverse relationship might indicate a point-source release where the highest concentrations are found nearest the point of release, which could be the Port and Haul Road;

- The mean concentration of lead exhibited a higher percentage difference (8 times) in salmonberry samples in the Terminal data set than either cadmium (2.25 times) or zinc (1.5 times), when compared to corresponding mean concentrations in salmonberries from other data sets. If atmospheric deposition is considered the main source for heavy metals on or in the plants, a relationship between the ratio of lead to zinc in the plant between the ratio of lead to zinc in the potential source; i.e., the ore concentrate might be expected. Such a source signature was not detected, although complicated biological and physical processes might make the relationship less apparent.

  Because zinc is a nutrient for many plants, adding a small amount of zinc to the already naturally, relatively high concentration of the zinc in/on the plants will only show little changes in the overall measured concentration. Contrarily, adding a small amount of lead from the ore concentrate dust to the plants might impact the concentration of the naturally occurring lead in/on the plants significantly. Thus, the ratios of zinc and lead in the ore concentrate and the plants could be very different without contradicting atmospheric deposition;

- The greatest concentration of cadmium in all subsistence food samples was found in salmonberries of the Terminal data set. This might be expected because these samples were collected immediately adjacent to the Port;

- The greatest concentrations of lead and zinc were in sour dock samples of the Port Site data set. Specifically, these samples were collected 1.9 miles north of the Terminal. A possible explanation for this is the surface area of the three subsistence foods. The leaves of sour dock have more surface area than the fruits of salmonberries or blackberries. More surface area allows for more accumulation of dust, if deposition of dust from Port and Haul Road operations are considered the main source

for fugitive dust. Another possibility is plant-specific uptake. Neither potential transport mechanism is investigated in this report;

- Within the Port Site data set, the mean concentrations of cadmium and zinc from five salmonberry samples collected 1.6 miles south of the Port were less than the mean concentrations of cadmium and zinc from five salmonberries collected 2.6 miles north of the Port. Lead also exhibited lower concentrations in the five salmonberry samples collected 1.6 miles south of the Port, but the difference between the concentrations of the five salmonberry samples north of the Port was too small to conclude a trend;

- Based on the results of t-tests with a 95% level of confidence, the concentrations of lead in salmonberries, sour dock, and blackberries from the Port Site data set were statistically greater than the concentrations of lead in the Noatak data set for the same subsistence foods;

- Based on the results of t-tests with a 95% level of confidence, the concentrations of lead and zinc in salmonberry samples from the Port Site data set were statistically greater than the concentrations of lead and zinc in salmonberries from the Point Hope data set;

- Based on the results of t-tests with a 95% level of confidence, the concentration of cadmium in sour dock samples from the Noatak data set is statistically greater than the concentration of cadmium in sour dock samples from the Port Site data set. The same relationship existed for zinc in blackberry samples;

- Analytical results indicated the likelihood of natural variations in the compositions of and between subsistence foods. The greatest metal concentrations were not always in the Terminal or Port Site data sets, although these two data sets are the ones most likely affected by the operations of the Port and Haul Road. For instance, samples from Noatak showed the greatest concentration of cadmium in sour dock samples and the greatest concentration of zinc in blackberries. Also, for the Noatak and Point Hope data sets, the mean concentration of zinc in sour dock samples was approximately twice the mean concentration of zinc in salmonberries, which is approximately twice the mean concentration of zinc in blackberries.

  In contrast, the results also indicated the likelihood of the similarities within subsistence foods. For the Noatak and Port Site data sets, the mean concentrations of cadmium and zinc in salmonberries were similar. The absence of sour dock and black-

berry samples from Point Hope prevented the depiction of other potential similarities.

These instances demonstrate the unresolved issues of soil and plant composition. The surficial soils near the Terminal, around Noatak, and around Point Hope have not been classified for metals. The local influence of soils on plant composition is unknown. In addition, the subsistence foods themselves have not been investigated. Each subsistence food has its own composition with varying natural concentrations of metals. Each subsistence food also has unique uptake ability of minerals from the soil. Lastly, each subsistence food has a unique mechanism for making minerals bio-available in its fruits and blossoms.

7

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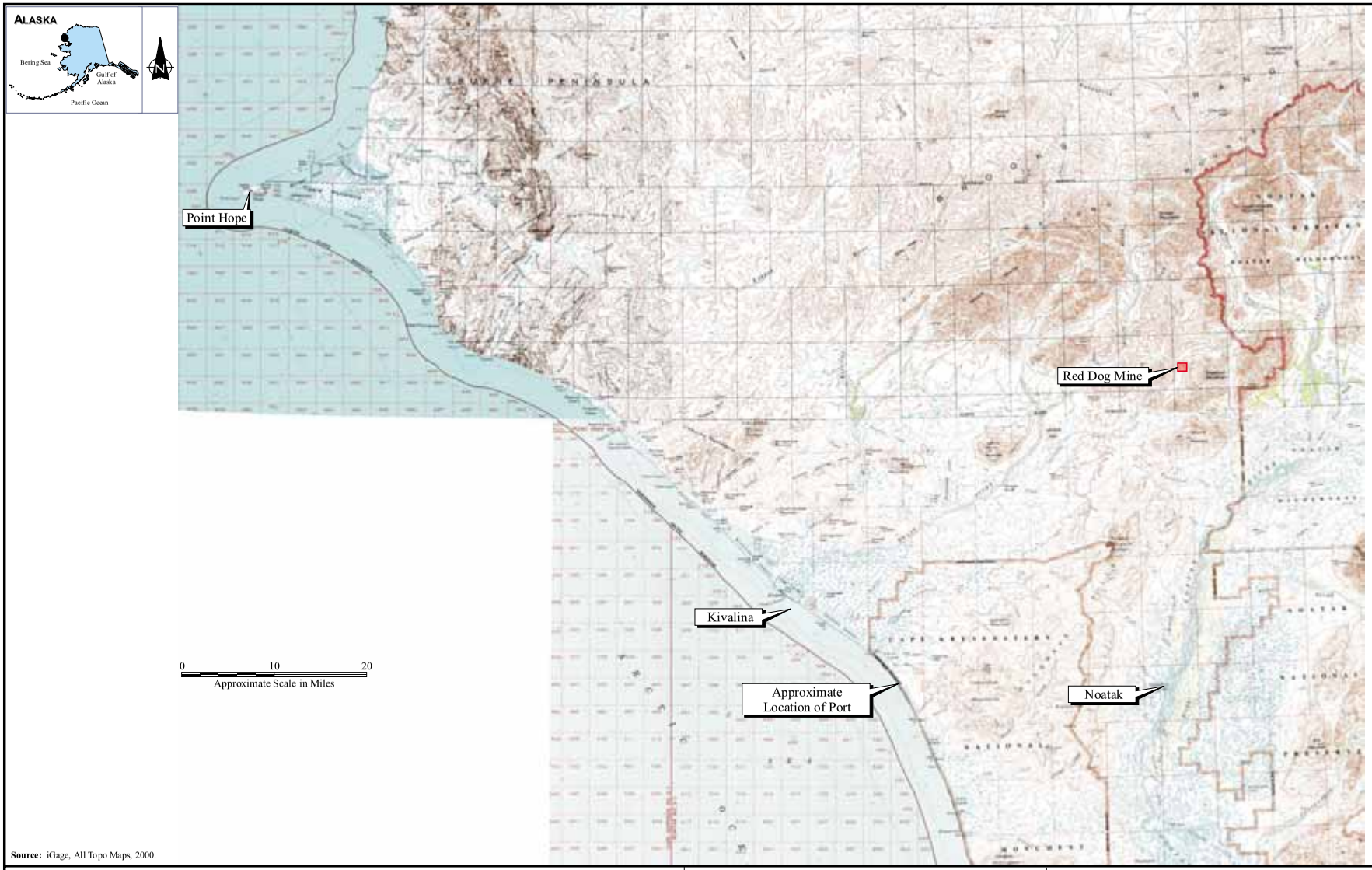

Source: iGage, All Topo Maps, 2000.

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WILD FOODS INVESTIGATION
Northwest, Alaska

Figure 2-1
SITE VICINITY MAP

Date:	Drawn by:	
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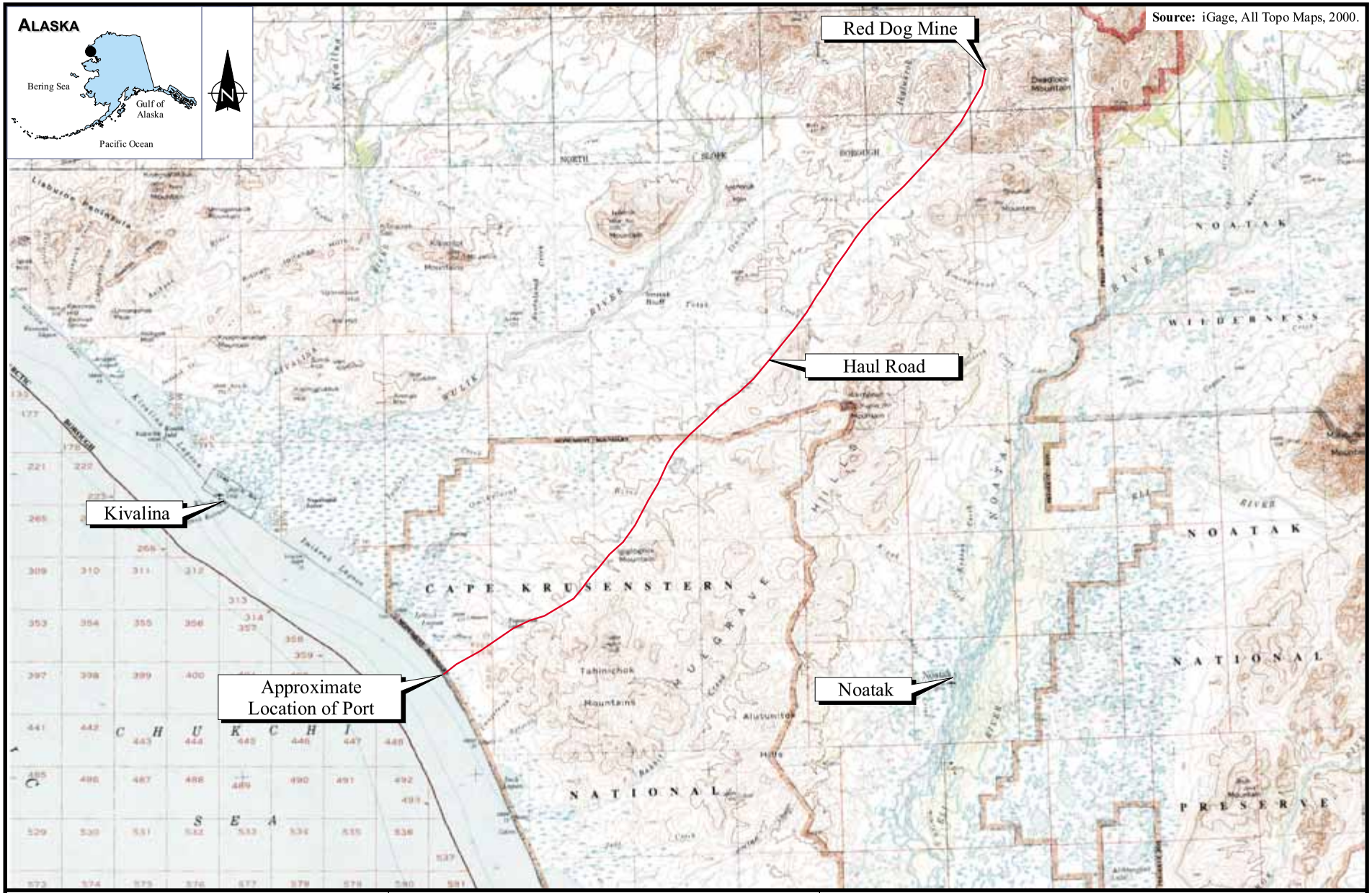

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WILD FOODS INVESTIGATION
Northwest, Alaska

Figure 2-2
SITE LOCATION MAP

0 5 10
Approximate Scale in Miles

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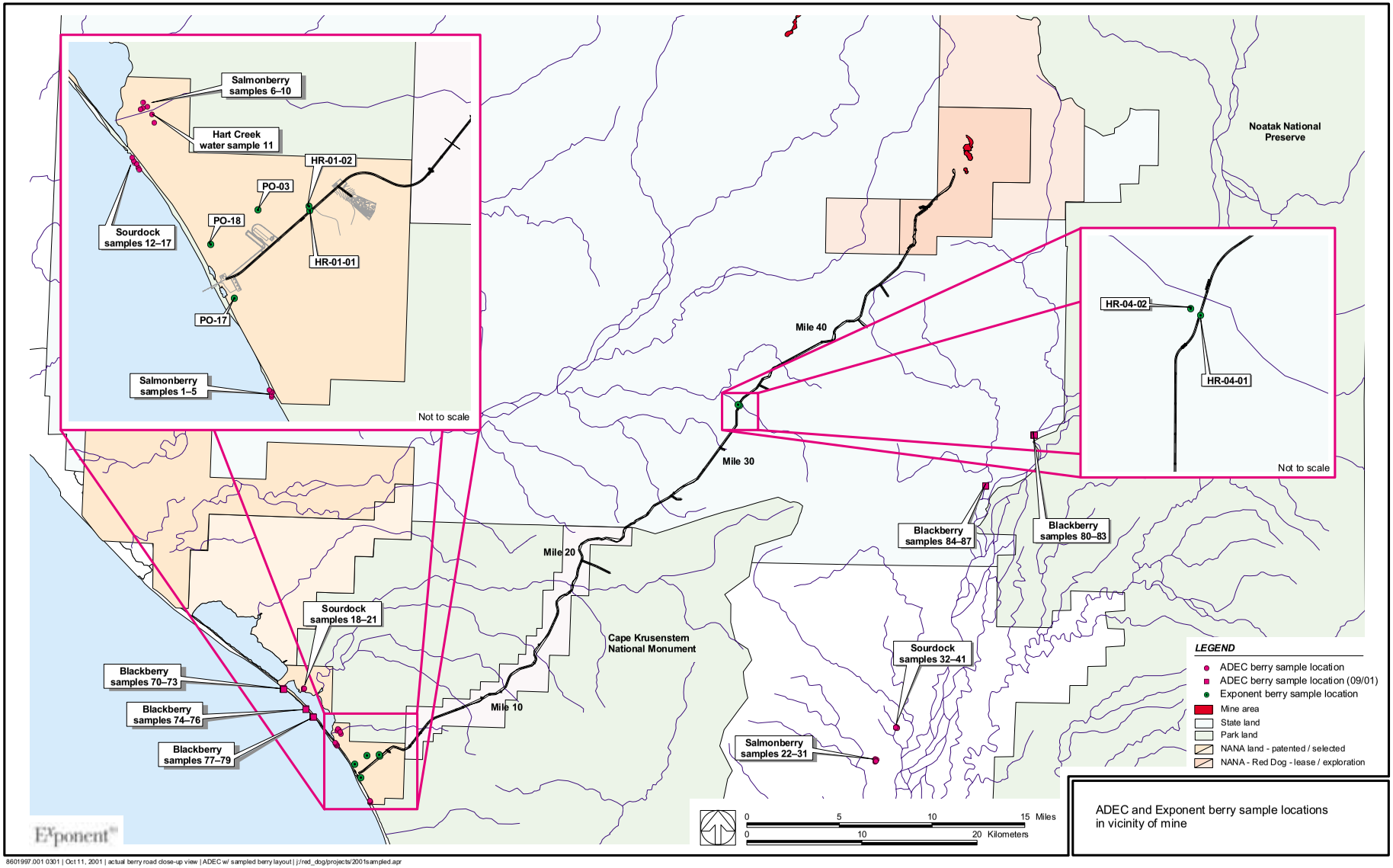

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WILD FOODS INVESTIGATION
Northwest, Alaska

Figure 3-1
SAMPLE LOCATION MAP

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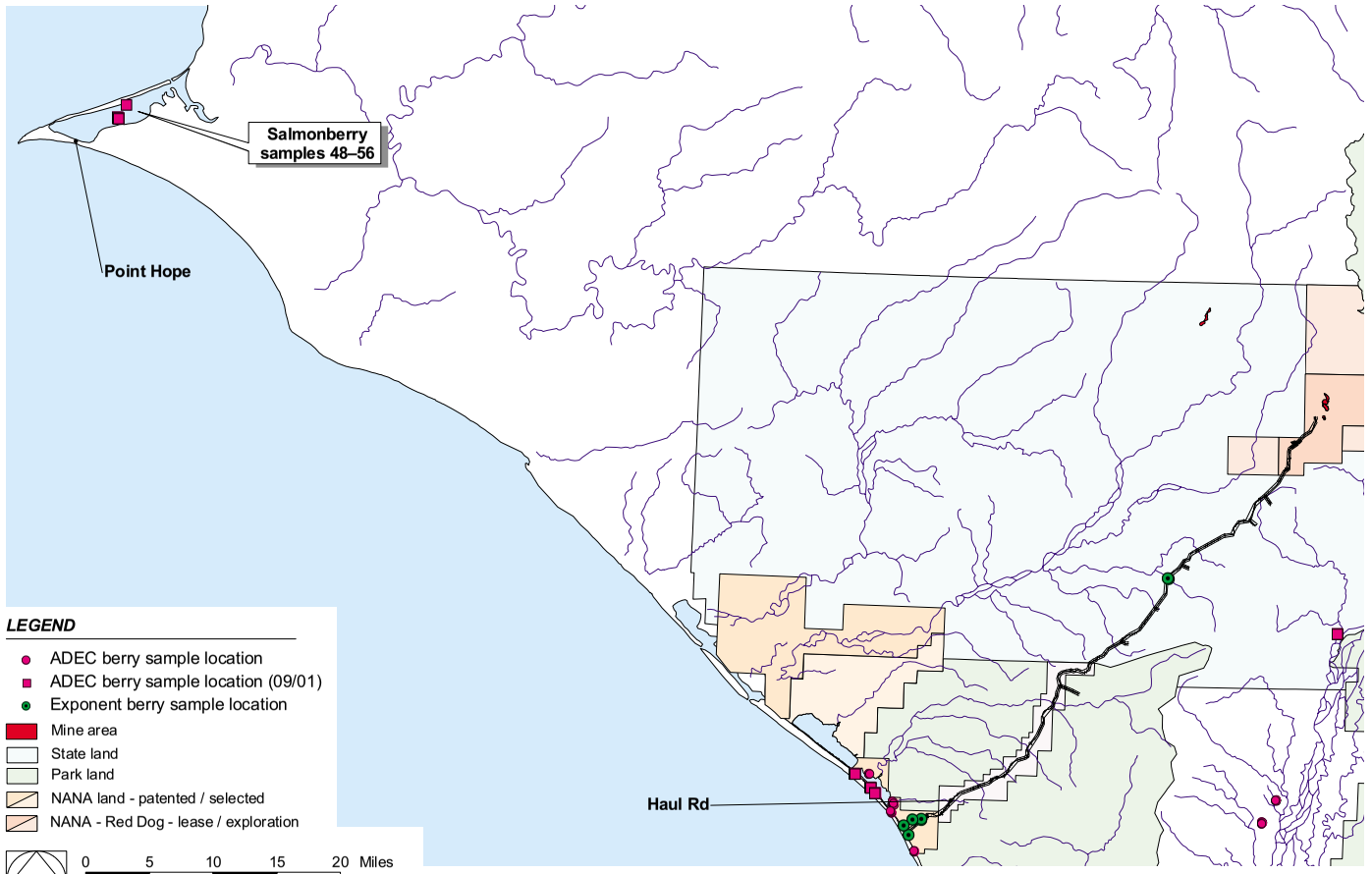

Point Hope berry samples

Exponent

8601997.001 0301 | Oct 11, 2001 | Pt Hope berry sampling | pt hope berry layout | j:/red_dog/projects/2001sampled.apr

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WILD FOODS INVESTIGATION
Northwest, Alaska

Figure 3-2
SAMPLE LOCATION MAP
FOR POINT HOPE

Date:	Drawn by:	
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Table 3-2 Sampling Event Summary; Wild Foods Investigation

Date	Location	Subsistence Foods Collected	Number of Samples	People Involved	Transportation Used
August 20, 2001	Port Site	Salmonberries Sour Dock	10 unwashed; 10 washed 10 washed; 10 unwashed	Enoch Shiedt - Maniilaq Austin Swan - Kivalina Jerry Norton - Kivalina Gerry Guay - DEC Barbara Trost - DEC Ben Martich - E & E Liz Maiers - Exponent	Helicopter from Kivalina
August 21, 2001	Port Site	Sour Dock	10 washed; 10 unwashed	Enoch Shiedt - Maniilaq Austin Swan - Kivalina Jerry Norton - Kivalina Nelda Swan - Kivalina Millie Hawley - Kivalina Gerry Guay - DEC Barbara Trost - DEC Ben Martich - E & E	Helicopter from Kivalina
August 22, 2001	Noatak	Salmonberries Sour Dock	10 washed; 10 unwashed 10 washed; 10 unwashed	Enoch Shiedt - Maniilaq Dwight Arnold - Noatak Roland Booth - Noatak Gerry Guay - DEC Barbara Trost - DEC Ben Martich - E & E	Helicopter from Port Site
September 7, 2001	Terminal	Salmonberries	4 unwashed	Walt Sandel - DEC	NA
September 19, 2001	Port Site	Blackberries	10 washed; 10 unwashed	Janet Mitchell - Kivalina Marilyn Booth - Kivalina Bob Mitchell - Kivalina Ben Martich - E & E	ATV from Kivalina
September 19, 2001	Point Hope	Salmonberries	10 unwashed	Jakie Koonuk - Point Hope Barbara Trost - DEC	ATV from Point Hope
September 20, 2001	Noatak	Blackberries	8 unwashed	Gretchen Booth - Noatak Gladys Mitchell - Noatak Stanley Norton - Noatak Ben Martich - E & E	Boat from Noatak

Key:

ATV = All terrain vehicle.
DEC = Alaska Department of Environmental Conservation.
E & E = Ecology and Environment, Inc.
NA = Not applicable.

Table 3-3 Sample Summary; Wild Foods Investigation

Sample Number	Date	Time	Data Set	Matrix	Washed Sample Collected
01DMT001SY	8/20/01	1620	Port Site	Salmonberry	Yes
01DMT002SY	8/20/01	1635	Port Site	Salmonberry	Yes
01DMT003SY	8/20/01	1648	Port Site	Salmonberry	Yes
01DMT004SY	8/20/01	1648	Port Site	Salmonberry	Yes
01DMT005SY	8/20/01	1700	Port Site	Salmonberry	Yes
01DMT006SY	8/20/01	1727	Port Site	Salmonberry	Yes
01DMT007SY	8/21/01	1250	Port Site	Salmonberry	Yes
01IDMT008SY	8/21/01	1258	Port Site	Salmonberry	Yes
01DMT009SY	8/21/01	1305	Port Site	Salmonberry	Yes
01IDMT010SY	8/21/01	1320	Port Site	Salmonberry	Yes
01DMT011WA	8/21/01	1330	New Hart Creek	Surface Water	NA
01DMT012SK	8/21/01	1408	Port Site	Sour Dock	Yes
01DMT013SK	8/21/01	1408	Port Site	Sour Dock	Yes
01DMT014SK	8/21/01	1422	Port Site	Sour Dock	Yes
01DMT015SK	8/21/01	1422	Port Site	Sour Dock	Yes
01DMT016SK	8/21/01	1430	Port Site	Sour Dock	Yes
01DMT017SK	8/21/01	1438	Port Site	Sour Dock	Yes
01DMT018SK	8/21/01	1517	Port Site	Sour Dock	Yes
01DMT019SK	8/21/01	1517	Port Site	Sour Dock	Yes
01DMT020SK	8/21/01	1522	Port Site	Sour Dock	Yes
01DMT021SK	8/21/01	1522	Port Site	Sour Dock	Yes
01DMT022SY	8/22/01	1405	Noatak	Salmonberry	Yes
01DMT023SY	8/22/01	1410	Noatak	Salmonberry	Yes
01DMT024SY	8/22/01	1420	Noatak	Salmonberry	Yes
01DMT025SY	8/22/01	1430	Noatak	Salmonberry	Yes
01DMT026SY	8/22/01	1435	Noatak	Salmonberry	Yes
01DMT027SY	8/22/01	1440	Noatak	Salmonberry	Yes
01DMT028SY	8/22/01	1450	Noatak	Salmonberry	Yes
01DMT029SY	8/22/01	1455	Noatak	Salmonberry	Yes
01DMT030SY	8/22/01	1500	Noatak	Salmonberry	Yes
01DMT031SY	8/22/01	1510	Noatak	Salmonberry	Yes
01DMT032SK	8/22/01	1545	Noatak	Sour Dock	Yes
01DMT033SK	8/22/01	1545	Noatak	Sour Dock	Yes
01DMT034SK	8/22/01	1545	Noatak	Sour Dock	Yes
01DMT035SK	8/22/01	1552	Noatak	Sour Dock	Yes
01DMT036SK	8/22/01	1555	Noatak	Sour Dock	Yes
01DMT037SK	8/22/01	1600	Noatak	Sour Dock	Yes
01DMT038SK	8/22/01	1607	Noatak	Sour Dock	Yes
01DMT039SK	8/22/01	1610	Noatak	Sour Dock	Yes
01DMT040SK	8/22/01	1614	Noatak	Sour Dock	Yes
01DMT041SK	8/22/01	1620	Noatak	Sour Dock	Yes
01DMT042WA	9/6/01	1645	Rinsate	Water	NA
01DMT043SY	9/7/01	0930	Terminal	Salmonberry	No
01DMT044SY	9/7/01	0945	Terminal	Salmonberry	No
01DMT045SY	9/7/01	0950	Terminal	Salmonberry	No
01DMT046SY	9/7/01	1000	Terminal	Salmonberry	No
01DMT047WA	8/21/01	1732	Wulik River	Surface Water	NA
01DMT048SY	9/19/01	1540	Point Hope	Salmonberry	No
01DMT049SY	9/19/01	1550	Point Hope	Salmonberry	No
01DMT050SY	9/19/01	1605	Point Hope	Salmonberry	No

Table 3-3 Sample Summary; Wild Foods Investigation

Sample Number	Date	Time	Data Set	Matrix	Washed Sample Collected
01DMT051SY	9/19/01	1620	Point Hope	Salmonberry	No
01DMT052SY	9/19/01	1530	Point Hope	Salmonberry	No
01DMT053SY	9/19/01	1540	Point Hope	Salmonberry	No
01DMT054SY	9/19/01	1635	Point Hope	Salmonberry	No
01DMT055SY	9/19/01	1655	Point Hope	Salmonberry	No
01DMT056SY	9/19/01	1730	Point Hope	Salmonberry	No
01DMT057SY	9/19/01	1735	Point Hope	Salmonberry	No
01DMT070BY	9/19/01	1150	Port Site	Blackberry	Yes
01DMT071BY	9/19/01	1205	Port Site	Blackberry	Yes
01DMT072BY	9/19/01	1217	Port Site	Blackberry	Yes
01DMT073BY	9/19/01	1230	Port Site	Blackberry	Yes
01DMT074BY	9/19/01	1305	Port Site	Blackberry	Yes
01DMT075BY	9/19/01	1315	Port Site	Blackberry	Yes
01DMT076BY	9/19/01	1330	Port Site	Blackberry	Yes
01DMT077BY	9/19/01	1346	Port Site	Blackberry	Yes
01DMT078BY	9/19/01	1355	Port Site	Blackberry	Yes
01DMT079BY	9/19/01	1405	Port Site	Blackberry	Yes
01DMT080BY	9/20/01	1415	Noatak	Blackberry	No
01DMT081BY	9/20/01	1415	Noatak	Blackberry	No
01DMT082BY	9/20/01	1430	Noatak	Blackberry	No
01DMT083BY	9/20/01	1440	Noatak	Blackberry	No
01DMT084BY	9/20/01	1515	Noatak	Blackberry	No
01DMT085BY	9/20/01	1515	Noatak	Blackberry	No
01DMT086BY	9/20/01	1535	Noatak	Blackberry	No
01DMT087BY	9/20/01	1535	Noatak	Blackberry	No
01DMT088WA	9/20/01	1830	Rinsate	Water	NA

Key:

NA = Not applicable.

Table 5-1 Analytical Results for Unwashed Samples; Dry Weight Analysis; Wild Foods Investigation

Sample Number	Metal Concentrations in mg/kg								
	Cadmium	Chromium	Cobalt	Copper	Lead	Manganese	Nickel	Selenium	Zinc
Salmonberries - Port Site									
01DMT001SY	0.103	0.223	0.0835	3.21	0.114	113	1.74	0.5 U	20.3
01DMT002SY	0.140	0.225	0.136	3.59	0.222	107	1.95	0.5 U	26.4
01DMT003SY	0.105	0.248	0.0856	2.99	0.263	151	1.35	0.5 U	20.1
01DMT004SY	0.131	0.232	0.110	4.01	0.162	163	2.79	0.5 U	20.3
01DMT005SY	0.150	0.223	0.147	4.17	0.225	160	2.73	0.5 U	23.4
01DMT006SY	0.201	0.213	0.0837	3.68	0.339	152	2.96	0.5 U	26.4
01DMT007SY	0.195	0.194	0.0857	4.08	0.289	118	2.60	0.5 U	24.1
01DMT008SY	0.241	0.241	0.105	4.20	0.204	103	2.37	0.5 U	29.5
01DMT009SY	0.166	0.237	0.0714	4.23	0.111	122	2.01	0.5 U	22.9
01DMT010SY	0.173	0.218	0.0803	4.38	0.161	102	2.39	0.5 U	22.9
Sour Dock - Port Site									
01DMT012SK	0.183	0.239 UB	0.449	4.08	2.77	183	1.78	0.091 JH	47.8
01DMT013SK	0.142	0.282 UB	0.480	3.46	2.07	70.5	1.76	0.202 JH	64.8
01DMT014SK	0.0527	0.269 UB	0.269	3.97	2.00	110	0.714	0.185 JH	27.8
01DMT015SK	0.0919	0.274 UB	0.296	3.43	2.24	86.4	1.26	0.213 JH	48.7
01DMT016SK	0.0767	0.279 UB	0.494	2.79	2.56	152	1.69	0.195 JH	49.9
01DMT017SK	0.109	0.299 UB	0.353	3.17	2.99	115	1.21	0.202 JH	41.8
01DMT018SK	0.0461	0.538 UB	0.964	3.42	0.391	240	3.08	0.250 JH	32.3
01DMT019SK	0.0209	0.523 UB	0.373	2.72	0.244	86.7	0.999	0.280 JH	18.7
01DMT020SK	0.0290	0.531 UB	0.422	3.73	0.279	102	0.890	0.202 JH	34.4
01DMT021SK	0.0371	0.671 UB	1.24	2.66	0.229	96.8	0.846	0.241 JH	26.4
Salmonberries - Noatak									
01DMT022SY	0.183	0.235 UB	0.0745	4.82	0.0058 J	150	2.19	0.135 JH	22.3
01DMT023SY	0.207	0.197 UB	0.0871	4.86	0.1154	204	2.57	0.174 JH	23.1
01DMT024SY	0.153	0.151 UB	0.0749	3.67	0.1885	139	2.10	0.138 JH	18.7
01DMT025SY	0.119	0.0950 UB	0.0525	3.09	0.0081 J	147	1.26	0.0858 JH	14.6
01DMT026SY	0.158	0.122 UB	0.100	3.79	0.0052 J	110	2.97	0.105 JH	21.9
01DMT027SY	0.188	0.137 UB	0.0792	5.21	0.007 J	181	2.04	0.113 JH	25.9
01DMT028SY	0.253	0.0897 UB	0.143	5.78	0.0036 J	102	3.65	0.103 JH	29.4
01DMT029SY	0.254	0.0909 UB	0.131	6.26	0.0093 J	206	4.98	0.142 JH	27.4
01DMT030SY	0.230	0.0984 UB	0.0870	4.69	0.0156 J	170	2.55	0.113 JH	25.1
01DMT031SY	0.220	0.0976 UB	0.0617	4.12	0.0081 J	162	2.36	0.0715 JH	20.2

Table 5-1 Analytical Results for Unwashed Samples; Dry Weight Analysis; Wild Foods Investigation

Sample Number	Metal Concentrations in mg/kg								
	Cadmium	Chromium	Cobalt	Copper	Lead	Manganese	Nickel	Selenium	Zinc
Sour Dock - Noatak									
01DMT032SK	0.656	0.219 UB	1.79	2.97	0.128	688	8.59	0.0322 JL	35.8
01DMT033SK	0.142	0.257 UB	0.238	4.68	0.152	168	4.83	0.0247 JL	43.7
01DMT034SK	0.125	0.155 UB	0.913	3.21	0.163	583	11.7	0.0474 JL	15.6
01DMT035SK	0.317	0.319 UB	1.61	3.68	0.133	606	6.52	0.0229 JL	78.1
01DMT036SK	0.137	0.199 UB	0.977	3.13	0.143	596	8.20	0.0445 JL	15.0
01DMT037SK	0.170	0.295 UB	0.233	4.90	0.116	214	6.09	0.0605 JL	41.7
01DMT038SK	0.327	0.180 UB	0.709	3.23	0.060	435	5.95	0.0554 JL	50.8
01DMT039SK	0.249	0.336 UB	0.532	3.47	0.170	423	6.69	0.0352 JL	26.0
01DMT040SK	0.261	0.311 UB	0.147	4.04	0.151	149	3.53	0.0326 JL	47.1
01DMT041SK	0.265	0.267 UB	0.697	3.47	0.119	471	5.79	0.0475 JL	73.7
Salmonberries - Terminal									
01DMT043SY	0.408	0.131 UB	0.0776	4.56	1.38	146	2.84	0.5 UL	31.9
01DMT044SY	0.395	0.109 UB	0.0823	4.60	1.19	96.4	5.40	0.5 UL	31.4
01DMT045SY	0.553	0.108 UB	0.0917	4.58	1.66	98.0	3.87	0.5 UL	31.0
01DMT046SY	0.379	0.129 UB	0.0780	4.25	1.97	170	1.94	0.5 UL	30.4
Salmonberries - Point Hope									
01DMT048SY	0.155	0.258 UB	0.449	4.09	0.0099 J	259	1.60	0.562 JH	19.1
01DMT049SY	0.121	0.269 UB	0.574	3.80	0.0098 J	238	1.20	0.573 JH	17.6
01DMT050SY	0.223	0.383 UB	0.178	3.67	0.0117 J	318	0.703	0.392 JH	18.2
01DMT051SY	0.281	0.340 UB	0.243	4.25	0.0096 J	258	1.34	0.707 JH	21.4
01DMT052SY	0.242	0.410 UB	0.394	4.81	0.0100 J	254	1.50	0.611 JH	19.4
01DMT053SY	0.195	0.357 UB	0.323	4.49	0.0187 J	261	1.33	0.677 JH	20.0
01DMT054SY	0.231	0.428 UB	0.246	4.99	0.0141 J	242	1.88	0.699 JH	23.8
01DMT055SY	0.295	0.387 UB	0.194	4.02	0.0113 J	345	1.79	0.891 JH	21.7
01DMT056SY	0.162	0.327 UB	0.206	4.96	0.0126 J	273	1.86	0.658 JH	24.0
01DMT057SY	0.171	0.386 UB	0.137	4.23	0.0153 J	253	1.28	0.597 JH	21.4
Blackberries - Port Site									
01DMT070BY	0.01 U	0.210 UB	0.00344	2.24	0.239	52.9	0.04 U	0.5 U	4.61
01DMT071BY	0.01 U	0.226 UB	0.00307	2.06	0.0868	30.1	0.04 U	0.5 U	4.07 B
01DMT072BY	0.01 U	0.207 UB	0.00542	2.84	0.133	45.8	0.726	0.5 U	4.64
01DMT073BY	0.01 U	0.401 UB	0.00777	2.54	0.094	41.0	0.04 U	0.0730 JH	4.21 B
01DMT074BY	0.01 U	0.398 UB	0.003 U	3.11	0.204	37.2	0.213	0.5 U	4.64
01DMT075BY	0.0186	0.420 UB	0.00707	3.54	0.254	39.0	0.166	0.115 JH	7.33
01DMT076BY	0.0230	0.415 UB	0.00972	3.80	0.146	28.2	0.134	0.0684 JH	5.42
01DMT077BY	0.01 U	0.222 UB	0.00348	3.72	0.280	39.4	0.04 U	0.148 JH	5.80
01DMT078BY	0.01 U	0.348 UB	0.003 U	2.48	0.235	16.6	0.04 U	0.5 U	4.29
01DMT079BY	0.01 U	0.341 UB	0.003 U	3.34	0.153	18.8	0.04 U	0.293 JH	4.74

Table 5-1 Analytical Results for Unwashed Samples; Dry Weight Analysis; Wild Foods Investigation

Sample Number	Metal Concentrations in mg/kg								
	Cadmium	Chromium	Cobalt	Copper	Lead	Manganese	Nickel	Selenium	Zinc
Blackberries - Noatak									
01DMT080BY	0.01 U	0.419 UB	0.00884	3.61	0.0525	48.0	0.04 U	0.5 U	15.9
01DMT081BY	0.01 U	0.274 UB	0.00730	4.08	0.0369	41.2	0.126	0.297 JH	5.98
01DMT082BY	0.01 U	0.295 UB	0.00609	3.91	0.0502	45.6	0.0824	0.227 JH	6.76
01DMT083BY	0.0129	0.469 UB	0.0131	4.42	0.107	60.9	0.124	0.452 JH	9.94
01DMT084BY	0.01 U	0.367 UB	0.00783	4.79	0.0383	28.4	0.04 U	0.488 JH	7.53
01DMT085BY	0.01 U	0.386 UB	0.00908	4.40	0.0336	35.3	0.04 U	0.150 JH	17.9
01DMT086BY	0.01 U	0.282 UB	0.00920	4.33	0.0273	37.7	0.04 U	0.324 JH	5.98
01DMT087BY	0.01 U	0.306 UB	0.0108	4.19	0.0324	44.1	0.04 U	0.416 JH	6.30

Key:

B = Less than five times mean blank concentration.
J = Reported below detection limit. Estimated value.
JH = Estimated value that has been biased high. Recovery of standard reference materials was significantly higher than quality control limits.
JL = Estimated value that has been biased low. Recovery of standard reference materials was significantly below quality control limits.
mg/kg = Milligrams per kilogram.
U = Not detected at or above detection limit shown.
UB = Not detected because of blank contamination. The analyte was detected at a level within five times the associated blank level.
UL = Undetected value may be subject to low bias.

Table 5-2 Analytical Results for Washed Samples; Dry Weight Analysis; Wild Foods Investigation

	Metal Concentrations (mg/kg)								
Sample Number	Cadmium	Chromium	Cobalt	Copper	Lead	Manganese	Nickel	Selenium	Zinc
Salmonberries - Port Site									
01DMT001SYC	0.111	0.177	0.0765	3.24	0.138	130	1.39	0.5 U	22.1
01DMT002SYC	0.135	0.212	0.116	2.08	0.370	292	1.17	0.5 U	19.8
01DMT003SYC	0.113	0.250	0.116	3.59	0.116	123	1.51	0.5 U	18.1
01DMT004SYC	0.134	0.235	0.116	3.76	0.136	224	2.61	0.5 U	20.9
01DMT005SYC	0.138	0.228	0.136	4.00	0.104	137	3.00	0.5 U	19.9
01DMT006SYC	0.195	0.254	0.0757	4.64	0.260	131	3.72	0.5 U	22.6
01DMT007SYC	0.203	0.206	0.0997	3.54	0.271	155	2.14	0.5 U	20.6
01DMT008SYC	0.246	0.228	0.107	4.61	0.132	92.7	3.05	0.5 U	27.3
01DMT009SYC	0.190	0.212	0.0921	3.87	0.174	100	2.33	0.5 U	23.0
01DMT010SYC	0.245	0.213	0.113	5.47	0.235	88.2	3.45	0.5 U	26.4
Sour Dock - Port Site									
01DMT012SKC	0.120	0.239 UB	0.724	3.38	1.54	162	1.68	0.196 JH	39.7
01DMT013SKC	0.139	0.343 UB	0.773	3.33	2.37	151	2.14	0.248 JH	129
01DMT014SKC	0.116	0.299 UB	0.280	3.63	1.76	80.0	0.917	0.192 JH	38.1
01DMT015SKC	0.0624	0.284 UB	0.442	3.41	1.71	95.9	1.33	0.215 JH	76.4
01DMT016SKC	0.144	0.293 UB	0.461	3.11	2.87	175	1.55	0.158 JH	62.5
01DMT017SKC	0.0790	0.296 UB	0.275	3.38	3.04	86.2	1.49	0.164 JH	59.2
01DMT018SKC	0.0338	0.649 UB	0.599	4.48	0.626	122	1.74	0.219 JH	39.1
01DMT019SKC	0.0236	0.479 UB	0.408	3.80	0.244	105	1.23	0.341 JH	38.5
01DMT020SKC	0.0341	0.564 UB	0.494	3.84	0.389	138	1.40	0.204 JH	70.8
01DMT021SKC	0.0271	0.605 UB	0.328	3.12	0.516	75.3	0.594	0.377 JH	29.3
Salmonberries - Noatak									
01DMT022SYC	0.239	0.196 UB	0.0905	5.60	0.00415 J	198	3.22	0.111 JH	25.1
01DMT023SYC	0.247	0.170 UB	0.0797	5.72	0.0121 J	207	2.67	0.0724 JH	22.8
01DMT024SYC	0.158	0.135 UB	0.0688	4.38	0.00342 J	123	1.95	0.103 JH	20.3
01DMT025SYC	0.0992	0.130 UB	0.0494	4.50	0.0545	110	1.44	0.119 JH	21.9
01DMT026SYC	0.139	0.137 UB	0.125	3.83	0.00309 J	120	2.83	0.111 JH	19.4
01DMT027SYC	0.260	0.138 UB	0.0843	5.09	0.00491 J	202	2.47	0.125 JH	26.7
01DMT028SYC	0.252	0.0852 UB	0.137	5.12	0.00795 J	126	2.66	0.0668 JH	25.0
01DMT029SYC	0.193	0.0847 UB	0.162	2.80	0.00422 J	134	2.67	0.0940 JH	17.0
01DMT030SYC	0.198	0.0993 UB	0.0694	4.68	0.0112 J	156	2.55	0.0967 JH	24.7
01DMT031SYC	0.236	0.0835 UB	0.0814	7.38	0.00494 J	242	3.14	0.0608 JH	21.3

Table 5-2 Analytical Results for Washed Samples; Dry Weight Analysis; Wild Foods Investigation

Sample Number	Metal Concentrations (mg/kg)								
	Cadmium	Chromium	Cobalt	Copper	Lead	Manganese	Nickel	Selenium	Zinc
Sour Dock - Noatak									
01DMT032SKC	0.542	0.222 UB	1.83	3.30	0.132	589	7.96	0.0560 JL	34.8
01DMT033SKC	0.182	0.309 UB	0.562	4.15	0.163	273	6.06	0.0665 JL	56.0
01DMT034SKC	0.105	0.148 UB	0.609	3.21	0.339	537	9.44	0.0466 JL	32.9
01DMT035SKC	0.279	0.237 UB	1.35	3.56	0.129	382	6.38	0.5 UL	46.6
01DMT036SKC	0.169	0.204 UB	1.21	3.21	0.108	855	12.6	0.233 JL	12.3
01DMT037SKC	0.131	0.269 UB	0.296	3.83	0.112	244	5.16	0.0628 JL	38.3
01DMT038SKC	0.202	0.196 UB	0.524	3.58	0.0833	323	5.43	0.00842 JL	44.1
01DMT039SKC	0.201	0.220 UB	0.521	4.01	0.170	355	7.04	0.0650 JL	33.2
01DMT040SKC	0.194	0.190 UB	0.111	3.83	0.150	118	3.26	0.0488 JL	49.9
01DMT041SKC	0.278	0.236 UB	1.13	3.49	0.133	449	5.29	0.0118 JL	65.1
Blackberries - Port Site									
01DMT070BYC	0.01 U	0.237 UB	0.003 U	2.70	0.0943	62.5	0.04 U	0.5 U	4.53
01DMT071BYC	0.01 U	0.387 UB	0.003 U	2.93	0.164	37.1	0.04 U	0.5 U	5.85
01DMT072BYC	0.01 U	0.364 UB	0.00738	2.93	0.181	47.7	0.04 U	0.263 JH	5.68
01DMT073BYC	0.01 U	0.341 UB	0.003 U	2.40	0.0907	34.5	0.04 U	0.217 JH	3.37 B
01DMT074BYC	0.01 U	0.462 UB	0.003 U	3.29	0.141	39.9	0.165	0.5 U	4.11 B
01DMT075BYC	0.01 U	0.419 UB	0.003 U	4.03	0.178	30.0	0.231	0.0582 JH	5.18
01DMT076BYC	0.01 U	0.465 UB	0.003 U	3.87	0.182	34.8	0.0727	0.144 JH	5.60
01DMT077BYC	0.01 U	0.326 UB	0.00304	4.36	0.149	29.2	0.04 U	0.302 JH	5.87
01DMT078BYC	0.01 U	0.326 UB	0.003 U	2.59	0.129	20.1	0.04 U	0.232 JH	4.46
01DMT079BYC	0.01 U	0.429 UB	0.003 U	2.66	0.209	29.3	0.0894	0.136 JH	4.93

Key:

B = Less than five times mean blank concentration.
J = Reported below detection limit. Estimated value.
JH = Estimated value that has been biased high. Recovery of standard reference materials was significantly higher than quality control limits.
JL = Estimated value that has been biased low. Recovery of standard reference materials was significantly below quality control limits.
mg/kg = Milligrams per kilogram.
U = Not detected at or above detection limit shown.
UB = Not detected because of blank contamination. The analyte was detected at a level within five times the associated blank level.
UL = Undetected value may be subject to low bias.

Table 5-3 Comparison of Unwashed Sample Sets; Dry Weight Analysis; Wild Foods Investigation

Location and Statistic	Metals (mg/kg)								
	Cadmium	Chromium	Cobalt	Copper	Lead	Manganese	Nickel	Selenium	Zinc
Salmonberries - Port Site									
Number of Samples	10	10	10	10	10	10	10	10	10
Mean	0.161	0.225	0.099	3.85	0.209	129	2.29	0.25	23.6
Standard Deviation	0.044	0.015	0.025	0.47	0.074	24.6	0.51	0	3.09
Minimum	0.103	0.194	0.0714	2.99	0.111	102	1.35	0.25	20.1
Maximum	0.241	0.248	0.147	4.38	0.339	163	2.96	0.25	29.5
Lower 95% conf limit	0.129	0.214	0.081	3.52	0.156	112	1.92	NA	21.4
Upper 95% conf limit	0.192	0.236	0.117	4.19	0.262	147	2.66	NA	25.8
Salmonberries - Terminal									
Number of Samples	4	4	4	4	4	4	4	4	4
Mean	0.434	0.119	0.0824	4.50	1.55	128	3.51	0.25	31.2
Standard Deviation	0.080	0.012	0.00655	0.17	0.340	36.5	1.48	0	0.63
Minimum	0.379	0.108	0.0776	4.25	1.19	96.4	1.94	0.25	30.4
Maximum	0.553	0.131	0.0917	4.60	1.97	170	5.40	0.25	31.9
Lower 95% conf limit	0.306	0.099	0.07197	4.23	1.01	69.6	1.15	NA	30.2
Upper 95% conf limit	0.562	0.139	0.093	4.76	2.09	186	5.88	NA	32.2
Salmonberries - Point Hope									
Number of Samples	10	10	10	10	10	10	10	10	10
Mean	0.208	0.355	0.294	4.33	0.0123	270	1.45	0.637	20.7
Standard Deviation	0.057	0.057	0.139	0.47	0.0030	34.4	0.360	0.128	2.19
Minimum	0.121	0.258	0.137	3.67	0.00956	238	0.703	0.392	17.6
Maximum	0.295	0.428	0.574	4.99	0.0187	345	1.88	0.891	24.0
Lower 95% conf limit	0.167	0.314	0.195	4.00	0.01018	246	1.19	0.545	19.1
Upper 95% conf limit	0.248	0.395	0.394	4.67	0.01442	295	1.71	0.728	22.2
Salmonberries - Noatak									
Number of Samples	10	10	10	10	10	10	10	10	10
Mean	0.196	0.131	0.08917	4.63	0.03664	157	2.67	0.118	22.9
Standard Deviation	0.044	0.050	0.02873	0.98	0.06325	35.1	1.03	0.030	4.36
Minimum	0.119	0.0897	0.05252	3.09	0.00358	102	1.26	0.072	14.6
Maximum	0.254	0.235	0.143	6.26	0.1885	206	4.98	0.174	29.4
Lower 95% conf limit	0.165	0.096	0.069	3.93	-0.0086	132	1.93	0.097	19.7
Upper 95% conf limit	0.228	0.167	0.110	5.33	0.08189	182	3.40	0.139	26.0
Sour Dock - Port Site									
Number of Samples	10	10	10	10	10	10	10	10	10
Mean	0.0788	0.390	0.533	3.34	1.58	124	1.42	0.206	39.3
Standard Deviation	0.0530	0.157	0.314	0.50	1.15	52.6	0.701	0.050	13.8
Minimum	0.02094	0.239	0.269	2.66	0.229	70.5	0.714	0.091	18.7
Maximum	0.183	0.671	1.24	4.08	2.99	240	3.08	0.280	64.8
Lower 95% conf limit	0.04091	0.278	0.309	2.98	0.754	86.6	0.921	0.170	29.4
Upper 95% conf limit	0.11668	0.503	0.758	3.70	2.40	162	1.92	0.242	49.1

Table 5-3 Comparison of Unwashed Sample Sets; Dry Weight Analysis; Wild Foods Investigation

Location and Statistic	Metals (mg/kg)								
	Cadmium	Chromium	Cobalt	Copper	Lead	Manganese	Nickel	Selenium	Zinc
Sour Dock - Noatak									
Number of Samples	10	10	10	10	10	10	10	10	10
Mean	0.265	0.254	0.785	3.68	0.134	433	6.79	0.040	42.8
Standard Deviation	0.156	0.063	0.56099	0.66	0.031	196	2.26	0.013	21.4
Minimum	0.125	0.155	0.147	2.97	0.060	149	3.53	0.023	15.0
Maximum	0.656	0.336	1.79	4.90	0.170	688	11.7	0.061	78.1
Lower 95% conf limit	0.153	0.209	0.383	3.20	0.11102	293	5.17	0.031	27.4
Upper 95% conf limit	0.377	0.299	1.19	4.15	0.15598	573	8.41	0.049	58.1
Blackberries - Port Site									
Number of Samples	10	10	10	10	10	10	10	10	10
Mean	0.00816	0.319	0.004	2.97	0.182	34.9	0.136	0.195	4.98
Standard Deviation	0.00674	0.09201	0.003	0.63	0.069	11.5	0.22002	0.084	0.984
Minimum	0.005	0.207	0.002	2.06	0.0868	16.6	0.02	0.068	4.07
Maximum	0.023	0.420	0.010	3.80	0.280	52.9	0.726	0.293	7.33
Lower 95% conf limit	0.00334	0.25298	0.002	2.52	0.133	26.7	-0.021	0.134	4.27
Upper 95% conf limit	0.01298	0.385	0.007	3.42	0.232	43.1	0.293	0.255	5.68
Blackberries - Noatak									
Number of Samples	8	8	8	8	8	8	8	8	8
Mean	0.00599	0.350	0.009	4.22	0.04728	42.7	0.054	0.3255	9.54
Standard Deviation	0.00279	0.072	0.002	0.36	0.02563	9.68	0.049	0.11809	4.75
Minimum	0.005	0.274	0.006	3.61	0.0273	28.4	0.02	0.15	5.98
Maximum	0.0129	0.469	0.013	4.79	0.107	60.9	0.126	0.488	17.9
Lower 95% conf limit	0.00365	0.290	0.007	3.92	0.02585	34.6	0.013	0.22677	5.56
Upper 95% conf limit	0.00832	0.410	0.011	4.52	0.0687	50.7	0.095	0.42423	13.5

Key:

conf = Confidence.
mg/kg= Milligrams per kilogram.
NA = Not applicable.

Table 5-4 Comparison of Washed Sample Sets; Dry Weight Analysis; Wild Foods Investigation

Location and Statistic	Metals (mg/kg)								
	Cadmium	Chromium	Cobalt	Copper	Lead	Manganese	Nickel	Selenium	Zinc
Salmonberries - Port Site									
Number of Samples	10	10	10	10	10	10	10	10	10
Mean	0.171	0.222	0.105	3.88	0.194	147	2.44	0.25	22.1
Standard Deviation	0.0514	0.02263	0.0190	0.914	0.08684	64.0	0.885	0	2.91
Minimum	0.111	0.177	0.0757	2.08	0.104	88.2	1.17	0.25	18.1
Maximum	0.246	0.254	0.136	5.47	0.370	292	3.72	0.25	27.3
Lower 95% Conf Limit	0.134	0.205	0.091	3.23	0.131	102	1.80	NA	20.0
Upper 95% Conf Limit	0.208	0.238	0.118	4.53	0.256	193	3.07	NA	24.2
Salmonberries - Noatak									
Number of Samples	10	10	10	10	10	10	10	10	10
Mean	0.202	0.126	0.09465	4.91	0.0110	162	2.56	0.0960	22.4
Standard Deviation	0.05488	0.03821	0.0350	1.22	0.01561	46.5	0.529	0.0225	3.03
Minimum	0.09917	0.08345	0.04944	2.80	0.00309	110	1.44	0.06082	17.0
Maximum	0.260	0.196	0.162	7.38	0.05453	242	3.22	0.125	26.7
Lower 95% Conf Limit	0.163	0.099	0.06959	4.04	-0.0001	129	2.18	0.07994	20.3
Upper 95% Conf Limit	0.241	0.153	0.120	5.78	0.0222	195	2.94	0.112	24.6
Sour Dock - Port Site									
Number of Samples	10	10	10	10	10	10	10	10	10
Mean	0.07787	0.405	0.478	3.55	1.51	119	1.41	0.231	58.3
Standard Deviation	0.04823	0.153	0.174	0.411	1.04	35.9	0.434	0.0727	29.6
Minimum	0.02364	0.239	0.275	3.11	0.244	75.3	0.594	0.158	29.3
Maximum	0.144	0.649	0.773	4.48	3.04	175	2.14	0.377	129
Lower 95% Conf Limit	0.043	0.295	0.354	3.25	0.766	93.3	1.10	0.179	37.1
Upper 95% Conf Limit	0.112	0.515	0.603	3.84	2.25	145	1.72	0.283	79.5
Sour Dock - Noatak									
Number of Samples	10	10	10	10	10	10	10	10	10
Mean	0.228	0.223	0.814	3.62	0.152	413	6.86	0.110	41.3
Standard Deviation	0.123	0.04434	0.53895	0.330	0.07068	208	2.63	0.151	14.6
Minimum	0.105	0.148	0.111	3.21	0.0833	118	3.26	0.00842	12.3
Maximum	0.542	0.309	1.83	4.15	0.339	855	12.6	0.5	65.1
Lower 95% Conf Limit	0.140	0.191	0.429	3.38	0.101	263	4.98	0.00219	30.9
Upper 95% Conf Limit	0.316	0.255	1.20	3.85	0.202	562	8.74	0.218	51.8

Table 5-4 Comparison of Washed Sample Sets; Dry Weight Analysis; Wild Foods Investigation

Location and Statistic	Metals (mg/kg)								
	Cadmium	Chromium	Cobalt	Copper	Lead	Manganese	Nickel	Selenium	Zinc
Blackberries - Port Site									
Number of Samples	10	10	10	10	10	10	10	10	10
Mean	0.005	0.376	0.00224	3.18	0.152	36.5	0.06781	0.210	4.96
Standard Deviation	0	0.07132	0.00187	0.682	0.03881	11.7	0.07475	0.07415	0.836
Minimum	0.005	0.237	0.0015	2.40	0.0907	20.1	0.02	0.0582	3.37
Maximum	0.005	0.465	0.00738	4.36	0.209	62.5	0.231	0.302	5.87
Lower 95% Conf Limit	NA	0.325	0.0009	2.69	0.124	28.1	0.0143	0.157	4.36
Upper 95% Conf Limit	NA	0.427	0.00358	3.66	0.180	44.9	0.121	0.263	5.56

Key:

Conf = Confidence.
mg/kg= Milligrams per kilogram.
NA = Not applicable.

Table 5-5 Comparison of Data Set Means; Dry Weight Analysis; Wild Foods Investigation

		Metal Concentrations in mg/kg								
		Cadmium	Chromium	Cobalt	Copper	Lead	Manganese	Nickel	Selenium	Zinc
Salmonberries - Port Site										
Unwashed	Mean	0.161	0.225	0.099	3.85	0.209	129	2.29	0.025	23.6
Washed	Mean	0.171	0.222	0.105	3.88	0.194	147	2.44	0.025	22.1
Sour Dock - Port Site										
Unwashed	Mean	0.0788	0.390	0.533	3.34	1.58	124	1.42	0.206	39.3
Washed	Mean	0.0779	0.405	0.478	3.55	1.51	119	1.41	0.231	58.3
Salmonberries - Noatak										
Unwashed	Mean	0.196	0.131	0.0892	4.63	0.0366	157	2.67	0.118	22.9
Washed	Mean	0.202	0.126	0.0946	4.91	0.0110	162	2.56	0.0960	22.4
Sour Dock - Noatak										
Unwashed	Mean	0.265	0.254	0.785	3.68	0.134	433	6.79	0.04029	42.8
Washed	Mean	0.228	0.223	0.814	3.62	0.152	413	6.86	0.110	41.3
Blackberries - Port Site										
Unwashed	Mean	0.0082	0.319	0.0044	2.97	0.182	34.9	0.136	0.195	4.98
Washed	Mean	0.0050	0.376	0.0021	3.18	0.152	36.5	0.0678	0.210	4.96

Note: Red highlight indicates that concentration is greater than that of the matched washed/unwashed counterpart.

Key:

mg/kg = Milligrams per kilogram.

Table 5-6 Analytical Results for Rinsate Water Samples; Wild Foods Investigation

Sample Number	Metal Concentrations in µg/L								
	Cadmium	Chromium	Cobalt	Copper	Lead	Manganese	Nickel	Selenium	Zinc
Rinsate Water Samples									
01DMT042WA	0.0149	0.231 B	0.003 U	0.159	0.907	0.609 B	0.04 U	0.5 U	0.223
01DMT088WA	0.01 U	0.03 U	0.003 U	0.0417	0.180	0.236 B	0.04 U	0.106 J	0.221

Key:

B = Less than five times mean blank concentration.
J = Reported below detection limit. Estimated value.
µg/L = Micrograms per liter.
U = Not detected at or above detection limit shown.

Table 5-7 Analytical Results for Water Samples; Wild Foods Investigation

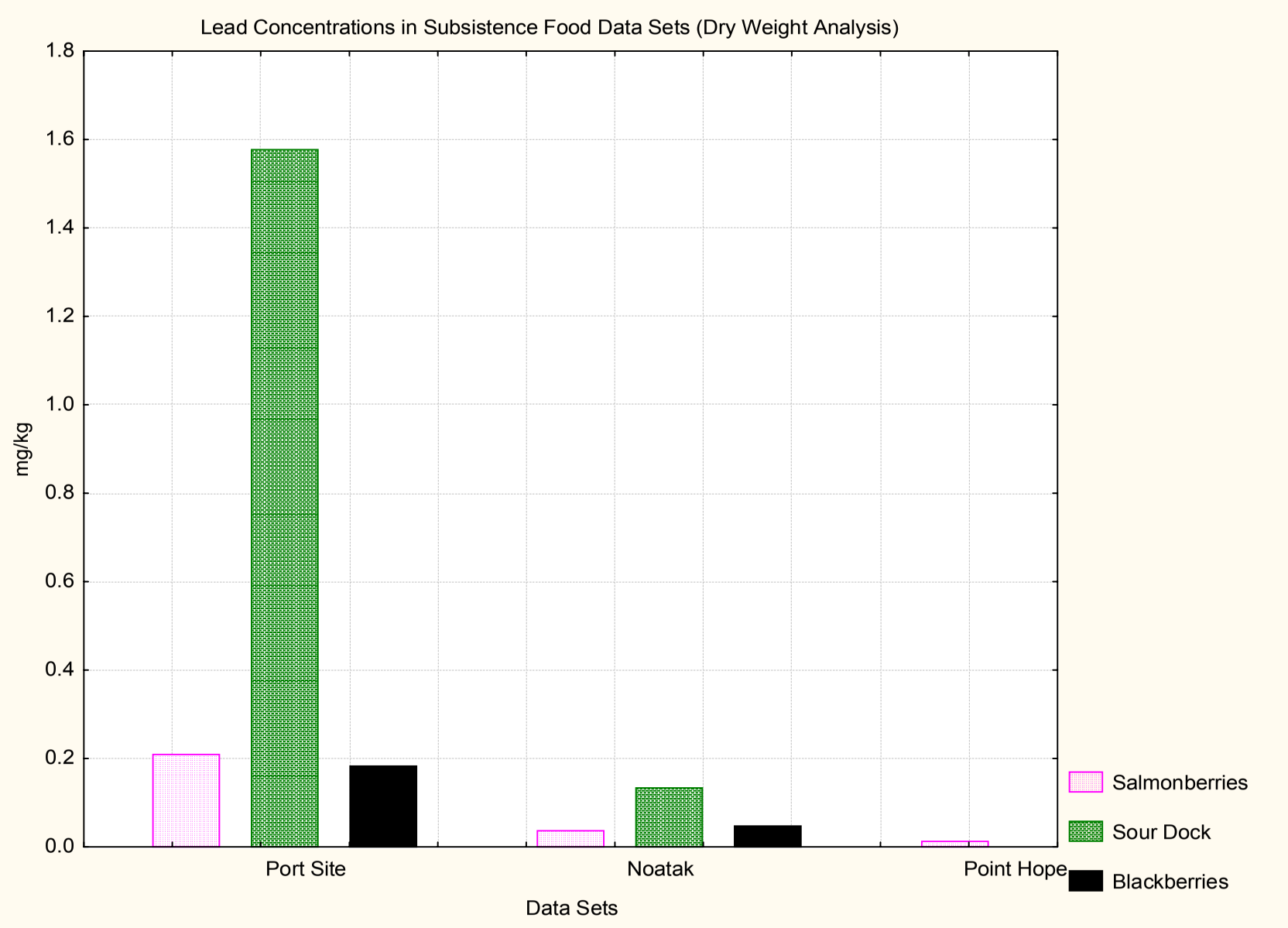
Sample Number	Location	Metal Concentrations in µg/L								
		Cadmium	Chromium	Cobalt	Copper	Lead	Manganese	Nickel	Selenium	Zinc
01DMT011WA	New Hart Creek	0.0241	0.546 B	0.163	1.14	0.317	9.38	0.444	0.293 J	2.97
01DMT047WA	Wulik River	0.112	0.82	0.229	1.07	0.648	20.7	0.04 U	1.14	13.6
ADEC Drinking Water Standards		5	100	---	1,000	15	50	100	50	5,000

Source: 18 AAC 80.300 and 18 AAC 80.510.

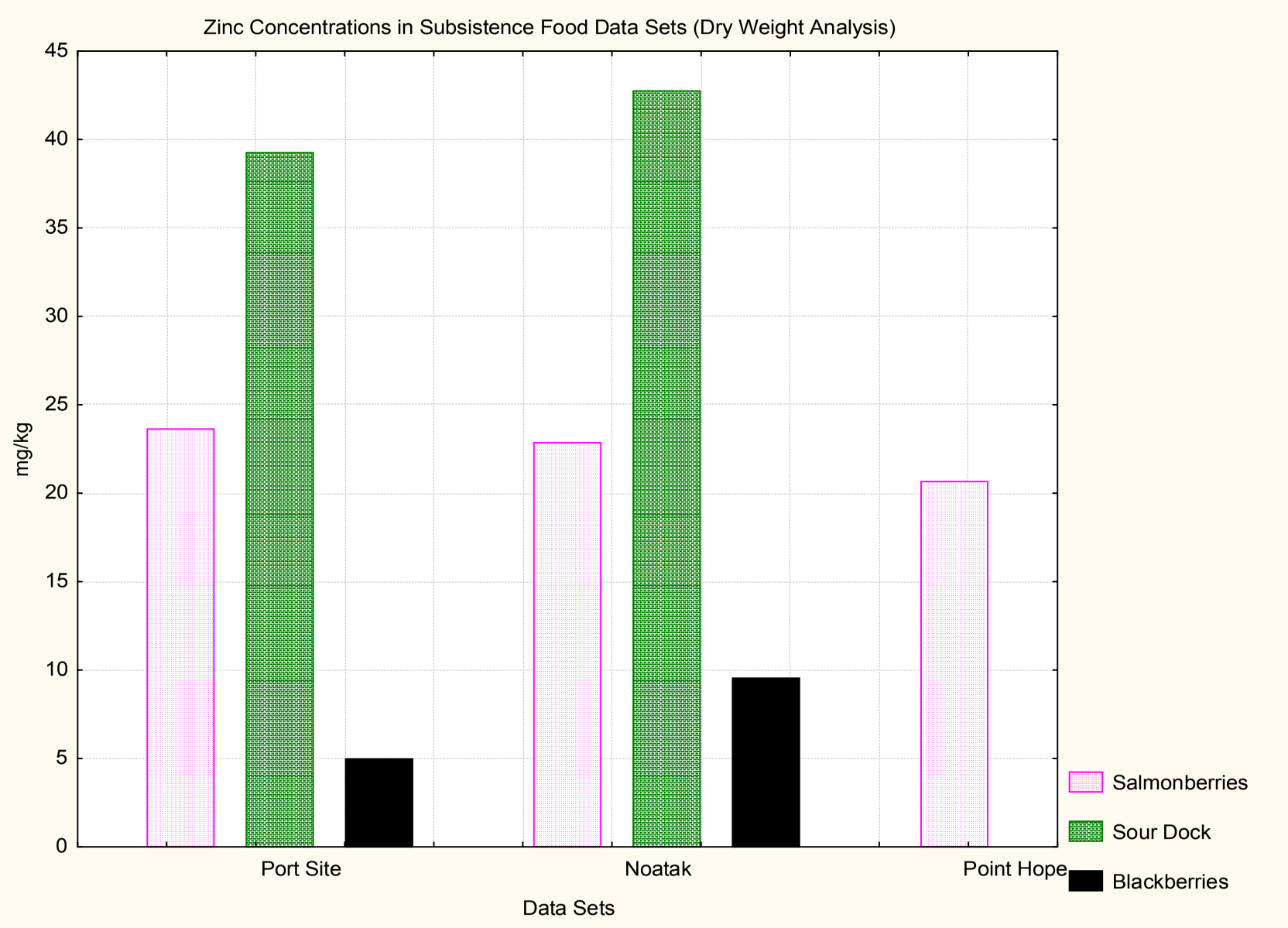
Key:

AAC = Alaska Administrative Code.
ADEC= Alaska Department of Environmental Conservation.
B = Less than five times mean blank concentration.
J= Reported below detection limit. Estimated value.
µg/L = Micrograms per liter.
U = Not detected at or above detection limit shown.

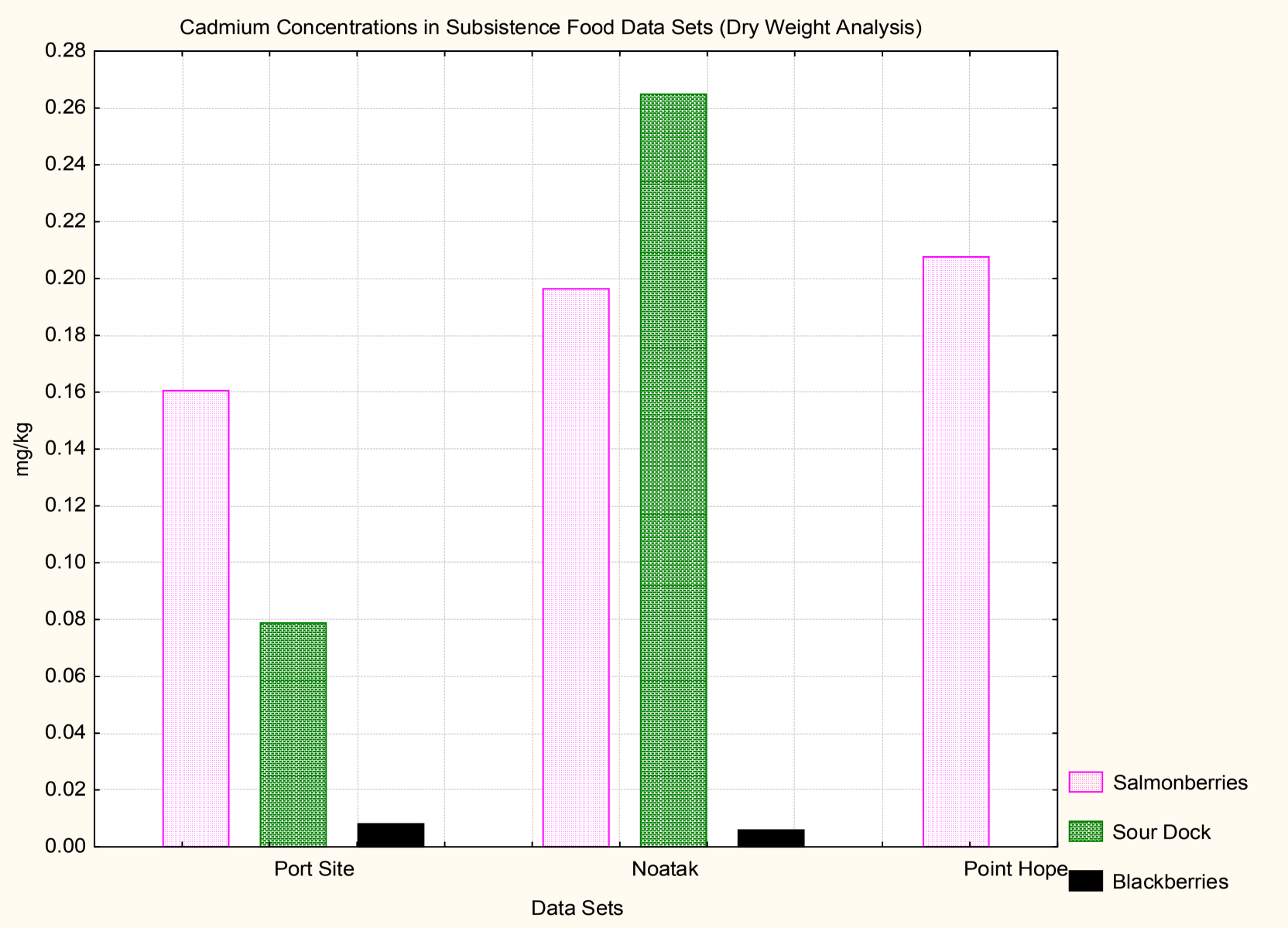
Graph 1


Lead Concentrations in Subsistence Food Data Sets (Dry Weight Analysis)
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
mg/kg
Port Site
Noatak
Point Hope
Data Sets
Salmonberries
Sour Dock
Blackberries

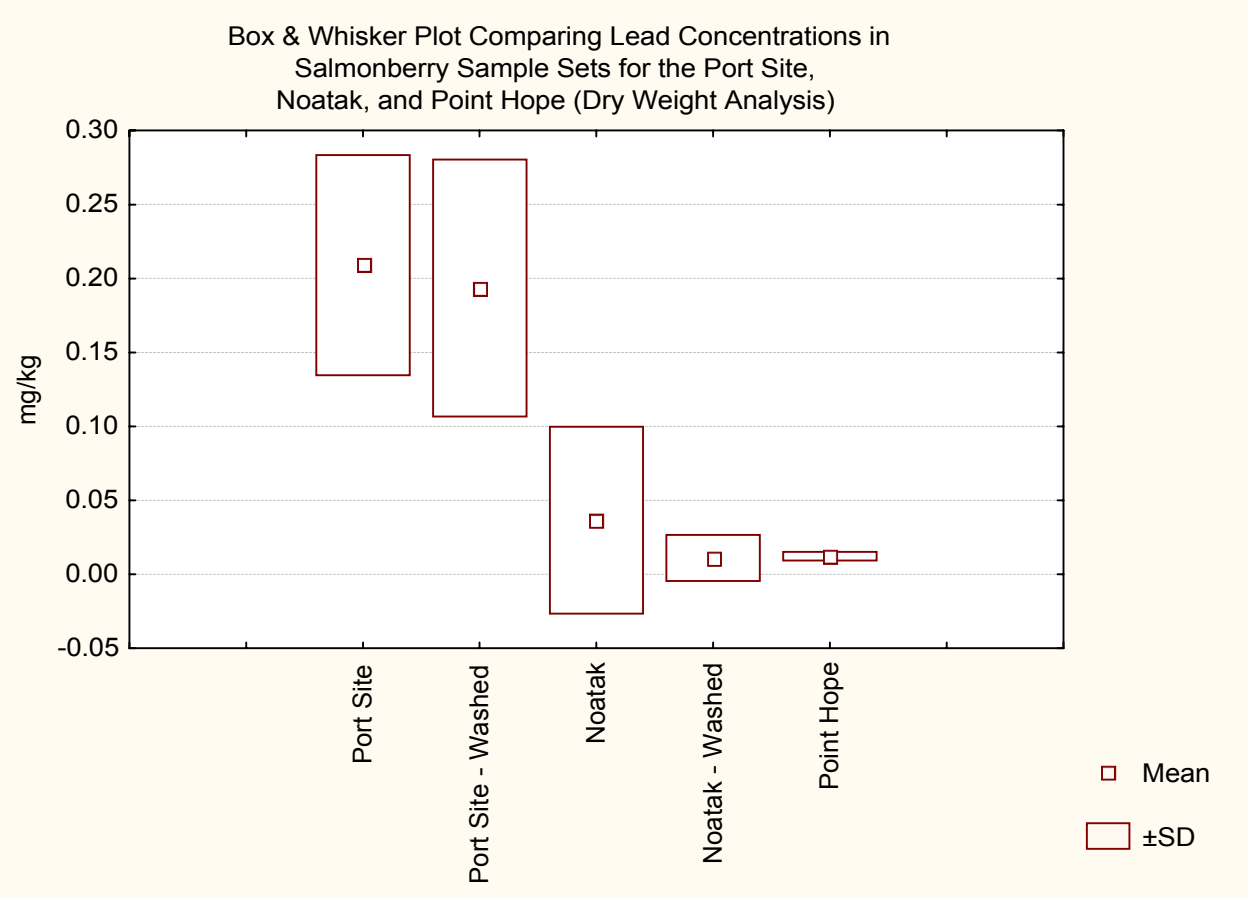
Graph 2


Zinc Concentrations in Subsistence Food Data Sets (Dry Weight Analysis)
45
40
35
30
25
20
15
10
5
0
mg/kg
Port Site
Noatak
Point Hope
Data Sets
Salmonberries
Sour Dock
Blackberries

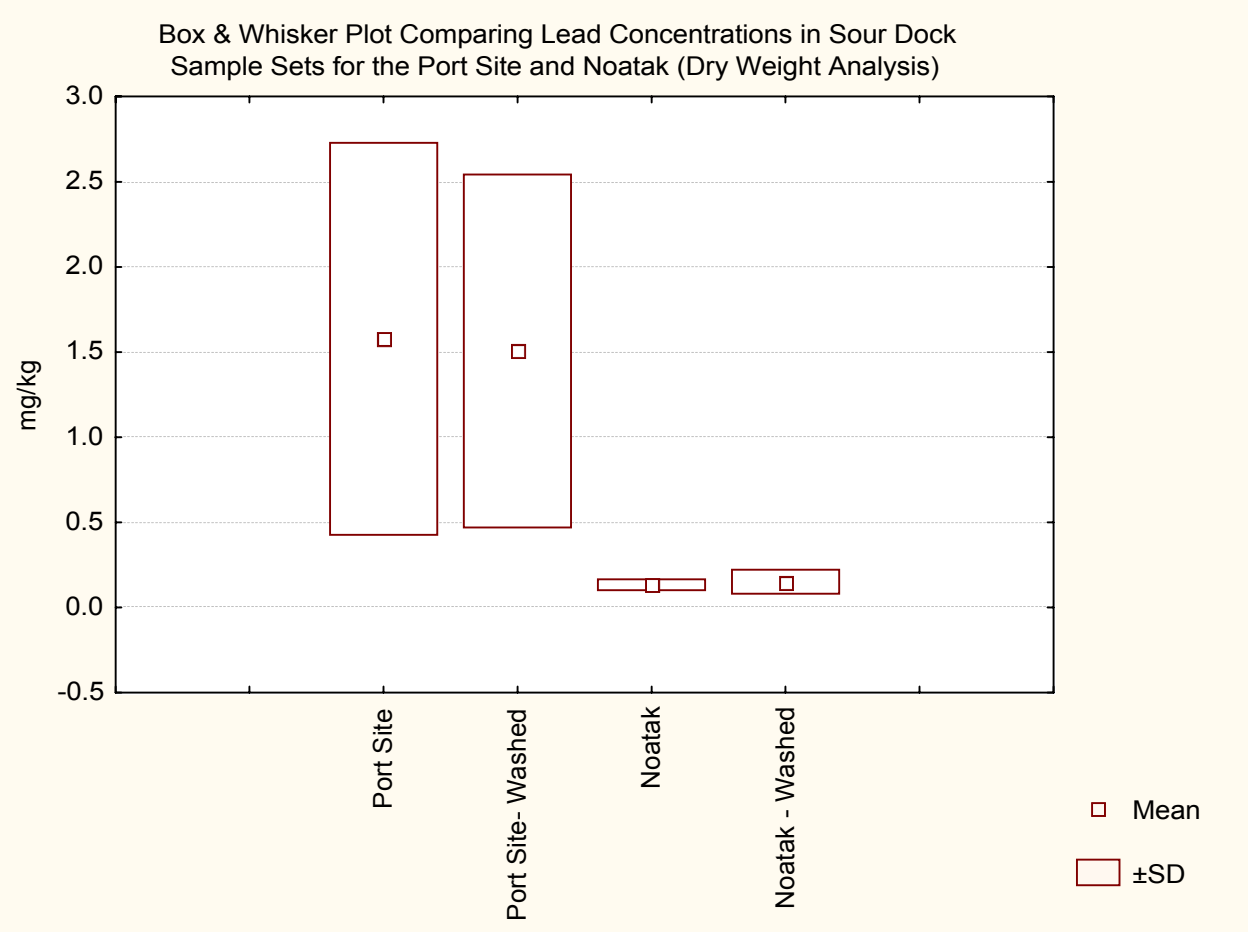
Graph 3


Cadmium Concentrations in Subsistence Food Data Sets (Dry Weight Analysis)
0.28
0.26
0.24
0.22
0.20
0.18
0.16
0.14
0.12
0.10
0.08
0.06
0.04
0.02
0.00
mg/kg
Port Site
Noatak
Point Hope
Data Sets
Salmonberries
Sour Dock
Blackberries

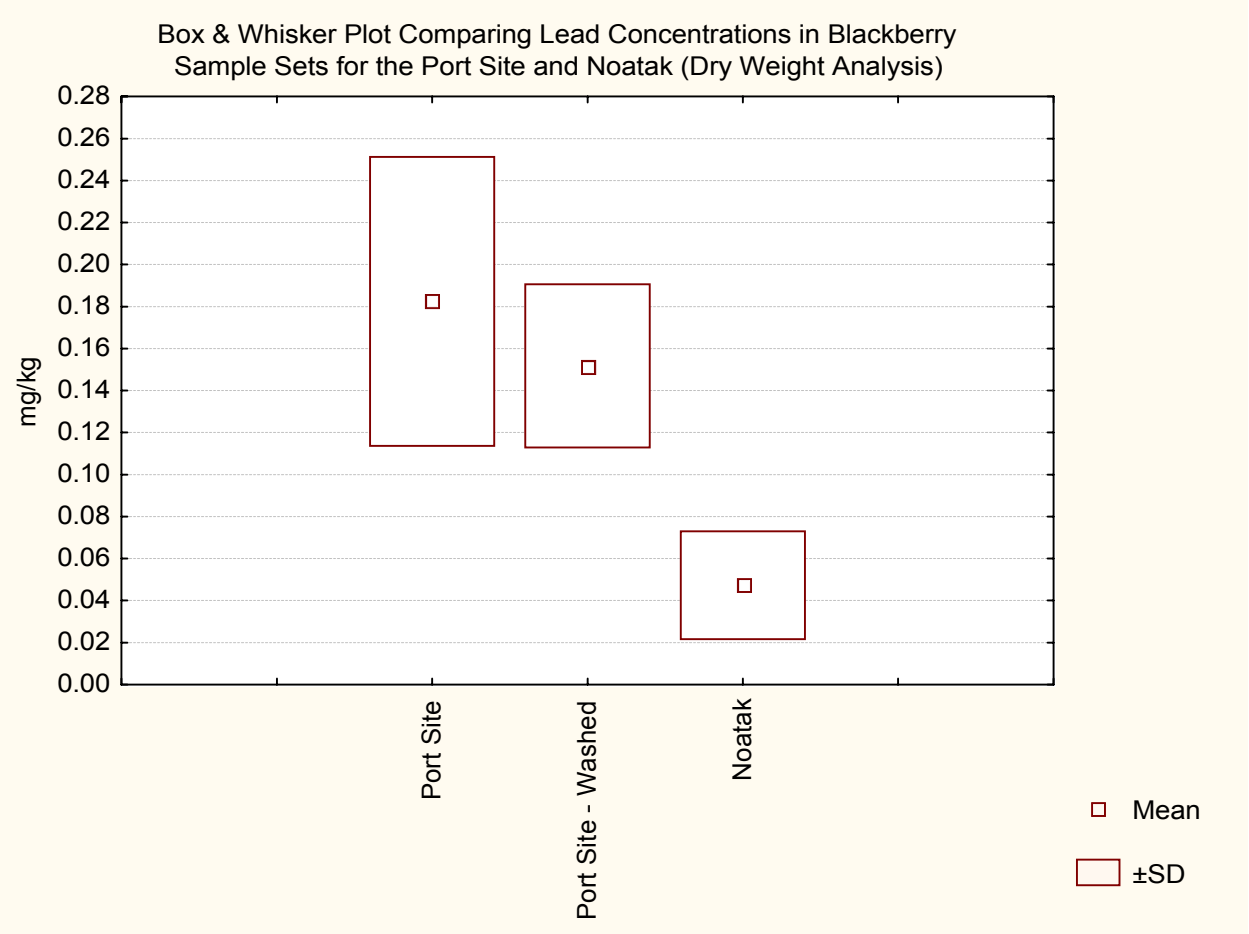
Graph 4


Box & Whisker Plot Comparing Lead Concentrations in
Salmonberry Sample Sets for the Port Site,
Noatak, and Point Hope (Dry Weight Analysis)
mg/kg
0.30
0.25
0.20
0.15
0.10
0.05
0.00
-0.05
Port Site
Port Site - Washed
Noatak
Noatak - Washed
Point Hope
Mean
±SD

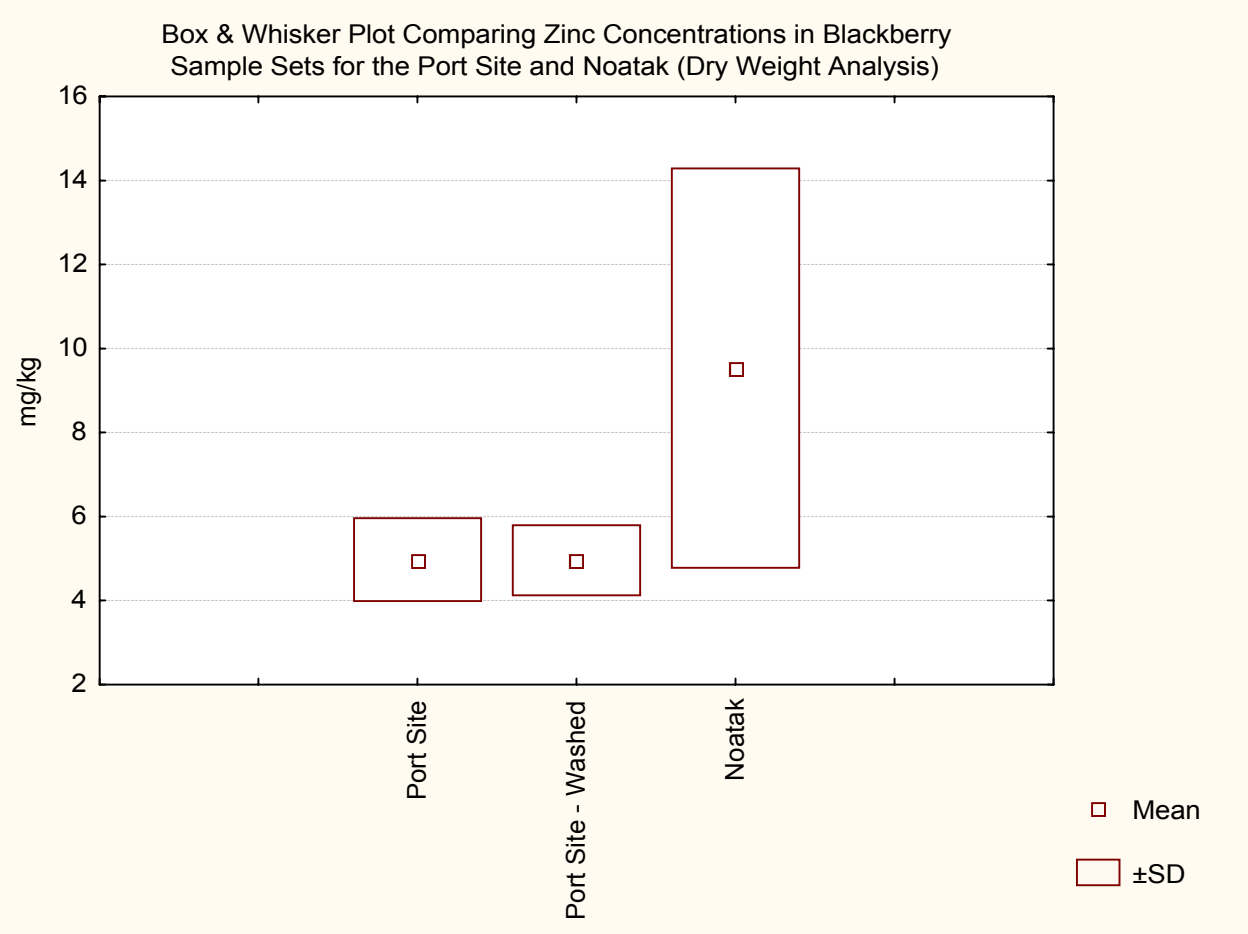
Graph 5


Box & Whisker Plot Comparing Lead Concentrations in Sour Dock
Sample Sets for the Port Site and Noatak (Dry Weight Analysis)
mg/kg
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
Port Site
Port Site- Washed
Noatak
Noatak - Washed
Mean
±SD

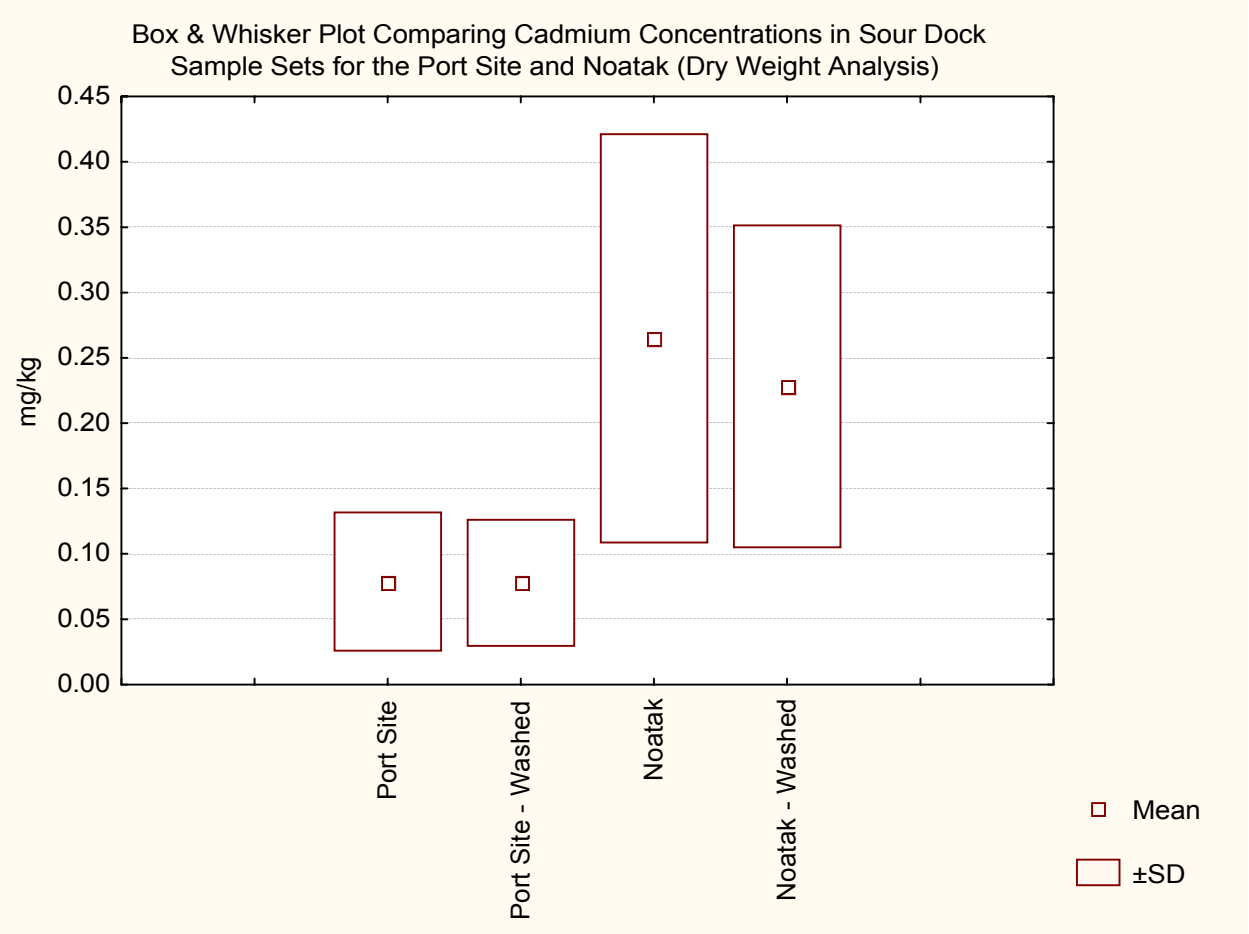
Graph 6


Box & Whisker Plot Comparing Lead Concentrations in Blackberry
Sample Sets for the Port Site and Noatak (Dry Weight Analysis)
mg/kg
0.28
0.26
0.24
0.22
0.20
0.18
0.16
0.14
0.12
0.10
0.08
0.06
0.04
0.02
0.00
Port Site
Port Site - Washed
Noatak
Mean
±SD

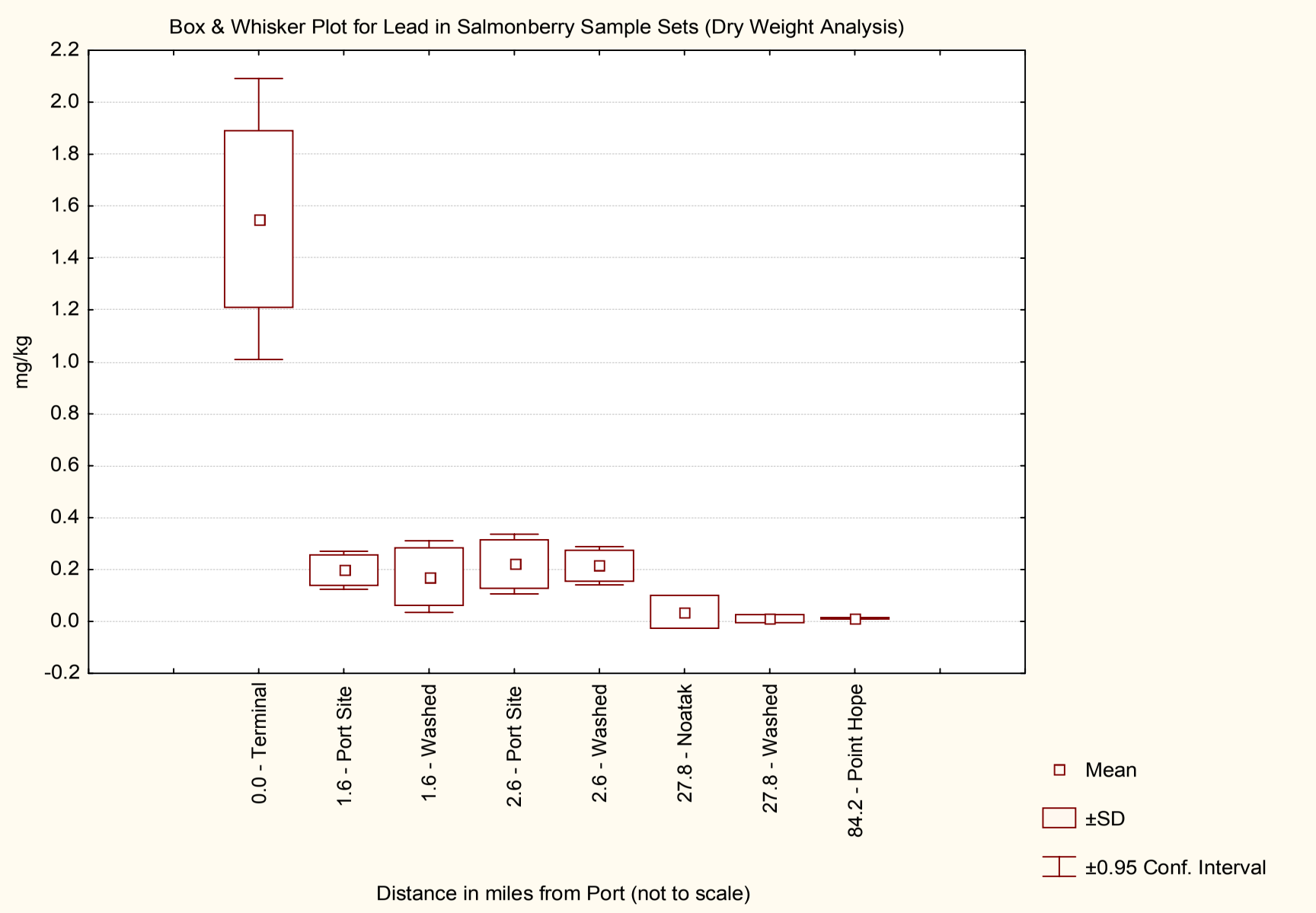
Graph 7


Box & Whisker Plot Comparing Zinc Concentrations in Blackberry
Sample Sets for the Port Site and Noatak (Dry Weight Analysis)
16
14
12
10
8
6
4
2
mg/kg
Port Site
Port Site - Washed
Noatak
Mean
±SD

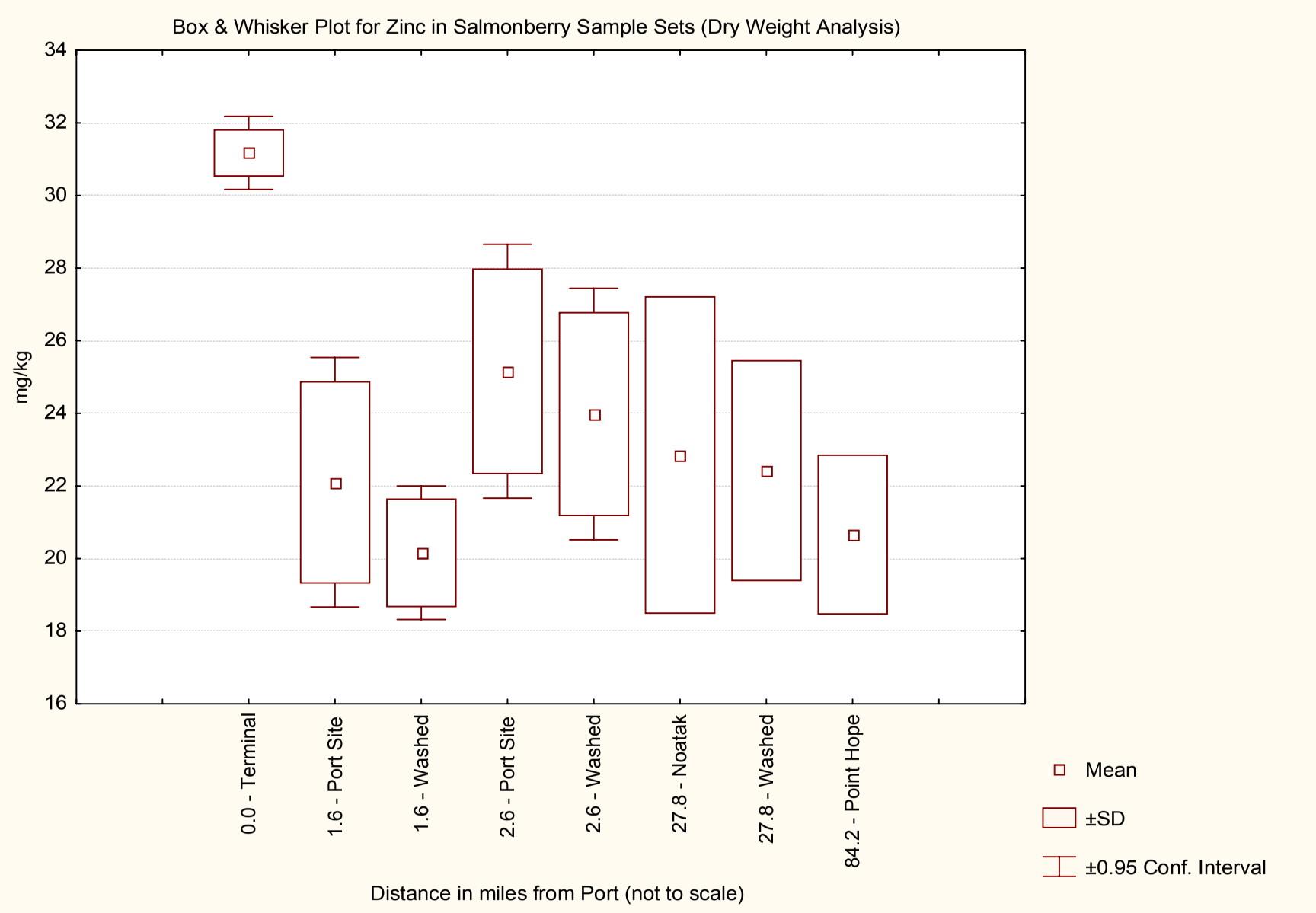
Graph 8


Box & Whisker Plot Comparing Cadmium Concentrations in Sour Dock
Sample Sets for the Port Site and Noatak (Dry Weight Analysis)
mg/kg
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
Port Site
Port Site - Washed
Noatak
Noatak - Washed
Mean
±SD

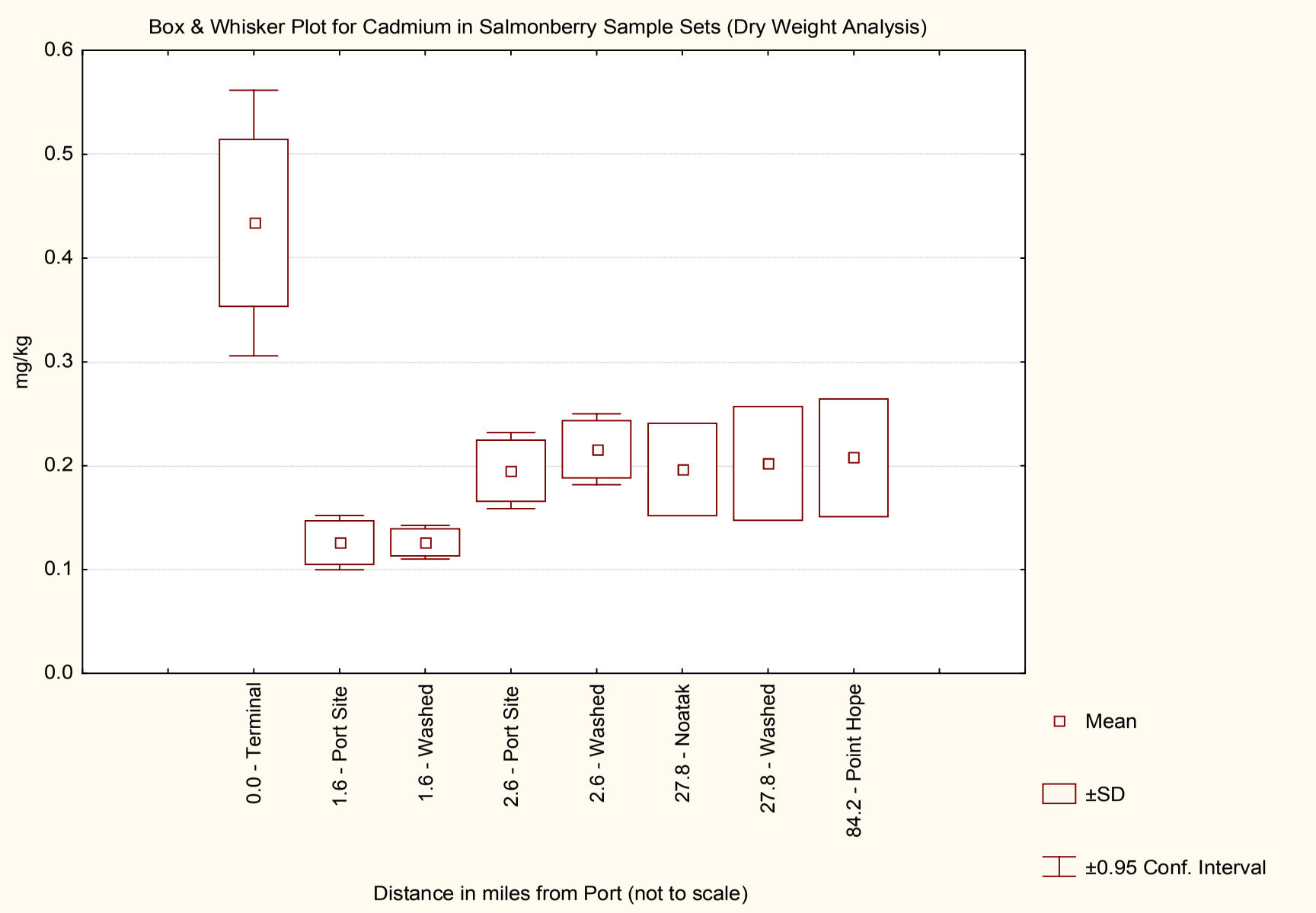
Graph 9


Box & Whisker Plot for Lead in Salmonberry Sample Sets (Dry Weight Analysis)
mg/kg
2.2
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
-0.2
0.0 - Terminal
1.6 - Port Site
1.6 - Washed
2.6 - Port Site
2.6 - Washed
27.8 - Noatak
27.8 - Washed
84.2 - Point Hope
Distance in miles from Port (not to scale)
Mean
±SD
±0.95 Conf. Interval

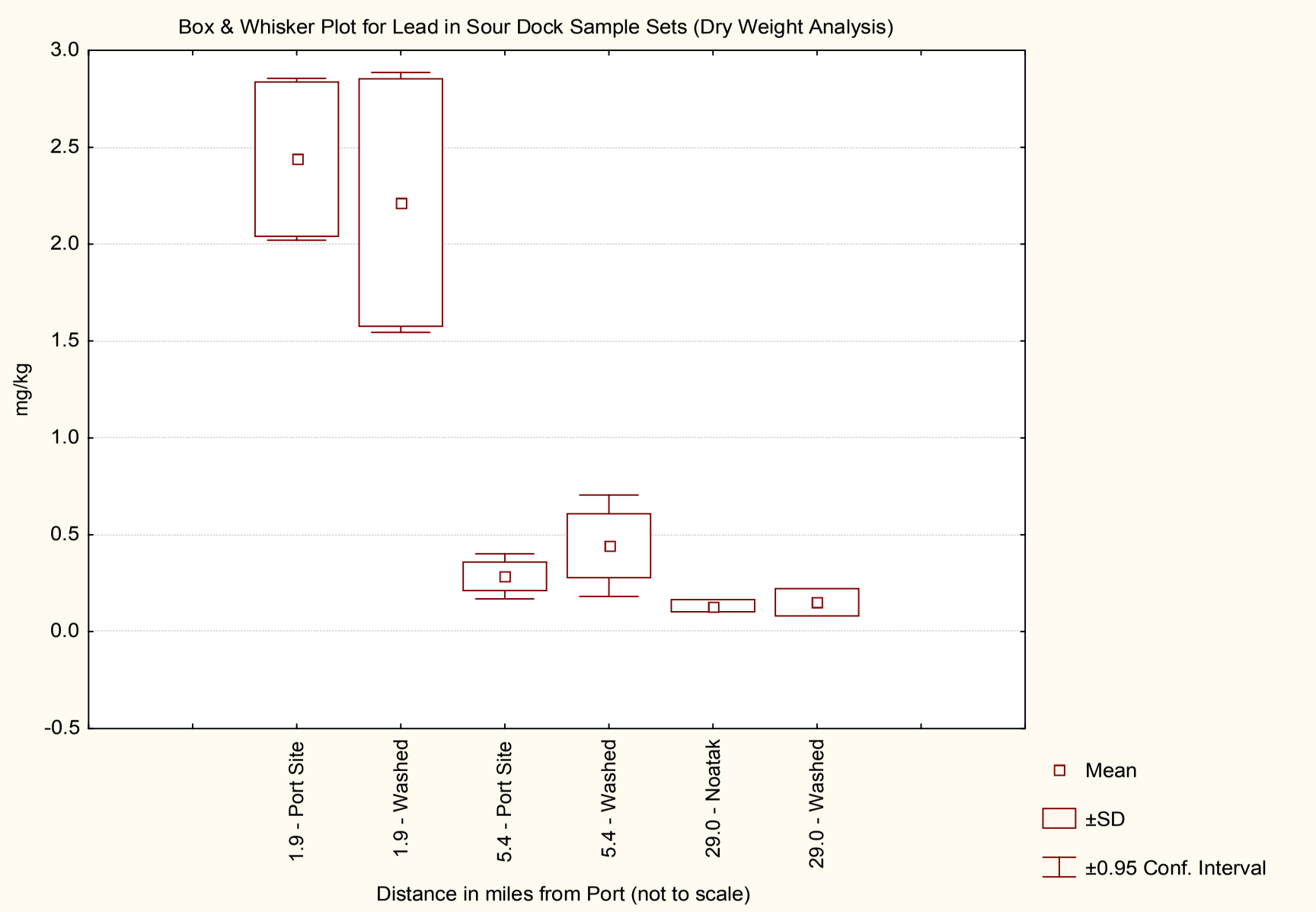
Graph 10


Box & Whisker Plot for Zinc in Salmonberry Sample Sets (Dry Weight Analysis)
mg/kg
34
32
30
28
26
24
22
20
18
16
0.0 - Terminal
1.6 - Port Site
1.6 - Washed
2.6 - Port Site
2.6 - Washed
27.8 - Noatak
27.8 - Washed
84.2 - Point Hope
Distance in miles from Port (not to scale)
Mean
±SD
±0.95 Conf. Interval

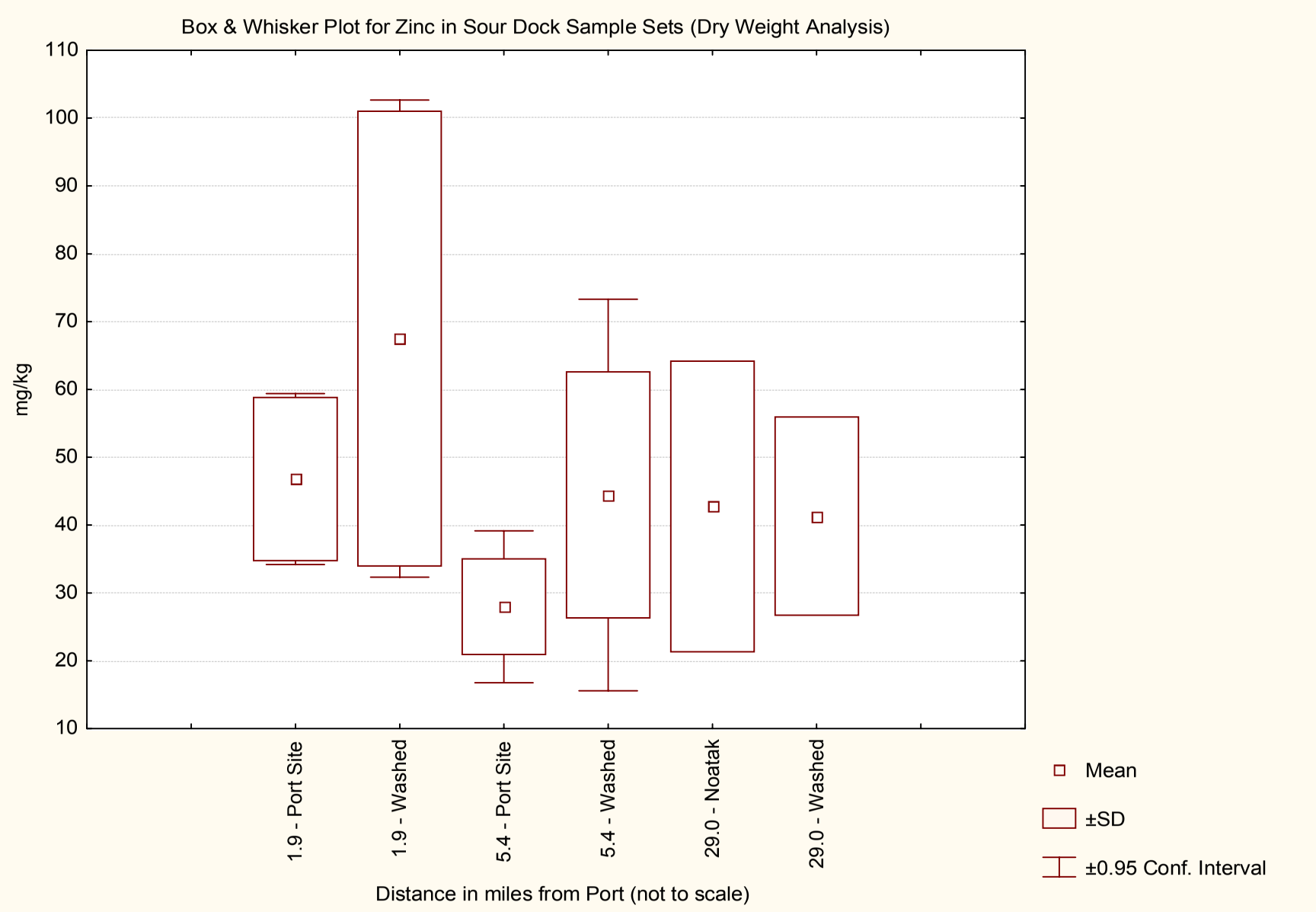
Graph 11


Box & Whisker Plot for Cadmium in Salmonberry Sample Sets (Dry Weight Analysis)
mg/kg
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0.0 - Terminal
1.6 - Port Site
1.6 - Washed
2.6 - Port Site
2.6 - Washed
27.8 - Noatak
27.8 - Washed
84.2 - Point Hope
Mean
±SD
±0.95 Conf. Interval
Distance in miles from Port (not to scale)

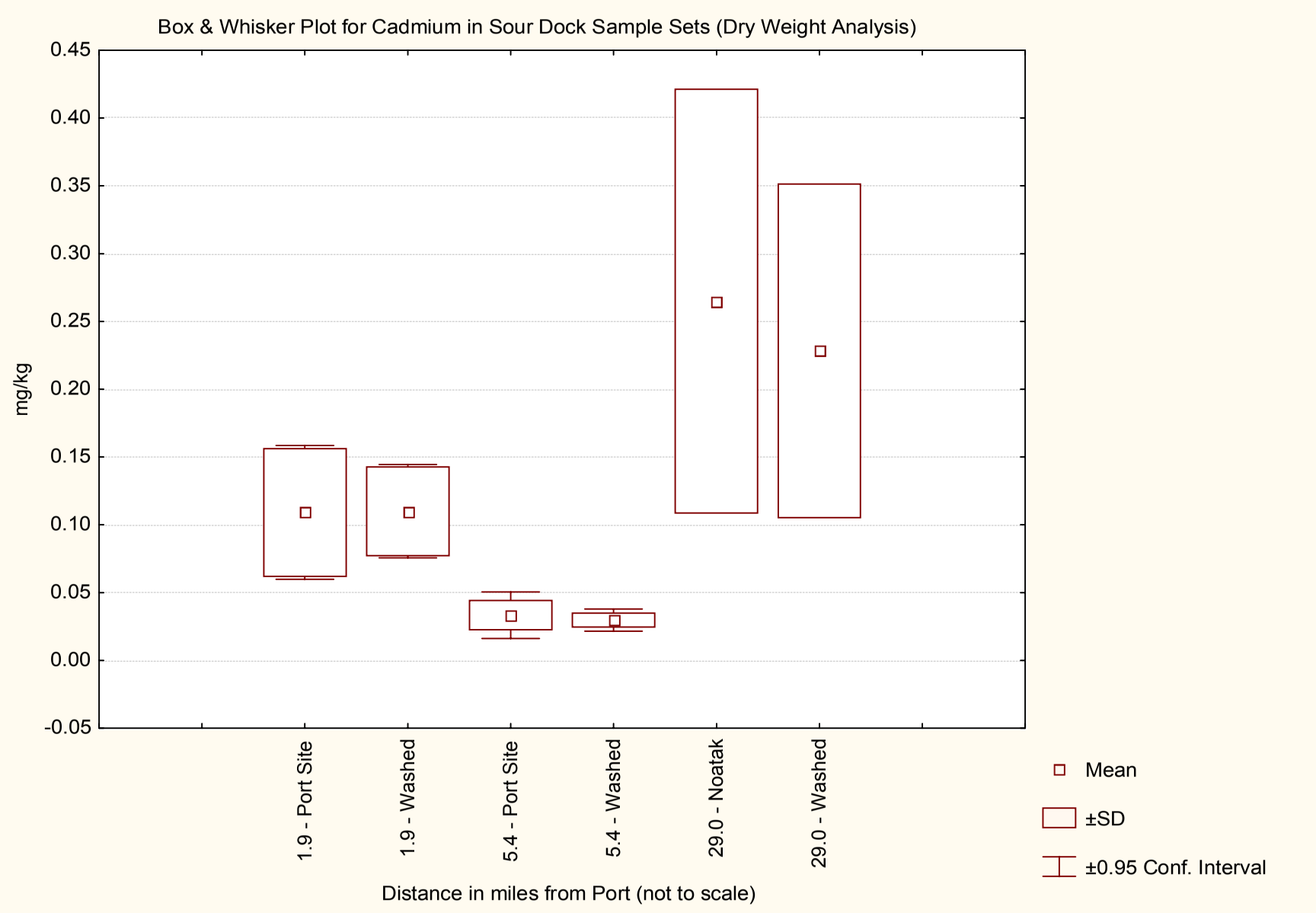
Graph 12


Box & Whisker Plot for Lead in Sour Dock Sample Sets (Dry Weight Analysis)
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
mg/kg
1.9 - Port Site
1.9 - Washed
5.4 - Port Site
5.4 - Washed
29.0 - Noatak
29.0 - Washed
Distance in miles from Port (not to scale)
Mean
±SD
±0.95 Conf. Interval

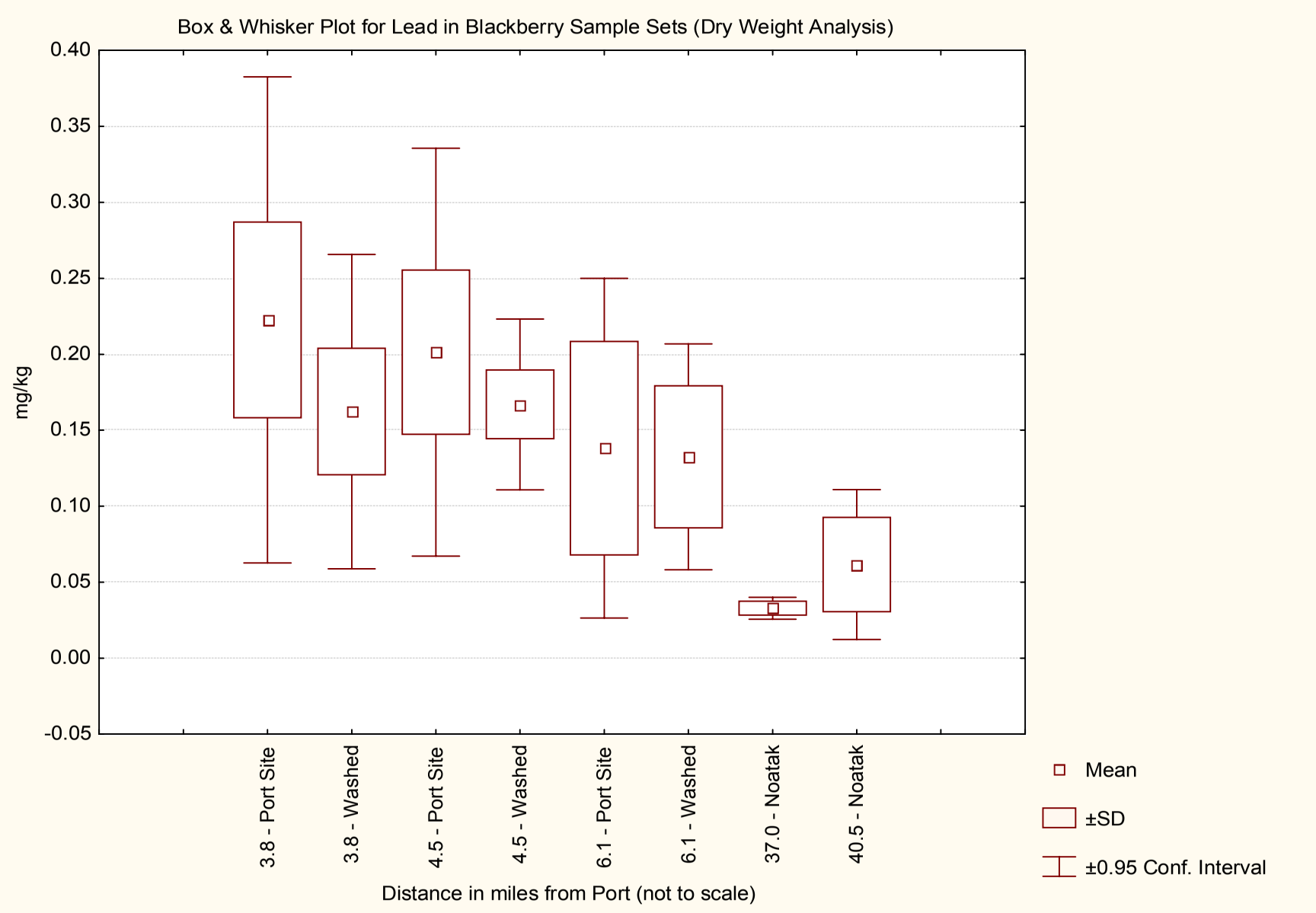
Graph 13


Box & Whisker Plot for Zinc in Sour Dock Sample Sets (Dry Weight Analysis)
mg/kg
110
100
90
80
70
60
50
40
30
20
10
1.9 - Port Site
1.9 - Washed
5.4 - Port Site
5.4 - Washed
29.0 - Noatak
29.0 - Washed
Distance in miles from Port (not to scale)
Mean
±SD
±0.95 Conf. Interval

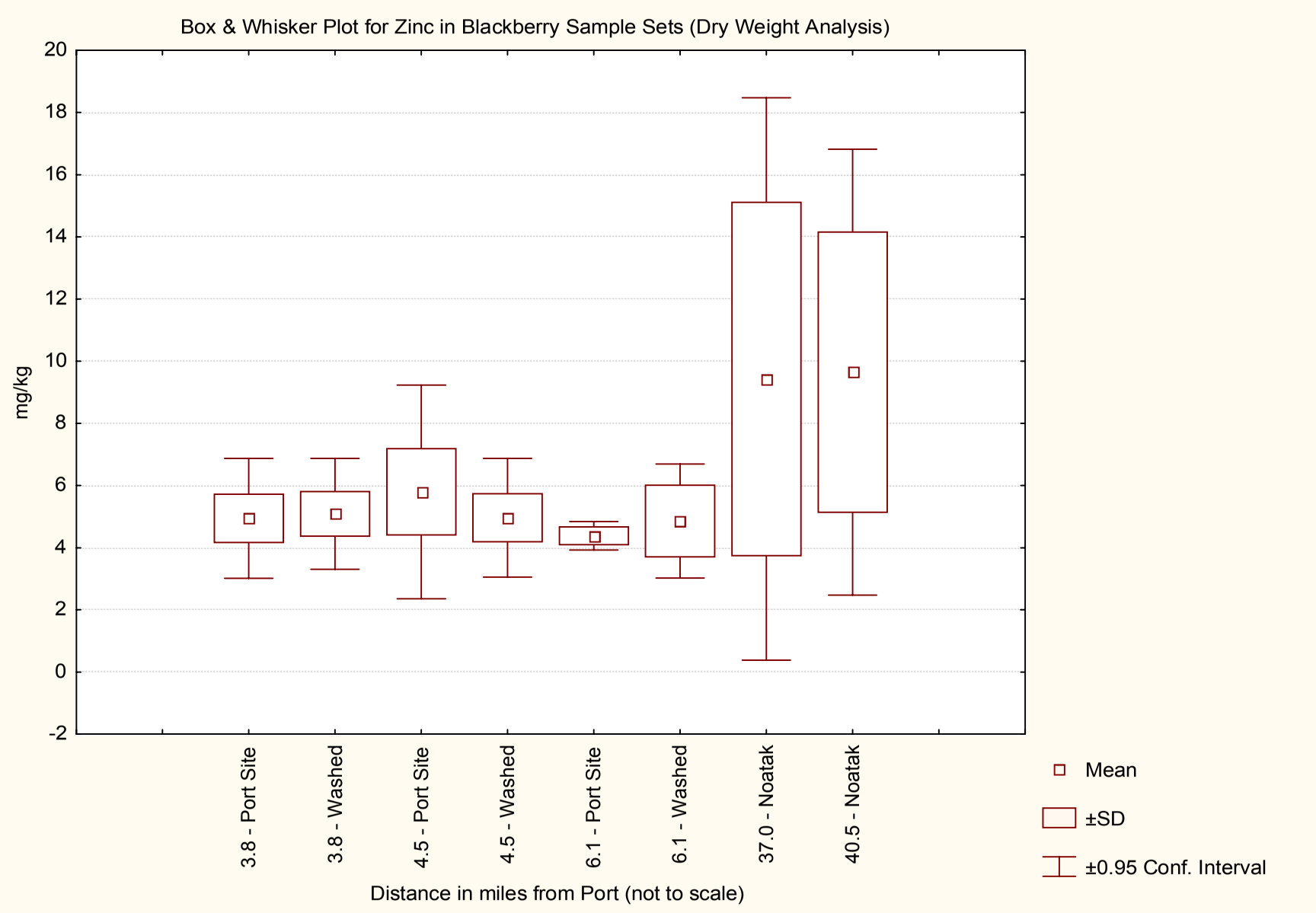
Graph 14


Box & Whisker Plot for Cadmium in Sour Dock Sample Sets (Dry Weight Analysis)
mg/kg
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
-0.05
1.9 - Port Site
1.9 - Washed
5.4 - Port Site
5.4 - Washed
29.0 - Noatak
29.0 - Washed
Distance in miles from Port (not to scale)
Mean
±SD
±0.95 Conf. Interval

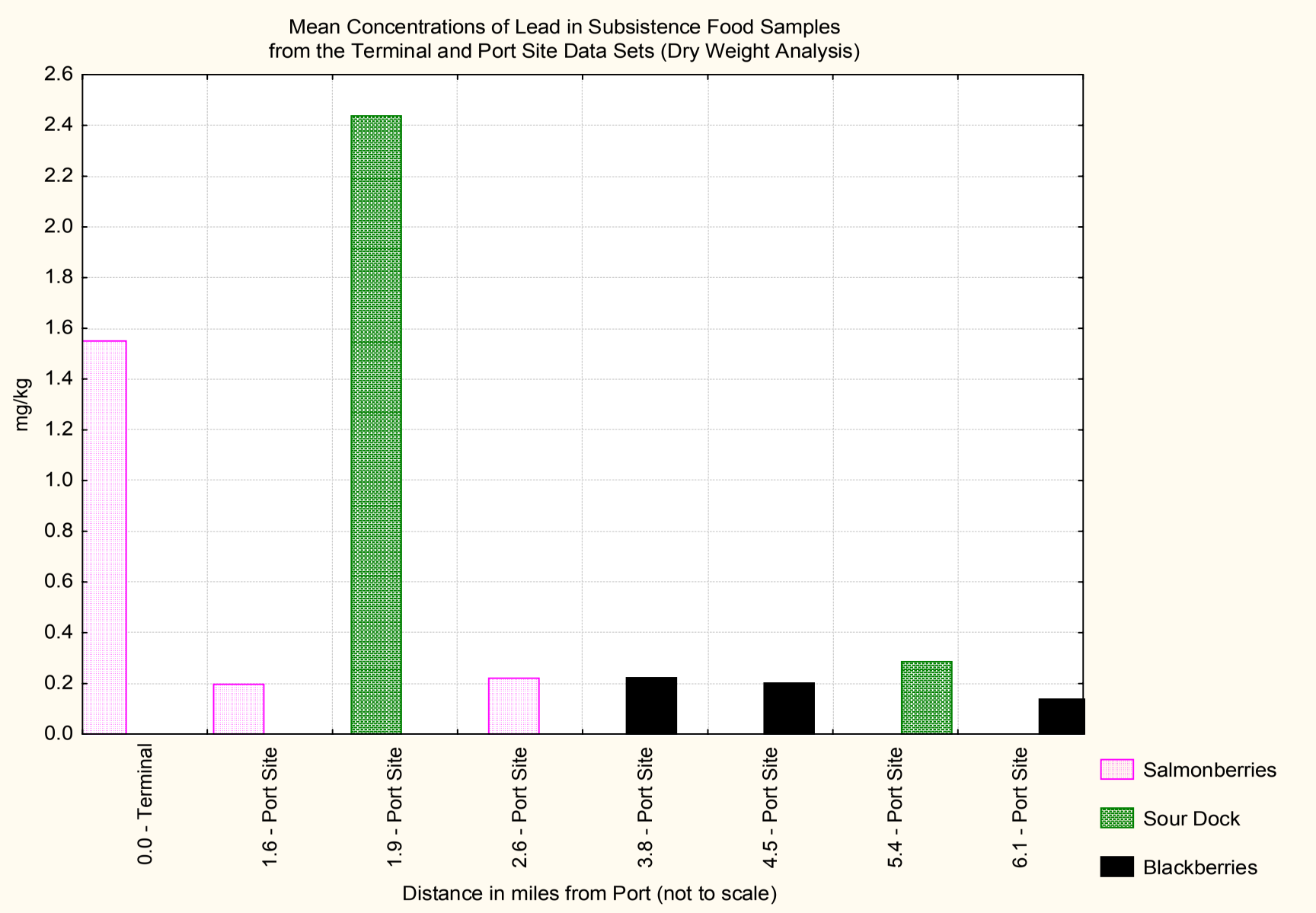
Graph 15


Box & Whisker Plot for Lead in Blackberry Sample Sets (Dry Weight Analysis)
mg/kg
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
-0.05
3.8 - Port Site
3.8 - Washed
4.5 - Port Site
4.5 - Washed
6.1 - Port Site
6.1 - Washed
37.0 - Noatak
40.5 - Noatak
Distance in miles from Port (not to scale)
Mean
±SD
±0.95 Conf. Interval

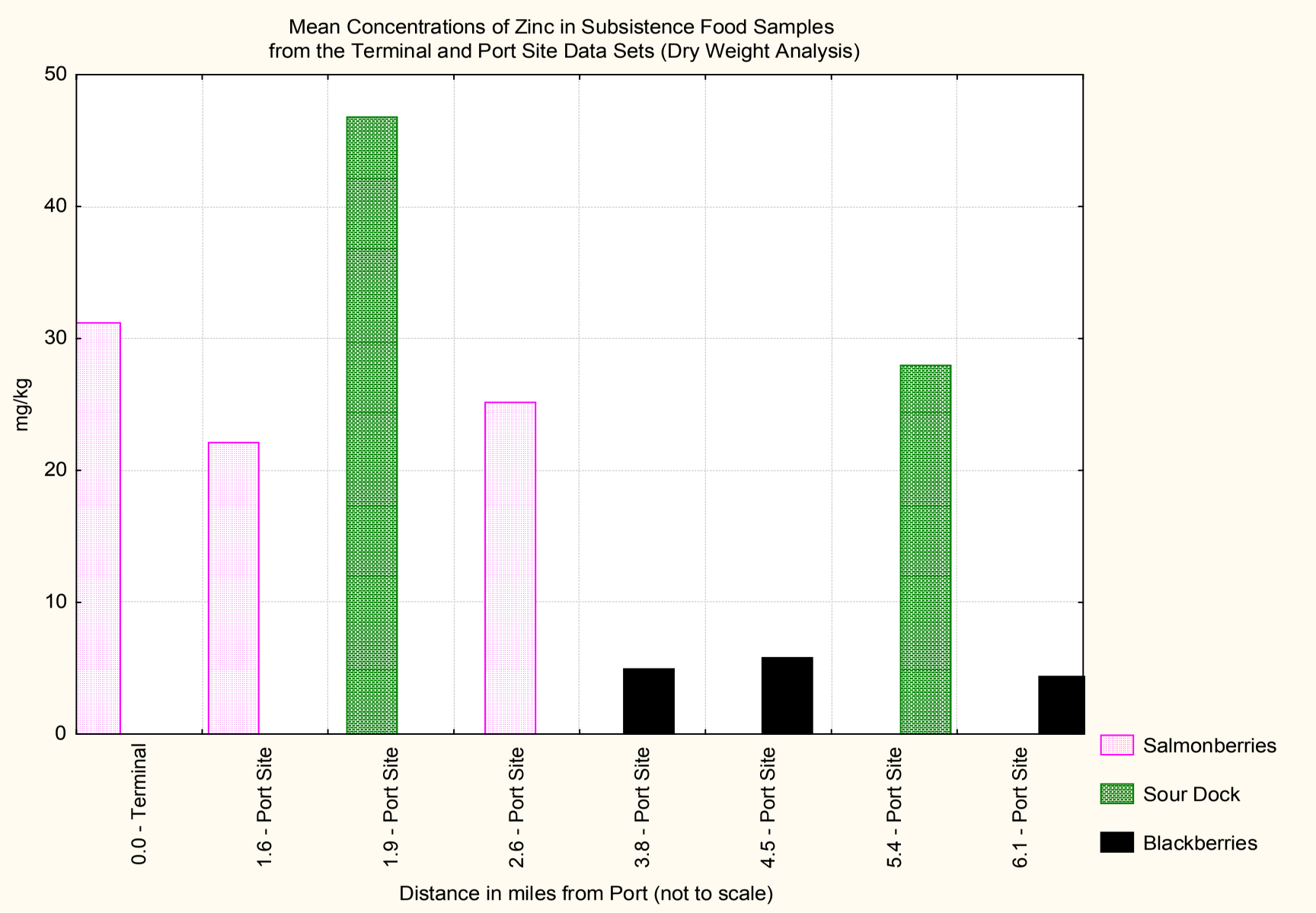
Graph 16


Box & Whisker Plot for Zinc in Blackberry Sample Sets (Dry Weight Analysis)
mg/kg
20
18
16
14
12
10
8
6
4
2
0
-2
3.8 - Port Site
3.8 - Washed
4.5 - Port Site
4.5 - Washed
6.1 - Port Site
6.1 - Washed
37.0 - Noatak
40.5 - Noatak
Distance in miles from Port (not to scale)
Mean
±SD
±0.95 Conf. Interval

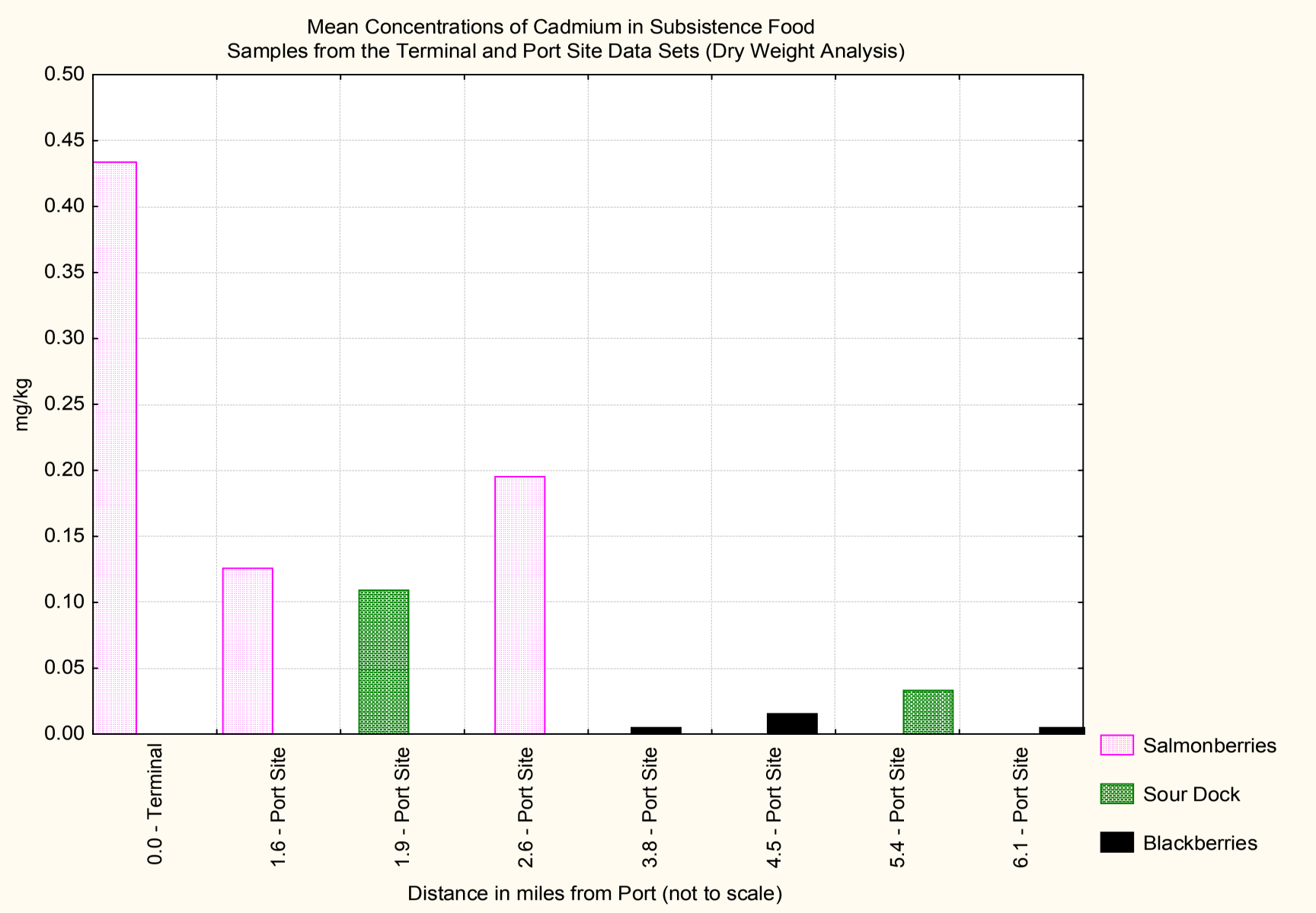
Graph 17


Mean Concentrations of Lead in Subsistence Food Samples
from the Terminal and Port Site Data Sets (Dry Weight Analysis)
mg/kg
2.6
2.4
2.2
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
0.0 - Terminal
1.6 - Port Site
1.9 - Port Site
2.6 - Port Site
3.8 - Port Site
4.5 - Port Site
5.4 - Port Site
6.1 - Port Site
Distance in miles from Port (not to scale)
Salmonberries
Sour Dock
Blackberries

Graph 18


Mean Concentrations of Zinc in Subsistence Food Samples
from the Terminal and Port Site Data Sets (Dry Weight Analysis)
mg/kg
50
40
30
20
10
0
0.0 - Terminal
1.6 - Port Site
1.9 - Port Site
2.6 - Port Site
3.8 - Port Site
4.5 - Port Site
5.4 - Port Site
6.1 - Port Site
Distance in miles from Port (not to scale)
Salmonberries
Sour Dock
Blackberries

Graph 19


Mean Concentrations of Cadmium in Subsistence Food
Samples from the Terminal and Port Site Data Sets (Dry Weight Analysis)
mg/kg
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0.0 - Terminal
1.6 - Port Site
1.9 - Port Site
2.6 - Port Site
3.8 - Port Site
4.5 - Port Site
5.4 - Port Site
6.1 - Port Site
Distance in miles from Port (not to scale)
Salmonberries
Sour Dock
Blackberries

A

Work Plan

August 17, 2001

Jeffrey D. Hock
Statewide Database Chief
Air & Water Quality Division
Alaska Department of Environmental Conservation
410 Willoughby Ave., Suite 303
Juneau, AK 99801

RE: Contract No. 18-5006-10; Notice to Proceed No. 185006101A; Final Berry and Plant Sampling, Summer 2001; Vicinity of DeLong Mountain Terminal, Northwest Alaska

Dear Mr. Hock:

Ecology & Environment Inc. (E & E) is pleased to submit this work plan to the Alaska Department of Environmental Conservation's, Air and Water Quality Division (Department). This work plan document discusses planned activities for assessing concentrations of certain metals in berries and plants (subsistence foods) near the DeLong Mountain Terminal (Port Site). The document is a combined sampling and analysis plan (SAP), quality assurance project plan (QAPP), and health and safety plan (HSP).

E & E adopted an abbreviated format for this combined SAP/QAPP/HSP. Given the expediency of the proposed subsistence food sampling, we sought brevity for the document. However, the proposed actions have been thoroughly explained so that the project may be well executed by the Department and residents of villages proximal to the sample areas.

If you, or Ron Klein, have questions or comments on the work plan document, please contact me at 257-5000. E & E thanks the Department for the opportunity to assist with implementing this very interesting project.

Sincerely,

ECOLOGY AND ENVIRONMENT, INC.

Greg J. Horner, R.G.
Manager, Alaska

XC: L. Flynn (E&E)
B. Martich (E&E)
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WORK PLAN DOCUMENTS FOR BERRY AND PLANT SAMPLING INVESTIGATION, VICINITY OF DELONG MOUNTAIN TERMINAL, CAPE KRUSENSTERN NATIONAL MONUMENT, ALASKA

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Prepared for:
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Division of Air and Water Quality
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SAMPLING AND ANALYSIS PLAN

1.0 Scope and Objectives

In recent years, residents from the coastal village of Kivalina have expressed concern about potential metal contamination in berries and plants (subsistence foods) harvested near the DeLong Mountain Terminal (Port Site). The Port Site is where zinc and lead ores mined at Red Dog Mine are stockpiled as ore concentrates. Periodically, these concentrates are loaded on ocean-going vessels and taken to smelters for incineration.

This investigation will study whether metals, dispersed from the Port Site as dust particles from the ore concentrates, are impacting subsistence foods via airborne transport and/or plant uptake. The study will focus on the target metals that have been identified in the Environmental Protection Agency's (EPA) Toxic Release Inventory (TRI) reports for Red Dog Mine: cadmium, chromium, cobalt, copper, lead, manganese, nickel, and zinc, plus selenium. The metal content results of samples collected near Ipiavik Lagoon (Site A) and the Port Site (Site B) will be compared statistically to results of a subsistence food sample set collected from a control site (Site C) located near Noatak in a historical subsistence harvest area. Figure 1-1 depicts the locations of Kivalina and the Port Site. Site C will be selected by the sample team based on its distance from any known mine impacts, use as a harvest area, and similar geologic features and soil types as the test sample areas.

The objectives of this investigation are:

- To determine statistically whether dust released by Port Site activities has accumulated on nearby subsistence foods;
- To determine statistically whether metals, through uptake, have accumulated in nearby subsistence foods;
- To provide data for health professionals to determine if ingestion of these subsistence foods is a potential exposure pathway.

Ecology and Environment, Inc. (E & E) was contracted by the Alaska Department of Environmental Conservation (ADEC), Air and Water Quality Division (Contract No. 18-5006-10; Notice to Proceed No. 185006101A**)** to prepare a sampling and analysis plan (SAP), quality assurance project plan (QAPP), and health and safety plan (HSP) for use in conducting this subsistence food sample collection and analysis.

2.0 Sampling Rationale

The subsistence food species selected for analysis were identified by ADEC and the Alaska Department of Health and Social Services (DHSS) in consultation with representatives from Kivalina and Noatak, nearby villages that utilize these foods in subsistence activities. The species of interest were selected based on their abundance in the area and use for subsistence activities.

Three species of subsistence foods will be targeted for sampling during this investigation. Table 2-1 presents the target subsistence foods. Other subsistence foods may be sampled depending on current species prevalence.

Table 2-1 Targeted Subsistence Foods

Common Name	Scientific Name	Inupiat Name
Sour Dock	*Rumex arcticus*	Quaguq
Blackberry (commonly called Crowberry)	*Empetrum nigrum*	Asiaq
Salmonberry (commonly called Cloudberry)	*Rubus chamaemorus*	Aqpik

An ADEC field team will lead the sampling efforts defined in this SAP/QAPP. Assisting the ADEC team in the identification and collection of subsistence food samples will be residents of the villages of Kivalina and Noatak. In addition, representatives of the Maniilaq Association, from Kotzebue, may participate. Site A and Site B will be sampled together. A helicopter will transport the sample team from Kivalina to Site A and Site B. The helicopter should land sufficiently distant from the sample areas, so that minimal disturbance occurs prior to entry and sampling. Site C will be sampled after sampling at Sites A and B is finished. A boat will be used to transport the sample team from Noatak to Site C.

At each sampling area, the samples should be collected in a pattern that begins most distant from the Port Site. In this way, the sample team will move toward the potential source of airborne metals and toward the biota that may have been more impacted by Port Site activities, thereby reducing the potential for carry over of residue containing metals.

At each sample location within each sample area, two samples will be collected. One sample will contain the subsistence food as it was picked, containing only those parts of the plants that are consumed. The other sample will be washed prior to containerization. The washed sample will indicate whether metals are accumulating within the subsistence food, while the unwashed sample will indicate how airborne deposition may be impacting subsistence foods. Given the nature of the sample collection, these samples are composite samples.

The goal for Site A and Site B is to collect a minimum of ten samples each of washed and unwashed sample material for the subsistence foods that are present at each area. The goal for Site C is to collect a minimum of ten samples each of washed and unwashed sample material for all species collected at Sites A and B. Ten samples will constitute a sufficient data set to adequately fit the statistical model that will be used (see Section 4.0). It should be noted that collecting more than ten samples would increase the power of the statistical analysis and provide more definitive results. E & E recommends as many as 20 samples per sample location, washed and unwashed. The final decision on the number of samples obviously will depend on economics, weather conditions, prevalence of the subsistence foods, and time in the field. It should be noted that the statistical models do not require the same number of samples per food species or the same number of samples between the test sites and the control site.

In addition to the samples of subsistence foods, a single surface water sample will be collected at either Site A or Site B. Subsistence users sometimes use surface water as a drinking water source during subsistence activities. The exact sample location should be chosen based on known historical and/or prospective drinking locations by the residents of Kivalina.

The sample team should also use a portable GPS unit to record all sample locations, so that the investigation may be replicated, if necessary.

3.0 Sampling Methodology

For Site A and Site B, the sample team should attempt to collect a minimum of ten samples for each species of subsistence food. Each sample should be collected from a distinct area, independent from the other samples collected. This means at a minimum that no two samples will be collected from the same plant. For each sample, the sample material will be placed in one, pre-cleaned wide mouth, 8-ounce glass jar with a teflon-lined lid. Each jar will contain at least 50 grams (wet weight) of sample material. Only the portion of each subsistence food that is consumed should be included for analysis. Extraneous material, such as grass, stems, mosses, and rocks, will be removed from the sample material. If necessary, the sour dock will be folded, not torn, to fit in the sample jar. Samplers will wear a new pair of talc-free latex or nitrile gloves for each sample collected. Care will be taken to ensure that only the same species are grouped together. Project samplers will rely on the expertise of the Kivalina and Noatak residents and any other village residents to catalogue the species appropriately.

Two samples will be collected for each subsistence food at each sample location. The first sample collected will contain sample material that has been washed. The sample material will be placed in a dedicated pre-cleaned plastic bowl and completely rinsed three successive times with deionized, reagent grade – ASTM Type II water. The second sample will contain unwashed sample material as it was collected. After collection of each sample, the containers will be sealed and placed on ice. After rinsing the sample material in the plastic bowl and placing the sample material in the sample jar, the bowl will be rinsed clean with deionized, reagent grade – ASTM Type II water.

For the single surface water sample to be collected, a pre-cleaned polyethylene bottle will be dipped into the surface water source. The water from this polyethylene bottle will then be transferred to one pre-cleaned 1-liter polyethylene bottle and preserved with nitric acid. After collection of the sample, the bottle will be sealed and placed on ice.

All samples will be submitted to Battelle Laboratory in Sequim, Washington. Approximately half of the samples from each sample area will be immediately analyzed for the following metals: cadmium, chromium, cobalt, copper, lead, manganese, nickel, selenium, and zinc. The other half of the samples will be analyzed if the analytical results from the first set do not exhibit normal distributions for the concentrations of the metals. The laboratory will report results on a wet weight (fresh – as received) basis to compare with other food data and on a dry weight basis to allow for a standardized comparison between the test areas and control area samples. The samples selected for immediate analysis will be randomly selected from the collection of samples.

4.0 Statistical Data Analysis

When analytical data is received, the data will be examined to determine if a significant difference exists between the test sets, Site A and Site B, and the control set, Site C. The examiner must first make a determination regarding the distribution of the data sets. For each metal of each food type, four data sets will exist: washed sample results from one of the test sites, washed samples results from Site C, unwashed sample results from one of the test sites, and unwashed sample results from Site C. The data sets should be paired for comparison this way:

- results from Site A or Site B and Site C for washed samples; and
- results from Site A or Site B and Site C for unwashed samples.

For washed samples, the examiner must verify that the data sets are normally distributed for each metal. The recommended test for normality is the Shapiro Wilk W Test. This test is very time consuming and its

execution is best performed by computer software. If software is not available, the studentized range test is a possible alternative to the Shapiro Wilk W Test. If the data sets prove to be normally distributed, then the two data sets may be compared using a t-test that assumes unequal variances (also known as Satterthwaite's t-Test). If any of the data sets do not exhibit a normal distribution, then the data should be log transformed (natural logarithm function) and again tested for normality. If the log transformed data passes the test for normality, then the log transformed data sets for the metal in question should be compared using Satterthwaite's t-Test. The same process will apply for the unwashed sample sets. For analytical results detected below the method reporting limit, one-half the reporting limit should be used as the analytical result for the statistical analysis.

In the event that a data set for any metal, washed or unwashed, does not exhibit a normal distribution, then the nonparametric Wilcoxon Rank Sum test (also known as Mann-Whitney U test) will be employed to compare data sets for the metal that failed the normality test.

Regardless of the statistical test employed to compare data sets, the following statistical hypothesis should be tested:

$$H_0: \ u_p = u_c$$
$$H_1: \ u_p > u_c$$

where u_p = the average concentration of a metal from a Site A or Site B data set and u_c = the average concentration of a metal from a Site C data set. It is recommended that a p-level, or level of significance, of 0.05 be utilized throughout the data analysis.

For the project report, a thorough literature search will be performed to locate data for similar plant species. The findings from the literature search will be compared to the analytical results to assist in the data evaluation.

5.0 Proposed Schedule

Table 5-1 highlights the planned schedule for the project:

Table 5-1 Project Schedule

DATES	ACTIVITY
August 15, 2001	Submit Work Plan
Late August	Fieldwork
Early October	Receipt of Data
November	Submit Draft Report

6.0 References

Ford, Jesse, and Linda Hasselbach. May 2001. *Heavy Metals in Mosses and Soils on Six Transects Along the Red Dog Mine Haul Road, Alaska.* Western Alaska Arctic National Parklands. National Park Service.

Guidance for Data Quality Assessment: Practical Methods for Data Analysis. January 1998. EPA QA/G-9. QA97 Version. United States Environmental Protection Agency: Office of Research and Development. Washington, D.C.

Walpole, Ronald E., and Raymond H. Myers. 1993. *Probability and Statistics for Engineers and Scientists*. Fifth Edition. MacMillan Publishing Company. New York, New York.

QUALITY ASSURANCE AND PROJECT PLAN

1.0 Scope and Objectives

The general quality assurance objective for this investigation is to obtain analytical data of sufficient quality and quantity to satisfy the specific objectives and intended data uses outlined in the project objectives. To achieve this general objective, data of known and acceptable precision, accuracy, representativeness, completeness, and comparability must be generated.

2.0 Field Documentation

Logbook

The field log will contain a detailed description of all field activities and samples collected. Sample documentation will include sample identification labels, photographs, laboratory analysis requests, and permanently bound field logs. Pages will not be removed from any data logbook for any reason. Corrections will be made by drawing a single line through the original entry, so that the original entry still can be read, and writing the corrected entry alongside. The correction must be initialed and dated.

Based on how many sampling teams are in the field, more than one field log may be used. Each group should maintain their own log if it is not possible for one individual to record the actions and observations of all the sample groups. However, a field team leader should be responsible for keeping a master log. The master log should reference sample team logs when necessary.

Sample Labeling

Each sample container will be pre-labeled and sealed immediately after collection. Sample labels will be completed using waterproof ink and will be affixed firmly to the sample containers with clear, waterproof tape. A sample code should be assigned to each sample as an identification number to track collected samples. The sample label will provide the following information:

- Project name;
- Date of collection;
- Sample identification number;
- Analysis required (including EPA or reference method number); and
- Preservation method used.

After the sample is collected, such pertinent information as sample identification number, date and time of collection, collection method, and sample description will be recorded in the field log.

Photographs

Photographs will be taken as directed by the fieldwork task manager. Documentation of a photograph is crucial to its validity as a representation of an existing situation. The following information concerning photographs will be noted in the task log:

- Date, time, and location of photograph;
- Photographer;
- Direction the photographer was facing;
- Description of photograph; and
- Sequential number of the photograph and film roll number.

Global Positioning System

Each sample's location will be documented using a portable GPS unit that contains a datalogger. Base station data may be obtained from the National Geodetic Survey (NGS) of the National Oceanic and Atmospheric Administration. NGS coordinates a network of continuously operating reference stations (CORS) that provide GPS carrier phase and code range measurements in support of 3-dimensional positioning activities throughout the United States. The CORS system enables positioning accuracy that approaches a few meters both vertically and horizontally.

3.0 Sampling Equipment

The following equipment should be included in the mobilization effort.

Personal Protective Equipment:
Talc-free nitrile or latex gloves

Sample Containers and Supplies:
At least 125 8-ounce glass jars (biota samples)
1 pre-preserved 1-liter polyethylene bottle (surface water sample)
1 1-liter polyethylene bottle (pouring surface water sample)
Deionized, reagent grade – Type II ASTM water for sample washing
Portable field scale
Pre-cleaned plastic bowl

Sample Shipment:
Chain of custodies
Coolers
Zip lock baggies
Blue ice or ice
Clear tape
Strapping tape
Trash bags

4.0 Sample Handling and Shipping Requirements

Samples must be packaged carefully to avoid breakage or contamination and must be shipped to the analytical laboratory at proper temperatures. The following sample packaging requirements will be followed:

- Enclose each glass and plastic sample container individually in a sealed, clear, plastic Ziplock bag;
- Surround sample containers with bubble wrap to prevent breakage from impact;
- Line each cooler with a garbage bag, and place a 1-inch layer of absorbent packing material at the bottom of the garbage bag;
- Place the samples into the coolers, and surround the samples with ice placed into freezer bags;
- Fill any remaining space in the coolers with inert packing material. Under no circumstances should materials such as sawdust or sand be used; and
- Tape chain of custody documents in a sealed plastic bag under the cooler lid, seal with custody seals, affix a label containing the laboratory name and address, and ship.

Shipping containers will be labeled clearly and custody-sealed for shipment. The container custody seal will consist of filament tape wrapped around the package at least twice and two custody seals affixed in such a way that access to the container can be gained only by cutting the filament tape and breaking the seal. When custody is relinquished to a shipper, field team personnel will telephone the analytical laboratory to inform them of the expected arrival of the sample shipment and to advise of any time constraints on sample analysis. All samples will be delivered to the following address for analyses:

Battelle Laboratory
1529 West Sequim Bay Rd.
Sequim, WA 98382
360-681-3604
Attention: Eric Crecelius

E & E recommends holding all samples until the field effort is complete. This will simplify the shipping process and reduce costs. The samples do not have holding times, and the only stipulation is that the samples should be kept on ice. The sample team should bring the samples to Anchorage when they return, and then ship them for overnight delivery to Battelle Laboratory. If for any reason this does not work out is not possible, the sample team will have to arrange for charter delivery of the sample coolers from Kivalina (or from wherever the sample team ships will ship).

5.0 Investigation-Derived Waste

Disposable sampling and personal protective equipment will be used during the field event. All used equipment will be double bagged and the ADEC team members will be responsible for transporting all solid (IDW) investigation-derived waste to a State-approved landfill.

Aqueous IDW will consist of the wash liquids used to rinse samples. The field team should dispose of this IDW on the ground directly where the sample was collected.

6.0 Quality Control

Quality control samples will be collected to assess potential errors introduced during sample collection, handling, and analysis. One in twenty samples of the subsistent food samples should contain double volume (100 grams), so that the analytical laboratory can run matrix pike and duplicate samples. No field quality control sample will be collected for the single water sample because laboratory/method quality control data will be used to support the result. In addition, a single water sample of the rinse water will be collected to verify the purity of the rinse water.

Table 6-1 presents the project sample requirements, and Table 6-2 contains laboratory quality assurance requirements.

The analytical laboratory will provide a hard copy and electronic copy of its report. All laboratory data will need to be validated by a chemist prior to using it for reporting purposes.

HEALTH AND SAFETY PLAN

A health and safety plan has been prepared and is provided. Prior to each day's activities, the field team should conduct a health and safety meeting, discussing the chemical and physical hazards present and safety measures to prevent injuries and exposures. The actions to be followed in case of an emergency should also be reviewed.

Table 2-2

SAMPLE AND ANALYSIS PLAN REQUIREMENTS
BERRY AND PLANT SAMPLING
DELONG MOUNTAIN TERMINAL, ALASKA

Matrix	No. Samples	Analytical Parameter	Analytical Method	Bottle Type	Preservative	Total Containers
Washed Samples						
Sour Dock	20	Metals	EPA Method 6020 ICPMS	(1) 8-ounce glass jar	Ice	20
Blackberry	20	Metals	EPA Method 6020 ICPMS	(1) 8-ounce glass jar	Ice	20
Salmonberry	20	Metals	EPA Method 6020 ICPMS	(1) 8-ounce glass jar	Ice	20
Unwashed Samples						
Sour Dock	20	Metals	EPA Method 6020 ICPMS	(1) 8-ounce glass jar	Ice	20
Blackberry	20	Metals	EPA Method 6020 ICPMS	(1) 8-ounce glass jar	Ice	20
Salmonberry	20	Metals	EPA Method 6020 ICPMS	(1) 8-ounce glass jar	Ice	20
Water Samples						
Surface water	1	Metals	EPA Method 6020 ICPMS	(1) 1-liter poly bottle	Ice; Nitric acid to pH < 2	1
Rinse water	1	Metals	EPA Method 6020 ICPMS	(1) 1-liter poly bottle	Ice; Nitric acid to pH < 2	1

Key:

EPA = United States Environmental Protection Agency Test Methods for Evaluating Solid Waste, SW-846, through Update III, 1986.
ICPMS = Inductively coupled plasma/matrix spike.

Table 6-1

SAMPLE AND ANALYSIS PLAN REQUIREMENTS
BERRY AND PLANT SAMPLING
DELONG MOUNTAIN TERMINAL, ALASKA

Matrix	No. Samples	Analytical Parameter	Analytical Method	Bottle Type	Preservative	Total Containers
Washed Samples						
Sour Dock	20	Metals	EPA Method 6020 ICPMS	(1) 8-ounce glass jar	Ice	22
Blackberry	20	Metals	EPA Method 6020 ICPMS	(1) 8-ounce glass jar	Ice	22
Salmonberry	20	Metals	EPA Method 6020 ICPMS	(1) 8-ounce glass jar	Ice	22
Unwashed Samples						
Sour Dock	20	Metals	EPA Method 6020 ICPMS	(1) 8-ounce glass jar	Ice	22
Blackberry	20	Metals	EPA Method 6020 ICPMS	(1) 8-ounce glass jar	Ice	22
Salmonberry	20	Metals	EPA Method 6020 ICPMS	(1) 8-ounce glass jar	Ice	22
Water Samples						
Surface water	1	Metals	EPA Method 6020 ICPMS	(1) 1-liter poly bottle	Ice; Nitric acid to pH < 2	1
Rinse water	1	Metals	EPA Method 6020 ICPMS	(1) 1-liter poly bottle	Ice; Nitric acid to pH < 2	1

Key:

EPA = United States Environmental Protection Agency Test Methods for Evaluating Solid Waste, SW-846, through Update III, 1986.
ICPMS = Inductively coupled plasma/matrix spike.

Table 6-2

SUMMARY OF LABORATORY QUALITY ASSURANCE OBJECTIVES
BERRY AND PLANT SAMPLING
DELONG MOUNTAIN TERMINAL, ALASKA

Matrix	Analysis	EPA Analytical Method	Quantitation Limits	Method Accuracy (%R)	Method Precision (%RPD)	Completeness Goal (%)
Sour Dock	Metals	EPA SW-846 Method 6020	Cd = 0.05 mg/kg; Cr = 0.5 mg/kg; Co = 0.5 mg/kg; Cu = 0.2 mg/kg; Pb = 0.05 mg/kg; Mn = 0.1 mg/kg; Ni = 0.5 mg/kg; Zn = 1.0 mg/kg; Se = 1.0 mg/kg	75-125	+35	90
Blackberry	Metals	EPA SW-846 Method 6020	Cd = 0.05 mg/kg; Cr = 0.5 mg/kg; Co = 0.5 mg/kg; Cu = 0.2 mg/kg; Pb = 0.05 mg/kg; Mn = 0.1 mg/kg; Ni = 0.5 mg/kg; Zn = 1.0 mg/kg; Se = 1.0 mg/kg	75-125	+35	90
Salmonberry	Metals	EPA SW-846 Method 6020	Cd = 0.05 mg/kg; Cr = 0.5 mg/kg; Co = 0.5 mg/kg; Cu = 0.2 mg/kg; Pb = 0.05 mg/kg; Mn = 0.1 mg/kg; Ni = 0.5 mg/kg; Zn = 1.0 mg/kg; Se = 1.0 mg/kg	75-125	+35	90
Surface water	Metals	EPA SW-846 Method 6020	Cd = 0.05 mg/kg; Cr = 0.5 mg/kg; Co = 0.5 mg/kg; Cu = 0.2 mg/kg; Pb = 0.05 mg/kg; Mn = 0.1 mg/kg; Ni = 0.5 mg/kg; Zn = 1.0 mg/kg; Se = 1.0 mg/kg	75-125	+/- 35	100
Rinse water	Metals	EPA SW-846 Method 6020	Cd = 0.05 mg/kg; Cr = 0.5 mg/kg; Co = 0.5 mg/kg; Cu = 0.2 mg/kg; Pb = 0.05 mg/kg; Mn = 0.1 mg/kg; Ni = 0.5 mg/kg; Zn = 1.0 mg/kg; Se = 1.0 mg/kg	75-125	+/- 35	100

Key:

Cd = Cadmium.
Cr = Chromium.
Co = Cobalt.
Cu = Copper.
EPA = United States Environmental Protection Agency.
Pb = Lead.
mg/kg = Milligrams per kilogram.
mg/L = Milligrams per liter.
Mn = Manganese.
Ni = Nickel.
R = Recovery.
RPD = Relative percent difference.
Se = Selenium.
Zn = Zinc.

B

GPS Data

GPS Summary; Wild Foods Investigation.

Sample Number	Date	Time	Data Set	Matrix	Latitude	Longitude
01DMT001SY	8/20/01	1620	Port Site	Salmonberry	67°33.343' N	164°01.636' W
01DMT002SY	8/20/01	1635	Port Site	Salmonberry	67°33.366' N	164°01.648' W
01DMT003SY	8/20/01	1648	Port Site	Salmonberry	67°33.398' N	164°01.632' W
01DMT004SY	8/20/01	1648	Port Site	Salmonberry	67°33.403' N	164°01.674' W
01DMT005SY	8/20/01	1700	Port Site	Salmonberry	67°33.422' N	164°01.709' W
01DMT006SY	8/20/01	1727	Port Site	Salmonberry	67°36.496' N	164°05.507' W
01DMT007SY	8/21/01	1250	Port Site	Salmonberry	67°36.663' N	164°05.868' W
01IDMT008SY	8/21/01	1258	Port Site	Salmonberry	67°36.680' N	164°05.728' W
01DMT009SY	8/21/01	1305	Port Site	Salmonberry	67°36.646' N	164°05.942' W
01IDMT010SY	8/21/01	1320	Port Site	Salmonberry	67°36.729' N	164°05.867' W
01DMT011WA	8/21/01	1330	New Hart Creek	Surface water	67°36.593' N	164°05.588' W
01DMT012SK	8/21/01	1408	Port Site	Sour Dock	67°35.965' N	164°05.952' W
01DMT013SK	8/21/01	1408	Port Site	Sour Dock	67°35.942' N	164°05.914' W
01DMT014SK	8/21/01	1422	Port Site	Sour Dock	67°36.021' N	164°06.061' W
01DMT015SK	8/21/01	1422	Port Site	Sour Dock	67°36.009' N	164°06.001' W
01DMT016SK	8/21/01	1430	Port Site	Sour Dock	67°36.045' N	164°06.094' W
01DMT017SK	8/21/01	1438	Port Site	Sour Dock	67°36.081' N	164°06.141' W
01DMT018SK	8/21/01	1517	Port Site	Sour Dock	67°38.532' N	164°10.233' W
01DMT019SK	8/21/01	1517	Port Site	Sour Dock	67°38.568' N	164°10.238' W
01DMT020SK	8/21/01	1522	Port Site	Sour Dock	67°38.522' N	164°10.232' W
01DMT021SK	8/21/01	1522	Port Site	Sour Dock	67°38.559' N	164°10.146' W
01DMT022SY	8/22/01	1405	Noatak	Salmonberry	67°35.887' N	162°59.948' W
01DMT023SY	8/22/01	1410	Noatak	Salmonberry	67°35.882' N	162°59.940' W
01DMT024SY	8/22/01	1420	Noatak	Salmonberry	67°35.897' N	162°59.882' W
01DMT025SY	8/22/01	1430	Noatak	Salmonberry	67°35.821' N	163°00.046' W
01DMT026SY	8/22/01	1435	Noatak	Salmonberry	67°35.923' N	162°59.845' W
01DMT027SY	8/22/01	1440	Noatak	Salmonberry	67°35.864' N	162°59.987' W
01DMT028SY	8/22/01	1450	Noatak	Salmonberry	67°35.931' N	162°59.972' W
01DMT029SY	8/22/01	1455	Noatak	Salmonberry	67°35.947' N	163°00.016' W
01DMT030SY	8/22/01	1500	Noatak	Salmonberry	67°35.884' N	163°00.059' W
01DMT031SY	8/22/01	1510	Noatak	Salmonberry	67°35.848' N	162°59.933' W
01DMT032SK	8/22/01	1545	Noatak	Sour Dock	67°37.456' N	162°57.513' W
01DMT033SK	8/22/01	1545	Noatak	Sour Dock	67°37.441' N	162°57.543' W
01DMT034SK	8/22/01	1545	Noatak	Sour Dock	67°37.441' N	162°57.478' W
01DMT035SK	8/22/01	1552	Noatak	Sour Dock	67°37.442' N	162°57.541' W
01DMT036SK	8/22/01	1555	Noatak	Sour Dock	67°37.456' N	162°57.449' W
01DMT037SK	8/22/01	1600	Noatak	Sour Dock	67°37.423' N	162°57.502' W
01DMT038SK	8/22/01	1607	Noatak	Sour Dock	67°37.425' N	162°57.578' W
01DMT039SK	8/22/01	1610	Noatak	Sour Dock	67°37.432' N	162°57.411' W
01DMT040SK	8/22/01	1614	Noatak	Sour Dock	67°37.409' N	162°57.422' W
01DMT041SK	8/22/01	1620	Noatak	Sour Dock	67°37.434' N	162°57.582' W
01DMT042WA	9/6/01	1645	Rinsate	Water	NA	NA
01DMT043SY	9/7/01	0930	Terminal	Salmonberry	Not Collected	Not Collected
01DMT044SY	9/7/01	0945	Terminal	Salmonberry	Not Collected	Not Collected
01DMT045SY	9/7/01	0950	Terminal	Salmonberry	Not Collected	Not Collected
01DMT046SY	9/7/01	1000	Terminal	Salmonberry	Not Collected	Not Collected
01DMT047WA	8/21/01	1732	Wulik River	Surface water	Not Collected	Not Collected
01DMT048SY	9/19/01	1540	Point Hope	Salmonberry	68°20.297' N	166°32.531' W
01DMT049SY	9/19/01	1550	Point Hope	Salmonberry	68°20.294' N	166°32.504' W
01DMT050SY	9/19/01	1605	Point Hope	Salmonberry	68°20.255' N	166°32.396' W

GPS Summary; Wild Foods Investigation.

Sample Number	Date	Time	Data Set	Matrix	Latitude	Longitude
01DMT051SY	9/19/01	1620	Point Hope	Salmonberry	68°20.257' N	162°32.412' W
01DMT052SY	9/19/01	1530	Point Hope	Salmonberry	68°20.233' N	162°32.448' W
01DMT053SY	9/19/01	1540	Point Hope	Salmonberry	68°20.216' N	162°32.410' W
01DMT054SY	9/19/01	1635	Point Hope	Salmonberry	68°20.238' N	162°32.464' W
01DMT055SY	9/19/01	1655	Point Hope	Salmonberry	68°20.207' N	162°32.323' W
01DMT056SY	9/19/01	1730	Point Hope	Salmonberry	68°21.188' N	162°31.070' W
01DMT057SY	9/19/01	1735	Point Hope	Salmonberry	Not Collected	Not Collected
01DMT070BY	9/19/01	1150	Port Site	Blackberry	N 67°38.513' N	164°12.820' W
01DMT071BY	9/19/01	1205	Port Site	Blackberry	N 67°38.497' N	164°12.784' W
01DMT072BY	9/19/01	1217	Port Site	Blackberry	N 67°38.492' N	164°12.750' W
01DMT073BY	9/19/01	1230	Port Site	Blackberry	N 67°38.476' N	164°12.706' W
01DMT074BY	9/19/01	1305	Port Site	Blackberry	N 67°37.608' N	164°09.917' W
01DMT075BY	9/19/01	1315	Port Site	Blackberry	N 67°37.598' N	164°09.884' W
01DMT076BY	9/19/01	1330	Port Site	Blackberry	N 67°37.585' N	164°09.876' W
01DMT077BY	9/19/01	1346	Port Site	Blackberry	N 67°37.248' N	164°08.992' W
01DMT078BY	9/19/01	1355	Port Site	Blackberry	N 67°37.249' N	164°09.010' W
01DMT079BY	9/19/01	1405	Port Site	Blackberry	N 67°37.235' N	164°08.962' W
01DMT080BY	9/20/01	1415	Noatak	Blackberry	N 67°51.173' N	162°41.037' W
01DMT081BY	9/20/01	1415	Noatak	Blackberry	N 67°51.176' N	162°41.041' W
01DMT082BY	9/20/01	1430	Noatak	Blackberry	N 67°51.168' N	162°41.031' W
01DMT083BY	9/20/01	1440	Noatak	Blackberry	N 67°51.168' N	162°41.022' W
01DMT084BY	9/20/01	1515	Noatak	Blackberry	N 67°48.770' N	162°46.984' W
01DMT085BY	9/20/01	1515	Noatak	Blackberry	N 67°48.769' N	162°46.980' W
01DMT086BY	9/20/01	1535	Noatak	Blackberry	N 67°48.773' N	162°46.965' W
01DMT087BY	9/20/01	1535	Noatak	Blackberry	N 67°48.769' N	162°46.951' W
01DMT088WA	9/20/01	1830	Rinsate	Water	NA	NA

Key:

N = North.
NA = Not applicable.
W = West.

C

Data Validation Report and Laboratory Analytical Reports

MEMORANDUM

DATE: November 19, 2001

TO: Ben Martich, Project Manager, E & E, Anchorage, AK

FROM: Carl Overpeck, Chemist, E & E, Anchorage, AK

SUBJ: **Inorganic Data Quality Assurance Review, DeLong Mountain Terminal**

REF: E & E Project # 001332.AU02.04

The data quality assurance review of samples collected from the DeLong Mountain Terminal area in Alaska has been completed. Salmonberry, sour dock, blackberry, and surface water and (berry) rinsate samples were collected in August and September 2001 and received for analysis by Battelle Marine Science Laboratories of Sequim, Washington (Battelle Lab) for selected metal (Cr, Co, Ni, Cu, Zn, Se, Cd, Pb, and Mn) analysis via EPA Method 6020 (ICP/MS).

The data are provided in four reports by Battelle Lab (plus an additional report providing missing Manganese data from report Nos. 2 and 3). The report format is limited with respect to quality control reporting format and, as such, conformance of much quality control criteria is inferred by the Battelle Lab Quality Assurance Program Plan. This review encompasses the data provided by Battelle Lab for all four reports.

Data Qualifications:

1. Sample Holding Times: Acceptable.

The samples were maintained at 4°C (+ 2°C) and were analyzed within 6 months between collection and analysis for all analyzed metals, therefore meeting QC requirements.

2. Initial and Continuing Calibration: Inferred.

ICV/CCV results and data were not provided with the reports. Conformance with QC criteria is inferred by conformance with the Battelle Lab Quality Assurance Program Plan.

3. Blanks: Acceptable, Exceptions Noted.

Blank results were provided with each report. Analytes were either not detected or were less than an order of magnitude of sample results, with the following exceptions: chromium was detected in report Nos. 2, 3, and 4 at values within 5x of all associated sample results. All associated sample results are flagged *UB*, undetected-blank contamination. The reporting limits for these analytical runs are adjusted to 5x the blank detection levels. Chromium data quality objectives for results reported in report Nos. 2 and 4 were not achieved.

4. ICP Interference Check Sample: Inferred.

ICP results and data were not provided with the reports. Conformance with QC criteria is inferred by conformance with the Battelle Lab Quality Assurance Program Plan.

5. Precision and Bias Determination: Acceptable, Exceptions Noted.

Sample analysis necessary to determine precision and bias was conducted by the laboratory using Standard Reference Materials (SRMs). At least two SRMs were analyzed with each analytical batch. All percent recoveries for the SRMs were reported within 75-125% QC limits, with the following exceptions: Report No. 1 — zinc recovery in one SRM was slightly below QC limits, and results are not qualified based upon the slight outlier; report No. 2 — selenium recovery in both SRMs greatly exceeded QC limits, and all positive Se results are qualified *JH*, estimated biased high; Report No. 3 — nickel recovery in one SRM was slightly above QC limits, and results are not qualified based upon the slight outlier; selenium recovery in both SRMs was greatly below QC limits, and all Se results are qualified *JL*, estimated biased low; report No. 4 (berries and vegetation) — nickel recovery was slightly above QC limits in one SRM and below QC limits in the other, and results are not qualified based upon the slight outliers; selenium recovery in both SRMs was greatly above QC limits, and all positive Se results are qualified *JH*, estimated biased high; report No. 4 (waters) — all water SRM recoveries were within QC limits.

6. Performance Evaluation Sample Analysis: Not Provided.

Performance evaluation samples were not provided to the laboratory.

7. ICP Serial Dilution: Inferred/Unknown.

No serial dilutions are referenced within the report. The performance of serial dilutions may be inferred by conformance with the Battelle Lab Quality Assurance Program Plan.

8. Matrix Spike Analysis: Satisfactory.

Matrix spike analyses were performed for all analytical groups. All water MS/MSDs were within QC limits. For berries/vegetation, all manganese recoveries were "overwhelmed by native concentrations." Likewise zinc recoveries were affected, but only slightly. Results are not qualified based upon MS/MSD recoveries alone.

9. Duplicate Analysis: Acceptable.

A duplicate analysis was performed for each analytical batch. Duplicate results were within QC limits with the following exceptions: report No. 1 — the lead RPD slightly exceeded QC limits; report No. 4 — zinc, lead, and chromium RPDs slightly exceeded QC limits. Data are not qualified based upon these slight outliers.

10. Laboratory Control Sample Analysis: Acceptable.

A laboratory control sample (LCS) was analyzed per analytical batch. All LCS results were within QC limits, with the exception of selenium LCS results for report Nos. 1, 3, and 4, which were slightly outside QC limits. Data are not qualified based upon these slight outliers.

11. Lab Communications

The lab was contacted on November 19, 2001 (Overpeck-E & E/Crecelius-Battelle Lab). The level of QC data provided by Battelle Lab was based upon contractual agreements between Exponent. Inc. (Teck Cominco Alaska, Inc.'s consultants) and Battelle Lab. Any additional level of QC reporting would require an authorization to incur additional expense.

12. Overall Assessment of Data for Use

In some instances data quality objectives for berries and vegetation were not met for chromium (blank contamination) and selenium (high and low bias).

The overall usefulness of the data is based upon the criteria outlined in the OSWER guidance document *Quality Assurance/Quality Control Guidance for Removal Activities, Sampling QA/QC Plan, and Data Validation Procedures* (EPA/540/G-90/004); the analytical methods; and, when applicable, the Office of Emergency and Remedial Response publication *USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review* (EPA 540/R-94/013). Based upon the information provided, the data are acceptable for use with the above-stated data qualifications.

Data Qualifiers and Definitions

U - The analyte was analyzed for but was not detected. The associated numerical value is the sample reporting limit.

J - The analyte was detected above the detection limit but below the reporting limit. The reported value is an estimate.

UJ - The analyte was analyzed for, but not detected. The reported detection limit is estimated because quality control criteria were not met.

B - Blank contamination. The analyte was detected in an associated blank.

UB - Undetected, blank contamination. The analyte was detected at a level within 5x the associated blank level. The associated reporting limit is adjusted to 5x the associated blank level.

JL - Estimated, biased low. Recovery of Standard Reference Materials was significantly below QC limits. The associated data are qualified estimated, biased low.

JH - Estimated, biased high. Recovery of Standard Reference Materials was significantly higher than QC limits. The associated data are qualified estimated, biased high.

QA/QC SUMMARY

PROJECT: DeLong Mountain Terminal
PARAMETER: Metals
LABORATORY: Battelle Sequim
MATRIX: Salmon Berries

SAMPLE CUSTODY: Eighty samples, including one water sample, were received on 8/23/01. All containers were received in good condition. The cooler temperatures upon receipt were 2.5°C, 3.1 and 5.6°C. Samples were entered into Battelle's log-in system. This data report is for 20 samples.

QA/QC DATA QUALITY OBJECTIVES:

	Reference Method	Range of Recovery	SRM Accuracy	Relative Precision	Target Detection Limit (ug/g)	Achieved Detection Limit (ug/g)
Cobalt	ICP-MS	75-125%	≤25%	≤25%	0.5	0.003
Cadmium	ICP-MS	75-125%	≤25%	≤25%	0.05	0.01
Chromium	ICP-MS	75-125%	≤25%	≤25%	0.5	0.03
Copper	ICP-MS	75-125%	≤25%	≤25%	0.2	0.02
Lead	ICP-MS	75-125%	≤25%	≤25%	0.05	0.02
Manganese	ICP-MS	75-125%	≤25%	≤25%	0.1	0.01
Nickel	ICP-MS	75-125%	≤25%	≤25%	0.5	0.04
Selenium	ICP-MS	75-125%	≤25%	≤25%	1.0	0.5
Zinc	ICP-MS	75-125%	≤25%	≤25%	1.0	0.02

METHODS: Nine metals were analyzed: cadmium (Cd), chromium (Cr), cobalt (Co), copper (Cu), lead (Pb), manganese (Mn), nickel (Ni), selenium (Se), and zinc (Zn). The samples were digested using nitric acid. All metals were analyzed by inductively coupled plasma mass spectrometry (ICP-MS) following EPA Method 6020. Dry weight was determined by freeze drying.

BLANKS: Cu and Zn were detected in the blank. Both were detected at a concentration less than 5 times the MDL and an order of magnitude lower than the sample concentrations; therefore no corrective action was taken.

MATRIX SPIKES: One matrix spike/matrix spike duplicate pair was analyzed. Recoveries of all metals were within QC limits of 75-125% and all RPDs were less than 25%.

QA/QC SUMMARY

REPLICATES: One sample was analyzed in duplicate. Precision is reported by calculating the relative percent difference (RPD) of replicate results. RPDs for all metals were within the QC limits of ±25%, except for Pb at 31%. Mn was not spike at a high enough concentration to provide useful data.

SRM and LCS: Two SRMs, MOSS M3 and Lichen IAEA 336 were analyzed. All results were within the QC recovery of 75-125%, except for Zn in lichen. The LCS sample, NIST 1640 trace metals in water, was run twice. Se recovery was above 125%.

Eric Crecelius
Project Manager

Deborah Coffey
Quality Assurance Engineer

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DELONG MOUNTAIN TERMINAL PROJECT
METALS IN SALMON BERRIES
(Samples Received 8/24/01)

MSL Code	Sponsor ID	Percent Dry Wt	concentrations in µg/g **dry** weight - data are not blank corrected) Cr	Co	Ni	Cu	Zn	Se	Cd	Pb	Mn (d)
1701-29	OIDMTO01SY	13.0	0.223	0.0835	1.74	3.21	20.3	0.5 U	0.103	0.114	113
1701-30	OIDMTO01SYC	12.2	0.177	0.0765	1.39	3.24	22.1	0.5 U	0.111	0.138	130
1701-31	OIDMTO02SY	13.0	0.225	0.136	1.95	3.59	26.4	0.5 U	0.140	0.222	107
1701-32 r1	OIDMTO02SYC	12.5	0.212	0.116	1.17	2.08	19.8	0.5 U	0.135	0.370	292
1701-32 r2	OIDMTO02SYC	12.5	0.213	0.127	1.45	2.24	21.1	0.5 U	0.139	0.272	289
1701-33	OIDMTO03SY	13.3	0.248	0.0856	1.35	2.99	20.1	0.5 U	0.105	0.263	151
1701-34	OIDMTO03SYC	12.2	0.250	0.116	1.51	3.59	18.1	0.5 U	0.113	0.116	123
1701-35	OIDMTO04SY	13.8	0.232	0.110	2.79	4.01	20.3	0.5 U	0.131	0.162	163
1701-36	OIDMTO04SYC	13.4	0.235	0.116	2.61	3.76	20.9	0.5 U	0.134	0.136	224
1701-37	OIDMTO05SY	13.2	0.223	0.147	2.73	4.17	23.4	0.5 U	0.150	0.225	160
1701-38	OIDMTO05SYC	12.7	0.228	0.136	3.00	4.00	19.9	0.5 U	0.138	0.104	137
1701-39	OIDMTO06SY	11.9	0.213	0.0837	2.96	3.68	26.4	0.5 U	0.201	0.339	152
1701-40	OIDMTO06SYC	11.9	0.254	0.0757	3.72	4.64	22.6	0.5 U	0.195	0.260	131
1701-41	OIDMTO07SY	12.9	0.194	0.0857	2.60	4.08	24.1	0.5 U	0.195	0.289	118
1701-42	OIDMTO07SYC	13.2	0.206	0.0997	2.14	3.54	20.6	0.5 U	0.203	0.271	155
1701-43	OIDMTO08SY	12.9	0.241	0.105	2.37	4.20	29.5	0.5 U	0.241	0.204	103
1701-44	OIDMTO08SYC	13.1	0.228	0.107	3.05	4.61	27.3	0.5 U	0.246	0.132	92.7
1701-45	OIDMTO09SY	13.7	0.237	0.0714	2.01	4.23	22.9	0.5 U	0.166	0.111	122
1701-46	OIDMTO09SYC	14.2	0.212	0.0921	2.33	3.87	23.0	0.5 U	0.190	0.174	100
1701-47a	OIDMTO10SY	12.7	0.218	0.0803	2.39	4.38	22.9	0.5 U	0.173	0.161	102
1701-48a	OIDMTO10SYC	12.6	0.213	0.113	3.45	5.47	26.4	0.5 U	0.245	0.235	88.2
Procedural Blank			0.03 U	0.003 U	0.04 U	0.0209	0.0805	0.5 U	0.01 U	0.02 U	0.01 U
Target Detection Limits			0.5	0.5	0.5	0.2	1.0	1.0	0.05	0.05	0.1
Acheived Detection Limits			0.03	0.003	0.04	0.02	0.02	0.5	0.01	0.02	0.01

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DELONG MOUNTAIN TERMINAL PROJECT
METALS IN SALMON BERRIES
(Samples Received 8/24/01)

MSL Code	Sponsor ID	Percent Dry Wt	concentrations in µg/g **dry** weight - data are not blank corrected) Cr	Co	Ni	Cu	Zn	Se	Cd	Pb	Mn (d)
STANDARD REFERENCE MATERIAL											
MOSS 1136			0.694	0.126	1.17	3.61	19.3	0.107 J	0.0973	3.47	501
	certified value		0.67	0.115	0.95	3.76	25.4	0.115	0.106	3.33	535
	percent recovery		104%	110%	123%	96%	76%	93%	92%	104%	94%
IAEA 366			1.07	0.286	0.962	3.07	22.7	0.205 J	0.100	4.57	62.4
	certified value		1.03	0.287	NC	3.55	31.6	0.216	0.117	5.0	64.0
	percent recovery		104%	100%	NA	86%	72% #	95%	85%	91%	98%
LABORATORY CONTROL SAMPLE											
1640 (µg/L)			35.5	22.4	28.9	89.7	64.4	29.4	26.6	28.3	117
			35.9	21.8	29.1	94.0	64.2	27.7	24.6	30.1	110
	certified value		38.6	20.3	27.4	85.2	53.2	22.0	22.8	27.9	122
	percent recovery		92%	110%	105%	105%	121%	134% #	117%	101%	96%
			93%	107%	106%	110%	121%	126% #	108%	108%	90%
REPLICATE ANALYSIS RESULTS											
1701-32 r1	OIDMTO02SYC	12.5	0.212	0.116	1.17	2.08	19.8	0.5 U	0.135	0.370	292
1701-32 r2	OIDMTO02SYC	12.5	0.213	0.127	1.45	2.24	21.1	0.5 U	0.139	0.272	289
Relative percent difference			**0%**	**9%**	**21%**	**7%**	**6%**	**0%**	**3%**	**31% #**	**1%**

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DELONG MOUNTAIN TERMINAL PROJECT
METALS IN SALMON BERRIES
(Samples Received 8/24/01)

MSL Code	Sponsor ID	Percent Dry Wt	concentrations in µg/g **dry** weight - data are not blank corrected) Cr	Co	Ni	Cu	Zn	Se	Cd	Pb	Mn (d)
MATRIX SPIKE RESULTS											
Amount Spiked			5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
1701-29	OIDMTO01SY	13.0	0.223	0.0835	1.74	3.21	20.3	0.5 U	0.103	0.114	113
1701-29 MS			5.02	5.68	6.80	8.65	24.5	5.07	4.44	5.00	122
Amount Recovered			4.80	5.60	5.06	5.44	4.20	5.07	4.34	4.89	9.0
Percent Recovery			96%	112%	101%	109%	84%	101%	87%	98%	SL
Amount Spiked			5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
1701-29	OIDMTO01SY	13.0	0.223	0.0835	1.74	3.21	20.3	0.5 U	0.103	0.114	113
1701-29 MSD			4.94	5.53	6.77	8.10	24.6	5.04	4.60	4.86	121
Amount Recovered			4.72	5.45	5.03	4.89	4.30	5.04	4.50	4.75	8.0
Percent Recovery			94%	109%	101%	98%	86%	101%	90%	95%	SL
Relative percent difference			**2%**	**3%**	**1%**	**11%**	**2%**	**1%**	**4%**	**3%**	**NA**

(d) Mn was diluted and re-analyzed; concentrations shown have been corrected for dilution
U Not detected at or above DL shown
J Reported below DL shown; estimated value
NC Not certified
NA Not applicable.available
Outside standard DQO (±25%)
SL Inappropriate spike level; native sample concentrations overwhelmed spike

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DELONG MOUNTAIN TERMINAL PROJECT
METALS IN SALMON BERRIES
(Samples Received 8/24/01)

MSL Code	Sponsor ID	Percent Dry Wt	concentrations in µg/g **wet** weight - data are not blank corrected) Cr	Co	Ni	Cu	Zn	Se	Cd	Pb	Mn
1701-29	OIDMTO01SY	13.0	0.0290	0.0109	0.226	0.417	2.64	0.0645 U	0.0134	0.0148	14.7
1701-30	OIDMTO01SYC	12.2	0.0216	0.00933	0.170	0.395	2.70	0.0645 U	0.0135	0.0168	15.9
1701-31	OIDMTO02SY	13.0	0.0293	0.0177	0.254	0.467	3.43	0.0645 U	0.0182	0.0289	13.9
1701-32 r1	OIDMTO02SYC	12.5	0.0265	0.0145	0.146	0.260	2.48	0.0645 U	0.0169	0.0463	36.5
1701-32 r2	OIDMTO02SYC	12.5	0.0266	0.0159	0.181	0.280	2.64	0.0645 U	0.0174	0.0340	36.1
1701-33	OIDMTO03SY	13.3	0.0330	0.0114	0.180	0.398	2.67	0.0645 U	0.0140	0.0350	20.1
1701-34	OIDMTO03SYC	12.2	0.0305	0.0142	0.184	0.438	2.21	0.0645 U	0.0138	0.0142	15.0
1701-35	OIDMTO04SY	13.8	0.0320	0.0152	0.385	0.553	2.80	0.0645 U	0.0181	0.0224	22.5
1701-36	OIDMTO04SYC	13.4	0.0315	0.0155	0.350	0.504	2.80	0.0645 U	0.0180	0.0182	30.0
1701-37	OIDMTO05SY	13.2	0.0294	0.0194	0.360	0.550	3.09	0.0645 U	0.0198	0.0297	21.1
1701-38	OIDMTO05SYC	12.7	0.0290	0.0173	0.381	0.508	2.53	0.0645 U	0.0175	0.0132	17.4
1701-39	OIDMTO06SY	11.9	0.0253	0.00996	0.352	0.438	3.14	0.0645 U	0.0239	0.0403	18.1
1701-40	OIDMTO06SYC	11.9	0.0302	0.00901	0.443	0.552	2.69	0.0645 U	0.0232	0.0309	15.6
1701-41	OIDMTO07SY	12.9	0.0250	0.0111	0.335	0.526	3.11	0.0645 U	0.0252	0.0373	15.2
1701-42	OIDMTO07SYC	13.2	0.0272	0.0132	0.282	0.467	2.72	0.0645 U	0.0268	0.0358	20.5
1701-43	OIDMTO08SY	12.9	0.0311	0.0135	0.306	0.542	3.81	0.0645 U	0.0311	0.0263	13.3
1701-44	OIDMTO08SYC	13.1	0.0299	0.0140	0.400	0.604	3.58	0.0645 U	0.0322	0.0173	12.1
1701-45	OIDMTO09SY	13.7	0.0325	0.00978	0.275	0.580	3.14	0.0645 U	0.0227	0.0152	16.7
1701-46	OIDMTO09SYC	14.2	0.0301	0.0131	0.331	0.550	3.27	0.0645 U	0.0270	0.0247	14.2
1701-47a	OIDMTO10SY	12.7	0.0277	0.0102	0.304	0.556	2.91	0.0645 U	0.0220	0.0204	13.0
1701-48a	OIDMTO10SYC	12.6	0.0268	0.0142	0.435	0.689	3.33	0.0645 U	0.0309	0.0296	11.1
Procedural Blank		*12.9*	0.00387 U	0.000387 U	0.00516 U	0.0209	0.0805	0.0645 U	0.00129 U	0.00258 U	0.00129 U
Target Detection Limits		*12.9*	0.0645	0.0645	0.0645	0.0258	0.129	0.129	0.00645	0.00645	0.0129
Acheived Detection Limits		*12.9*	0.00387	0.000387	0.00516	0.00258	0.00258	0.0645	0.00129	0.00258	0.00129

U Not detected at or above DL shown

Wet weight concentrations are calculated values (dry wt conc * % dry wt/100)

QA/QC SUMMARY

PROJECT: DeLong Mountain Terminal
PARAMETER: Metals
LABORATORY: Battelle Sequim
MATRIX: Salmon Berries and Sour Dock

SAMPLE CUSTODY: Eighty samples, including one water sample, were received on 8/23/01. All containers were received in good condition. The cooler temperatures upon receipt were 2.5°C, 3.1 and 5.6°C. Samples were entered into Battelle's log-in system. This data report is for 40 samples.

QA/QC DATA QUALITY OBJECTIVES:

	Reference Method	Range of Recovery	SRM Accuracy	Relative Precision	Target Detection Limit (ug/g)	Achieved Detection Limit (ug/g)
Cobalt	ICP-MS	75-125%	≤25%	≤25%	0.5	0.003
Cadmium	ICP-MS	75-125%	≤25%	≤25%	0.05	0.01
Chromium	ICP-MS	75-125%	≤25%	≤25%	0.5	0.03
Copper	ICP-MS	75-125%	≤25%	≤25%	0.2	0.02
Lead	ICP-MS	75-125%	≤25%	≤25%	0.05	0.02
Manganese	ICP-MS	75-125%	≤25%	≤25%	0.1	0.01
Nickel	ICP-MS	75-125%	≤25%	≤25%	0.5	0.04
Selenium	ICP-MS	75-125%	≤25%	≤25%	1.0	0.5
Zinc	ICP-MS	75-125%	≤25%	≤25%	1.0	0.02

METHODS: Nine metals were analyzed: cadmium (Cd), chromium (Cr), cobalt (Co), copper (Cu), lead (Pb), manganese (Mn), nickel (Ni), selenium (Se), and zinc (Zn). The samples were digested using nitric acid. All metals were analyzed by inductively coupled plasma mass spectrometry (ICP-MS) following EPA Method 6020. Dry weight was determined by freeze drying.

Mn exceeded the linear range of the calibration; results are not reported here. Samples will be diluted, re-analyzed, and reported at a later date.

BLANKS: Cd, Cr, and Zn were detected in the blank. These metals were detected at a concentration less than the target detection limit and an order of magnitude lower than the sample concentrations; therefore no corrective action was taken. Data are not blank corrected.

QA/QC SUMMARY

MATRIX SPIKES: Two matrix spike/matrix spike duplicate pairs were analyzed. Recoveries of all metals except Zn were within QC limits of 75-125%. Because Zn samples were not spiked high enough for the concentrations in the samples, the spike recovery data are not useful. All RPDs were less than 25%.

REPLICATES: Two samples were analyzed in duplicate. Precision is reported by calculating the relative percent difference (RPD) of replicate results. RPDs for all metals were within the QC limits of ±25%.

SRM and LCS: Two SRMs, MOSS M3 and Tomato Leaves 1573a, were analyzed for all metals reported. Results were within the data quality objective of 75-125% recovery, except for one replicate of Cd, one Zn value, and all four Se results. Se results for the two SRMs are reported as estimate (J flagged) values only; both the results and the certified value are below the achieved MDL.

The LCS sample, NIST 1640 trace metals in water, was run twice, with acceptable recovery for all metals analyzed.

Comments: Se and some Pb concentrations were below the detection limit and were "J" flagged.

Once CCV for Cr (116% recovery) exceeded the acceptable range (±15%); however the following two CCVs were acceptable (115%, 115% recovery). All QC were within DQO limits, therefore, no corrective action was taken.

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DELONG MOUNTAIN TERMINAL PROJECT
METALS IN BERRIES & PLANTS
(Samples Received 8/24/01)

MSL Code	Sponsor ID	Percent Dry Wt	Matrix	concentrations in µg/g **dry** weight - data are not blank corrected) Cd	Cr	Co	Cu	Ni	Pb	Se	Zn	Mn (d)
1701*1	01DMT018SK	11.7	Sour Dock	0.0461	0.538 B	0.964	3.42	3.08	0.391	0.250 J	32.3	240
1707*2	01DMT018SKC	10.1	Sour Dock	0.0338	0.649 B	0.599	4.48	1.74	0.626	0.219 J	39.1	122
1701*3	01DMT019SK	12.3	Sour Dock	0.0209	0.523 B	0.373	2.72	0.999	0.244	0.280 J	18.7	86.7
1701*4r1	01DMT019SKC	9.64	Sour Dock	0.0236	0.479 B	0.408	3.80	1.23	0.244	0.341 J	38.5	105
1701*4r2	01DMT019SKC	9.64	Sour Dock	0.0250	0.386 B	0.392	3.61	1.19	0.232	0.278 J	37.7	103
1701*5	01DMT020SK	11.8	Sour Dock	0.0290	0.531 B	0.422	3.73	0.890	0.279	0.202 J	34.4	102
1701*6	01DMT020SKC	10.1	Sour Dock	0.0341	0.564 B	0.494	3.84	1.40	0.389	0.204 J	70.8	138
1701*7	01DMT021SK	8.30	Sour Dock	0.0371	0.671 B	1.24	2.66	0.846	0.229	0.241 J	26.4	96.8
1701*8	01DMT021SKC	9.66	Sour Dock	0.0271	0.605 B	0.328	3.12	0.594	0.516	0.377 J	29.3	75.3
1701*9	01DMT022SY	14.8	Salmonberries	0.183	0.235 B	0.0745	4.82	2.19	0.00576 J	0.135 J	22.3	150
1707*10	01DMT022SYC	14.9	Salmonberries	0.239	0.196 B	0.0905	5.60	3.22	0.00415 J	0.111 J	25.1	198
1701*11	01DMT023SY	14.6	Salmonberries	0.207	0.197 B	0.0871	4.86	2.57	0.115	0.174 J	23.1	204
1701*12	01DMT023SYC	15.4	Salmonberries	0.247	0.170 B	0.0797	5.72	2.67	0.0121 J	0.0724 J	22.8	207
1701*13	01DMT024SY	15.1	Salmonberries	0.153	0.151 B	0.0749	3.67	2.10	0.189	0.138 J	18.7	139
1701*14	01DMT024SYC	15.2	Salmonberries	0.158	0.135 B	0.0688	4.38	1.95	0.00342 J	0.103 J	20.3	123
1701*15	01DMT025SY	14.2	Salmonberries	0.119	0.0950 B	0.0525	3.09	1.26	0.00805 J	0.0858 J	14.6	147
1701*16	01DMT025SYC	13.5	Salmonberries	0.0992	0.130 B	0.0494	4.50	1.44	0.0545	0.119 J	21.9	110
1701*17	01DMT026SY	15.8	Salmonberries	0.158	0.122 B	0.100	3.79	2.97	0.00519 J	0.105 J	21.9	110
1701*18	01DMT026SYC	15.5	Salmonberries	0.139	0.137 B	0.125	3.83	2.83	0.00309 J	0.111 J	19.4	120
1701*19	01DMT027SY	14.3	Salmonberries	0.188	0.137 B	0.0792	5.21	2.04	0.00700 J	0.113 J	25.9	181
1701*20	01DMT027SYC	14.3	Salmonberries	0.260	0.138 B	0.0843	5.09	2.47	0.00491 J	0.125 J	26.7	202
1701*21	01DMT028SY	14.7	Salmonberries	0.253	0.0897 B	0.143	5.78	3.65	0.00358 J	0.103 J	29.4	102
1701*22	01DMT028SYC	14.6	Salmonberries	0.252	0.0852 B	0.137	5.12	2.66	0.00795 J	0.0668 J	25.0	126
1701*23	01DMT029SY	14.9	Salmonberries	0.254	0.0909 B	0.131	6.26	4.98	0.00927 J	0.142 J	27.4	206
1701*24r1	01DMT029SYC	15.0	Salmonberries	0.193	0.0847 B	0.162	2.80	2.67	0.00422 J	0.0940 J	17.0	134
1701*24r2	01DMT029SYC	15.0	Salmonberries	0.181	0.0918 B	0.165	3.10	3.16	0.00390 J	0.0817 J	18.5	124
1701*25	01DMT030SY	14.6	Salmonberries	0.230	0.0984 B	0.0870	4.69	2.55	0.0156 J	0.113 J	25.1	170
1701*26	01DMT030SYC	14.4	Salmonberries	0.198	0.0993 B	0.0694	4.68	2.55	0.0112 J	0.0967 J	24.7	156
1701*27A	01DMT031SY	14.2	Salmonberries	0.220	0.0976 B	0.0617	4.12	2.36	0.00806 J	0.0715 J	20.2	162
1701*28A	01DMT031SYC	14.4	Salmonberries	0.236	0.0835 B	0.0814	7.38	3.14	0.00494 J	0.0608 J	21.3	242
1701*49	01DMT012SK	11.4	Sour Dock	0.183	0.239 B	0.449	4.08	1.78	2.77	0.091 J	47.8	183
1701*50	01DMT012SKC	9.80	Sour Dock	0.120	0.239 B	0.724	3.38	1.68	1.54	0.196 J	39.7	162
1701*51	01DMT013SK	11.4	Sour Dock	0.142	0.282 B	0.480	3.46	1.76	2.07	0.202 J	64.8	70.5
1701*52	01DMT013SKC	8.73	Sour Dock	0.139	0.343 B	0.773	3.33	2.14	2.37	0.248 J	129	151

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DELONG MOUNTAIN TERMINAL PROJECT
METALS IN BERRIES & PLANTS
(Samples Received 8/24/01)

MSL Code	Sponsor ID	Percent Dry Wt	Matrix	concentrations in µg/g **dry** weight - data are not blank corrected) Cd	Cr	Co	Cu	Ni	Pb	Se	Zn	Mn (d)
1701*53A	01DMT014SK	10.8	Sour Dock	0.0527	0.269 B	0.269	3.97	0.714	2.00	0.185 J	27.8	110
1701*54A	01DMT014SKC	9.37	Sour Dock	0.116	0.299 B	0.280	3.63	0.917	1.76	0.192 J	38.1	80.0
1701*55	01DMT015SK	11.9	Sour Dock	0.0919	0.274 B	0.296	3.43	1.26	2.24	0.213 J	48.7	86.4
1701*56	01DMT015SKC	11.4	Sour Dock	0.0624	0.284 B	0.442	3.41	1.33	1.71	0.215 J	76.4	95.9
1701*57	01DMT016SK	12.9	Sour Dock	0.0767	0.279 B	0.494	2.79	1.69	2.56	0.195 J	49.9	152
1701*58	01DMT016SKC	10.2	Sour Dock	0.144	0.293 B	0.461	3.11	1.55	2.87	0.158 J	62.5	175
1701*59	01DMT017SK	14.1	Sour Dock	0.109	0.299 B	0.353	3.17	1.21	2.99	0.202 J	41.8	115
1701*60	01DMT017SKC	11.0	Sour Dock	0.0790	0.296 B	0.275	3.38	1.49	3.04	0.164 J	59.2	86.2
Procedural Blank 1		*12.8*		0.01 U	0.120	0.003 U	0.02 U	0.04 U	0.02 U	0.5 U	0.103	0.01 U
Procedural Blank 2		*12.8*		0.0196	0.164	0.003 U	0.02 U	0.04 U	0.02 U	0.5 U	0.161	0.045
			Mean Blank	*NA*	*0.142*	*NA*	*NA*	*NA*	*NA*	*NA*	*0.132*	*0.0225*
Target Detection Limits		*12.8*		0.05	0.5	0.5	0.2	0.5	0.05	1.0	1.0	0.1
Acheived Detection Limits		*12.8*		0.01	0.03	0.003	0.02	0.04	0.02	0.5	0.02	0.01
STANDARD REFERENCE MATERIAL												
MOSS 3				0.0967	0.746	0.108	3.56	0.992	3.54	0.275 J	21.7	522
MOSS 3				0.108	0.745	0.116	3.83	1.11	3.43	0.133 J	21.3	532
	certified value			0.106	0.67	0.115	3.76	0.95	3.33	0.115	25.4	535
	percent recovery			91%	111%	94%	95%	104%	106%	239% #	85%	98%
				102%	111%	101%	102%	117%	103%	116%	84%	99%
Tomato Leaves				1.17	1.87	0.522	4.02	1.86	0.509	0.374 J	23.8	219
1573a				0.928	1.67	0.475	3.73	1.78	0.428	0.291 J	20.0	188
	certified value			1.52	1.99	0.57	4.70	1.59	NC	0.054	30.9	246
	percent recovery			77%	94%	92%	86%	117%	NA	693% #	77%	89%
				61% #	84%	83%	79%	112%	NA	539% #	65%	76%
LABORATORY CONTROL SAMPLE												
1640 (µg/L)				23.2	37.0	19.6	83.3	26.1	26.5	25.6	55.8	NA
				20.8	40.8	21.4	93.0	29.6	27.2	22.2	58.1	NA

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METALS IN BERRIES & PLANTS
(Samples Received 8/24/01)

MSL Code	Sponsor ID	Percent Dry Wt	Matrix	concentrations in µg/g **dry** weight - data are not blank corrected) Cd	Cr	Co	Cu	Ni	Pb	Se	Zn	Mn (d)
	certified value			22.8	38.6	20.3	85.2	27.4	27.9	22.0	53.2	
	percent recovery			102%	96%	97%	98%	95%	95%	116%	105%	NA
				91%	106%	105%	109%	108%	97%	101%	109%	NA
REPLICATE ANALYSIS RESULTS												
1701*4r1	01DMT019SKC	9.64	Sour Dock	0.0236	0.479 B	0.408	3.80	1.23	0.244	0.341	38.5	105
1701*4r2	01DMT019SKC	9.64	Sour Dock	0.0250	0.386 B	0.392	3.61	1.19	0.232	0.278	37.7	103
Relative percent difference				**6%**	**22%**	**4%**	**5%**	**3%**	**5%**	**20%**	**2%**	**2%**
1701*24r1	01DMT029SYC	15.0	Salmonberries	0.193	0.0847 B	0.162	2.80	2.67	0.00422 J	0.0940	17.0	134
1701*24r2	01DMT029SYC	15.0	Salmonberries	0.181	0.0918 B	0.165	3.10	3.16	0.00390 J	0.0817	18.5	124
Relative percent difference				**6%**	**8%**	**2%**	**10%**	**17%**	**8%**	**14%**	**8%**	**8%**
MATRIX SPIKE RESULTS												
Amount Spiked				5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
1701-1	01DMT018SK	11.7	Sour Dock	0.0461	0.538 B	0.964	3.42	3.08	0.391	0.250	32.3	240
1701-1 MS				4.40	5.84	6.00	8.11	7.94	5.03	5.70	35.6	244
Amount Recovered				4.35	5.30	5.04	4.69	4.86	4.64	5.70	3.30	4
Percent Recovery				87%	106%	101%	94%	97%	93%	114%	SL	SL
Amount Spiked				5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
1701-1	01DMT018SK	11.7	Sour Dock	0.0461	0.538 B	0.964	3.42	3.08	0.391	0.250	32.3	240
1701-1 MSD				4.71	6.38	6.15	8.47	8.23	5.27	5.95	37.6	249
Amount Recovered				4.66	5.84	5.19	5.05	5.15	4.88	5.95	5.30	9
Percent Recovery				93%	117%	104%	101%	103%	98%	119%	SL	SL
Relative percent difference				**7%**	**10%**	**3%**	**7%**	**6%**	**5%**	**4%**	**NA**	**NA**
Amount Spiked				5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
1701-21	01DMT028SY	14.7	Salmonberries	0.253	0.0897 B	0.143	5.78	3.65	0.00358 J	0.103	29.4	102
1701-21 MS				4.53	5.40	5.24	9.94	7.99	4.68	5.49	29.0	127
Amount Recovered				4.28	5.31	5.10	4.16	4.34	4.68	5.49	-0.40	25
Percent Recovery				86%	106%	102%	83%	87%	94%	110%	SL	SL

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(Samples Received 8/24/01)

MSL Code	Sponsor ID	Percent Dry Wt	Matrix	concentrations in µg/g **dry** weight - data are not blank corrected) Cd	Cr	Co	Cu	Ni	Pb	Se	Zn	Mn (d)
Amount Spiked				5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
1701-21	01DMT028SY	14.7	Salmonberries	0.253	0.0897 B	0.143	5.78	3.65	0.00358 J	0.103	29.4	102
1701-21 MSD				4.53	5.58	5.38	10.1	8.39	4.73	5.60	30.6	119
Amount Recovered				4.28	5.49	5.24	4.32	4.74	4.73	5.60	1.20	17
Percent Recovery				86%	110%	105%	86%	95%	95%	112%	SL	SL
Relative percent difference				**0%**	**3%**	**3%**	**4%**	**9%**	**1%**	**2%**	**NA**	**NA**

(d) Mn was diluted and re-analyzed 11/9/01.
U Not detected at or above DL shown
J Reported below DL shown; estimated value
NC Not certified
NA Not applicable.available
Outside standard DQO (±25%)
SL Inappropriate spike level; native sample concentrations overwhelmed spike
B <5x Mean blank concentration

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(Samples Received 8/24/01)

MSL Code	Sponsor ID	Percent Dry Wt	Matrix	concentrations in µg/g **WET** weight - data are not blank corrected) Cd	Cr	Co	Cu	Ni	Pb	Se	Zn	Mn
1701*1	01DMT018SK	11.7	Sour Dock	0.00539 B	0.0629	0.113	0.400	0.360	0.0457	0.0293 J	3.78	28.1
1707*2	01DMT018SKC	10.1	Sour Dock	0.00341 B	0.0655	0.0605	0.452	0.176	0.0632	0.0221 J	3.95	12.3
1701*3	01DMT019SK	12.3	Sour Dock	0.00257 B	0.0643	0.0459	0.335	0.123	0.0300	0.0344 J	2.30	10.7
1701*4r1	01DMT019SKC	9.64	Sour Dock	0.00228 B	0.0462	0.0393	0.366	0.119	0.0235	0.0329 J	3.71	10.1
1701*4r2	01DMT019SKC	9.64	Sour Dock	0.00241 B	0.0372	0.0378	0.348	0.115	0.0224	0.0268 J	3.63	9.93
1701*5	01DMT020SK	11.8	Sour Dock	0.00342 B	0.0627	0.0498	0.440	0.105	0.0329	0.0238 J	4.06	12.0
1701*6	01DMT020SKC	10.1	Sour Dock	0.00344 B	0.0570	0.0499	0.388	0.141	0.0393	0.0206 J	7.15	13.9
1701*7	01DMT021SK	8.30	Sour Dock	0.00308 B	0.0557	0.103	0.221	0.0702	0.0190	0.0200 J	2.19	8.03
1701*8	01DMT021SKC	9.66	Sour Dock	0.00262 B	0.0584	0.0317	0.301	0.057	0.0498	0.0364 J	2.83	7.27
1701*9	01DMT022SY	14.8	Salmonberries	0.0271 B	0.0348	0.0110	0.713	0.324	0.000852 J	0.0200 J	3.30	22.2
1707*10	01DMT022SYC	14.9	Salmonberries	0.0356 B	0.0292	0.0135	0.834	0.480	0.000618 J	0.0165 J	3.74	29.5
1701*11	01DMT023SY	14.6	Salmonberries	0.0302 B	0.0288	0.0127	0.710	0.375	0.0168	0.0254 J	3.37	29.8
1701*12	01DMT023SYC	15.4	Salmonberries	0.0380 B	0.0262	0.0123	0.881	0.411	0.00186 J	0.0111 J	3.51	31.9
1701*13	01DMT024SY	15.1	Salmonberries	0.0231 B	0.0228	0.0113	0.554	0.317	0.0285	0.0208 J	2.82	21.0
1701*14	01DMT024SYC	15.2	Salmonberries	0.0240 B	0.0205	0.0105	0.666	0.296	0.000520 J	0.0157 J	3.09	18.7
1701*15	01DMT025SY	14.2	Salmonberries	0.0169 B	0.0135	0.00746	0.439	0.179	0.00114 J	0.0122 J	2.07	20.9
1701*16	01DMT025SYC	13.5	Salmonberries	0.0134 B	0.0176	0.00667	0.608	0.194	0.00736	0.0161 J	2.96	14.9
1701*17	01DMT026SY	15.8	Salmonberries	0.0250 B	0.0193	0.0158	0.599	0.469	0.000820 J	0.0166 J	3.46	17.4
1701*18	01DMT026SYC	15.5	Salmonberries	0.0215 B	0.0212	0.0194	0.594	0.439	0.000479 J	0.0172 J	3.01	18.6
1701*19	01DMT027SY	14.3	Salmonberries	0.0269 B	0.0196	0.0113	0.745	0.292	0.00100 J	0.0162 J	3.70	25.9
1701*20	01DMT027SYC	14.3	Salmonberries	0.0372 B	0.0197	0.0121	0.728	0.353	0.000702 J	0.0179 J	3.82	28.9
1701*21	01DMT028SY	14.7	Salmonberries	0.0372 B	0.0132	0.0210	0.850	0.537	0.000526 J	0.0151 J	4.32	15.0
1701*22	01DMT028SYC	14.6	Salmonberries	0.0368 B	0.0124	0.0200	0.748	0.388	0.00116 J	0.00975 J	3.65	18.4
1701*23	01DMT029SY	14.9	Salmonberries	0.0378 B	0.0135	0.0195	0.933	0.742	0.00138 J	0.0212 J	4.08	30.7
1701*24r1	01DMT029SYC	15.0	Salmonberries	0.0290 B	0.0127	0.0243	0.420	0.401	0.000633 J	0.0141 J	2.55	20.1
1701*24r2	01DMT029SYC	15.0	Salmonberries	0.0272 B	0.0138	0.0248	0.465	0.474	0.000585 J	0.0123 J	2.78	18.6
1701*25	01DMT030SY	14.6	Salmonberries	0.0336 B	0.0144	0.0127	0.685	0.372	0.00228 J	0.0165 J	3.66	24.8
1701*26	01DMT030SYC	14.4	Salmonberries	0.0285 B	0.0143	0.0100	0.674	0.367	0.00161 J	0.0139 J	3.56	22.5
1701*27A	01DMT031SY	14.2	Salmonberries	0.0312 B	0.0139	0.0088	0.585	0.335	0.00114 J	0.0102 J	2.87	23.0
1701*28A	01DMT031SYC	14.4	Salmonberries	0.0340 B	0.0120	0.0117	1.06	0.452	0.000711 J	0.00876 J	3.07	34.8
1701*49	01DMT012SK	11.4	Sour Dock	0.0209 B	0.0272	0.0512	0.465	0.203	0.316	0.0104 J	5.45	20.9
1701*50	01DMT012SKC	9.80	Sour Dock	0.0118 B	0.0234	0.0710	0.331	0.165	0.151	0.0192 J	3.89	15.9
1701*51	01DMT013SK	11.4	Sour Dock	0.0162 B	0.0321	0.0547	0.394	0.201	0.236	0.0230 J	7.39	8.04
1701*52	01DMT013SKC	8.73	Sour Dock	0.0121 B	0.0299	0.0675	0.291	0.187	0.207	0.0217 J	11.3	13.2
1701*53A	01DMT014SK	10.8	Sour Dock	0.00569 B	0.0291	0.0291	0.429	0.0771	0.216	0.0200 J	3.00	11.9
1701*54A	01DMT014SKC	9.37	Sour Dock	0.0109 B	0.0280	0.0262	0.340	0.0859	0.165	0.0180 J	3.57	7.50
1701*55	01DMT015SK	11.9	Sour Dock	0.0109 B	0.0326	0.0352	0.408	0.150	0.267	0.0253 J	5.80	10.3
1701*56	01DMT015SKC	11.4	Sour Dock	0.00711 B	0.0324	0.0504	0.389	0.152	0.195	0.0245 J	8.71	10.9

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DELONG MOUNTAIN TERMINAL PROJECT
METALS IN BERRIES & PLANTS
(Samples Received 8/24/01)

MSL Code	Sponsor ID	Percent Dry Wt	Matrix	concentrations in µg/g **WET** weight - data are not blank corrected) Cd	Cr	Co	Cu	Ni	Pb	Se	Zn	Mn
1701*57	01DMT016SK	12.9	Sour Dock	0.00989 B	0.0360	0.0637	0.360	0.218	0.330	0.0252 J	6.44	19.6
1701*58	01DMT016SKC	10.2	Sour Dock	0.0147 B	0.0299	0.0470	0.317	0.158	0.293	0.0161 J	6.38	17.9
1701*59	01DMT017SK	14.1	Sour Dock	0.0154 B	0.0422	0.0498	0.447	0.171	0.422	0.0285 J	5.89	16.2
1701*60	01DMT017SKC	11.0	Sour Dock	0.00869 B	0.0326	0.0303	0.372	0.164	0.334	0.0180 J	6.51	9.48
Procedural Blank 1		*12.8*		0.00128 U	0.0154	0.00038 U	0.00256 U	0.00512 U	0.00256 U	0.0640 U	0.0132	0.001 U
Procedural Blank 2		*12.8*		0.00251	0.0210	0.00038 U	0.00256 U	0.00512 U	0.00256 U	0.0640 U	0.0206	0.00576
			Mean Blank	*NA*	*0.0182*	*NA*	*NA*	*NA*	*NA*	*NA*	*0.0169*	*0.00352*
Target Detection Limits		*12.8*		0.00640	0.0640	0.0640	0.0256	0.0640	0.00640	0.128	0.128	0.01
Acheived Detection Limits		*12.8*		0.00128	0.00384	0.00038	0.00256	0.00512	0.00256	0.0640	0.00256	0.00128

QA/QC SUMMARY

PROJECT: DeLong Mountain Terminal
PARAMETER: Metals in Berries and Sour Dock
LABORATORY: Battelle Sequim
MATRIX: Salmon Berries

SAMPLE CUSTODY: Twenty sour dock samples were received on 8/24/01. On 9/11/01 four salmon berry and two water samples were received. All containers were received in good condition. The cooler temperatures upon receipt were 2.5°C, 3.1, 3.2 and 5.6°C. Samples were entered into Battelle's log-in system. This data report is for 20 sour dock and 4 salmon berry samples. The water samples will be reported with the next batch of samples, received the end of September, along with Mn data that exceeded the linear range for the instrument, requiring dilution and reanalysis.

QA/QC DATA QUALITY OBJECTIVES:

	Reference Method	Range of Recovery	SRM Accuracy	Relative Precision	Target Detection Limit (ug/g)	Achieved Detection Limit (ug/g)
Cobalt	ICP-MS	75-125%	≤25%	≤25%	0.5	0.003
Cadmium	ICP-MS	75-125%	≤25%	≤25%	0.05	0.01
Chromium	ICP-MS	75-125%	≤25%	≤25%	0.5	0.03
Copper	ICP-MS	75-125%	≤25%	≤25%	0.2	0.02
Lead	ICP-MS	75-125%	≤25%	≤25%	0.05	0.02
Manganese	ICP-MS	75-125%	≤25%	≤25%	0.1	0.01
Nickel	ICP-MS	75-125%	≤25%	≤25%	0.5	0.04
Selenium	ICP-MS	75-125%	≤25%	≤25%	1.0	0.5
Zinc	ICP-MS	75-125%	≤25%	≤25%	1.0	0.02

METHODS: Eight metals were analyzed: cadmium (Cd), chromium (Cr), cobalt (Co), copper (Cu), lead (Pb), nickel (Ni), selenium (Se), and zinc (Zn). The samples were digested using nitric acid. All metals were analyzed by inductively coupled plasma mass spectrometry (ICP-MS) following EPA Method 6020M. Dry weight was determined by freeze drying.

BLANKS: Cr, Se and Zn were detected in the blank. These metals were detected at a concentration less than the target detection limit and an order of magnitude lower than the sample concentrations; therefore no corrective action was taken.

MATRIX SPIKES: Two matrix spike/matrix spike duplicate pairs were analyzed. Recoveries of all metals were within QC limits of 75-125% and all RPDs were less than 25%. Because Mn and Zn were not spiked high enough for the concentrations in the samples, these recoveries are not useful.

QA/QC SUMMARY

REPLICATES: Two samples were analyzed in duplicate. Precision is reported by calculating the relative percent difference (RPD) of replicate results. RPDs for all metals, ranged from 0-11%, were within the QC limits of ±25%.

SRM and LCS: Two SRMs, MOSS M3 and Tomato Leaves 1573a were analyzed. All results were within the QC recovery of 75-125%, except for one replicate of Ni and one for Se. Se results for the two SRMs are reported as estimates (J flagged) values only. Both the results and the certified values are below the achieved MDL.

The LCS sample, NIST 1640 trace metals in water, was analyzed twice, with acceptable recovery, within the criteria of 75-125% except for one of the Se results, which was 126%.

Comments: Se concentrations were below the detection limit and were "J" flagged. Mn will need to be reanalyzed because it was above the range of the instrument at the dilution used for analysis.

Eric Crecelius
Project Manager

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DELONG MOUNTAIN TERMINAL PROJECT
METALS IN PLANTS
(Plant Samples Received 8/24/01; Berry Samples Received 9/11/01)

MSL Code	Sponsor ID	Percent Dry Wt	Matrix	concentrations in µg/g **dry** weight - data are not blank corrected) Cr	Co	Ni	Cu	Zn	Se	Cd	Pb	Mn (d)
1701-61A	01DMT032SK	11.5	Sour Dock	0.219	1.79	8.59	2.97	35.8	0.0322 J	0.656	0.128	688
1701-62A	01DMT032SKC	9.80	Sour Dock	0.222	1.83	7.96	3.30	34.8	0.0560 J	0.542	0.132	589
1701-63	01DMT033SK	9.07	Sour Dock	0.257	0.238	4.83	4.68	43.7	0.0247 J	0.142	0.152	168
1701-64 r1	01DMT033SKC	9.25	Sour Dock	0.309	0.562	6.06	4.15	56.0	0.0665 J	0.182	0.163	273
1701-64 r2	01DMT033SKC	9.25	Sour Dock	0.296	0.604	6.78	4.42	57.1	0.0687 J	0.193	0.151	305
1701-65	01DMT034SK	13.0	Sour Dock	0.155	0.913	11.7	3.21	15.6	0.0474 J	0.125	0.163	583
1701-66	01DMT034SKC	9.65	Sour Dock	0.148	0.609	9.44	3.21	32.9	0.0466 J	0.105	0.339	537
1701-67	01DMT035SK	10.6	Sour Dock	0.319	1.61	6.52	3.68	78.1	0.0229 J	0.317	0.133	606
1701-68	01DMT035SKC	9.22	Sour Dock	0.237	1.35	6.38	3.56	46.6	0.5 U	0.279	0.129	382
1701-69	01DMT036SK	13.1	Sour Dock	0.199	0.977	8.20	3.13	15.0	0.0445 J	0.137	0.143	596
1701-70	01DMT036SKC	8.29	Sour Dock	0.204	1.21	12.6	3.21	12.3	0.233 J	0.169	0.108	855
1701-71	01DMT037SK	10.2	Sour Dock	0.295	0.233	6.09	4.90	41.7	0.0605 J	0.170	0.116	214
1701-72	01DMT037SKC	7.57	Sour Dock	0.269	0.296	5.16	3.83	38.3	0.0628 J	0.131	0.112	244
1701-73	01DMT038SK	10.4	Sour Dock	0.180	0.709	5.95	3.23	50.8	0.0554 J	0.327	0.0600	435
1701-74	01DMT038SKC	9.06	Sour Dock	0.196	0.524	5.43	3.58	44.1	0.00842 J	0.202	0.0833	323
1701-75	01DMT039SK	12.7	Sour Dock	0.336	0.532	6.69	3.47	26.0	0.0352 J	0.249	0.170	423
1701-76	01DMT039SKC	10.5	Sour Dock	0.220	0.521	7.04	4.01	33.2	0.0650 J	0.201	0.170	355
1701-77	01DMT040SK	10.7	Sour Dock	0.311	0.147	3.53	4.04	47.1	0.0326 J	0.261	0.151	149
1701-78	01DMT040SKC	9.01	Sour Dock	0.190	0.111	3.26	3.83	49.9	0.0488 J	0.194	0.150	118
1701-79	01DMT041SK	10.2	Sour Dock	0.267	0.697	5.79	3.47	73.7	0.0475 J	0.265	0.119	471
1701-80	01DMT041SKC	9.04	Sour Dock	0.236	1.13	5.29	3.49	65.1	0.0118 J	0.278	0.133	449
1701-83	01DMT043SY	14.2	Berries	0.131	0.0776	2.84	4.56	31.9	0.5 U	0.408	1.38	146
1701-84	01DMT044SY	14.2	Berries	0.109	0.0823	5.40	4.60	31.4	0.5 U	0.395	1.19	96.4
1701-85	01DMT045SY	14.7	Berries	0.108	0.0917	3.87	4.58	31.0	0.5 U	0.553	1.66	98.0
1701-86 r1	01DMT046SY	15.9	Berries	0.129	0.0780	1.94	4.25	30.4	0.5 U	0.379	1.97	170
1701-86 r2	01DMT046SY	15.9	Berries	0.136	0.0861	1.83	4.08	33.1	0.5 U	0.419	2.12	169
Procedural Blank 1		*10.1*		0.0541	0.003 U	0.04 U	0.02 U	0.211	0.0642	0.01	0.02	0.01 U
Procedural Blank 2		*10.1*		0.0693	0.003 U	0.04 U	0.02 U	0.0898	0.5 U	0.0143	0.02	0.032
Target Detection Limits				0.5	0.5	0.5	0.2	1.0	1.0	0.05	0.05	0.1
Acheived Detection Limits				0.03	0.003	0.04	0.02	0.02	0.5	0.01	0.02	0.01

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DELONG MOUNTAIN TERMINAL PROJECT
METALS IN PLANTS
(Plant Samples Received 8/24/01; Berry Samples Received 9/11/01)

MSL Code	Sponsor ID	Percent Dry Wt	Matrix	concentrations in µg/g **dry** weight - data are not blank corrected) Cr	Co	Ni	Cu	Zn	Se	Cd	Pb	Mn (d)
STANDARD REFERENCE MATERIAL												
MOSS 3				0.573	0.118	1.06	3.53	20.0	0.00866 J	0.0966	3.56	506
MOSS 3				0.722	0.128	1.34	3.82	19.2	0.0154 J	0.105	3.67	527
	certified value			0.67	0.115	0.95	3.76	25.4	0.115	0.106	3.33	535
	percent recovery			86%	103%	112%	94%	79%	8% #	91%	107%	95%
				108%	111%	141% #	102%	76%	13% #	99%	110%	99%
1573a				2.11	0.628	1.61	4.47	23.9	0.0302 J	1.33	0.671	243
1573a				2.23	0.668	1.65	4.51	23.1	0.00284 J	1.29	0.640	251
	certified value			1.99	0.57	1.59	4.70	30.9	0.054	1.52	NC	246
	percent recovery			106%	110%	101%	95%	77%	56% #	88%	NA	99%
				112%	117%	104%	96%	75%	5% #	85%	NA	102%
LABORATORY CONTROL SAMPLE												
1640 (µg/L)				39.2	21.8	28.8	90.5	61.4	26.7	24.7	28.1	NA
				43.3	23.5	30.5	91.7	62.1	27.7	23.5	24.8	NA
	certified value			38.6	20.3	27.4	85.2	53.2	22.0	22.8	27.9	
	percent recovery			102%	107%	105%	106%	115%	121%	108%	101%	NA
				112%	116%	111%	108%	117%	126% #	103%	89%	NA
REPLICATE ANALYSIS RESULTS												
1701-64 r1	01DMT033SKC	9.25	Sour Dock	0.309	0.562	6.06	4.15	56.0	0.0665 J	0.182	0.163	273
1701-64 r2	01DMT033SKC	9.25	Sour Dock	0.296	0.604	6.78	4.42	57.1	0.0687 J	0.193	0.151	305
	Relative percent difference			**4%**	**7%**	**11%**	**6%**	**2%**	**3%**	**6%**	**8%**	**11%**
1701-86 r1	01DMT046SY		Berries	0.129	0.0780	1.94	4.25	30.4	0.5 U	0.379	1.97	170
1701-86 r2	01DMT046SY		Berries	0.136	0.0861	1.83	4.08	33.1	0.5 U	0.419	2.12	169
	Relative percent difference			**5%**	**10%**	**6%**	**4%**	**9%**	**0%**	**10%**	**7%**	**1%**

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DELONG MOUNTAIN TERMINAL PROJECT
METALS IN PLANTS
(Plant Samples Received 8/24/01; Berry Samples Received 9/11/01)

MSL Code	Sponsor ID	Percent Dry Wt	Matrix	concentrations in µg/g **dry** weight - data are not blank corrected) Cr	Co	Ni	Cu	Zn	Se	Cd	Pb	Mn (d)
MATRIX SPIKE RESULTS												
Amount Spiked				5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
1701-61A	01DMT032SK	11.5	Sour Dock	0.219	1.79	8.59	2.97	35.8	0.0322 J	0.656	0.128	688
1701-61A MS				5.67	7.09	13.9	7.79	39.8	4.70	5.00	5.77	699
Amount Recovered				5.45	5.30	5.31	4.82	4.00 SL	4.67	4.34	5.64	11.0
Percent Recovery				109%	106%	106%	96%	80%	93%	87%	113%	SL
Amount Spiked				5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
1701-61A	01DMT032SK	11.5	Sour Dock	0.219	1.79	8.59	2.97	35.8	0.0322 J	0.656	0.128	688
1701-61A MSD				5.45	6.86	13.3	7.71	39.4	4.82	4.99	5.43	685
Amount Recovered				5.23	5.07	4.71	4.74	3.60	4.79	4.33	5.30	-3.0
Percent Recovery				105%	101%	94%	95%	72% SL	96%	87%	106%	SL
Relative percent difference				**4%**	**4%**	**12%**	**2%**	**11%**	**3%**	**0%**	**6%**	**NA**
Amount Spiked				5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
1701-83	01DMT043SY	14.2	Berries	0.131	0.0776	2.84	4.56	31.9	0.5 U	0.408	1.38	146
1701-83 MS				5.01	4.82	7.74	9.11	32.1	4.94	4.51	5.12	125
Amount Recovered				4.88	4.74	4.90	4.55	0.20	4.94	4.10	3.74	-21.0
Percent Recovery				98%	95%	98%	91%	SL	99%	82%	75%	SL
Amount Spiked				5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
1701-83	01DMT043SY	14.2	Berries	0.131	0.0776	2.84	4.56	31.9	0.5 U	0.408	1.38	146
1701-83 MSD				5.50	5.35	8.47	9.62	34.8	5.17	4.80	5.49	140
Amount Recovered				5.37	5.27	5.63	5.06	2.90	5.17	4.39	4.11	-6.0
Percent Recovery				107%	105%	113%	101%	SL	103%	88%	82%	SL
Relative percent difference				**10%**	**11%**	**14%**	**11%**	**NA**	**5%**	**7%**	**9%**	**NA**

(d) Mn was diluted and re-analyzed 11/9/01.
U Not detected at or above DL shown
J Reported below DL shown; estimated value
NC Not certified
NA Not applicable.available
Outside standard DQO (±25%)
SL Inappropriate spike level; native sample concentrations overwhelmed spike

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DELONG MOUNTAIN TERMINAL PROJECT
METALS IN PLANTS
(Samples Received 8/24/01)

MSL Code	Sponsor ID	Percent Dry Wt	concentrations in µg/g **wet** weight - data are not blank corrected) Cr	Co	Ni	Cu	Zn	Se	Cd	Pb	Mn
1701-61A	01DMT032SK	11.5	0.0252	0.206	0.988	0.342	4.12	0.00370 J	0.0754	0.0147	79.1
1701-62A	01DMT032SKC	9.80	0.0218	0.179	0.780	0.323	3.41	0.00549 J	0.0531	0.0129	57.7
1701-63	01DMT033SK	9.07	0.0233	0.0216	0.438	0.424	3.96	0.00224 J	0.0129	0.0138	15.2
1701-64 r1	01DMT033SKC	9.25	0.0286	0.0520	0.561	0.384	5.18	0.00615 J	0.0168	0.0151	25.3
1701-64 r2	01DMT033SKC	9.25	0.0274	0.0559	0.627	0.409	5.28	0.00635 J	0.0179	0.0140	28.2
1701-65	01DMT034SK	13.0	0.0202	0.119	1.52	0.417	2.03	0.00616 J	0.0163	0.0212	75.8
1701-66	01DMT034SKC	9.65	0.0143	0.0588	0.911	0.310	3.17	0.00450 J	0.0101	0.0327	51.8
1701-67	01DMT035SK	10.6	0.0338	0.171	0.691	0.390	8.28	0.00243 J	0.0336	0.0141	64.2
1701-68	01DMT035SKC	9.22	0.0219	0.124	0.588	0.328	4.30	0.0505 U	0.0257	0.0119	35.2
1701-69	01DMT036SK	13.1	0.0261	0.128	1.07	0.410	1.97	0.00583 J	0.0179	0.0187	78.1
1701-70	01DMT036SKC	8.29	0.0169	0.100	1.04	0.266	1.02	0.0193 J	0.0140	0.00895	70.9
1701-71	01DMT037SK	10.2	0.0301	0.0238	0.621	0.500	4.25	0.00617 J	0.0173	0.0118	21.8
1701-72	01DMT037SKC	7.57	0.0204	0.0224	0.391	0.290	2.90	0.00475 J	0.0099	0.00848	18.5
1701-73	01DMT038SK	10.4	0.0187	0.0737	0.619	0.336	5.28	0.00576 J	0.0340	0.00624	45.2
1701-74	01DMT038SKC	9.06	0.0178	0.0475	0.492	0.324	4.00	0.00076 J	0.0183	0.00755	29.3
1701-75	01DMT039SK	12.7	0.0427	0.0676	0.850	0.441	3.30	0.00447 J	0.0316	0.0216	53.7
1701-76	01DMT039SKC	10.5	0.0231	0.0547	0.739	0.421	3.49	0.00683 J	0.0211	0.0179	37.3
1701-77	01DMT040SK	10.7	0.0333	0.0157	0.378	0.432	5.04	0.00349 J	0.0279	0.0162	15.9
1701-78	01DMT040SKC	9.01	0.0171	0.0100	0.294	0.345	4.50	0.00440 J	0.0175	0.0135	10.6
1701-79	01DMT041SK	10.2	0.0272	0.0711	0.591	0.354	7.52	0.00485 J	0.0270	0.0121	48.0
1701-80	01DMT041SKC	9.04	0.0213	0.102	0.478	0.315	5.89	0.00107 J	0.0251	0.0120	40.6
1701-83	01DMT043SY	14.2	0.0186	0.0110	0.403	0.648	4.53	0.0505 U	0.0579	0.196	20.7
1701-84	01DMT044SY	14.2	0.0155	0.0117	0.767	0.653	4.46	0.0505 U	0.0561	0.169	13.7
1701-85	01DMT045SY	14.7	0.0159	0.0135	0.569	0.673	4.56	0.0505 U	0.0813	0.244	14.4
1701-86 r1	01DMT046SY	15.9	0.0205	0.0124	0.308	0.676	4.83	0.0505 U	0.0603	0.313	27.0
1701-86 r2	01DMT046SY	15.9	0.0216	0.0137	0.291	0.649	5.26	0.0505 U	0.0666	0.337	26.9
Procedural Blank 1		*10.1*	0.0055	0.0003 U	0.004 U	0.002 U	0.0213	0.0065	0.001 U	0.002 U	0.001 U
Procedural Blank 2		*10.1*	0.0070	0.0003 U	0.004 U	0.002 U	0.00907	0.0505 U	0.00144	0.002 U	0.00323
Target Detection Limits		*10.1*	0.0505	0.051	0.051	0.020	0.10	0.101 U	0.0051	0.0051	0.01
Acheived Detection Limits		*10.1*	0.0030	0.0003	0.004	0.002	0.002	0.0505 U	0.001	0.002	0.001

U Not detected at or above DL shown
J Reported below DL shown; estimated value

Wet weight concentrations are calculated values (dry wt conc * % dry wt/100)

QA/QC SUMMARY

PROJECT: DeLong Mountain Terminal (set 4 data report)
PARAMETER: Metals
LABORATORY: Battelle Sequim
MATRIX: Blackberries and Salmon Berries

SAMPLE CUSTODY: On 9/26/01 28 blackberries, 10 salmon berry and one water samples were received. All containers were received in good condition. The cooler temperatures upon receipt were 1.1 and 3.3°C. Samples were entered into Battelle's log-in system. This data report is for 28 blackberry, 10 salmon berry samples, and four water samples, three received with previous shipments of samples.

QA/QC DATA QUALITY OBJECTIVES:

	Reference Method	Range of Recovery	SRM Accuracy	Relative Precision	Target Detection Limit (ug/g)	Achieved Detection Limit (ug/g)
Cobalt	ICP-MS	75-125%	≤25%	≤25%	0.5	0.003
Cadmium	ICP-MS	75-125%	≤25%	≤25%	0.05	0.01
Chromium	ICP-MS	75-125%	≤25%	≤25%	0.5	0.03
Copper	ICP-MS	75-125%	≤25%	≤25%	0.2	0.02
Lead	ICP-MS	75-125%	≤25%	≤25%	0.05	0.02
Manganese	ICP-MS	75-125%	≤25%	≤25%	0.1	0.01
Nickel	ICP-MS	75-125%	≤25%	≤25%	0.5	0.04
Selenium	ICP-MS	75-125%	≤25%	≤25%	1.0	0.5
Zinc	ICP-MS	75-125%	≤25%	≤25%	1.0	0.02

METHODS: Nine metals were analyzed: cadmium (Cd), chromium (Cr), cobalt (Co), copper (Cu), lead (Pb), manganese (Mn), nickel (Ni), selenium (Se), and zinc (Zn). The samples were digested using nitric acid. All metals were analyzed by inductively coupled plasma mass spectrometry (ICP-MS) following EPA Method 6020. Dry weight was determined by freeze drying.

BLANKS: Cr and Zn were detected in the berry blank. These metals were detected at a concentration less than the target detection limit; therefore no corrective action was taken. Cr, Mn and Zn were detected in the water procedural blank at concentrations below the target limits

MATRIX SPIKES: Two matrix spike/matrix spike duplicate pairs were analyzed. Recoveries of all metals, except Mn and Zn, were within QC limits of 75-125% and all RPDs were less than 25%. Because Mn and Zn were not spiked high enough for the concentrations in the samples, these recoveries are not useful.
The results for the water MS/MSD were all acceptable.

QA/QC SUMMARY

REPLICATES: Two berry samples were analyzed in duplicate. Precision is reported by calculating the relative percent difference (RPD) of replicate results. RPDs for all metals were within the QC limits of ±25%, except for Cr in both sets, and Pb and Zn in one set. The concentrations of Cr and Pb were near or below the target limits.
Replicates of the water sample had three metals, Cr, Ni and Se that exceeded the 25% RPD.

SRM and LCS: Two SRMs, MOSS M3 and Tomato Leaves 1573a were analyzed induplicate. Most of the results were within the QC recovery of 75-125%, with the exception of three of the four samples for Ni, all four Se results and two of the Zn results. Se results for the two SRMs are reported as estimates (J flagged) values only. Both the results and the certified values are below the achieved MDL.

The LCS sample, NIST 1640 trace metals in water, was run twice, with acceptable recovery for all metals except one of the Se values that was recovered at 138%.

Comments: The concentrations of several metals were below the detection limit and were "J" flagged or were within 5 times the procedural blank and were "B" flagged.

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DELONG MOUNTAIN TERMINAL PROJECT
METALS IN PLANTS
(Samples Received 9/26/01)

MSL Code	Sponsor ID	Percent Dry Wt	Matrix	concentrations in µg/g **dry** weight - data are not blank corrected) Cr	Co	Ni	Cu	Zn	Se	Cd	Pb	Mn
1701-88	01DMT070BY	11.9	Blackberries	0.210 B	0.00344	0.04 U	2.24	4.61	0.5 U	0.01 U	0.239	52.9
1701-89	01DMT070BYC	12.5	Blackberries	0.237 B	0.003 U	0.04 U	2.70	4.53	0.5 U	0.01 U	0.0943	62.5
1701-90	01DMT071BY	12.3	Blackberries	0.226 B	0.00307	0.04 U	2.06	4.07 B	0.5 U	0.01 U	0.0868	30.1
1701-91 r1	01DMT071BYC	11.9	Blackberries	0.387 B	0.003 U	0.04 U	2.93	5.85	0.5 U	0.01 U	0.164	37.1
1701-91 r2	01DMT071BYC	11.9	Blackberries	0.259 B	0.003 U	0.04 U	2.54	3.69 B	0.5 U	0.01 U	0.127	35.7
1701-92	01DMT072BY	12.1	Blackberries	0.207 B	0.00542	0.726	2.84	4.64	0.5 U	0.01 U	0.133	45.8
1701-93	01DMT072BYC	12.7	Blackberries	0.364 B	0.00738	0.04 U	2.93	5.68	0.263 J	0.01 U	0.181	47.7
1701-94	01DMT073BY	11.1	Blackberries	0.401 B	0.00777	0.04 U	2.54	4.21 B	0.0730 J	0.01 U	0.0940	41.0
1701-95	01DMT073BYC	11.3	Blackberries	0.341 B	0.003 U	0.04 U	2.40	3.37 B	0.217 J	0.01 U	0.0907	34.5
1701-96	01DMT074BY	11.1	Blackberries	0.398 B	0.003 U	0.213	3.11	4.64	0.5 U	0.01 U	0.204	37.2
1701-97	01DMT074BYC	10.5	Blackberries	0.462 B	0.003 U	0.165	3.29	4.11 B	0.5 U	0.01 U	0.141	39.9
1701-98	01DMT075BY	11.4	Blackberries	0.420 B	0.00707	0.166	3.54	7.33	0.115 J	0.0186	0.254	39.0
1701-99	01DMT075BYC	10.5	Blackberries	0.419 B	0.003 U	0.231	4.03	5.18	0.0582 J	0.01 U	0.178	30.0
1701-100	01DMT076BY	11.1	Blackberries	0.415 B	0.00972	0.134	3.80	5.42	0.0684 J	0.0230	0.146	28.2
1701-101	01DMT076BYC	10.5	Blackberries	0.465 B	0.003 U	0.0727	3.87	5.60	0.144 J	0.01 U	0.182	34.8
1701-102	01DMT077BY	11.4	Blackberries	0.222 B	0.00348	0.04 U	3.72	5.80	0.148 J	0.01 U	0.280	39.4
1701-103	01DMT077BYC	11.5	Blackberries	0.326 B	0.00304	0.04 U	4.36	5.87	0.302 J	0.01 U	0.149	29.2
1701-104	01DMT078BY	12.1	Blackberries	0.348 B	0.003 U	0.04 U	2.48	4.29	0.5 U	0.01 U	0.235	16.6
1701-105	01DMT078BYC	11.8	Blackberries	0.326 B	0.003 U	0.04 U	2.59	4.46	0.232 J	0.01 U	0.129	20.1
1701-106	01DMT079BY	11.3	Blackberries	0.341 B	0.003 U	0.04 U	3.34	4.74	0.293 J	0.01 U	0.153	18.8
1701-107	01DMT079BYC	11.5	Blackberries	0.429 B	0.003 U	0.0894	2.66	4.93	0.136 J	0.01 U	0.209	29.3
1701-108	01DMT080BY	11.0	Blackberries	0.419 B	0.00884	0.04 U	3.61	15.9	0.5 U	0.01 U	0.0525	48.0
1701-109	01DMT081BY	11.2	Blackberries	0.274 B	0.00730	0.126	4.08	5.98	0.297 J	0.01 U	0.0369	41.2
1701-110 r1	01DMT082BY	11.6	Blackberries	0.295 B	0.00609	0.0824	3.91	6.76	0.227 J	0.01 U	0.0502	45.6
1701-110 r2	01DMT082BY	11.6	Blackberries	0.413 B	0.00627	0.04 U	3.65	6.08	0.187 J	0.01 U	0.0376	41.0
1701-111	01DMT083BY	10.8	Blackberries	0.469 B	0.0131	0.124	4.42	9.94	0.452 J	0.0129	0.107	60.9
1701-112	01DMT084BY	11.6	Blackberries	0.367 B	0.00783	0.04 U	4.79	7.53	0.488 J	0.01 U	0.0383	28.4
1701-113	01DMT085BY	13.2	Blackberries	0.386 B	0.00908	0.04 U	4.40	17.9	0.150 J	0.01 U	0.0336	35.3
1701-114	01DMT086BY	12.1	Blackberries	0.282 B	0.00920	0.04 U	4.33	5.98	0.324 J	0.01 U	0.0273	37.7
1701-115	01DMT087BY	12.0	Blackberries	0.306 B	0.0108	0.04 U	4.19	6.30	0.416 J	0.01 U	0.0324	44.1
1701-117	01DMT048SY	11.3	Salmonberries	0.258 B	0.449	1.60	4.09	19.1	0.562	0.155	0.00992 J	259
1701-118	01DMT049SY	11.0	Salmonberries	0.269 B	0.574	1.20	3.80	17.6	0.573	0.121	0.009816 J	238
1701-119	01DMT050SY	10.9	Salmonberries	0.383 B	0.178	0.703	3.67	18.2	0.392 J	0.223	0.0117 J	318
1701-120	01DMT051SY	10.7	Salmonberries	0.340 B	0.243	1.34	4.25	21.4	0.707	0.281	0.009555 J	258
1701-121	01DMT052SY	11.3	Salmonberries	0.410 B	0.394	1.50	4.81	19.4	0.611	0.242	0.0100 J	254
1701-122	01DMT053SY	11.4	Salmonberries	0.357 B	0.323	1.33	4.49	20.0	0.677	0.195	0.0187 J	261
1701-123	01DMT054SY	10.8	Salmonberries	0.428 B	0.246	1.88	4.99	23.8	0.699	0.231	0.0141 J	242
1701-124	01DMT055SY	11.7	Salmonberries	0.387 B	0.194	1.79	4.02	21.7	0.891	0.295	0.0113 J	345
1701-125	01DMT056SY	12.2	Salmonberries	0.327 B	0.206	1.86	4.96	24.0	0.658	0.162	0.0126 J	273
1701-126	01DMT057SY	12.3	Salmonberries	0.386 B	0.137	1.28	4.23	21.4	0.597	0.171	0.0153 J	253
Procedural Blank 1				0.275	0.003 U	0.04 U	0.02 U	0.846	0.5 U	0.01 U	0.02 U	0.01 U
Procedural Blank 2				0.244	0.003 U	0.04 U	0.02 U	0.0513	0.314	0.01 U	0.02 U	0.0729

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DELONG MOUNTAIN TERMINAL PROJECT
METALS IN PLANTS
(Samples Received 9/26/01)

MSL Code	Sponsor ID	Percent Dry Wt	Matrix	concentrations in µg/g **dry** weight - data are not blank corrected) Cr	Co	Ni	Cu	Zn	Se	Cd	Pb	Mn
Target Detection Limits				0.5	0.5	0.5	0.2	1.0	1.0	0.05	0.05	0.1
Acheived Detection Limits				0.03	0.003	0.04	0.02	0.02	0.5	0.01	0.02	0.01
STANDARD REFERENCE MATERIAL												
MOSS 3				0.770 B	0.112	0.649	3.44	18.3	0.5 U	0.0850	3.61	490
MOSS 3				0.827 B	0.117	0.559	3.47	19.2	0.257 J	0.0974	3.63	476
	certified value			0.67	0.115	0.95	3.76	25.4	0.115 J	0.106	3.33	535
	percent recovery			115%	97%	68% #	91%	72% #	NA	80%	108%	92%
				123%	102%	59% #	92%	76%	223% #	92%	109%	89%
1573a				2.30	0.609	2.25	4.29	23.8	0.767	1.28	0.657	272
1573a				2.40	0.623	1.97	4.32	22.4	0.479 J	1.27	0.618	296
	certified value			1.99	0.57	1.59	4.70	30.9	0.054 J	1.52	NC	246
	percent recovery			116%	107%	142% #	91%	77%	1420% #	84%	NA	111%
				121%	109%	124%	92%	72% #	887% #	84%	NA	120%
LABORATORY CONTROL SAMPLE												
1640 (µg/L)				39.4	21.6	27.9	86.4	59.2	26.0	23.5	29.4	125
1640 (µg/L)				40.4	22.1	26.8	89.8	61.9	30.4	23.8	26.1	125
	certified value			38.6	20.3	27.4	85.2	53.2	22.0	22.8	27.9	122
	percent recovery			102%	106%	102%	101%	111%	118%	103%	105%	102%
				105%	109%	98%	105%	116%	138% #	104%	94%	102%
REPLICATE ANALYSIS RESULTS												
1701-91 r1	01DMT071BYC	11.9	Blackberries	0.387 B	0.003 U	0.04 U	2.93	5.85	0.5 U	0.01 U	0.164	37.1
1701-91 r2	01DMT071BYC	11.9	Blackberries	0.259 B	0.003 U	0.04 U	2.54	3.69 B	0.5 U	0.01 U	0.127	35.7
Relative percent difference				**40% #**	**0%**	**NA**	**14%**	**45% #**	**NA**	**0%**	**25%**	**4%**
1701-110 r1	01DMT082BY	11.6	Blackberries	0.295 B	0.006085	0.08243	3.91	6.76	0.227 J	0.01 U	0.0502	45.6
1701-110 r2	01DMT082BY	11.6	Blackberries	0.413 B	0.006272	0.04 U	3.65	6.08	0.187 J	0.01 U	0.0376	41.0
Relative percent difference				**33% #**	**3%**	**NA**	**7%**	**11%**	**19%**	**0%**	**29% #**	**11%**

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MSL Code	Sponsor ID	Percent Dry Wt	Matrix	concentrations in µg/g **dry** weight - data are not blank corrected) Cr	Co	Ni	Cu	Zn	Se	Cd	Pb	Mn
MATRIX SPIKE RESULTS												
Amount Spiked				5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
1701-88	01DMT070BY	11.9	Blackberries	0.210 B	0.003438	0.04 U	2.24	4.61	0.5 U	0.01 U	0.239	52.9
1701-88 MS				5.42	5.12	4.77	7.22	8.20	3.98	4.36	5.26	49.5
Amount Recovered				5.21	5.12	4.77	4.98	3.59	3.98	4.36	5.02	-3.40
Percent Recovery				104%	102%	95%	100%	72% SL	80%	87%	100%	NA SL
Amount Spiked				5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
1701-88	01DMT070BY	11.9	Blackberries	0.210 B	0.003438	0.04 U	2.24	4.61	0.5 U	0.01 U	0.239	52.9
1701-88 MSD				5.54	5.35	4.93	7.66	9.51	4.43	4.71	5.37	57.0
Amount Recovered				5.33	5.35	4.93	5.42	4.90	4.43	4.71	5.13	4.10
Percent Recovery				107%	107%	99%	108%	98% SL	89%	94%	103%	82% SL
Relative percent difference				**2%**	**4%**	**3%**	**8%**	**31% #**	**11%**	**8%**	**2%**	**NA**
Amount Spiked				5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
1701-108	01DMT080BY	11.0	Blackberries	0.419 B	0.00884	0.04 U	3.61	15.9	0.5 U	0.01 U	0.0525	48.0
1701-108 MS				6.00	5.47	5.31	8.79	10.7	3.81	4.14	4.79	50.5
Amount Recovered				5.58	5.46	5.31	5.18	-5.20	3.81	4.14	4.74	2.50
Percent Recovery				112%	109%	106%	104%	SL	76%	83%	95%	50% SL
Amount Spiked				5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
1701-108	01DMT080BY	11.0	Blackberries	0.419 B	0.00884	0.04 U	3.61	15.9	0.5 U	0.01 U	0.0525	48.0
1701-108 MSD				5.88	5.44	5.25	8.71	10.4	4.02	4.10	4.75	49.0
Amount Recovered				5.46	5.43	5.25	5.10	-5.50	4.02	4.10	4.70	1.00
Percent Recovery				109%	109%	105%	102%	SL	80%	82%	94%	20% SL
Relative percent difference				**2%**	**1%**	**1%**	**2%**	**NA**	**5%**	**1%**	**1%**	**NA**

U Not detected at or above DL shown
J Reported below DL shown; estimated value
NC Not certified
NA Not applicable.available
Outside standard DQO (±25%)
SL Inappropriate spike level; native sample concentrations overwhelmed spike
B <5x Mean blank concentration

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MSL Code	Sponsor ID	Percent Dry Wt	concentrations in µg/g **wet** weight - data are not blank corrected) Cr	Co	Ni	Cu	Zn	Se	Cd	Pb	Mn
1701-88	01DMT070BY	11.9	0.0250 B	0.000409	0.0046 U	0.267	0.549	0.0575 U	0.0012 U	0.0284	6.30
1701-89	01DMT070BYC	12.5	0.0296 B	0.0003 U	0.0046 U	0.338	0.566	0.0575 U	0.0012 U	0.0118	7.81
1701-90	01DMT071BY	12.3	0.0278 B	0.000378	0.0046 U	0.253	0.501 B	0.0575 U	0.0012 U	0.0107	3.70
1701-91 r1	01DMT071BYC	11.9	0.0461 B	0.0003 U	0.0046 U	0.349	0.696	0.0575 U	0.0012 U	0.0195	4.41
1701-91 r2	01DMT071BYC	11.9	0.0308 B	0.0003 U	0.0046 U	0.302	0.439 B	0.0575 U	0.0012 U	0.0151	4.25
1701-92	01DMT072BY	12.1	0.0250 B	0.000656	0.0878	0.344	0.561	0.0575 U	0.0012 U	0.0161	5.54
1701-93	01DMT072BYC	12.7	0.0462 B	0.000937	0.0046 U	0.372	0.721	0.0334 J	0.0012 U	0.0230	6.06
1701-94	01DMT073BY	11.1	0.0445 B	0.000862	0.0046 U	0.282	0.467 B	0.00810 J	0.0012 U	0.0104	4.55
1701-95	01DMT073BYC	11.3	0.0385 B	0.0003 U	0.0046 U	0.271	0.381 B	0.0245 J	0.0012 U	0.0102	3.90
1701-96	01DMT074BY	11.1	0.0442 B	0.0003 U	0.0236	0.345	0.515	0.0575 U	0.0012 U	0.0226	4.13
1701-97	01DMT074BYC	10.5	0.0485 B	0.0003 U	0.0173	0.345	0.432 B	0.0575 U	0.0012 U	0.0148	4.19
1701-98	01DMT075BY	11.4	0.0479 B	0.000806	0.0189	0.404	0.836	0.0131 J	0.00212	0.0290	4.45
1701-99	01DMT075BYC	10.5	0.0440 B	0.0003 U	0.0243	0.423	0.544	0.00611 J	0.0012 U	0.0187	3.15
1701-100	01DMT076BY	11.1	0.0461 B	0.00108	0.0149	0.422	0.602	0.00759 J	0.00255	0.0162	3.13
1701-101	01DMT076BYC	10.5	0.0488 B	0.0003 U	0.0076	0.406	0.588	0.0151 J	0.0012 U	0.0191	3.65
1701-102	01DMT077BY	11.4	0.0253 B	0.000397	0.0046 U	0.424	0.661	0.0169 J	0.0012 U	0.0319	4.49
1701-103	01DMT077BYC	11.5	0.0375 B	0.000350	0.0046 U	0.501	0.675	0.0347 J	0.0012 U	0.0171	3.36
1701-104	01DMT078BY	12.1	0.0421 B	0.0003 U	0.0046 U	0.300	0.519	0.0575 U	0.0012 U	0.0284	2.01
1701-105	01DMT078BYC	11.8	0.0385 B	0.0003 U	0.0046 U	0.306	0.526	0.0274 J	0.0012 U	0.0152	2.37
1701-106	01DMT079BY	11.3	0.0385 B	0.0003 U	0.0046 U	0.377	0.536	0.0331 J	0.0012 U	0.0173	2.12
1701-107	01DMT079BYC	11.5	0.0493 B	0.0003 U	0.0103	0.306	0.567	0.0156 J	0.0012 U	0.0240	3.37
1701-108	01DMT080BY	11.0	0.0461 B	0.000972	0.0046 U	0.397	1.75	0.0575 U	0.0012 U	0.00578	5.28
1701-109	01DMT081BY	11.2	0.0307 B	0.000818	0.0141	0.457	0.670	0.0333 J	0.0012 U	0.00413	4.61
1701-110 r1	01DMT082BY	11.6	0.0342 B	0.000706	0.0096	0.454	0.784	0.0263 J	0.0012 U	0.00582	5.29
1701-110 r2	01DMT082BY	11.6	0.0479 B	0.000727	0.0046 U	0.423	0.705	0.0217 J	0.0012 U	0.00436	4.76
1701-111	01DMT083BY	10.8	0.0507 B	0.00141	0.0134	0.477	1.07	0.0488 J	0.00139	0.0116	6.58
1701-112	01DMT084BY	11.6	0.0426 B	0.000908	0.0046 U	0.556	0.873	0.0566 J	0.0012 U	0.00444	3.29
1701-113	01DMT085BY	13.2	0.0510 B	0.00120	0.0046 U	0.581	2.36	0.0198 J	0.0012 U	0.00444	4.66
1701-114	01DMT086BY	12.1	0.0341 B	0.00111	0.0046 U	0.524	0.7236	0.0392 J	0.0012 U	0.00330	4.56
1701-115	01DMT087BY	12.0	0.0367 B	0.00130	0.0046 U	0.503	0.7560	0.0499 J	0.0012 U	0.00389	5.29
1701-117	01DMT048SY	11.3	0.0292 B	0.0507	0.181	0.462	2.158	0.0635	0.0175	0.00112 J	29.3
1701-118	01DMT049SY	11.0	0.0296 B	0.0631	0.132	0.418	1.936	0.0630	0.0133	0.00108 J	26.2
1701-119	01DMT050SY	10.9	0.0417 B	0.0194	0.0766	0.400	1.984	0.0427 J	0.0243	0.00128 J	34.7
1701-120	01DMT051SY	10.7	0.0364 B	0.0260	0.143	0.455	2.290	0.0756	0.0301	0.00102 J	27.6
1701-121	01DMT052SY	11.3	0.0463 B	0.0445	0.170	0.544	2.192	0.0690	0.0273	0.00113 J	28.7
1701-122	01DMT053SY	11.4	0.0407 B	0.0368	0.152	0.512	2.280	0.0772	0.0222	0.00213 J	29.8
1701-123	01DMT054SY	10.8	0.0462 B	0.0266	0.203	0.539	2.570	0.0755	0.0249	0.00152 J	26.1
1701-124	01DMT055SY	11.7	0.0453 B	0.0227	0.209	0.470	2.539	0.1042	0.0345	0.00132 J	40.4
1701-125	01DMT056SY	12.2	0.0399 B	0.0251	0.227	0.605	2.928	0.0803	0.0198	0.00154 J	33.3
1701-126	01DMT057SY	12.3	0.0475 B	0.0169	0.157	0.520	2.632	0.0734	0.0210	0.00188 J	31.1
Procedural Blank 1		*11.5*	0.0316	0.0003 U	0.0046 U	0.0023 U	0.0973	0.0575 U	0.0012 U	0.0023 U	0.001 U

BATTELLE MARINE SCIENCE LABORATORIES
1529 West Sequim Bay Road
Sequim, Washington 98382-9099
360/681-3604

DELONG MOUNTAIN TERMINAL PROJECT
METALS IN PLANTS
(Samples Received 9/26/01)

MSL Code	Sponsor ID	Percent Dry Wt	concentrations in µg/g **wet** weight - data are not blank corrected) Cr	Co	Ni	Cu	Zn	Se	Cd	Pb	Mn
Target Detection Limits		*11.5*	0.0575	0.0575	0.0575	0.0230	0.115	0.115	0.0058	0.0058	0.01
Acheived Detection Limits		*11.5*	0.00345	0.0003	0.0046	0.0023	0.0023	0.0575	0.0012	0.0023	0.001

U Not detected at or above DL shown
J Reported below DL shown; estimated value
B <5x Mean blank concentration

Wet weight concentrations are calculated values (dry wt conc * % dry wt/100)

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DELONG MOUNTAIN TERMINAL PROJECT
METALS IN WATER

MSL Code	Sponsor ID	Date Received	concentrations in µg/L - data are not blank corrected) Cr	Co	Ni	Cu	Zn	Se	Cd	Pb	Mn
1701-81 r1	01DMT011WA	8/24/01	0.546 B	0.163	0.444	1.14	2.97	0.293 J	0.0241	0.317	9.38
1701-81 r2	01DMT011WA	8/24/01	0.417 B	0.149	0.263	1.07	2.76	0.426 J	0.01 U	0.321	8.83
1701-82	01DMT042WA	9/11/01	0.231 B	0.003 U	0.04 U	0.159	0.223	0.5 U	0.0149	0.907	0.609 B
1701-87	01DMT047WA	9/11/01	0.820	0.229	0.04 U	1.07	13.6	1.14	0.112	0.648	20.7
1701-116	01DMT088WA	9/26/01	0.03 U	0.003 U	0.04 U	0.0417	0.221	0.106 J	0.01 U	0.180	0.236 B
Procedural Blank 1			0.142	0.00406	0.04 U	0.02 U	0.0308	0.5 U	0.01 U	0.02 U	0.770
Target Detection Limits			0.5	0.5	0.5	0.2	1.0	1.0	0.05	0.05	0.1
Acheived Detection Limits			0.03	0.003	0.04	0.02	0.02	0.5	0.01	0.02	0.01
STANDARD REFERENCE MATERIAL											
1640			39.4	21.6	27.9	86.4	59.2	23.0	23.5	29.4	125
1640			40.4	22.1	26.8	89.8	61.9	23.9	23.8	26.1	125
certified value			38.6	20.3	27.4	85.2	53.2	22.0	22.8	27.9	122
percent recovery			102%	106%	102%	101%	111%	105%	103%	105%	102%
			105%	109%	98%	105%	116%	109%	104%	94%	102%
MATRIX SPIKE RESULTS											
Amount Spiked			10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
1701-81 mean	01DMT011WA	8/24/01	0.482 B	0.156	0.353	1.10	2.86	0.360 J	0.0121	0.319	9.11
1701-81 MS			11.9	11.6	11.1	11.5	12.7	10.6	9.99	10.0	20.0
Amount Recovered			11.4	11.4	10.7	10.4	9.84	10.2	10.0	9.68	10.9
Percent Recovery			114%	114%	107%	104%	98%	102%	100%	97%	109%
Amount Spiked			10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
1701-81 mean	01DMT011WA	8/24/01	0.482 B	0.156	0.353	1.10	2.86	0.360 J	0.0121	0.319	9.11
1701-81 MSD			11.8	11.1	10.9	11.4	12.7	12.7	9.71	9.70	19.4
Amount Recovered			11.3	10.9	10.5	10.3	9.84	10.6	9.70	9.38	10.3
Percent Recovery			113%	109%	105%	103%	98%	106%	97%	94%	103%
Relative percent difference			**1%**	**4%**	**2%**	**1%**	**0%**	**3%**	**3%**	**3%**	**6%**

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DELONG MOUNTAIN TERMINAL PROJECT
METALS IN WATER

MSL Code	Sponsor ID	Date Received	concentrations in µg/L - data are not blank corrected) Cr	Co	Ni	Cu	Zn	Se	Cd	Pb	Mn
REPLICATE ANALYSIS RESULTS											
1701-81 r1	01DMT011WA	8/24/01	0.546 B	0.163	0.444	1.14	2.97	0.293 J	0.0241	0.317	9.38
1701-81 r2	01DMT011WA	8/24/01	0.417 B	0.149	0.263	1.07	2.76	0.426 J	0.01 U	0.321	8.83
Relative percent difference			**27% #**	**9%**	**51% #**	**6%**	**7%**	**37% #**	**NA**	**1%**	**6%**
Mean			*0.482*	*0.156*	*0.354*	*1.11*	*2.87*	*0.360*	*0.0121*	*0.319*	*9.11*

U Not detected at or above DL shown
J Reported below DL shown; estimated value
NC Not certified
NA Not applicable.available
Outside standard DQO (±25%)
SL Inappropriate spike level; native sample concentrations overwhelmed spike

D

Statistical Procedures

Statistical Assumptions

The purpose of this study is to form conclusions regarding the concentrations of metals in salmonberry, sour dock, and blackberry populations from the Port Site, Terminal, Noatak, and Point Hope data sets; for example, how the average concentration of zinc in salmonberries compares between the Port Site and Noatak. In order to reach a conclusion, a hypothesis must be posed and tested. A hypothesis is an assertion regarding populations (in this case, subsistence foods), and it is tested using data from the sample sets.

Data analysis yields two possible results. One result is that insufficient evidence exists to refute the hypothesis. The other result is that sufficient evidence exists to refute the hypothesis. Refuting the hypothesis logically implies that an alternative hypothesis exists: a hypothesis that is opposite of the original hypothesis. For example, consider the hypothesis that the world is round. The logical alternative hypothesis is that the world is not round. The combination of the hypothesis and alternative hypothesis is known as the "statistical hypothesis."

For this project, the hypothesis is that the mean concentration of a metal in a subsistence food from one location is equal to the mean concentration of the same metal in the same subsistence food at another location. This is called the "null hypothesis" and is designated by H_0. The alternative hypothesis, designated by H_a, is that the mean concentration of a metal at the original location is greater than the mean concentration of a metal at the other location. Therefore, the null hypothesis is accepted if insufficient evidence exists to refute that the mean concentrations are the same for each metal. Conversely, if sufficient evidence exists to refute the null hypothesis, then the alternative hypothesis is accepted. The "evidence" described here is presented below.

The null hypothesis and alternative hypothesis usually are presented mathematically in the following manner:

$$H_0: \mu_t = \mu_c$$
$$H_a: \mu_t > \mu_c$$

where H_o is the null hypothesis; H_a is the alternative hypothesis; μ_t is the mean concentration of a metal from a test site; and μ_c is the mean concentration of the same metal from a control site.

In addition to the hypothesis test described above, a *level of significance* is associated with the statistical hypothesis. Level of significance is the probability of rejecting the null hypothesis when it is true. In the case of this project, it is the probability of rejecting the null hypothesis that the mean concentration of a metal from one location is equal to the mean concentration of the same metal from another location when the means are actually equal.

The level of significance, also known as the *probability level* or *confidence level*, is a selected value. It depends on project objectives, previous testing, and the repercussion of committing the error described above. The level of significance often is set at *0.05* for cases such as this project, where minimal data exist. The level of significance is commonly denoted by the Greek letter, α. Therefore, for this project, $\alpha = 0.05$. This means that there is a 5% chance of erroneously concluding that the mean concentration of a metal in a subsistence food from one location is statistically greater than the mean concentration of the same metal in the same subsistence food from another location. Alternatively, it means that the probability that the null hypothesis is correct is no more than 95%.

To determine whether a null hypothesis should be accepted or refuted, a p-value is compared to the level of significance. The p-value is calculated during the statistical analysis. When the p-value is greater than the preset level of significance, $\alpha = 0.05$, the null hypothesis is accepted because insufficient evidence exists to refute it. Alternatively, when the p-value falls below 0.05, then the null hypothesis is rejected and the alternative hypothesis is accepted. The p-value represents the probability (chance) of obtaining the calculated difference between the means of the data sets given that the null hypothesis is true.

As an example, consider two data sets for zinc concentrations in salmonberries. One data set is from the Port Site and one is from Noatak. The mean concentration of zinc in the Port Site data set is 15 milligrams per kilogram (mg/kg), and the mean concentration of zinc in the Noatak data set is 10 mg/kg. Then the difference between the means is 5. Now, a statistical test is executed to determine whether the concentration of zinc in the Port Site data set is statistically greater than the concentration of zinc in the Noatak data set. The test returns a p-value of 0.02. That implies that there is a 2% chance of obtaining a difference of 5 between the means, assuming that the concentration of zinc in the two populations is equal. Intuitively, that seems to be an unlikely scenario. Two populations (concentration of zinc in salmonberries from the Port Site and Noatak) that have the same concentration of zinc would show a difference of 5 only 2% of the time. Therefore, the null hypothesis should be rejected. The conclusion is that the two populations do not have equal concentrations of zinc.

The p-value is a valuable tool because it enables the user to interpret the statistical test result. For instance, consider these two p-values: 0.75 and 0.06. For both results, the null hypothesis would be accepted because each p-value is greater than 0.05. However, probably less confidence should be placed in the conclusion with the p-value of 0.06. This is because the calculated difference in the means of the sample sets is likely to occur only 6% of the time, given that the two means are equal. That likelihood is much less than a likelihood of 75% of the time, as is the case with the other example.

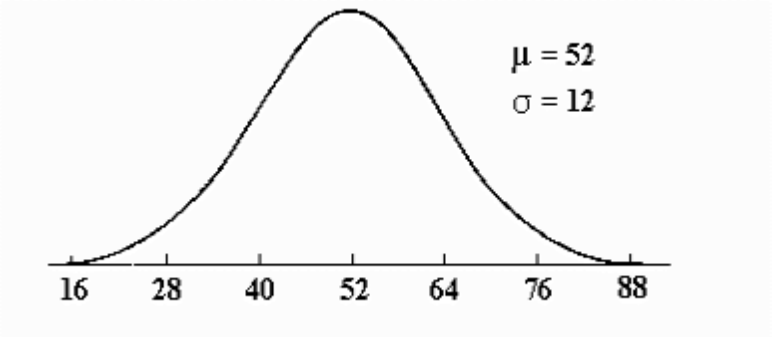
Now consider these two p-values: 0.04 and 0.0004. For both results, the null hypothesis would be rejected and the alternative hypothesis accepted. In the first case, the calculated difference in the means of the sample sets is likely to occur 4% of the time, given that the two means are equal. In the second case, the calculated difference in the means of the sample sets is likely to occur 0.04% of the time, given that the two means are equal. Intuitively, the user feels much more confident with the conclusion reached with the p-value of 0.0004. This is because something occurring 0.04% of the time is 100 times less likely to happen than something occurring 4% of the time. This implies that it is 100 times less likely to conclude erroneously that a difference exists between the means.

Determining Distribution of the Data Sets

Normal Distributions

Before comparing the mean concentrations of metals between locations, more information regarding the data sets must be determined. Namely, the distribution of the data sets for each metal at each location must be assessed. The distribution of a data set is a measure of the range of values in the data set. There are many types of distributions, but the important one for this project is the normal distribution. That is because the preferred statistical tests for this study require that the data be normally distributed.

The normal distribution is a commonly studied distribution in statistics. It describes many phenomena that occur in nature, industry, and research. Even errors in scientific measurements usually are distributed normally (Walpole and Myers 1993). The normal distribution is recognized by its distinctive bell-shaped curve. The mean of the distribution is found in the center of the bell-shaped curve, and values greater than and less than the mean are equally likely to occur. Also, values occurring farther from the mean (outliers) occur less frequently than values immediately around the mean. All these characteristics can be observed in the graph below. The graph represents a normally distributed population that has a mean of 52 and a standard deviation of 12.



For this project, to test whether each data set is normally distributed, a statistical hypothesis for normality is formed:

H_0: data set is normal
H_a: data set is not normal

with a level of significance, $\alpha = 0.05$.

The test for normality that has been employed is the Shapiro-Wilk W test (EPA 1998). The Shapiro-Wilk W test produces a p-value, which is compared to $\alpha = 0.05$. If the p-value is greater than 0.05, then it is assumed that the data set provides insufficient evidence to refute the null hypothesis. Therefore, the data set is assumed to be normally distributed.

Each data set is tested for normal distribution. Each data set has the following components: location (Port Site, Terminal, Point Hope, or Noatak), subsistence food type (salmonberries, sour dock, or blackberries), and metal (cadmium, chromium, cobalt, copper, lead, manganese, nickel, selenium, or zinc).

The data sets that are normally distributed will be statistically analyzed using a t-test.

Log-normal Distributions

If a data set is not normally distributed, then that set is log-transformed to determine whether the data set is log-normally distributed. A log-transformation of a data set will yield a normally distributed data set if the original data set is log-normally distributed. The statistical hypothesis in this case is:

H_0: data set is log-normal

H_a: data set is not log-normal

with a level of significance, $\alpha = 0.05$.

Again, the Shapiro-Wilk W test is used to test the statistical hypothesis of log-normality. If the result of the Shapiro-Wilk W test indicates that a log-transformed data set is normally distributed, then the data set is assumed to be log-normally distributed.

The data sets that are log-normally distributed will be statistically analyzed using a t-test on the log-transformed data.

Non-normal Distributions

The data sets that are neither normally distributed nor non-normally distributed will be statistically analyzed using the nonparametric Mann-Whitney U test, which does not require an assumption of normal distribution.

E

Photographs

Date: 8/20/01 **Time:** 1510 **Direction:** South
Description: Aerial view of the Port Site facility.

Date: 8/20/01 **Time:** 1510 **Direction:** Southeast
Description: The concentrate storage buildings located at the Port Site.

Date: 8/20/01 **Time:** 1510 **Direction:** South
Description: Ipiavik Lagoon on the north side of the Port Site. Most of the Kivalina data set was collected around the lagoon.

Date: 8/20/01 **Time:** 1500 **Direction:** Southeast
Description: The sample team mobilizing from Kivalina.

Date: 9/19/01 **Time:** 1316 **Direction:** East
Description: Janet Mitchell and Marilyn Booth of Kivalina collecting blackberry sample 01DMT075BY.

Date: 8/21/01 **Time:** 1430 **Direction:** West
Description: A sample team washing sour dock sample 01DMT015SKC.

Date: 8/21/01 **Time:** 1455 **Direction:** West
Description: Jerry Norton and Millie Hawley assist in containerizing sample 01DMT017SKC.

Date: 8/20/01 **Time:** 1649 **Direction:** East
Description: Salmonberry sample 01DMT004SY.

Date: 8/22/01 **Time:** 1607 **Direction:** Southwest
Description: Roland Booth of Noatak collecting sour dock sample 01DMT038SK.

Date: 9/20/01 **Time:** 1436 **Direction:** Southeast
Description: Gretchen Booth of Noatak collecting blackberry sample 01DMT082BY.