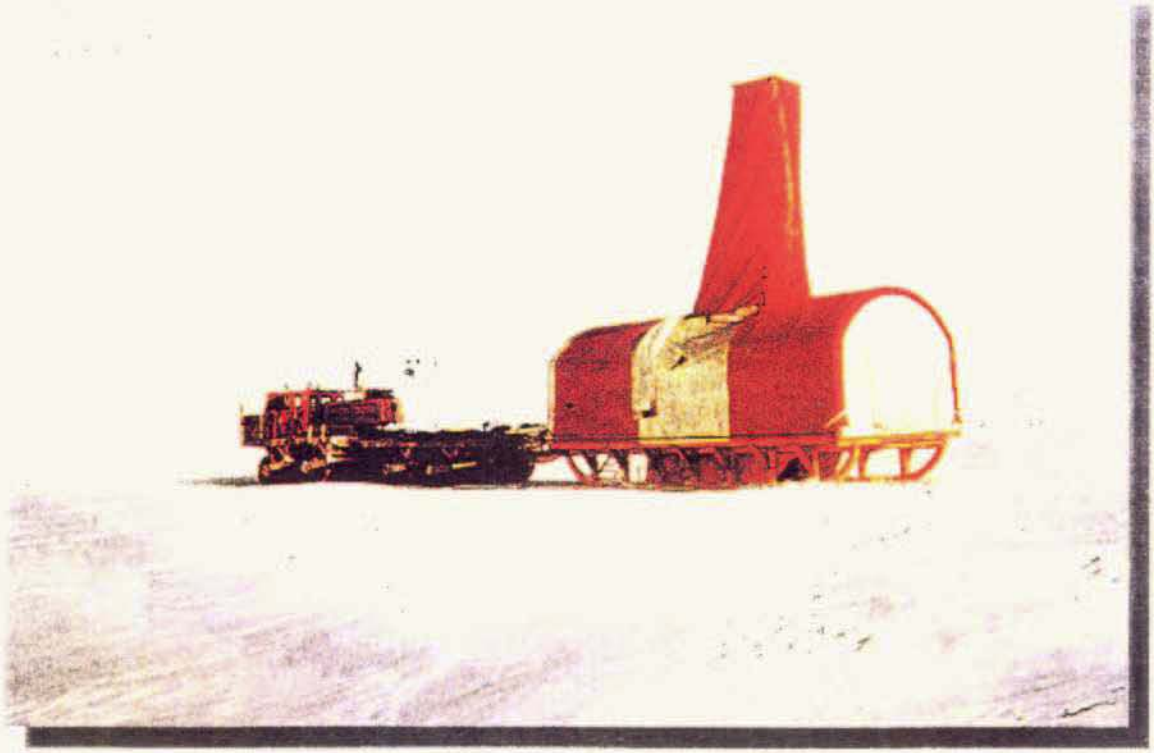


BP Exploration (Alaska) Inc.

Liberty Island Route

Water / Sediment Sampling
March 18-19, 1998

Revised and Corrected
Final Data Report - August 1998

MONTGOMERY WATSON

TABLE OF CONTENTS

Figures

Tables

Appendices

Revisions included in the August, 1998, Final Data Report.

This document was originally published in May of 1998. The document was revised and corrected following comments received by BPXA in a letter from Jeffery Walker of Minerals Management Service to Peter Hanley dated August 3, 1998. Issues raised by MMS include the following, followed with a response from Montgomery Watson.

1. **Discrepancy between field and laboratory turbidity.**

   A comparison of field and laboratory turbidity data to laboratory total suspended solids (TSS) data demonstrates some consistent patterns. Field turbidity data are uniformly higher that laboratory data for each individual water sample. Field turbidity data were reported to 3 significant figures, while BPXA laboratory data were reported to one significant figure, including 3 reported values of "0". We interpret "0" values from the BPXA laboratory to indicate less than a detection limit of 1.0 NTU. It is unreasonable to conclude that there would be "0" NTU's in the samples.

   The holding time limitation for turbidity is 48 hours. Sample results are subject to particle aggregation and settling between the time of sample collection and the time of analysis. The laboratory did not report date and time of analysis; thus, compliance with holding times cannot be verified. The laboratory turbidity values may be biased low due to the interaction between particles over time. Alternatively, field values may reflect the presence of tiny ice crystals that would exist in the field at sub-freezing temperatures, but not be apparent in the laboratory at standard temperatures above freezing. 1997 field notes from the Liberty Island Route water quality analyses note complications with field turbidity measurements due to ice formation.

   TSS analyses were performed on the seventh day of a seven-day holding time. Particles in seawater which make up TSS are subject to degradation by dissolution and/or biochemical reaction over time. TSS results may be biased low due to solute/solvent interaction in the manner suggested above for laboratory turbidity. Most of the TSS results were very close (within 150%) of the reported detection limit. Of the four values in excess of 200% of the stated detection limit, a consistent and reasonable relationship with turbidity can be discerned from both field and laboratory measurements. QC data reported by the laboratory showed good recovery of a spike sample at 60 mg/L TSS, but data is not provided which documents accuracy of reporting within 200% of the detection limit of 10 mg/L.

2. **pH below expected range.**

   pH data from the 1997 Liberty Island water quality sampling effort was in the range of 7.5 to 8.4, using methods and instrumentation identical to the 1998 effort. Other recent North Slope investigations have yielded seawater pH values ranging from as low as 5.8 (Endicott NPDES Environmental Monitoring, April, 1995) to 8.06 (Northstar Development Project 1997 Data Report). The Beckman meter used in each of these efforts is a model programmed for internal temperature compensation. The particular unit used in March of 1998 was factory calibrated and checked in January, and a field calibration was performed at each site. The gel-filled probe on this model is more reliable for cold weather sampling then other probe types. The electronic meter box is often suspect when exposed in cold weather sampling. We ensured that the meter box was kept warm in an insulated container to prevent effects of frost on the meter workings. Calibration or machine error is unlikely.

3. **Apparent density instability.**

Densities were calculated and presented in Table 2 of the May, 1998, data report from temperature and salinity data that were transcribed incorrectly from the field data sheets. This edition features an update to Table 2, with corrected values of field and laboratory data for all samples. The corrected table indicates a density instability in the water column at station 98BPXLI14, with water slightly warmer and fresher (-0.5°C, 27 ppt salinity, 1021.7 kg/m^3) underlying cooler saltier water (-1.0°C, 28 ppt salinity, 1022.5 kg/m^3). The calculated densities yield a false impression of precision in the salinity and temperature measurements. Temperature and salinity field instruments have a resolution of 0.5 degrees and 1 ppt, respectively. A small error in either the salinity or temperature measured in the field could lead to a resultant change in the relative density of the samples. Conductivity measurements for both sample depths are the same, suggesting that there is no significant difference in salinity or density within the water column.

Table 2 has also been expanded to include results of metals analyses of the water samples. Text has been corrected to reflect the appropriate ranges of values of various water quality measurements.

4. **Sample preservation.**

The previous edition stated incorrectly that samples were "cooled to 4^0 Celsius", which would be a common requirement for sampling in temperate weather. Samples from the March, 1998 sampling of the Beaufort Sea were maintained at temperatures less than $+4^0$ C prior to laboratory analysis.

Other changes made in the document include:

1. Section 1.1. Deleted reference to pipeline "shown in Figure 1". The pipeline alignment is not shown in that figure, although the proposed alignment is shown in Appendix A in documentation of the sample sites provided by BPXA contract surveyors.

2. Section 2.3. Added references to metals sampling of the water column and clarified procedures for field measurements of water quality.

3. Section 3.1. Corrected sample locations.

4. Section 3.2.1. Revised and added commentary on water quality results.

5. Section 4.1.8. Referenced summary statistics on Table 4.

6. Figures 2-6. Added information to titles and legends to indicate data are for sediment samples, taken from various depths below the sea floor.

7. Figure 9. Revised to more clearly represent findings with respect to water depth.

8. Table 1. Revised and condensed to single page.

9. Table 2. Expanded to 2 pages to present metals results.

1. INTRODUCTION

1.1 BACKGROUND

The Liberty Island Development Project involves offshore exploration and production of oil and gas resources within Foggy Island Bay between Endicott and Liberty #1 Ice Island in the ice-ridden Beaufort Sea. Oil and gas produced by the project are intended to be brought to existing onshore delivery facilities by way of offshore pipeline.

1.1.1 Water Quality Monitoring Objectives

In 1997, geochemical characterization of sediments and water quality took place along several potential offshore pipeline alignments. In 1998, a final proposed alignment was selected, requiring further characterization for project engineering and National Environmental Policy Act (NEPA) documentation. A series of sampling stations was identified by BP Exploration (Alaska) Inc. (BPXA) (Figure 1). A water quality and geochemical sampling plan was prepared by Woodward-Clyde and was amended through discussions with BP Exploration and Montgomery Watson on March 7 and in accordance with input from John Malik of U.S. Environmental Protection Agency (USEPA) and Barbara Reilly of the U.S. Army Corps of Engineers (USACE).

The objective of this field study was to provide baseline water and sediment characterization along the final proposed offshore pipeline alignment. These results augment the 1997 work performed by Montgomery Watson on three alternative alignments for the Liberty Island pipeline route, thus confirming and supplementing existing data and information to the BPXA Liberty project team on the nature and dispersal of sediments which may be disturbed in the trenching operations.

1.1.2 Monitoring Program Organization and Responsibilities

Montgomery Watson performed this work under the direction of Mary Cocklan-Vendl of the Health Safety, and Environment Department of BPXA. The BPXA Prudhoe Bay laboratory performed water analysis for BOD_5 and turbidity. Quanterra's laboratory in West Sacramento, California, performed the soil and water analysis for metal parameters. Multichem Analytical Service, (MAS) in Anchorage, Alaska, completed the remainder of the analyses for the soil parameters. Montgomery Watson's project team was directed by Project Manager, J. Brett Jokela, P.E. in conjunction with field operations supervisor Bonnie McLean. Field work was undertaken by Bonnie McLean, Senior Environmental Scientist and Associate Geologist Sharon Sadlon. Bonnie McLean is experienced in offshore winter field operations on the North Slope, having participated in water quality and sediment monitoring at the Endicott NPDES Monitoring Program, the 1996 Northstar Pilot Offshore Trenching Program, and the Liberty Island Route water/sediment sampling. Lynn DeGeorge, Senior Environmental Scientist, reviewed the chemical data.

BPXA provided transportation to and from Deadhorse, accommodations, and workspace for mobilization and sample shipment preparation at the Endicott Spill Response Warehouse, Building 608.

Duane Miller and Associates provided logistical support for the fieldwork, under a separate project task authorization with BPXA. Duane Miller and Associates provided on-ice transportation through subcontracts to equipment operators. A tundra Rolligon was supplied by CATCO. The Rolligon was used to transport a skid mounted warming safety shack and Discovery Drilling's CME-75 drill rig, stationed in a rig enclosure (see Photo cover and Appendix C). This equipment was mobilized to four pre-located stations and was used to drill through the ice, allowing water quality sampling measurements and soil sample collection.

1.2 DATA REPORT

This report describes sampling sites, analytes, and methodologies; presents analytical findings; and describes quality control established for this field effort.

2. MONITORING PROCEDURES

2.1 LOCATION AND PROBLEM STATEMENT

The final proposed pipeline alignment for the Liberty Island project was identified by BPXA Inc. on a transect extending north-northeast from shore at SE 1/4, Section 24, T.10N, R.17E., Umiat Meridian through Foggy Island Bay and terminating at the proposed island. Sampling locations were established approximately 1/3 and 2/3 the distance from shore to the proposed island (sample I.D. DMA98-14 & DMA98-9, respectively) and at the proposed island pipeline riser location (sample I.D. DMA98-2). A fourth location (sample I.D. DMA98-30) was approximately 600m NW of the proposed island DMA98-1). Sampling was conducted at these four (4) sites in water (ice) depths ranging from approximately 20.7 to 6.8feet. Ice thickness varied from approximately 5.2 to 4.6 feet.

A shallow trench, 8 to 12 feet below the sea floor, has been proposed for Liberty pipeline construction, using a large hydraulic excavator working from a thickened ice pad on top of the sea ice. A major consideration is the potential occurrence of contaminants, including trace metals and hydrocarbons in the sediments. A baseline of sediment chemical quality is necessary to evaluate potential effects of construction activity on the marine environment. Work by Montgomery Watson at the Northstar Development Project (Montgomery Watson, April 1, 1996) demonstrated that sediment dispersal from trenching activities is most likely short in duration and limited to a small area near the trench. However, associated with the disruption of the sediment by trenching is the potential for release of toxic contaminants from the sediments that may affect the viability of epibenthos and/or plankton which live in the shallow waters of the nearshore Beaufort Sea. Background levels of trace metals and volatile and semi-volatile organic compounds were documented by measuring their concentrations at three discrete depths beneath the sediment surface.

2.2 SAMPLE LOCATIONS AND MOBILIZATION

Sample sites were positioned along the final proposed pipeline route at the locations identified on the map attached as Figure 1 at the end of this section. The locations were staked and identified with respect to Alaska State Plane coordinates and latitude/longitude in advance by BPXA contract surveyor support. Each of the sampling locations was located by the field sampling crew by navigating a Rolligon vehicle using the GPS coordinates provided by the BPXA contract surveyor.

One Rolligon was used during the sampling regimen, and two skids were towed separately to each location. One skid held an enclosed CME-75 drill rig, which augered through the sea ice and drove and retrieved the split spoons for soil samples. The second skid held a warming shack in which extra equipment and supplies were stored.

2.3 SAMPLE COLLECTION PROCEDURES

Data collection at each station was performed in the following order:

1. Locate station using GPS positioning
2. Bore through ice, measure and record distances from drill rig floor to ice
3. Measure and record thickness of ice
4. Measure and record distances from top of water in hole to top of ice
5. Measure and record bottom depth (depth to seafloor)
6. Conduct salinity, conductivity/temperature profiles
7. Collect sample for dissolved oxygen (DO), turbidity, metals, and pH at each distinct stratum
8. Collect total suspended solids (TSS), turbidity (laboratory), BOD_5, and TOC samples at each discrete sample point
9. Drive and retrieve 4"x 2' split spoon from surface to 2 feet below surface
10. Collect soil samples from 0.5' to 1' for organic, metal, and grain size analyses
11. Drive and retrieve 4" x 2' split spoon from 2' to 4' below surface
12. Collect soil samples from 2' to 3' for organic, metal, and grain size analyses
13. Drive and retrieve 4"x 5' split spoon from surface to 8 to 10 feet below surface
14. Collect soil samples from 8' to 9' for organic, metal, and grain size analyses
15. Confirm GPS location and close out site

Station positioning (Activities 1 and 15) have been outlined in Section 2.2. Field measurements and conditions are contained in the field note forms supplied in Appendix A and are summarized in Table 2. Techniques for each of the other activities are discussed below:

Activity 2, Activity 3, and Activity 4: Sea Ice Thickness

The CME-75 enclosed drill rig-mounted auger was used to bore through the ice for water column and sediment sampling. Depth of the boring was monitored closely; the auger was withdrawn for depth checking and clearing of ice chips several times as the drilling progressed.

Ice thickness and depth to water surface were measured using a graduated sounding rod equipped with a small hook to catch the ice edge. The top of the "black" sea ice was used as a datum.

Activity 5: Bottom Depth

The bottom depth was measured using a sounding lead and calibrated brass chain. Ice-free water depth was calculated as the difference of depth to bottom and ice-depth. The maximum ice-free water depth was 16.7 feet deep at the sampling location DMA98-2.

Activity 6: Conduct Salinity(Conductivity)/Temperature profiles

Temperature, conductivity and salinity measurements were made at 0.5-foot increments through the water profile.

Activity 7: Measure Dissolved Oxygen Turbidity and pH at each sampling station

Dissolved oxygen (DO), turbidity, and pH were measured in the field, *ex-situ*, from samples taken at each of the sampling points within the water column.. DO measurements were completed with a Hach

2100 colorimeter and a high range (HR) standard. Field measurements for pH were made with a Beckman pH meter. Turbidity was measured by a Hach 2100P nephelometric turbidimeter.

Activity 8: Collect Samples for Turbidity, Total Organic Carbon, Biological Oxygen Demand, Metal, and Total Suspended Solids

Samples of under-ice free water were collected with a stainless steel point source sampler to document the occurrence of turbidity, total organic carbon (TOC), five-day biological oxygen demand (BOD_5), trace metals, and total suspended solids (TSS). Samples were contained in 1-liter, nalgene plastic bottles. Color and appearance were documented in the field note form for the site. Samples for turbidity and BOD_5 were submitted to the BPXA BOC laboratory for analysis. TSS and TOC samples were shipped off-site to be measured by MAS Laboratories in Anchorage. Metals samples were sent unfiltered to Quanterra Laboratories in Sacramento California for analysis of total arsenic, total barium, total chromium, total lead, and total mercury.

Activities 9 through 14: Sediment sampling

Soil samples were collected at three intervals in the following depth ranges below the soil/water interface: (1) one-half to one foot, (2) two to three feet, and (3) eight to nine feet.

In each instance, a split spoon was driven by a 340 lb. mechanical hammer with a 30-inch drop into the sediment. Each core was removed, drained, and troweled into sample jars, beginning with samples for volatile organics, and progressing to semivolatiles, total organic carbon, metals, and finally, grain size analysis.

Duplicate core samples were collected for all analyses at two stations (DMA98-2 and DMA98-30) selected at random in the field.

Activity 15: Site close-out

At the completion of each site sampling effort, the field team leader initialed the form to confirm that all field note form information had been entered. The final GPS location was recorded on the field note form prior to leaving the site.

3. MONITORING RESULTS

3.1 SAMPLING CHRONOLOGY

Sampling was performed over two days (two 12 hours shifts), from Wednesday, March 18, 1998 through Thursday, March 19, 1998. The following table relates the sampling order for this project:

Date	Site	Geodetic Location		Sampled by
03/18/98	DMA98-14	Lat: 70° 13' 43" N	Long: 147° 38' 45" W	BGM
03/18/98	DMA98-9	Lat: 70° 15' 11" N	Long: 147° 36' 7 " W	BGM
03/18/98	DMA98-2	Lat: 70° 16' 38" N	Long: 147° 33' 31" W	SS
03/19/98	DMA98-30	Lat: 70° 16' 54" N	Long: 147° 34' 10" W	SS

BGM = Bonnie McLean, MW
SS = Sharon Sadlon, MW

3.1.1 Laboratory Analyses

BPXA BOC laboratory conducted analyses for turbidity and BOD_5. Other samples were analyzed by MAS Laboratory in Anchorage, Alaska and Quanterra Laboratory in West Sacramento, California. Appropriate methodologies are available in the following references:

- Test Methods for Evaluating Solid Waste Physical/Chemical Methods (SW-846, November 1990)
- Methods for Chemical Analysis of Water and Wastes (EPA 600/4-79-020, March 1982)

The following table summarizes project sampling requirements:

Measurement	Matrix	Method	Sample Container	Preservation Method	Holding Time
Salinity (Conductivity)	water	field measurement	field aliquot	n/a	n/a
Dissolved Oxygen	water	field measurement	field aliquot	*n/a*	*n/a*
Turbidity	water	field measurement EPA 180.1	field aliquot/ 500 ml. HDPE	n/a n/a	immediate 48 hours
Temperature	water	field measurement	in situ	n/a	immediate
pH	water	field measurement	field aliquot	n/a	immediate
BOD_5	water	EPA 405.1	1 liter HDPE	n/a	12 hours
Total Suspended Solids	water	SWA 160.2	500 ml HDPE	Held at 2°- 4°C	28 days
Total Organic Carbon	soil	SWA 415.1	4oz Clear Wide Mouth	Held at 2°- 4°C	28 days
Arsenic (As)	soil, water	SWA 6020	4oz Clear Wide Mouth	Held at 2°- 4°C	6 months
Barium (Ba),Total ionic	soil, water	SWA 6020	"	Held at 2°- 4°C	6 months
Chromium (Cr), Total	soil, water	SWA 6020	"	Held at 2°- 4°C	6 months
Lead (Pb)	soil, water	SWA 6020	"	Held at 2°- 4°C	6 months
Mercury (Hg)	soil, water	SWA 7471 - CV	"	Held at 2°- 4°C	28 days
Volatile Organic Compounds	soil	8260a	2oz Clear Wide Mouth	Held at 2°- 4°C	14 days
Semi-volatile Organic Compounds	soil	8270	4oz Clear Wide Mouth	Held at 2°- 4°C	14 days
Grain Size	soil	ASTM D-422	1L polyethylene bag	n/a	indefinite
Particle Size	soil	ASTM D2487	1 gal. bag	n/a	indefinite

3.2 ANALYTICAL RESULTS

Tables and figures documenting results are provided at the end of this section. Table 1 is a sample plan checklist identifying what analyses were run on each sample. Table 2 is a summary of water quality parameters, including field measurements. Table 3 lists results of grain size analysis. Table 4 is a summary of the analytical results for soils and water. All laboratory and field data are included in Appendices.

3.2.1 Sea Water

Field measurements showed temperatures of -1 to -2 degrees Celsius, with salinities in the range from 27 to 33 parts per thousand. pH ranged from 6.3 to 7.6, while dissolved oxygen ranged from 7.4 to 11.0 ppm.

Turbidity field measurements ranged from a low of 6.12 NTU to a high of 17.6 NTU. Turbidity laboratory measurements ranged from a low of 0 NTU to a high of 11 NTU. Field turbidity may have

been affected by ice crystals.

All BOD_5 results were less than 1 mg/l (the laboratory reporting limit). Total suspended solids ranged from a low of less than 10 mg/l to a high of 74 mg/l, as illustrated in Figure 9. Trace metals results show some detected levels of arsenic in the water column near the reporting limit. Barium was found in each water sample, ranging from 0.0175 mg/L to 0.0551 mg/L. No chromium, lead, or mercury was reported in any of the water samples.

3.2.2 Sediment Chemistry

Results of metals analyses are shown in Figures 2 through 6 at the end of this section. Less than detection limit results are assigned a value of "0" for statistical purposes in Table 4. Arsenic averaged 5.5 mg/kg throughout the pipeline alignment. The coefficient of variation (the standard deviation of the samples divided by the mean) for all of the sites was 39%.

Barium averaged 44.8 mg/kg across the pipeline alignment with a coefficient of variation of 33%.

Chromium averaged 12.2 mg/kg across the pipeline alignment with a coefficient of variation of 41%.

Mercury averaged 0.035 mg/kg across the pipeline alignment with a coefficient of variation of 78%.

Lead averaged 5.36 mg/kg across the pipeline alignment with a coefficient of variation of 52 %.

Sediment grain size data are illustrated in Figures 7 and 8. All samples were shown to be predominantly silt with a trace to some sand, with the exception of the deep sample at Station 14, which was predominantly sand.

There were no detections of volatile organic compounds (VOC).

Six components of the Semi-volatile Organic Compounds (SVOC) exceeded the minimum report detection limit (see Table 4). These compounds are: bis-(2-ethylhexyl)phthalate, Benzo(a)pyrene, and 2-Methylnapthalene, 4-Methyphenol (p-Cresol), Phenanthrene, and Phenol.

3.3 SEDIMENT QUALITY STANDARDS

Sediment quality standards are driven by the impacts of pollutants on benthic biota. State sediment quality standards have not been established by the state of Alaska, thus other benchmark criteria were sought for comparative analysis. As the work performed at Liberty Island is a baseline study of the water and sediment quality, all criteria are used for comparison only. Exceedances do not necessarily indicate concern.

Liberty Island Route sediment data were compared to the following benchmarks: EPA Ecotox Thresholds; Puget Sound Dredged Disposal Analysis; and EPA Region III's Risk-Based Concentrations.

EPA Ecotox Thresholds (ET): The EPA has developed a group of ecotoxicologically-based threshold criteria (ET) for use in ecological risk assessments at Superfund sites. The ETs are intended to provide technical information to EPA and other government employees but do not constitute rulemaking by the EPA. Benchmarks have been developed for surface water and sediments, with sediment benchmarks presented as sediment quality criteria (SQC) for fresh water and marine environments, sediment quality benchmarks (SQB), and effects range low (ERL). If neither SQC nor SQB has been calculated, the ERL will be used as the sediment ET. For the analytes detected at Liberty Island only ERLs have been

calculated. The ERL represents the lower 10th-percentile concentration associated with observation of biological effects. Accordingly, concentrations below the ERL would rarely be associated with adverse effects. Table 4 provides a summary of the analytical results and benchmark screening levels.

Puget Sound Dredged Disposal Analysis (PSDDA): PSDDA analytic methods and criteria have been established for the Puget Sound area in Washington state. PSDDA chemical analyses were developed by the collaborative efforts of EPA Region X (Seattle), the USACE and the Washington State Departments of Natural Resources and Ecology. The Washington Department of Ecology is responsible for issuing state certification for USACE Section 404 permits. Data and criteria are reviewed annually; however, no changes in numeric standards have been made since 1988.

Three levels of contaminant concentrations have been established by PSDDA: a screening level, a bioaccumulation level, and a maximum level. Standards for each level are derived from a statistical model, in which apparent effects thresholds are defined. The model is applied to a rigorously quality-controlled database of sediment chemistry and bio-effect data. The maximum level is the level of highest apparent effects. The screening level is established at either the lowest biological effects level or at 10% of the maximum effect level. Arsenic, lead, mercury, and 42 volatile and semi-volatile organic compounds are included in the list of PSDDA parameters. There are no PSSDA criteria for the barium or chromium species.

Liberty Island sediment results are uniformly below the PSDDA screening level criteria for all components shown in Table 4 except 4-Methylphenol (p-Cresol).

Risk-Based Concentrations (RBCs): EPA Region III has calculated separate carcinogenic and non-carcinogenic RBCs for various pathways of ingestion or inhalation. The lower of the two is presented in the RBC tables published by EPA Region III which are updated and distributed semi-annually. The various pathways include residential water, ambient air, edible fish, industrial soil ingestion, and residential soil ingestion (which are generally lower (more stringent) than industrial soil ingestion). There are no RBCs for diesel range organics.

Liberty Island sediment results are uniformly below the RBCs for all the metals sampled as shown in Table 4. Results of analyses for discrete volatile and semi-volatile compounds were all below detection levels, with the exception of Benzo(a)pyrene.

4. DOCUMENTATION AND REPORTING

4.1 FIELD DOCUMENTATION

The field team leader was responsible for maintaining records of field activities, including field analytical measurements, sample locations, and sample identification. Data was entered into a bound notebook while field activities were in progress. All field documents were supplied to the project manager at the end of the field investigation. Field results were incorporated into progress reports or final reports, as appropriate. A sample plan checklist was used to identify sample numbers, sample locations, sample matrices, analytical parameters, sample containers, and quality control samples. This checklist was prepared by the project manager prior to mobilization and provided the field team with a concise list of samples by location. The field team leader reviewed the checklist for completion following sample collection and prior to the shipment of samples or departing from the site.

4.1.1 Field Logbook

Logbooks and data forms are necessary to provide sufficient data and observations to enable participants to reconstruct events that occurred during the project and to refresh the memory of field personnel if called upon to give testimony during legal proceedings. All daily logs were kept in bound, waterproof notebooks containing numbered pages. All entries were dated and signed. No pages were removed for any reason. Unused pages were crossed through, signed, and dated by the field team leader or project manager. Corrections were made by drawing a single line through the original entry (so the original entry can still be read) and writing the corrected entry beside the original. Corrections were initialed and dated.

4.1.2 Field Note Forms

Field note forms were used to record all data pertaining to a particular sampling event at a single sampling station. Field note forms are designed to assist the field crews in completing the work at each station. Field note forms were reviewed for completeness and accuracy and initialed in the field by the field sampling task leader. Copies of the original field note forms are provided in Appendix A.

4.1.3 Chain-of-Custody Forms

The purpose of chain-of-custody procedures is to ensure that the integrity of samples is maintained during their collection, transportation, storage, and analysis. All chain-of-custody requirements comply with standard operating procedures indicated in EPA sample handling protocol. Chain-of-custody records are provided in Appendix B.

4.1.4 Photographs

Photographs were taken at the sampling locations as directed by the team leader. Selected photographs are provided in Appendix C. Documentation of a photograph is crucial to its validity as a representation of an existing situation.

4.1.5 Sample Documentation

The field crew recorded the location of all samples on scaled site maps.

Each sample was labeled and sealed immediately after collection. The sample label was filled out using waterproof ink and firmly affixed to the sample containers with clear waterproof tape. An alphanumeric code was assigned to each sample as an identification number to track samples at the site. The sample code is broken down as follows:

Year	Project	Sample Location	Sample matrix	Sample
98	BPXLI	2, 9, 14, 30	SD=Sediment	01=primary
			WA=Water	61=duplicate

The sample label contains the following identification:

Date and time of collection;
Sample identification number;
Analysis required (including analytical method number);
Preservation method used; and
Initials of field team member compiling samples.

Sample volume levels were marked on each liquid sample container. After the sample was collected,

pertinent information, such as sample identification number, date and time of sample collection, sample collection method, description of sample, and any field measurements (temperature, salinity, turbidity, etc.), were recorded on the field note form, and the recorder initialed the entry.

4.1.6 Laboratory Data Log

All data generated was reviewed by comparing and interpreting results from chromatograms (responses, stability, retention times), accuracy (mean percent recovery of spiked samples), and precision (reproducibility of results). Laboratory Data Sheets are presented in Appendix D.

4.1.7 Data Reporting and Data Deliverables

All laboratory-generated data was supplied in both hard copy and electronic formats in compliance with EPA Tier I guidelines.

4.1.8 Summary Statistics

Station values for water quality parameters have been summarized in tabular and graphic form. Statistics are calculated and presented in Table 4.

5. QUALITY ASSURANCE AND QUALITY CONTROL

5.1 QUALITY ASSURANCE OBJECTIVES

Characteristics used to assess generated data were precision, accuracy, representativeness, completeness, and comparability, often referred to as PARCC parameters. PARCC parameters were integrated throughout the work plan and applied throughout the data collection process.

Project goals expressed specific PARCC parameters necessary to meet regulatory requirements, such as maximum level. Performance goals were specifically related to indicator quality control (QC) samples as quantitative measures of PARCC parameters. For example, analysis of one duplicate in ten samples is a performance goal and the results of duplicate analyses are an indicator of precision. The completeness goal for all analytes is 87.5%, or 7 of 8 results.

Accuracy and Precision Criteria

	Laboratory Precision (Duplicate Relative Percent Difference)		Laboratory Accuracy (Laboratory Control Sample % Recovery)	
Total Suspended Solids	20		80-120	
Total Organic Carbon	20		80-120	
Grain Size	n/a		n/a	
Arsenic (As)	20		80-120	
Barium (Ba),Total ionic	20		80-120	
Chromium (Cr), Total	20		80-120	
Lead (Pb)	20		80-120	
Mercury (Hg)	20		80-120	
Volatile Organic Compounds	1,1-Dichloroethene	22	1,1-Dichloroethene	54-138
	Benzene	21	Benzene	70-130
	Trichloroethene (TCE)	24	Trichloroethene (TCE)	57-132
	Toluene	21	Toluene	71-129
	Chlorobenzene	21	Chlorobenzene	72-128
Semi-volatile Organic Compounds	Phenol	35	Phenol	28-110
	2-Chlorophenol	50	2-Chlorophenol	22-110
	1,4-Dichlorobenzene	27	1,4-Dichlorobenzene	21-110
	N-Nitroso-di-n-propylamine	38	N-Nitroso-di-n-propylamine	24-110
	1,2,4-Trichlorobenzene	23	1,2,4-Trichlorobenzene	32-110
	4-Chloro-3-methylphenol	33	4-Chloro-3-methylphenol	35-112
	Acenaphthene	19	4-Nitrophenol	29-127
	4-Nitrophenol	50	2,4-Dinitrotoluene	51-112
	2,4-Dinitrotoluene	47	Pentachlorophenol	41-133
	Pentachlorophenol	47	Pyrene	45-135
	Pyrene	36		

Note:

Only system monitoring compounds are listed for Volatile and Semi-volatile Organic Compounds.

n/a - Criteria do not apply due to the nature of the analysis

* - Because this parameter has no standard analysis method, Limits are advisory only.

5.2 CALIBRATION PROCEDURES

All instruments and equipment used during the sampling and analysis were operated, calibrated, and maintained according to the manufacturer's guidelines and recommendations as well as criteria set for the instrument in the applicable methodology references. Operation, calibration, and maintenance were performed by personnel properly trained in these procedures.

5.2.1 Field Equipment

Each field instrument was calibrated prior to use at each sample location and, in some instances where appropriate, before each use. These instruments include a portable digital temperature/salinity/ conductivity meter, pH meter, dissolved oxygen meter, and a turbidity meter. Calibration assured accurate readings for each day of use and was noted in the Field Notebook of the calibrator.

5.2.2 Laboratory Instrumentation

Laboratory capabilities were initially demonstrated for instrument and reagent/standards performed as well as accuracy and precision of analytical methodology. Brief descriptions of calibration procedures for major instrument types are presented in the previously referenced methodologies.

5.3 DATA VALIDATION SUMMARY

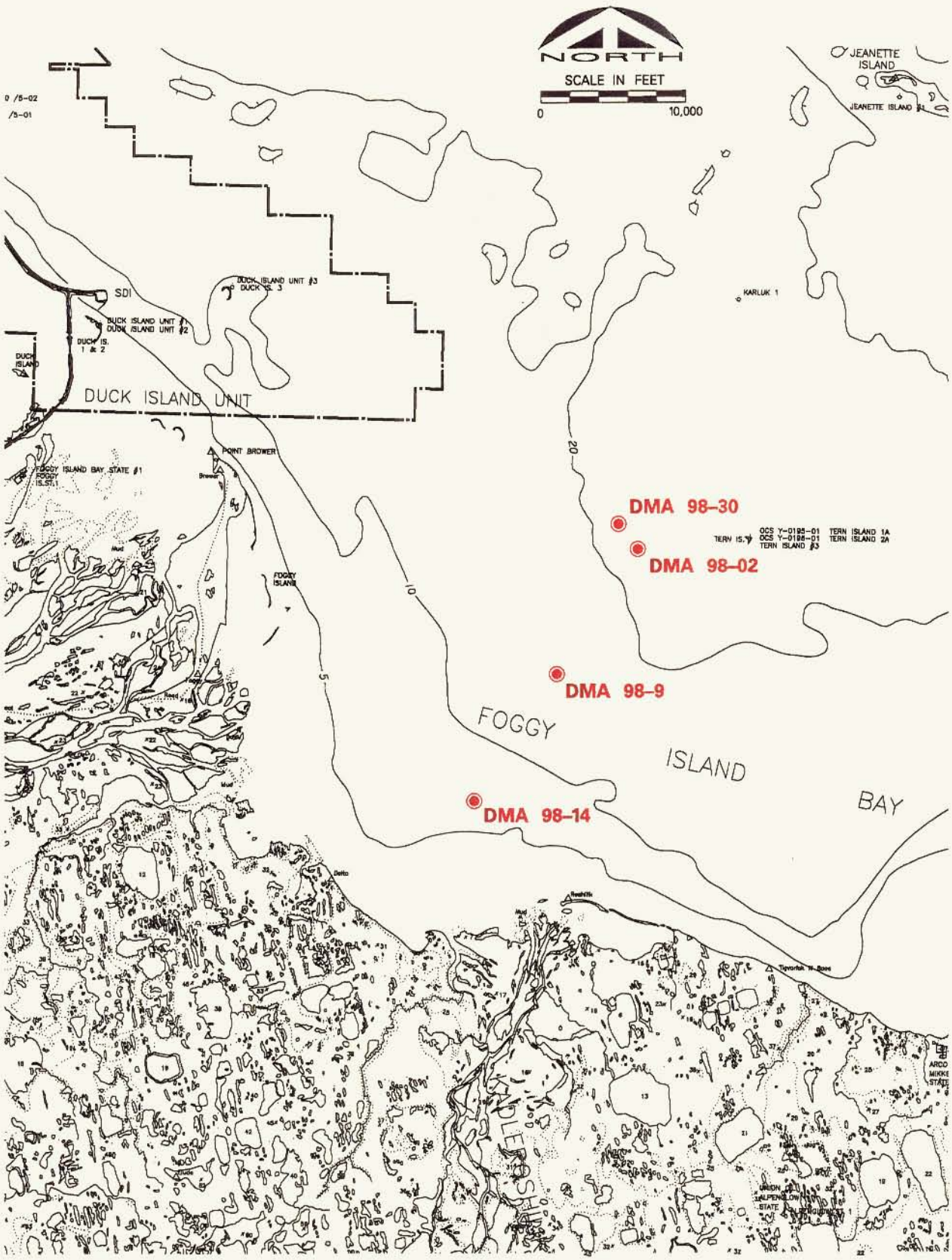
DATA VALIDATION SUMMARY

Thirteen water and fourteen sediment samples were collected March 18 and 19, 1998 and submitted to three laboratories for the suite of analyses summarized in the following table.

Laboratory	Analysis	Method
Prudhoe Bay Laboratory	BOD-5	
	Turbidity	
Quanterra Environmental Services	Mercury	EPA Method 7471
	Arsenic	EPA Method 6020
	Barium	EPA Method 6020
	Chromium	EPA Method 6020
	Lead	EPA Method 6020
MultiChem Analytical Services	Volatile Organic Compounds	EPA Method 8260A
	Semi-Volatile Organic Compounds	EPA Method 8270
	Total Organic Carbon	EPA Method 415.1
	Grain Size	
	Particle Size	
	Total Suspended Solids	EPA Method 160.2
	Hexachlorobenzene*	EPA Method 8081
	Hexachlorobutadiene*	EPA Method 8081

* - Hexachlorobenzene and Hexachlorobutadiene were analyzed using EPA Method 8081 to achieve lowest possible reporting levels. However, some samples with high moisture content yielded reporting levels above PSSDA action criteria.

Data were validated in accordance with accuracy and precision objectives established by the subcontracted laboratories: MultiChem Analytical Services (MAS) of Anchorage, Alaska, and Quanterra Environmental Services (Quanterra) of West Sacramento, California. In addition, data were evaluated for conformance with the Quality Assurance Objectives specified in Section 4 of the 1997 Technical Plan (MW, 1997). Acceptance criteria for accuracy, precision, and method reporting limits (MRLs) are provided in the laboratory reports. Where applicable, data validation guidance contained in the National Functional Guidelines for Organic and Inorganic Data Review (EPA, 1994) were followed. All data were considered valid as qualified using data quality objectives defined for the project.



MONTGOMERY WATSON

Anchorage, Alaska

FIGURE 1

BP EXPLORATION (ALASKA) INC.
LIBERTY ISLAND ROUTE WATER /SEDIMENT SAMPLING

1998 BOREHOLE SAMPLING LOCATIONS

JOB No. 1185 0101 TIME: 04-SEP-1998 08:38 FILE: S:\CAD\Proj\bpx\liberty\FIG1.DGN

Figure 2
Arsenic Concentrations in Sediment
by Sample Location

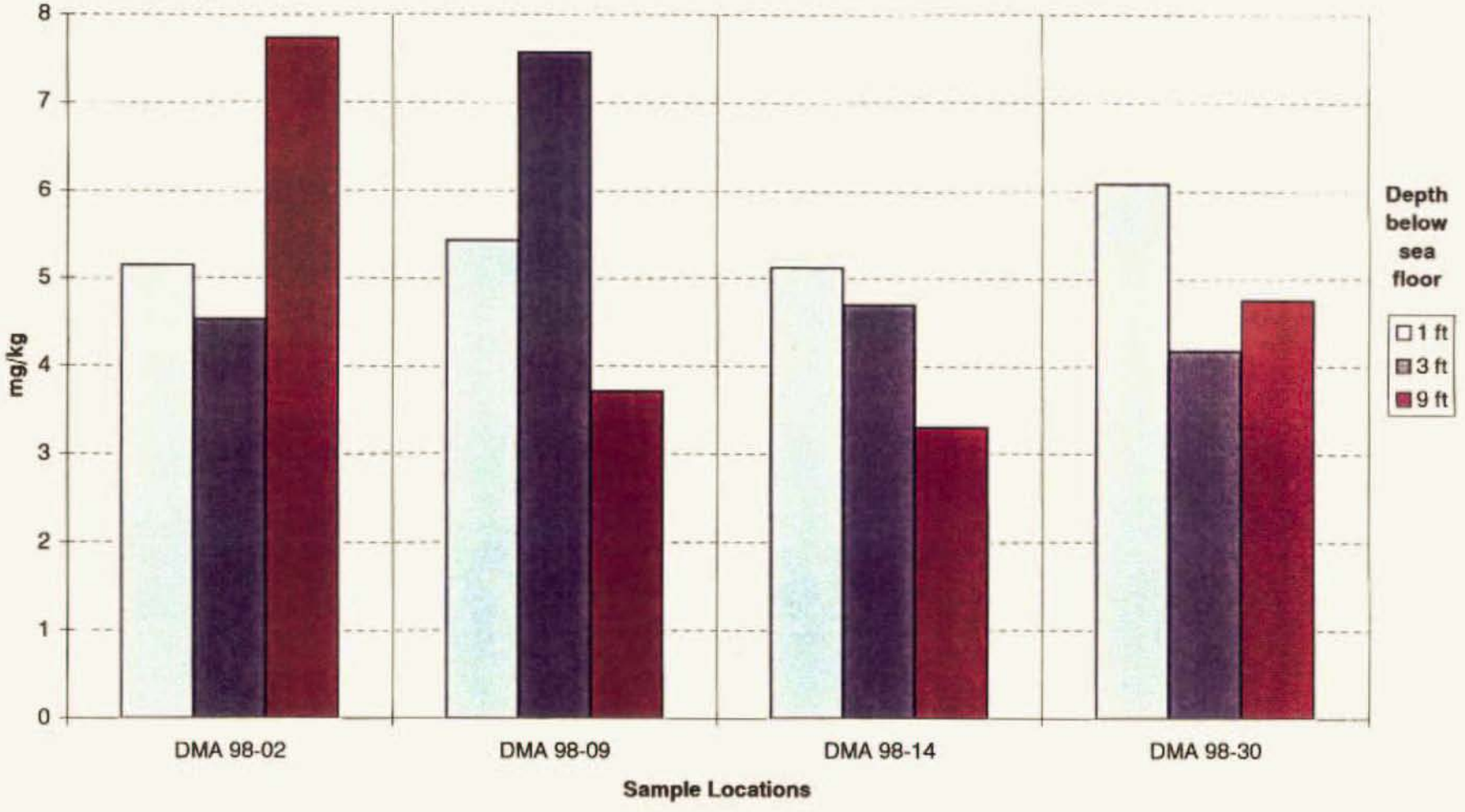


Figure 3
Barium Concentrations in Sediment
by Sample Location

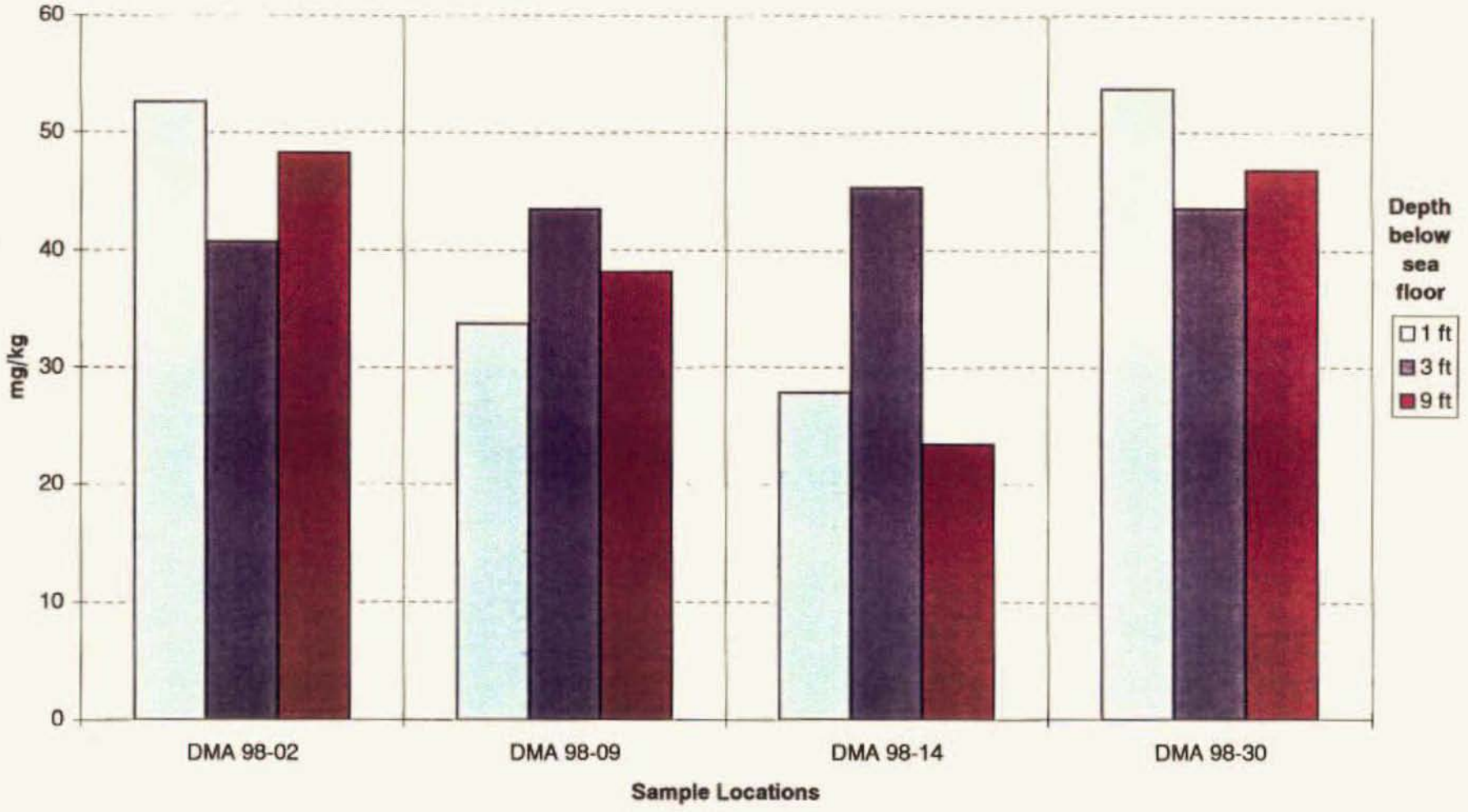
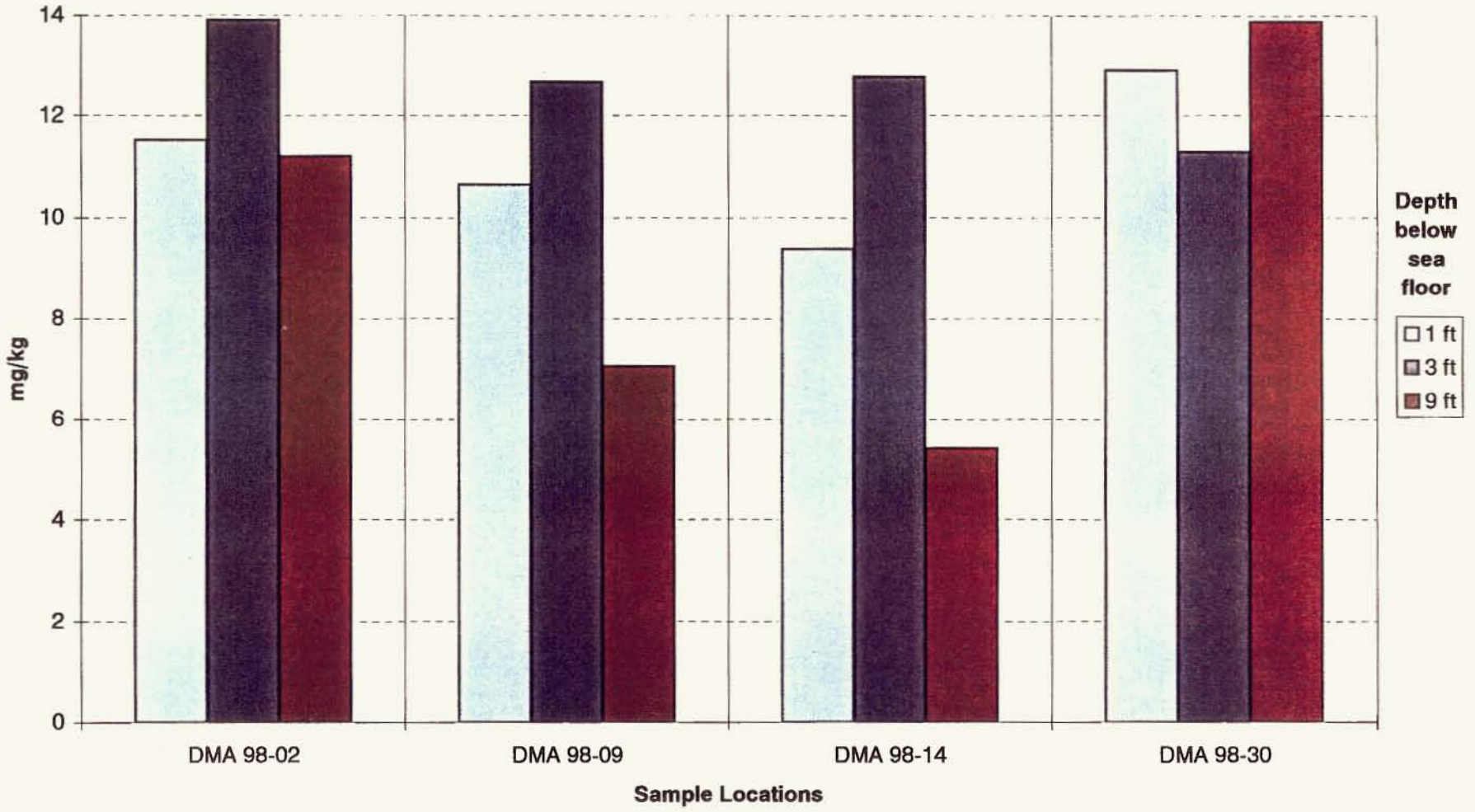
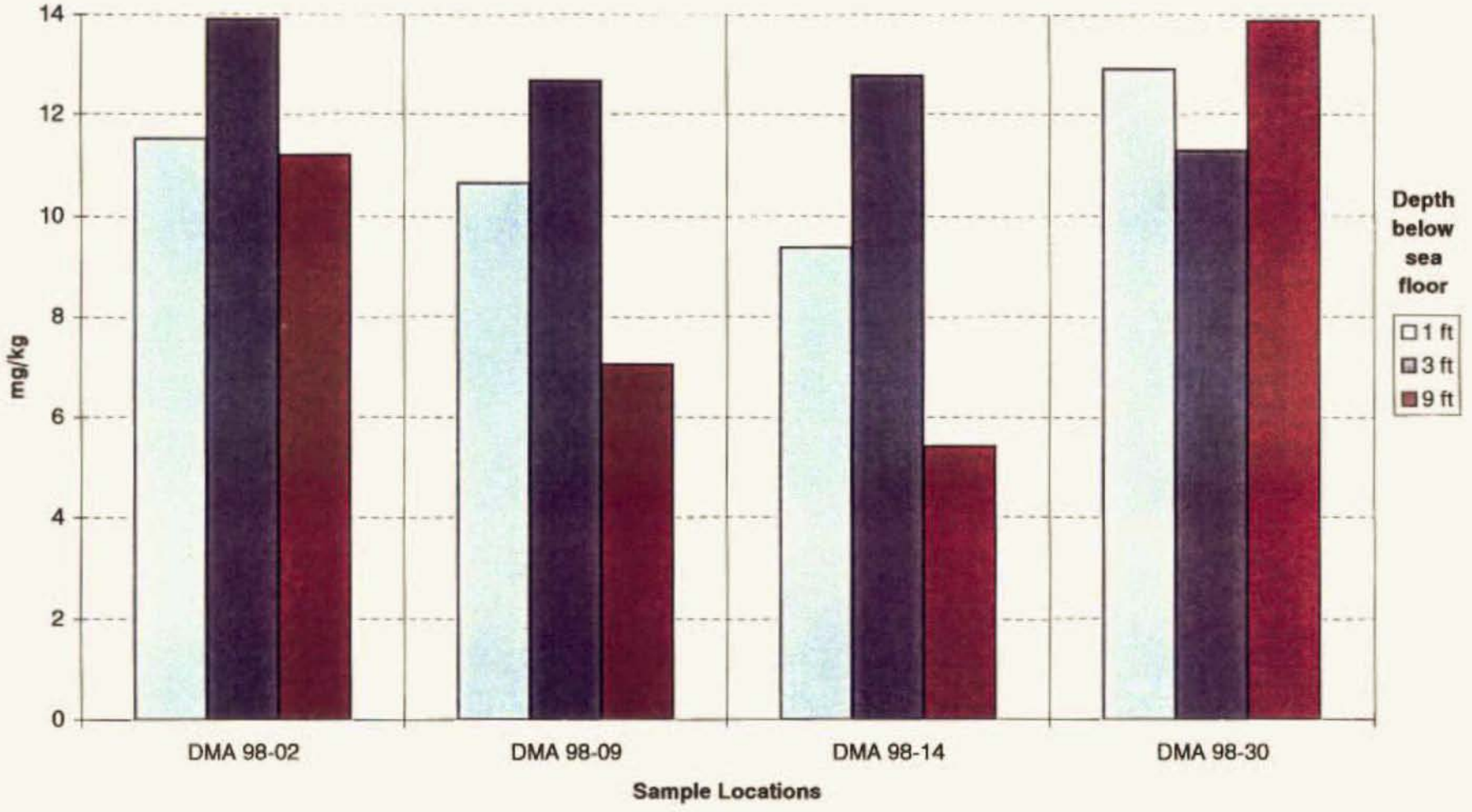


Figure 4
Chromium Concentrations in Sediment
by Sample Location



]

Figure 4
Chromium Concentrations in Sediment
by Sample Location



]

Figure 6
Mercury Concentrations in Sediment
by Sample Location

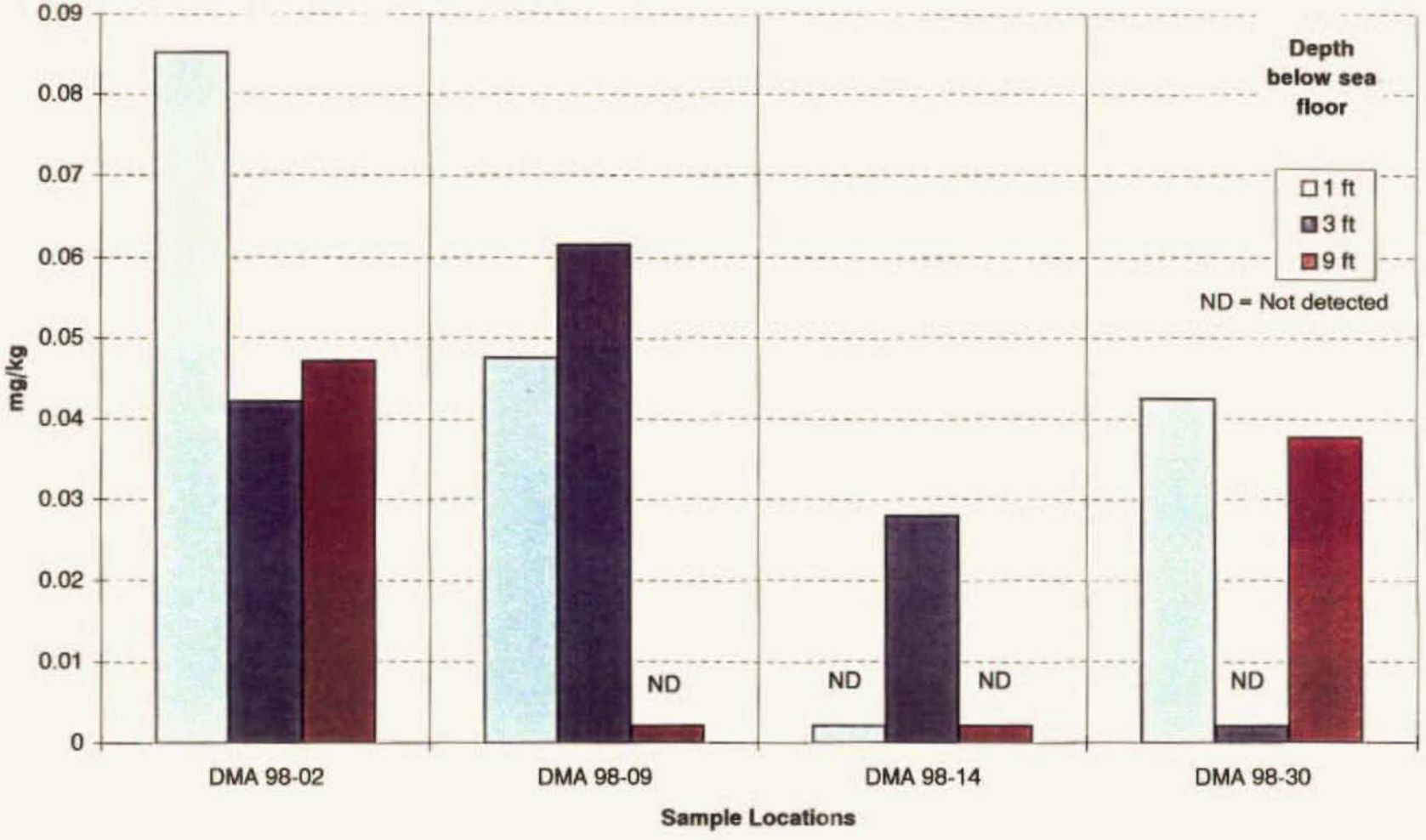


Figure 7
Grain Size Distribution

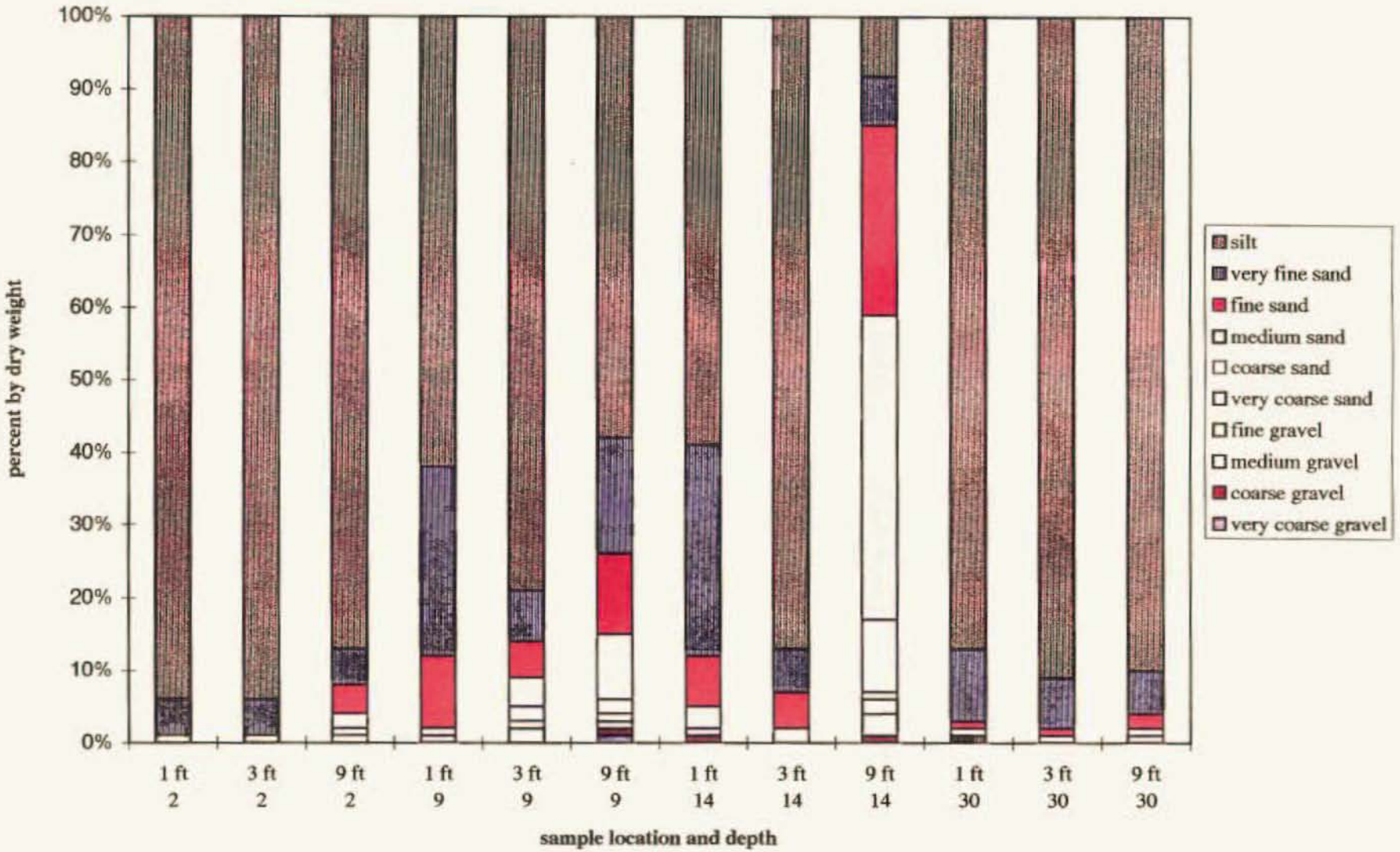


Figure 8
Grain Size Distribution by Sample Location
Sorted by Depth

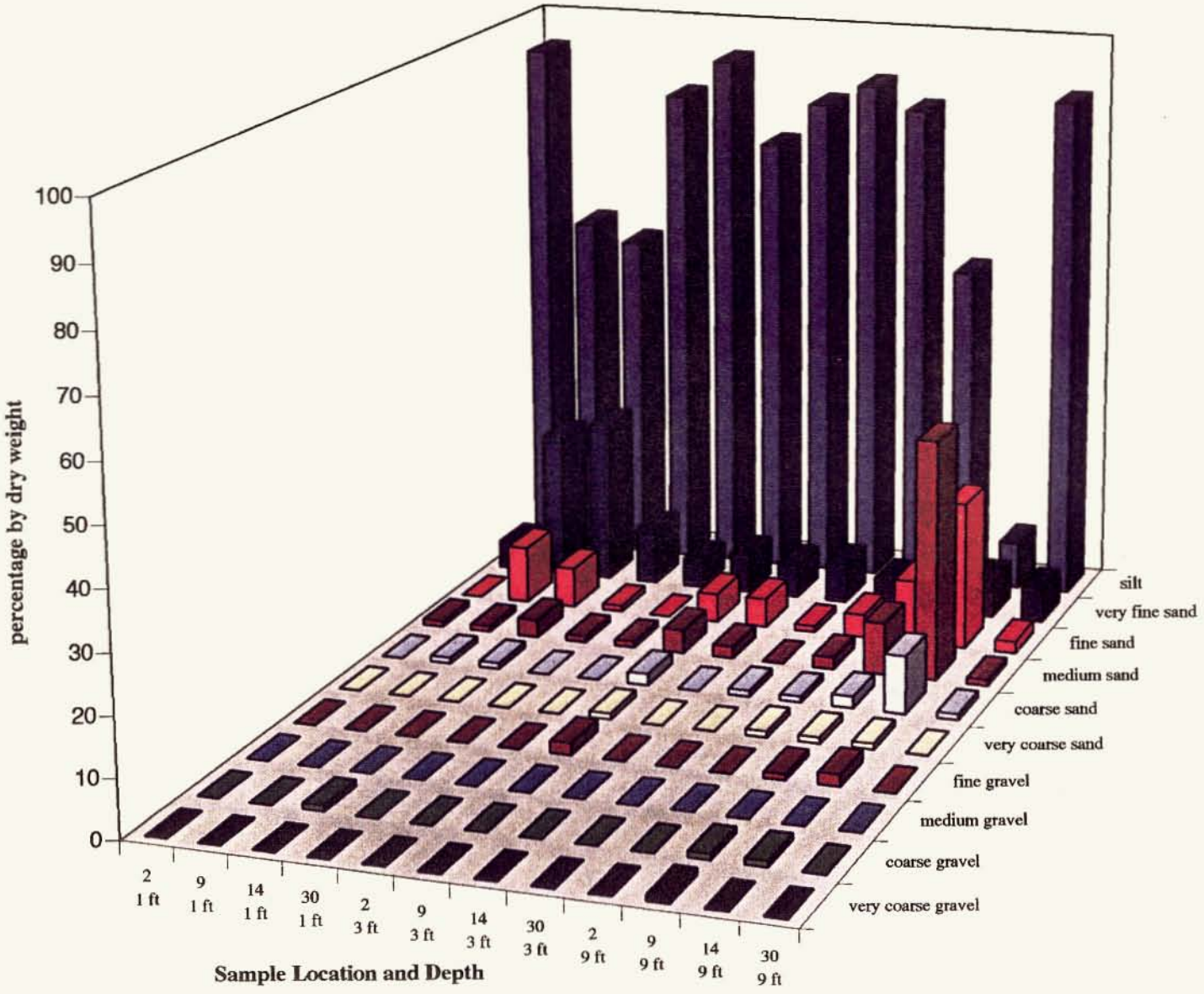
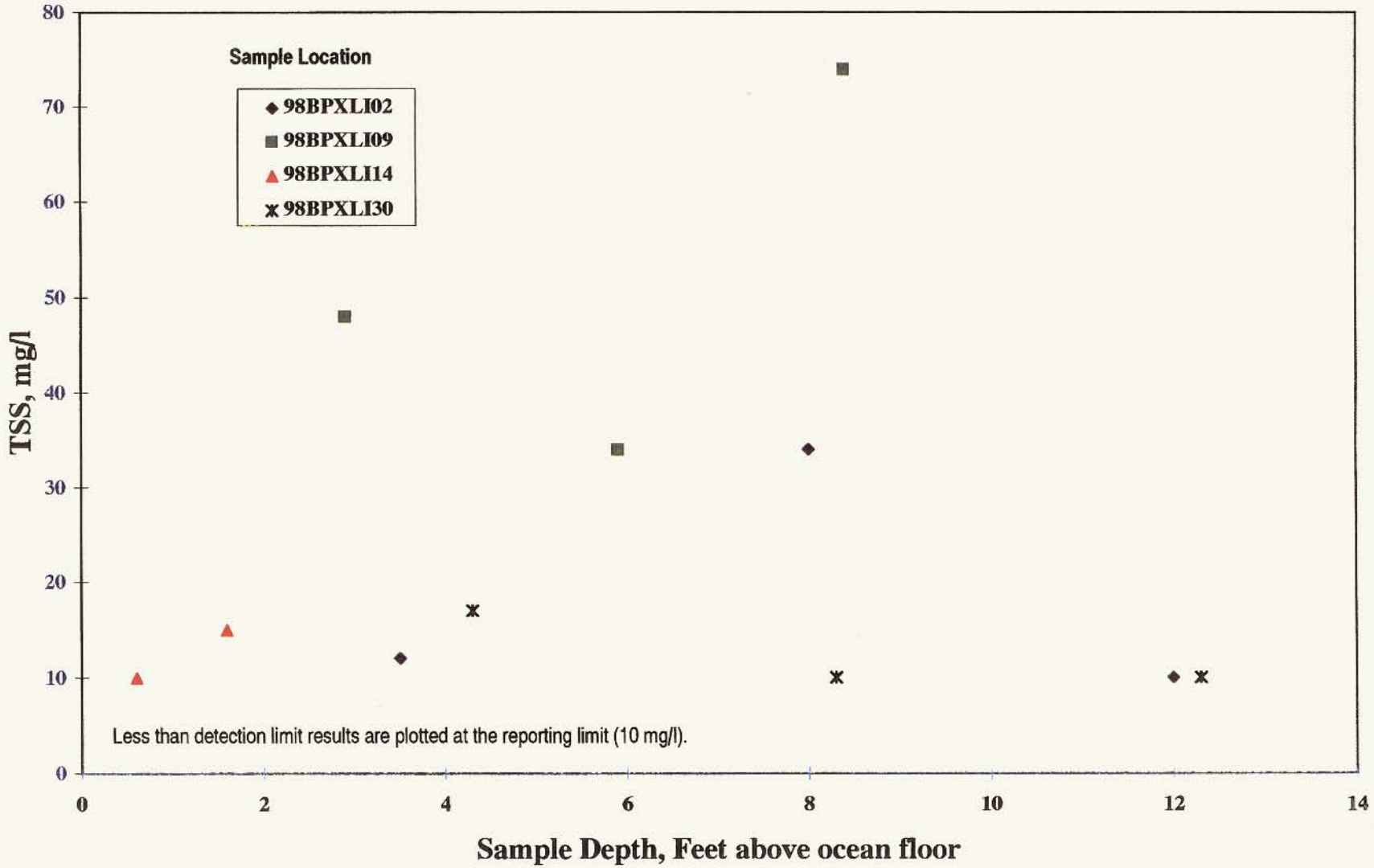


Figure 9
Total Suspended Solids by Water Depth



9/3/98

T LE 1
Sample Plan Checklist
Liberty Island Pipeline Routes
Water and Sediment Sampling

						MATRIX		FIELD PARAMETER						ANALYTICAL PARAMETERS								
Sample Identification	Borehole Number	Latitude	Longitude	Date	Time	Soil/Sediment	Sea Water	Temperature	Conductivity	Salinity	pH	Turbidity	Dissolved Oxygen	Total Suspended Solids (EPA 160.2)	BOD5/Turbidity	VOC (EPA 8260)	SVOC (EPA 8270)	TOC(415.1)	Mercury (EPA 7471)	Metals (EPA 6020)	Particle Size (ASTM D2487)	Grain Size (ASTM D442)	Field Duplicate
[redacted]																							
98BPXLI02SD1 (01)	DMA 98-2	70 16 38	147 33 31	3/18/98	2210	X										X	X	X	X	X	X	X	
98BPXLI02SD2 (03)	DMA 98-2	70 16 38	147 33 31	3/18/98	2230	X										X	X	X	X	X	X	X	
98BPXLI02SD62 (03)	DMA 98-2	70 16 38	147 33 31	3/18/98	2220	X										X	X	X	X	X	X	X	X
98BPXLI02SD3 (09)	DMA 98-2	70 16 38	147 33 31	3/18/98	2330	X										X	X	X	X	X	X	X	
[redacted]																							
98BPXLI09SD1 (01)	DMA 98-9	70 15 11	147 36 07	3/18/98	1610	X										X	X	X	X	X	X	X	
98BPXLI09SD2 (03)	DMA 98-9	70 15 11	147 36 07	3/18/98	1620	X										X	X	X	X	X	X	X	
98BPXLI09SD3 (09)	DMA 98-9	70 15 11	147 36 07	3/18/98	1630	X										X	X	X	X	X	X	X	
[redacted]																							
98BPXLI14SD01 (01)	DMA 98-14	70 13 43	147 38 45	3/18/98	1330	X										X	X	X	X	X	X	X	
98BPXLI14SD02 (03)	DMA 98-14	70 13 43	147 38 45	3/18/98	1345	X													X				
98BPXLI14SD03 (09)	DMA 98-14	70 13 43	147 38 45	3/18/98	1400	X										X	X	X	X	X	X	X	
[redacted]																							
98BPXLI30SD01 (01)	DMA 98-30	70 16 54	147 34 10	3/18/98	0250	X										X	X	X	X	X	X	X	
98BPXLI30SD02 (03)	DMA 98-30	70 16 54	147 34 10	3/18/98	0300	X										X	X	X	X	X	X	X	
98BPXLI30SD62 (03)	DMA 98-30	70 16 54	147 34 10	3/18/98	0310	X										X	X	X	X	X	X	X	X
98BPXLI30SD03 (09)	DMA 98-30	70 16 54	147 34 10	3/18/98	0330	X										X	X	X	X	X	X	X	

Table 2
Water Quality Parameters
Liberty Island Pipeline Route
Water and Sediment Sampling

Station	Sample	Borehole Number	Date	Time	Depth to Water Surface (BTI) (ft)	Depth to Bottom (BTI) (ft)	Total Water Depth (ft)	Ice Thickness (ft)	Ice Free Water Depth (ft)	Sample Depth (BTI) (ft)	Temp (°C)	Salinity[2] (ppt)	Calculated Seawater Density (kg/m^3)	Conductivity (umho's)	pH	Dissolved Oxygen (mg/l)	Field Turbidity (NTU)
98BPXLI09	WA01	DMA 98-09	3/18/98	1610	1.0	17	16	5.2	11.8	8.6	-2	32	1025.7	25050	7.4	7.7	13.3
98BPXLI09	WA02	DMA 98-09	3/18/98	1540	1.0	17	16	5.2	11.8	11.1	-2	32	1025.7	25050	7.2	8.5	8.4
98BPXLI09	WA03	DMA 98-09	3/18/98	1550	1.0	17	16	5.2	11.8	14.1	-2	32	1025.7	25050	6.9	7.4	12.5
98BPXLI30	WA01	DMA 98-30	3/19/98	120	1.2	21.1	19.9	4.9	16.2	8.8	-2	33	1026.6	26500	7.3	9.6	8.4
98BPXLI30	WA02	DMA 98-30	3/19/98	140	1.2	21.1	19.9	4.9	16.2	12.8	-2	33	1026.6	26000	7.6	9.7	11.7
98BPXLI30	WA03	DMA 98-30	3/19/98	200	1.2	21.1	19.9	4.9	16.2	16.8	-2	33	1026.6	26000	7.6	9.6	12.8

BTI = Below Top of Ice

Note:

1. Millero, F.J. and A. Poisson. 1981. International one-atmosphere equation of state of sea water. Deep- Sea Research, Vol. 28A, No. 6. p. 625-626
2. Salinity in Parts Per Thousand (ppt) converted from percent (%)

Table 2
Water Quality Parameters
Liberty Island Pipeline Route
Water and Sediment Sampling

Station	Sample	Sample Depth (BTI) (ft)	Sample Depth above Ocean Floor (ft)	BOD5	Lab Turbidity (NTU)	Total Organic Carbon (mg/L)	Total Suspended Solids (TSS) (mg/l)	Arsenic (mg/L)	Barium (mg/L)	Chromium (mg/L)	Lead (mg/L)	Mercury (mg/L)
98BPXLI09	WA01	8.6	8.4	<1	11	1.2	74	<.02	0.0200	<.01	<.01	<.0002
98BPXLI09	WA02	11	5.9	<1	7	1.2	34	<.02	0.0218	<.01	<.01	<.0002
98BPXLI09	WA03	14	2.9	<1	11	1.2	48	0.0202	0.0254	<.01	<.01	<.0002
98BPXLI30	WA01	8.8	12	<1	0	1.7	< 10	0.0206	0.0179	<.01	<.01	<.0002
98BPXLI30	WA02	13	8.3	<1	0	1.2	10	0.0226	0.0175	<.01	<.01	<.0002
98BPXLI30	WA03	17	4.3	<1	6	1.2	17	0.0213	0.0195	<.01	<.01	<.0002

BTI = Below Top of Ice

TABLE 3
Grain Size Results
Liberty Island Pipeline Routes
Water and Sediment Sampling
(all data are % by dry weight)

Sample Identification	Borehole Location	Depth (ft.)	Medium gravel (4.75 mm) No. 4	Fine Gravel (2.00 mm) No. 10	Very Coarse Sand (0.850 mm) No. 20	Coarse Sand (0.425 mm) No. 40	Medium Sand (0.250 mm) No. 60	Fine Sand (0.106 mm) No. 100	Very Fine Sand (0.075 mm) No. 200	Engineering Class	Frost Class
98BPXLI02SD01 (1.0)	DMA 98-2	0.5-1 ft.	100	100	100	100	99	99	94	Silt, ML	F4
98BPXLI02SD02 (3.0)	DMA 98-2	2-3 ft.	100	100	100	100	99	99	94	Silt, ML	F4
98BPXLI02SD03 (9.0)	DMA 98-2	8-9 ft.	100	100	99	98	96	92	87	Silt, ML	F4
98BPXLI09SD02 (1.0)	DMA 98-9	0.5-1 ft.	100	100	100	99	98	88	62	Silt, ML	F4
98BPXLI09SD02 (3.0)	DMA 98-9	2-3 ft.	100	98	97	95	91	86	79	Silt w/Sand	F4
98BPXLI09SD03 (9.0)	DMA 98-9	8-9 ft.	98	97	96	94	85	74	58	Sandy Silt, ML	F4
98BPXLI14SD01 (1.0)	DMA 98-14	0.5-1 ft.	99	99	99	98	95	88	59	Sandy Silt	F4
98BPXLI14SD02 (3.0)	DMA 98-14	2-3 ft.	100	100	100	100	98	93	87	Silt, ML	F4
98BPXLI14SD03 (9.0)	DMA 98-14	8-9 ft.	96	94	93	83	41	15	83	SP-SM	N/A
98BPXLI30SD01 (1.0)	DMA 98-30	0.5-1 ft.	99	99	99	99	98	97	87	Silt, ML	F4
98BPXLI30SD02 (3.0)	DMA 98-30	2-3 ft.	100	100	100	99	99	98	91	Silt, ML	F4
98BPXLI30SD03 (9.0)	DMA 98-30	8-9 ft.	100	100	100	99	98	96	90	Fat Clay, CH	F4

All Samples = PI (Non Plastic)

TABLE 4
Summary of Analytical Results and Benchmark Criteria
Liberty Island Pipeline Routes
Water and Sediment Sampling
(all data are % by dry weight)

			Project Values and Statistics							PSDDA Criteria				EPA Region IX	
	Analyte	units	Minimum lab detection limit	Minimum report detection limit	Minimum result	Maximum result	Average result (includes 0 for ND)	STDEV	Coefficient of Variation	MDS for PSDDA	Screening Level	Bioaccumulation Level	Maximum Level	Risk Based Concentrations (RBC)	Ecotox Effects Range Low (ERL)
Soil															
Percent Moisture		PERCENT	0.0000	0.000	18	41	28.728	5.947	20.703	0.1	--	--	--	--	--
Total Metals (SW6020 & SW7471)															
	Arsenic	MG/KG	0.1186	0.250	3.3052	11.2429	5.506	2.123	38.560	2.5	57	507.1	700	23	8.2
	Barium	MG/KG	0.0275	0.125	23.4768	86.1714	44.824	14.668	32.723	--	--	--	--	5,500	--
	Chromium	MG/KG	0.1073	0.250	5.4262	27.4382	12.229	5.000	40.890	--	--	--	--	78,000	81
	Lead	MG/KG	0.0062	0.125	2.2282	13.8598	5.358	2.777	51.824	0.5	66	--	660	660	47
	Mercury	MG/KG	0.0037	0.025	ND	0.0852	0.035	0.028	77.617	0.02	0.21	1.5	2.1	2.1	0.15
Volatile Organic Compounds (SW8260a)															
	1,2-Dichlorobenzene	UG/KG	2.000	2.000	ND	ND	0	0	0	3.2	19	37	350	7,000,000	340 (2)
	1,3-Dichlorobenzene	UG/KG	2.0000	2.000	ND	ND	0	0	0	3.2	170	1241	--	7,000,000	1,700 (2)
	1,4-Dichlorobenzene	UG/KG	2.000	2.000	ND	ND	0	0	0	3.2	26	190	260	27,000	350 (2)
	1,2,4-Trichlorobenzene	UG/KG	6.000	6.000	ND	ND	0	0	0	6	13	--	64	780,000	--
	Ethylbenzene	UG/KG	2.0000	2.000	ND	ND	0	0	0	3.2	10	27	50	7,800,000	3,600 (2)
	Hexachlorobenzene (SW8081) (1)	UG/KG	2.0000	2.000	ND	ND	0	0	0	12	23	168	230	--	--
	Tetrachloroethene	UG/KG	2.0000	2.000	ND	ND	0	0	0	3.2	14	102	210	12,000	530 (2)
	Trichloroethene	UG/KG	2.0000	2.000	ND	ND	0	0	0	3.2	160	1168	1600	58,000	1,600 (2)
	Xylenes	UG/KG	2.0000	2.000	ND	ND	0	0	0	3.2	12	--	160	320,000	--
Semi-volatile Organic Compounds (SW8270a)															
	Acenaphthene	UG/KG	21.000	21.000	ND	ND	0	0	0	20	63	--	630	4,700,000	1,100 (2)
	Acenaphthylene	UG/KG	19.000	19.000	ND	ND	0	0	0	20	64	--	640	--	--
	Anthracene	UG/KG	22.000	22.000	ND	ND	0	0	0	20	130	--	1300	23,000,000	--
	bis-(2-ethylhexyl)phthalate	UG/KG	31.000	31.000	46	560	189.4286	164.4996	86.84	20	3100	13870	--	46,000	--
	Benzo(a)anthracene	UG/KG	27.000	27.000	ND	ND	0	0	0	20	450	--	4500	880	--
	Benzo(a)pyrene	UG/KG	23.000	23.000	ND	92	6.5714	24.5880	374.17	20	680	4964	6800	88	430 (2)
	Benzo(b)fluoranthene	UG/KG	29.000	29.000	ND	ND	0	0	0	20	800	--	8000	880	--
	Benzo(k)fluoranthene	UG/KG	36.000	36.000	ND	ND	0	0	0	20	800	--	8000	8,800	--
	Benzo(g,h,i)perylene	UG/KG	37.000	37.000	ND	ND	0	0	0	20	540	--	5400	--	--

T, . .E 4
Summary of Analytical Results and Benchmark Criteria
Liberty Island Pipeline Routes
Water and Sediment Sampling
(all data are % by dry weight)

		Project Values and Statistics							PSDDA Criteria				EPA Benchmarks	
Analyte	units	Minimum lab detection limit	Minimum report detection limit	Minimum result	Maximum result	Average result (includes 0 for ND)	STDEV	Coefficient of Variation	MDS for PSDDA	Screening Level	Bioaccumulation Level	Maximum Level	Risk Based Concentrations (RBC)	Ecotox Effects Range Low (ERL)
Soil 8 (continued)														
Semi-volatile Organic Compounds (SW8270a) (continued)														
Benzoic acid	UG/KG	150.000	150.000	ND	ND	0	0	0	100	400	--	690	310,000,000	--
Benzyl alcohol	UG/KG	32.000	32.000	ND	ND	0	0	0	6	25	--	73	23,000,000	--
Benzyl butyl phthalate	UG/KG	37.000	37.000	ND	ND	0	0	0	20	470	--	--	16,000,000	11,000 (2)
Chrysene	UG/KG	27.000	27.000	ND	ND	0	0	0	20	670	--	6700	88,000	--
Dibenzo(a,h)anthracene	UG/KG	38.000	38.000	ND	ND	0	0	0	20	120	--	1200	88	--
Dibenzofuran	UG/KG	21.000	21.000	ND	ND	0	0	0	20	54	--	540	310,000	2,000 (2)
Diethyl Phthalate	UG/KG	49.000	49.000	ND	ND	0	0	0	20	97	--	--	63,000,000	630 (2)
2,4-Dimethylphenol	UG/KG	19.000	19.000	ND	ND	0	0	0	6	29	--	50	--	--
Dimethyl phthalate	UG/KG	42.000	42.000	ND	ND	0	0	0	20	160	1168	--	780,000,000	--
Di-n-butyl phthalate	UG/KG	29.000	29.000	ND	ND	0	0	0	20	1400	10220	--	7,800,000	11,000 (2)
Di-n-octyl phthalate	UG/KG	35.000	35.000	ND	ND	0	0	0	20	6200	--	--	1,600,000	--
Fluoranthene	UG/KG	23.000	23.000	ND	ND	0	0	0	20	630	4600	6300	3,100,000	1,400 (2)
Fluorene	UG/KG	24.000	24.000	ND	ND	0	0	0	20	64	--	640	3,100,000	540 (2)
Hexachlorobutadiene (SW8081) (1)	UG/KG	2.000	2.000	ND	ND	0	0	0	20	29	212	290	8,200	--
Hexachloroethane	UG/KG	23.000	23.000	ND	ND	0	0	0	20	1400	10220	14000	46,000	1,000 (2)
Indeno(1,2,3-cd)pyrene	UG/KG	36.000	36.000	ND	ND	0	0	0	20	69	--	5200	880	--
2-Methylnaphthalene	UG/KG	20.000	20.000	ND	31	5.7857	11.5770	200.1	20	67	--	670	--	--
2-Methylphenol (o-Cresol)	UG/KG	20.000	20.000	ND	ND	0	0	0	6	20	--	72	3,900,000	--
4-Methylphenol (p-Cresol)	UG/KG	22.000	22.000	ND	280	31.6429	75.2898	237.94	20	120	--	1200	--	--
Naphthalene	UG/KG	21.000	21.000	ND	ND	0	0	0	20	210	--	2100	3,100,000	480 (2)
n-Nitrosodiphenylamine	UG/KG	25.000	25.000	ND	ND	0	0	0	12	28	161	220	130,000	--
Pentachlorophenol	UG/KG	35.000	35.000	ND	ND	0	0	0	61	100	504	690	5,300	--
Phenanthrene	UG/KG	24.000	24.000	ND	33	8.8571	14.5964	164.8	20	320	--	3200	--	1,100 (2)
Phenol	UG/KG	19.000	19.000	ND	38	2.7143	10.1559	374.17	20	120	876	1200	47,000,000	--
Pyrene	UG/KG	29.000	29.000	ND	ND	0	0	0	20	430	--	7300	2,300,000	660 (2)
Total Organic Carbon (TOC) (E415.1)	MG/KG	0.100	0.1	0.42	6.5	2.3057	1.6941	73.476	0.1	--	--	--	--	--

T. .4

Summary of Analytical Results and Benchmark Criteria
Liberty Island Pipeline Routes
Water and Sediment Sampling
(all data are % by dry weight)

	Analyte	units	Minimum lab detection limit	Minimum report detection limit	Minimum result	Maximum result	Average result (includes 0 for ND)	STDEV	Coefficient of Variation	MDS for PSDDA	Screening Level	Bioaccumulation Level	Maximum Level	Risk Based Concentrations (RBC)	Ecotox Effects Range Low (ERL)
Water															
Total Metals (SW6020 & SW7470)															
	Arsenic	MG/L	0.0114	0.020	ND	0.0226	0.0097	0.0109	112.575	--	--	--	--	0.011	0.036
	Barium	MG/L	0.0013	0.010	0.0175	0.0551	0.0252	0.0098	38.932	--	--	--	--	2.6	--
	Chromium	MG/L	0.0084	0.010	ND	ND	0	0	0	--	--	--	--	--	--
	Lead	MG/L	0.0007	0.010	ND	ND	0	0	0	--	--	--	--	--	0.0081
	Mercury	MG/L	0.0001	0.000	ND	ND	0	0	0	--	--	--	--	0.023	0.0011
Suspended Solids (E160.2)		MG/L	10.0000	10.000	ND	74	21.0769	21.4727	101.88	--	--	--	--	--	--
Total Organic Carbon (TOC) (E415.1)		MG/L	0.5000	0.500	1.1	1.7	1.3231	0.1833	13.852	--	--	--	--	--	--

Symbols

--	Not Applicable or Not Available	MG/KG	milligrams / kilogram
UG/KG	micrograms / kilogram	MG/L	milligrams / liter
		ND	not detected above the reporting limit

Footnotes

(1) Analyzed with an alternate method to achieve lower detection limits for comparison to PSDDA criteria.

(2) Ecotox value assumes the fraction of carbon in salt water sediments is 1%.

APPENDIX A
Field Notes and Logs

Montgomery Watson

BP Exploration (Alaska), .
LIBERTY ISLAND water/sediment samplir.
FIELD NOTE FORM

98-

Station No. 02 | Air Temp 1°F | Date 3/18/98
Wind 5e | Crew Thom Sadler, Tom Calkin, Gary Cormier, Ken Nalsteo
Sky clear | Start Time 19:30

ICE/Datum Below Platform Decking | **Location**

a	Depth to Top of Ice	4.7	Description	Liberty Island
b	Depth to Bottom of Ice	9.3		
c	Depth to Seafloor	26		
d	Ice Thickness	4.6	Latitude	70-16-38
e	Ice Free Water	21.3	Longitude	147-33-31
f	Depth to Water	5.3	Northing	5953376.54 ASP
g	Water Column	20.7	Easting	307357.18 ASP

ADD .7 feet to sounder reading

Water Column Profile (every 0.5 feet) Datum Below Platform Decking

Depth (feet)	Temp °C	EC uhmos	DO mg/L	pH	Turbidity HNU		Salinity ppm	Temp (oC) for salinity	
26	-2	7.600					33	-2	
25.5	-2	26mm					33		
25.0	-2	26mm					33		
24.5	-2	26mm					33		
24.0	-2	26mm					32		
23.5	-2	26mm					32		
23.0	-2	26mm					32		
22.5	-2	26mm	10.9	6.4	9.3		32		WA01
22.0	-2	26mm					32		
21.5	-2	26mm					32		
21.0	-2	26mm					32		
20.5	-2	26mm					32		
20.0	-2	26mm					32		
19.5	-2	26mm					32		
19.0	-2	26mm					32		
18.5	-2	26mm					32		
18.0	-2	25mm	8.7	6.3	7.16		32		WA 02
17.5	-2	25mm					32		
17.0	-2	26mm					32		

Water Sample(s) — add 1 foot to bomb depth measurement

	Depth	Time	Date	Methods
98BPXLI02WA01 Dup 101	14.0	21:00	3/18/97	Bomb Dup 21:10
98BPXLI02WA02	18.0	21:30	↓	Bomb
98BPXLI02WA03	22.5	22:00	↓	Bomb

Sediment Samples

	Depth	Time	Date	Methods
98BPXLI02SD01(01)	0-1	22:10	3/18/97	SS.
98BPXLI02SD02(03)	2-3	22:30		
98BPXLI02SD03(06)	8-9	23:30		
Duplicate 98BPXLI02SD02(08)	0-1	22:20	↓	↓

Comments

Meters used:
YSI 300, T-C-L STD. 1413
HACH 2100P, Turbidimeter 5.10NTU STD reads 5.20 NTU
HACH, Colorimeter, DO , LR
YSI 33, S-T-L-pH , STD. 1413
Beckman φ11 pHmeter , STD. 487

Montgomery Watson

BP Exploration (Alaska), Inc.
LIBERTY ISLAND water/sediment sampling
FIELD NOTE FORM

pg 2 of 2

Station No. 98-02 | Air Temp | | Date | 3-18-98
Wind | | Crew |
Sky | | Start Time |

ICE: Datum Below Platform Decking | Location

a	Depth to Top of Ice	4.7	Description	
b	Depth to Bottom of Ice	9.3		
c	Depth to Seafloor	26		
d	Ice Thickness		Latitude	
e	Ice Free Water		Longitude	
f	Depth to Water		Northing	
g	Water Column		Easting	

ADD .7 feet to sounder reading

Water Column Profile (every 0.5 feet): Datum Below Platform Decking

Depth (feet)	Temp °C	EC uhmos	DO mg/L %	pH	Turbidity HNU		Salinity ppm	Temp (oC) for salinity	
16.5	-2	26000					32	-2	
16.0	-2	26000					32		
15.5	-2	26000					32		
15.0	-2	26000					32		
14.5	-2	26000					32		
14.0	-2	26000	9.1	6.6	6.12		32		WA01
13.5	-2	26000					32		
13.0	-2	26000					32		
12.5	-2	26000					32		
12.0	-2	26000					32		
11.5	-2	26000					32		
11.0	-2	26000					32		
10.5	-2	26000					32		
10.0	-2	26000					32		
9.5	-2	26000					32	↓	

Water Sample(s) — add 1 foot to bomb depth measurement

	Depth	Time	Date	Methods
98BPXLI___WA01				
98BPXLI___WA02				
98BPXLI___WA03				

Sediment Samples

	Depth	Time	Date	Methods
98BPXLI___SD01(01)				
98BPXLI___SD02(03)				
98BPXLI___SD03(06)				
Duplicate 98BPXLI___SD6__1(01)				

Comments

Meters used: YSI 300, T-C-L
HACH 2100P, Turbidimeter
HACH, Colorimeter, DO
YSI 33, S-T-L-pH

Montgomery Watson

Pg 1 of 1

BP Exploration (Alaska), Inc.
LIBERTY ISLAND water/sediment sampling
FIELD NOTE FORM

98

Station No. 09 | Air Temp −29°F | Date 3-18-98
Wind 16 kn | Crew BGM / WP
Sky Clear | Start Time 1510 — 1700

ICE: Datum Below Platform Decking | **Location**

a	Depth to Top of Ice	4.4	Description	
b	Depth to Bottom of Ice	9.6		
c	Depth to Seafloor	21.4		
d	Ice Thickness	5.2	Latitude	70-16-38
e	Ice Free Water	13.2	Longitude	147-33-31
f	Depth to Water	5.4	Northing	5953376.54
g	Water Column	14.2	Easting	307397.18

ADD .7 feet to sounder reading

Water Column Profile (every 0.5 feet): Datum Below Platform Decking

Depth (feet)	Temp °C	EC uhmos	DO mg/l %	pH	Turbidity HNU		Salinity ppm	Temp (oC) for salinity	
21.0	−2°	25050			Field		32	−2.0	
20.5	"	"					"		
20.0	"	"					"		
19.5	"	"					"		
19.0	"	"					"		
18.5	"	"	7.4	6.9	12.5		"		WA-03
18.0	"	"					"		
17.5	"	"					"		
17.0	"	"					"		
16.5	"	"					"		
16.0	"	"					"		
15.5	"	"	8.5	7.2	8.4		"		WA 02
15.0	"	"					"		
14.5	"	"					"		
14.0	"	"					"		
13.0	"	"	7.7	7.4	13.3		"	−2.0	WA 01
12.0	"	"					"	−2.5	
11.0	"	"					"	−2.4	
10.0	"	"					"	−2.4	

Water Sample(s) — add 1 foot to bomb depth measurement

	Depth	Time	Date	Methods
98BPXLI 09 WA01	13.0	1530	3-18	"Bomb" pt source Sampler
98BPXLI 09 WA02	15.5	1540	3-18	"
98BPXLI 09 WA03	18.5	1550	3-18	"

Sediment Samples

	Depth	Time	Date	Methods
98BPXLI 09 SD01(01)	.5-1	1610	3-18	SS, 18" x 4"
98BPXLI 09 SD02(03)	2-3	1620	3-18	↓
98BPXLI 09 SD03(04)	8-9	1630	3-18	↓
Duplicate 98BPXLI SD6 1(01) N/A				

Comments

Meters used:
YSI 3006T-C-L, 1413 STD ⇒ 1445
HACH 2100P, Turbidimeter, 53.1 ⇒ 53.4
HACH, Colorimeter, DO, LR
YSI 33, S-T-L-pH 1413 STD ⇒ 1441
Beckman 11, pH, STD 4 & 7
Decon complete

BGM

Montgomery Watson

98-

Pg 1 of 1

BP Exploration (Alaska), Inc.
LIBERTY ISLAND water/sediment sampling
FIELD NOTE FORM

Station No. 14 | Air Temp -35 | Date 3-18-98
Wind 15-20Kn | Crew BJM
Sky clear | Start Time 1215

ICE: Datum Below Platform Decking | **Location**

a	Depth to Top of Ice	4.3	Description	
b	Depth to Bottom of Ice	9.4		
c	1.4 Depth to Seafloor	12.		
d	Ice Thickness	5.1	Latitude	70-13-43
e	Ice Free Water	3.3	Longitude	147-38-45
f	Depth to Water	5.7	Northing	5935509.00
g	Water Column	3.3	Easting	2960880.00

ADD .7 feet to sounder reading

Water Column Profile (every 0.5 feet) Datum Below Platform Decking

Depth (feet)	Temp °C	EC uhmos	DO mg/L	pH	Turbidity HNU		Salinity ppm	Temp (oC) for salinity	
10.0	-1	24000	—	—	—		28	-1.8	
10.5	-1	24000	11.0	6.7	17.6		28	-1.0	← WA01
11.5	-.5	24000	—	—	—		27	-0.5	← WA02
12.0	0	24000	10.4	6.9	17.6		27	-0.5	

Water Sample(s) add 1foot to bomb depth measurement

	Depth	Time	Date	Methods
98BPXLI 14 WA01	10.2	1300	3-18	Bomb, Pt. Source Sampler
98BPXLI 14 WA02	11.8	1315	3-18	Bomb
98BPXLI WA03	N/A			

Sediment Samples

	Depth	Time	Date	Methods
98BPXLI 14 SD01(01)	5-7	1330	3-18	SS 18" x 4"
98BPXLI 14 SD02(03)	7-8	1345	3-18	↓
98BPXLI 14 SD03(09)	8-9	1400	3-18	↓
Duplicate 98BPXLI SD6_1(01)				

Comments

Meters used: YSI 3000T-C-L 1413 STD
HACH 2100P, Turbidimeter, 53.1 ⇒ 53.9 Beckman 11, pH 7 & 4 STD.
HACH, Colorimeter, DO, LR
YSI 33, S-T-L-pH,
Beckman 11, pH, STD. 4 & 7 used
Dacon completed

BJM

Montgomery Watson

BP Exploration (Alaska), Inc.
LIBERTY ISLAND water/sediment sampling
FIELD NOTE FORM

Pg 1 of 2

Station No. 98-30

Air Temp	-3°F	Date	3/19/98
Wind	7E	Crew	Shawn Sadlon
Sky	Clear	Start Time	00:30

ICE - Datum Below Platform Decking

a	Depth to Top of Ice	4.7	
b	Depth to Bottom of Ice	9.6	
c	Depth to Seafloor	25.8	
d	Ice Thickness	4.9	
e	Ice Free Water	16.2	
f	Depth to Water	5.5	
g	Water Column	20.3	

ADD .7 feet to sounder reading

Location

Description: Liberty Island

70 16 38.670 N 147 34 10.662 W

Latitude	70-16-54
Longitude	147-34-10
Northing	5955095 ASP
Easting	306049

Water Column Profile (every 0.5 feet) - Datum Below Platform Decking

Depth (feet)	Temp °C	EC uhmos	DO mg/l %	pH	Turbidity HNU		Salinity ppm	Temp (oC) for salinity
25.5	-2	27000					33	-2
25.0	-2	27000					33	
24.5	-2	26000					33	
24.0	-2	26000					33	
23.5	-2	26000					33	
23.0	-2	26000					33	
22.5	-2	26000					33	
22.0	-2	26000					33	
21.5	-2	26000	8.6/96	7.59/7.59	9.4/12.8		33	
21.0	-2	26000					33	
20.5	-2	26000					33	
20.0	-2	26000					33	
19.5	-2	26000					33	
19.0	-2	27000					33	
18.5	-2	27000					33	
18.0	-2	26000					33	
17.5	-2	26000	10.5/9.7	7.51/7.56	7.0/11.7		33	
17.0	-2	27000					33	
16.5	-2	26500					33	V

Water Sample(s) — add .6 foot to bomb depth measurement

	Depth Ft	Time	Date	Methods
98BPXLI30 WA01	13.5	01:20	3/19/98	
98BPXLI30 WA02 #02	17.5	01:40	"	Dup #01:50
98BPXLI30 WA03	21.5	02:00	"	

Sediment Samples

	Depth	Time	Date	Methods
98BPXLI30 SD01(01)	0-1	02:50	3/19/98	
98BPXLI30 SD02(03)	2-3	03:00	"	
98BPXLI30 SD03(06)	8-9	03:30	"	
Duplicate 98BPXLI30 SD02(03)	2-3	03:10	"	

Comments

Meters used:
YSI 3000T-C-L
HACH 2100P, Turbidimeter
HACH, Colorimeter, DO, LR
YSI 33, S-T-L-pH

Montgomery Watson

BP Exploration (Alaska), Inc.
LIBERTY ISLAND water/sediment sampling
FIELD NOTE FORM

pg 2 of 2

Station No. 96-30 | Air Temp | | Date | |
Wind | | Crew | |
Sky | | Start Time | |

ICE - Datum Below Platform Decking | **Location**

a	Depth to Top of Ice		Description	
b	Depth to Bottom of Ice			
c	Depth to Seafloor			
d	Ice Thickness		Latitude	
e	Ice Free Water		Longitude	
f	Depth to Water		Northing	
g	Water Column		Easting	

ADD .7 feet to sounder reading

Water Column Profile (every 0.5 feet) - Datum Below Platform Decking

Depth (feet)	Temp °C	EC uhmos	DO %	pH	Turbidity HNU		Salinity ppm	Temp (oC) for salinity	
16.0	-2	26000					33	-2	
15.5	-2	26500					33		
15.0	-2	26500					33		
14.5	-2	27000					33		
14.0	-2	26000					33		
13.5	-2	26500	9.6	7.26	8.36		33		
13.0	-2	26000					33		
12.5	-2	26000					33		
12.0	-2	26500					33		
11.5	-2	26000					33		
11.0	-2	26000					33		
10.5	-2	26000					33		
10.0	-2	26500					33		
9.5	-2	26000					33		

Water Sample(s) add 1 foot to bomb depth measurement

	Depth	Time	Date	Methods
98BPXLI___WA01				
98BPXLI___WA02				
98BPXLI___WA03				

Sediment Samples

	Depth	Time	Date	Methods
98BPXLI___SD01(01)				
98BPXLI___SD02(03)				
98BPXLI___SD03(06)				
Duplicate 98BPXLI___SD6__1(01)				

Comments

Meters used: YSI 300, T-C-L
HACH 2100P, Turbidimeter
HACH, Colorimeter, DO
YSI 33, S-T-L-pH

Duane Miller & Associates
Arctic & Geotechnical Engineering
FIELD LOG

Project: LIBERTY Hole No. SB-02
Job No. 4119.33 Total Depth 9.5'
Sheet 1 of
Contractor: [illegible] Operator [illegible] Logged By [illegible]

Location of Hole LIBERTY SB-02 (MW)

4.7' DELL TO ICE
9.3' DELL TO BOTTOM ICE
21.0' DELL TO MUD
Conditions -1°F, SE, CLEAR

Rig Type [illegible]
Sampling Methods 4" SS
Hammer Wt. and Drop 340# 30"
Hammer Type MANUAL AUTOMATIC
Started TIME 7:43 PM DATE 3/9/98
Completed TIME 11:23 PM DATE 3/10/98

Hole Depth (Ft)				
Casing Depth (Ft)				
Water Depth (Ft)				
Time				
Date				

Surface Elevation _____ Datum _____
Instrumentation WELL Date
Backfilled TIME NA DATE _____ BY _____

Sample No.	Sample Depth	Sampler Type	Blows / 6-in.	Inches Driven	Inches Recovered	Depth in Feet	Sample	Graphic Log	Frozen?
	0.0	MW	0	18	18	1			
	2.0	MW	3/10"	18		2			
						3			
						4			
						5			
						6			
						7			
	8.0	MW	0	18	18	8			
			3			9			
			5						
						10			
						11			

0.0' - dark gray to blue SILT (ML), scattered bivalve shells, color change @ 1.2' to gray. Weight of hammer caused sample to penetrate, no blows. Sample retained in MW.

3.0' - gray SAND, (SP) w/ trace SILT, fine grained, loose. Sample retained by MW.

8.0' - gray SILT (ML) w/ trace CLAY, soft. 8.0' to 8.4' brown ORGANICS w/ trace gray SILT. Sample retained by MW. Organics amorphous, odiferous. BOH @ 9.5' @ 2323 3/10/98. No PVC.

DMA 98-[illegible]

Duane Miller & Associates
Arctic & Geotechnical Engineering
FIELD LOG

Project: LIBERTY
Hole No. M-2
Job No. [illegible]
Total Depth 9.5
Sheet 1 / 1
Contractor: [illegible]
Operator [illegible]
Logged By [illegible]

Location of Hole [illegible]
St. 104+[illegible]

Rig Type [illegible]
Sampling Methods 3.5" [illegible]
Hammer Wt. and Drop 340# [illegible]
Hammer Type MANUAL AUTOMATIC ✓
Started TIME 3:15 PM DATE 18 MAR 98
Completed TIME 5:45PM DATE 19 MAR 98

Conditions [illegible] Ice 4.4, Ice 5.2, H_2O=11.8
[illegible]

Hole Depth (Ft)				
Casing Depth (Ft)				
Water Depth (Ft)				
Time				
Date				

Surface Elevation ~17.0 Datum [illegible]

Instrumentation NONE

Backfilled TIME N/A DATE ______ BY ______

Sample No.	Sample Depth	Sampler Type	Blows / 6-in.	Inches Driven	Inches Recovered	Depth in Feet	Graphic Log	Description
	0.0	SS	1	6	6			0.0 – 0.2 Brown Sand w/ [illegible]
		↓	1	6	6	1		0.2 – 0.5 Black organic Silt
			2	6	6			w/ organic pieces, wood & [illegible]
						2		0.5 – 2.3 Dark Gray Silt
	2.0	SS	1	6	6			2.3 – 3.0 Two layers of brown
			1	6	6	3		fibrous peat w/ [illegible] odor
			2	6	6			of decomposition – with 2"
						4		interbedded gray silt layer
								3.0 – 6.0 Dk Gray Silt
						5		
								driller: "Sand" @ 6 ft
						6		
								6.0 – 9.5 Interbedded
						7		Gray Sand and Dark Gray
								Silt
						8		
	8.0	SS	5	6				
			5	6		9		
			7	6	4			
						10	TD 9.5	
						11		

DMA 9814

Duane Miller & Associates
Arctic & Geotechnical Engineering
FIELD LOG

Project: LIBERTY Hole No. M-1 Sheet 1 of 1
Job No. 4116.73 Total Depth 9.5
Contractor: Discovery/CATO Operator Scott Logged By Phillips/Acimovic

Location of Hole 10 ft E of Loc DMA 98-14
Sta 207+87, 10'L
(Meteor 74+29, 3.3L)

Conditions Deck to ice 9A.' ice = 5.6' H2O 1½'
Deck to Mud 12A

Rig Type CME-75
Sampling Methods 3.5" solid stem auger + SS
Hammer Wt. and Drop 340 lbs, 30"
Hammer Type MANUAL AUTOMATIC
Started TIME 12:30 PM DATE 18 MAR 98
Completed TIME 2:30 PM DATE 18 MAR 98

Hole Depth (Ft)	9.5			
Casing Depth (Ft)	21.6			
Water Depth (Ft)	+7.7			
Time	1:00P			
Date	18 MAR			

Surface Elevation -7.7' Datum Mud surface
Instrumentation NONE Date

Backfilled TIME DATE BY

Sample No.	Sample Depth	Sampler Type	Blows/6in.	Inches Driven	Inches Recovered	Depth in Feet	Graphic Log
	0.0	SS	2	6	6	1	
			3	6	6		
			3	6	6		
	1.5	SS	1	6	6	2	
			2	6	6		
			4	6	6	3	
	8.0	SS	2	6	6	8	
			3	6	6		
			2	6	6	9	
						10	
						11	

0.0 - 0.5 Brown Sand, Sand is medium grained, well sorted (SP)
0.5 - 4.5 Dk Grey Silt
4.5 - 9.5 Grey Sand w/ scattered small pebbles

Project Liberty Hole No. M-1 Sheet 1 of 1

Duane Miller & Associates
Arctic & Geotechnical Engineering
FIELD LOG

Project: LIBERTY Hole No. 98-30 Sheet 1 of 1
Job No. 7115.2 Total Depth 9.5
Contractor: DISCOVERY #8 Operator CC Logged By CC

Location of Hole LIBERTY
98-30 (MW)

4.7' DEEP TO ICE
9.6' DEEP TO BOTTOM OF ICE
27.8' DEEP TO MUD
Conditions - 30°F, FE, CLEAR

Rig Type CME 75
Sampling Methods 4" SS
Hammer Wt. and Drop 340# 30"
Hammer Type MANUAL AUTOMATIC
Started TIME 12:10 PM DATE 3/19/98
Completed TIME 3:27 PM DATE 3/19/98

Hole Depth (Ft)				
Casing Depth (Ft)				
Water Depth (Ft)				
Time				
Date				

Surface Elevation _____ Datum _____

Instrumentation NONE Date

Backfilled TIME NA DATE BY

Sample No.	Sample Depth	Sampler Type	Blows / 6-in.	Inches Driven	Inches Recovered	Depth in Feet
	0.0	MW	0	18	12	1
			2			
			3			2
		MW	0	18	15	
			2			3
			5			
						4
						5
						6
						7
						8
	8.0	MW	2	18	16	
			3			9
			4			
						10
						11

Graphic Log: Sample | Frozen?

0.0'- open SILT (ML) w/ trace black amorphous ORGANICS & trace fine SAND, scattered pebble gravel, soft. Sample retained by MW. Weight of hammer used sampler 0' to 0.5'.

2.0'- open SAND (SM) w/ some SILT & 2 pieces subangular GRAVEL (0.6" & 1.5" ϕ)

2.7' to 2.9'- brown amorphous ORGANICS w/ interlayers of open SILT ± 0.2" thick.

2.9'- open SILT (ML) w/ some CLAY, soft. Sample retained by MW.

8.0'- open CLAY, firm. Sample retained by MW.

BOH @ 9.3' @ 0327 3/19/98. AB PIC

Project LIBERTY Hole No. 98-30 Sheet 1 of 1

F. Robert Bell and Associates
Surveyors / Engineers
Prudhoe Bay
Phone 659-5000/5005
FAX 659-5065

Transmittal Cover Sheet

Post-it™ brand fax transmittal memo 7671	# of pages ▸ 2
To BONNIE MCLEAN	From DUANE
Co. MW	Co.
Dept.	Phone #
Fax # 248-8884	Fax #

Date: March 24, 1998

To: Jeffrey Cotton
Fax: 564-5020
From: Steve Stoll
Subject: LIBERTY
Pages Following Cover: 1

THESE ARE THE REAL LOCATIONS DRILLED FOR YOU.

Comments:

Attached are two sheets with Liberty sketches.
The following are coords points you are interested in.

Current Zone: AK-3

>>Point number: 10201 DMA 98-30
Grid Northing: 5955095 Grid Easting: 306049
Convergence: -1-28-39 Scale factor: 0.999942732097
Latitude: 70-16-54 Longitude: 147-34-10

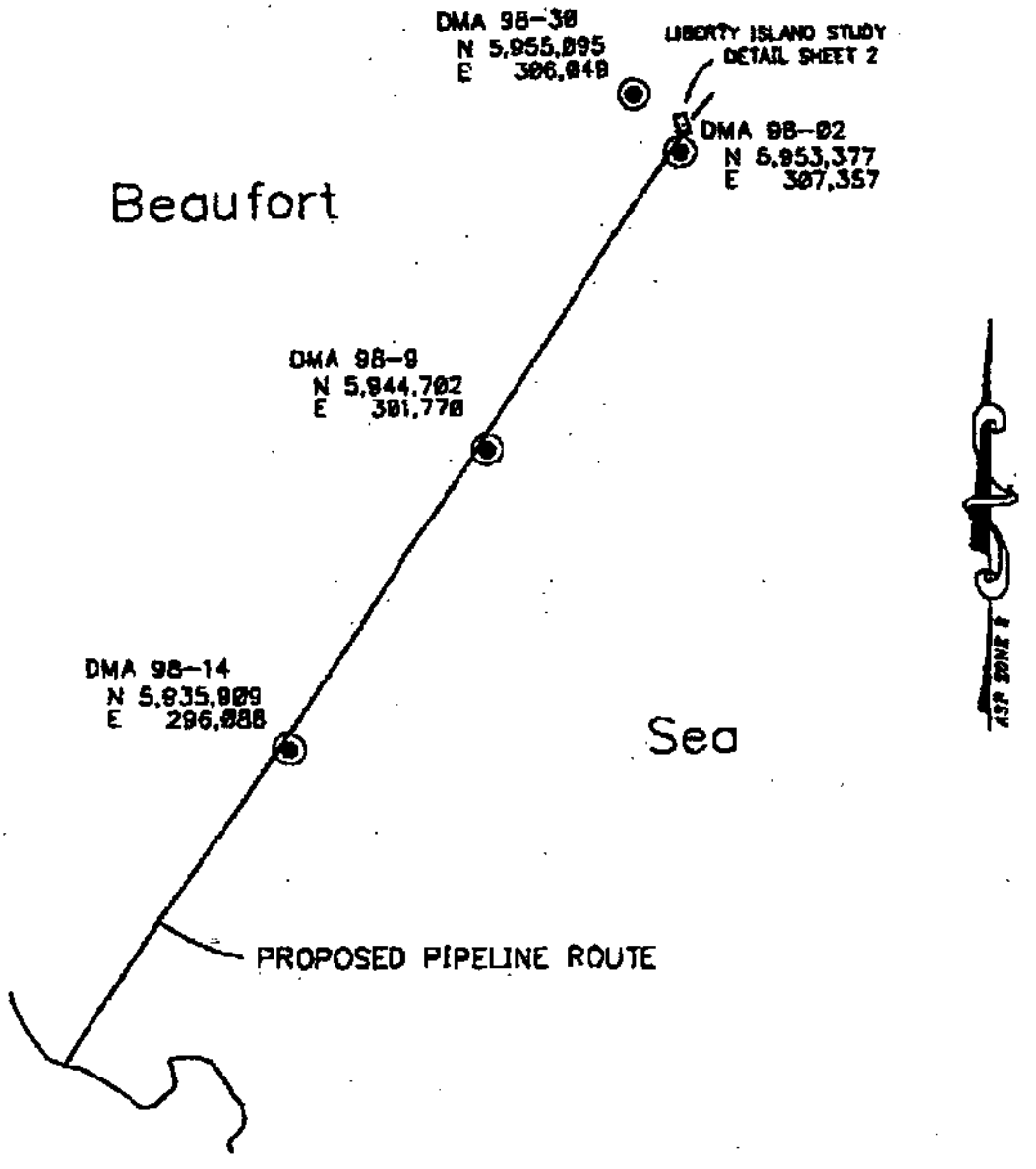
>>Point number: 10105 DMA 98-02
Northing: 5953376.54 Easting: 307357.18
Convergence: -1-28-02 Scale factor: 0.999942157796
Latitude: 70-16-38 Longitude: 147-33-31

>>Point number: 10116 DMA 98-9
Grid Northing: 5944702.00 Grid Easting: 301770.00
Convergence: -1-30-28 Scale factor: 0.999944638807
Latitude: 70-15-11 Longitude: 147-36-07

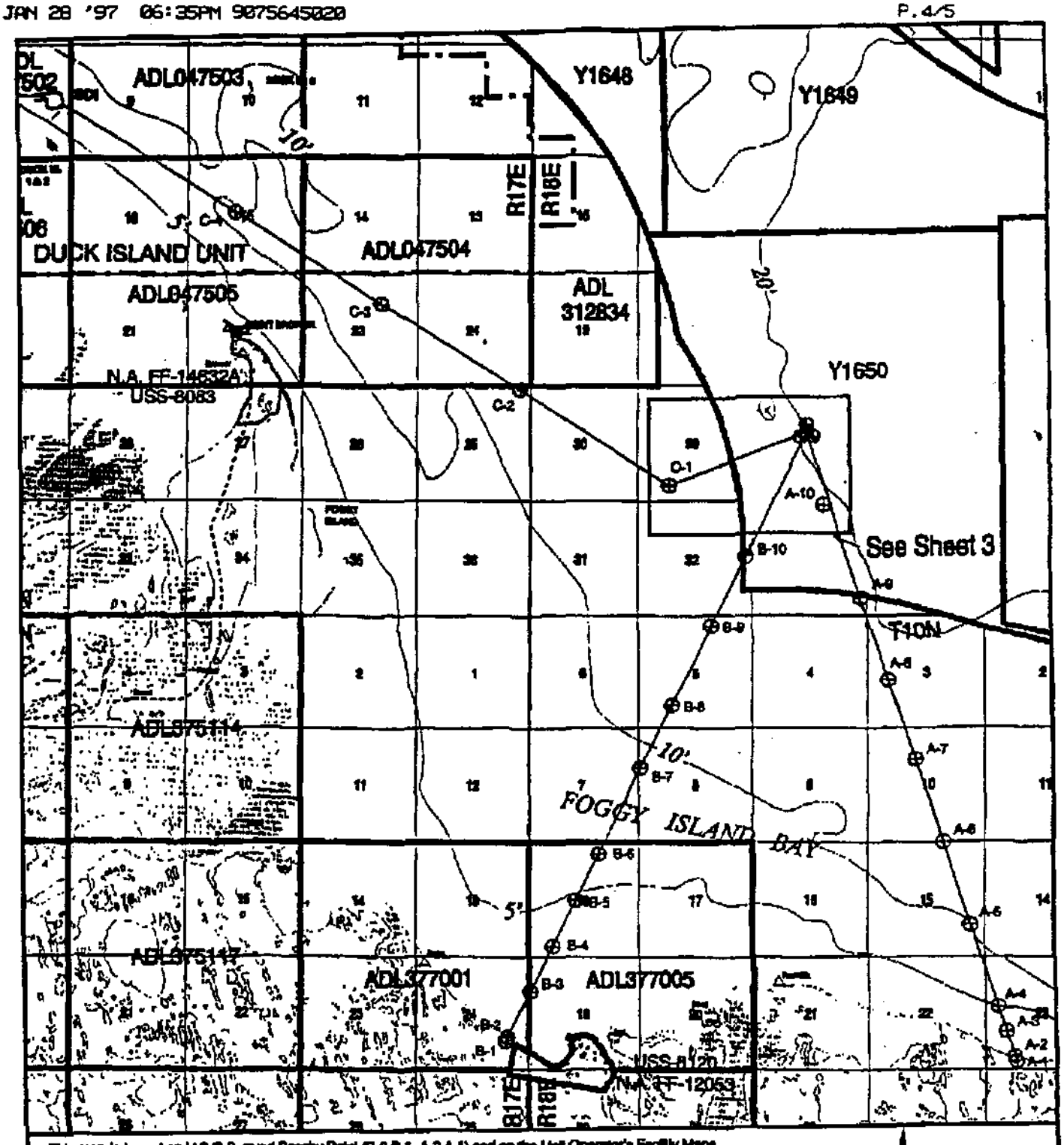
>>Point number: 10126 DMA 98-14
Grid Northing: 5935909.00 Grid Easting: 296088.00
Convergence: -1-32-56 Scale factor: 0.999947234682
Latitude: 70-13-43 Longitude: 147-38-45

NOTES

1. COORDINATES SHOWN ARE ALASKA STATE PLANE ZONE 3, NAD 1927.
2. LOCATION BASED ON STATION "DELTA" AND WCMC3 USS 8120.
3. REFERENCE GPS FILE: EX031998
4. DATES OF SURVEY: MARCH 18–19, 1998.



RELEASED FOR INFORMATION	F. Robert Bell & Associates	STOLL / DONNELLY 3/24/98 / LEHMA 1" = 5000'	BP EXPLORATION LIBERTY ISLAND DRILLHOLE LOCATIONS SHEET 1 of 2



This map is based on U.S.G.S. quad Beechy Point (B-2,B-1, A-2,A-1) and on the Unit Operator's Facility Maps.

NORTH

⊕ Boring less than 50' deep

⊕ Boring greater than 50' deep

Within T11NR17E Sec. 8, 9, 14, 15, 16, 23, 24, 25
T11NR18E Sec. 29, 30, 32, 33
T10NR17E Sec. 24
T10NR18E Sec. 3, 4, 5, 7, 8, 10, 16, 18, 19, 22, 23

BP EXPLORATION (ALASKA) INC.

LIBERTY
GEOTECHNICAL
BORE HOLE LOCATIONS
PERMIT APPLICATION

DATE:	SCALE:	SHEET:
1/28/97	1" = 1.25 Mile	2 OF 3

bs13351.dgn

APPENDIX B
Chain of Custody Records

1mx mounts to 248-8884

Montgomery Watson 4100 Spenard Road Anchorage AK 99517 (907)248-8883 Fax (907) 248-8884 ATTN: Lynn DeGeorge	Laboratory: PRUDHOE Laboratory (BP) West Prudo Bay, Alaska (907) 659-4356 Attn: Al Kukla **MW Job Number:** **48-hour holding time**			SOIL						WATER		
										Turbidity- EPA 180.1 100 ml poly	BOD5- EPA 405.1 1 l poly	Comments
Sampler's Signature 1998	Bmclaa			Cool to 4 degrees C								
Date	Time	Sample ID	Matrix	Total Containers								
3-18	2100	98BPXLI 02 WA01	W	2						✓	✓	
3-18	2130	98BPXLI 02 WA02	W	2						✓	✓	
3-19	2250	98BPXLI 02 WA03	W	2						✓	✓	
3-18	1530	98BPXLI 09 WA01	W	2						✓	✓	
3-18	1540	98BPXLI 09 WA02	W	2						✓	✓	
3-18	1550	98BPXLI 09 WA03	W	2						✓	✓	
3-18	1300	98BPXLI 14 WA01	W	2						✓	✓	
3-18	1315	98BPXLI 14 WA02	W	2						✓	✓	
3-19	0200	98BPXLI 30 WA03	W	2						✓	✓	
3-19	0120	98BPXLI 30 WA01	W	2						✓	✓	
3-19	0140	98BPXLI 30 WA02	W	2						✓	✓	
		98BPXLI ___ WA03										
3-19	0150	98BPXLI 30 WA6Z	W	1						NO	✓	BOD only
3-18	2110	98BPXLI 02 WA6L	W	1						NO	✓	BOD only
		98BPXLI ___ WA__										
		98BPXLI ___ WA__										

Relinquished by:		Date Time	Hand Delivered (Y) N	Shipped Via N/A	Airbill Number	Date Time
Received for Laboratory by:		Date Time	Cooler Temperature Upon Arrival °C		Laboratory Notified Faxed	

FO'O

MAS 821354

Montgomery Watson 4100 Spenard Road Anchorage AK 99517 (907)248-8313 Fax (907) 248-8884 ATTN: Lynn DeGeorge	Laboratory: Multichem Analytical Services 2000 West International Airport Road Anchorage, Alaska 99502 (907) 248-8273 (907) 248-8273 FAX Attn: Mike Vogel MW Job Number: 7189002. 21-DAY 330101 TURNAROUND			SOIL							WATER		
				VOCs- 8260 2 x 2-oz amber glass	SVOCs- 8270 1 x 8-oz amber glass	TOC- 415.1 1 x 4-oz amber glass	Grain Size - ASTM D422 1 x 8-oz amber glass	Particle Size- ASTM D2487 1 x 4-oz amber glass			TPH- 1663 250 ml poly	TOC- 415.1 1 x 250 ml amber	Comments
Sampler's Signature:													
MAS#													
-1	3-18	2210	98BPXLJ 02-WA01	W	2						✓	✓	
-2	3-18	2130	98BPXLJ 02-WA02	W	2						✓	✓	
-3	3-18	2200	98BPXLJ 02-WA03	W	2						✓	✓	
-4	3-18	1530	98BPXLJ 09-WA01	W	2						✓	✓	MS/MSD
-5	3-18	1540	98BPXLJ 09-WA02	W	2						✓	✓	
-6	3-18	1550	98BPXLJ 09-WA03	W	2						✓	✓	
-7	3-18	1300	98BPXLJ 14-WA01	W	2						✓	✓	
-8	3-18	1315	98BPXLJ 14-WA02	W	2						✓	✓	
-9	3-19	0200	98BPXLJ 30-WA03	W	2						✓	✓	
-10	3-19	0120	98BPXLJ 30-WA01	W	2						✓	✓	
-11	3-19	0140	98BPXLJ 30-WA02	W	2						✓	✓	
			98BPXLJ ___-WA04										No Sample
-12	3-19	0150	98BPXLJ 30-WA05		2						✓	✓	
-13	3-18	2110	98BPXLJ 02-WA04		2						✓	✓	
			98BPXLJ ___-WA___	MAS									
			98BPXLJ ___-WA___										

Relinquished by:	Date: 5-20-98	Rec'd Delivered: Y / N	Shipped Via	MAS# Number	Date
	Time: 1000				Time
Received for Laboratory by:	Date: 5/20	Cooler Temperature: 4.8° 3.7° °C		Laboratory Notified	
	Time: 10:00	Upon Arrival: 5.1° 11.7°		Faxed	

BPXU nd

P8 2 of 2

1.0.01.1

330101

Montgomery Watson 4100 Spenard Road Anchorage AK 99517 (907)248-8883 Fax (907) 248-8884 ATTN: Lynn DeGeorge	Laboratory: Multichem Analytical Services 2000 West International Airport Road Anchorage, Alaska 99502 (907) 248-8273 (907) 248-8273 FAX Attn: Mike Vogel 118900, 330101 3/10 MW Job Number: GF 110922.30101 21-DAY TURNAROUND	SOIL: VOCs- 8260b, 2 x 2-oz amber glass; SVOCs- 8270, 1 x 8-oz amber glass; TOC- 415.1, 1 x 4-oz amber glass; Grain Size - ASTM D422, 1 x 8-oz amber glass; Particle Size- ASTM D2487, 1 x 4-oz amber glass	WATER: TDS- 160.3, 250 ml poly; TOC- 415.1, 1 x 250 ml amber	MAS 821354

Sampler's Signature: [signature]

MAS #	Date	Time	Sample ID	Number	Container	VOCs	SVOCs	TOC	Grain Size	Particle Size	TDS	TOC	Comments
-14	3-18	2240	918PXLJ 02 SD01(01)	5	5	✓	✓	✓	✓	✓			
-15	3-18	2230	918PXLJ 02 SD01(03)	5	5								
-16	3-18	2330	918PXLJ 02 SD03(09)	5	5								
-17	3-18	1610	918PXLJ 09 SD01(01)	5	5								MS/MSD
-18	3-18	1620	918PXLJ 09 SD02(03)	5	5								
-19	3-18	1630	918PXLJ 09 SD03(09)	5	5								
-20	3-18	1330	918PXLJ 19 SD01(01)	5	5								
-21	3-18	1345	918PXLJ 19 SD02(03)	5	5								
-22	3-18	1400	918PXLJ 14 SD03(09)	5	5								
23	3-19	0230	918PXLJ 30 SD01(01)	5	5								
-24	3-19	0300	918PXLJ 30 SD02(03)	5	5				✓	✓			
-25	3-19	0330	918PXLJ 30 SD03(09)	5	5	✓	✓	✓	✓	✓			
-26	3-19	0310	918PXLJ 30 SD12(03)	5	3	✓	✓	✓					
-27	3-18	2200	918PXLJ 02 SD02(03)	5	3	✓	✓	✓					
			918PXLJ SD ( )										
			918PXLJ SD ( )										

Relinquished by: [signature] Date 3-20-98 Time 1630 Hand Delivered N Shipped Via

Received for Laboratory by: [signature] Date 3-20-98 Time 10:00 Cooler Temperature Upon Arrival °C

AA&R Number Date Time

Laboratory Work Bed Found

ultiChem Analytical Services, LLC **Anchorage, AK**

SAMPLE LOG-IN CHECKLIST

CESSION #: 821354 SUBCONTRACT WORK? (YES) / NO

NT NAME: Montgomery Watson TO LAB (circle): (MAS-R) OTHER: AK Test Lab

GED-IN BY (print): Gary Fisher (sign): Gary Fisher

received: 3/20/98 Client's Cooler # (if any):

the project for: ACOE? YES (NO) NAVY? YES (NO)

Did cooler arrive with shipping document? (Hand delivery)	(N/A)	YES	NO
Are Custody seals present on cooler? YES (NO) How many? Where?			
Seal date: Seal name: Intact?	N/A	YES	NO
Are Custody seals present on sample containers?		YES	NO
If "YES", intact?	N/A	YES	(NO)
s the Chain of Custody (C-O-C) sealed in plastic bag? YES (NO) Taped to cooler lid?		YES	(NO)
Is the C-O-C complete? * Relinquished by client: YES / NO Analyses marked off:		YES	NO
C-O-C or other representative documents, letters, and/or shipping memos. Signed/received by lab:		YES	NO
..s the C-O-C in agreement with samples received?			
Sample ID's: (YES) / NO Matrix:		(YES)	NO
Date sampled: (YES) / NO # Containers:		YES	(NO)
Has the main logbook been filled out properly?		(YES)	NO
If samples are RUSH has notice been given?	(N/A)	YES	NO
proper preservation indicated on label(s)?	(N/A)	YES	NO
Did pH check verify preservative indicated? (Volatiles)	(N/A)	YES	NO
ere sufficient sample volume for analyses?		(YES)	NO
samples in proper containers? (see reference chart)		(YES)	NO
all samples within holding times for requested analysis?		(YES)	NO
e all sample containers intact? (i.e. not broken, leaking...)		(YES)	NO
are samples individually bagged ?		(YES)	NO
re all volatile samples headspace-free (<pea-size for waters)?	(N/A)	YES	NO

ipping container (circle one): (Cooler) / Box / Other:

Type of packing material used (circle one): (Bubble Wrap) / Styrofoam Peanuts / Vermiculite / None

frigerant (circle one): (Gel Ice) / Loose Ice / Other: / None

as refrigerant frozen upon receipt? (YES) NO

Cooler temperature(s): #3) 5.1°C #4) 11.7°C #1: 4.8 °C #2: 3.7 °C

e tagging check for QC:

ple ID's issued in order of appearance on C-O-C:	YES	NO
placed in appropriate areas of sample containers:	(YES)	NO

of reviewer:

ribe any "NO" items from checklist above: Sample #1 Time on label = 21:00, on COC = 2210, all else noted

mples #14-25 only four of each not Five as listed on (COC), ~~Samples #1-13 only one of each not Two as Listed,~~ OK

ent contacted: YES / NO / N/A Date: Name of person contacted:

lient instructions or actions taken:

Quanterra Incorporated - West Sacramento
PROJECT RECEIPT CHECKLIST

Client Name: Montgomery Watson Log #: 50-2

Project # (LIMS ID): 98184 Project copied:

Location(s): W2E

		Initials	Date
Date Received:	3-21-98 Time Received: 0930	AH	3-24-98

Delivered by:
- [x] Federal Express
- [ ] Airborne
- [ ] Courier Express
- [ ] DHL
- [ ] White Cotton Delivers
- [ ] UPS
- [ ] Over the counter (OTC)
- [ ] Go-Getters

Other:

Custody Seal Status: [x] Intact [ ] Broken [ ] N/A

Custody Seal Number(s): 17451, 17452

Shipping Container(s): [ ] Quanterra [x] Client [ ] N/A

Temperature Record (in °C):

COC#: N/A

Temp Blank:

Ambient Temp: 4°C

pH Measured: [ ] Yes [ ] Anomaly [x] N/A

Sample(s) Labeled By:

Sample Labeling Checked By:

Short Hold Time Notification: Sample Receiving [x] N/A

Wet Chem [x] N/A

Metals (Fil/Pres) [x] N/A

[x] Complete shipment received in good condition, with appropriate temperatures, containers, and preservatives. [ ] N/A

[ ] Anomaly (-lies)/comments:

[ ] Temperature exceeded (2°C-6°C)

[ ] PM notified [x] N/A

Leave no spaces blank. Use "N/A" if not applicable. Initial and date all "N/A" entries. QA185 02/96 MCD

Montgomery Watson 4100 Spenard Road Anchorage AK 99517 (907)248-8883 Fax (907) 248-8884 ATTN: Lynn DeGeorge	Laboratory: Quanterra 880 Riverside Parkway West Sacramento, CA 95605 (916) 374-4427 (916) 372-1059 FAX Attn: Nile Ligi MW Job Number: 21-DAY TURNAROUND			SOIL						WATER		Comments
				Metals- Mercury- 7471, Arsenic, Barium, Chromium, Lead- 6020, Ext. gas								
Sampler's Signature				Cool to 4 degrees C								
Date	Time	Sample ID	Matrix	Total Containers								
3-18	2210	98BPXLJ 02 SD01(01)	S	1	✓							
3-18	2230	98BPXLJ 02 SD02(03)	S	1	✓							
3-18	2330	98BPXLJ 02 SD03(09)	S	1	✓							
3-18	1610	98BPXLJ 09 SD01(01)	S	1	✓							MS/MSD
3-18	1620	98BPXLJ 09 SD02(03)	S	1	✓							
3-18	1630	98BPXLJ 09 SD03(09)	S	1	✓							
3-18	1330	98BPXLJ 14 SD01(01)	S	1	✓							
3-18	1345	98BPXLJ 14 SD02(03)	S	1	✓							
3-18	1400	98BPXLJ 14 SD03(09)	S	1	✓							
3-19	0250	98BPXLJ 30 SD01(01)	S	1	✓							
3-19	0350	98BPXLJ 30 SD02(03)	S	1	✓							
3-19	0330	98BPXLJ 30 SD03(09)	S	1	✓							
3-18	2220	98BPXLJ 02 SD62(03)	S	1	✓							
3-18	0310	98BPXLJ 30 SD62(03)	S	1	✓							
		98BPXLJ SD ( )						LAB: T Item				
		98BPXLJ SD ( )										80169535 8828
Relinquished by: Burchman				Date 3-19-98 Time 1702	Hand Delivered Y (N)	Shipped Via FedEx			Airbill Number		Date Time	
Received for Laboratory by: CA Hoffa				Date 3-21-98 Time 1100	Cooler Temperature Upon Arrival 4°C	032198-8 MM			Laboratory Method Used		032198 MMO	

Rec'd in good condition
032198 mmo

15:30

P.03

Montgomery Watson 4100 Spenard Road Anchorage AK 99517 (907)248-8883 Fax (907) 248-8884 ATTN: Lynn DeGeorge	Laboratory: Quanterra 3355 Riverside Parkway West Sacramento, CA 95606 (916) 374-4427 (916) 372-1059 FAX Attn: Nilo Ligi MW Job Number: 21-DAY TURNAROUND			SOIL						WATER		
										Metals: Arsenic, Barium, Chromium, Lead- 6020, Mercury- 7471 Filtered 1 poly		
Sampler's Signature: 1958				Cool to 4 degrees C						Cool to 4 degrees C		Comments
Date	Time	Sample ID	Matrix	Total Containers								
3-18	2100	98BPXLI02 WA01	W	1						✓		
3-18	2130	98BPXLI02 WA02	W	1						✓		
3-18	2200	98BPXLI02 WA03	W	1						✓		
3-18	1530	98BPXLI09 WA01	W	1						✓		
3-18	1540	98BPXLI09 WA02	W	1						✓		
3-18	1550	98BPXLI09 WA03	W	1						✓		
3-18	1300	98BPXLI14 WA01	W	1								
3-19	1315	98BPXLI14 WA02	W	1								
3-19	0700	98BPXLI30 WA00	W	1								
3-19	0120	98BPXLI30 WA01	W	1								
3-19	140	98BPXLI30 WA02	W	1								
		98BPXLI WA03			NO Sample							Bottle
3-19	150	98BPXLI30 WA04	W	1								
3-18	2110	98BPXLI02 WA01	W	1								
		98BPXLI WA			LAST Item							
		98BPXLI WA										801695358828
Relinquished by:				Date 3-19-98 Time 1700	Hand Delivered Y N	Shipped Via Fed X				Airbill Number	Date Time	
Received by Laboratory by:				Date 3-21-98 Time 1100	Cooler Temperature Upon Arrival 4°	°C				Laboratory Modified Faxed	Date 03/24/98 Time 15:30	

032498 MLP received in good condition

CALLAB-098184

:erra Environmental Services, Sacramento -
'verside Parkway

amento, California 95605
3-5600

Date Received : 21 MAR 98 09:30

nn DeGeorge
mery Watson -
penard Road
rage, Alaska
99517

248-8883 Fax: (907) 248-8884

Project ID,
EPA Case, RMA Lot : ICPMS Metals + Hg

P.O. Number :

Delivered By :

Storage Location : W2E

Logged in by : KGONYEA

l) and aqueous(13) samples received in good condition under
-of-Custody. Delivered by Federal Express.

ID	Client's label info		Date/Time Samp.	Containers
4-0001-SA	98BPXLI02SD01(01)		18 MAR 98 22:10	125CGJ
0002-SA	98BPXLI02SD02(03)		18 MAR 98 22:30	125CGJ
0003-SA	98BPXLI02SD03(09)		18 MAR 98 23:30	125CGJ
4-0004-SA	98BPXLI09SD01(01)		18 MAR 98 16:10	125CGJ
4-0004-MS	98BPXLI09SD01(01)	Matrix Spike	18 MAR 98 16:10	Matrix Spike
04-SD	98BPXLI09SD01(01)	Matrix Spike	18 MAR 98 16:10	Matrix Spike Dup
0005-SA	98BPXLI09SD02(03)		18 MAR 98 16:20	125CGJ
0006-SA	98BPXLI09SD03(09)		18 MAR 98 16:30	125CGJ
0007-SA	98BPXLI14SD01(01)		18 MAR 98 13:30	125CGJ
0008-SA	98BPXLI14SD02(03)		18 MAR 98 13:45	125CGJ
-0009-SA	98BPXLI14SD03(09)		18 MAR 98 14:00	125CGJ
4-0010-SA	98BPXLI30SD01(01)		19 MAR 98 02:50	125CGJ
0011-SA	98BPXLI30SD02(03)		19 MAR 98 03:00	125CGJ
0012-SA	98BPXLI30SD03(09)		19 MAR 98 03:30	125CGJ
4-0013-SA	98BPXLI02SD62(03)		18 MAR 98 22:20	125CGJ
4-0014-SA	98BPXLI30SD62(03)		18 MAR 98 03:10	125CGJ
0015-SA	98BPXLI02WA01		18 MAR 98 21:00	500PBn
0016-SA	98BPXLI02WA02		18 MAR 98 21:30	500PBn
4-0017-SA	98BPXLI02WA03		18 MAR 98 22:00	500PBn
4-0018-SA	98BPXLI09WA01		18 MAR 98 15:30	500PBn
0019-SA	98BPXLI09WA02		18 MAR 98 15:40	500PBn
0020-SA	98BPXLI09WA03		18 MAR 98 15:50	500PBn
4-0021-SA	98BPXLI14WA01		18 MAR 98 13:00	500PBn
0022-SA	98BPXLI14WA02		18 MAR 98 13:15	500PBn
0023-SA	98BPXLI30WA03		19 MAR 98 02:00	500PBn

Samples not destroyed in testing are retained a maximum
of thirty (30) days unless otherwise requested.

:t Manager:

)	Client's label info	Date/Time Samp.	Containers
J24-SA	98BPXLI30WA01	19 MAR 98 01:20	500PBn
-0025-SA	98BPXLI30WA02	19 MAR 98 01:40	500PBn
0026-SA	98BPXLI30WA62	19 MAR 98 01:50	500PBn
B4-0027-SA	98BPXLI02WA61	18 MAR 98 21:10	500PBn

Samples not destroyed in testing are retained a maximum of thirty (30) days unless otherwise requested.

: Manager: