A Department of Ecology Report

Interim Performance Standards for Puget Sound Reference Areas

June 1989 Publication No. 89-09-003

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PTI

ENVIRONMENTAL SERVICES

Interim Performance Standards for Puget Sound Reference Areas

For

Washington Department of Ecology
Sediment Management Unit
Olympia, Washington

June 1989

PTI Environmental Services
15375 SE 30th Place
Suite 250
Bellevue, Washington 98007

INTERIM PERFORMANCE STANDARDS FOR PUGET SOUND REFERENCE AREAS

By

Robert A. Pastorok, Rolf Sonnerup, John J. Greene, Michael A. Jacobson, Lorraine B. Read, and Robert C. Barrick

For

Washington Department of Ecology
Sediment Management Unit
Mail Stop PV-11
Olympia, Washington 98504

Ecology Contract No. C0089108
PTI Contract C901-08

June 1989

CONTENTS

	Page
LIST OF FIGURES	v
LIST OF TABLES	vi
EXECUTIVE SUMMARY	vii
INTRODUCTION	1
.OBJECTIVES	1
BACKGROUND	2
DATA TYPES	2
REPORT ORGANIZATION	3
APPROACH	4
POTENTIAL REFERENCE AREAS AND PERFORMANCE STANDARDS FRAMEWORK	4
DATA COMPILATION AND QUALITY ASSURANCE REVIEW	4
DATA ANALYSES	5
Chemical Data Analyses	5
Biological Data Analysis	7
Habitat Characteristics	7
Potential Anthropogenic Disturbance	7
DEVELOPMENT OF INTERIM PERFORMANCE STANDARDS	8
FRAMEWORK FOR REFERENCE AREA PERFORMANCE STANDARDS	9
REVIEW OF EXISTING PERFORMANCE STANDARDS FOR REFERENCE AREAS	9
ENVIRONMENTAL FACTORS INFLUENCING P-2 SEDIMENT VARIABLES	11
REVIEW OF DATA FOR POTENTIAL REFERENCE AREAS	14
POTENTIAL REFERENCE AREAS	14
DATA COMPILATION AND QA/QC EVALUATION	14

	Page
SEDIMENT CHEMISTRY AND CONVENTIONAL VARIABLES	16
Comparison of Potential Reference Areas	16
Frequency Distributions of Chemical and Conventional Variables	16
AET Comparisons	28
PSDDA Screening Level Comparisons	28
AMPHIPOD BIOASSAY	37
BIVALVE LARVAE BIOASSAY	37
MICROTOX BIOASSAY	43
Saline Extract	43
Organic Extract	43
BENTHIC MACROINVERTEBRATES	43
HABITAT CHARACTERISTICS	44
POTENTIAL ANTHROPOGENIC DISTURBANCE	51
Current Source Concern	51
Future Growth Impacts	51
DEVELOPMENT OF PERFORMANCE STANDARDS	56
STRUCTURE OF PERFORMANCE STANDARDS	56
QUALITY ASSURANCE/QUALITY CONTROL OF PERFORMANCE STANDARDS DATABASE	59
Chemical Data	59
Biological Data	60
INTERIM PERFORMANCE STANDARDS	60
Station Locations	60
Sediment Chemistry	61
Bioassays	61
Benthic Macroinvertebrates	63
INTERIM REFERENCE AREAS	64
DATA GAPS AND RECOMMENDED STUDIES	69
DATA GAPS	69
RECOMMENDED STUDIES	70
Biogeographic Zones and Habitats	70
Interim Reference Areas (Marine Subtidal)	71
REFERENCES	72

APPENDIX A - ANNOTATED BIBLIOGRAPHY

APPENDIX B - DATA QA/QC RESULTS

APPENDIX C - HISTORICAL DATA LISTING

APPENDIX D - COMPARISONS OF HISTORICAL CHEMICAL DATA TO SEDIMENT QUALITY VALUES

APPENDIX E - FIELD STUDIES WORK PLAN

LIST OF TABLES

		Page
Table 1.	Potential reference areas with suitable data on sediment chemistry and conventional variables	17
Table 2.	Summary of chemical data for potential reference areas	22
Table 3.	Summary of stations exceeding 95th percentile chemical concentrations	27
Table 4.	Summary of potential sources of contaminants by potential reference area	29
Table 5.	Summary of LAET exceedances by reference area	31
Table 6.	Summary of PSDDA screening level exceedances by reference area	33
Table 7.	Summary of biological data for potential reference areas	34
Table 8.	Frequency of values ≥25 percent for mean amphipod mortality at potential reference areas	39
Table 9.	Habitat characteristics for potential reference areas	41
Table 10.	Potential anthropogenic disturbance	49
Table 11.	Proposed general structure of performance standards for Element P-2 reference areas	52
Table 12.	Interim performance standards for reference areas	58
Table 13.	Summary of available data for potential reference areas	62
Table 14.	Summary of chemical concentrations and conventional variables for selected reference and nonreference areas of Puget Sound	65

LIST OF FIGURES

		Page
Figure 1.	Model of amphipod survival vs. percent fine-grained material in reference area sediments	12
Figure 2.	Locations of potential reference areas in Puget Sound	15
Figure 3.	Chemical concentrations and percent fine-grained material in sediments of potential reference areas	18
Figure 4.	Frequency distribution histograms for chemical and conventional variables	23
Figure 5.	Amphipod, bivalve larvae, and microtox bioassay responses for potential reference areas	38
Figure 6.	Frequency distributions of means and individual replicate values for percent mortality in amphipod mortality bioassays	40
Figure 7.	Percent mortality of amphipods vs. percent fine-grained material in sediments of potential reference areas	42
Figure 8.	Abundances of major taxa of benthic macroinvertebrates in potential reference areas	45
Figure 9.	Total abundance of benthic macroinvertebrates in potential reference areas	46
Figure 10.	Frequency distributions of abundance for major taxa of benthic macroinvertebrates	47
Figure 11.	Frequency distribution of total abundance of benthic macroinvertebrates	48
Figure 12.	Locations of interim reference areas and areas for further study	67

EXECUTIVE SUMMARY

INTRODUCTION

In response to Element P-2 of the 1987 *Puget Sound Water Quality Management Plan*, the Washington Department of Ecology is developing regulatory standards for identifying and classifying contaminated sediments. Performance standards will be developed for reference areas (i.e., relatively uncontaminated areas) selected to provide data suitable for comparison with data on potentially contaminated sediments. Performance standards are criteria for suitable reference conditions that are defined in terms of a range of habitat characteristics and biological properties (e.g., chemical concentrations, benthic macroinvertebrate abundance, toxicity bioassay response).

Historically, the suitability of reference area data sets has been judged on a case-by-case basis. Performance standards for reference areas throughout Puget Sound are needed to provide an objective and consistent basis for assessing contaminated sediments in various environments. The objectives of this report are to evaluate available data on reference areas, to define interim reference area performance standards, and to develop a work plan for field studies. The field studies will support the development of a database for reference areas.

FRAMEWORK FOR REFERENCE AREA PERFORMANCE STANDARDS

Few investigators have proposed quantitative performance standards for Puget Sound reference areas. Most historical studies simply required reference areas to be located away from urban areas or away from known contaminant sources. Reference area performance standards should account for temporal variability by incorporating a range of chemical and biological conditions that reflect seasonal variations in natural physical/chemical factors. Initial recommendations are provided that define the properties of suitable reference areas.

REVIEW OF DATA FOR POTENTIAL REFERENCE AREAS

Sixty potential reference areas are identified in the present study. A bibliography of documents that describe potential reference areas in Puget Sound is provided in Appendix A.

Sediment Chemistry and Conventional Variables—The majority of the potential reference areas evaluated had at least one sediment contaminant that exceeded the 1988 Puget Sound lowest apparent effects threshold (LAET). LAET were exceeded to the greatest degree and/or at the most stations in Blakely Harbor, Dyes Inlet, Oak Harbor, Port Madison, Port Susan, and Quartermaster Harbor.

Bioassays—A broad range of mean values of percent mortality in the amphipod bioassay was observed among stations within some of the potential reference areas (e.g., 7-36 percent mortality for Dabob Bay, 10-37 percent mortality for Port Susan, 20-47 percent mortality for Samish Bay, and 6-37 percent for Sequim Bay). The model of DeWitt et al. (1988) relating percent mortality of amphipods to percent fine-grained material in sediments of reference areas was consistent with the data compiled during the present study. Five of the potential reference areas had mean mortality values greater than the guideline derived from the model of DeWitt et al. (1988): Carr Inlet, Port Susan, Case Inlet, Samish Bay, and Possession Sound. Data that passed quality assurance (QA) review for the bivalve larvae bioassay were available for only three potential reference areas sampled during two surveys. All mean values of percent abnormality were less than 25 percent, with a maximum of 23 percent for Port Susan. Data for the Microtox saline extract bioassay were available only for Carr Inlet, Port Susan, Possession Sound, and Sequim Bay. Saline extract bioassay responses for all areas were classified as nontoxic. Organic extracts of sediments from Carr Inlet

and Dabob Bay displayed relatively low toxicity to the Microtox bacterium. A sample from Discovery Bay showed the highest toxicity in the Microtox organic extract test.

Benthic Macroinvertebrates—Data that passed QA review for benthic macroinvertebrate communities were available for only four potential reference areas (including three embayments) sampled during five surveys (Possession Sound, Blakely Harbor, Carr Inlet, and Port Susan). Although the overall median abundances of major taxa generally varied little among the three embayments, the station-specific mean abundances varied by more than an order of magnitude within and among the embayments.

Habitat Characteristics—A wide variation of maximum depths (from 2 to 219 meters) was found at potential reference areas. Most of the potential reference areas have low freshwater input (i.e., <200 ft^3/sec). Nisqually Reach, Port Susan, Saratoga Passage, and Skagit Bay have high freshwater input (i.e., >2,000 ft^3/sec). Fisherman's Bay, Samish Bay, and Sequim Bay were considered to have relatively high coverage by eelgrass or kelp or both (60-80 percent coverage). The wide range of percent fine-grained material in many locations indicates the diversity of sediment types. Pickering Passage, President Point, Skagit Bay, and West Beach have low values of percent fine-grained material (<16 percent). Only five areas have stations with total organic carbon values above 3 percent (i.e., Case Inlet, Dabob Bay, Dyes Inlet, East Sound, and Oak Harbor).

Potential Anthropogenic Disturbance—Tetra Tech (1988) assigned moderate ranks of concern for current sources of toxic contaminants to Blakely Harbor, Discovery Bay, East Sound, Friday Harbor, Nisqually Reach, Oak Bay, Oak Harbor, Padilla Bay, Penn Cove, Port Susan, Possession Sound, Skagit Bay, and Tacoma Narrows. Eight of the potential reference areas were given moderate ranks based on the likelihood of impacts associated with future population growth: Dyes Inlet, Henderson Inlet, Oak Harbor, Padilla Bay, Port Susan, Possession Sound, Poverty Bay, and Tacoma Narrows. These locations are generally near urban or industrial areas or areas likely to grow rapidly. Other potential reference areas were ranked low for concern about anthropogenic disturbances.

DEVELOPMENT OF PERFORMANCE STANDARDS

A hierarchical structure is proposed for the performance standards incorporating four tiers of environmental variables:

- Biogeographic region [including estuarine or low-salinity (i.e., <25 ppt salinity) subareas defined by interstitial water salinity]
- Season
- Water depth (or tidal height)
- Sediment type.

Interim Performance Standards—Interim performance standards were developed for subtidal reference conditions throughout Puget Sound. The interim performance standards for chemical variables were generally defined as the 90th percentile values for frequency distributions of chemical concentrations in potential reference areas. The performance standards represent upper limits for the concentrations of chemicals in acceptable reference samples. The performance standards for the amphipod bioassay were defined as maximum allowable toxic responses to reference area sediments.

Limited data are available from bivalve larvae bioassays, Microtox bioassays, and studies of benthic macroinvertebrate communities. For these data types, technical judgments about the acceptability of reference area data sets can be made on a case-by-case basis until quantitative performance standards for all Puget Sound reference areas are established. Guidelines for reference areas defined by the Puget Sound Dredged Disposal Analysis (PSDDA 1988, 1989) could be adopted as interim performance standards until more reference area data are available.

Interim Reference Areas—The available data for potential reference areas were evaluated to select the following interim reference areas for the P-2 sediment management program:

- Carr Inlet
- Dabob Bay
- Samish Bay
- Sequim Bay.

These areas are distributed throughout Puget Sound, covering most of the defined large-scale biogeographic zones. Other areas that could be investigated further for use as P-2 reference areas include:

- Birch Bay
- Discovery Bay
- Griffin Bay
- Lopez Sound
- Mutiny Bay
- Padilla Bay
- Saratoga Passage
- Useless Bay.

DATA GAPS

The main data gaps identified in this study are described below:

- Limited data are available for potential reference areas around Whidbey Island (e.g., Mutiny Bay, Useless Bay, and Saratoga Passage) that could serve as reference areas for sites in the Seattle and Everett metropolitan areas
- Almost no data are available for P-2 sediment variables in intertidal and low-salinity habitats of reference areas (although data are available in some urban areas)
- Reference area data are limited for the following biological variables: the larvae bioassay (seven stations), the Microtox saline extract bioassay (eight stations), and benthic macroinvertebrate communities (14 stations).

RECOMMENDED STUDIES

Several studies are recommended to fill the data gaps identified above:

- A reconnaissance survey to collect data on P-2 sediment variables should be performed in Mutiny Bay and Useless Bay to expand the number of interim reference areas
- Data on sediment chemistry, conventional variables, and bioassays should be collected for low-salinity environments and intertidal habitats
- P-2 sediment variables for sediment chemistry, bioassays, and benthic macroinvertebrates should be measured in the subtidal habitats of each of the interim reference areas for use in refining the proposed structure of the performance standards.

INTRODUCTION

The 1987 *Puget Sound Water Quality Management Plan* [the Plan (revised in 1989)] (PSWQA 1987) includes a series of measures to control sediment contamination in Puget Sound. In response to Element P-2 of the Plan, the Washington Department of Ecology (Ecology) is developing regulatory standards for identifying and designating sediments that have adverse biological effects or pose a human health threat. As part of the P-2 sediment standards, relatively uncontaminated areas of Puget Sound will be selected to define chemical and biological characteristics of sediments that serve as reference conditions for comparison with data on potentially contaminated sediments.

OBJECTIVES

The objectives of this report are to evaluate available data on reference areas, to define interim reference area performance standards, and to develop a work plan for additional field studies. Performance standards are criteria for suitable reference conditions defined in terms of habitat characteristics (e.g., sediment grain size, salinity, chemical concentrations) and biological properties (e.g., benthic macroinvertebrate abundance, toxicity bioassay response). The standards are needed to provide an objective and consistent basis for assessing contaminated sediments in various environments. Performance standards for reference areas ultimately will be developed from a comprehensive database containing information on sites throughout Puget Sound. A sound-wide database is needed to characterize the range of conditions expected in reference areas. In this report, interim performance standards for reference areas are defined based on available data. Where quantitative performance standards could not be developed for certain variables, general objectives for evaluation of reference area data are provided to guide technical judgments regarding the acceptability of reference sites on a case-by-case basis. The inability to define sound-wide quantitative performance standards for selected sediment variables at this time should not limit administrative and technical decisions regarding particular data sets.

The following tasks were performed to support development of interim performance standards for reference areas:

- Preparation of an annotated bibliography for available sediment data for potential reference areas in Puget Sound
- Development of recommendations for selecting reference areas for use in developing performance standards
- Review of available sediment data for potential reference areas in Puget Sound, and recommendation of interim performance standards and future studies or activities
- Preparation of a field studies work plan to support further development of performance standards for reference areas.

The term sediment data refers to physical, chemical, and biological data on subtidal and intertidal sediments in marine and low salinity (<25 ppt salinity) waters of Puget Sound, identified by geographic location.

BACKGROUND

Under the P-2 sediment management program, Ecology is developing a sediment classification scheme to identify and rank sediments that may cause adverse biological or human health effects. Chemical criteria are included in the P-2 regulatory testing scheme to identify sediment chemical concentrations below which adverse biological effects would rarely be expected. Biological analyses are used to allow site-specific confirmation that biological effects are induced by sediments having chemical concentrations above the chemical criteria (Becker et al. 1989). The key elements of the sediment classification scheme are as follows:

- Chemical criteria to identify sediments having a very low potential for causing adverse acute and chronic biological effects
- Biological testing using acute and chronic sediment bioassays and effects on indigenous organisms to confirm that sediments with chemical concentrations above chemical criteria have acute and/or chronic effects and to classify the sediments in accordance with the observed biological results.

Because there is little information regarding chronic effects in Puget Sound, Becker et al. (1989) recommends that chemical criteria initially be developed based on effects on benthic macroinvertebrate assemblages (i.e., an indicator that includes both chronic and acute effects on indigenous organisms), and on an acute-to-chronic ratio of 10:1 relative to several acute bioassays (amphipod mortality, oyster larvae abnormality, and Microtox tests). The lower limit for chemical criteria would be set at the 90th percentile of chemical concentrations from Puget Sound reference areas. Adverse effects would be confirmed using three sediment bioassays [amphipod (*Rhepoxynius abronius*) mortality, bivalve larvae (*Crassostrea gigas* or *Mytilus edulis*) developmental abnormality, Microtox (*Photobacterium phosphoreum*) bacteria decrease in luminescence] and effects on benthic macroinvertebrate assemblages.

Incorporation of human health criteria into the sediment quality standards requires further development of available hazard and risk assessment techniques. Because reference area data related to human health criteria are not needed at this time, the focus of the present report is on compilation and analysis of physical, chemical, and ecological data.

DATA TYPES

The specific kinds of data considered in development of reference area performance standards are listed below:

- **Sediment chemistry**—concentrations of chemical contaminants
- **Ancillary physical/chemical variables**—interstitial water salinity and the conventional variables of grain size composition (percent fine-grained material), total organic carbon (TOC) and nitrogen content, and sulfides
- **Amphipod bioassay**—percent mortality of *Rhepoxynius abronius*
- **Bivalve larvae bioassay**—percent abnormal development of *Crassostrea gigas* or *Mytilus edulis*

- **Microtox**—EC_{50} (i.e., effective concentration for a 50 percent response) and percent decrease in luminescence for concentrated extract (saline and organic extracts)
- **Benthic macroinvertebrates**—species abundances and taxonomic richness (i.e, total number of taxa), and abundances of higher taxa.

The extent of geographic and temporal coverage for each variable is summarized in a later section of this report (see Review of Data for Potential Reference Areas).

REPORT ORGANIZATION

The general approach to evaluation of reference area data and development of interim performance standards is described in the section following this introduction. The next section on the framework for reference area performance standards addresses existing performance standards defined by previous authors and environmental factors that affect P-2 sediment variables. Available data for P-2 sediment variables are reviewed in the next section. Interim performance standards for reference areas are then defined. Finally, data gaps and recommended studies are summarized.

APPROACH

The approach used to develop interim performance standards for Puget Sound reference areas is described in the following sections. First, criteria for definition of potential reference areas and the framework for the performance standards are described. Methods used to compile and review data are then discussed. Finally, the approach used to define the performance standards and select interim reference areas is described.

POTENTIAL REFERENCE AREAS AND PERFORMANCE STANDARDS FRAMEWORK

Potential reference areas are defined as portions of Puget Sound located away from major contaminant sources. A list of potential reference areas was compiled from a review of the *Puget Sound Environmental Atlas* (Evans-Hamilton and D.R. Systems 1987), a recent U.S. Environmental Protection Agency (EPA) report on toxic contamination problems in nonurban areas of Puget Sound (Tetra Tech 1988), and other literature. Potential reference areas primarily included areas designated as reference areas by previous investigators or areas that were ranked low for concern about toxic contamination problems by Tetra Tech (1988). The potential reference areas identified in this report are not all uniformly "clean" and should not be considered as pristine. Nevertheless, many of them have proved suitable in the past for defining adverse effects of more contaminated sediments. For example, Tetra Tech (1986) used Blakely Harbor as a proximate reference area for comparison to contaminated areas in Eagle Harbor. Because Blakely Harbor represented a background of low-level contamination common to many areas of central Puget Sound, it was especially useful for identifying localized sources in Eagle Harbor. Because available data on reference conditions in Puget Sound are limited, the data compilation was not restricted to only the cleanest areas that might be selected for future use in the P-2 sediments standards program. Data for all potential reference areas were needed to evaluate relative differences among areas. For example, are there discrete groups of clean areas and dirty areas among the potential reference sites, or is there a gradient of contamination among areas? Such information is needed to select reference areas for future use.

Reference area performance standards defined by previous investigators for Puget Sound reference areas were reviewed to provide historical perspective on the development of P-2 interim performance standards. Based on a literature review, environmental factors that may potentially influence P-2 sediment variables were identified (e.g., sediment grain size, TOC, and season). In some cases, information on these environmental variables was used to define the structure of the performance standards (e.g., the maximum allowable level of amphipod mortality for a P-2 reference site may depend on the sediment grain size at that site).

DATA COMPILATION AND QUALITY ASSURANCE REVIEW

Citations for an annotated bibliography were compiled by reviewing primarily the EPA Puget Sound Estuary Program (PSEP) bibliographic database (ACCESS), the PSEP report on toxic problems in nonurban areas of Puget Sound (PSEP 1988), and the *Puget Sound Environmental Atlas* (Evans-Hamilton and D.R. Systems 1987). Original data sets on sediment chemistry, grain size,

bioassays, and benthic macroinvertebrates for potential reference areas were compiled and evaluated.

Chemical and biological methods were reviewed for acceptability and comparability based on sample collection and sample handling procedures, quality assurance (QA) review, analytical or statistical methods, and detection limits. Procedures used in each study were evaluated relative to the Puget Sound protocols (PSEP 1986) to assess data quality. Comparisons of procedures among studies were made to assess comparability of the data sets. Each data set was reviewed for documentation of QA methods and summaries of QA review results. When QA documentation was not provided in a report, QA information was sometimes available directly from the authors of those studies. Data sets for which no QA information was available were generally not included in the database.

The QA review of chemical data emphasized evaluation of analytical methods, detection limits, and documented recovery of analytes. The QA review of benthic macroinvertebrate data focused on sampling methods, especially the use of subsampling techniques (e.g., cores taken from grab samples) and level of replication. The QA review of toxicological data focused on sediment storage (fresh vs. frozen) and on the general acceptance of the bioassay methods used. Sediment data from surveys judged suitable in the quality assurance/quality control (QA/QC) process were compiled and entered into a database.

DATA ANALYSES

Analyses of chemical and biological data for P-2 sediment variables are outlined below.

Chemical Data Analyses

Analyses of chemical data included the following:

- Calculation of median and range for each variable by area and for all data pooled across areas
- Analysis of frequency distributions of data for each variable
- Comparisons with sediment quality values.

Sediment conventional variables reported in studies that passed QA review included grain size analyses, percent TOC, total sulfides, total volatile solids, total extractable organic matter, and total solids. Many of these variables were not measured in a large enough number or variety of potential reference areas to allow intercomparisons of areas. As a result only data for grain size, TOC, and total sulfides were included in the analyses. Chemical variables reported in studies that passed QA review included polycyclic aromatic hydrocarbons (PAH), polychlorinated biphenyls (PCB), phthalate esters, acid extractable organics such as phenols, miscellaneous base or neutral organic compounds, and metals. Many of the organic chemicals, for example phenols and furans, were analyzed in a small number of studies in a small number of the potential reference areas. Because these data were not suitable for analysis of frequency distributions and comparisons among reference areas, they were excluded from these analyses. However, data for all chemical variables reported in the accepted studies were included in comparisons with sediment quality values.

The sediment chemistry variables that were used to compare potential reference areas and derive performance standards were: total low molecular weight polycyclic aromatic hydrocarbons (LPAH); total high molecular weight polycyclic aromatic hydrocarbons (HPAH); total PCB; total phthalates; and arsenic, cadmium, copper, chromium, mercury, lead, nickel, silver, and zinc. These chemicals were analyzed in sediments from a wide variety of locations exhibiting a wide range of depth, grain size, and habitat variability. In addition, these are common chemicals of concern in sediments from industrialized embayments, so sediment quality values are available for these chemicals. Because of the small amount of data from intertidal areas, only the subtidal data were analyzed. Data for intertidal stations and composite sample results representing more than one station were not included in the analyses. Undetected observations were included only where noted below.

The median and the range of each chemical variable (and percent fine-grained material in sediments) were determined for each potential reference area. Median values were calculated twice; once using all data, and once using only detected values. Comparisons among reference areas were based on plots of values for the median (calculated both ways) and the range.

Median values and ranges for each chemical variable (and percent fine-grained material) were determined from data for detected chemicals pooled across potential reference areas. Frequency distributions were plotted and 95th percentile values were determined. Stations with chemical concentrations above the 95th percentile were identified.

Sediment chemical concentrations were compared with the lowest among the Microtox bioassay, amphipod mortality, oyster larvae toxicity, and benthic macroinvertebrate apparent effects threshold (AET) [or lowest AET (LAET); Barrick et al. 1988] for each chemical. All sediment chemistry data that passed QA review (i.e., both intertidal and subtidal stations from all of the potential reference areas) were included in this comparison. The AET approach was selected by Ecology as the currently preferred method for developing sediment quality standards that address adverse biological effects in Puget Sound. Eight alternative approaches were evaluated (Becker et al. 1989). The primary reason for selecting the AET approach was its relatively high reliability in classifying Puget Sound samples as "impacted" or "not impacted." The reliability of the AET has been assessed using a large database comprising samples from 13 Puget Sound embayments (not all biological indicators were available in all embayments). In at least 85 percent of the available samples for each biological indicator, the approach either correctly classifies as "impacted" samples that exhibit adverse biological effects or correctly classifies as "not impacted" samples that do not exhibit adverse biological effects. In addition to its reliability in classifying sediments, the AET approach can be used to provide sediment quality values for the greatest number and widest range of chemicals of concern in Puget Sound. The approach also incorporates the widest range of biological indicators that are directly applicable to sediment conditions.

Sediment chemistry data from all of the potential reference areas were also compared to the Puget Sound Dredged Disposal Analysis (PSDDA) screening levels (SL) for each chemical reported. Data from all subtidal and intertidal stations and from composite samples were included in this comparison. The PSDDA SL is defined as the level of a specific contaminant in marine sediments above which biological testing is required to determine suitability for disposal of those sediments at PSDDA dredged material disposal sites. The PSDDA maximum level (ML) for a given chemical is the highest value among the Microtox bioassay, amphipod mortality, benthic macroinvertebrate, and oyster larvae toxicity AET, or the highest AET (HAET) for that chemical. The PSDDA SL has been set at one-tenth the PSDDA ML unless this value falls below concentrations commonly found in Puget Sound reference areas or this value exceeds the LAET for that compound. If one-

tenth the ML falls below the mean reference area value (defined by the Puget Sound SEDQUAL database), then the SL is set at the mean reference value. If one-tenth the ML exceeds the LAET, then the SL for that compound is set at the LAET.

Biological Data Analysis

Analyses of biological data included:

- Calculation of median and range for each variable by area and for individual replicate data pooled across areas
- Determination of range of mean values for stations within each area
- Analysis of frequency distributions of data for each variable.

Comparisons among potential reference areas were based on values of the median and the range of station means. For each pooled data set (i.e., all potential reference areas), the form of the frequency distribution and the 95th percentile value were determined. Stations with mean values above the 95th percentile were identified.

In addition to the analyses just described, the relationship between amphipod mortality and percent fine-grained material in sediments was evaluated. The lower 95 percent prediction limit on number of survivors in reference area sediment bioassays using the amphipod *Rhepoxynius abronius* (DeWitt et al. 1988) was converted to an upper 95 percent prediction limit on percent mortality. Data compiled during the present study were evaluated relative to the guideline derived from the model of DeWitt et al. (1988).

Habitat Characteristics

Habitat characteristics were considered in selecting potential reference areas to represent a range of environmental conditions throughout Puget Sound. Habitat variables evaluated in this study include water depth, freshwater influence, amount of aquatic vegetation, range of grain sizes, and TOC content. Information on depths and aquatic vegetative cover was obtained from the *Puget Sound Environmental Atlas* (Evans-Hamilton and D.R. Systems 1987). Information on freshwater inputs was obtained from the *State of the Sound* (PSWQA 1988). Grain size and TOC data were compiled as part of the present study.

Potential Anthropogenic Disturbance

The potential for anthropogenic disturbance of possible reference areas was evaluated by reviewing information on predicted population growth, land uses, and pollutant sources in Puget Sound watersheds. Pollution impacts to reference areas may increase with rapid population growth, increased industrial land use, and proximity to urban centers. All of these factors were evaluated to determine the relative effect of future population growth impacts on potential reference areas.

In addition to information on specific sources of contaminants, ranks were assigned to potential reference areas based on predicted impacts of future population growth. Population density projections for the year 2000 were developed for each county bordering Puget Sound from

census information provided in the *Puget Sound Environmental Atlas* (Evans-Hamilton and D.R. Systems 1987). These projections were used as a starting point for assessing potential growth impacts. Land use development patterns and present population density are two additional factors that may influence the impact of increased population density. In some cases, these factors were used to modify a rating of growth impacts based initially on population density projections for the year 2000. For example, an area located within a county with a high expected density may have rural or suburban land uses and a very low site-specific density. It was assumed that industrialized land use causes relatively more toxic contamination than do residential or rural land uses. Thus, a suburban area located in a county with a moderate to high expected future density was considered a relatively minor contributor of contaminants to a potential reference area.

The proximity of an area to a major urban center may also influence the degree of growth and resultant impacts. Potential reference areas situated near urban centers may be influenced by contaminants transported from nearby urban sources. In addition, industrial growth tends to occur where industries and populations already exist, to support their activities. Industrial growth is more likely to occur along the Everett-Seattle-Tacoma corridor, for example, than near Hood Canal. All of these factors were considered in ranking potential reference areas according to approximate impacts due to future growth.

DEVELOPMENT OF INTERIM PERFORMANCE STANDARDS

A structure for reference area performance standards was developed based on consideration of environmental factors that may influence P-2 sediment variables. Interim performance standards were derived from the available data where possible, and data gaps were identified. A simplified structure for the interim performance standards was proposed because of limitations of the available data.

The following criteria were used to select interim reference areas for future use in the P-2 program:

- The area is ranked low for current source concerns and for predicted impacts of future population growth
- The median concentration of each chemical evaluated in an area is less than the interim performance standard (i.e., 90th percentile concentration derived from data at individual stations for all potential reference areas)
- The LAET is not exceeded for more than one chemical contaminant (other than phthalates, which are common laboratory contaminants, and sulfides)
- The LAET is not exceeded for any single chemical (other than phthalates and sulfides) at more than one station within the area
- The mean value of amphipod mortality does not exceed the interim performance standard (e.g., guideline developed from model of DeWitt et al. 1988).

Interim reference areas and potential reference areas that warrant further investigation were identified. Study designs were developed for the recommended studies.

FRAMEWORK FOR REFERENCE AREA PERFORMANCE STANDARDS

Few investigators have proposed quantitative performance standards for Puget Sound reference areas (e.g., Barrick et al. 1988; DeWitt et al. 1988; PSDDA 1988, 1989). Some effort has been made to define reference conditions for benthic macroinvertebrates according to habitat types to account for the influence of sediment grain size and water depth (Evans-Hamilton and D.R. Systems 1987). Only DeWitt et al. (1988) have explicitly accounted for potential effects of sediment grain size or related factors in a model to define performance standards for amphipod mortality in bioassays of reference area sediments. These and other studies are reviewed in the next section. Environmental factors that affect P-2 sediment variables are also discussed below.

REVIEW OF EXISTING PERFORMANCE STANDARDS FOR REFERENCE AREAS

Most historical studies (Appendix A) have simply required that reference areas be located away from urban areas or away from known contaminant sources. Tetra Tech (1985) stated "The ideal reference area exhibits physical characteristics (e.g., sediment type, water depth, wave exposure, freshwater influence) that are similar to those of the study area, but is without significant human influence." PSEP (1986) defined a reference area as a location "that is pristine or is considered to have acceptably low levels of contamination and no apparent biological disturbance." Battelle (1986) stated "Ideally, a reference bay should contain little or no chemical contamination, demonstrate few or no impacts when evaluated by infaunal analyses and sediment bioassays, but should also possess physical characteristics (depth and grain size) that closely approximate the urban bay(s) to be examined." Based on a reconnaissance survey of eight bays in Puget Sound, Battelle (1986) concluded that the reference bay concept was valid but that the process to select reference sites needed refinement. Battelle (1986) suggested that the selection of reference sites should be based on physical, chemical, and biological data. Battelle (1986) also pointed out that the concept of *reference stations* was more appropriate than *reference bays*. In this report, the term *area* applies to a single station or a collection of stations that define an area. Quantitative criteria for reference areas defined by previous investigators are summarized below.

Evans-Hamilton and D.R. Systems (1987) defined reference conditions in the *Puget Sound Environmental Atlas* for sediment variables, including sediment chemistry and benthic macroinvertebrates. A critical reference value for each contaminant in sediment was defined as the maximum concentration observed in the following areas (and data sets): Carr Inlet (Tetra Tech 1985; Crecelius et al. 1985); Samish Bay, Dabob Bay, and Sequim Bay (Battelle 1986); Case Inlet (Crecelius et al. 1985; Malins et al. 1980); Port Madison (Malins et al. 1980); Port Susan (Malins et al. 1981); and Nisqually Delta and Hood Canal (Crecelius et al. 1985). A similar approach was followed in the PSEP urban bay programs (e.g., PTI and Tetra Tech 1988a), although the database for reference sites was expanded beyond that used for the *Puget Sound Environmental Atlas* (Evans-Hamilton and D.R. Systems 1987).

Evans-Hamilton and D.R. Systems (1987) defined reference conditions for benthic macroinvertebrate data stratified by season (spring and summer), water depth, and sediment grain size. For the summer season, the data were sufficient to exclude stations where sediments had concentrations of any one metal or organic compound (or group of related compounds) greater than 10 times the

critical reference value. The data set on which the spring reference conditions were based could have included sediments with concentrations of metals up to 50 times or concentrations of organic compounds up to 100 times the critical reference values. The guidelines for the spring data set allowed more contamination because the sample size (i.e., number of stations) was limited. Because the studies compiled by Evans-Hamilton and D.R. Systems (1987) included data in urban embayments and the main basin of Puget Sound, effects of unanalyzed chemicals could have substantially influenced the "reference" conditions defined for benthic macroinvertebrate communities. Evans-Hamilton and D.R. Systems (1987) did not define reference values for bioassay variables. However, they noted that based on data from Mearns et al. (1986), mean mortality values of 11-25 percent in the amphipod (*Rhepoxynius abronius*) bioassay provided evidence of toxic effects but did not clearly indicate that the sediments were toxic. Mean mortality values of 10 percent or less were considered indicative of nontoxic sediments.

Schiewe et al. (1987) performed chemical analyses, Microtox organic extract bioassays, and amphipod bioassays on sediments from six reference areas in Puget Sound. They found that low EC_{50} (i.e., high toxicity) values in the Microtox organic extract test resulted in the absence of any apparent chemical contamination in Sequim Bay. Schiewe et al. (1987) postulated that the high toxicity may be associated with naturally occurring substances in the sediment extract that are not routinely detected using standard chemical analyses. Natural substances or contaminants that are normally not bioavailable may have been extracted from the sediments during the organic extraction process used in this Microtox test. Schiewe et al. (1987) also demonstrated that reduced survival in amphipod (*Rhepoxynius abronius*) bioassays can result from exposure of these organisms to fine-grained sediment in the absence of any apparent chemical contamination. These authors used the results from the Microtox tests, chemical analyses, and amphipod bioassays to determine the suitability of areas as sources of reference sediments. Based on these tests, five of the six areas tested (including Sequim Bay) were judged to be well suited for use as "clean" reference areas in studies of sediment toxicity. The five reference areas designated by Schiewe et al. (1987) were Carr Inlet, Dabob Bay, Discovery Bay, Samish Bay, and West Beach. Schiewe et al. (1987) did not propose performance standards for these reference areas.

Barrick et al. (1988) defined reference area performance standards for amphipod (*Rhepoxynius abronius*) mortality bioassays. Reference area stations having a mean mortality $\geq$25 percent or a standard deviation $\geq$20 were considered unsuitable for use as reference conditions in statistical comparisons with potentially toxic sites. The critical value for mean mortality was based on interlaboratory studies by Mearns et al. (1986), who concluded that mortality $\geq$25 percent in the amphipod bioassay could be reliably interpreted as representing sediment toxicity. The critical value for the standard deviation of mean mortality was derived by examining the values for 23 reference stations from eight studies available in the PSEP sediment quality values database. All but one of the standard deviation values ranged from 4.0 to 16 percent mortality. The reference area performance standards defined by Barrick et al. (1988) for the amphipod bioassay were applied to the sediment quality values database (PTI and Tetra Tech 1988a).

For the PSDDA program, PSDDA (1988) defined reference area performance standards for the amphipod (*Rhepoxynius abronius*) mortality bioassay, the bivalve larvae (*Crassostrea gigas* or *Mytilus edulis*) developmental abnormality bioassay, the Microtox (*Photobacterium phosphoreum*) luminescence bioassay, and other tests. PSDDA (1988) specified that reference sites should be isolated from contaminant sources. According to PSDDA (1988), reference area sediments should have low concentrations of chemicals of concern and should support healthy and abundant biota. Furthermore, in the procedures for evaluating dredged material, reference area sediments used for biological testing must have a grain size distribution similar to that of the dredged material.

Matching the grain size distribution of reference sediment and dredged material is intended to control for physical effects of sediment texture on test organisms.

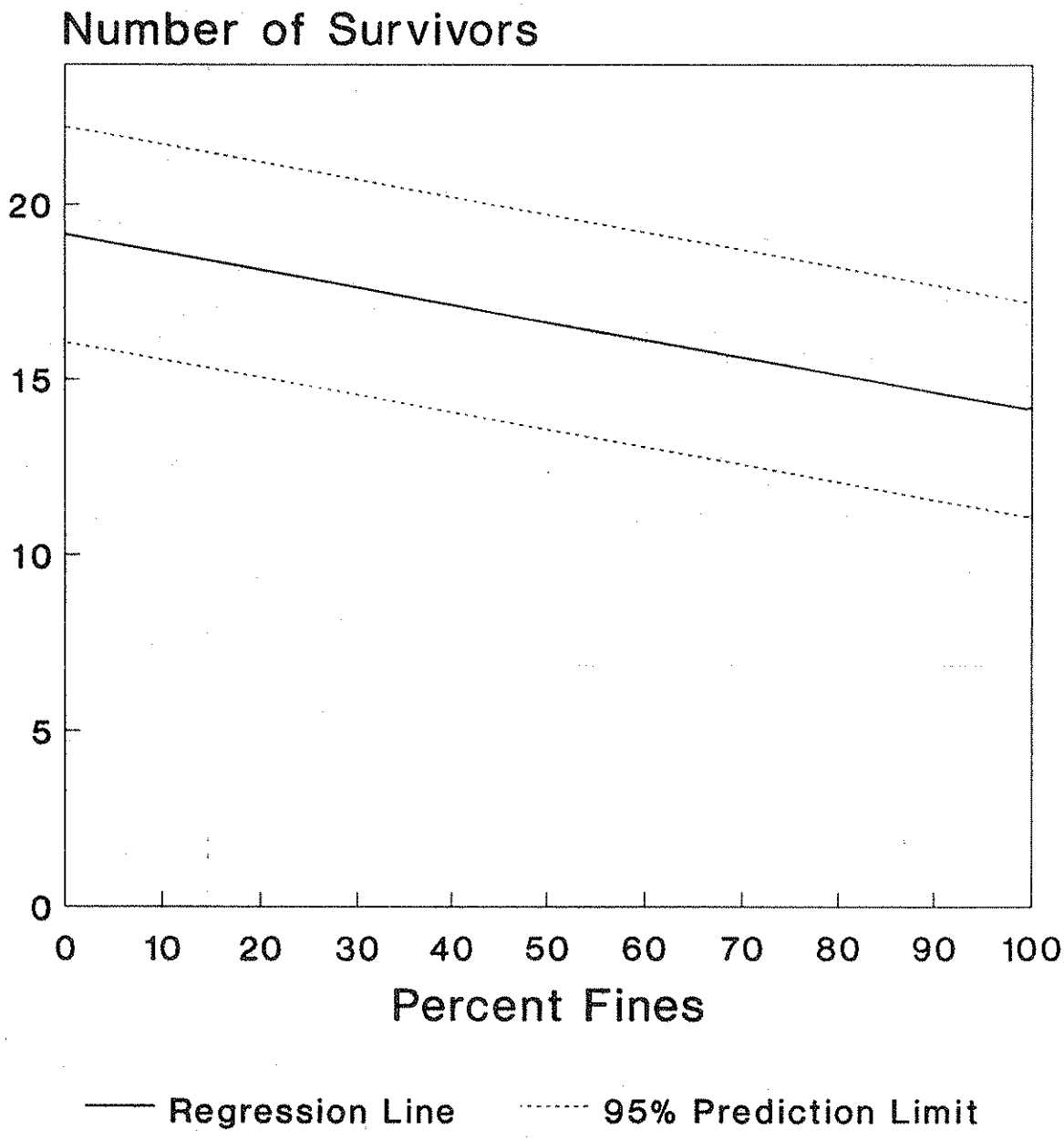
As part of PSDDA (1988) a quantitative performance standard for reference areas was proposed for acute mortality tests such as the amphipod bioassay. The performance standard specified that acute mortality in response to reference area sediments could not be more than 20 percent greater than the absolute mortality observed for control (native) sediments. The PSDDA Phase II draft management plan (PSDDA 1989) adopted a similar reference area performance standard for the amphipod mortality and bivalve larvae bioassays. These guidelines specify that the absolute amphipod mortality observed in reference area sediments cannot exceed that observed in control samples by more than 20 percent. For the bivalve larvae test, the performance standard for reference area samples requires that the abnormality response to reference sediments be no more than 20 percent greater than the abnormality response to control sample sediments, which is limited to 10 percent. Under the PSDDA guidelines, if the observed response to reference area sediments exceeds that of the control samples by more than 20 percent, the bioassay must be repeated (PSDDA 1989). The PSDDA performance standards for reference areas are currently under revision.

DeWitt et al. (1988) have shown that elevated mortality in the amphipod (*Rhepoxynius abronius*) bioassay can result solely from exposure of the organisms to sediments having a high percentage of fine-grained material. Elevated mortality values were found for reference area sediments without apparent chemical contamination, and these values were attributed to physical characteristics of the sediment or some other natural factor that correlated with the physical characteristics. DeWitt et al. (1988) developed a linear regression model to account for potential effects of such factors on amphipod mortality. The authors determined that a significant ($P \leq 0.001$) linear regression curve explained 29 percent of the variance in the relationship between *Rhepoxynius abronius* survival and percent fine-grained material for sediments from reference areas of Puget Sound and the Oregon coast. The 95 percent prediction limit for the regression relationship was suggested by DeWitt et al. (1988) as a guideline for defining potentially toxic sediments (Figure 1). For example, using the DeWitt et al. (1988) model, mean survival values less than approximately 55 percent (i.e., mean mortality values greater than approximately 45 percent) measured for sediments with 90-percent fine-grained material would be defined as indicative of toxic sediment.

ENVIRONMENTAL FACTORS INFLUENCING P-2 SEDIMENT VARIABLES

Environmental variables (e.g., grain size, water depth) that may naturally influence contaminant concentrations in sediments, sediment toxicity, or benthic macroinvertebrate communities are identified in this section. These variables represent factors by which the reference area performance standards may be stratified (e.g., different performance standards may be developed to reflect the influence of variations in grain size composition in sediment). The selection of key environmental variables to use in stratifying performance standards and the quantitative values for the interim performance standards will be presented later (see Development of Performance Standards).

Contaminant concentrations and biological characteristics of reference areas may be influenced by the following environmental variables:



Note: Figure based on model of Dewitt et al. (1988)

Figure 1. Model of amphipod survival vs. percent fine-grained material in reference area sediments

- Sediment grain size
- Nitrogen and TOC
- Sulfides
- Interstitial water salinity
- Water depth or tidal height
- Temperature
- Season
- Biogeographic location (defined by oceanographic features).

This is not a comprehensive list of all environmental variables that control reference area conditions. However, the variables listed here represent some key factors that have been measured in previous studies. Because seasonal and interannual variability in temperature and salinity (e.g., el Niño) may have a large influence on reference conditions, reference area sediments and sediments to be evaluated for potential toxicity should be collected at the same time. Reference area performance standards should account for temporal variability by incorporating a range of chemical and biological conditions that reflect seasonal variations in natural physical/chemical factors.

REVIEW OF DATA FOR POTENTIAL REFERENCE AREAS

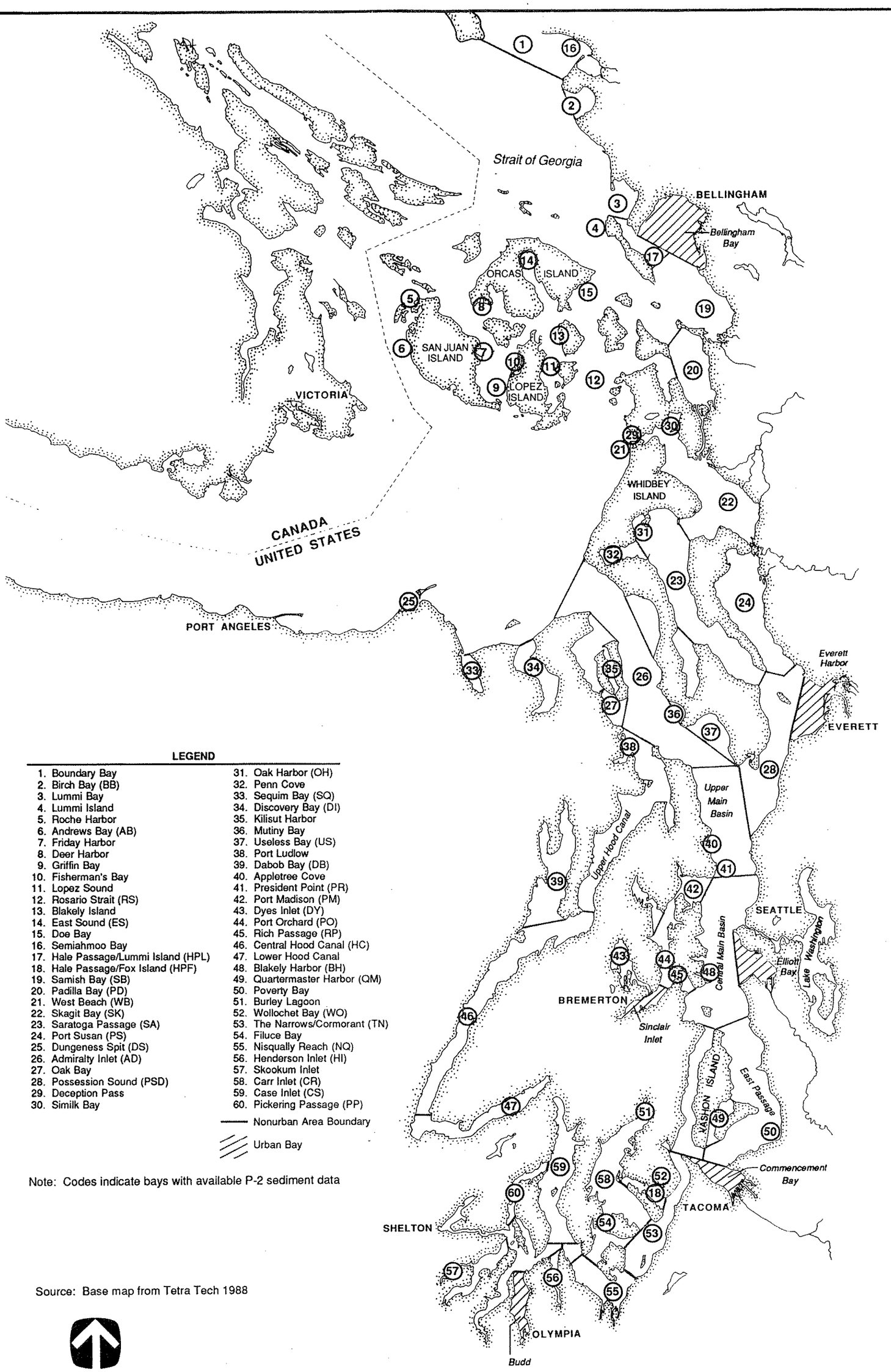
Available sediment data for potential reference areas are reviewed in the following sections. Potential reference areas are defined in the next section. The results of the data compilation and QA review of the data are then described. Finally, available data for each category of P-2 sediment variables (i.e., sediment chemistry and conventional variables, bioassays, and benthic macroinvertebrates) are reviewed.

POTENTIAL REFERENCE AREAS

The following areas of Puget Sound were initially identified as potential reference areas based on designation as reference sites in previous studies: Carr Inlet (Tetra Tech 1985; Battelle 1986; Schiewe et al. 1987; DeWitt et al. 1988; PSDDA 1988), Case Inlet (Malins et al. 1980, 1982; Battelle 1986; DeWitt et al. 1988), Blakely Harbor (PSEP 1986), Port Madison (Malins et al. 1980, 1982; Chapman et al. 1982), Port Susan (Malins et al. 1982; PTI and Tetra Tech 1988a), Dabob Bay (Battelle 1986; Schiewe et al. 1987; DeWitt et al. 1988; PSDDA 1988), President Point (Malins et al 1985a), Rich Passage/Clam Bay (Cummins et al. 1976), Birch Bay (Chapman et al. 1982), Samish Bay (Battelle 1986; PSDDA 1988), Sequim Bay (Chan et al. 1985a,b; Anderson and Crecelius 1986a,b; Battelle 1986; Schiewe et al. 1987; PSDDA 1988), Discovery Bay (Malins et al. 1982; Schiewe et al. 1987), Hood Canal (PSDDA 1988), Nisqually River Delta (PSDDA 1988), Poverty Bay (Crecelius et al. 1989), West Beach (Schiewe et al. 1987; DeWitt et al. 1988), and Useless Bay (Malins, D.C., 21 November 1984, personal communication; Krahn et al. 1986). Other areas were identified based on information in the *Puget Sound Environmental Atlas* (Evans-Hamilton and D.R. Systems 1987). Nisqually Reach (also see PSDDA 1988) and Skagit Bay were included because of the potential for low salinity habitats, and Quartermaster Harbor, Oak Harbor, and Penn Cove were included because of their relatively nonurban nature and accessibility. Areas that were ranked low for concern about toxic contamination problems by Tetra Tech (1988) were also considered potential reference areas for the present study. Locations of all potential reference areas are shown in Figure 2.

DATA COMPILATION AND QA/QC EVALUATION

A bibliography of documents containing information on potential reference areas in Puget Sound is provided in Appendix A. The types of data available in each document are listed as key words in the bibliography and summarized in Table A-1 of Appendix A. No biological data related to the P-2 sediment standards are available for several of the potential reference areas listed in Table A-1. These areas include Admiralty Inlet, Andrews Bay (San Juan Island), Hood Canal, East Sound (Orcas Island), Henderson Inlet, western Lummi Island, Pickering Passage, Possession Sound, Rosario Strait, Saratoga Passage, Tacoma Narrows, and Wollochet Bay/Hale Passage. Areas that have been sampled most often for P-2 biological variables include Carr Inlet, Case Inlet, Dabob Bay, Oak Harbor, Port Susan, Samish Bay, and Sequim Bay. Areas where the most sediment chemistry studies (four or more studies with original data) have been conducted include Carr Inlet, Case Inlet, Dabob Bay, Port Susan, and Sequim Bay.



LEGEND

1. Boundary Bay
2. Birch Bay (BB)
3. Lummi Bay
4. Lummi Island
5. Roche Harbor
6. Andrews Bay (AB)
7. Friday Harbor
8. Deer Harbor
9. Griffin Bay
10. Fisherman's Bay
11. Lopez Sound
12. Rosario Strait (RS)
13. Blakely Island
14. East Sound (ES)
15. Doe Bay
16. Semiahmoo Bay
17. Hale Passage/Lummi Island (HPL)
18. Hale Passage/Fox Island (HPF)
19. Samish Bay (SB)
20. Padilla Bay (PD)
21. West Beach (WB)
22. Skagit Bay (SK)
23. Saratoga Passage (SA)
24. Port Susan (PS)
25. Dungeness Spit (DS)
26. Admiralty Inlet (AD)
27. Oak Bay
28. Possession Sound (PSD)
29. Deception Pass
30. Similk Bay
31. Oak Harbor (OH)
32. Penn Cove
33. Sequim Bay (SQ)
34. Discovery Bay (DI)
35. Kilisut Harbor
36. Mutiny Bay
37. Useless Bay (US)
38. Port Ludlow
39. Dabob Bay (DB)
40. Appletree Cove
41. President Point (PR)
42. Port Madison (PM)
43. Dyes Inlet (DY)
44. Port Orchard (PO)
45. Rich Passage (RP)
46. Central Hood Canal (HC)
47. Lower Hood Canal
48. Blakely Harbor (BH)
49. Quartermaster Harbor (QM)
50. Poverty Bay
51. Burley Lagoon
52. Wollochet Bay (WO)
53. The Narrows/Cormorant (TN)
54. Filuce Bay
55. Nisqually Reach (NQ)
56. Henderson Inlet (HI)
57. Skookum Inlet
58. Carr Inlet (CR)
59. Case Inlet (CS)
60. Pickering Passage (PP)

Nonurban Area Boundary

Urban Bay

Note: Codes indicate bays with available P-2 sediment data

Source: Base map from Tetra Tech 1988

Figure 2. Locations of potential reference areas in Puget Sound

Results of the QA review and the rationale for excluding certain data sets are presented in Table B-1 of Appendix B. A summary of the numbers of stations analyzed for each variable in each potential reference area for which data were accepted is presented in Table B-2. Historical data and station coordinates entered in the database are listed in Appendix C.

SEDIMENT CHEMISTRY AND CONVENTIONAL VARIABLES

Data on sediment conventional variables were compiled from 22 surveys of 31 potential reference areas listed in Table 1. Data on sediment conventional variables were compiled primarily from surveys conducted between the years 1950 and 1988. Data on toxic chemical concentrations in sediments were compiled from 25 surveys of 28 potential reference areas listed in Table 1. These data were compiled from surveys performed between 1972 and 1988.

Comparison of Potential Reference Areas

A summary of the specific chemicals and conventional variables analyzed in each potential reference area and the number of stations in each area at which each of these variables were measured is presented in Table B-2 of Appendix B. Reference areas that exhibited the best coverage in terms of numbers of stations and numbers of variables analyzed include Carr Inlet, Case Inlet, Dabob Bay, Dyes Inlet, Oak Harbor, Port Madison, Port Susan, Samish Bay, Sequim Bay, Quartermaster Harbor, and West Beach (Whidbey Island). Relatively few chemical/ conventional variables were measured (or few stations were sampled) in the remaining reference areas listed in Table B-2.

Plots of the median and range for each chemical and conventional variable are presented in Figure 3. Three potential reference areas had the highest median values (based on detected values only) for more than one chemical variable. These were Port Susan (chromium, nickel), Dyes Inlet (zinc, lead, mercury, copper, HPAH), and Quartermaster Harbor (silver, LPAH). The relatively high chromium and nickel concentrations in Port Susan may be partially the result of the total digestion procedure used to generate those data. Sequim Bay and Samish Bay exhibited the highest sulfides values compared to the medians for other areas, but these results were based on only one sample from each of the two bays. The di-n-octyl phthalate values reported in Port Madison are likely a result of laboratory contamination (Figure 3). Central Hood Canal exhibited the highest median cadmium concentration. However, this result, based on only one sample, is far below the maximum values reported in Case Inlet, Port Madison, and Carr Inlet.

Frequency Distributions of Chemical and Conventional Variables

A summary of the range and median value for each variable measured at subtidal sampling stations is presented in Table 2. Frequency distributions of chemical variables for the entire reference area data set for each variable analyzed are presented in Figure 4. Most of the chemical variables analyzed exhibited a left skewed or apparent lognormal distribution with a single mode. Thus, these univariate analyses indicate that the potential reference areas form a single statistical population rather than two or more discrete groups. For each chemical, most areas exhibited relatively low concentrations, fewer areas exhibited moderate concentrations, and several areas exhibited relatively high concentrations. Chemical concentrations in sediments of potential reference areas are generally low relative to those observed in nonreference areas (Table 3).

TABLE 1. POTENTIAL REFERENCE AREAS WITH SUITABLE DATA ON SEDIMENT CHEMISTRY AND CONVENTIONAL VARIABLES[a]

Reference Areas with Suitable Sediment Chemistry Data	Reference Areas with Suitable Sediment Conventional Variables Data
Admiralty Inlet	Admiralty Inlet
Blakely Harbor	Birch Bay
Carr Inlet	Blakely Harbor
Case Inlet	Carr Inlet
Dabob Bay	Case Inlet
Discovery Bay	Dabob Bay
Dyes Inlet	Discovery Bay
East Sound	Dyes Inlet
Central Hood Canal	East Sound, Orcas Island
Henderson Inlet	Central Hood Canal
Nisqually Reach	Henderson Inlet
Oak Harbor	Hale Passage, Fox Island
Padilla Bay	Hale Passage, Lummi Island
Port Madison	Nisqually Reach
Port Orchard	Oak Harbor
President Point	Padilla Bay
Port Susan	Port Madison
Possession Sound	Port Orchard
Quartermaster Harbor	Pickering Passage
Rich Passage, Bainbridge Island	President Point
Rosario Strait	Port Susan
Saratoga Passage	Possession Sound
Skagit Bay	Quartermaster Harbor
Samish Bay	Rosario Straight
Sequim Bay	Saratoga Passage
Tacoma Narrows/Cormorant Passage	Skagit Bay
West Beach	Samish Bay
Wollochet Bay	Sequim Bay
	Tacoma Narrows
	West Beach
	Wollochet Bay

[a] Areas listed consider subtidal stations only. Additional areas with both acceptable chemistry and conventionals variables data at intertidal stations include Andrews Bay (San Juan Island) and Dungeness Spit.

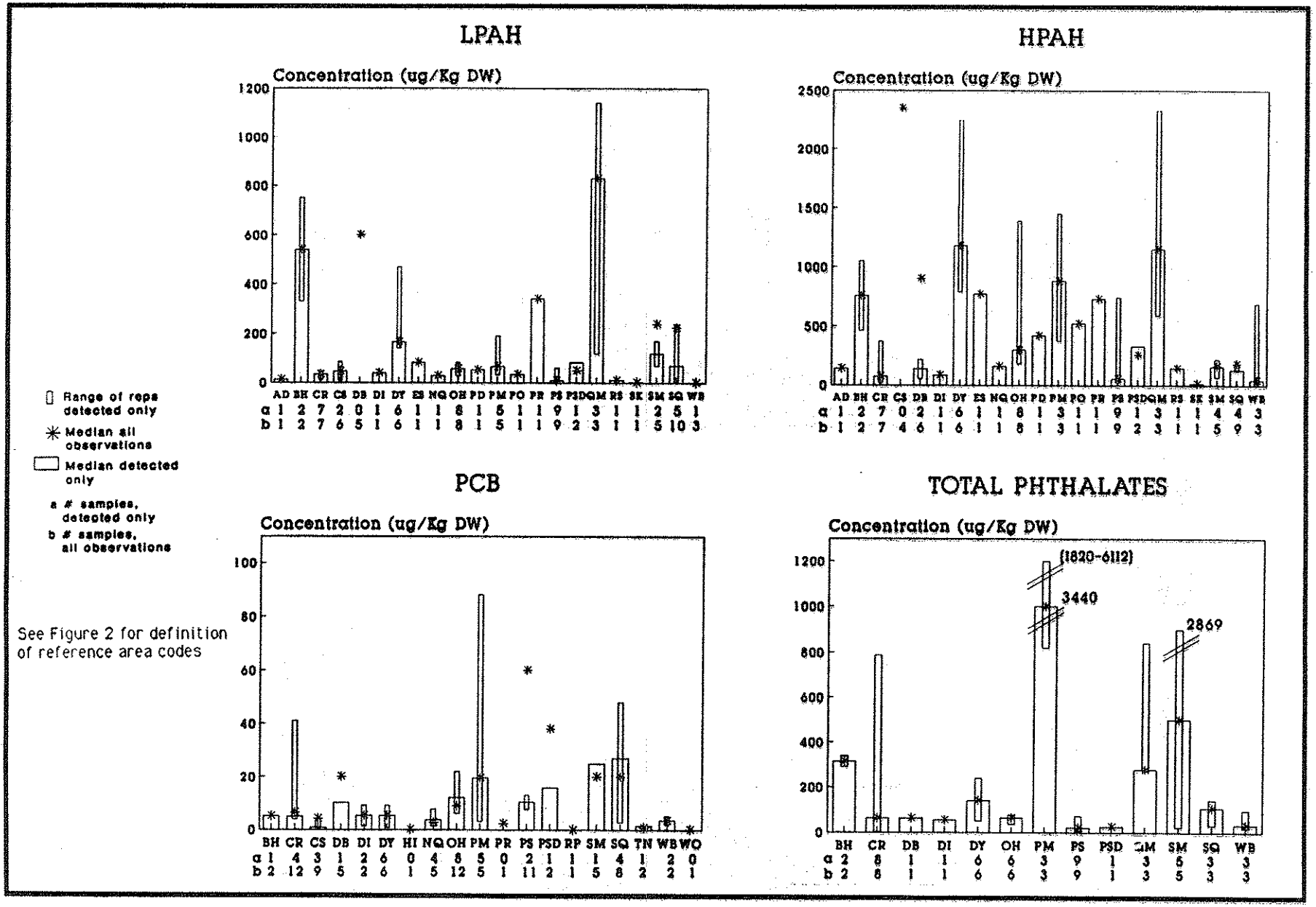


Figure 3. Chemical concentrations and percent fine-grained material in sediments of potential reference areas

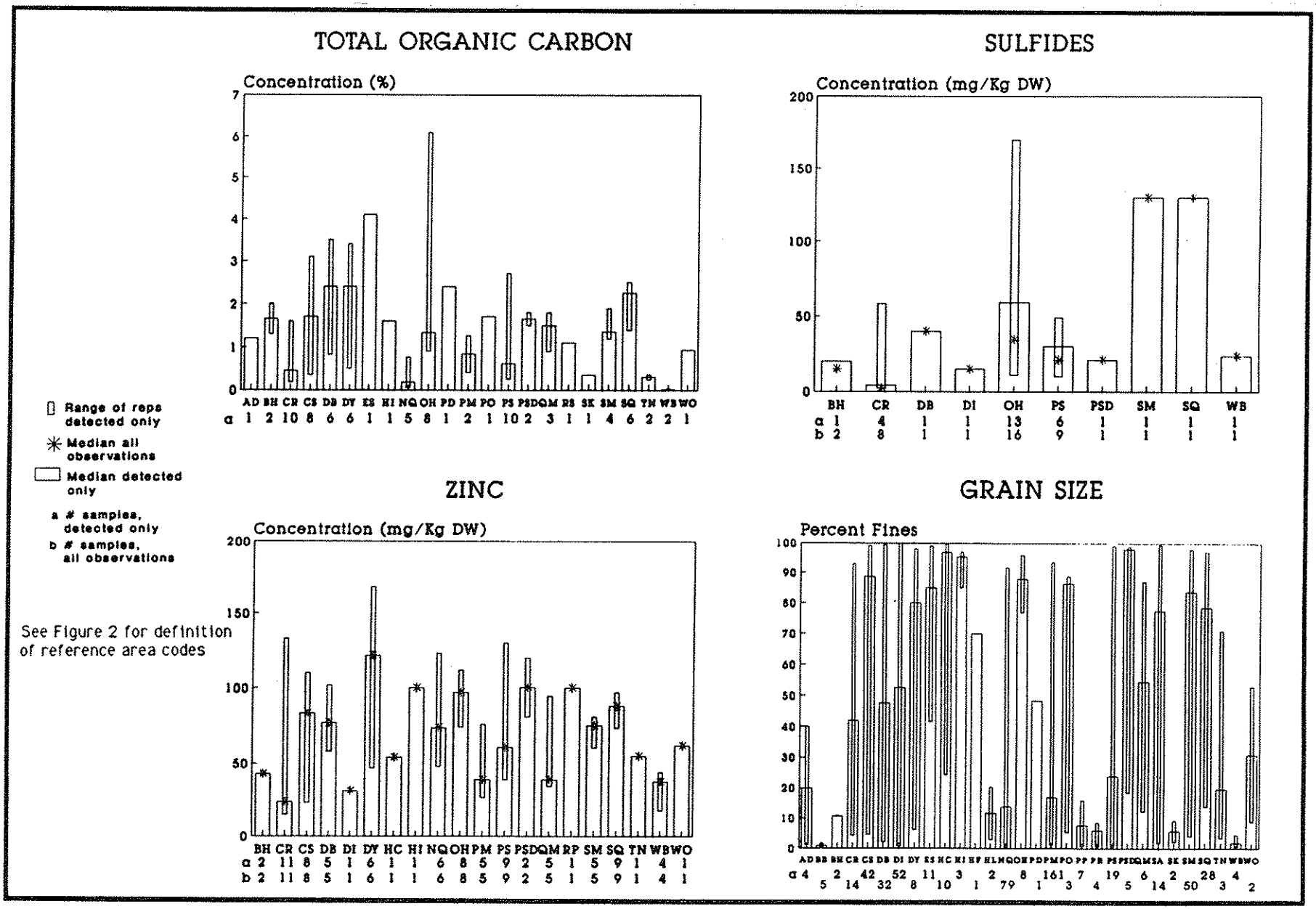
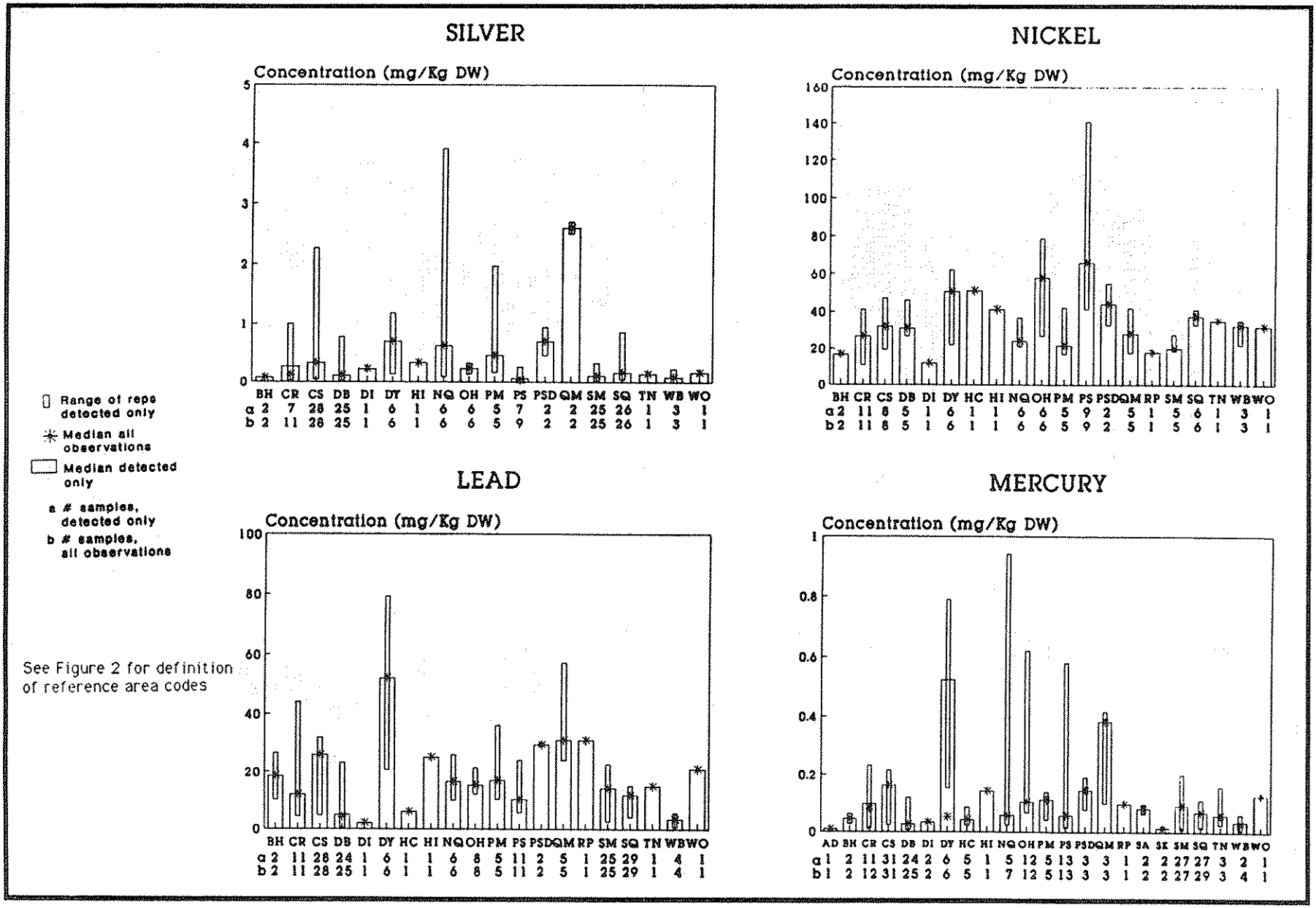


Figure 3. (Continued)



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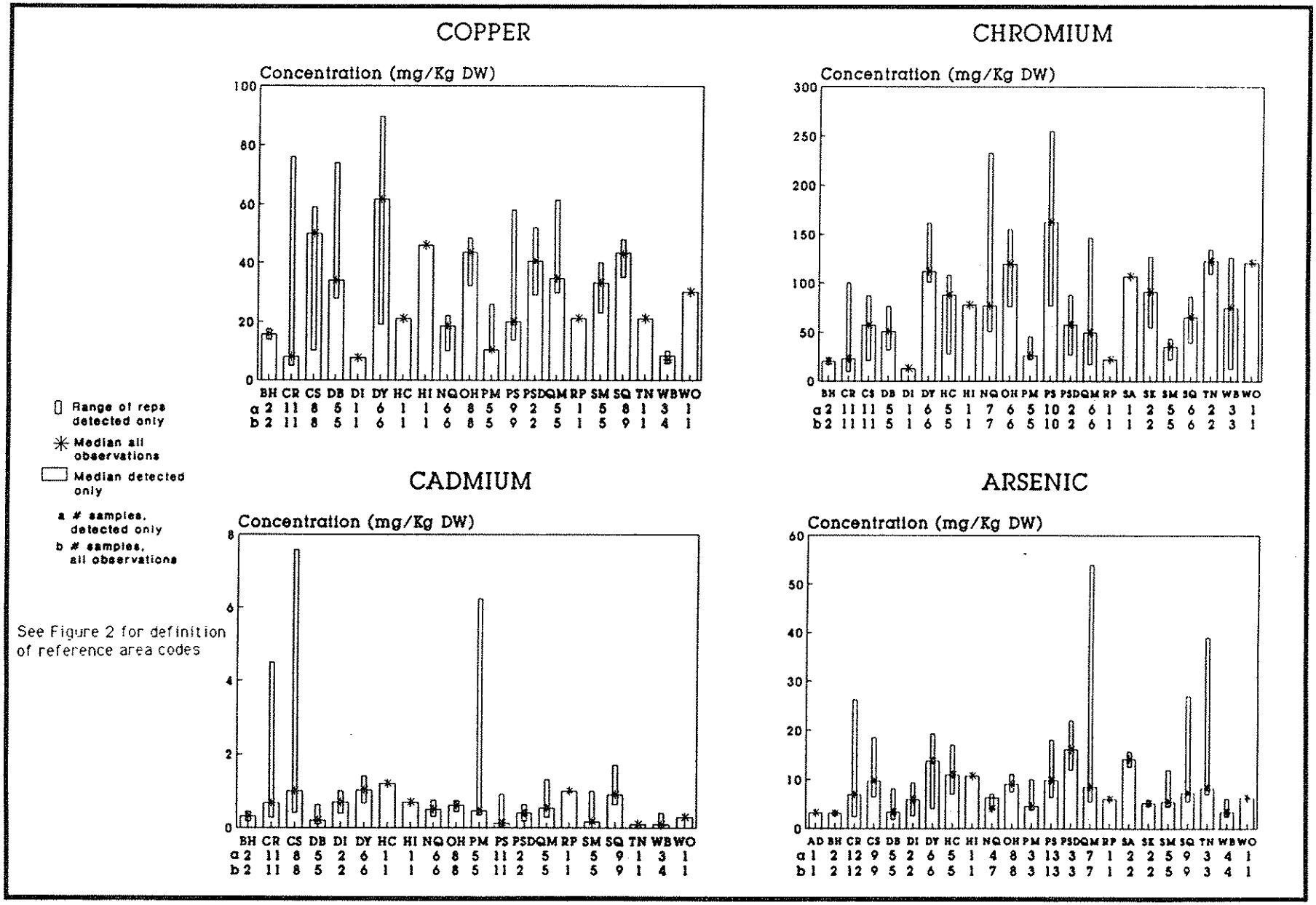


Figure 3.(Continued)

TABLE 2. SUMMARY OF CHEMICAL DATA FOR SUBTIDAL STATIONS IN POTENTIAL REFERENCE AREAS[a]

Chemical	Range of Values		Median Value
	Minimum	Maximum	
Organic Compounds (μg/kg DW[b])			
LPAH	1.4	1,100	54
HPAH	2.5	2,300	220
PCB	0.10	88	7.8
Total Phthalates	0.50	6,100	71
Inorganic Chemicals (mg/kg DW)			
Arsenic	1.9	54	8.4
Cadmium	0.04	7.6	0.60
Chromium	9.6	260	76
Copper	4.9	90	33
Lead	0.40	79	14
Mercury	0.006	0.94	0.089
Nickel	11	140	33
Silver	0.01	3.9	0.16
Zinc	15	170	76
Total Organic Carbon (% DW)	0.0	6.1	1.4
Sulfides (mg/kg, DW)	0.70	170	21

[a] This analysis includes detected data only from studies that passed QA review.

[b] DW = dry weight.

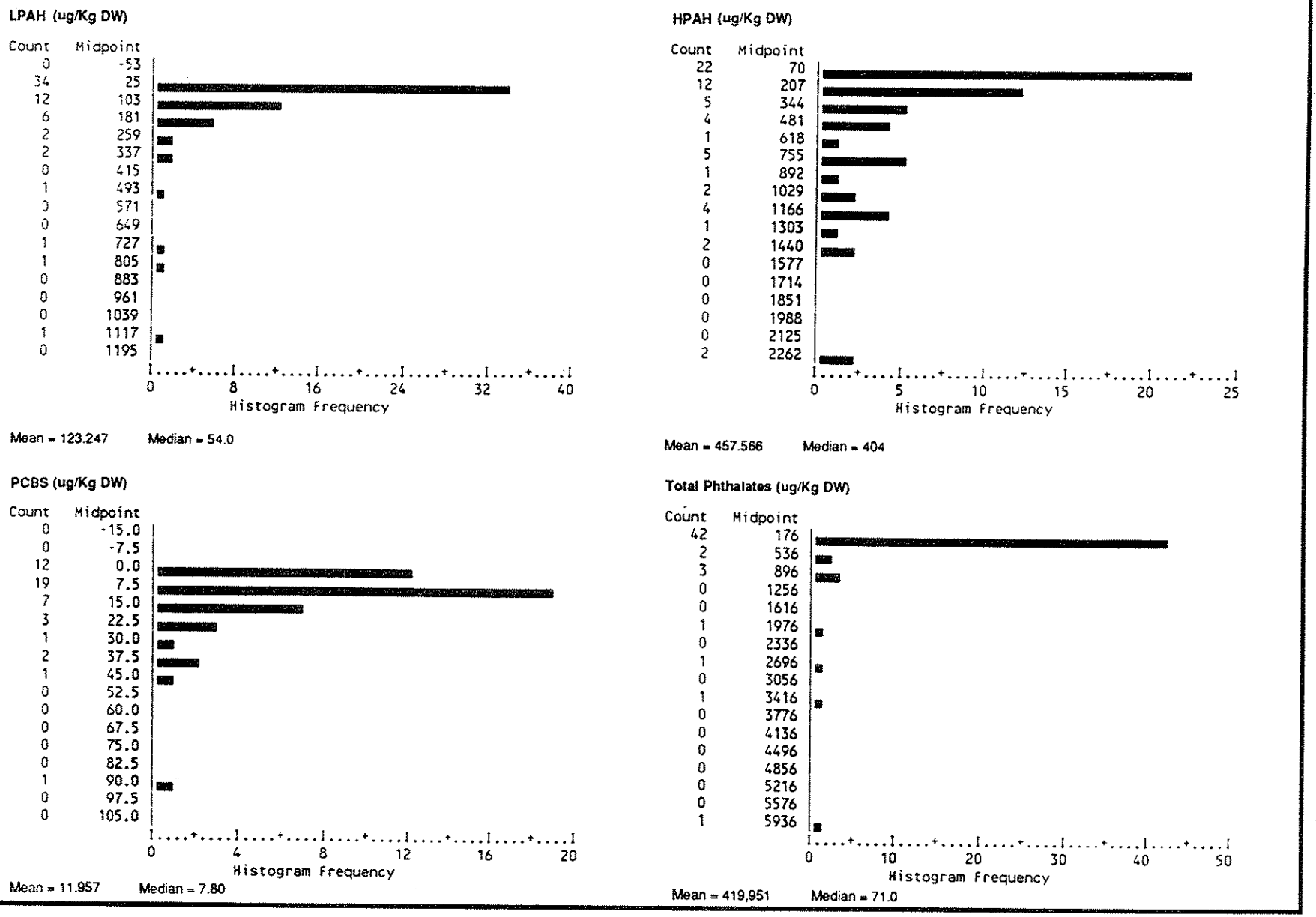
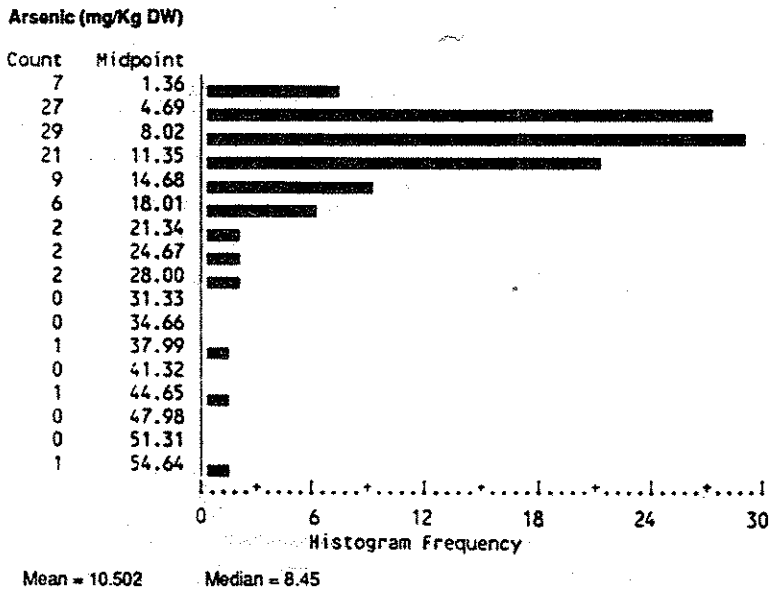
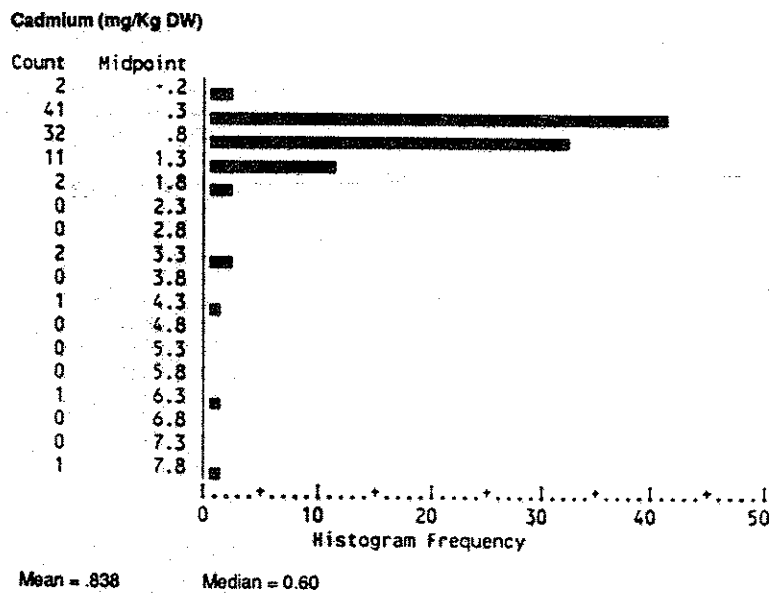
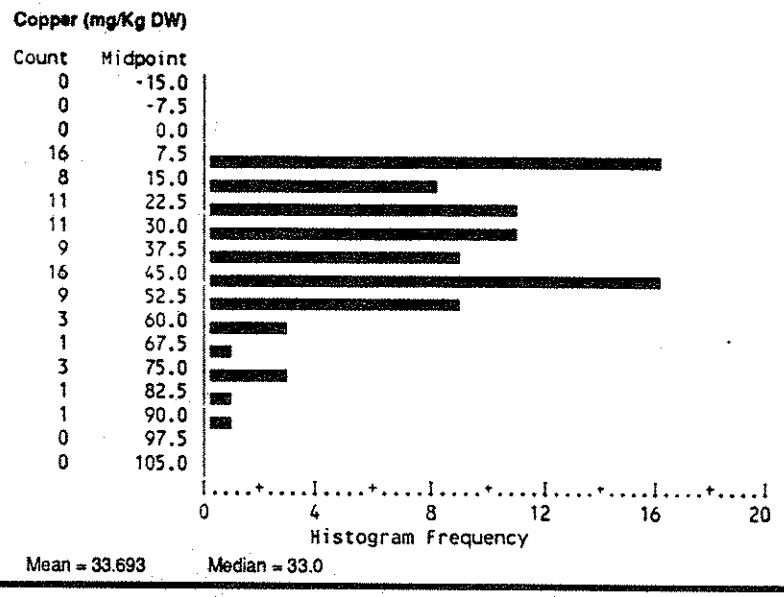


Figure 4. Frequency distribution histograms for chemical and conventional variables







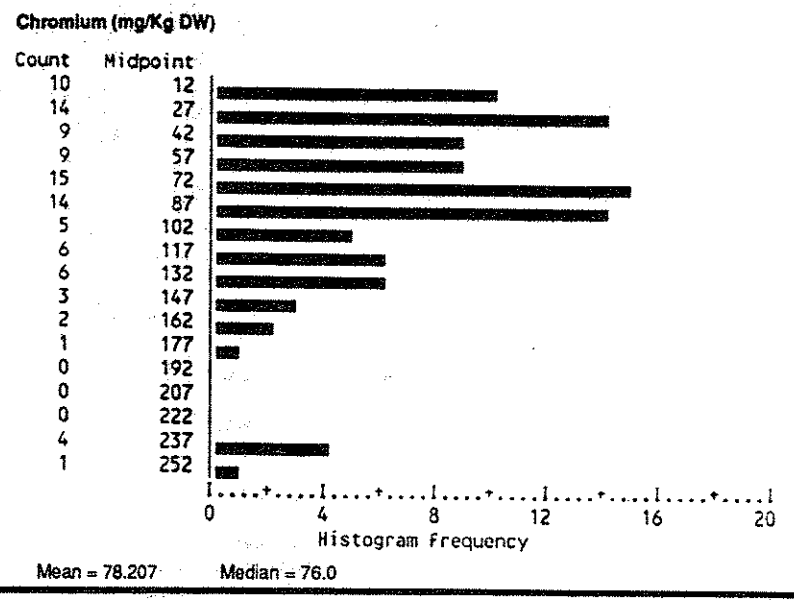
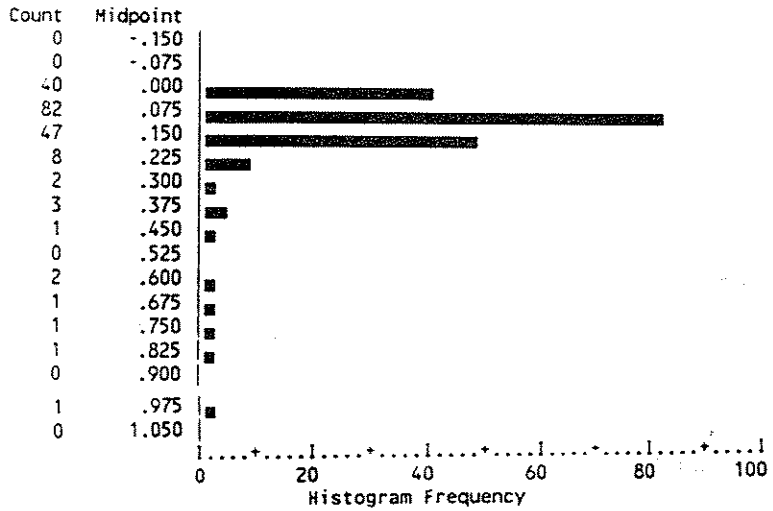


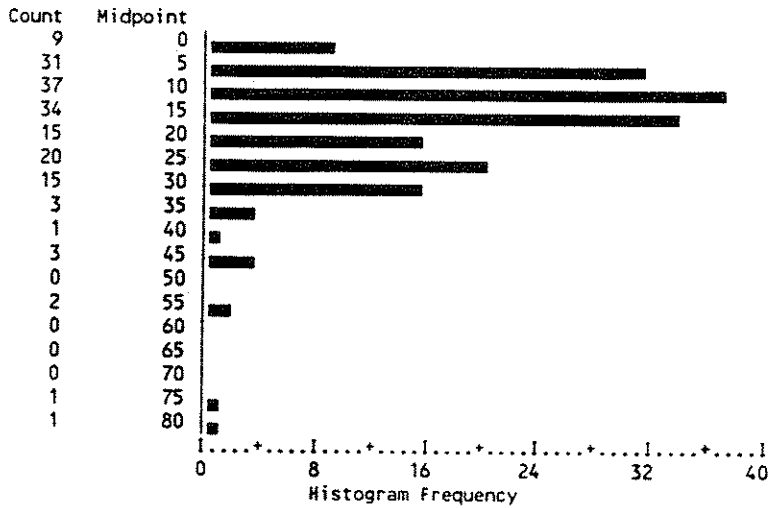
Figure 4.(Continued)

Mercury (mg/Kg DW)



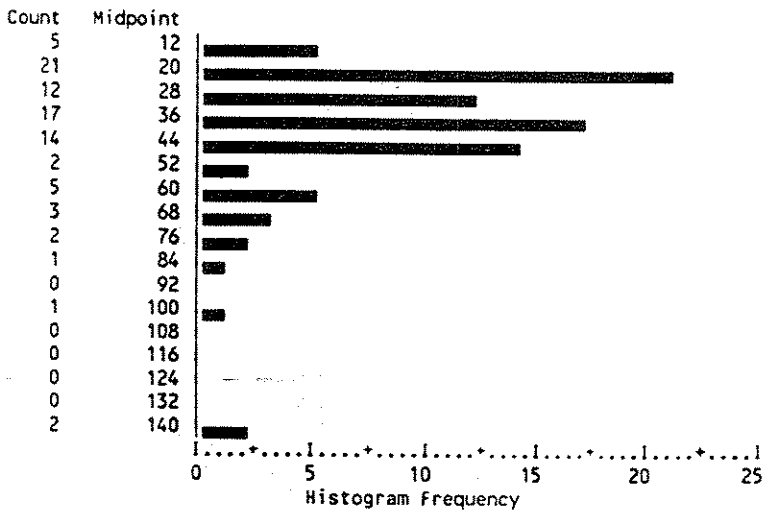
Mean = 0.118 Median = 0.089

Lead (mg/Kg DW)



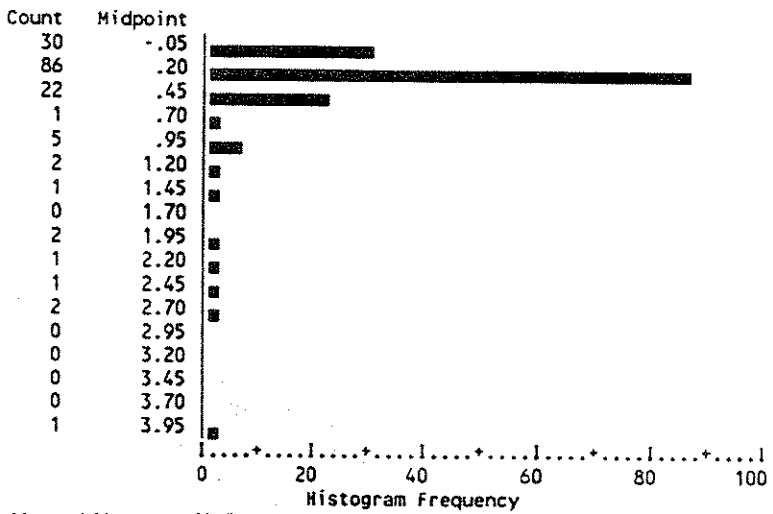
Mean = 16.494 Median = 13.8

Nickel (mg/Kg DW)



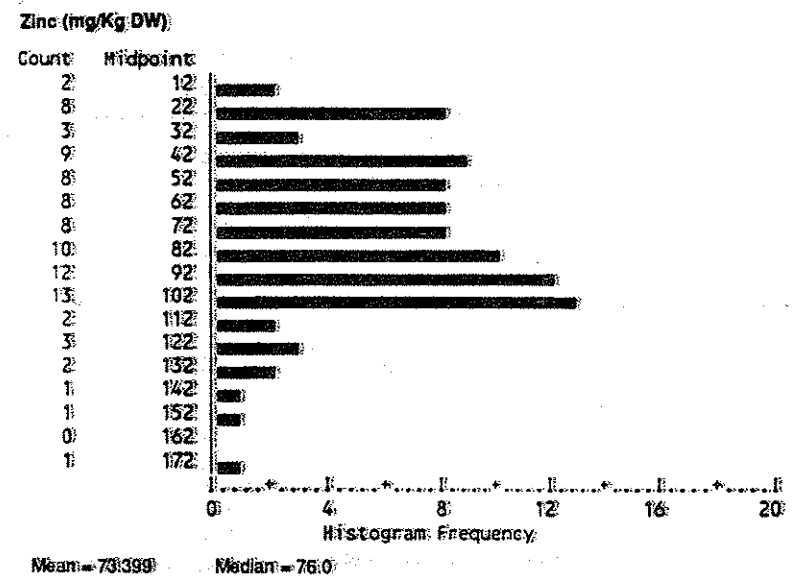
Mean = 38.140 Median = 33.0

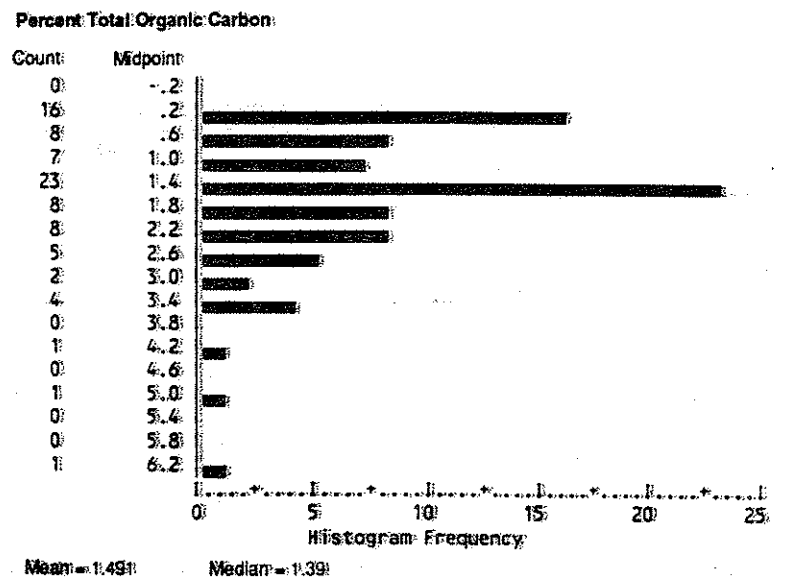
Silver (mg/Kg DW)

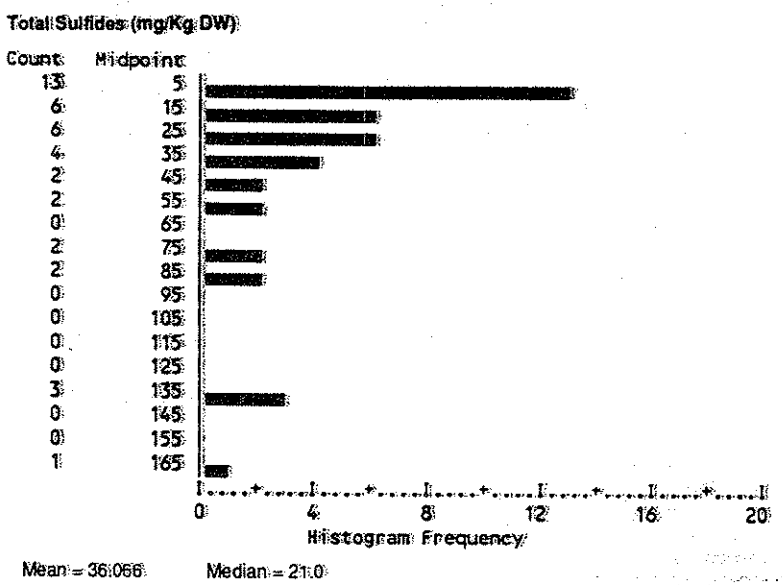


Mean = 0.336 Median = 0.16

Figure 4.(Continued)







See Figure 2 for definition of reference area codes

Figure 4.(Continued)

TABLE 3. SUMMARY OF CHEMICAL CONCENTRATIONS AND CONVENTIONAL VARIABLES FOR SELECTED REFERENCE AND NONREFERENCE AREAS OF PUGET SOUND[a,b]

Chemical	Potential Reference Area		Nonreference Area[b,c]	
	Minimum	Maximum	Minimum	Maximum
Metals (mg/kg DW)				
Antimony	0.041	9.5	0.1	1,370
Arsenic	1.9	54	0.34	9,700
Cadmium	0.04	7.6	0.3	184
Chromium	9.6	260	5.4	555
Copper	4.9	90	3.6	11,400
Lead	0.4	79	0.79	71,100
Mercury	0.006	0.94	0.06	52
Nickel	11	140	6.9	118
Silver	0.01	3.9	0.013	8.27
Zinc	15	170	18.4	6,010
Organic Compounds (μg/kg DW)				
LPAH	1.4	1,100	1.3	630,000
HPAH	2.5	2,300	7.5	3,200,000
1,4,-Dichlorobenzene	0.5	4	1	31,000
Hexachlorobenzene (HCB)	0.03	0.31	0.05	730
Hexachlorobutadiene	0.2	0.89	1	730
N-Nitrosodiphenylamine	U0.2	U2,500	4	610
4-Methylphenol	2	560	3	100,000
Phenol	5	1,800	0.9	2,900
Total PCB	0.1	88	0.5	9,600
Tributyltin	1.7	100	--	--
Conventional Sediment Variables				
Total organic carbon (% DW)	0.056	6.1	0.06	29
Fine-grained material (% DW)	0	100	2.7	96
Sulfides (mg/kg DW)	2.2	170	1	7,600

[a] "U" indicates undetected in all samples over the detection limit range shown; otherwise the minimum value is the lowest detected concentration and the maximum value is the highest detected concentration (detection frequencies are not indicated but are less than 100 percent for most chemicals except metals).

[b] Ranges are based only on biological stations used in the evaluation of Puget Sound AET (Barrick et al. 1988). Higher concentrations for some chemicals have been detected in sediment samples for which there are no biological data, including several samples collected at depth.

[c] Most data for nonreference areas are from industrialized urban embayments. Nonreference data include **both** nonimpacted and impacted stations. Impacted stations are those that exhibited statistically significant biological effects (Barrick et al. 1988).

Fourteen reference areas have stations where the concentration(s) of one or more chemicals in sediments exceeded the 95th percentile of the frequency distribution(s) of contaminant concentrations. A summary of these stations and the variables that exceeded the 95th percentile concentrations is presented in Table 4. A summary of potential sources for chemical contaminants found in these potential reference areas is provided in Table 5. The 95th percentile was chosen to identify selected sites with relatively high concentrations of contaminants in sediments. Nevertheless, exceedance of the 95th percentile is not necessarily indicative of potential biological effects (information on predicted biological effects is presented in the section below on AET comparisons). Also, note that the 95th percentile was not proposed as the interim performance standard (see below, Development of Performance Standards, Interim Performance Standards).

There are two cases where elevated concentrations of contaminants (exceeding 95th percentile) shown in Table 4 may be artifacts of laboratory analyses. The first case is elevated levels of total phthalates in Port Madison sediments. Laboratory contamination could be contributing to these elevated levels, because di-n-octyl phthalate and butyl benzyl phthalate commonly show high levels as a result of random laboratory events. The second case is elevated concentrations of nickel and chromium in Port Susan sediments. All but one sample from the Port Susan stations identified in Table 4 were analyzed most recently by the "total metals" digestion method. In one case, (i.e., Station PSR-01), the data were reported as the average of the results from the total metals and strong acid digestion techniques. The strong acid digestion or x-ray fluorometry method was used in the majority of the studies included in the database (Table 3). PTI (1988) has shown that the total digestion method can result in consistently higher recoveries for metals, and for lead, arsenic, and nickel in particular. Thus, the elevated levels of nickel [and potentially chromium, although the methods comparison by PTI (1988) did not evaluate chromium] reported for Port Susan stations in the most recent studies could be the result of changes in analytical methods and not the result of any significant differences in the levels of these metals. Previous studies analyzing for nickel and chromium at these same stations using the strong acid digestion did not show similar high values.

AET Comparisons

In most of the potential reference areas evaluated, the concentration of at least one contaminant in sediment exceeded 1988 Puget Sound LAET. A summary by potential reference area of the LAET exceedances observed in this comparison is presented in Table 6 (for details see Appendix D). LAET exceedances were greatest or more prevalent in Blakely Harbor, Dyes Inlet, Oak Harbor, Port Madison, Port Susan, and Quartermaster Harbor.

PSDDA Screening Level Comparisons

A summary by potential reference area of the 1988 PSDDA SL exceedances observed in this comparison is presented in Table 7 (for details, see Appendix D). Nineteen of the potential reference areas had one or more sediment contaminants that exceeded PSDDA SL.

TABLE 4. SUMMARY OF STATIONS EXCEEDING 95th PERCENTILE CHEMICAL CONCENTRATIONS

Potential Reference Area	Station Identifier	Chemicals >95th Percentile[a]
Blakely Harbor	BH-01	LPAH
Carr Inlet	CRR01	Cadmium
	CARRINL	PCB
	NG-10	Arsenic, copper, lead, zinc
	NG-11	Lead
Case Inlet	CS-62	Cadmium, silver
	CS-63	Cadmium, silver
	CS-17	Cadmium
Dabob Bay	DBE	TOC
	DB-15	Copper
Dyes Inlet	DY-4	Lead, mercury, zinc, copper, silver, LPAH, HPAH
	DY-5	Mercury, lead, copper, zinc
	DY-6	Mercury, lead, copper, zinc, TOC
	DY-2	Mercury, lead
East Sound	ES-73	TOC
Nisqually Reach	NISQ1	Silver, mercury
	NISQ2	Chromium, zinc
	NISQ3	Silver
Oak Harbor	OH-3	Nickel
	OH-1	TOC
	OH-C3	Sulfides, mercury
	OH-B4	Sulfides
	OH-D1	HPAH
	OH-2	TOC
Port Madison	PM-73	PCB, phthalates, lead
	PM-06	Cadmium, silver
	PM-07	Silver, cadmium
	PM-72	Phthalates
	PM-71	Phthalates
Port Susan	PS-00	Mercury
	PS-01	Nickel, chromium
	PS-02	Chromium, nickel
	PS-03	Chromium
	PSR-01	Nickel, zinc
	PS-25	Mercury

TABLE 4. (Continued)

Potential Reference Area	Station Identifier	Chemicals >95th Percentile[a]
Quartermaster Harbor	QM-1	Lead, arsenic, mercury, silver, LPAH, HPAH
	QM-2	Arsenic, silver, LPAH, mercury, lead
	QM-01	Arsenic
Samish Bay	SM-01	Total phthalates
	Samish	Sulfides
Sequim Bay	Sequim 17	PCB, arsenic, sulfides
Tacoma Narrows/Cormorant Passage	TN-01	Arsenic

[a] Chemicals for which concentrations exceeded the 95th percentile concentrations in sediments of potential reference areas.

TABLE 5. SUMMARY OF POTENTIAL SOURCES OF CONTAMINANTS BY POTENTIAL REFERENCE AREA[a]

Potential Reference Area	Historical Source	Current Source
Blakely Harbor	Lumber mill at Thatcher	Marina
Carr Inlet	Small lumber mill	Small marina in Lake Bay Possible transport of pollutants from a contaminated site in Burley Lagoon
Case Inlet	Lumber milling activities	9's Fairharbor Marina at Allyn Sargent Oyster Company in Allyn[b]
Dabob Bay	Logging and lumber mill activities	Large marina at Brinnon Oiled telemetry cables used to monitor naval torpedo experiments
Dyes Inlet	Manette sewage treatment plant Charleston Sewage treatment plant	PhotoDynamics Company discharge[b] 3 marinas Advective transport from U.S. naval shipyard in Sinclair Inlet
East Sound		2 small marinas East Sound Water District[b] Rosario Resort[b] East Sound bulk plant (operated by Chevron, Inc.)
Nisqually Reach		DuPont de Nemours explosives manufacturing plant
Oak Harbor	Lumber milling activities	Marina City of Oak Harbor municipal discharge[b] Melco Manufacturing Chevron U.S.A. bulk plant Island County landfill
Port Madison	Sawmilling operations	Suquamish sewage treatment plant[b] Small marina

TABLE 5. (Continued)

Potential Reference Area	Historical Source	Current Source
Port Susan	Military munitions storage at Tulalip	Stanwood sewage treatment plant Tulalip Indian Reservation Marine disposal landfill leachate Boeing test facility in Tulalip
Possession Sound		Alderwood Water District[b] Olympus Terrace sewer district Ferry terminal at Clinton on Whidbey Island Small marina on Gedney Island
Quartermaster Harbor	Drydocking facilities Lumber milling activities	Small marina Medium marina City of Burton sewage treatment plant[b] Island Springs food processing discharge[b]
Samish Bay	Logging and lumber mill activities	Rock Point Oyster Company NPDES permitted source in the city of Edison[b]
Sequim Bay	Lumber milling activities Sequim Bay State Park septic wastes City of Sequim	Log sort yard City of Sequim[b] Sequim containment site
Tacoma Narrows/ Cormorant Passage	Paper/pulping activities	South Sound marina Boise-Cascade in Steilacoom[b] City of Steilacoom municipal sewer system[b] Ketron Island Enterprise municipal sewer system[b] Washington Corrections municipal sewer system on McNeil Island[b]

[a] Tetra Tech (1988).

[b] NPDES permitted discharges.

TABLE 6. SUMMARY OF LAET EXCEEDANCES BY REFERENCE AREA

Location	Chemical Exceeded	Ratio of Number of Exceedances to Number of Samples	LAET Exceedance Ratios	Maximum Concentration[a]
Blakely Harbor	Butylbenzyl phthalate	2/2	2.2-2.5	160
Carr Inlet	Phenol	1/8	4.3	1,800
	Sulfides	1/8	1.3	58
Case Inlet	Phenol	1/4	1.3	560
	Cadmium	1/8	1.5	7.6
Dyes Inlet	Mercury	3/6	1.0-1.9	Z 0.79
Nisqually Reach	Mercury	1/5	2.3	0.94
Oak Harbor	Fluoranthene[b]	1/10	2.7	4,000
	Pyrene[b]	1/10	1.6	4,100
	Benz(a)anthracene[b]	1/10	1.0	1,400
	Chrysene[b]	1/10	1.1	1,600
	Mercury	1/12	1.1	0.62
	Sulfides	7/16	1.3-3.8	170
Port Madison	Di-n-butyl phthalate	1/3	2.8	3,900
	Di-n-octyl phthalate	3/3	28.4-128.0	3,200
	Cadmium	1/5	1.2	6.3
Port Susan	HPAH[c]	1/10	2.3	E 28,000
	Dibenz(a,h)anthracene[c]	1/10	1.7	E 390
	Anthracene[c]	1/10	1.2	1,100
	Benz(a)anthracene[c]	1/10	1.9	2,500
	Benzo(a)pyrene[c]	1/10	1.2	E 1,900
	Benzo(g,h,i)perylene[c]	1/10	1.9	E 1,300
	Chrysene[c]	1/10	4.3	6,000
	Fluoranthene[c]	1/10	2.9	5,000
	Indeno(1,2,3-cd)pyrene[c]	1/10	1.7	E 1,000
	Pyrene[c]	1/10	1.7	4,500
	Benzofluoranthenes[c]	1/10	1.6	5,200
	Perylene	1/10	1.1	260
	Di-n-octyl phthalate	1/9	2.2	E 56
	Mercury	1/13	1.4	0.58
	Sulfides	1/9	1.1	49
Quartermaster Harbor	Fluorene	1/4	1.9	M 1,000
	Di-n-octyl phthalate[d]	4/4	10.8-31.2	780
	Mercury	1/4	1.0	0.42
Samish Bay	Bis(2-ethylhexyl) phthalate	1/5	2.2	2,800
	Di-n-octyl phthalate	3/5	6.4	1,160
	Sulfides	1/1	2.9	130
Sequim Bay	Sulfides	1/1	2.9	130

[a] Organic compound concentrations are expressed in parts per billion (μg/kg DW). Sulfides and metals concentrations are expressed in parts per million (mg/kg DW). See Appendix C for definitions of qualifier codes.

[b] LAET was exceeded in a composite sample only.

[c] LAET was exceeded at an intertidal station only.

[d] One of these four LAET exceedances (not the highest) was observed at an intertidal station.

TABLE 7. SUMMARY OF PSDDA SCREENING LEVEL EXCEEDANCES BY POTENTIAL REFERENCE AREA

Location	Chemical Exceeded	Ratio of Number of Exceedances to Number of Samples	SL Exceedance Ratios	Maximum Concentration[a]
Blakely Harbor	LPAH	1/2	1.2	750
	Fluorene	1/2	2.0	130
	Phenanthrene	1/2	1.1	340
	Diethylphthalate	2/2	1.3-2.1	200
	Phenol	1/2	1.6	190
	2,4 - Dimethylphenol	1/2	1.8	18
Carr Inlet	Phenol	1/8	15.0	1,800
	Benzoic Acid	1/6	2.0	430
	Antimony	3/11	1.7-3.7	9.5
	Cadmium	5/11	1.2-4.7	LM 4.5
	Mercury	1/12	1.1	0.23
	Nickel	4/11	1.2-1.5	41
Case Inlet	Phenol	1/4	4.7	560
	Cadmium	4/8	1.2-7.9	7.6
	Mercury	1/31	1.0	0.215
	Nickel	5/8	1.1-1.7	47
	Silver	2/28	1.5-1.9	2.3
Dabob Bay	Nickel	4/5	1.1-1.6	46
	Cadmium	1/5	1.0	1.0
Dyes Inlet	Acenaphthene	1/6	1.4	87
	HPAH	1/6	1.3	2,300
	Indeno(1,2,3-c,d)pyrene	4/6	1.3-2.3	160
	Cadmium	4/6	1.0-1.5	1.4
	Copper	1/6	1.1	90
	Lead	2/6	1.1-1.2	79
	Mercury	5/6	1.5-3.8	Z 0.79
	Nickel	5/6	1.5-2.2	62
	Zinc	1/6	1.1	170
Henderson Inlet	Nickel	1/1	1.5	41
Nisqually Reach	Mercury	1/5	4.5	0.94
	Nickel	3/6	1.0-1.3	37
	Silver	2/6	2.3-3.3	3.9
Oak Harbor	LPAH[b]	1/8	1.2	720
	Phenanthrene[b]	1/8	2.3	720
	HPAH[b]	1/8	8.9	16,000
	Fluoranthene[b]	1/8	7.3	4,600
	Pyrene[c]	4/8	9.5	4,100
	Benz(a)anthracene[b]	1/8	3.1	1,400
	Chrysene[b]	1/8	2.4	1,600
	Benzofluoranthenes[b]	1/8	3.6	2,900
	Benzo(a)pyrene[b]	1/8	1.6	1,100
	Mercury[d]	4/12	1.2-3.0	0.62
	Nickel	5/6	1.3-2.8	79

TABLE 7. (Continued)

Location	Chemical Exceeded	Ratio of Number of Exceedances to Number of Samples	SL Exceedance Ratios	Maximum Concentration[a]
Port Madison	Indeno(1,2,3-c,d)pyrene	2/3	1.1-1.4	98
	Di-n-butyl phthalate	1/3	2.8	3,900
	Cadmium	2/5	3.2-6.6	6.3
	Nickel	2/5	1.1-1.5	42
	Silver	2/5	1.3-1.1	2.0
Port Susan	LPAH[f]	1/10	5.9	E 3,600
	Acenaphthylene[f]	1/10	7.7	E 490
	Acenaphthene[f]	1/10	2.1	E 130
	Fluorene[f]	1/10	4.2	E 270
	Phenanthrene[f]	1/10	4.7	1,500
	Anthracene[f]	1/10	8.5	1,100
	2-methylnapthalene[f]	1/10	1.1	E 75
	HPAH[f]	1/10	15.6	E 28,000
	Fluoranthene[f]	1/10	7.9	5,000
	Pyrene[f]	1/10	10.5	4,500
	Benz(a)anthracene[f]	1/10	5.6	2,500
	Chrysene[f]	1/10	9.0	6,000
	Benzofluoranthenes[f]	1/10	6.5	5,200
	Benzo(a)pyrene[f]	1/10	2.8	E 1,900
	Indeno(1,2,3-c,d)pyrene[f]	1/10	14.5	E 1,000
	Dibenz(a,h)anthracene[f]	1/10	3.3	E 390
	Benzo(g,h,i)perylene[f]	1/10	2.4	E 1,300
	Phenol[e]	3/9	1.2-3.3	E 400
	4-Methylphenol	2/9	1.2-2.4	290
	Dibenzofuran[f]	1/9	2.4	E 130
	Antimony	2/11	1.0-1.1	2.9
	Mercury	2/13	1.7-2.8	E 0.58
	Nickel[e]	9/9	1.5-5.0	140
Possession Sound	Antimony	1/3	5.0	13
	Nickel	2/3	2.0	55
President Point	Anthracene	1/2	1.2	150
Quartermaster Harbor	LPAH	2/4	1.4-1.8	1,100
	Fluorene	1/4	15.6	M 1,000
	Phenanthrene	1/4	2.2	690
	HPAH	1/4	1.3	2,300
	Pyrene	1/4	1.2	530
	Indeno(1,2,3-cd)pyrene	2/4	1.2-2.8	190
	Antimony	1/2	1.4	3.6
	Cadmium	1/6	1.4	1.3
	Mercury	2/4	1.8-2.0	0.42
	Nickel	2/6	1.4-1.5	42
	Silver[e]	3/3	1.3-2.3	2.7
Samish Bay	Cadmium	1/5	1.0	0.99
Sequim Bay	2-Methylnaphthalene	1/10	2.4	160
	Cadmium	2/9	1.2-1.8	1.7
	Nickel	5/6	1.2-1.5	41
	4-Methylphenol	1/2	4.7	560
Skagit Bay	Nickel[b]	3/4	1.0-1.2	33
Tacoma Narrows/ Cormorant Passage	Antimony	1/3	4.6	12

TABLE 7. (Continued)

Location	Chemical Exceeded	Ratio of Number of Exceedances to Number of Samples	SL Exceedance Ratios	Maximum Concentration[a]
West Beach	Chrysene	1/3	1.0	690
	Nickel	2/3	1.2-1.3	35
Wollochet Bay	Nickel	1/1	1.1	32

[a] Organic compound maximum concentrations are expressed in parts per billion (μg/kg DW). Sulfides and metals maximum concentrations are expressed in parts per million (mg/kg DW). See Appendix C for definitions of qualifier codes.

[b] Screening level was exceeded in composite samples only.

[c] Two of the four screening level exceedances indicated for this compound were in composite samples.

[d] One of the four screening level exceedances indicated for this compound was in a composite sample.

[e] One of the screening level exceedances indicated for this compound occurred at an intertidal station.

[f] Screening level was exceeded at an intertidal station only.

AMPHIPOD BIOASSAY

Data that passed QA review for the amphipod bioassay were available for 12 potential reference areas sampled during 13 surveys. The 12 areas are Blakely Harbor, Carr Inlet, Case Inlet, Dabob Bay, Discovery Bay, Oak Harbor, Padilla Bay, Port Susan, Possession Sound, Poverty Bay, Samish Bay, and Sequim Bay. Areas with the most data based on replicated bioassays include Carr Inlet (6 stations with replicated data), Case Inlet (5 stations), Dabob Bay (8 stations), Oak Harbor (9 stations), Port Susan (8 stations), Samish Bay (5 stations), and Sequim Bay (9 stations). The total number of stations sampled in each area (replicated and nonreplicated data) is shown in Table B-2 of Appendix B. The data are summarized by area in Figure 5. A broad range of mean values of percent mortality was observed among stations within some of the potential reference areas (e.g., 7-36 percent mortality for Dabob Bay, 10-37 percent mortality for Port Susan, 20-47 percent mortality for Samish Bay, and 6-37 percent mortality for Sequim Bay).

The ranges of individual replicate observations and mean percent mortality for the amphipod bioassay are summarized in Table 8. The maximum observed value of percent mortality was 51 percent at the single station in Possession Sound (PSDDA Station PGB-02). The data for amphipod mortality were analyzed to obtain the frequency distributions shown in Figure 6. The frequency distribution of individual (single beaker) observations was strongly skewed toward low values of percent mortality, with a primary mode at 0-5 percent mortality. Approximately 10 percent of the values were greater than 40 percent mortality. All potential reference areas except Blakely Harbor, Oak Harbor, Padilla Bay, and Poverty Bay displayed some individual replicate values of percent mortality $\geq$40. The frequency distribution of mean (station) mortality observations appeared approximately lognormal, with a primary mode at 11-13 percent and a secondary mode at 23-25 percent mean mortality. The frequency of mean amphipod mortality values $\geq$25 percent for each area is shown in Table 9. The 95th percentile of the distribution of mean mortality values was equal to 43 percent. Areas with mean values of percent mortality above the 95th percentile included Case Inlet, Samish Bay, and Possession Sound.

The model of DeWitt et al. (1988) relating toxicity response in the amphipod bioassay to percent fine-grained material in sediments of potential reference areas is generally consistent with the data compiled during the present study (Figure 7). Most of the data compiled during this project were also included in the analyses of DeWitt et al. (1988). The 95 percent prediction limit on amphipod survival, which was proposed by DeWitt et al. (1988) as a guideline for defining toxic sediments (see above; Figure 1), was converted to percent mortality and plotted in the upper panel of Figure 7. In this case, mean mortality values greater than the 95 percent prediction limit for reference areas derived from the model of DeWitt et al. (1988) were assumed to indicate toxic sediments. Eight stations clearly had mean mortality values greater than the guideline derived from the model of DeWitt et al. (1988): Station CR-11 in Carr Inlet; Stations PS-02-G and PS-03-G in Port Susan; Stations CS1, CS-15, and CS-17 in Case Inlet; Station SM-03 in Samish Bay; and Station PGB-02C in Possession Sound (Table 9).

BIVALVE LARVAE BIOASSAY

Data that passed QA review for the bivalve larvae bioassay were available for three potential reference areas sampled during two surveys. The three areas are Carr Inlet, Port Susan, and Possession Sound. Four stations were sampled in Carr Inlet in 1984, and sediments were assayed using *Crassostrea gigas*. Each of the other areas is represented by a single station sampled during 1988, with sediments assayed using *Mytilus edulis*. The data are summarized by area in Figure 5.

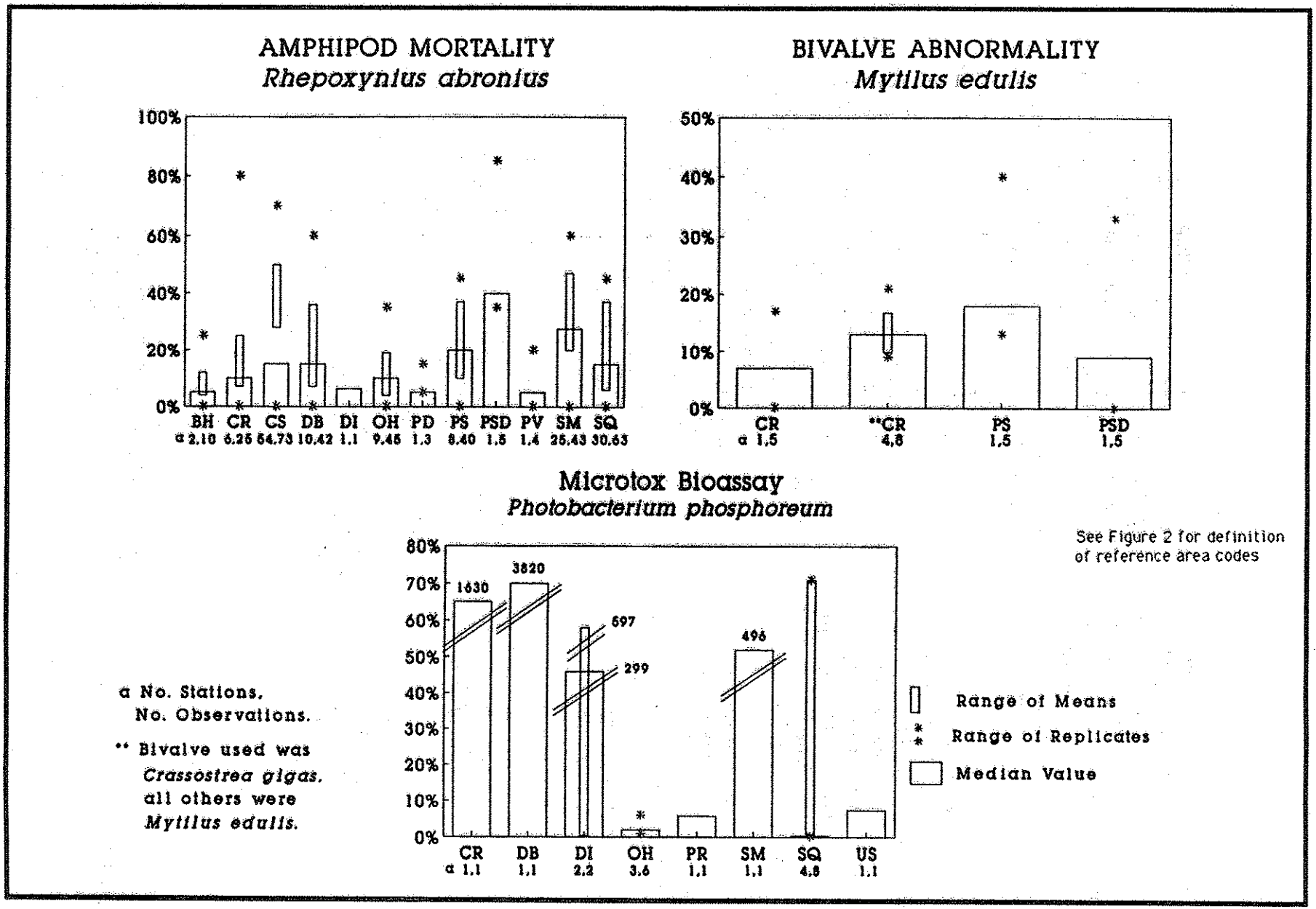


Figure 5. Amphipod, bivalve larvae, and microtox bioassay responses for potential reference areas

TABLE 8. SUMMARY OF BIOLOGICAL DATA FOR POTENTIAL REFERENCE AREAS

Variable	Individual Values				Means[a]		
	Minimum	Maximum	Median[b]	(n)	Minimum	Maximum	(n)
Bioassay							
Amphipod mortality (%)	0	85	15	(349)	4.0	51	(60)
Bivalve larvae abnormality (%)	0	40	13	(23)	3.1	17	(7)
Microtox (O) EC_{50} (μL/mL)[c]	0.36	3,820	6.5	(24)	0.36	3,820	(11)
Benthic Taxa							
Polychaetes (no./m^2)	383	4,580	1,440	(56)	473	3,120	(14)
Gastropods (no./m^2)	0	950	85	(56)	16	600	(14)
Bivalves (no./m^2)	17	3,460	1,160	(56)	120	3,180	(12)
Amphipods (no./m^2)	10	2,330	95	(56)	26	1,490	(14)
Total (no./m^2)	750	8,550	4,360	(56)	1,020	7,230	(14)

[a] Range of values for stations with replicate data.

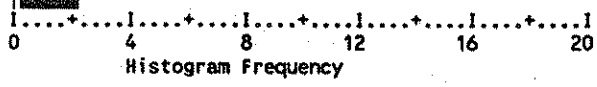
[b] Based on pooled individual replicate observations for all data entered in the database.

[c] Median effective concentration (EC_{50}) for organic extract bioassay. The single Sequim Bay sample, the five Carr Inlet samples, and each of the samples from Port Susan and Possession Sound tested in the saline extract bioassay were nontoxic (i.e., EC_{50} could not be calculated).

Mean Values

% Mortality

Count	Midpoint
2	3
4	6
7	9
11	12
4	15
5	18
4	21
6	24
5	27
3	30
0	33
4	36
0	39
2	42
0	45
1	48
2	51

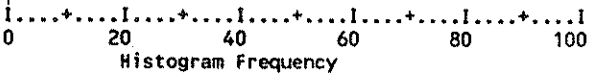


Mean 20.158

Individual Values

% Mortality

Count	Midpoint
0	-20.0
0	-12.5
0	-5.0
94	2.5
48	10.0
83	17.5
27	25.0
49	32.5
15	40.0
18	47.5
5	55.0
7	62.5
1	70.0
1	77.5
1	85.0
0	92.5
0	100.0



Mean 19.673

Note: All % mortality values should be rounded to two significant figures

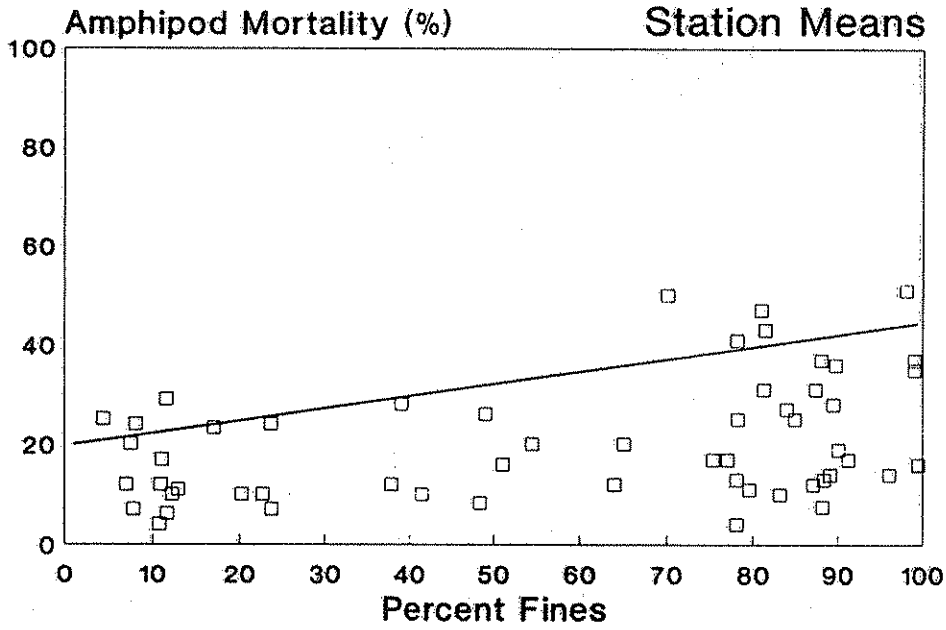
Figure 6. Frequency distributions of means and individual replicate values for percent mortality in amphipod bioassays

TABLE 9. FREQUENCY OF VALUES ≥25 PERCENT FOR MEAN AMPHIPOD MORTALITY AT POTENTIAL REFERENCE AREAS

Area	Frequency (%) ≥25	Frequency (%) "toxic"[a]	No. Stations (n)
Blakely Harbor	0	0	2
Carr Inlet	17	17	6
Case Inlet	100[b]	60	5
Dabob Bay	33[b]	0	9
Discovery Bay	0	0	1
Oak Harbor	0	0	1
Padilla Bay	0	0	1
Port Susan	25	25	
Possession Sound	100[b]	100	1
Poverty Bay	0	0	1
Samish Bay	66[b]	17	6
Sequim Bay	36[b]	0	11

[a] Frequency of studies with mean mortality greater than the upper 95 percent prediction limit were derived from the model of DeWitt et al. (1988).

[b] High percentage (>70 percent) of fine-grained material in sediments is associated with high observed mortality at some stations.



Note: Line shown in figure is the upper 95% prediction limit for mean percent mortality based on the model of Dewitt et al. (1988).

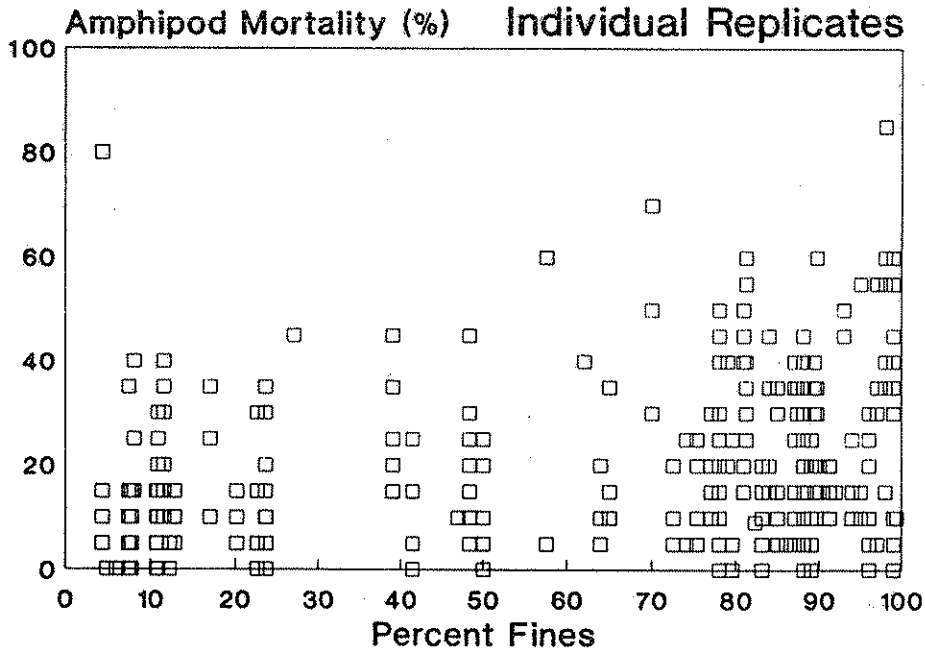


Figure 7. Percent mortality of amphipods vs. percent fine-grained material in sediments of potential reference areas

Among the four stations in Carr Inlet, there was a narrow range of mean values of percent abnormality (11-17 percent).

The data for the prevalence of developmental abnormalities in bivalve larvae were too limited to obtain a reliable frequency distribution (i.e., only 30 individual observations from seven stations were available). The range of individual replicate observations and mean percent abnormality are summarized in Table 8. All mean values of percent abnormality were less than 25 percent. The maximum was 23 percent, at Port Susan.

MICROTOX BIOASSAY

Results of the data review for Microtox bioassays of saline and organic extracts of sediments are presented below.

Saline Extract

Data that passed QA review for the Microtox saline extract bioassay were available for Carr Inlet (Williams et al. 1986; PTI 1988), Port Susan (PTI 1988), Possession Sound (PTI 1988), and Sequim Bay (Varanasi et al. 1989). Data were not available to calculate EC_{50} for four Carr Inlet samples analyzed using the Microtox saline extract bioassay. Nevertheless, data from Williams et al. (1986) showed low responses of the Microtox bioassay to Carr Inlet sediments. Percent decrease in luminescence was 1.0 for Station CR-11, -0.4 for Station CR-12, 0.9 for Station CR-13, and 1.3 for Station CR-14 (Williams et al. 1986). Saline extracts of Carr Inlet, Port Susan, and Possession Sound sediments were classified by PTI (1988) as nontoxic (EC_{50} >1,000 μL/mL). An EC_{50} for the response of Microtox bacteria to saline extracts of the Sequim Bay sample was undefined. Because the data indicated the absence of a significant dose-response relationship and low percent decrease in luminescence, this sample was classified as nontoxic by Varanasi et al. (1989).

Organic Extract

Data that passed QA review for the Microtox organic extract bioassay were available for eight potential reference areas sampled during four surveys. The eight areas are Carr Inlet, Dabob Bay, Discovery Bay, Oak Harbor, President Point, Samish Bay, Sequim Bay, and Useless Bay. The data are summarized by area in Figure 5. Carr Inlet and Dabob Bay displayed the highest EC_{50} values, indicating the relatively low toxicity of sediments from these bays to the Microtox bacterium.

The data for EC_{50} in the Microtox organic extract bioassay were too limited to obtain a reliable frequency distribution (i.e., only 13 individual observations were available). The range of individual replicate observations and EC_{50} are summarized in Table 8. All mean values of EC_{50} were greater than 0.3 μL/mL with the minimum (i.e., indicator of the highest toxicity) being 0.36 μL/mL for Discovery Bay.

BENTHIC MACROINVERTEBRATES

Data that passed QA review for benthic macroinvertebrate communities were available for four potential reference areas sampled during five surveys. The four areas are Blakely Harbor,

Carr Inlet, Port Susan, and Possession Sound. Only a few stations (1-4) were sampled in each area, although several stations in Port Susan were sampled twice (one year apart). Because the four areas were sampled during different seasons, the data are not directly comparable. The median abundance of each major taxon generally varied little among the three embayments (Figure 8; also see PTI and Tetra Tech 1988b). In contrast, the corresponding mean abundances varied by more than an order of magnitude among stations within and among embayments (Figures 8 and 9). Overall, the macroinvertebrate fauna at the single station in Possession Sound (PSDDA Station PGB-02) were less abundant than at stations in the embayments. Compared to the other taxa evaluated, the abundance of polychaetes showed less variation among stations.

Frequency distributions of benthic macroinvertebrate abundances in individual grab samples are shown in Figures 10 and 11. Data for mean abundances were too limited to derive a similar frequency distribution. The frequency distribution of individual observations was skewed toward low abundance values for gastropods and amphipods. The polychaete abundance distribution appeared lognormal, and the distribution of bivalve abundance values appeared to have two strong modes. The distribution of total macroinvertebrate abundance values may have multiple modes, but they are indistinct. Further data are needed to verify the presence of multiple modes in frequency distributions of benthic taxa abundance data and to determine their relationship to substrate texture, season of sampling, or other factors.

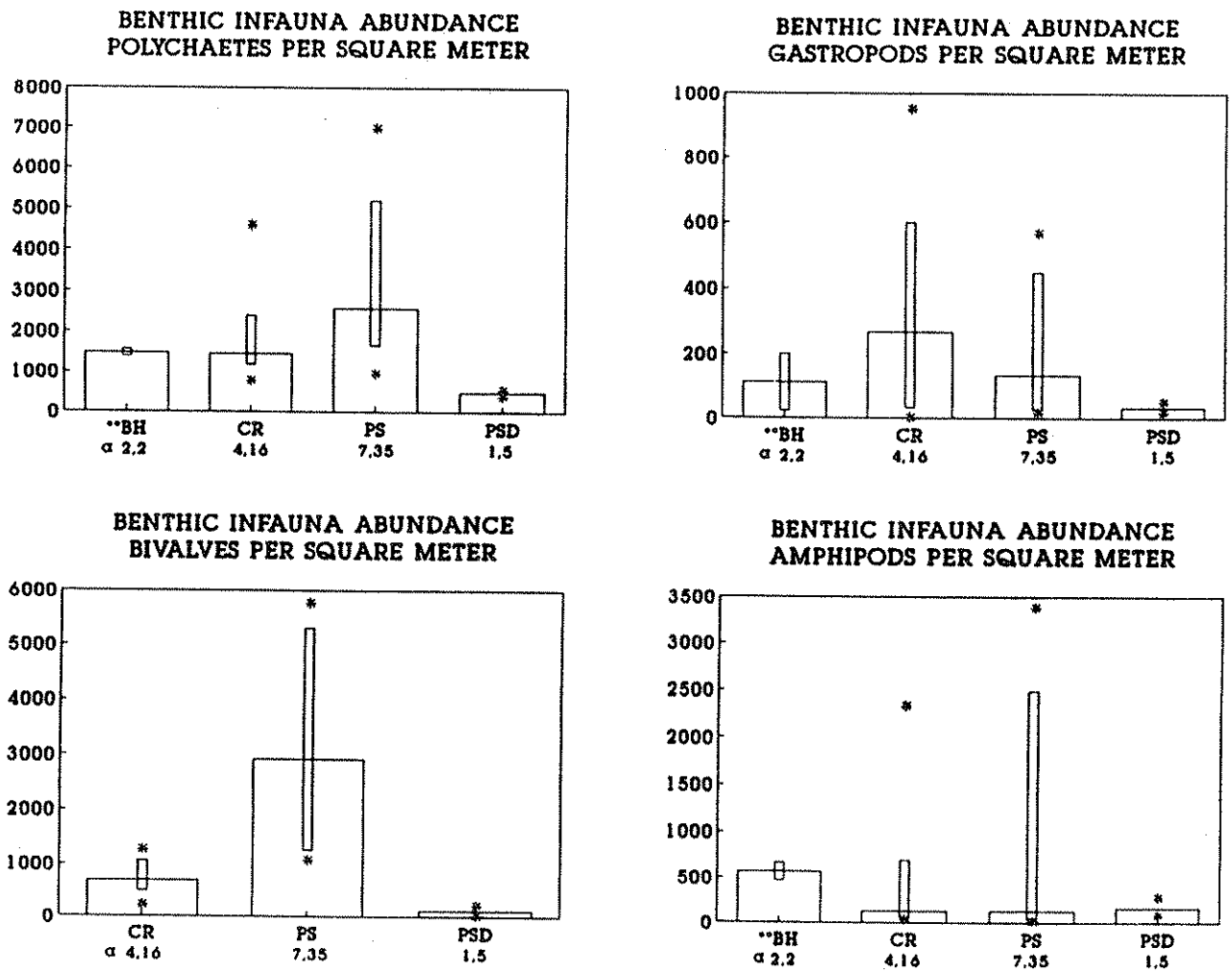
HABITAT CHARACTERISTICS

Water depth, freshwater influence, amount of aquatic vegetation, range of grain sizes, and TOC content all influence and define specific habitats in Puget Sound. Table 10 shows numerical or relative values for each of these variables for potential reference areas.

A wide variation of maximum depths (from 2 meters to 219 meters) was found at potential reference areas (Table 10). Many of the individual areas have a wide range of depths (e.g., water depths in Possession Sound range up to 219 meters). Very shallow areas (<20 meters deep) included Birch Bay, Burley Lagoon, Doe Bay, Filuce Bay, Fisherman's Bay, Henderson Inlet, Kilisut Bay, Lummi Bay, Oak Harbor, Padilla Bay, Port Madison, Roche Harbor, Semiahmoo Bay, Samish Bay, Similk Bay, Skookum Inlet, and West Beach.

Most of the potential reference areas have low freshwater input (i.e., <200 ft^3/sec) (Table 10). Case Inlet, Dabob Bay, Discovery Bay, Dungeness Bay, central Hood Canal, Henderson Inlet, and Skookum Inlet have moderate freshwater input (i.e., 200 to 2,000 ft^3/sec). These seven sites usually have more than one stream or river emptying fresh water into the area. Only Nisqually Reach, Port Susan, Saratoga Passage, and Skagit Bay have high freshwater input (i.e., >2,000 ft^3/sec). These four sites have major rivers as sources of fresh water.

In most potential reference areas, vegetative cover is restricted to water depths less than 20 meters deep. Fourteen of the potential reference areas have relatively low amounts of eelgrass or kelp cover (e.g., <10-20 percent average of subtidal soft-bottom areas <20 meters deep) (Table 10). Ten sites have low to moderate vegetative cover compared to the other areas. Another ten other sites have relatively moderate cover by eelgrass and/or kelp. Seventeen sites have moderate to heavy coverage by aquatic vegetation. Fisherman's Bay, Samish Bay, and Sequim Bay were considered to have relatively high coverage (e.g., 60-80 percent) by eelgrass and/or kelp.



** Median based on station means where replicate data were unavailable.
α No. Stations, No. Observations.

- Range of means
- Range all observations
- Median value

See Figure 2 for definition of reference area codes

Figure 8. Abundances of major taxa of benthic macroinvertebrates in potential reference areas

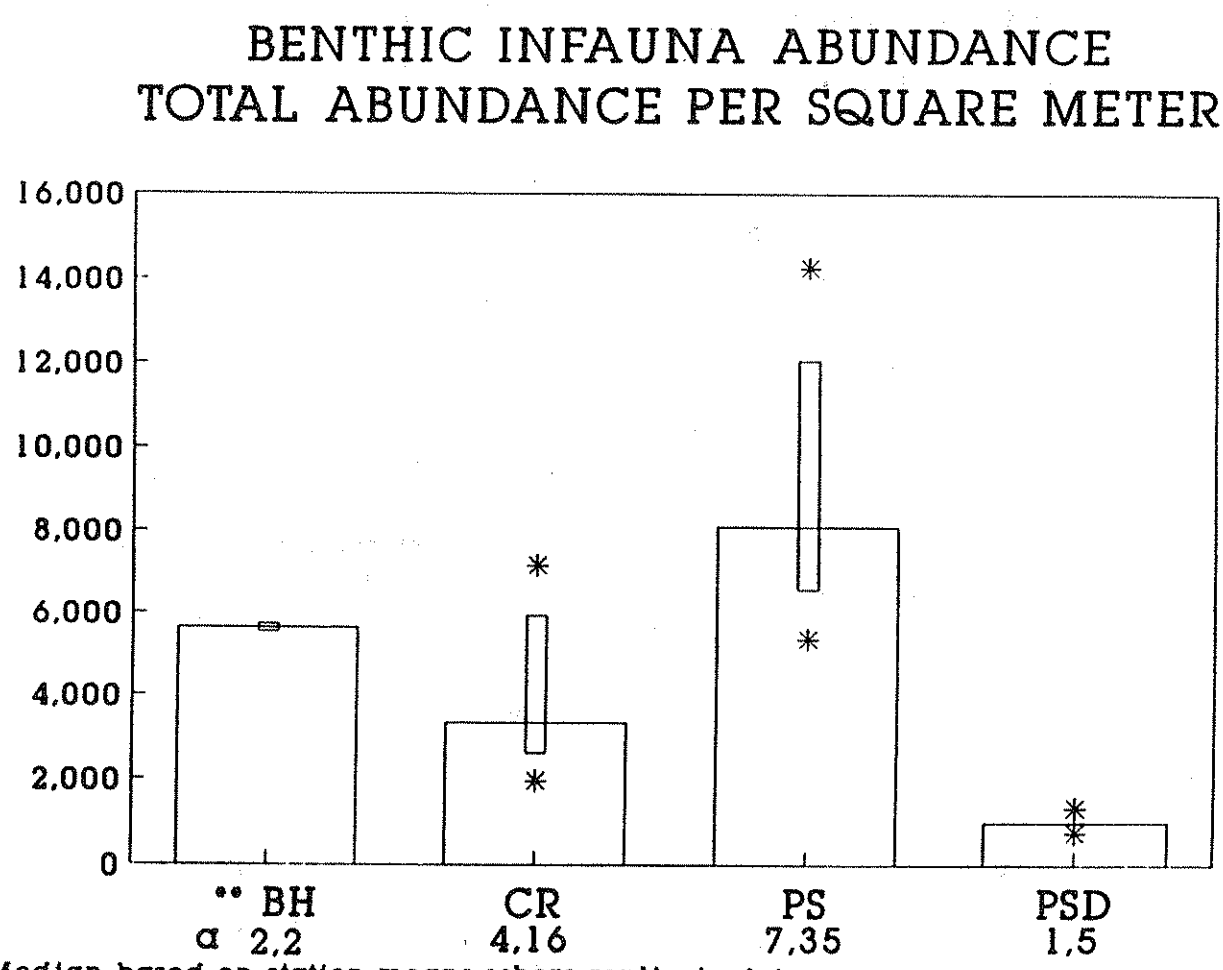


Figure 9. Total abundance of benthic macroinvertebrates in potential reference areas

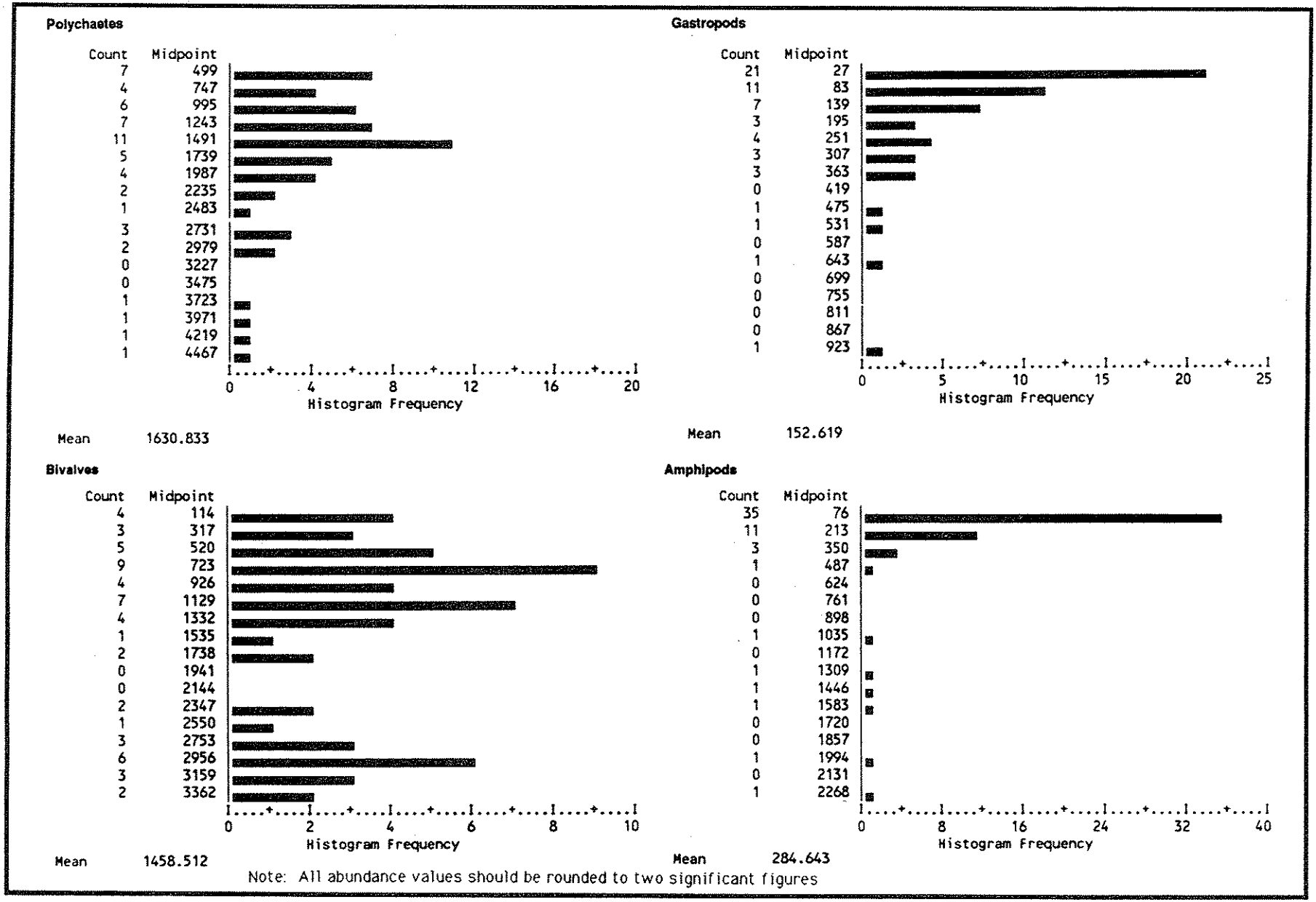
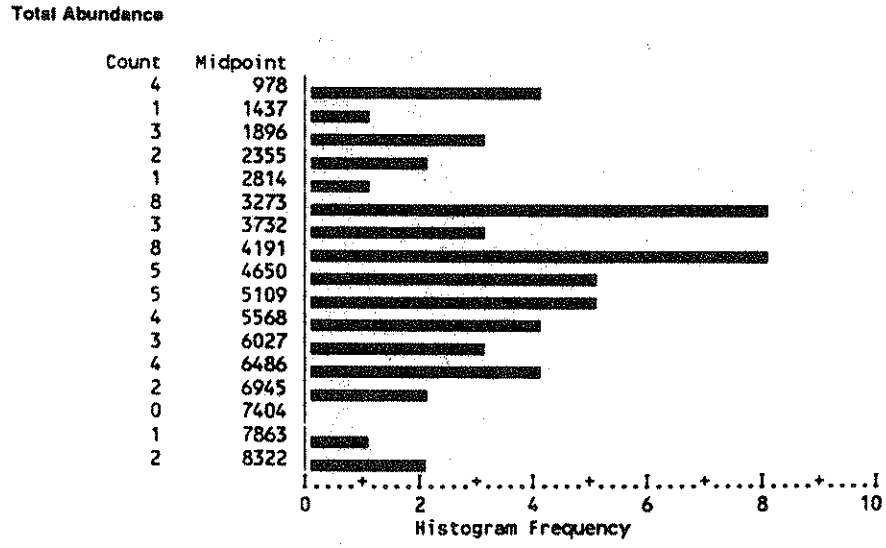


Figure 10. Frequency distributions of abundance (No./m²) for major taxa of benthic macroinvertebrates



Note: Abundance values should be rounded to two significant figures

Figure 11. Frequency distribution of total abundance (No/m^2) of benthic macroinvertebrates

TABLE 10. HABITAT CHARACTERISTICS FOR POTENTIAL REFERENCE AREAS

Location	Maximum Depth (meters)	Freshwater Inputs[a]	Vegetative Cover[b]	Grain Size % Fines	TOC
Admiralty Inlet	188	L	L	1.3-40	1.2
Andrews Bay (San Juan Island)	113	L	L	ND[c]	0.08-0.18
Appletree Cove	48	L	M	ND	ND
Birch Bay	9	L	M-H	ND	ND
Blakely Harbor	24	L	M-H	ND	ND
Blakely Island	33	L	M-H	10	1.3-2
Boundary Bay	35	L	ND	ND	ND
Burley Lagoon	3	L	L	ND	ND
Carr Inlet	150	L	L-M	4.3-93	0.19-1.6
Case Inlet	110	M	L	4.7-95	0.36-31
Dabob Bay	181	M	M-H	6.9-99	0.83-3.5
Deception Pass	29	L	M-H	ND	ND
Deer Harbor	22	L	M-H	ND	ND
Discovery Bay	59	M	M-H	0.83-100	ND
Doe Bay	9	L	M-H	ND	ND
Dungeness Spit (Bay)	38	M	M-H	ND	0.07-0.13
Dyes Inlet	37	L	L	6.2-98	0.5-3.4
East Sound (Orcas Island)	48	L	L-M	42-99	4.1
Filuce Bay	15	L	L	ND	ND
Fisherman's Bay	7	L	H	ND	ND
Friday Harbor	33	L	M	ND	ND
Griffin Bay	44	L	M-H	ND	ND
Hale Passage (east of Fox Island)	49	L	L	3.2	ND
Hale Passage/ (east of Lummi Island)	24	L	L	20-70	ND
Henderson Inlet	11	M	L	85-97	1.6
Hood Canal, central/lower	166	M	L-M	24-100	ND
Kilisut Bay	13	L	M	ND	ND
Lopez Sound	62	L	M	ND	ND
Lummi Bay	2	L	L	ND	ND
Lummi Island	102	L	L	ND	ND
Mutiny Bay	38	L	M-H	ND	ND
Nisqually Reach	55	H	L-M	0-98	0.056-0.77
Oak Bay	33	L	L-M	49	2.4
Oak Harbor	15	L	M-H	71-96	0.59-6.1
Padilla Bay	13	L	M-H	48	2.4
Penn Cove	24	L	M	ND	ND

TABLE 10. (Continued)

Location	Maximum Depth (meters)	Freshwater Inputs	Vegetative Cover	Grain Size % Fines	TOC
Pickering Passage	31	L	M	0.85-16	ND
Port Ludlow	26	L	M	ND	ND
Port Madison	2	L	M-H	1.2-93	0.41-1.3
Port Orchard	38	L	L-M	5.4-89	1.7
Port Susan	121	H	M	0.6-99	0.26-1.6
Possession Sound	219	L	L-M	90-99	1.5-2.7
Poverty Bay	176	L	M-H	88	2.1
President Point	31	L	M-H	0.7-8.5	ND
Quartermaster Harbor	20	L	L-M	12-87	0.25-1.8
Rich Passage	29	L	L-M	ND	ND
Roche Harbor	11	L	M	ND	ND
Rosario Strait	110	L	M-H	1.1	ND
Samish Bay	18	L	H	21-91	1.3-1.9
Saratoga Passage	170	H	M	ND	ND
Semiahmoo Bay	16	L	ND	ND	ND
Sequim Bay	35	L	H	64-88	1.4-2.5
Similk Bay	5	L	L	ND	ND
Skagit Bay	29	H	H	0.6-9.3	0.19-0.35
Skookum Inlet	3	M	L	ND	ND
Tacoma Narrows/ Cormorant Passage	130	L	M-H	3.6-71	0.25-0.37
Useless Bay	75	L	M-H	ND	ND
West Beach	4-5	L	L	0.71-4.5	0-0.04
Wollochet Bay	33	L	L	9.1-53	0.93

[a] L = Low (annual average discharge <200 ft^3/sec)
M = Moderate (200-2,000 ft^3/sec)
H = High (>2,000 ft^3/sec).

[b] Eelgrass and/or kelp ranking based on coverage at water depths where vegetation reasonably expected (i.e., <20 meters depth). L = Low, M = Moderate, H = High.

[c] ND = No data.

Grain size is an indicator of the types of benthic habitats that exist in an area. Information on grain size was represented by the range of percent fine-grained material in samples (percent fines) (Table 10). The wide range of percent fine-grained material in many locations indicates the diversity of sediment types. Pickering Passage, President Point, Skagit Bay, and West Beach had a narrow range of low percent fine-grained material (<16 percent). Henderson Inlet, Oak Harbor, Possession Sound, and Poverty Bay had a narrow range of high percent fine-grained material (>70 percent).

TOC concentrations at most potential reference areas ranged below 3 percent (Table 10). Only five areas had stations with TOC values above 3 percent (i.e., Case Inlet, Dabob Bay, Dyes Inlet, East Sound, and Oak Harbor).

POTENTIAL ANTHROPOGENIC DISTURBANCE

Table 11 provides information on the relative level of concern about contaminant sources and predicted impact of future population growth for each potential reference area. Tetra Tech (1988) described historical and current sources in nonurban areas of Puget Sound. Where the level of concern was moderate, a brief list of sources is given in Table 11. In addition, the locations of sites are noted where the overall rank based on sources and observed biological effects was lower than the level of concern indicated by the sources alone. Where specific factors may influence the potential for future anthropogenic impact, a note is provided next to the ranking in Table 11.

Current Source Concern

Tetra Tech (1988) assigned moderate ranks because of concern about current sources of toxic contaminants to Blakely Harbor, Discovery Bay, East Sound, Friday Harbor, Nisqually Reach, Oak Bay, Oak Harbor, Padilla Bay, Penn Cove, Port Susan, Possession Sound, Skagit Bay, and Tacoma Narrows. Eight of these areas are receiving waters for at least one National Pollutant Discharge Elimination System (NPDES) permitted facility. These eight areas with NPDES facilities usually had more than one such facility (e.g., six NPDES facilities for Skagit Bay). Marinas, refineries, shipyards, military facilities, log storage yards, ferry terminals, landfills, and past dredging operations are also found in some of the potential reference areas.

Of the 13 potential reference sites with moderate source concern, seven were ranked low for overall levels of concern and six had moderate overall levels of concern (Tetra Tech 1988). The overall level of concern was based on information on sediment contamination and toxicity as well as sources (Tetra Tech 1988). A low overall level of concern was assigned by Tetra Tech (1988) to areas with a low concern about sources, a low degree of certainty regarding source information, minimal sediment impacts, or low toxicity results.

Future Growth Impacts

Eight of the potential reference areas were given moderate ranks for the likelihood of impacts associated with future population growth: Dyes Inlet, Henderson Inlet, Oak Harbor, Padilla Bay, Port Susan, Possession Sound, Poverty Bay, and Tacoma Narrows. These locations are generally near urban/industrial areas or in areas that are likely to grow rapidly. The Tacoma Narrows, for instance, received a moderate ranking because it is adjacent to Tacoma and near the rapidly

TABLE 11. POTENTIAL ANTHROPOGENIC DISTURBANCE IN POTENTIAL REFERENCE AREAS[a]

	Current Source Concern[b]	Sources[b]	Future Growth Impacts	Justification
Admiralty Inlet	L		L	
Andrews Bay	L		L	
Appletree Cove	L		L	Low density residential development
Birch Bay	L		L	
Blakely Harbor	M	Sites in this area have a moderate level of concern	L	
Blakely Island	L		L	
Boundary Bay	L		L	
Burley Lagoon	M (L)	Strandley PCB transformer disposal site	L	Low density residential development
Carr Inlet	L		L	Low density residential development
Case Inlet	L		L	Low density residential development
Dabob Bay	L		L	
Deer Harbor	L		L	
Deception Pass	L		L	Park and low density residential development
Discovery Bay	M (L)	Log storage yard	L	
Doe Bay	L		L	
Dungeness Bay	L		L	
Dyes Inlet	L		M	Near Bremerton
East Sound	M (L)	2 marinas, 2 NPDES[c] permits, and Chevron plant	L	
Filuce Bay	L		L	Low density residential development
Fisherman's Bay	L		L	
Friday Harbor	M	4 marinas, shipyard, and 3 NPDES permits	L	
Griffin Bay	L		L	
Hale Passage (Fox Island)	L		L	Low density residential development
Hale Passage (Lummi Island)	L		L	
Henderson Inlet	L		M	Near Olympia
Hood Canal, central/lower	L		L	Low density residential development
Killisut Bay	L		L	

TABLE 11. (Continued)

	Current Source Concern[b]	Sources[b]	Future Growth Impacts	Justification
Lopez Sound	L		L	
Lummi Bay	L		L	
Lummi Island	L		L	
Mutiny Bay	L		L	Low density residential development
Nisqually Reach	M	DuPont explosives plant, Fort Lewis, and federal penitentiary	L	
Oak Bay	M (L)	Dredging operations	L	
Oak Harbor	M	NPDES permit, marina, manufacturing, and Chevron plant	M	Near Crescent Harbor and city of Oak Harbor
Padilla Bay	M (L)	March Point refineries	M	Near Anacortes and March Point
Penn Cove	M	Fort Casey, 2 NPDES permits, and 2 marinas	L	
Pickering Passage	L		L	
Port Ludlow	L		L	
Port Madison	L		L	Low density residential development
Port Orchard	L		L	Low density residential development
Port Susan	M	NPDES permit, former military munitions depot, and Tulalip marine disposal landfill	M	Near Everett
Possession Sound	M (L)	2 NPDES permits and ferry terminal	M	Near Everett
Poverty Bay	L		M	Near Tacoma and I-5 corridor
President Point	L		L	
Quartermaster Harbor	L		L	
Rich Passage	L		L	Low density residential development
Roche Harbor	L		L	
Rosario Strait	L		L	
Samish Bay	L		L	
Saratoga Passage	L		L	Low density residential development
Semiahmoo Bay	L		L	
Sequim Bay	L		L	

TABLE 11. (Continued)

	Current Source Concern[b]	Sources[b]	Future Growth Impacts	Justification
Similk Bay	L		L	
Skagit Bay	M	6 NPDES permits in LaConner and marinas	L	
Skookum Inlet	L		L	
Tacoma Narrows / Cormorant	M (L)	4 NPDES permits in Steilacoom	M	Near Tacoma and Interstate-5 corridor
Useless Bay	L		L	Low density residential development
West Beach	L		L	
Wollochet Bay	L		L	

[a] The rankings for potential anthropogenic disturbance were based on concerns about current sources and predicted impacts of future population growth.

L = Low
M = Moderate

[b] Information in these columns is taken from Tetra Tech (1988). Rankings in parentheses are overall rankings based on sources and observed biological effects.

[c] NPDES - National Pollutant Discharge Elimination System.

developing Interstate 5 corridor. For each site that received a moderate rating for future growth impact, the reason for concern is documented in Table 11.

Fifteen of the potential reference areas were given low ratings even though the countywide projection of population density was high (Table 11). These sites were rated low for future growth impacts based on the type of development occurring in the area. For instance, Carr Inlet is in Pierce County, a rapidly growing area. The portion of the county near Carr Inlet, however, is experiencing only low density residential development. Major point sources of pollution are generally not associated with this type of development.

DEVELOPMENT OF PERFORMANCE STANDARDS

Interim performance standards and reference areas for P-2 sediment variables are defined in the following sections. The proposed structure of the performance standards is based on consideration of key environmental variables that influence natural sediment conditions (see above, Framework for Reference Area Performance Standards, Environmental Factors Influencing P-2 Sediment Variables). The interim performance standards are based on an evaluation of all suitable data compiled during the present study of potential reference areas. The simplified scheme proposed for the structure of the interim performance standards reflects the limited amount of data for reference areas. Not all of the areas used to define the interim performance standards are recommended for use as reference areas in the future. Interim reference areas for use in the P-2 sediment management program were selected by integrating information on degree of contamination, biological effects, potential anthropogenic disturbance, habitat characteristics, and geographic location.

STRUCTURE OF PERFORMANCE STANDARDS

Performance standards are defined above as criteria for suitable reference conditions based on specified values of P-2 sediment variables. For each variable, the interim performance standard recommended below is generally expressed as the 90th percentile of the observed distribution of values for potential reference areas. It is recognized that the potential reference areas for which data are available include areas that may not be suitable for use in the future as P-2 reference areas because of relatively high contamination and biological effects. Use of these areas in defining the interim performance standards is essential because of the small database available at this time. As more data are developed for the interim reference areas proposed below, the performance standards should be revised. At that time, it may be warranted to define the standards as the 95th or the 99th percentile of the distribution of reference area values based on sample size or skewness of the distribution.

A hierarchical structure is proposed for reference area performance standards, consisting of four tiers of environmental variables:

- Biogeographic region, including estuarine (i.e., low-salinity) subareas defined by interstitial water salinity of sediments
- Season within biogeographic region
- Water depth (or tidal height) within season and within region
- Sediment type within a particular range of water depths, within season, and within region.

For benthic macroinvertebrate variables, performance standards should be defined within each tier of this system. For example, an acceptable range of abundance would be defined for each major taxon of benthic macroinvertebrates for sediments of a certain range of grain sizes, within a certain range of water depths, within a certain season, and within a certain biogeographic zone. However,

not all tiers may be relevant to a particular variable. For example, in the system proposed below for the interim performance standards, chemistry variables are not stratified by season, water depth, and sediment type.

Different biogeographic regions within Puget Sound are proposed as the first level of the hierarchical system. Interim biogeographic regions were defined based on gross physical features, expected influence of fresh waters, and requirements for locating representative reference areas throughout Puget Sound. The latter requirements were imposed to satisfy the logistical constraints of sampling and to ensure that one or more of the selected reference areas were located relatively close to contaminated areas that might be evaluated under the P-2 standards. The first level of the performance standards system includes the following biogeographic zones:

- **Strait of Juan de Fuca/Strait of Georgia**—Areas generally north and west of Admiralty Inlet, including associated bays (e.g., Sequim Bay, Discovery Bay, Padilla Bay, Samish Bay, San Juan Islands, and Boundary Bay)
- **Hood Canal**—Hood Canal (in its entirety) and associated bays (e.g., Dabob Bay, Port Ludlow)
- **Northeastern Puget Sound**—Saratoga Passage and associated bays (e.g., Penn Cove, Oak Harbor, Port Susan, and Skagit Bay)
- **Puget Sound Main Basin**—Areas from the northern boundary of Admiralty Bay in the north to the Tacoma Narrows in the south, and associated bays (e.g., Oak Bay, Useless Bay, Port Madison, and Poverty Bay)
- **Southern Puget Sound**—Areas south of the Tacoma Narrows (e.g., Carr Inlet, Case Inlet, Nisqually Reach, Skookum Inlet).

Further subdivision of these areas will likely be necessary in the future as more data becomes available from the Puget Sound Ambient Monitoring Program (PSAMP) survey, the PSDDA Phase II baseline survey, or the Ecology sediment management program.

Based on gross oceanographic features, these zones might be expected to have somewhat different benthic macroinvertebrate communities. However, the importance of these differences at the major taxon level is unknown. Each of the large biogeographic zones also defines an area within which at least one reference area should be located to allow efficient sampling. Within the large-scale zones, smaller biogeographic zones corresponding to estuarine systems (<25 ppt salinity) within Puget Sound should be defined. Because salinity measurements on interstitial water in sediments are generally not available, these estuarine zones cannot be defined precisely at this time. This special class of low-salinity reference areas will be discussed further when interim reference areas are proposed (see below, Interim Reference Areas).

Within each biogeographic region or estuarine subarea, reference conditions should be defined for different seasons. Ranges of water depths for subtidal stations and tidal heights for intertidal stations should also be incorporated into the performance standards system. Within each season and range of depths (or tidal heights), the final tier of environmental variables should be organized into various sediment types defined as combinations of ranges of percent fine-grained material.

The proposed structure of the performance standards for each kind of P-2 sediment variable is summarized in Table 12. All variables should be stratified by major biogeographic zone and sediment interstitial water salinity because of the potentially important influence of these factors.

TABLE 12. PROPOSED GENERAL STRUCTURE OF PERFORMANCE STANDARDS FOR ELEMENT P-2 REFERENCE AREAS

Sediment Variable	Performance Standards Stratum[a]			
	Biogeographic[b] Zone	Season	Water Depth[c]	Grain Size
Chemistry	Yes	No	No	No
Bioassays	Yes	No	No	Yes
Benthic macroinvertebrates	Yes	Yes	Yes	Yes

[a] Environmental variable by which the performance standards for a sediment variable are stratified.

[b] Incorporates stratification by estuarine subarea within each large-scale biogeographic region defined in the text.

[c] Incorporates stratification into intertidal and subtidal areas.

Chemistry of sediments is strongly affected by interstitial water salinity and by natural materials (e.g., plant material, glacial silt) carried by rivers that create low-salinity areas. Performance standards for the amphipod bioassay should be stratified by sediment grain size (or some covariate) because of potential physicochemical influences on organism responses to toxic chemicals (DeWitt et al. 1988). Also, different kinds of bioassays or modifications of present bioassays will be required to test the toxicity of low-salinity sediments. The Microtox test is the only available bioassay that can be applied immediately to freshwater sediments. Stratification of performance standards for bioassays to account for seasonal effects is not recommended. However, the availability of test organisms may limit the application of a given bioassay on a seasonal basis. The structure of the performance standards is most complex for benthic macroinvertebrate variables because of the well known variation in benthic communities with changes in environmental variables. Because of the variability of benthic macroinvertebrate populations in intertidal habitats and low-salinity environments, it is recommended that this indicator of toxicity not be used as part of the P-2 testing scheme for these habitats.

QUALITY ASSURANCE/QUALITY CONTROL OF PERFORMANCE STANDARDS DATABASE

Options and recommendations are presented in this section for procedures to screen anomalous data from the reference area database. In general, data collection efforts and QA/QC procedures should follow regional protocols (PSEP 1986; PTI 1989). Specific recommendations for QA/QC of chemical and biological data are provided in the text below.

Chemical Data

Chemical data that have passed QA review may still be qualified. Qualified data (e.g., data qualified as estimates) may be less certain than data that have not been qualified but the degree of uncertainty is typically undefined. Potential options for addressing the use of chemical data with qualifiers to develop reference area performance standards include:

- **Option 1**—Exclude undetected data (i.e., data with a "B" or "U" qualifier).
- **Option 2**—Exclude the above and any data subjected to large recovery corrections (i.e., organic data with an "X" qualifier, indicating that greater than an order-of-magnitude recovery correction was applied based on surrogate recovery standards in the sample). (For data on organic compounds and metals that have not been recovery-corrected using the isotope dilution technique, a control limit of 50-75 percent recovery is recommended by PSEP 1986.)
- **Option 3**—Exclude the above and any data that have been qualified as "estimates." (This option would have a major impact on use of many data sets, including use of any tentatively identified compounds that are by definition qualified with an "E".)

Option 1 or 2 is recommended for development of reference area performance standards. Option 2, however, addresses concerns about setting reference criteria too high (i.e., in case large recovery corrections overestimate sediment concentrations). Option 3 limits the appropriate use of data qualified as "estimates." Data are qualified as "estimates" for a wide variety of reasons, which should be considered on a case-by-case basis as part of the QA screening of data prior to entry into the P-2 reference area database. Note that Option 1 was implemented during the present study.

Biological Data

Use of reference data with abnormally high variability (e.g., unusually high standard deviation) could reduce the ability to discriminate between test samples and reference conditions when attempting to identify adverse biological effects. Barrick et al. (1988) proposed screening Puget Sound biological data to qualify mean values with abnormally high variance. For example, a value of 20 percent was proposed as a QA/QC limit on the standard deviation in the amphipod mortality test. In this case, the critical value for the standard deviation of mean mortality was derived by examining the values for the 23 reference stations from the eight studies in the sediment quality values (SEDQUAL) database. All but one value (i.e., a value of 31 percent) of the standard deviation ranged from 4.0 to 16 percent. It is recommended that in the future this guideline be applied to reference area data used in the P-2 sediment management program. Because similar guidelines do not exist for all P-2 biological variables, the available guideline for the amphipod mortality bioassay was not applied to the data used to derive the interim performance standards presented below.

INTERIM PERFORMANCE STANDARDS

The proposed structure for the P-2 reference area performance standards was simplified for the purposes of the interim performance standards. Available data are not adequate to support full implementation of the recommended performance standards system. For example, interim performance standards were developed only for subtidal reference conditions throughout Puget Sound. Development of reference area performance standards for intertidal areas or for specific biogeographic regions (including low-salinity habitats) requires further data collection. The interim performance standards are summarized in the following sections.

Station Locations

Reference areas used in evaluating sediments relative to the P-2 standards should be relatively clean. Reference areas should not be located immediately adjacent to contaminated sites (e.g., within the central basin, within the East Passage, or within an urbanized embayment such as Elliott Bay or Commencement Bay). Sampling stations in reference areas should be located to achieve the following general objectives:

- Existing or planned anthropogenic development (e.g., major shoreline or water projects) should be minimal in the vicinity of reference sites
- Reference stations should be located away from areas normally subjected to physical disturbance from anthropogenic factors (e.g., prop wash from vessels)
- For bioassays and benthic macroinvertebrate analyses, the reference sediment should have a texture similar to that of the test sediment (i.e., a sample from a potentially impacted site)
- Reference stations should be located in areas free of macrophytic species (e.g., large algae, seagrass) unless the sediments being evaluated are taken from similar vegetated habitats (the composition and abundance of the benthic macroinvertebrate community may be modified by the presence of macrophytes; in these habitats, special techniques are required to sample benthic macroinvertebrates)
- A reference area should be accessible for sampling by routine techniques.

Sediment Chemistry

General reference area objectives related to chemical variables are listed below:

- Concentrations of all chemicals in sediments should be representative of relatively uncontaminated areas of Puget Sound removed from significant sources of contaminants
- Concentrations of all chemicals analyzed in sediments should be lower than available sediment quality values for identifying adverse biological effects.

The interim performance standards for chemical variables are generally defined as the 90th percentile values for frequency distributions of chemical concentrations in potential reference areas (Table 13). The performance standards represent upper limits to the concentrations of chemicals in acceptable reference samples. Data for some chemicals listed among the PSEP and PSDDA contaminants of concern were not suitable for the analysis of frequency distributions. These chemicals have rarely been detected in sediments of nonurban areas of Puget Sound (e.g., <20 percent detection frequency). The interim performance standards for these chemicals are generally defined as quantification limits for routine analytical use by the EPA Contract Laboratory Program (U.S. EPA 1988). For chemicals with routine quantification limits greater than the P-2 sediment standards, the interim reference area performance standard could be defined as the quantification limit that can be achieved using best available analytical methods as determined by Ecology. Chemistry data for reference sediment samples should also satisfy the QA/QC recommendations developed by regional programs (e.g., PSEP 1986; PTI 1989), as determined by Ecology.

Bioassays

For the amphipod bioassay, two options are available for defining the interim performance standards for reference areas. In the first option, the interim performance standards would require that the mean mortality for a reference sample be less than 25 percent. The value of 25 percent mean mortality was selected by Barrick et al. (1988) as a guideline for reference area data. This guideline was based on a study by Mearns et al. (1986) that demonstrated that 25 percent mortality could be consistently discriminated as a toxic response relative to control sediment. Approximately 70 percent of the reference sites for which data are available displayed amphipod mortality values less than 25 percent. The guideline of 25 percent mean mortality would provide a consistent, environmentally protective value for the interim performance standard.

In the second option, the interim performance standard for the amphipod bioassay would be defined as the upper 95 percent prediction limit on mortality derived from the model of DeWitt et al. (1988). In this model, the upper 95 percent prediction limit for amphipod mortality varies with percent fine-grained material in reference sediments. The second option for the interim performance standard therefore accounts for the potential effects of sediment texture or covarying natural factors. The second option would provide a high degree of confidence that adverse effects detected in the amphipod bioassay are associated with chemical contamination rather than sediment texture or some other natural factor.

Because of the limited database for the bivalve larvae bioassay and the Microtox bioassays in reference areas, quantitative performance standards could not be defined on a strictly technical basis. As an administrative guideline, the PSDDA performance standard for reference area data

TABLE 13. INTERIM PERFORMANCE STANDARDS FOR REFERENCE AREAS

Variable	Performance Standard[a]
Organic Compounds (μg/kg DW)	
LPAH	240
HPAH	1,200
PCB	30
Inorganics (mg/kg DW)	
Arsenic	19
Cadmium	1.4
Copper	58
Chromium	150
Mercury	0.19
Lead	30
Nickel	65
Silver	0.78
Zinc	110
Total Organic Carbon (% DW)	3.0
Sulfides (mg/kg DW)	84
Bioassays	
Amphipod mortality (%)	25[b]
Bivalve larvae abnormality (%)	[c]
Microtox - saline (EC_{50}, μL/mL)	[c]
Microtox - organic (EC_{50}, μL/mL)	[c]
Benthic Macroinvertebrates (No./m^2)	[c]
Polychaete abundance	[c]
Gastropod abundance	[c]
Bivalve abundance	[c]
Amphipod abundance	[c]
Total abundance	[c]
Number of species	[c]

[a] These performance standards apply only to marine subtidal sediments. The interim performance standard is the maximum value to be allowed for P-2 reference conditions. For each chemical variable, the interim performance standard is equal to the 90th percentile of the distribution of sediment concentration values for potential reference areas.

[b] For the amphipod bioassay, alternative interim performance standards could be defined by the 95 percent prediction limit for mortality derived from the model of DeWitt et al. (1988) for the relationship of mortality to grain size (see text).

[c] Quantitative interim performance standards cannot be defined on a sound-wide basis because of limited available data. Qualitative performance standards are described in the text.

for the bivalve larvae bioassay could be adopted as an interim P-2 guideline until more reference data are available. The PSDDA performance standard for the bivalve test specifies that percent abnormality for reference area samples should not be more than 20 percent higher than that measured for the control sediment (West Beach). Quantitative interim performance standards for Microtox bioassays could not be defined as 90th percentile values based on the limited data available. Moreover, the EC_{50} for the Microtox organic extract tests of reference samples varied over a range of four orders of magnitude. Before performance standards are developed for this test, reasons for this large variation in reference conditions in relationship to the range of responses to contaminated samples should be investigated. Further data are needed to determine adequate reference area performance standards for both Microtox tests. For the bivalve larvae and the Microtox bioassays, technical judgments about the acceptability of reference sites should be made on a case-by-case basis until sound-wide performance standards for reference areas are established. Bioassay data for reference sediment samples should also satisfy the QA/QC recommendations developed by regional programs (e.g., PSEP 1986; PTI 1989), as determined by Ecology.

Benthic Macroinvertebrates

Reference areas should have benthic macroinvertebrate assemblages representative of areas of Puget Sound removed from significant sources of contaminants, with the following characteristics:

- The taxonomic richness of benthic macroinvertebrates and the abundances of higher taxonomic groups should reflect seasonality and natural physical/chemical conditions in a reference area (e.g., grain size composition and salinity of sediments, water depth) and should not be obviously depressed as a result of chemical toxicity
- Normally abundant species that are known to be sensitive to chemical contaminants should be present
- Normally rare species that are known to become abundant only under chemically disturbed conditions should be rare or absent
- The abundances of normally rare species that control community structure through physical modification of the sediment (e.g., large, tube-dwelling worms, geoduck, or sea pens) should be similar to those observed at the potentially impacted site.

Sound-wide interim performance standards for benthic macroinvertebrates could not be defined based on the limited data available from potential reference areas. Ranges of major taxon abundances are presented in Table 8. Although these data represent different sampling seasons, water depths, and sediment grain size distributions, the limited amount of data precluded stratification by each environmental factor. The general guidelines provided above should be used by Ecology on a case-by-case basis to determine if data for a reference site are within the range of Puget Sound reference conditions. Benthic macroinvertebrate data for reference sediment samples should also satisfy the QA/QC recommendations developed by regional programs (e.g., PSEP 1986; PTI 1989), as determined by Ecology.

INTERIM REFERENCE AREAS

Various reference areas should be established to encompass the range of natural environmental conditions throughout Puget Sound. Interim reference areas established for the P-2 sediment management program should include sites at various geographic locations throughout Puget Sound to accommodate the need for reference locations in proximity to comparison sites in all major areas of the sound. Of the reference areas included in the data review, some may not be suitable for future use as part of chemical and biological testing requirements of the P-2 sediment standards. Therefore, the available data for potential reference areas were evaluated to select interim reference areas for implementation of the P-2 sediment standards.

First, potential reference areas that received a ranking of moderate concern for current sources or future growth impacts (see Table 11) were excluded from further consideration. These areas included the following:

- Blakely Harbor*
- Burley Lagoon
- Dyes Inlet*
- East Sound (Orcas Island)
- Friday Harbor
- Henderson Inlet
- Nisqually Reach*
- Oak Bay
- Oak Harbor*
- Penn Cove
- Port Susan*
- Possession Sound*
- Skagit Bay
- Tacoma Narrows/Cormorant Passage*.

An asterisk following the area name above indicates that P-2 sediment variables displayed relatively high values (as defined in Table 14). Areas listed above without an asterisk had inadequate data [i.e., poor coverage of EPA priority pollutant PAH, PCB, and metals; no amphipod bioassay data (Table 14)]. Discovery Bay and Padilla Bay had moderate rankings for contaminant source concerns but received a low ranking overall for toxic contamination and a low ranking for future growth impacts (Table 11). Also, the available data for P-2 sediment variables indicated that Discovery Bay and Padilla Bay are acceptable reference areas (Table 14). Therefore, these areas were included in further evaluations.

Second, potential reference areas that displayed relatively high chemical contamination or high amphipod mortality were excluded from consideration as future reference areas. High chemical contamination was defined as median concentration greater than the performance standard (i.e., 90th percentile) for at least one chemical and at least one station that exceeded AET for one or more chemicals. High amphipod mortality was defined as at least one station exceeding the interim performance standard. Two additional areas, Case Inlet and Quartermaster Harbor, were eliminated as candidate reference sites for the P-2 testing program based on these criteria. Although Samish Bay and Sequim Bay showed relatively high sulfides (Table 14), they were included in subsequent evaluations because median values for contaminants were generally low for these bays, and the high sulfides values were observed at only one station in each bay.

TABLE 14. SUMMARY OF AVAILABLE DATA FOR POTENTIAL REFERENCE AREAS[a]

Location	Moderate Disturbance[c]	Chemistry[b]		High Amphipod Mortality[d]
		High Median	>AET	
Admiralty Inlet	+[e]	—[e]	—	—
Blakely Harbor	yes	LPAH	+	+
Burley Lagoon	(yes)	—	—	—
Carr Inlet	+	+	yes	1
Case Inlet	+	—	yes	yes, 3
Dabob Bay	+	+	+	+
Discovery Bay	(yes)	+	+	+
Dyes Inlet	yes	Zn,Hg,Pb,Cu	yes	—
East Sound, Orcas Island	(yes)	TOC	—	—
Friday Harbor	(yes)	—	—	—
Henderson Inlet	yes	—	—	—
Hood Canal, central/lower	+	—	—	—
Nisqually Reach	yes	+	yes	—
Oak Bay	(yes)	—	—	—
Oak Harbor	yes	+	yes	+
Padilla Bay	(yes)	—	—	+
Penn Cove	yes	—	—	—
Port Madison	+	+	yes	—
Port Orchard	+	—	—	—
Port Susan	yes	Ni	yes	2
Possession Sound	(yes)	+	+	yes, 1
Poverty Bay	yes	—	—	+
President Point	+	LPAH	—	—
Quartermaster Harbor	+	LPAH,Ag,Pb,Hg	yes	—
Rich Passage	+	Pb	—	—
Rosario Strait	yes	—	—	—
Samish Bay	+	(sulfide)[f]	(yes)[f]	(yes), 1
Saratoga Passage	+	—	—	—
Sequim Bay	+	(sulfide)[f]	(yes)[f]	(yes)
Skagit Bay	yes	—	—	—
Tacoma Narrows/Cormorant Passage	(yes)	+	+	—
West Beach	+	+	+	NA[g]
Wollochet Bay	+	—	—	—

[a] Areas that ranked low for potential anthropogenic disturbance (Table 11) and had no data for P-2 sediment variables are not listed in this table.

[b] High median (i.e., median exceeds the performance standard listed in Table 13) or AET exceedance (Table 6) for one or more chemicals at one or more stations based on detected values (phthalates excluded).

[c] Moderate ranking for current source concerns or future growth impacts (Table 11). Parentheses indicate that an area was ranked low overall by Tetra Tech (1988) based on sources and biological conditions.

[d] Median mortality ≥25 percent or more than 33 percent of stations with mean amphipod mortality values ≥25 percent. Parentheses indicate that high percentage of fine-grained material in sediments may account for high mortality values at most sites. The number of stations that exceed the optional interim performance standard derived from the model of Dewitt et al. (1988) is also shown.

[e] + = low potential disturbance, low contamination, or low amphipod mortality
— = inadequate data (i.e., poor coverage of EPA priority pollutant PAH, PCB, and metals; no amphipod bioassay data).

[f] Single station.

[g] NA = not applicable; West Beach is the native sediment control for the amphipod bioassay.

Third, the remaining potential reference areas with little or no data for P-2 sediment variables were identified, including the following:

- Admiralty Inlet
- Andrews Bay (San Juan Island)
- Appletree Cove
- Birch Bay
- Blakely Island
- Boundary Bay
- Deception Pass
- Deer Harbor
- Doe Bay
- Dungeness Spit
- Filuce Bay
- Griffin Bay
- Hood Canal, central
- Hale Passage (Fox Island)
- Hale Passage (Lummi Island)
- Kilisut Bay
- Lopez Sound
- Lummi Bay
- Mutiny Bay
- Pickering Passage
- Port Ludlow
- Poverty Bay
- President Point
- Rich Passage
- Roche Harbor
- Saratoga Passage
- Semiahmoo Bay
- Similk Bay
- Skookum Bay
- Useless Bay
- Wollochet Bay.

These areas were classified as lower priority areas for possible use as interim P-2 reference areas, pending further investigation.

Finally, data for the remaining areas were evaluated to select the following proposed interim reference areas:

- Carr Inlet
- Dabob Bay
- Samish Bay
- Sequim Bay.

These four areas are distributed throughout Puget Sound, covering most of the large-scale biogeographic zones defined earlier. West Beach is appropriate for a chemistry reference site and a control (native sediment) site for the amphipod bioassay. However, West Beach offers a limited range of habitats and is not recommended as a primary reference area. The five areas identified may not satisfy long-term needs for reference conditions. The following areas could be investigated further for use as P-2 reference areas:

- Birch Bay
- Discovery Bay
- Mutiny Bay
- Padilla Bay

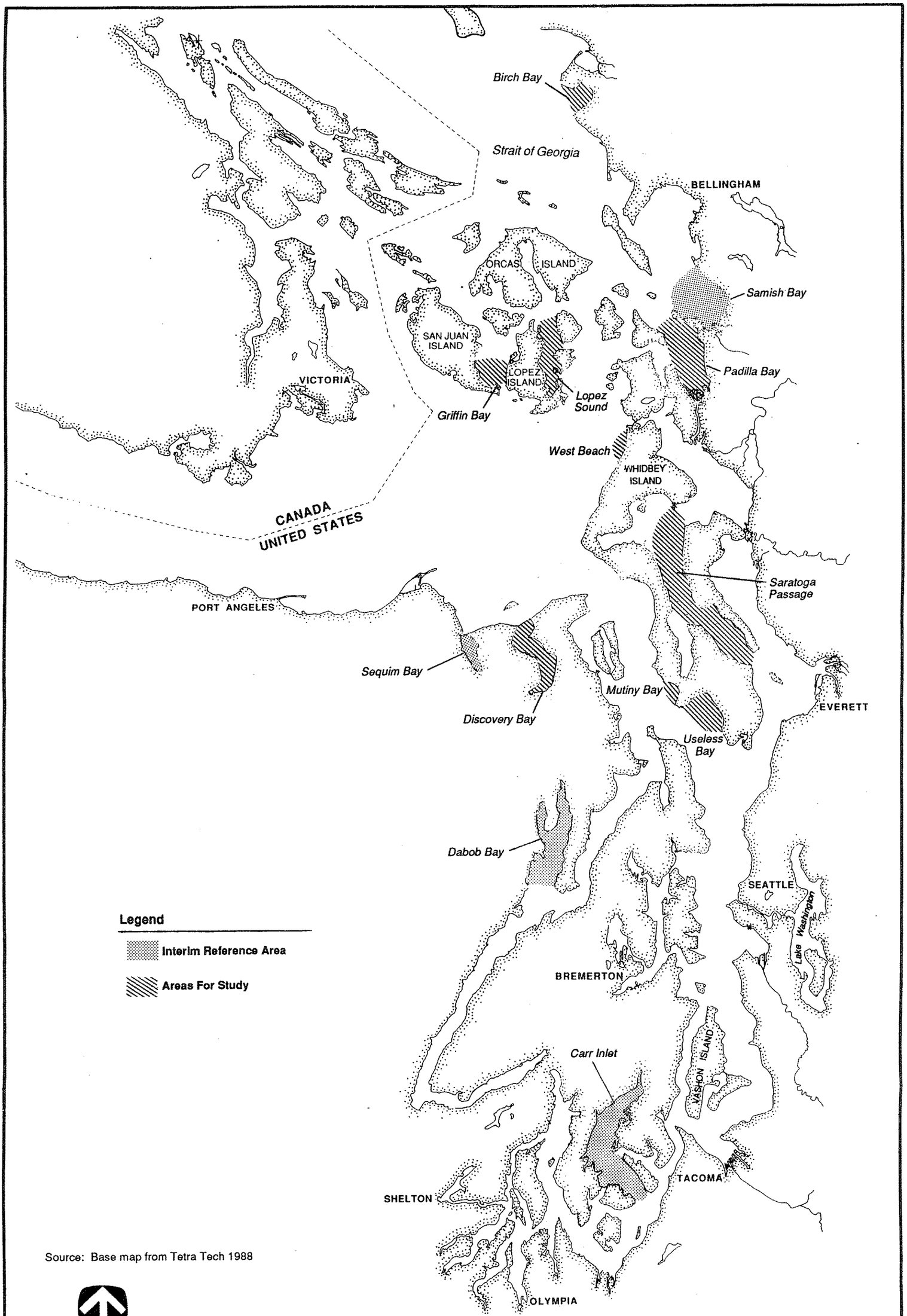


Figure 12. Locations of interim reference areas and areas for further study

- Griffin Bay
- Lopez Sound
- Saratoga Passage
- Useless Bay.

These areas were selected mainly on the basis of habitat characteristics. Also, the limited sediment data available for Discovery Bay, Padilla Bay, and Useless Bay indicated that they are suitable reference areas (Table 14).

DATA GAPS AND RECOMMENDED STUDIES

Available data on potential reference areas were evaluated to derive interim performance standards and select reference areas for use during the P-2 sediment management program. Data sets available for each potential reference area were characterized to identify data gaps (e.g., Table A-2 and Appendix B). In this section, major data gaps are identified and further studies are recommended.

DATA GAPS

Limitations of the available database for potential reference areas were considered relative to the P-2 data types (sediment chemistry, bioassays, and benthic macroinvertebrates), biogeographic zones, and habitat types (subtidal vs. intertidal, marine vs. low-salinity). The main data gaps identified in this study are listed below:

- Biogeographic zones and habitats
  - Limited data are available for potential reference areas around Whidbey Island (e.g., Mutiny Bay, Useless Bay, and Saratoga Passage), which could possibly serve as reference areas for sites in the Seattle and Everett metropolitan areas.
  - Almost no data for P-2 sediment variables are available for intertidal and low salinity habitats in potential reference areas.
  - Locations of low salinity habitats cannot be defined precisely based on the available data. Interstitial water salinity has generally not been reported in past studies.
  - Benthic macroinvertebrate data are inadequate to verify the existence of biogeographic zones and to define their boundaries.
- Sediment chemistry
  - Data for LPAH and HPAH in Sequim Bay are limited because of high detection limits at five stations.
  - No data have been collected on the presence of natural toxins in sediments that may be responsible for elevated toxicity values in biological tests [e.g., Sequim Bay Microtox results (Schiewe et al. 1987)].
  - Data have been reported on the potential presence of pulp mill related compounds (e.g., guaiacols and resin acids) only for Port Susan sediments.
  - Data on the following compounds listed as EPA priority pollutants are limited for the selected interim reference areas: acid extractable compounds (total of 24 samples from the four areas), miscellaneous base-neutrals (total of 20 samples from the four areas), chlorinated benzenes (total of 27 samples for the four areas), and tributyltin (one sample from Carr Inlet).

- Bioassays
  - Reference area data for the bivalve larvae and Microtox saline extract bioassays are limited (seven stations and eight stations, respectively).
  - The model of DeWitt et al. (1988) relating amphipod mortality to percent fine-grained material in sediments has not been confirmed using an independent data set from the proposed interim reference areas. The model of DeWitt et al. (1988) has not been applied to intertidal sediments.
  - Data are not available on the effects of fine-grained material in reference area sediments on larval mortality and abnormality in the bivalve larvae bioassay.
- Benthic macroinvertebrates
  - Data on benthic macroinvertebrate communities in the selected interim reference areas are limited (14 stations).
  - Seasonal changes in benthic macroinvertebrate communities could not be evaluated using the available data for potential reference areas.
  - Adequate data are not available to define the relationship in Puget Sound between environmental factors (e.g., depth, grain size) and characteristics of benthic macroinvertebrate communities in potential reference areas.
  - Data are not available to evaluate the use of benthic macroinvertebrates as indicators of toxic contamination in low salinity habitats.

RECOMMENDED STUDIES

The following studies are recommended to fill the data gaps identified above. Before further data analyses are conducted to develop reference area performance standards, data from the recent PSAMP and PSDDA Phase II baseline surveys should be incorporated into the reference areas database.

Biogeographic Zones and Habitats

- The biogeographic zones of Puget Sound need to be defined, especially relative to natural variations in major taxa of benthic macroinvertebrates. Data from PSAMP will potentially be valuable in filling this data gap because of the PSAMP sampling design's widespread distribution of sampling sites in nonurban areas throughout Puget Sound. The appropriateness of the proposed interim reference areas should be confirmed for designated zones where contaminated sediments may be tested.
- Data on sediment chemistry, conventional variables, and bioassays should be collected for low salinity environments and intertidal habitats.
- A reconnaissance survey to collect data on P-2 sediment variables should be performed in Mutiny Bay and Useless Bay to possibly expand the number of interim

reference areas. These areas would provide more accessible sampling locations relative to contaminated sites in the central Puget Sound region.

- The model of DeWitt et al. (1988) relating amphipod mortality to percent fine-grained material in sediments should be evaluated for intertidal sediments.

Interim Reference Areas (Marine Subtidal)

- P-2 sediment variables for sediment chemistry, bioassay, and benthic macroinvertebrates should be measured in subtidal habitats of each of the interim references areas to fill data gaps and provide information to address relationships among variables. For example, the influence of grain size, depth, and TOC on benthic macroinvertebrate communities in Puget Sound needs to be evaluated, especially relative to abundances of higher taxa and species richness (i.e., number of taxa). This information will be used to refine the proposed structure of the performance standards. The data analysis approach to accomplishing these objectives is described in Appendix E. Data from recent PSAMP and PSDDA Phase II baseline surveys should be incorporated into the reference areas database before the data analyses recommended in Appendix E are performed. Studies to address some additional issues related to grain size effects on bioassay responses are recommended below.
- The model of DeWitt et al. (1988) relating amphipod mortality to percent fine-grained material in sediment should be confirmed for subtidal sediments from the proposed interim reference areas.
- The effects of fine-grained material in reference area sediments on mortality and abnormality in the bivalve larvae test should be evaluated further.

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APPENDIX A

ANNOTATED BIBLIOGRAPHY

TABLE A-1. MATRIX OF DATA TYPES FOR POTENTIAL REFERENCE AREAS[a]

Reference Area	Sediment Chemistry (Metals)	Sediment Chemistry (Organics)	Sediment Conventionals	Benthic Infauna	Amphipod Mortality Bioassay	Microtox Bioassay (Organic)	Microtox Bioassay (Saline)	Bivalve Abnormality Bioassay
Admiralty Inlet	18	4,6	21,50					
Andrews Bay/San Juan Island		8*						
Birch Bay		8*	13		*13*			
Blakely Harbor	59	59	59	59	59			
Boundary Bay		16		16				
Carr Inlet	18,49,43,53,58	*26*,49,39,46,43,53,58	49,50,43,53,58	58	43,53,58	53,58	66,43	43[c],58
Case Inlet	7,18,*34*,49,*30*,*32*, 33,*26*,*36*,*57*	7,*34*,49,*30*,*32*,33,39, 46,*12*,*26*,*36*,*57*	49,50,*57*,7,*32*	*12*,34,*32*,*57*	25,*57*,7,*32*			7
Dabob Bay	*57*,7,53	*57*,4,7,46,47,*48*,53	*57*,5,7,50,24,53	57	25,7,53	53		7
Discovery Bay	*36*,34,53	*36*,34,52,53	50,21,53	34	53	52,53		
Dungeness Spit		8*	(41)	41				
Dyes Inlet	21	21	*23*,50,21		*23*,21			
East Sound/Orcas Island		4	50					
Henderson Inlet	49	49	49,50					
Hood Canal, central/lower	18,22		50					
Lummi Island/Hale Passage		4	50					
Nisqually Reach	18,49	*26*,4,49,39,46	49,50					
Oak Harbor	21	21	21		21,1	1		
Padilla Bay		4	25,3,*61*	3	25			
Pickering Passage		46	50					
Port Madison	*26*,*36*,33,*34*, 51,*30*,*17*	*26*,*36*,33,*34*, 51,*30*,*17*	50,21,13,*17*	34	17,*13*			14
Port Orchard	*17*	4,*17*	50,*17*		17			
Port Susan	*36*,18,34,44, *30*,45,43	*36*,4,34,44,*30*, 45,46,43	50,21,44,45,43	34,44,45	44,45,43		43	43[c]
Possession Sound	18,43,51	43,51	43,50	43	43		43	43[c]
President Point		31,37,*38*,*52*	50,21			52		
Quartermaster Harbor	40,18,68,*17*	40,68,*17*	40,(28),*17*		17			
Rich Passage/Bainbridge Island	22							
Rosario Strait		4						
Samish Bay	*57*,18,7,*32*, 53,*62*	*12*,*57*,7, *32*,53,*62*	7,*57*,*15*,9,*32*, 53,*61*,50	*12*,*57*,9,*32*	*57*,7,15,*32*,53	53		7,15
Saratoga Passage	18	46	50,21					
Sequim Bay	*57*,7,1,2, 11,53,54,64	*57*,64,7,1,2,10, 11,53	7,*57*,64,53 54	*57*	*57*,7,1,2,10, 11,19,53,21, 65	1,2,*19*,53,10	64	7
Skagit Bay	18,21	4,21	50,21	55,56				
Tacoma Narrows	18,49	*26*,39,49,6,46	49					
Useless Bay		35,31,*52*				52		
Wollochet Bay/Hale Passage	49	49	49,50					
West Beach	42,41,2,64	42,41,2,64	42,41,2,21, 64		42[b],2[b]	42,2	42	
All Potential Reference Areas	*29*,*60*	*29*,*60*	*29*,*60*	*29*,*60*	*29*,*60*			

TABLE A-1. (Continued)

Key:

bold = accepted to database
italics = no original data
(parentheses) = general information only
redline = document not available
double underline = excluded from database

* Intertidal stations.

[a] Numbers refer to sources cited in the bibliography of Appendix A.

[b] West Beach is native sediment-control for amphipods.

[c] Bioassay done with *Mytilus edulis*, all others are *Crassostrea gigas*.

ANNOTATED BIBLIOGRAPHY OF PUGET SOUND REFERENCE AREAS

The following is a list of sources containing information on Puget Sound reference area data. Keywords are supplied to identify geographic location and data types.

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67. Yake, B. 1986. Quartermaster Harbor: Dockton--a reconnaissance survey of nearshore sediments. Washington Department of Ecology, Olympia, WA. 10 pp. **Keywords:** Quartermaster Harbor - sediment chemistry metals and organics. (QMHARBOR Survey.) (Note: Station coordinates are unavailable.)

APPENDIX B

DATA QA/QC RESULTS

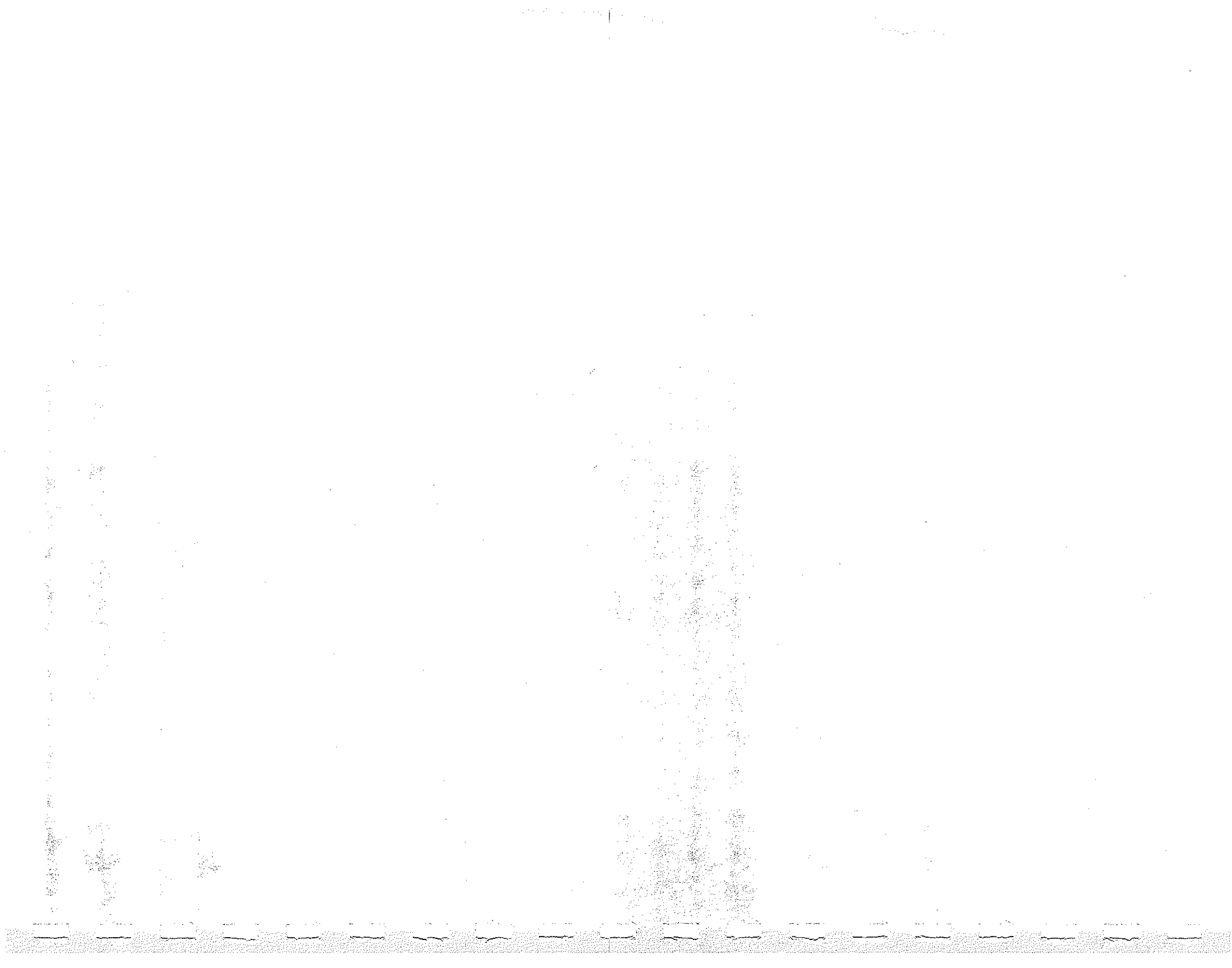


TABLE B-1. QA EVALUATION SUMMARY OF DATA SOURCES.

Document*	Database Entry	SC	SH	QA	AM	DL	Comments
SEDIMENT CHEMISTRY DATA							
Anderson 1986a (OAKHRBR)	YES	A	A	A	A	A	High detection limits for some contaminants.
Anderson 1986b (KENM86)	YES	A	A	A	A	A	High detection limits for some contaminants.
Barrick 1987 (BARRICK)	YES	A	A	A	A	A	Data collected primarily 1975-1976; PAH are almost always detected.
Bates 1979 (MISCREFS)	YES	A	A	--	A	A	
Battelle 1986 (EIGHTBAY)	YES	A	A	A	A	A	Detection limits for several organic compounds in reference areas are high.
Brown 1981 (BROWN7)	YES	A	A	A	A	A	Intertidal stations; analytical method susceptible to interferences for some PAH.
Chan 1985a (DUWRIV2)	YES	A	A	A	A	A	
Chan 1985b (DUWRIV1)	YES	A	A	A	A	A	
Chapman (No date)	NO	--	--	--	--	--	Secondary source, no original data.
Comiskey 1984	NO	--	--	--	--	--	Secondary source, no original data.
Crecelius 1975 (CREC72)	YES	A	A	A	A	A	All contaminants were detected in samples; detailed QA given in Crecelius 1974.
Crecelius 1986 (EVERETT1)	YES	A	A	A	A	A	Analytical method was susceptible to interferences for some PAH.
Crecelius 1987 (PTGARQC)	YES	A	I	A	A	A	Samples from different stations were composited.
Crecelius 1989 (88PSRECN)	YES	A	A	A	A	A	
Cummins 1976 (LIBERT88)	YES	A	A	N	A	N	
Dexter 1981	NO	--	--	--	--	--	Secondary source.
Konasewich 1982	NO	--	--	--	--	--	Secondary source, no original data.
Krahn 1986 (MISCREFS)	YES	A	A	A	A	A	Methods and QA cited from previous reports.
Long 1985	NO	--	--	--	--	--	Secondary source, no original data.
Malins 1980 (MALINS)	YES	A	A	A	A	A	
Malins 1982 (MALINS)	YES	A	N	A	A	N	All data should be qualified estimates.
Malins 1984	NO	--	--	--	--	--	Secondary source.
Malins 1985a (MISCREFS)	YES	A	A	N	A	A	
Malins 1985b	NO	--	--	--	--	--	Same data as in Krahn 1986.
Mowrer 1977 (MISCREFS)	YES	A	A	A	A	A	Data acceptable for best estimates of total PCB concentration.
Nevissi 1984 (SEAHBASE)	YES	A	A	A	A	A	
Nyblade 1979	NO	--	--	--	--	--	General information only.
Pastorok 1988 (EPAPS88)	YES	A	A	A	A	A	West Beach only.
Prahl 1979 (BARRICK)	YES	A	A	A	A	A	Data reported for 6 PAH only.
Prahl 1980	NO	--	--	--	--	--	Secondary source.
PTI 1988 (PSDDA1)	YES	A	A	A	A	A	

TABLE B-1. QA EVALUATION SUMMARY OF DATA SOURCES.

Document*	Database Entry	SC	SH	QA	AM	DL	Comments
PTI 1988a (EBCHEM)	YES	A	A	A	A	A	Detection limits for some contaminated samples are high.
PTI 1988b (EVCHEM)	YES	A	A	A	A	A	Includes analysis of compounds indicative of pulp mill effluent.
Riley 1983 (RILEY001)	YES	A	A	A	A	A	
Romberg 1984 (TPPS3AB)	YES	A	A	A	A	A	
Schiewe 1985 (MISCREFS)	YES	A	A	A	A	A	Duplicate data from Krahn; contains one unique station.
Schiewe 1987 (NOADW86)	YES	A	A	A	A	A	
Strand 1984	NO	--	--	--	--	--	Secondary source for EIGHTBAY survey.
Tetra Tech 1985 (CBMSQS)	YES	A	A	A	A	A	
Tetra Tech 1986 (EHCHEM)	YES	A	A	A	A	A	
U.S. EPA 1984	NO	--	--	--	--	--	Secondary Source (EIGHTBAY data).
Varanasi 1989 (OLYHAR88)	YES	A	A	N	A	N	Document excerpt only.
Yake 1986 (QMHARBOR)	YES	A	A	A	A	A	
SEDIMENT CONVENTIONAL VARIABLES							
Battelle 1986 (EIGHTBAY)	YES	A	A	A	A	A	Detection limits for several organic compounds in reference areas are high.
Broad 1973	NO	I	A	--	--	--	
Crecelius 1986 (EVERETT1)	YES	A	A	A	A	A	Analytical method was susceptible to interferences for some PAH.
Dewitt 1988 (REFGRAIN)	YES	A	A	N	A	--	
Dewitt 1989 (REFGRAIN)	NO	N	N	N	N	--	
Emerson 1984	NO	--	--	--	--	--	General information only.
Long 1985	NO	--	--	--	--	--	Secondary source, no original data.
Nevissi 1984 (SEAHBASE)	YES	A	A	A	A	A	
Pastorok 1988 (EPAPS88)	YES	A	A	A	A	A	West Beach only.
PTI 1988 (PSDDA1)	YES	A	A	A	A	A	
PTI 1988a (EBCHEM)	YES	A	A	A	A	A	Detection limits for some contaminated samples are high.
PTI 1988b (EVCHEM)	YES	A	A	A	A	A	Includes analysis of compounds indicative of pulp mill effluent.
Riley 1983 (RILEY001)	YES	A	A	A	A	A	
Roberts 1974 (ROBERT74)	YES	A	A	N	A	A	
Schiewe 1987 (NOADW86)	YES	A	A	A	A	A	
Strand 1984	NO	--	--	--	--	--	Secondary source for EIGHTBAY survey.

TABLE B-1. QA EVALUATION SUMMARY OF DATA SOURCES.

Document*	Database Entry	SC	SH	QA	AM	DL	Comments
Tetra Tech 1985 (CBMSQS)	YES	A	A	A	A	A	
Tetra Tech 1986 (EHCHEM)	YES	A	A	A	A	A	
Word 1984	NO	--	--	--	--	--	East Passage rejected as reference area.
AMPHIPOD MORTALITY BIOASSAY DATA							
Anderson 1986a (OAKHRBR)	YES	A	A	A	A	--	
Anderson 1986b (KENM86)	YES	A	A	A	A	--	
Battelle 1986 (EIGHTBAY)	YES	A	A	A	A	--	
Chan 1985a (DUWRIV2)	YES	A	A	A	A	--	
Chan 1985b (DUWRIV1)	YES	A	A	A	A	--	
Chapman 1984	NO	A	I	--	A	--	Samples frozen.
Comiskey 1984	NO	A	I	A	A	--	Samples frozen.
Crecelius 1986 (EVERETT1)	YES	A	A	A	A	--	
Crecelius 1987 (PTGARQC)	NO	A	I	A	A	--	Samples composited across stations.
Dewitt 1988 (REFGRAIN)	YES	A	A	A	A	--	
Dewitt 1989 (REFGRAIN)	YES	N	A	A	A	--	
Long 1985	NO	--	--	--	--	--	Secondary source, no original data.
Pastorok 1988 (EPAPS88)	YES	A	A	A	A	--	West Beach only.
PTI 1988 (PSDDA1)	YES	A	A	A	A	--	
PTI 1988a (EBCHEM)	YES	A	A	A	A	--	
PTI 1988b (EVCHEM)	YES	A	A	A	A	--	
Schiewe 1987 (NOADW86)	YES	A	A	A	A	--	
Strand 1984	NO	--	--	--	--	--	Secondary source.
Tetra Tech 1985 (CMBSQS)	YES	A	A	A	A	--	
Tetra Tech 1986 (EHCHEM)	YES	A	A	A	A	--	
Ward 1989	NO	A	I	A	A	--	Exceeds 2 week holding time
OYSTER LARVAE TOXICITY BIOASSAY DATA							
Battelle 1986 (EIGHTBAY)	NO	A	A	A	I	--	Inadequate subsampling of larvae.

TABLE B-1. QA EVALUATION SUMMARY OF DATA SOURCES.

Document*	Database Entry	SC	SH	QA	AM	DL	Comments
Chapman 1983	NO	A	I	A	A	--	Samples frozen.
Chapman 1984	NO	A	I	--	A	--	Samples frozen.
Cummins 1976 (LIBERT88)	NO	A	A	N	I	--	Sediment suspensions tested.
PTI 1988 (PSDDA1)	YES	A	A	A	A	--	Bivalve bioassay done on Mytilus edulis.
Tetra Tech 1985 (CMBSQS)	YES	A	A	A	A	--	
MICROTOX BIOASSAY DATA							
Anderson 1986a (OAKHRBR)	YES	A	A	A	A	--	
Anderson 1986b (KENM86)	YES	A	A	N	A	--	
Crecelius 1986 (EVERETT1)	YES	A	A	N	A	--	
Pastorok 1988 (EPAPS88)	YES	A	A	A	A	--	West Beach only.
PTI 1988 (PSDDA1)	YES	A	A	A	A	--	
Schiewe 1985 (MISCREFS)	YES	A	A	A	A	--	
Schiewe 1987 (NOADW86)	YES	A	A	A	A	--	
Tetra Tech 1985 (CMBSQS)	YES	A	A	A	A	--	
Varanasi 1989 (OLYHAR88)	YES	A	A	A	A	--	
BENTHIC INFAUNA ABUNDANCE							
Battelle 1986 (EIGHTBAY)	NO	I	A	A	I	--	Sampling method incompatible with other Puget Sound studies.
Broad 1973	NO	I	A	--	--	--	Only 2 replicates.
Comiskey 1984	NO	--	--	--	--	--	Urban sites only.
Long 1985	NO	--	--	--	--	--	Secondary source, no original data.
Malins 1980	NO	I	A	N	A	--	Core used to subsample grab.
Malins 1982	NO	I	A	N	A	--	Core used to subsample grab.
Nyblade 1979	NO	I	A	N	A	--	Sampling method incompatible with other Puget Sound studies.
PTI 1988 (PSDDA1)	YES	A	A	A	A	--	
PTI 1988a (EBCHEM)	YES	A	A	A	A	--	

TABLE B-1. QA EVALUATION SUMMARY OF DATA SOURCES.

Document*	Database Entry	SC	SH	QA	AM	DL	Comments
PTI 1988b (EVCHEM)	YES	A	A	A	A	--	
Stober 1973	NO	A	A	N	A	--	0.495 mm screen mesh is incompatible with other Puget Sound studies.
Strand 1984	NO	--	--	--	--	--	Secondary source.
Tetra Tech 1985 (CMBSQS)	YES	A	A	A	A	--	
Tetra Tech 1986 (EHCHEM)	YES	A	A	A	A	--	
Word 1984	NO	A	A	A	A	--	East Passage rejected as reference area due to chemistry.

* Documents referenced are in the annotated bibliography (Appendix A); survey name is listed in parentheses.

"--" means not applicable; or not reviewed because the data set was excluded based on a previous category of information.

Codes: SC=Sample collection.
SH=Sampling handling/storage.
QA=Quality assurance/quality control.
AM=Analytical methods.
DL=Detection limits.

A=Adequate
I=Inadequate
N=No Description

TABLE B-2. SUMMARY OF STATION COUNTS BY SURVEY AND BAY FOR CHEMICAL AND BIOLOGICAL VARIABLES

Bay	Study	Sulfides	TOC	Percent Fines	LPAH	HPAH	Total PCBs	Phthalates	Arsenic	Cadmium	Copper	Chromium	Lead	Mercury	Nickel	Silver	Zinc
Admiralty Inlet	88PSRECN			2													
	BARRICK		1		1	1											
	CREC72								1					1			
	ROBERT74			2													
Andrews Bay (San Juan Isl)	BROWN7		1ab		1ab	1ab											
Birch Bay	BROWN7		1ab		1ab	1ab											
	REFGRAIN			5													
Blakely Harbor	EHCHEM	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Carr Inlet	CBMSQS	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
	CBPRELIM	2	2	2	1	1	2	2	2	2	2	2	2	2	2	2	2
	CREC72								1		1	1		1			
	MISCREFS						1										
	NOADW86	1		1	1	1	1	1	1	1	1	1	1	1	1	1	1
	PSDDA1	1	1	1	1	1	1	1	1	1	1		1	1	1	1	1
	RILEY001		2b	2b			2b		2b	2b	2b	2b	2b	2b	2b	2b	2b
	ROBERT74			3													
Case Inlet	CREC72								2b			2b		2b			
	EIGHTBAY		4	24	4	4	4		4	4	4	4	24	24	4	24	4
	MALINS		2	2	2		2			2	2	2	2	2	2	2	2
	MISCREFS						1										
	RILEY001		2	2			2		2	2	1	2	2	2	2	2	2
	ROBERT74			9b													
	(DEWITT)																
Dabob Bay	BARRICK		1			1											
	EIGHTBAY		4	24	4	4	4		4	4	4	4	24	24	4	24	4
	MISCREFS		1														
	NOADW86	1		1	1	1	1	1	1	1	1	1	1	1	1	1	1
	REFGRAIN			4													
	ROBERT74			3													
Discovery Bay	88PSRECN			1b													
	MALINS						1		1	1				1			
	MISCREFS																

TABLE B-2. (Continued) SUMMARY OF STATION COUNTS BY SURVEY AND BAY FOR CHEMICAL AND BIOLOGICAL VARIABLES

Bay	Study	Sulfides	TOC	Percent Fines	LPAH	HPAH	Total PCBS	Phthalates	Arsenic	Cadmium	Copper	Chromium	Lead	Mercury	Nickel	Silver	Zinc
	NOADW86	1		1	1	1	1	1	1	1	1	1	1	1	1	1	1
	ROBERT74			49													
Dungeness Spit	BROWN7		1ab		1ab	1ab											
Dyes Inlet	88PSRECN		6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
	ROBERT74			2													
East Sound (Orcas Island)	BARRICK		1		1	1											
	ROBERT74			11													
Hale Passage/ Fox Island vicinity	ROBERT74			1													
Hale Passage Lummi Island vicinity	ROBERT74			2													
Henderson Inlet	RILEY001		1	1			1		1	1	1	1	1	1	1	1	1
	ROBERT74			2													
Hood Canal, Central	CREC72								4			4		4			
	LIBERT88								1	1	1	1	1	1	1		1
	ROBERT74			10													
Nisqually Reach	BARRICK		1		1	1											
	CREC72								1			1		1			
	MISCREFS						1										
	NOAA84		3	3			3			3	3	2	3	3	3	3	
	RILEY001		1	1			1		1b	1b	1b	1b	1b	1b	1b	1b	1b
	ROBERT74			68													
Oak Harbor	88PSRECN		6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
	OAKHRBR	16	2	2	2	2	6		2	2	2		2	5			1
Padilla Bay	BARRICK		1		1	1											
	REFGRAIN			1													
Pickering Passage	ROBERT74			3b													
Port Madison	88PSRECN			1b													
	MALINS		2	2	2		2			2	2	2	2	2	2	2	2
	REFGRAIN			6													
	ROBERT74			39b													
	TPPS3AB				3	3	3	3	3	3	3	3	3	3	3	3	3

TABLE B-2. (Continued) SUMMARY OF STATION COUNTS BY SURVEY AND BAY FOR CHEMICAL AND BIOLOGICAL VARIABLES

Bay	Study	Sulfides	Percent TOC	Percent Fines	Total LPAH	Total HPAH	Total PCBS	Total Phthalates	Arsenic	Cadmium	Copper	Chromium	Lead	Mercury	Nickel	Silver	Zinc
Port Orchard	BARRICK		1		1	1											
	ROBERT74			3													
Port Susan	88PSRECN			3b													
	BARRICK		1		1	1											
	CREC72								2			1		2			
	EBCHEM	4b,1a	4b,1a	4b,1a	4,1a	4,1a	4b,1a	4b,1a	4b,1a	4b,1a	4b,1a	4b,1a	4b,1a	4b,1a	4b,1a	4b,1a	4b,1a
	EVCHEM	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
	MALINS						2		2	2			2	2			
	PSDDA1	1	1	1	1	1	1	1	1	1	1		1	1	1	1	1
	ROBERT74			2													
Possession Sound	CREC72								1			1		1			
	PSDDA1	1	1b	1b	1	1	1	1	1	1	1		1	1	1	1	1
	ROBERT74			3													
	TPPS3AB				1	1	1		1	1	1	1	1	1	1	1	1
Poverty Bay	88PSRECN																
President Point	88PSRECN			2b													
	MISCREFS				1		1										
Quartermaster Harbor	CREC72								2			1		1			
	QMHARBOR		3	3	1	1		1	3	3	3	3	3		3		3
	ROBERT74			1													
	SEAHBASE			2,1a	2,1a	2,1a		2,1a	2,1a	2,1a	2,1a	2,1a	2,1a	2,1a	2,1a	2,1a	2,1a
Rich Passage (Bainbridge Island)	LIBERT88						1		1	1	1	1	1	1	1		1
Rosario Strait	BARRICK		1		1	1											
Samish Bay	CREC72													2			
	EIGHTBAY		4	24	4	4	4	4	4	4	4	4	24	24	4	24	4
	NOADW86	1		1	1	1	1	1	1	1	1	1	1	1	1	1	1
	REFGRAIN			2													
	ROBERT74			23													
Saratoga Passage	88PSRECN			3b													
	CREC72								2			1		2			
	ROBERT74			5													

TABLE B-2. (Continued) SUMMARY OF STATION COUNTS BY SURVEY AND BAY FOR CHEMICAL AND BIOLOGICAL VARIABLES

Bay	Study	Sulfides	TOC	Percent Fines	LPAH	HPAH	PCBS	Total Phthalates	Arsenic	Cadmium	Copper	Chromium	Lead	Mercury	Nickel	Silver	Zinc
Sequim Bay	DUWRIV1			1													
	DUWRIV2																
	EIGHTBAY		4	24	4	4	4		4	4	4	4	24	24	4	24	4
	EVERETT1																
	KENM86				1	1			1	1	1		1	1			1
	NOADW86	1		1	1	1	1	1	1	1	1	1	1	1	1	1	1
	OAKHRBR		1	1	1				1	1	1		1	1			1
	OLYHAR88			1	1	1	1	1	1	1	1	1	1	1	1	1	1
Skagit Bay	BARRICK		1		1	1											
	CREC72								2			2		2			
	ROBERT74			2													
Tacoma Narrows/	CREC72								2			1		2			
Cormorant Passage	MISCREFS		1				1										
	RILEY001		1	1			1		1	1	1	1	1	1	1	1	1
	ROBERT74			2													
Useless Bay	MISCREFS																
West Beach	88PSRECN			1													
	EPAPS88	1	1	1	1	1		1		1	1	1	1	1	1	1	1
	KENM86								1	1	1		1	1			1
	NOADW86			1	1	1	1	1	1	1	1	1	1	1		1	1
	OAKHRBR					1											
	OLYHAR88			1			1	1	1	1	1	1	1	1	1	1	1
	SEAHBASE			1a					1a	1a	1a	1a	1a	1a	1a	1a	1a
Wollochet Bay	RILEY001		1	1			1		1	1	1	1	1	1	1	1	1
	ROBERT74			1													

Numbers listed are the number of unique stations.

a = intertidal stations, all other stations are subtidal.

b = 1 or more stations were sampled multiple times.

c = 1 or more stations did not have replicate data.

TABLE B-2. SUMMARY OF STATION COUNTS BY SURVEY AND BAY FOR CHEMICAL AND BIOLOGICAL VARIABLES

Bay	Study	Amphipod Mortality Bioassay	Benthic Infauna Abundance	Bivalve Abnormality Bioassay	Microtox Bioassay (saline)	Microtox Bioassay (organic)
Admiralty Inlet	88PSRECN					
	BARRICK					
	CREC72					
	ROBERT74					
Andrews Bay (San Juan Isl)	BROWN7				(EC50 values only)	
Birch Bay	BROWN7					
	REFGRAIN					
Blakely Harbor	EHCHEM	2	2			
Carr Inlet	CBMSQS	4	4	4	4	
	CBPRELIM					
	CREC72					
	MISCREFS					
	NOADW86	1c				1c
	PSDDA1	1		1	1	
	RILEY001					
	ROBERT74					
Case Inlet	CREC72					
	EIGHTBAY	24c				
	MALINS					
	MISCREFS					
	RILEY001					
	ROBERT74					
	(DEWITT)	31c				
Dabob Bay	BARRICK					
	EIGHTBAY	4				
	MISCREFS					
	NOADW86	1c				1c
	REFGRAIN	5c				
	ROBERT74					
Discovery Bay	88PSRECN					
	MALINS					
	MISCREFS					1c

TABLE B-2. (Continued) SUMMARY OF STATION COUNTS BY SURVEY AND BAY FOR CHEMICAL AND BIOLOGICAL VARIABLES

Bay	Study	Amphipod Mortality Bioassay	Benthic Infauna Abundance	Bivalve Abnormality Bioassay	Microtox Bioassay (saline)	Microtox Bioassay (organic)
	NOADW86		1c			1c
	ROBERT74					
Dungeness Spit	BROWN7					
Dyes Inlet	88PSRECN					
	ROBERT74					
East Sound (Orcas Island)	BARRICK					
	ROBERT74					
Hale Passage/ Fox Island vicinity	ROBERT74					
Hale Passage Lummi Island vicinity	ROBERT74					
Henderson Inlet	RILEY001					
	ROBERT74					
Hood Canal, Central	CREC72					
	LIBERT88					
	ROBERT74					
Nisqually Reach	BARRICK					
	CREC72					
	MISCREFS					
	NOAA84					
	RILEY001					
	ROBERT74					
Oak Harbor	88PSRECN		6			
	OAKHRBR		3			4c
Padilla Bay	BARRICK					
	REFGRAIN		3			
Pickering Passage	ROBERT74					
Port Madison	88PSRECN					
	MALINS					
	REFGRAIN					
	ROBERT74					
	TPPS3AB					

TABLE B-2. (Continued) SUMMARY OF STATION COUNTS BY SURVEY AND BAY FOR CHEMICAL AND BIOLOGICAL VARIABLES

Bay	Study	Amphipod Mortality Bioassay	Benthic Infauna Abundance	Bivalve Abnormality Bioassay	Microtox Bioassay (saline)	Microtox Bioassay (organic)
Port Orchard	BARRICK					
	ROBERT74					
Port Susan	88PSRECN					
	BARRICK					
	CREC72					
	EBCHEM	4	4			
	EVCHEM	3	3			
	MALINS					
	PSDDA1	1		1	1	
	ROBERT74					
Possession Sound	CREC72					
	PSDDA1	1	1	1	1	
	ROBERT74					
	TPPS3AB					
Poverty Bay	88PSRECN	1				
President Point	88PSRECN					
	MISCREFS					1c
Quartermaster Harbor	CREC72					
	QMHARBOR					
	ROBERT74					
	SEAHBASE					
Rich Passage (Bainbridge Island)	LIBERT88					
Rosario Strait	BARRICK					
Samish Bay	CREC72					
	EIGHTBAY	24c				
	NOADW86	1c				1c
	REFGRAIN					
	ROBERT74					
Saratoga Passage	88PSRECN					
	CREC72					
	ROBERT74					

TABLE B-2. (Continued) SUMMARY OF STATION COUNTS BY SURVEY AND BAY FOR CHEMICAL AND BIOLOGICAL VARIABLES

Bay	Study	Amphipod Mortality Bioassay	Benthic Infauna Abundance	Bivalve Abnormality Bioassay	Microtox Bioassay (saline)	Microtox Bioassay (organic)
Sequim Bay	DUWRIV1					
	DUWRIV2	1				1c
	EIGHTBAY	24c				
	EVERETT1	1				
	KENM86	1				1
	NOADW86	2c				1c
	OAKHRBR	1				1
	OLYHAR88				1c	
Skagit Bay	BARRICK					
	CREC72					
	ROBERT74					
Tacoma Narrows/ Cormorant Passage	CREC72					
	MISCREFS					
	RILEY001					
	ROBERT74					
Useless Bay	MISCREFS					1c
West Beach	88PSRECN					
	EPAPS88					
	KENM86					
	NOADW86					
	OAKHRBR					
	OLYHAR88					
	SEAHBASE					
Wollochet Bay	RILEY001					
	ROBERT74					

Numbers listed are the number of unique stations.

a = intertidal stations, all other stations are subtidal.
b = 1 or more stations were sampled multiple times.
c = 1 or more stations did not have replicate data.

APPENDIX C

HISTORICAL DATA LISTING

Qualifier codes used in all tables are as follows:

Qualifier Code	Description
B	Blank-corrected down to detection limit
C	Combined with unresolved substances
E	Estimate
G	Estimate is greater than value shown
K	Detected at less than detection limit shown
L	Value is less than the maximum shown
M	Value is a mean
Q	Questionable value
T	Detected below quantification limit shown
U	Undetected at the detection limit shown
X	Recovery less than 10 percent
Z	Blank-corrected, still above detection limit

For further details on averaging and reporting features, please refer to the SEDQUAL Users Manual (PTI 1989b).

06/14/89

TABLE C-1. CONCENTRATIONS OF METALS IN PUGET SOUND REFERENCE AREA SAMPLES (mg/kg dry weight).

Survey	Station	Date	Sample	FieldRep	ANTIMONY	ARSENIC	CADMIUM	COPPER	CHROMIUM	LEAD	MERCURY	NICKEL	SILVER	ZINC
88PSRECN	DY-1	04/21/88	DY-1		0.27	4.1	0.93	19	118	20.5	0.153 Z	22	0.13	47
88PSRECN	DY-2	04/21/88	DY-2		0.55	8.9	1.11	51	162	46.6	0.386 Z	43	0.54	100
88PSRECN	DY-3	04/22/88	DY-3		0.54	9.9	0.67	43.5	104	34.5	0.316 Z	42	0.43	92.8
88PSRECN	DY-4	04/22/88	DY-4		1.29	17.7	0.97	89.6	111	79.2	0.717 Z	60	1.18	168
88PSRECN	DY-5	04/22/88	DY-5		0.81	18.8	1.41	72.4	113	57.4	0.659 Z	58	0.85	143
88PSRECN	DY-6	04/22/88	DY-6		1.03	19.3	1.07	81.2	101	74	0.79 Z	62	1.04	150
88PSRECN	OH-1	04/28/88	OH-1		0.27	8.6	0.74	34.2	76	21.4	0.285 Z	27	0.13	92.2
88PSRECN	OH-2	04/28/88	OH-2		0.27	9	0.59	39.9	87	21.4	0.253 Z	35	0.17	95.9
88PSRECN	OH-3	04/28/88	OH-3		0.28	11.1	0.45	43.3	126	15.3	0.083 Z	79	0.32	98.5
88PSRECN	OH-4	04/28/88	OH-4		0.27	10.5	0.44	47.3	113	13.7	0.095 Z	78	0.29	112
88PSRECN	OH-5	04/28/88	OH-5		0.21	10.4	0.63	48.1	155	15.1	0.099 Z	71	0.31	94.6
88PSRECN	OH-6	04/28/88	OH-6		0.07	7.5	0.54	32.1	126	12.1	0.067 Z	45	0.15	74.1
CBMSQS	CR-11	01/01/84	CR-11		0.13	2.4	1.1	4.9	9.9	11	0.055	11	0.1 U	15
CBMSQS	CR-12	01/01/84	CR-12		0.1 U	3.8	1.4	7.3	11	13	0.098	14	0.1 U	19
CBMSQS	CR-13	01/01/84	CR-13		0.1 U	3.8	1.1	5.2	9.6	10	0.049	12	0.1 U	15
CBMSQS	CR-14	01/01/84	CR-14		0.14	3.8	1.5	7.8	11	12	0.034	13	0.1 U	17
CBPRELIM	CR-03	03/01/84	CR-03		0.1	2.6	0.33	8	23	4.4	0.01	27.6	0.12	23.6
CBPRELIM	CR-04	03/01/84	CR-04		0.1	3.8	0.29	5	24.4	4.8	0.01	26.7	0.02	24.1
CREC72	AD-01	01/01/72	AD-01		0.43	3.2					0.009			
CREC72	CR-01	01/01/72	CS-01		1.82	15.7			80		0.114			
CREC72	CS-02	01/01/72	CS-02A	1	1.28	14.7			77		0.121			
CREC72	CS-02	01/01/72	CS-02B	2	1.51	18.5			87		0.117			
CREC72	CS-03	01/01/72	CS-03		1.69	12.7			79		0.15			
CREC72	HC-01	01/01/72	HC-01		0.63	9.7			92		0.042			
CREC72	HC-02	01/01/72	HC-02		0.72	11			88		0.085			
CREC72	HC-03	01/01/72	HC-03		1.16	12			80		0.022			
CREC72	HC-04	01/01/72	HC-04		0.61	17			108		0.073			
CREC72	NQ-01	01/01/72	NQ-01		0.59	4			60		0.023			
CREC72	PSD-1	01/01/72	PSD-1		1.13	16.1			88		0.146			
CREC72	PS-01	01/01/72	PS-01		0.97	15.5			179		0.11			
CREC72	PS-02	01/01/72	PS-02		0.64	9.6			77		0.051			
CREC72	QM-01	01/01/72	QM-01		3.6	54								
CREC72	QM-02	01/01/72	QM-02		0.68	7.5			147		0.101			

06/14/89

TABLE C-1. (Continued) CONCENTRATIONS OF METALS IN PUGET SOUND REFERENCE AREA SAMPLES (mg/kg dry weight).

Survey	Station	Date	Sample	FieldRep	ANTIMONY	ARSENIC	CADMIUM	COPPER	CHROMIUM	LEAD	MERCURY	NICKEL	SILVER	ZINC
CREC72	SA-01	01/01/72	SA-01		0.79	15.7			107		0.098			
CREC72	SA-02	01/01/72	SA-02		0.92	12.6					0.063			
CREC72	SK-01	01/01/72	SK-01		0.4	5.8			55		0.01			
CREC72	SK-02	01/01/72	SK-02		0.35	4.7			127		0.017			
CREC72	SM-01	01/01/72	SM-01								0.2			
CREC72	SM-02	01/01/72	SM-02								0.1			
CREC72	TN-01	01/01/72	TN-01		12	39			135		0.158			
CREC72	TN-02	01/01/72	TN-02		0.9	7					0.025			
DUWRIV1	SQ-09	04/19/85	SQ-09			22	0.64	35		12	0.03 U			93
EBCHEM	PS-01	10/12/85	PS-01	1	2.66	11.6	0.14	49.8	236 E	10.4	0.087 E	139	0.1 E	100
EBCHEM	PS-01	10/12/85	PS-01	2	2.86	9.8	0.16	49	230 E	12	0.134 E	141	0.13 E	102
EBCHEM	PS-02	10/12/85	PS-02		2.07	8.45	0.13	26.3	132 E	8.5	0.054 E	82.1	0.056 E	63.5
EBCHEM	PS-03	10/12/85	PS-03		0.92	6.41	0.11	16.2	255 E	9.7	0.029 E	66.1	0.02 U	60.8
EBCHEM	PS-04	10/12/85	PS-04		2.06	7.05	0.07	20	147 E	7.2	0.015 E	63.2	0.02 U	57.2
EBCHEM	PS-05	10/15/85	PS-05		2.6	4.64	0.15	21.9	886 E	7.2	0.012 E	102	0.02 U	63.9
EHCHEM	BH-01	06/01/85	B1			3.6	0.44	17.4	23.6	26.6	0.062	17.5	0.08	42
EHCHEM	BH-02	06/01/85	B1			2.7	0.18	13.8	16.9	10.2	0.026	16.2	0.07	44
EIGHTBAY	CS1	09/14/83	CS1							29.6	0.183		0.402	
EIGHTBAY	CS10	09/14/83	CS10							26.9	0.18		0.322	
EIGHTBAY	CS11	09/15/83	CS11							14	0.089		0.134	
EIGHTBAY	CS12	09/15/83	CS12							22.2	0.19		0.269	
EIGHTBAY	CS13	09/15/83	CS13							30	0.19		0.349	
EIGHTBAY	CS14	09/15/83	CS14							24.7	0.185		0.273	
EIGHTBAY	CS15	09/15/83	CS15							23.4	0.17		0.267	
EIGHTBAY	CS16	09/15/83	CS16							31.8	0.17		0.337	
EIGHTBAY	CS17	09/15/83	CS17							22.6	0.129		0.24	
EIGHTBAY	CS18	09/15/83	CS18							23.8	0.134		0.28	
EIGHTBAY	CS19	09/15/83	CS19							4.7	0.042		0.037	
EIGHTBAY	CS2	09/14/83	CS2							26.9	0.181		0.328	
EIGHTBAY	CS20	09/15/83	CS20							14.3	0.08		0.188	
EIGHTBAY	CS3	09/14/83	CS3							27.7	0.181		0.269	
EIGHTBAY	CS4	09/14/83	CS4							27.3	0.167		0.379	
EIGHTBAY	CS5	09/14/83	CS5							29.3	0.176		0.42	

06/14/89

TABLE C-1. (Continued) CONCENTRATIONS OF METALS IN PUGET SOUND REFERENCE AREA SAMPLES (mg/kg dry weight).

Survey	Station	Date	Sample	FieldRep	ANTIMONY	ARSENIC	CADMIUM	COPPER	CHROMIUM	LEAD	MERCURY	NICKEL	SILVER	ZINC
EIGHTBAY	CS6	09/14/83	CS6							31.6	0.215		0.447	
EIGHTBAY	CS7	09/14/83	CS7							29.5	0.168		0.382	
EIGHTBAY	CS8	09/14/83	CS8							26.9	0.18		0.311	
EIGHTBAY	CS9	09/14/83	CS9							31	0.18		0.343	
EIGHTBAY	CS-01	05/29/84	CS-01		0.1 U	8.2	0.7	56	38	23	0.12	21	0.569	82
EIGHTBAY	CS-11	05/29/84	CS-11		0.1 U	6.9	0.6	30	41	9.3	0.054	22	0.119	57
EIGHTBAY	CS-15	05/29/84	CS-15		0.1 U	6.5	1.1	59	57	19	0.11	33	0.364	98
EIGHTBAY	CS-17	05/29/84	CS-17		0.1 U	8.1	1.9	52	57	13	0.082	31	0.262	84
EIGHTBAY	DB1	09/10/83	DB1							15	0.089		0.109	
EIGHTBAY	DB14	09/09/83	DB14							15.4	0.11		0.239	
EIGHTBAY	DB15	09/09/83	DB15							16.3	0.091		0.183	
EIGHTBAY	DB16	09/09/83	DB16							11.3	0.089		0.204	
EIGHTBAY	DB17	09/08/83	DB17							4.1	0.016		0.016	
EIGHTBAY	DB18	09/08/83	DB18							3.3	0.02		0.028	
EIGHTBAY	DB19	09/08/83	DB19							3.9	0.025		0.042	
EIGHTBAY	DB2	09/10/83	DB2							21.8	0.112		0.148	
EIGHTBAY	DB20	09/08/83	DB20							1.8	0.02		0.014 L	
EIGHTBAY	DB21	09/08/83	DB21							3	0.012		0.014 L	
EIGHTBAY	DB22	09/08/83	DB22							1.8	0.006 L		0.014 L	
EIGHTBAY	DB23	09/09/83	DB23							1.8	0.008		0.014 L	
EIGHTBAY	DB24	09/09/83	DB24							2.4	0.008		0.014 L	
EIGHTBAY	DB25	09/09/83	DB25							2.4	0.019		0.014 L	
EIGHTBAY	DB26	09/09/83	DB26							2.7	0.016		0.014 L	
EIGHTBAY	DB3	09/10/83	DB3							23.1	0.12		0.159	
EIGHTBAY	DB4	09/10/83	DB4							20.6	0.094		0.109	
EIGHTBAY	DB5	09/10/83	DB5							8.3	0.056		0.036	
EIGHTBAY	DB6	09/10/83	DB6							14.8	0.087		0.094	
EIGHTBAY	DB7	09/10/83	DB7							15.7	0.079		0.124	
EIGHTBAY	DB-01	05/22/84	DB-01		0.1 U	1.9	0.1	28	49	0.4	0.016	27	0.37	72
EIGHTBAY	DB-05	05/22/84	DB-05		0.1 U	2.1	0.1	33	51	0.1 U	0.022	30	0.37	77
EIGHTBAY	DB-07	05/22/84	DB-07		0.1 U	3.4	0.2	50	60	5.6	0.029	33	0.78	86
EIGHTBAY	DB-15	05/22/84	DB-15		0.1 U	5.6	0.4	74	76	9.9	0.047	46	0.218	102
EIGHTBAY	SM1	08/06/83	SM1							14.7	0.109		0.079	

06/14/89

TABLE C-1. (Continued) CONCENTRATIONS OF METALS IN PUGET SOUND REFERENCE AREA SAMPLES (mg/kg dry weight).

Survey	Station	Date	Sample	FieldRep	ANTIMONY	ARSENIC	CADMIUM	COPPER	CHROMIUM	LEAD	MERCURY	NICKEL	SILVER	ZINC
EIGHTBAY	SM10	08/08/83	SM10							17.2	0.123		0.115	
EIGHTBAY	SM11	08/08/83	SM11							9.4	0.08		0.075	
EIGHTBAY	SM12	08/08/83	SM12							6.1	0.039		0.047	
EIGHTBAY	SM13	08/09/83	SM13							2.7	0.009		0.016	
EIGHTBAY	SM14	08/09/83	SM14							3.4	0.013		0.027	
EIGHTBAY	SM15	08/09/83	SM15							3.6	0.021		0.014 L	
EIGHTBAY	SM16	08/09/83	SM16							22.7	0.118		0.106	
EIGHTBAY	SM17	08/09/83	SM17							3.3	0.033		0.019	
EIGHTBAY	SM18	08/09/83	SM18							16.2	0.125		0.105	
EIGHTBAY	SM19	08/09/83	SM19							18.6	0.137		0.119	
EIGHTBAY	SM2	08/06/83	SM2							18.8	0.162		0.053	
EIGHTBAY	SM20	08/09/83	SM20							15.2	0.083		0.075	
EIGHTBAY	SM3	08/06/83	SM3							8.9	0.068		0.061	
EIGHTBAY	SM4	08/06/83	SM4							20.2	0.166		0.137	
EIGHTBAY	SM5	08/08/83	SM5							16.9	0.154		0.108	
EIGHTBAY	SM6	08/08/83	SM6							15.3	0.117		0.084	
EIGHTBAY	SM7	08/08/83	SM7							14.3	0.091		0.084	
EIGHTBAY	SM8	08/08/83	SM8							16.8	0.146		0.117	
EIGHTBAY	SM9	08/08/83	SM9							19.2	0.155		0.118	
EIGHTBAY	SM-01	04/24/84	SM-01		0.1 U	4.5	0.14	33	32	5	0.08	20.2	0.104	74
EIGHTBAY	SM-03	04/24/84	SM-03		0.1 U	8	0.21	40	43	5	0.073	27.5	0.13	75
EIGHTBAY	SM-07	04/24/84	SM-07		0.1 U	4.6	0.17	33	35	6	0.069	19.7	0.108	76
EIGHTBAY	SM-20	04/24/84	SM-20		0.1 U	5.5	0.14	40	40	6	0.063	21.8	0.118	81
EIGHTBAY	SQ1	08/15/83	SQ1							6.5	0.025		0.063	
EIGHTBAY	SQ10	09/17/83	SQ10							14.7	0.111		0.154	
EIGHTBAY	SQ11	09/17/83	SQ11							8.2	0.061		0.107	
EIGHTBAY	SQ12	09/17/83	SQ12							4.1	0.027		0.06	
EIGHTBAY	SQ13	09/17/83	SQ13							13	0.061		0.123	
EIGHTBAY	SQ14	09/18/83	SQ14							8.9	0.051		0.107	
EIGHTBAY	SQ15	09/18/83	SQ15							13.8	0.096		0.186	
EIGHTBAY	SQ16	09/18/83	SQ16							11.8	0.091		0.135	
EIGHTBAY	SQ17	09/18/83	SQ17							13.8	0.09		0.16	
EIGHTBAY	SQ18	09/18/83	SQ18							13.8	0.091		0.176	

06/14/89

TABLE C-1. (Continued) CONCENTRATIONS OF METALS IN PUGET SOUND REFERENCE AREA SAMPLES (mg/kg dry weight).

Survey	Station	Date	Sample	FieldRep	ANTIMONY	ARSENIC	CADMIUM	COPPER	CHROMIUM	LEAD	MERCURY	NICKEL	SILVER	ZINC
EIGHTBAY	SQ19	09/18/83	SQ19							15.1	0.086		0.217	
EIGHTBAY	SQ2	08/15/83	SQ2							12	0.075		0.118	
EIGHTBAY	SQ20	09/18/83	SQ20							13	0.071		0.142	
EIGHTBAY	SQ3	08/15/83	SQ3							4.3	0.014		0.043	
EIGHTBAY	SQ4	08/15/83	SQ4							5.2	0.014		0.043	
EIGHTBAY	SQ5	08/16/83	SQ5							12	0.066		0.168	
EIGHTBAY	SQ6	08/16/83	SQ6							13.6	0.065		0.19	
EIGHTBAY	SQ7	09/17/83	SQ7							11.8	0.081		0.182	
EIGHTBAY	SQ8	09/17/83	SQ8							13.9	0.111		0.179	
EIGHTBAY	SQ9	09/17/83	SQ9							13	0.081		0.157	
EIGHTBAY	SQ-14	05/29/84	SQ-14		0.1 U	5.6	0.9	43	60	6.8	0.041	37	0.107	76
EIGHTBAY	SQ-17	05/29/84	SQ-17		0.1 U	7.3	0.9	48	67	9	0.068	41	0.226	88
EIGHTBAY	SQ-18	05/29/84	SQ-18		0.1 U	6.9	1.1	48	66	8.5	0.06	39	0.223	85
EIGHTBAY	SQ-20	05/29/84	SQ-20		0.1 U	6.9	0.9	44	65	9	0.055	38	0.2	83
EPAPS88	WB	05/01/88	WB		0.53	6.07	0.088	8.39	74.9	5.03	0.061	35.4	0.23	38.9
EVCHEM	PS-02	10/13/86	PS-02G	PS02	1.64 E	6.7	0.069	15	232	10.9	0.056	59.3	0.027	51.5
EVCHEM	PS-03	10/13/86	PS-03G	PS03	2.18 E	9	0.082	16.7	89	7.9	0.035	65	0.02	50.7
EVCHEM	PS-04	10/10/86	PS-04G	PS04	1.52 E	10.1	0.047	13.6	145	5.6	0.029	41.3	0.027	39.1
KENM86	SEQUIM	07/01/85	SEQUIM	1		12	0.87	37		10.3	0.082			97
KENM86	WHIDBEY	07/01/85	WHIDBEY	1		3.4	0.04	10		5.5	0.006			37
LIBERT88	HC-MP	09/16/75	MP		0.1 U	7	1.2	21	28	6	0.026	51		54
LIBERT88	RP-CB	09/16/75	CB		3.5	6	1	21	22	31	0.097	18		100
MALINS	CS-62	01/01/79	12062				7.58	45	52.7	23.9	0.118	47	2.26	82.5
MALINS	CS-63	01/01/79	12063				3.16	10.2	20.9	7.93	0.024	19.4	1.83	23.2
MALINS	DI-41	09/01/80	02041			2.6 E	0.39 E				0.03 E			
MALINS	PM-06	01/01/79	08106				6.25	25.8	45.6	20.1	0.113	42	1.97	61.9
MALINS	PM-07	01/01/79	08107				3.08	10.4	22.8	10.3	0.042	21.5	1.48	26.8
MALINS	PS-00	06/01/80	50200			15 E	0.91 E			22 E	0.58 E			
MALINS	PS-25	06/01/80	50225			14 E	0.86 E			21 E	0.36 E			
NOAA84	NISQ1	10/15/84	NISQ1	1	0.99	0.11 U	0.67	10	50.8	25.9	0.942	24.8	3.9	97
NOAA84	NISQ2	10/15/84	NISQ2	1	0.87	0.11 U	0.76	14	233	22.9	0.014 U	36.8	1.13	123
NOAA84	NISQ3	10/15/84	NISQ3	1	0.91	0.11 U	0.6	16	70.4	24.9	0.014 U	28.7	2.82	96
NOADW86	CARRINL	05/01/86	CARRINL		0.15 U	11	0.45	10	13	4.8	0.03 U	16	0.241	23.5

06/14/89

TABLE C-1. (Continued) CONCENTRATIONS OF METALS IN PUGET SOUND REFERENCE AREA SAMPLES (mg/kg dry weight).

Survey	Station	Date	Sample	FieldRep	ANTIMONY	ARSENIC	CADMIUM	COPPER	CHROMIUM	LEAD	MERCURY	NICKEL	SILVER	ZINC
NOADW86	CPSD	05/01/86	CPSD		0.15 U	3.4	0.41	5.6	13	0.71	0.03 U	22	0.071	17.7
NOADW86	DABOB	05/01/86	DABOB		0.15 U	8.1	0.64	34	32	3.5	0.02 U	31	0.279	57.9
NOADW86	DISCOVRY	05/01/86	DISCOVRY		0.15 U	9.3	1	7.7	13	2	0.035	12	0.22	31.2
NOADW86	SAMISH	05/01/86	SAMISH		0.2 U	12	0.99	23	22	7.4	0.08	19	0.33	60.5
NOADW86	SEQUIM17	05/01/86	SEQUIM17		0.35 U	27	1.7	37	39	8.3	0.07	33	0.863	73.7
OAKHRBR	OH-B	02/26/85	OH-B			8.3	0.63	44.6		15	0.1			90.5
OAKHRBR	OH-C	02/26/85	OH-C			8.8	0.68	55.7		22.2	0.4			102.
OAKHRBR	OH-C1	02/26/85	OH-C1								0.11			
OAKHRBR	OH-C2	02/26/85	OH-C2								0.12			
OAKHRBR	OH-C3	02/26/85	OH-C3								0.62			
OAKHRBR	OH-C4	02/26/85	OH-C4								0.18			
OAKHRBR	OH-D1	02/26/85	OH-D1			9	0.66	48.4		16	0.092			99.6
OAKHRBR	OH-D2	02/26/85	OH-D2			9	0.65	43.9		15.4	0.093			98.4
OAKHRBR	SEQUIM	02/26/85	SEQUIM			7.3	0.9	48		9	0.068			88
OLYHAR88	SQ-01	01/01/88	SQ-01		0.072	10.8	0.97	29.1 U	86.7	8.5	0.016 U	35.4	0.26	89
OLYHAR88	WB-01	01/01/88	WB-01		0.041	2.46	0.07 U	0.05 U	126.3	1.8	0.016 U	32.5	0.079	44
PSDDA1	CRR01	05/17/88	CRR01C		4.5 E	16	4.5 LM	48		34	0.15	33	1 E	100
PSDDA1	PGB02	05/23/88	PGB02C		0.5 LM	12	0.19	52		29	0.19	55	0.46 E	120
PSDDA1	PSR01	05/23/88	PSR01C		0.55 LM	18	0.23	58		24	0.17	100	0.26 E	130
PTGARQC*	SWIN-5	03/19/86	SWIN-5			4.6	0.04	18	37	9.8	0.007	33		64
PTGARQC*	SWIN-6	03/19/86	SWIN-6			3.3	0.04	14	41	8.9	0.003	30		63
PTGARQC*	SWIN-7	03/19/86	SWIN-7			7.2	0.04	13	93	4.6	0.003	29		69
PTGARQC*	SWIN-8	03/19/86	SWIN-8			4	0.02	14	55	9	0.003	27		65
QMHARBOR	QM-A	02/03/86	067312			6 M	0.54 M	33.2 M	17 M	29.6 M		17.7 M		34.4
QMHARBOR	QM-B	02/03/86	067310			5.5	0.44	34.6	20.9	24.1		28.1		38.9
QMHARBOR	QM-C	02/03/86	067311			8.5	0.8	29.8	17.1	30.9		20.2		38.5
RILEY001	NG-10	08/01/82	NG-10	1	9.47	26.2	0.67	76	81	44	0.231	39	0.545	133
RILEY001	NG-10	08/01/82	NG-11	2	7.76	24.7	0.43	66	82	40	0.213	41	0.496	117
RILEY001	NG-12	08/01/82	NG-12		1.51	8.3	0.09	21	110	15	0.058	35	0.138	55
RILEY001	NG-13	08/01/82	NG-13B		0.53	7	0.31	21	77	10	0.055	21	0.115	48
RILEY001	NG-13	08/01/82	NG-13C		0.76	6.3	0.34	22	83	10	0.064	23	0.091	48
RILEY001	NG-13	08/01/82	NG-13A		0.63	6.2	0.4	22	80	10	0.058	21	0.115	51
RILEY001	NG-14	08/01/82	NG-14		1.54	10.7	0.7	46	78	25	0.143	41	0.332	100

06/14/89

TABLE C-1. (Continued) CONCENTRATIONS OF METALS IN PUGET SOUND REFERENCE AREA SAMPLES (mg/kg dry weight).

Survey	Station	Date	Sample	FieldRep	ANTIMONY	ARSENIC	CADMIUM	COPPER	CHROMIUM	LEAD	MERCURY	NICKEL	SILVER	ZINC
RILEY001	NG-15	08/01/82	NG-15		1.61	9.7	0.42	48	68	27	0.153	35	0.295	92
RILEY001	NG-16	08/01/82	NG-16		1.27	13.3	0.9	53	72	28	0.162	46	0.328	110
RILEY001	NG-8	08/01/82	NG-8		1.27	6.3	0.29	30	121	21	0.126	32	0.164	62
RILEY001	NG-9	08/01/82	NG-9		1.88	10.1	0.6	42	100	29	0.159	41	0.27	85
SEAHBASE	QM-1	07/01/82	85			26.9	1.31	61.3	83.5	57.1	0.417	41.8	2.5	94.7
SEAHBASE	QM-2	07/01/82	86			45.3	0.28	53.8	78.5	43.5	0.381	40.4	2.7	87.4
SEAHBASE	QM-D	02/01/84	5017			4.3	0.14	13.9	47.5	16.7	0.083	26.5	1.5	46.1
SEAHBASE	WB-18	02/01/84	5018			2.8	0.049	14.2	56.7	5.1	0.0059	38.9	2.1	44.9
TPPS3AB	PM-71	10/01/82	2147		0.3 U	3.8	0.46	10	26	17	0.13	17	0.16	36
TPPS3AB	PM-72	10/01/82	2146		0.4	4.6	0.37	10	22	12	0.11	21	0.16	39
TPPS3AB	PM-73	10/01/82	2145		0.3 U	10	0.35	22	42	36	0.14	30	0.46	76
TPPS3AB	PSD-11	03/04/81	561		13	22	0.63	29	27	30	0.078	33	0.94	81

* PTGARQC survey composited sediment samples within regions; these data were included only in AET comparisons.

06/14/89

TABLE C-2. CONCENTRATIONS OF TRIBUTYLTIN (REPORTED AS TIN) IN PUGET SOUND REFERENCE AREA SEDIMENT SAMPLES (ug/kg dry weight).

Survey	Station	Date	Sample	FieldRep	TRIBUTYLTIN
88PSRECN	DY-2	04/21/88	DY-2		60
88PSRECN	DY-3	04/22/88	DY-3		57
88PSRECN	DY-4	04/22/88	DY-4		60
88PSRECN	DY-5	04/22/88	DY-5		50
88PSRECN	DY-6	04/22/88	DY-6		57
88PSRECN	OH-1	04/28/88	OH-1		100
88PSRECN	OH-2	04/28/88	OH-2		0
88PSRECN	OH-3	04/28/88	OH-3		0
88PSRECN	OH-4	04/28/88	OH-4		0
88PSRECN	OH-5	04/28/88	OH-5		70
88PSRECN	OH-6	04/28/88	OH-6		100
EVCHEM	PS-02	10/13/86	PS-02G	PS02	6 U
PSDDA1	CRR01	05/17/88	CRR01C		1.7
PSDDA1	PGB02	05/23/88	PGB02C		2
PSDDA1	PSR01	05/23/88	PSR01C		1.2 U

06/14/89

TABLE C-3. CONCENTRATIONS OF PHENOLS AND SUBSTITUTED PHENOLS IN PUGET SOUND REFERENCE AREA SEDIMENT SAMPLES (ug/kg dry weight)

Survey	Station	Date	Sample	FieldRep	PHENOL	2-METHYLPHENOL	4-METHYL PHENOL	PENTACHLOROPHENOL
88PSRECN	DY-1	04/21/88	DY-1		75 U	75 U	73 U	210 U
88PSRECN	DY-2	04/21/88	DY-2		75 U	75 U	73 U	210 U
88PSRECN	DY-3	04/22/88	DY-3		75 U	75 U	73 U	210 U
88PSRECN	DY-4	04/22/88	DY-4		75 U	75 U	12	210 U
88PSRECN	DY-5	04/22/88	DY-5		75 U	75 U	73 U	210 U
88PSRECN	DY-6	04/22/88	DY-6		75 U	75 U	73 U	210 U
88PSRECN	OH-1	04/28/88	OH-1		75 U	75 U	73 U	210 U
88PSRECN	OH-2	04/28/88	OH-2		75 U	75 U	73 U	210 U
88PSRECN	OH-3	04/28/88	OH-3		75 U	75 U	12	210 U
88PSRECN	OH-4	04/28/88	OH-4		75 U	75 U	73 U	210 U
88PSRECN	OH-5	04/28/88	OH-5		75 U	75 U	73 U	210 U
88PSRECN	OH-6	04/28/88	OH-6		75 U	75 U	73 U	210 U
CBMSQS	CR-11	01/01/84	CR-11		10 U	10 U	10 U	50 U
CBMSQS	CR-12	01/01/84	CR-12		10 U	10 U	10 U	50 U
CBMSQS	CR-13	01/01/84	CR-13		44	10 U	26	50 U
CBMSQS	CR-14	01/01/84	CR-14		62	10 U	32	50 U
CBPRELIM	CR-03	03/01/84	CR-03		40	1 U	1 U	0.1
CBPRELIM	CR-04	03/01/84	CR-04		1800	1 U	1 U	0.5 U
EBCHEM	PS-01	10/12/85	PS-01	2	13 E	11 U	11 U	190 U
EBCHEM	PS-01	10/12/85	PS-01	1	23 X	14 U	2 E	410 U
EBCHEM	PS-02	10/12/85	PS-02		4.3 U	5.6 U	5.7 U	220 U
EBCHEM	PS-03	10/12/85	PS-03		33 X	3.3 U	5.1 E	38 U
EBCHEM	PS-04	10/12/85	PS-04		3.3 U	8.2 U	8.3 U	89 U
EBCHEM	PS-05	10/15/85	PS-05		400 E	48 U	52 U	5400 U
EHCHEM	BH-01	06/01/85	B1		190			1200 U
EHCHEM	BH-02	06/01/85	B1		96			1300 U
EIGHTBAY	CS-01	05/29/84	CS-01		560			1500 U
EIGHTBAY	CS-11	05/29/84	CS-11		100 U			1500 U
EIGHTBAY	CS-15	05/29/84	CS-15		100 U			1500 U
EIGHTBAY	CS-17	05/29/84	CS-17		100 U			1500 U
EIGHTBAY	DB-01	05/22/84	DB-01		40 U			600 U
EIGHTBAY	DB-05	05/22/84	DB-05		40 U			600 U
EIGHTBAY	DB-07	05/22/84	DB-07		40 U			600 U
EIGHTBAY	DB-15	05/22/84	DB-15		40 U			600 U

06/14/89

TABLE C-3. (Continued) CONCENTRATIONS OF PHENOLS AND SUBSTITUTED PHENOLS IN PUGET SOUND REFERENCE AREA SEDIMENT SAMPLES (ug/kg dry weight)

Survey	Station	Date	Sample	FieldRep	PHENOL	2-METHYLPHENOL	4-METHYL PHENOL	PENTACHLOROPHENOL
EIGHTBAY	SM-01	04/24/84	SM-01		40 U			600 U
EIGHTBAY	SM-03	04/24/84	SM-03		40 U			600 U
EIGHTBAY	SM-07	04/24/84	SM-07		40 U			600 U
EIGHTBAY	SM-20	04/24/84	SM-20		40 U			600 U
EIGHTBAY	SQ-14	05/29/84	SQ-14		100 U			1500 U
EIGHTBAY	SQ-17	05/29/84	SQ-17		100 U			1500 U
EIGHTBAY	SQ-18	05/29/84	SQ-18		100 U			1500 U
EIGHTBAY	SQ-20	05/29/84	SQ-20		100 U			1500 U
EPAPS88	WB	05/01/88	WB		5	0.2 U	0.2 U	0.2 U
EVCHEM	PS-02	10/13/86	PS-02G	PS02	200 Z	50 U	290	3 U
EVCHEM	PS-03	10/13/86	PS-03G	PS03	110 Z	50 U	84	3 U
EVCHEM	PS-04	10/10/86	PS-04G	PS04	140 Z	20 U	140	3 U
NOADW86	CARRINL	05/01/86	CARRINL		3 U	5 U	6 U	
NOADW86	CPSD	05/01/86	CPSD		2 U	3 U	3 U	
NOADW86	DABOB	05/01/86	DABOB		7 U	5 U	6 U	
NOADW86	DISCOVRY	05/01/86	DISCOVRY		17 U	23 U	12 U	
NOADW86	SAMISH	05/01/86	SAMISH		17 U	12 U	12 U	
NOADW86	SEQUIM17	05/01/86	SEQUIM17		29 U	20 U	21 U	
OLYHAR88	SQ-01	01/01/88	SQ-01		72	8 U	560	5 U
OLYHAR88	WB-01	01/01/88	WB-01		16	3 U	2 U	13 U
PSDDA1	CRR01	05/17/88	CRR01C		75	7.2 U	7.2 U	12 U
PSDDA1	PGB02	05/23/88	PGB02C		10 U	10 U	10 U	16 U
PSDDA1	PSR01	05/23/88	PSR01C		10 U	10 U	10 U	16 U
TPPS3AB	PM-71	10/01/82	2147		4.3 U			
TPPS3AB	PM-72	10/01/82	2146		4.3 U			
TPPS3AB	PM-73	10/01/82	2145		4.3 U			
TPPS3AB	PSD-11	03/04/81	561		4.3 U			

06/14/89

TABLE C-4. CONCENTRATIONS OF LOW MOLECULAR WEIGHT POLYCYCLIC AROMATIC HYDROCARBONS IN PUGET SOUND REFERENCE AREA SEDIMENT SAMPLES (ug/kg dry weight).

Survey	Station	Date	Sample	FieldRep	POLYCYCLIC ARMOATIC HYDROCARBON-LIGHT*	NAPHTHALENE	2-METHYLNAPHTHALENE	ACENAPHTHYLENE	ACENAPHTHENE	FLUORENE	PHENANTHRENE	ANTHRACENE
88PSRECN	DY-1	04/21/88	DY-1		158	22	8		29	13	50	44
88PSRECN	DY-2	04/21/88	DY-2		148	13	6		34	8	43	50
88PSRECN	DY-3	04/22/88	DY-3		141	25	12		28	13	43	32
88PSRECN	DY-4	04/22/88	DY-4		470	78	33		87	36	160	110
88PSRECN	DY-5	04/22/88	DY-5		229	33	14		35	16	81	64
88PSRECN	DY-6	04/22/88	DY-6		174	32	52 U		26	44 U	76	40
88PSRECN	OH-1	04/28/88	OH-1		28	10	5		2	44 U	16	46 U
88PSRECN	OH-2	04/28/88	OH-2		52	17	3		4	5	18	8
88PSRECN	OH-3	04/28/88	OH-3		54	11	5		5	5	20	13
88PSRECN	OH-4	04/28/88	OH-4		59	15	4		4	7	20	13
88PSRECN	OH-5	04/28/88	OH-5		83	15	52 U		6	9	32	21
88PSRECN	OH-6	04/28/88	OH-6		59	22	4		45 U	6	21	10
BARRICK	AD-62	01/01/76	62		12					0.2	11	1.2
BARRICK	ES-73	01/01/76	73		83					7.1	70	5.6
BARRICK	NQ-82	01/01/76	82		29					1.7	23	4.2
BARRICK	PD-78	01/01/76	78		51					4.3	41	5.4
BARRICK	PO-52	01/01/76	52		33					0.9	27	5.3
BARRICK	PS-98	01/01/76	98		60					0.9	49	10
BARRICK	RS-65	01/01/76	65		11					0.5 U	10	1
BARRICK	SK-95	01/01/76	95		1.4					0.7	0.7	0.5 U
BROWN7	AB-01	09/01/78	AB-01		4	0.1 U	1			0.7	2	1
BROWN7	AB-01	01/01/79	AB-01		7	1	1			1	4	0.6
BROWN7	AB-01	06/01/78	AB-01		11	2	2			2	5	2
BROWN7	BB-01	01/01/79	BB-01		0.5	0.1 U	0.1 U			0.1 U	0.5	0.2 U
BROWN7	BB-01	06/01/78	BB-01		3	0.1 U	0.7			0.1 U	0.6	2
BROWN7	BB-01	09/01/78	BB-01		1	0.1 U	0.5			0.1 U	1	0.1 U
BROWN7	DS-01	06/01/78	DS-01		2	2	0.3 U			0.3 U	0.3 U	0.3 U
BROWN7	DS-01	09/01/78	DS-01		2	0.1 U	0.4			0.1 U	2	0.1 U
BROWN7	DS-01	01/01/79	DS-01		1	0.1 U	0.4			0.1 U	1	0.1 U
CBMSQS	CR-11	01/01/84	CR-11		28	7.4	5 U	5 U	5 U	5 U	14	6.7
CBMSQS	CR-12	01/01/84	CR-12		34	13	5 U	5 U	5 U	5 U	12	8.6
CBMSQS	CR-13	01/01/84	CR-13		16	5 U	5 U	5 U	5 U	5 U	16	5 U
CBMSQS	CR-14	01/01/84	CR-14		45	7.5	5 U	5 U	5 U	5 U	16	22

06/14/89

TABLE C-4. (Continued) CONCENTRATIONS OF LOW MOLECULAR WEIGHT POLYCYCLIC AROMATIC HYDROCARBONS IN PUGET SOUND REFERENCE AREA SEDIMENT SAMPLES (ug/kg dry weight).

Survey	Station	Date	Sample	FieldRep	POLYCYCLIC ARMOATIC HYDROCARBON-LIGHT*	NAPHTHALENE	2-METHYLNAPHTHALENE	ACENAPHTHYLENE	ACENAPHTHENE	FLUORENE	PHENANTHRENE	ANTHRACENE
CBPRELIM	CR-03	03/01/84	CR-03		11 E	1 Z	1 U	0.5 U	0.5 U	0.5	5 Z	3
CBPRELIM	CR-04	03/01/84	CR-04		2 Z	0.5 U	1 U	0.5 U	0.5 U		2 Z	0.5 U
DUWRIV1	SQ-09	04/19/85	SQ-09		2.5	3 U	9.1	37 U	2.8 U	2.5	40 U	2.3 U
DUWRIV2	SQ-21	07/01/85	SEQUIM		55	7	16		3 U	4 U	48	2 U
EBCHEM	PS-01	10/12/85	PS-01	2	16 E	33 U	3.6 E	9.3 U	14 U	13 U	16 E	16 U
EBCHEM	PS-01	10/12/85	PS-01	1	19 E	2 X	3 E	11 U	17 U	17 U	18 E	18 U
EBCHEM	PS-02	10/12/85	PS-02		11 E	21 U	18 U	5.2 U	8 U	8.7 U	11 E	13 U
EBCHEM	PS-03	10/12/85	PS-03		7.9 E	2.7 E	0.3 E	4.1 U	6.7 U	6.7 U	5.2 E	20 U
EBCHEM	PS-04	10/12/85	PS-04		9 E	26 U	22 U	7.5 U	11 U	11 U	7 E	2 E
EBCHEM	PS-05	10/15/85	PS-05		3600 E	120 E	75 E	490 E	130 E	270 E	1500	1100
EHCHEM	BH-01	06/01/85	B1		750	200		27	54	130	340	60 U
EHCHEM	BH-02	06/01/85	B1		330	800 U		60 U	31	44	210	46
EIGHTBAY	CS-01	05/29/84	CS-01		600 U	100 U		100 U	100 U	100 U	100 U	100 U
EIGHTBAY	CS-11	05/29/84	CS-11		600 U	100 U		100 U	100 U	100 U	100 U	100 U
EIGHTBAY	CS-15	05/29/84	CS-15		600 U	100 U		100 U	100 U	100 U	100 U	100 U
EIGHTBAY	CS-17	05/29/84	CS-17		600 U	100 U		100 U	100 U	100 U	100 U	100 U
EIGHTBAY	DB-01	05/22/84	DB-01		240 U	40 U		40 U	40 U	40 U	40 U	40 U
EIGHTBAY	DB-05	05/22/84	DB-05		240 U	40 U		40 U	40 U	40 U	40 U	40 U
EIGHTBAY	DB-07	05/22/84	DB-07		240 U	40 U		40 U	40 U	40 U	40 U	40 U
EIGHTBAY	DB-15	05/22/84	DB-15		240 U	40 U		40 U	40 U	40 U	40 U	40 U
EIGHTBAY	SM-01	04/24/84	SM-01		170	40 U		40 U	40 U	40 U	170	40 U
EIGHTBAY	SM-03	04/24/84	SM-03		240 U	40 U		40 U	40 U	40 U	40 U	40 U
EIGHTBAY	SM-07	04/24/84	SM-07		240 U	40 U		40 U	40 U	40 U	40 U	40 U
EIGHTBAY	SM-20	04/24/84	SM-20		240 U	40 U		40 U	40 U	40 U	40 U	40 U
EIGHTBAY	SQ-14	05/29/84	SQ-14		600 U	100 U		100 U	100 U	100 U	100 U	100 U
EIGHTBAY	SQ-17	05/29/84	SQ-17		600 U	100 U		100 U	100 U	100 U	100 U	100 U
EIGHTBAY	SQ-18	05/29/84	SQ-18		600 U	100 U		100 U	100 U	100 U	100 U	100 U
EIGHTBAY	SQ-20	05/29/84	SQ-20		600 U	100 U		100 U	100 U	100 U	100 U	100 U
EPAPS88	WB	05/01/88	WB		1.1 U	0.2 U	0.3 U	0.2 U	0.3 U	0.2 U	0.1 U	0.1 U
EVCHEM	PS-02	10/13/86	PS-02G	PS02	6	3 B	3	10 U	10 U	10 U	5	1
EVCHEM	PS-03	10/13/86	PS-03G	PS03	9	3 B	2	10 U	10 U	10 U	7	2
EVCHEM	PS-04	10/10/86	PS-04G	PS04	6	10 U	10 U	1	10 U	10 U	4	1
KENM86	SEQUIM	07/31/85	SEQUIM	1	238 L	213	157	5 U	5 U	5 U	5 U	5 U

06/14/89

TABLE C-4. (Continued) CONCENTRATIONS OF LOW MOLECULAR WEIGHT POLYCYCLIC AROMATIC HYDROCARBONS IN PUGET SOUND REFERENCE AREA SEDIMENT SAMPLES (ug/kg dry weight).

Survey	Station	Date	Sample	Field Rep	POLYCYCLIC AROMATIC HYDROCARBON-LIGHT*	NAPHTHALENE	2-METHYLNAPHTHALENE	ACENAPHTHYLENE	ACENAPHTHENE	FLUORENE	PHENANTHRENE	ANTHRACENE
MALINS	CS-62	01/01/79	12062		84 L	20	20	0.4 U	5	1	50	8
MALINS	CS-63	01/01/79	12063		8 L	3	1	0.1 U	0.2	0.1 U	4	0.3
MALINS	PH-06	01/01/79	08106		113 L	30	20	0.1 U	3	10	60	10
MALINS	PH-07	01/01/79	08107		32 L	8	7	0.1 U	0.1 U	0.4	20	3
MISCREFS	PR-1	12/01/83	PR-1		340	8.9	3.5 U		2 U	34	150	150
NOAA84	NISQ1	10/15/84	NISQ1	1		2 U	2 U		2 U	2 U	2 U	2 U
NOAA84	NISQ2	10/15/84	NISQ2	1		2 U	2 U		2 U	2 U	2 U	6 U
NOAA84	NISQ3	10/15/84	NISQ3	1		6 U	6 U		6 U	6 U	5 U	5 U
NOADW86	CARRINL	05/01/86	CARRINL		36 L	5 U	6 U	5 U	5 U	5 U	12	4 U
NOADW86	CPSD	05/01/86	CPSD		33 U	6 U	6 U	6 U	6 U	5 U	5 U	5 U
NOADW86	DABOB	05/01/86	DABOB		22 U	4 U	5 U	4 U	4 U	4 U	3 U	3 U
NOADW86	DISCOVRY	05/01/86	DISCOVRY		39 L	5 U	5 U	4 U	4 U	4 U	19	3 U
NOADW86	SAMISH	05/01/86	SAMISH		69 L	8 U	21	8 U	8 U	7 U	32	6 U
NOADW86	SEQUIM17	05/01/86	SEQUIM17		68 U	13 U	13 U	12 U	12 U	11 U	11 U	9 U
OAKHRBR	OH-B	02/26/85	OH-B		90	5 U	5 U	5 U	5 U	5 U	31	59
OAKHRBR	OH-C	02/26/85	OH-C		723	5 U	5 U	5 U	5 U	5 U	723	5 U
OAKHRBR	OH-D1	02/26/85	OH-D1		75	6 LM	2	5 U	1	5 U	39	29
OAKHRBR	OH-D2	02/26/85	OH-D2		49	5 U	5 U	5 U	5 U	5 U	27	22
OAKHRBR	SEQUIM	02/26/85	SEQUIM		213	213	157	5 U	5 U	5 U	5 U	5 U
OAKHRBR	WHIDBEY	02/26/85	WHIDBEY			5 U	28	5 U	5 U	5 U	5 U	5 U
OLYHAR88	SQ-01	01/01/88	SQ-01		70	19	18	3 U	4 U	6	42	3
OLYHAR88	WB-01	01/01/88	WB-01		2	2	2 U	1 U	2 U	1 U	0.8 U	0.7 U
PSDDA1	CRR01	05/17/88	CRR01C		47 E	7.2 U	3 E	2.1 U	7.2 U	7.2 U	35 E	12 E
PSDDA1	PGB02	05/23/88	PGB02C		83 E	5 E	6 E	8 E	10 U	8 E	50 Z	12 E
PSDDA1	PSR01	05/23/88	PSR01C		40 E	10 U	10 U	10 U	10 U	10 U	32 Z	8 E
PTGARQC**	SWIN-6	03/19/86	SWIN-6		117 L	5 U	5 U	5 U	16	21	24	46
QMHARBOR	QM-B	02/03/86	067310		118 E					13 E	75 E	30 E
RILEY001	NG-10	08/01/82	NG-10	1	62	16	4			2	12	32
RILEY001	NG-10	08/01/82	NG-11	2	80	32	10			6	21	21
RILEY001	NG-12	08/01/82	NG-12		22	4	1			1	3	14
RILEY001	NG-13	08/01/82	NG-13A		12	2	1			1	2	7
RILEY001	NG-14	08/01/82	NG-14		42	11	4			2	11	18
RILEY001	NG-15	08/01/82	NG-15		41	8	3			1	9	23

06/14/89

TABLE C-4. (Continued) CONCENTRATIONS OF LOW MOLECULAR WEIGHT POLYCYCLIC AROMATIC HYDROCARBONS IN PUGET SOUND REFERENCE AREA SEDIMENT SAMPLES (ug/kg dry weight).

Survey	Station	Date	Sample	FieldRep	POLYCYCLIC ARMOATIC HYDROCARBON-LIGHT*	NAPHTHALENE	2-METHYLNAPHTHALENE	ACENAPHTHYLENE	ACENAPHTHENE	FLUORENE	PHENANTHRENE	ANTHRACENE
RILEY001	NG-16	08/01/82	NG-16		56	11	5			2	11	32
RILEY001	NG-8	08/01/82	NG-8		19 L	1 U	1 U			1	6	12
RILEY001	NG-9	08/01/82	NG-9		42	10	4			4	10	18
SEAHBASE	QM-1	07/01/82	85		1140					1000 M	110	30 M
SEAHBASE	QM-2	07/01/82	86		830					13 M	690	130 M
SEAHBASE	QM-D	02/01/84	5017		68					52 M	13 M	3 M
TPPS3AB	PM-71	10/01/82	2147		67 L	8.9 L		2.7 U	8.9 L	10 L	30	6 L
TPPS3AB	PM-72	10/01/82	2146		67 L	1.6 U		2.7 U	12 L	13 L	29	8.7 L
TPPS3AB	PM-73	10/01/82	2145		190 L	1.6 U		2.7 U	3 U	20 L	140	22
TPPS3AB	PSD-11	03/04/81	561		16.5 U	1.6 U		2.7 U	3 U	3.4 U	2.9 U	2.9 U

* The sum of low molecular weight PAH (LPAH) does not include 2-methylnaphthalene.

** PTGARQC survey composited sediment samples within regions; these data were included only in AET comparisons.

06/13/89

TABLE C-5. CONCENTRATIONS OF HIGH MOLECULAR WEIGHT POLYCYCLIC AROMATIC HYDROCARBONS IN PUGET SOUND REFERENCE AREA SEDIMENT SAMPLE (ug/kg dry weight).

Survey	Station	Date	Sample	Field Rep	POLYCYCLIC AROMATIC HYDROCARBON-HEAVY	FLUORANTHENE	PYRENE	BENZO(A)-ANTHRACENE	CHRYSENE	TOTAL BENZO-FLUORANTHENES (B + K)	BENZO(A)-PYRENE	INDENO(1,2,3-CD)-PYRENE	DIBENZO(A,H)-ANTHRACENE	BENZO(G,H,I)-PERYLENE
88PSRECN	DY-1	04/21/88	DY-1		1200	170	200	110	180	240	110	86	15	93
88PSRECN	DY-2	04/21/88	DY-2		1050	160	240	110	150	153	88	58	20	72
88PSRECN	DY-3	04/22/88	DY-3		790	120	140	63	100	147	67	60	16	73
88PSRECN	DY-4	04/22/88	DY-4		2250	310	400	220	280	410	240	160	45	190
88PSRECN	DY-5	04/22/88	DY-5		1160	180	230	90	120	210	93	94	14	130
88PSRECN	DY-6	04/22/88	DY-6		1290 L	150	220	100	120	250	130	120	44 U	160
88PSRECN	OH-1	04/28/88	OH-1		185 L	46 U	27	13	17	19	6	5	44 U	8
88PSRECN	OH-2	04/28/88	OH-2		269 L	36	31	13	22	26	10	43 U	44 U	44 U
88PSRECN	OH-3	04/28/88	OH-3		299 L	62	54	22	37	42	15	10	44 U	13
88PSRECN	OH-4	04/28/88	OH-4		303 L	61	57	22	37	48	17	8	44 U	9
88PSRECN	OH-5	04/28/88	OH-5		439 L	93	81	31	43	96 L	21	13	44 U	17
88PSRECN	OH-6	04/28/88	OH-6		241 L	37	37	17	21	27	9	43 U	44 U	6
BARRICK	AD-62	01/01/76	62		141	25	26	8.5	17	21	12	13	2.2	16
BARRICK	DBE	01/01/76	DBE		219	64	54			94	7			
BARRICK	ES-73	01/01/76	73		770	140	130	38	110	170	38	64	15	66
BARRICK	NQ-82	01/01/76	82		159	37	31	12	19	11	13	13	2.9	20
BARRICK	PD-78	01/01/76	78		420	110	93	22	66	55	19	23	2.9	31
BARRICK	PO-52	01/01/76	52		520	76	72	31	67	120	47	48	7	55
BARRICK	PS-98	01/01/76	98		740	130	150	45	58	130	65	66	2.5	91
BARRICK	RS-65	01/01/76	65		147	28	23	9.3	22	28	7.8	10	8.1	11
BARRICK	SK-95	01/01/76	95		15 L	2.7	2.6	0.9	2.1	2.9	0.2	1.3	1 U	1.6
BROWN7	AB-01	06/01/78	AB-01		16	7	4	3	2		0.5			
BROWN7	AB-01	09/01/78	AB-01		8	4	2	1	0.8		0.1 U			
BROWN7	AB-01	01/01/79	AB-01		11	5	3	2	0.8		0.2 U			
BROWN7	BB-01	01/01/79	BB-01		2	1	0.6	0.3 U	0.2 U		0.2 U			
BROWN7	BB-01	06/01/78	BB-01		2	0.8	1	0.3 U	0.2 U		0.2 U			
BROWN7	BB-01	09/01/78	BB-01		4	1	1	0.3 U	0.7		0.8			
BROWN7	DS-01	09/01/78	DS-01		2	1	1	0.3 U	0.1 U		0.1 U			
BROWN7	DS-01	06/01/78	DS-01			0.3 U	0.3 U	0.7 U	0.4 U		0.4 U			
BROWN7	DS-01	01/01/79	DS-01		0.5	0.5	0.1 U	0.3 U	0.2 U		0.2 U			
CBMSQS	CR-11	01/01/84	CR-11		65	16	16	5.5	9.2	18	5 U	5 U	5 U	5 U
CBMSQS	CR-12	01/01/84	CR-12		69	14	14	5.8	11	17	7.1	5 U	5 U	5 U
CBMSQS	CR-13	01/01/84	CR-13		22	11	11	5 U	5 U	5 U	5 U	5 U	5 U	5 U

06/13/89

TABLE C-5. (Continued) CONCENTRATIONS OF HIGH MOLECULAR WEIGHT POLYCYCLIC AROMATIC HYDROCARBONS IN PUGET SOUND REFERENCE AREA SEDIMENT SAMPLE (ug/kg dry weight).

Survey	Station	Date	Sample	Field Rep	POLYCYCLIC AROMATIC HYDROCARBON-HEAVY	FLUORANTHENE	PYRENE	BENZO(A)-ANTHRACENE	CHRYSENE	TOTAL BENZO-FLUORANTHENES (B + K)	BENZO(A)-PYRENE	INDENO(1,2,3-CD)-PYRENE	DIBENZO(A,H)-ANTHRACENE	BENZO(G,H,I)-PERYLENE
CBMSQS	CR-14	01/01/84	CR-14		75	16	18	7	10	15	8.5	5 U	5 U	5 U
CBPRELIM	CR-03	03/01/84	CR-03		78 L	20	13 Z	8	19	8	3	4	0.4	3
CBPRELIM	CR-04	03/01/84	CR-04		34	14	11	4	5					
DUWRIV1	SQ-09	04/19/85	SQ-09		136	53	35	2.7 U	16	9.1	8.3	6.6	3.3 U	8.3
DUWRIV2	SQ-21	07/01/85	SEQUIM		123	63	45	7	8		4 U		3 U	
EBCHEM	PS-01	10/12/85	PS-01		58 E	17 E	14 E	2.5 E	8.1 E	13 E	2.5 E	8.9 U	14 U	1.2 E
EBCHEM	PS-01	10/12/85	PS-01	1	71 E	15 E	13 E	3 E	10 E	12 E	28 E	6.5 U	10 U	6 U
EBCHEM	PS-02	10/12/85	PS-02		56 E	19 E	19 E	5 E	13 E	13 U	7 U	8.2 U	13 U	7.6 U
EBCHEM	PS-03	10/12/85	PS-03		48 E	9.4 E	8 E	3.7 E	5 E	12 E	3.8 E	2.3 E	1 E	3.2 E
EBCHEM	PS-04	10/12/85	PS-04		74 E	16 E	16 E	6.5 E	9.8 E	14 E	6.4 E	2.2 E	9.5 U	2.8 E
EBCHEM	PS-05	10/15/85	PS-05		27800 E	5000	4500	2500	6000	5200	1900 E	1000 E	390 E	1300 E
EHCHEM	BH-01	06/01/85	B1		1050	330	380	100	140	190	98	60 U	800 U	60 U
EHCHEM	BH-02	06/01/85	B1		460	170	170	49	70	160 U	60 U	60 U	160 U	60 U
EIGHTBAY	CS-01	05/29/84	CS-01		2350 U	100 U	100 U	100 U	100 U	200 U	250 U	500 U	500 U	500 U
EIGHTBAY	CS-11	05/29/84	CS-11		2350 U	100 U	100 U	100 U	100 U	200 U	250 U	500 U	500 U	500 U
EIGHTBAY	CS-15	05/29/84	CS-15		2350 U	100 U	100 U	100 U	100 U	200 U	250 U	500 U	500 U	500 U
EIGHTBAY	CS-17	05/29/84	CS-17		2350 U	100 U	100 U	100 U	100 U	200 U	250 U	500 U	500 U	500 U
EIGHTBAY	DB-01	05/22/84	DB-01		900 U	40 U	40 U	40 U	40 U	40 U	100 U	200 U	200 U	200 U
EIGHTBAY	DB-05	05/22/84	DB-05		900 U	40 U	40 U	40 U	40 U	40 U	100 U	200 U	200 U	200 U
EIGHTBAY	DB-07	05/22/84	DB-07		900 U	40 U	40 U	40 U	40 U	40 U	100 U	200 U	200 U	200 U
EIGHTBAY	DB-15	05/22/84	DB-15		900 U	40 U	40 U	40 U	40 U	40 U	100 U	200 U	200 U	200 U
EIGHTBAY	SM-01	04/24/84	SM-01		164	76	88	40 U	40 U	40 U	100 U	200 U	200 U	200 U
EIGHTBAY	SM-03	04/24/84	SM-03		220	97	120	40 U	40 U	40 U	100 U	200 U	200 U	200 U
EIGHTBAY	SM-07	04/24/84	SM-07		68	68	40 U	40 U	40 U	40 U	100 U	200 U	200 U	200 U
EIGHTBAY	SM-20	04/24/84	SM-20		900 U	40 U	40 U	40 U	40 U	40 U	100 U	200 U	200 U	200 U
EIGHTBAY	SQ-14	05/29/84	SQ-14		2350 U	100 U	100 U	100 U	100 U	200 U	250 U	500 U	500 U	500 U
EIGHTBAY	SQ-17	05/29/84	SQ-17		2350 U	100 U	100 U	100 U	100 U	200 U	250 U	500 U	500 U	500 U
EIGHTBAY	SQ-18	05/29/84	SQ-18		2350 U	100 U	100 U	100 U	100 U	200 U	250 U	500 U	500 U	500 U
EIGHTBAY	SQ-20	05/29/84	SQ-20		2350 U	100 U	100 U	100 U	100 U	200 U	250 U	500 U	500 U	500 U
EPAPS88	WB	05/01/88	WB		2.5 L	0.2 U	0.4	0.1 U	0.3 U	0.2 U	0.1 U	0.4 U	0.4 U	0.4 U
EVCHEM	PS-02	10/13/86	PS-02G	PS02	28	5	7	3	4	5	1	10 U	10 U	3
EVCHEM	PS-03	10/13/86	PS-03G	PS03	33	7	6	3	5	10 U	3	3	2	4
EVCHEM	PS-04	10/10/86	PS-04G	PS04	26	5	5	2	4	5	1	1	10 U	3

06/13/89

TABLE C-5. (Continued) CONCENTRATIONS OF HIGH MOLECULAR WEIGHT POLYCYCLIC AROMATIC HYDROCARBONS IN PUGET SOUND REFERENCE AREA SEDIMENT SAMPLE (ug/kg dry weight).

Survey	Station	Date	Sample	Field Rep	POLYCYCLIC AROMATIC HYDROCARBON-HEAVY	FLUORANTHENE	PYRENE	BENZO(A)-ANTHRACENE	CHRYSENE	TOTAL BENZO-FLUORANTHENES (B + K)	BENZO(A)-PYRENE	INDENO(1,2,3-CD)-PYRENE	DIBENZO(A,H)-ANTHRACENE	BENZO(G,H,I)-PERYLENE
KENM86	SEQUIM	07/31/85	SEQUIM	1	50 U	5 U	5 U	5 U	5 U	10 UM	5 U	5 U	5 U	5 U
MALINS	CS-62	01/01/79	12062		390	100	90	40	40	60	30	30		
MALINS	CS-63	01/01/79	12063		37	7	8	3	3	7	7	2		
MALINS	PM-06	01/01/79	08106		450	80	110	70	50	80	30	30		
MALINS	PM-07	01/01/79	08107		159	30	30	20	20	40	9	10		
MISCREFS	PR-1	12/01/83	PR-1		730	220	93	71	140	100	41	30	8.3	23
NOAA84	NISQ1	10/15/84	NISQ1	1		2 U	2 U	2 U	2 U		2 U			
NOAA84	NISQ2	10/15/84	NISQ2	1		2 U	2 U	2 U	2 U		2 U			
NOAA84	NISQ3	10/15/84	NISQ3	1		5 U	5 U	7 U	7 U		7 U			
NOADW86	CARRTNL	05/01/86	CARRTNL		98 L	10	16	7 U	19	16	9	7 U	7 U	7 U
NOADW86	CPSD	05/01/86	CPSD		45 L	5 U	7	4 U	5 U	4 U	5 U	5 U	5 U	5 U
NOADW86	DABOB	05/01/86	DABOB		54 L	5 U	9	4 U	8	4 U	6 U	6 U	6 U	6 U
NOADW86	DISCOVRY	05/01/86	DISCOVRY		87 L	21	26	3 U	10	10	5 U	4 U	4 U	4 U
NOADW86	SAMISH	05/01/86	SAMISH		149 L	22	41	9	7 U	23	15	20	6 U	6
NOADW86	SEQUIM17	05/01/86	SEQUIM17		127 L	10 U	34	10 U	20	10 U	10 U	11 U	11 U	11 U
OAKHRBR	OH-B	02/26/85	OH-B		1368	112	674	25	39	288	230	5 U	5 U	5 U
OAKHRBR	OH-C	02/26/85	OH-C		15758	4597	4137	1449	1575	2901	1099	5 U	5 U	5 U
OAKHRBR	OH-D1	02/26/85	OH-D1		1389	107	778	31	51	328	94	5 U	5 U	5 U
OAKHRBR	OH-D2	02/26/85	OH-D2		1231	74	670	18	28	257	184	5 U	5 U	5 U
OAKHRBR	SEQUIM	02/26/85	SEQUIM			5 U	5 U	5 U	5 U	10 UM	5 U	5 U	5 U	5 U
OAKHRBR	WHIDBEY	02/26/85	WHIDBEY		688	5 U	5 U	5 U	688	10 UM	5 U	5 U	5 U	5 U
OLYHAR88	SQ-01	01/01/88	SQ-01		183	48	34	9	18	30	10	17	2 U	17
OLYHAR88	WB-01	01/01/88	WB-01			0.7 U	0.6 U	0.7 U	0.7 U	0.8 U	0.8 U	2 U	1 U	1 U
PSDDA1	CRR01	05/17/88	CRR01C		370 E	55 E	55 E	41 E	42 E	66 E	46 E	36 E	7.2 U	25 E
PSDDA1	PGB02	05/23/88	PGB02C		330 E	16 Z	27 Z	22 Z	18 Z	79 E	47 E	54 E	12 E	51 E
PSDDA1	PSR01	05/23/88	PSR01C		180 E	15 B	8 Z	5 Z	3 Z	39 E	40 E	34 E	12 E	36 E
PTGARGC*	SWIN-6	03/19/86	SWIN-6		1066 L	593	212	166	63	12 L	5 U	5 U	5 U	5 U
RILEY001	NG-10	08/01/82	NG-10	1	170	58	48	44	20		1 U			
RILEY001	NG-10	08/01/82	NG-11	2	440	89	82	133	97		42			
RILEY001	NG-12	08/01/82	NG-12		54	35	9	6	4		1 U			
RILEY001	NG-13	08/01/82	NG-13A		27	10	9	4	4		1 U			
RILEY001	NG-14	08/01/82	NG-14		140	50	33	17	22		18			
RILEY001	NG-15	08/01/82	NG-15		140	33	27	54	23		5			

TABLE C-5. (Continued) CONCENTRATIONS OF HIGH MOLECULAR WEIGHT POLYCYCLIC AROMATIC HYDROCARBONS IN PUGET SOUND REFERENCE AREA SEDIMENT SAMPLE (ug/kg dry weight).

Survey	Station	Date	Sample	Field Rep	POLYCYCLIC AROMATIC HYDROCARBON-HEAVY	FLUORANTHENE	PYRENE	BENZO(A)-ANTHRACENE	CHRYSENE	TOTAL BENZO-FLUORANTHENES (B + K)	BENZO(A)-PYRENE	INDENO(1,2,3-CD)-PYRENE	DIBENZO(A,H)-ANTHRACENE	BENZO(G,H,I)-PERYLENE
RILEY001	NG-16	08/01/82	NG-16		130	17	59	18	32		1 U			
RILEY001	NG-8	08/01/82	NG-8		130	40	30	34	17		13			
RILEY001	NG-9	08/01/82	NG-9		450	43	44	213	63		86			
SEAHBASE	QM-1	07/01/82	85		2330	500	530	170 M	280 M	250	170	190	20 M	220
SEAHBASE	QM-2	07/01/82	86		1150	240	240	120	160	130	91	80		84
SEAHBASE	QM-D	02/01/84	5017		39	13 M	26 M							
TPPS3AB	PM-71	10/01/82	2147		880 L	85	120	30	64	300	67	98	34 U	82
TPPS3AB	PM-72	10/01/82	2146		375 L	63	98	20 L	29	44	16	25	34 U	46
TPPS3AB	PM-73	10/01/82	2145		1450 L	200	420	85	170	220	110	77 L	34 U	130
TPPS3AB	PSD-11	03/04/81	561		186 U	7.6 U	7.6 U	18 U	18 U	24 UM	12 U	33 U	34 U	32 U

* PTGARQC survey composited sediment samples within regions; these data were included only in AET comparisons.

06/13/89

TABLE C-6. CONCENTRATIONS OF CHLORINATED AROMATIC HYDROCARBONS AND CHLORINATED ALIPHATIC HYDROCARBONS IN PUGET SOUND REFERENCE AREA SEDIMENT SAMPLES (ug/kg, dry weight).

Survey	Station	Date	Sample	FieldRep	1,2-DICHLORO-BENZENE	1,3-DICHLORO-BENZENE	1,4-DICHLORO-BENZENE	1,2,4-TRICHLORO-BENZENE	HEXACHLORO-BENZENE	HEXACHLORO-BUTADIENE
88PSRECN	DY-1	04/21/88	DY-1		51 U	52 U	52 U	53 U	71 U	53 U
88PSRECN	DY-2	04/21/88	DY-2		51 U	52 U	52 U	53 U	71 U	53 U
88PSRECN	DY-3	04/22/88	DY-3		51 U	52 U	52 U	53 U	71 U	53 U
88PSRECN	DY-4	04/22/88	DY-4		51 U	52 U	4	53 U	71 U	53 U
88PSRECN	DY-5	04/22/88	DY-5		51 U	52 U	52 U	53 U	71 U	53 U
88PSRECN	DY-6	04/22/88	DY-6		51 U	52 U	52 U	53 U	71 U	53 U
88PSRECN	OH-1	04/28/88	OH-1		51 U	52 U	52 U	53 U	71 U	53 U
88PSRECN	OH-2	04/28/88	OH-2		51 U	52 U	52 U	53 U	71 U	53 U
88PSRECN	OH-3	04/28/88	OH-3		51 U	52 U	52 U	53 U	71 U	53 U
88PSRECN	OH-4	04/28/88	OH-4		51 U	52 U	52 U	53 U	71 U	53 U
88PSRECN	OH-5	04/28/88	OH-5		51 U	52 U	52 U	53 U	71 U	53 U
88PSRECN	OH-6	04/28/88	OH-6		51 U	52 U	52 U	53 U	71 U	53 U
CBMSQS	CR-11	01/01/84	CR-11		5 U	5 U	5 U	5 U	10 U	25 U
CBMSQS	CR-12	01/01/84	CR-12		5 U	5 U	5 U	5 U	10 U	25 U
CBMSQS	CR-13	01/01/84	CR-13		5 U	5 U	5 U	5 U	10 U	25 U
CBMSQS	CR-14	01/01/84	CR-14		5 U	5 U	5 U	5 U	10 U	25 U
CBPRELIM	CR-03	03/01/84	CR-03		0.5 U	0.5 U	0.5 B	0.5 U	0.5 U	0.5 U
CBPRELIM	CR-04	03/01/84	CR-04		0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
DUWRIV1	SQ-09	04/19/85	SQ-09		40 U	40 U	40 U		0.5 U	1.3 U
DUWRIV2	SQ-21	07/01/85	SEQUIM						0.3 U	
EBCHEM	PS-01	10/12/85	PS-01	1	160 U	160 U	160 U	320 U	130 U	820 U
EBCHEM	PS-01	10/12/85	PS-01	2	57 U	170 U	85 U	190 U	100 U	570 U
EBCHEM	PS-02	10/12/85	PS-02		65 U	65 U	43 U	130 U	69 U	34 U
EBCHEM	PS-03	10/12/85	PS-03		15 U	30 U	20 U	75 U	49 U	150 U
EBCHEM	PS-04	10/12/85	PS-04		60 U	120 U	120 U	150 U	76 U	400 U
EBCHEM	PS-05	10/15/85	PS-05		520 U	1000 U	1000 U	620 U	390 U	3900 U
EHCHEM	BH-01	06/01/85	B1		300 U	300 U	300 U	60 U	60 U	60 U
EHCHEM	BH-02	06/01/85	B1		650 U	650 U	650 U	300 U	60 U	300 U
EIGHTBAY	CS-01	05/29/84	CS-01		100 U	100 U	100 U	200 U	800 U	400 U
EIGHTBAY	CS-11	05/29/84	CS-11		100 U	100 U	100 U	200 U	800 U	400 U
EIGHTBAY	CS-15	05/29/84	CS-15		100 U	100 U	100 U	200 U	800 U	400 U
EIGHTBAY	CS-17	05/29/84	CS-17		100 U	100 U	100 U	200 U	800 U	400 U
EIGHTBAY	DB-01	05/22/84	DB-01		40 U	40 U	40 U	80 U	400 U	160 U

TABLE C-6. (Continued) CONCENTRATIONS OF CHLORINATED AROMATIC HYDROCARBONS AND CHLORINATED ALIPHATIC HYDROCARBONS IN PUGET SOUND REFERENCE AREA SEDIMENT SAMPLES (ug/kg dry weight).

Survey	Station	Date	Sample	FieldRep	1,2-DICHLORO-BENZENE	1,3-DICHLORO-BENZENE	1,4-DICHLORO-BENZENE	1,2,4-TRICHLORO-BENZENE	HEXACHLORO-BENZENE	HEXACHLORO-BUTADIENE
EIGHTBAY	DB-05	05/22/84	DB-05		40 U	40 U	40 U	80 U	400 U	160 U
EIGHTBAY	DB-07	05/22/84	DB-07		40 U	40 U	40 U	80 U	400 U	160 U
EIGHTBAY	DB-15	05/22/84	DB-15		40 U	40 U	40 U	80 U	400 U	160 U
EIGHTBAY	SM-01	04/24/84	SM-01		40 U	40 U	40 U	80 U	400 U	160 U
EIGHTBAY	SM-03	04/24/84	SM-03		40 U	40 U	40 U	80 U	400 U	160 U
EIGHTBAY	SM-07	04/24/84	SM-07		40 U	40 U	40 U	80 U	400 U	160 U
EIGHTBAY	SM-20	04/24/84	SM-20		40 U	40 U	40 U	80 U	400 U	160 U
EIGHTBAY	SQ-14	05/29/84	SQ-14		100 U	100 U	100 U	200 U	800 U	400 U
EIGHTBAY	SQ-17	05/29/84	SQ-17		100 U	100 U	100 U	200 U	800 U	400 U
EIGHTBAY	SQ-18	05/29/84	SQ-18		100 U	100 U	100 U	200 U	800 U	400 U
EIGHTBAY	SQ-20	05/29/84	SQ-20		100 U	100 U	100 U	200 U	800 U	400 U
EPAPS88	WB	05/01/88	WB		2 U	2 U	2 U		0.3 U	1 U
EVCHEM	PS-02	10/13/86	PS-02G	PS02	10 U	10 U	10 U	10 U	10 U	10 U
EVCHEM	PS-03	10/13/86	PS-03G	PS03	10 U	10 U	10 U	10 U	10 U	10 U
EVCHEM	PS-04	10/10/86	PS-04G	PS04	10 U	10 U	10 U	10 U	10 U	10 U
MALINS	CS-62	01/01/79	12062						0.04	0.2
MALINS	CS-63	01/01/79	12063						0.01	0.03 U
MALINS	DI-41	09/01/80	02041						0.03 E	
MALINS	PM-06	01/01/79	08106						0.1	0.3
MALINS	PM-07	01/01/79	08107						0.03	0.2
MALINS	PS-00	06/01/80	50200						0.29 E	
MALINS	PS-25	06/01/80	50225						0.31 E	
MISCREFS	PR-1	12/01/83	PR-1						0.1 U	2 U
NOAA84	NISQ1	10/15/84	NISQ1	1					0.1 U	
NOAA84	NISQ2	10/15/84	NISQ2	1					0.1 U	
NOAA84	NISQ3	10/15/84	NISQ3	1					0.1 U	
NOADW86	CARRINL	05/01/86	CARRINL		50 U	50 U	50 U	12 U	0.7 U	0.3 U
NOADW86	CPSD	05/01/86	CPSD		50 U	50 U	50 U	14 U	0.3 U	0.3 U
NOADW86	DABOB	05/01/86	DABOB		50 U	50 U	50 U	10 U	0.5 U	0.3 U
NOADW86	DISCOVRY	05/01/86	DISCOVRY		50 U	50 U	50 U	9 U	0.3 U	0.3 U
NOADW86	SAMISH	05/01/86	SAMISH		50 U	50 U	50 U	19 U	0.5 U	0.5 U
NOADW86	SEQUIM17	05/01/86	SEQUIM17		50 U	50 U	50 U	30 U	0.6 U	1 U
OLYHAR88	SQ-01	01/01/88	SQ-01					3 U	0.4 U	0.5 U

06/13/89

TABLE C-6. (Continued) CONCENTRATIONS OF CHLORINATED AROMATIC HYDROCARBONS AND CHLORINATED ALIPHATIC HYDROCARBONS IN PUGET SOUND REFERENCE AREA SEDIMENT SAMPLES (ug/kg dry weight).

Survey	Station	Date	Sample	FieldRep	1,2-DICHLORO-BENZENE	1,3-DICHLORO-BENZENE	1,4-DICHLORO-BENZENE	1,2,4-TRICHLORO-BENZENE	HEXACHLORO-BENZENE	HEXACHLORO-BUTADIENE
OLYHAR88	WB-01	01/01/88	WB-01					1 U	0.2 U	0.2 U
PSDDA1	CRR01	05/17/88	CRR01C		7.2 U	7.2 U	7.2 U	7.2 U	7.2 U	7.9 U
PSDDA1	PGB02	05/23/88	PGB02C		10 U	10 U	10 U	10 U	10 U	11 U
PSDDA1	PSR01	05/23/88	PSR01C		10 U	10 U	10 U	10 U	10 U	11 U
RILEY001	NG-10	08/01/82	NG-11	2					0.1 U	
RILEY001	NG-10	08/01/82	NG-10	1					0.1 U	
RILEY001	NG-12	08/01/82	NG-12						0.1 U	
RILEY001	NG-13	08/01/82	NG-13A						0.1 U	
RILEY001	NG-14	08/01/82	NG-14						0.1 U	
RILEY001	NG-15	08/01/82	NG-15						0.1 U	
RILEY001	NG-16	08/01/82	NG-16						0.1 U	
RILEY001	NG-8	08/01/82	NG-8						0.1 U	
RILEY001	NG-9	08/01/82	NG-9						0.1 U	
TPPS3AB	PM-71	10/01/82	2147		3.5 U	4 U	3 U			0.89
TPPS3AB	PM-72	10/01/82	2146		3.5 U	4 U	3 U			0.031 U
TPPS3AB	PM-73	10/01/82	2145		3.5 U	4 U	3 U			0.2
TPPS3AB	PSD-11	03/04/81	561		3.5 U	4 U	3 U			0.031 U

06/13/89

TABLE C-7. CONCENTRATIONS OF PHTHALATE ESTERS IN PUGET SOUND REFERENCE AREA SEDIMENT SAMPLES (ug/kg dry weight).

Survey	Station	Date	Sample	FieldRep	DIMETHYL PHTHALATE	DIETHYL PHTHALATE	DI-N-BUTYL PHTHALATE	BUTYL BENZYL PHTHALATE	BIS(2-ETHYLHEXYL) PHTHALATE	DI-N-OCTYL PHTHALATE
88PSRECN	DY-1	04/21/88	DY-1						240	
88PSRECN	DY-2	04/21/88	DY-2						50	
88PSRECN	DY-3	04/22/88	DY-3						130	
88PSRECN	DY-4	04/22/88	DY-4						200	
88PSRECN	DY-5	04/22/88	DY-5						110	
88PSRECN	DY-6	04/22/88	DY-6						150	
88PSRECN	OH-1	04/28/88	OH-1						61	
88PSRECN	OH-2	04/28/88	OH-2						49	
88PSRECN	OH-3	04/28/88	OH-3						71	
88PSRECN	OH-4	04/28/88	OH-4						76	
88PSRECN	OH-5	04/28/88	OH-5						67	
88PSRECN	OH-6	04/28/88	OH-6						37	
CBMSQS	CR-11	01/01/84	CR-11		50 U	10 U	760 Z	25 U	25 B	25 U
CBMSQS	CR-12	01/01/84	CR-12		50 U	13	25 B	25 U	25 B	25 U
CBMSQS	CR-13	01/01/84	CR-13		50 U	10	25 B	25 U	25 B	25 U
CBMSQS	CR-14	01/01/84	CR-14		50 U	18	30 Z	25 U	25 B	25 U
CBPRELIM	CR-03	03/01/84	CR-03		0.5 B	4 Z	30 Z	0.5 U	0.5 B	0.5 B
CBPRELIM	CR-04	03/01/84	CR-04					0.5 U	0.5 B	
DUWRIV1	SQ-09	04/19/85	SQ-09		11	15	17		100	
EBCHEM	PS-01	10/12/85	PS-01	1	0.7 E			10 E		10 E
EBCHEM	PS-01	10/12/85	PS-01	2	8.9 U			17 E		9.2 E
EBCHEM	PS-02	10/12/85	PS-02		5.9 U			3.7 U		56 E
EBCHEM	PS-03	10/12/85	PS-03		4.4 U			6.3 E		11 E
EBCHEM	PS-04	10/12/85	PS-04		7.5 U			4.7 E		3 E
EBCHEM	PS-05	10/15/85	PS-05		29 E			1.1 B		6 U
EHCHEM	BH-01	06/01/85	B1		60 U	130		160 Q		
EHCHEM	BH-02	06/01/85	B1		60 U	200		140 Q		
EIGHTBAY	CS-01	05/29/84	CS-01		100 U	100 U	100 U	100 U	200 U	100 U
EIGHTBAY	CS-11	05/29/84	CS-11		100 U	100 U	100 U	100 U	200 U	100 U
EIGHTBAY	CS-15	05/29/84	CS-15		100 U	100 U	100 U	100 U	200 U	100 U
EIGHTBAY	CS-17	05/29/84	CS-17		100 U	100 U	100 U	100 U	200 U	100 U
EIGHTBAY	DB-01	05/22/84	DB-01		40 U	40 U	40 U	40 U	120 U	40 U
EIGHTBAY	DB-05	05/22/84	DB-05		40 U	40 U	75 U	40 U	190 U	40 U

06/13/89

TABLE C-7. (Continued) CONCENTRATIONS OF PHTHALATE ESTERS IN PUGET SOUND REFERENCE AREA SEDIMENT SAMPLES (ug/kg dry weight).

Survey	Station	Date	Sample	FieldRep	DIMETHYL PHTHALATE	DIETHYL PHTHALATE	DI-N-BUTYL PHTHALATE	BUTYL BENZYL PHTHALATE	BIS(2-ETHYLHEXYL) PHTHALATE	DI-N-OCTYL PHTHALATE
EIGHTBAY	DB-07	05/22/84	DB-07		40 U	40 U	40 U	40 U	310 U	40 U
EIGHTBAY	DB-15	05/22/84	DB-15		40 U	40 U	40 U	40 U	360 U	40 U
EIGHTBAY	SM-01	04/24/84	SM-01		40 U	40 U	40 U	40 U	2800	69
EIGHTBAY	SM-03	04/24/84	SM-03		40 U	40 U	40 U	40 U	340	160
EIGHTBAY	SM-07	04/24/84	SM-07		40 U	40 U	40 U	40 U	180	40 U
EIGHTBAY	SM-20	04/24/84	SM-20		40 U	40 U	40 U	40 U	740	100
EIGHTBAY	SQ-14	05/29/84	SQ-14		100 U	100 U	100 U	100 U	200 U	100 U
EIGHTBAY	SQ-17	05/29/84	SQ-17		100 U	100 U	100 U	100 U	200 U	100 U
EIGHTBAY	SQ-18	05/29/84	SQ-18		100 U	100 U	100 U	100 U	200 U	100 U
EIGHTBAY	SQ-20	05/29/84	SQ-20		100 U	100 U	100 U	100 U	200 U	100 U
EPAPS88	WB	05/01/88	WB		1 U	2		1 U	17	1 U
EVCHEM	PS-02	10/13/86	PS-02G	PS02	10 U	10 U	10 B	10 U	10 B	10 U
EVCHEM	PS-03	10/13/86	PS-03G	PS03	10 U	10 U	10 B	10 U	58 Z	3 B
EVCHEM	PS-04	10/10/86	PS-04G	PS04	10 U	10 U	10 B	10 U	10 B	10 U
NOADW86	CARRINL	05/01/86	CARRINL		3 U	2 U	5 U	2 U	470	3 U
NOADW86	CPSD	05/01/86	CPSD		0.1 U	2	9 U	5 U	94	2
NOADW86	DABOB	05/01/86	DABOB		0.1 U	2	2	2	56	3 U
NOADW86	DISCOVRY	05/01/86	DISCOVRY		0.4 U	2	15 U	2	50	1
NOADW86	SAMISH	05/01/86	SAMISH		0.3 U	5	4	6 U	14	0.6
NOADW86	SEQUIM17	05/01/86	SEQUIM17		0.4 U	7	31	15	51	3
OLYHAR88	SQ-01	01/01/88	SQ-01		6 U	5 U	4 U	18 U	31	10 U
OLYHAR88	WB-01	01/01/88	WB-01		3 U	2 U	2 U	8 U	32	5 U
PSDDA1	CRR01	05/17/88	CRR01C		7.2 U	7.2 U	7.2 U	7.2 U	35 Z	7.2 U
PSDDA1	PGB02	05/23/88	PGB02C		10 U	16 U	9 E	10 U	16 B	10 U
PSDDA1	PSR01	05/23/88	PSR01C		10 U	18 E	10 U	10 U	17 B	10 U
QMHARBOR	QM-B	02/03/86	067310			20 E	240			580
SEAHBASE	QM-1	07/01/82	85							280
SEAHBASE	QM-2	07/01/82	86					4 M		270
SEAHBASE	QM-D	02/01/84	5017			6 M				780
TPPS3AB	PM-71	10/01/82	2147		3.7 U	12 L	3900	7.5 U		2200
TPPS3AB	PM-72	10/01/82	2146		3.7 U	10 L	1100	7.5 U		710
TPPS3AB	PM-73	10/01/82	2145		3.7 U	3.6 U	240	7.5 U		3200
TPPS3AB	PSD-11	03/04/81	561		3.7 U	3.6 U	2.4 U	7.5 U		7.5 U

06/13/89

TABLE C-8. CONCENTRATIONS OF MISCELLANEOUS OXYGENATED COMPOUNDS AND ORGANONITROGEN COMPOUNDS IN PUGET SOUND REFERENCE AREA SEDIMENT SAMPLES (ug/kg dry weight).

Survey	Station	Date	Sample	FieldRep	BENZYL ALCOHOL	BENZOIC ACID	DIBENZOFURAN	N-NITROSO DIPHENYLAMINE
CBMSQS	CR-11	01/01/84	CR-11		10 U	25 U	5 U	5 U
CBMSQS	CR-12	01/01/84	CR-12		10 U	430	5 U	5 U
CBMSQS	CR-13	01/01/84	CR-13		10 U	210	5 U	5 U
CBMSQS	CR-14	01/01/84	CR-14		10 U	200	5 U	5 U
CBPRELIM	CR-03	03/01/84	CR-03			7	1 U	0.5 U
CBPRELIM	CR-04	03/01/84	CR-04			1 U	1 U	
EBCHEM	PS-01	10/12/85	PS-01	2	240 U	110 U	15 E	
EBCHEM	PS-01	10/12/85	PS-01	1	480 U	200 U	13 E	
EBCHEM	PS-02	10/12/85	PS-02		130 U	82 U	6.6 U	
EBCHEM	PS-03	10/12/85	PS-03		58 U	46 U	14 E	
EBCHEM	PS-04	10/12/85	PS-04		340 U	90 U	13 E	
EBCHEM	PS-05	10/15/85	PS-05		3100 U	380 U	130 E	
EHCHEM	BH-01	06/01/85	B1					160 U
EHCHEM	BH-02	06/01/85	B1					160 U
EIGHTBAY	CS-01	05/29/84	CS-01					2500 U
EIGHTBAY	CS-11	05/29/84	CS-11					2500 U
EIGHTBAY	CS-15	05/29/84	CS-15					2500 U
EIGHTBAY	CS-17	05/29/84	CS-17					2500 U
EIGHTBAY	DB-01	05/22/84	DB-01					1000 U
EIGHTBAY	DB-05	05/22/84	DB-05					1000 U
EIGHTBAY	DB-07	05/22/84	DB-07					1000 U
EIGHTBAY	DB-15	05/22/84	DB-15					1000 U
EIGHTBAY	SM-01	04/24/84	SM-01					1000 U
EIGHTBAY	SM-03	04/24/84	SM-03					1000 U
EIGHTBAY	SM-07	04/24/84	SM-07					1000 U
EIGHTBAY	SM-20	04/24/84	SM-20					1000 U
EIGHTBAY	SQ-14	05/29/84	SQ-14					2500 U
EIGHTBAY	SQ-17	05/29/84	SQ-17					2500 U
EIGHTBAY	SQ-18	05/29/84	SQ-18					2500 U
EIGHTBAY	SQ-20	05/29/84	SQ-20					2500 U
EPAPS88	WB	05/01/88	WB		0.2 U		0.1 U	0.2 U
EVCHEM	PS-02	10/13/86	PS-02G	PS02	200 U	100 U	10 U	10 U
EVCHEM	PS-03	10/13/86	PS-03G	PS03	20 U	10 E	11	10 U
EVCHEM	PS-04	10/10/86	PS-04G	PS04	20 U	100 U	10 U	10 U

06/13/89

TABLE C-8. (Continued) CONCENTRATIONS OF MISCELLANEOUS OXYGENATED COMPOUNDS AND ORGANONITROGEN COMPOUNDS IN PUGET SOUND REFERENCE AREA SEDIMENT SAMPLES (ug/kg dry weight

Survey	Station	Date	Sample	FieldRep	BENZYL ALCOHOL	BENZOIC ACID	DIBENZOFURAN	N-NITROSO DIPHENYLAMINE
OLYHAR88	SQ-01	01/01/88	SQ-01			6 U	3 U	5 U
OLYHAR88	WB-01	01/01/88	WB-01			1 U	2 U	4 U
PSDDA1	CRR01	05/17/88	CRR01C		40 U	8 E	7.2 U	7.2 U
PSDDA1	PGB02	05/23/88	PGB02C		50 U	100 U	10 U	10 U
PSDDA1	PSR01	05/23/88	PSR01C		50 U	22 E	10 U	10 U
QMHARBOR	QM-B	02/03/86	067310				15 E	
TPPS3AB	PM-71	10/01/82	2147					4.8 U
TPPS3AB	PM-72	10/01/82	2146					4.8 U
TPPS3AB	PM-73	10/01/82	2145					4.8 U
TPPS3AB	PSD-11	03/04/81	561					4.8 U

06/14/89

TABLE C-9. CONCENTRATIONS OF PESTICIDES AND PCBS IN PUGET SOUND REFERENCE AREA SEDIMENT SAMPLES (ug/kg dry weight).

Survey	Station	Date	Sample	FieldRep	P,P'-DDT	P,P'-DDE	P,P'-DDD	HEPTACHLOR	ALDRIN	DIELDRIN	HEXACHLOROCYCLOHEXANE-GAMMA (LINDANE)
88PSRECN	DY-1	04/21/88	DY-1		0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
88PSRECN	DY-2	04/21/88	DY-2		0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
88PSRECN	DY-3	04/22/88	DY-3		0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
88PSRECN	DY-4	04/22/88	DY-4		0.5 U	0.5 G	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
88PSRECN	DY-5	04/22/88	DY-5		0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
88PSRECN	DY-6	04/22/88	DY-6		0.5 U	0.7 G	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
88PSRECN	OH-1	04/28/88	OH-1		0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
88PSRECN	OH-2	04/28/88	OH-2		0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
88PSRECN	OH-3	04/28/88	OH-3		0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
88PSRECN	OH-4	04/28/88	OH-4		0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
88PSRECN	OH-5	04/28/88	OH-5		0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
88PSRECN	OH-6	04/28/88	OH-6		0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
CBMSQS	CR-11	01/01/84	CR-11		25 U	25 U	25 U	25 U	25 U	25 U	25 U
CBMSQS	CR-12	01/01/84	CR-12		25 U	25 U	25 U	25 U	25 U	25 U	25 U
CBMSQS	CR-13	01/01/84	CR-13		25 U	25 U	25 U	25 U	25 U	25 U	25 U
CBMSQS	CR-14	01/01/84	CR-14		25 U	25 U	25 U	25 U	25 U	25 U	25 U
CBPRELIM	CR-03	03/01/84	CR-03		10 U	10 U	10 U	10 U	10 U	10 U	10 U
CBPRELIM	CR-04	03/01/84	CR-04				10 U	10 U	10 U	10 U	10 U
DUWRIV1	SQ-09	04/19/85	SQ-09		0.5 U	0.5 U	0.5 U				
DUWRIV2	SQ-21	07/01/85	SEQUIM		0.4 U	0.3 U	0.5 U				
EBCHEM	PS-01	10/12/85	PS-01	1	3 U	2.7 U	33 U	2.3 U	2.5 U	2.3 U	1.8 U
EBCHEM	PS-01	10/12/85	PS-01	2	2.3 U	2.1 U	2.6 U	1.8 U	1.9 U	1.8 U	1.4 U
EBCHEM	PS-02	10/12/85	PS-02		2.1 U	1.9 U	2.3 U	1.6 U	1.7 U	1.6 U	1.2 U
EBCHEM	PS-03	10/12/85	PS-03		1.9 U	1.8 U	2.1 U	1.5 U	1.6 U	1.5 U	1.2 U
EBCHEM	PS-04	10/12/85	PS-04		1.7 U	1.6 U	1.9 U	1.3 U	1.4 U	1.3 U	1 U
EBCHEM	PS-05	10/15/85	PS-05		5.8 U	5.2 U	7.5 U	3.8 U	4.1 U	5.4 U	2.6 U
EHCHEM	BH-01	06/01/85	B1			1 U					
EHCHEM	BH-02	06/01/85	B1			1 U					
EIGHTBAY	CS-01	05/29/84	CS-01		1 U	1 U	1 U				
EIGHTBAY	CS-11	05/29/84	CS-11		1 U	1 U	1 U				
EIGHTBAY	CS-15	05/29/84	CS-15		1 U	1 U	1 U				
EIGHTBAY	CS-17	05/29/84	CS-17		1 U	1 U	1 U				
EIGHTBAY	DB-01	05/22/84	DB-01		1 U	1 U	1 U				
EIGHTBAY	DB-05	05/22/84	DB-05		1 U	1 U	1 U				

06/14/89

TABLE C-9. (Continued) CONCENTRATIONS OF PESTICIDES AND PCBS IN PUGET SOUND REFERENCE AREA SEDIMENT SAMPLES (ug/kg dry weight).

Survey	Station	Date	Sample	FieldRep	P,P'-DDT	P,P'-DDE	P,P'-DDD	HEPTACHLOR	ALDRIN	DIELDRIN	HEXACHLOROCYCLOHEXANE-GAMMA (LINDANE)
EIGHTBAY	DB-07	05/22/84	DB-07		1 U	1 U	1 U				
EIGHTBAY	DB-15	05/22/84	DB-15		1 U	1 U	1 U				
EIGHTBAY	SM-01	04/24/84	SM-01		1 U	1 U	1 U				
EIGHTBAY	SM-03	04/24/84	SM-03		1 U	1 U	1 U				
EIGHTBAY	SM-07	04/24/84	SM-07		1 U	1 U	1 U				
EIGHTBAY	SM-20	04/24/84	SM-20		1 U	1 U	1 U				
EIGHTBAY	SQ-14	05/29/84	SQ-14		1 U	1 U	1 U				
EIGHTBAY	SQ-17	05/29/84	SQ-17		1 U	1 U	1 U				
EIGHTBAY	SQ-18	05/29/84	SQ-18		1 U	1 U	1 U				
EIGHTBAY	SQ-20	05/29/84	SQ-20		1 U	1 U	1 U				
EPAPS88	WB	05/01/88	WB		0.7 U	0.4 U	0.7 U	0.4 U	0.9 U	0.5 U	0.5 U
EVCHEM	PS-02	10/13/86	PS-02G	PS02	10 U	10 U	10 U	50 U	5 U	10 U	50 U
EVCHEM	PS-03	10/13/86	PS-03G	PS03	1 U	1 U	1 U	0.5 U	0.5 U	1 U	0.5 U
EVCHEM	PS-04	10/10/86	PS-04G	PS04	1 U	1 U	1 U	0.5 U	0.5 U	1 U	0.5 U
MALINS	CS-62	01/01/79	12062		0.2 U	0.1 U		0.03 U	0.03 U		0.03 U
MALINS	CS-63	01/01/79	12063		0.02 U	0.03 U		0.01 U	0.01 U		0.01 U
MALINS	PM-06	01/01/79	08106		0.1	0.2		0.01 U	0.01 U		0.06 U
MALINS	PM-07	01/01/79	08107		0.6	0.02 U		0.01 U	0.01 U		0.01 U
NOAA84	NISQ1	10/15/84	NISQ1	1	0.1 U	0.1 U		0.1 U	0.1 U	0.1 U	
NOAA84	NISQ2	10/15/84	NISQ2	1	0.1 U	0.5 U		0.1 U	0.1 U	0.1 U	
NOAA84	NISQ3	10/15/84	NISQ3	1	0.1 U	0.1 U		0.1 U	0.1 U	0.1 U	
NOADW86	CARRINL	05/01/86	CARRINL		1 U	0.8 U	2 U	1 U	1 U	1 U	0.8 U
NOADW86	CPSD	05/01/86	CPSD		0.5 U	0.3 U	0.7 U	0.5 U	0.4 U	0.5 U	0.3 U
NOADW86	DABOB	05/01/86	DABOB		1 U	0.7 U	1 U	0.8 U	1 U	1 U	0.7 U
NOADW86	DISCOVRY	05/01/86	DISCOVRY		0.5 U	0.3 U	0.6 U	0.4 U	0.4 U	0.5 U	0.3 U
NOADW86	SAMISH	05/01/86	SAMISH		0.8 U	0.5 U	1 U	0.7 U	0.6 U	0.8 U	0.5 U
NOADW86	SEQUIM17	05/01/86	SEQUIM17		1 U	0.7 U	1 U	1 U	0.9 U	1 U	0.7 U
OLYHAR88	SQ-01	01/01/88	SQ-01		0.6 U	0.4 U	0.7 U	0.5 U	0.5 U	0.4 U	0.4 U
OLYHAR88	WB-01	01/01/88	WB-01		0.2 U	0.2 U	0.3 U	0.2 U	0.2 U	0.2 U	0.2 U
PSDDA1	CRR01	05/17/88	CRR01C		4 U	4 U	4 U	2 U	2 U	4 U	2 U
PSDDA1	PGB02	05/23/88	PGB02C		6 U	6 U	6 U	3 U	3 U	6 U	3 U
PSDDA1	PSR01	05/23/88	PSR01C		6 U	6 U	6 U	3 U	3 U	6 U	3 U
TPPS3AB	PM-71	10/01/82	2147		0.1 U	0.15 L	0.089 U			0.09 U	0.074 U
TPPS3AB	PM-72	10/01/82	2146		0.1 U	0.29	0.089 U			0.09 U	0.074 U
TPPS3AB	PM-73	10/01/82	2145		0.1 U	0.6	0.089 U			0.09 U	0.074 U
TPPS3AB	PSD-11	03/04/81	561		0.1 U	0.45	0.089 U			0.09 U	0.074 U

06/14/89

TABLE C-9. (Continued) CONCENTRATIONS OF PESTICIDES AND PCBS IN PUGET SOUND REFERENCE AREA SEDIMENT SAMPLES (ug/kg dry weight).

Survey	Station	Date	Sample	FieldRep	HEXACHLOROCYCLOHEXANE-ALPHA	HEXACHLOROCYCLOHEXANE-BETA	HEXACHLOROCYCLOHEXANE-DELTA	ALPHA ENDOSULFAN	BETA ENDOSULFAN	ENDOSULFAN SULFATE	ENDRIN	ENDRIN KETONE
EBCHEM	PS-01	10/12/85	PS-01	1	1.5 U	3.4 U	1.8 U				3.1 U	
EBCHEM	PS-01	10/12/85	PS-01	2	1.2 U	2.6 U	1.4 U				2.4 U	
EBCHEM	PS-02	10/12/85	PS-02		1.1 U	2.4 U	1.3 U				2.2 U	
EBCHEM	PS-03	10/12/85	PS-03		0.99 U	2.2 U	1.1 U				2 U	
EBCHEM	PS-04	10/12/85	PS-04		0.87 U	1.9 U	1 U				1.8 U	
EBCHEM	PS-05	10/15/85	PS-05		2.2 U	5.4 U	3 U				6.4 U	
EVCHEM	PS-02	10/13/86	PS-02G	PS02	50 U	50 U	5 U	5 U	10 U	10 U	10 U	10 U
EVCHEM	PS-03	10/13/86	PS-03G	PS03	0.5 U	0.5 U	0.5 U	0.5 U	1 U	1 U	1 U	1 U
EVCHEM	PS-04	10/10/86	PS-04G	PS04	0.5 U	0.5 U	0.5 U	0.5 U	1 U	1 U	1 U	1 U
NOADW86	CARRINL	05/01/86	CARRINL		0.4 U	0.9 U	0.4 U	0.5 U	0.5 U	0.5 U	0.4 U	
NOADW86	CPSD	05/01/86	CPSD		0.4 U	1 U	0.4 U	0.5 U	1 U	1 U	0.4 U	
NOADW86	DABOB	05/01/86	DABOB		0.3 U	0.8 U	0.3 U	0.4 U	0.4 U	0.4 U	0.3 U	
NOADW86	DISCOVRY	05/01/86	DISCOVRY		0.3 U	1 U	0.4 U	0.4 U	0.4 U	0.5 U	0.4 U	
NOADW86	SAMISH	05/01/86	SAMISH		0.5 U	1 U	1 U	1 U	1 U	1 U	0.5 U	
NOADW86	SEQUIM17	05/01/86	SEQUIM17		1 U	2 U	1 U	1 U	1 U	1 U	0.7 U	
OAKHRBR	OH-B	02/26/85	OH-B				0.3 U					
OAKHRBR	OH-C	02/26/85	OH-C				2.9					
OAKHRBR	OH-C1	02/26/85	OH-C1				3.3					
OAKHRBR	OH-C3	02/26/85	OH-C3				0.5					
OAKHRBR	OH-D1	02/26/85	OH-D1				2.9					
OAKHRBR	OH-D2	02/26/85	OH-D2				4					
OAKHRBR	SEQUIM	02/26/85	SEQUIM				20 U					
PSDDA1	CRR01	05/17/88	CRR01C		2 U	2 U	2 U	6 U	4 U	4 U	4 U	4 U
PSDDA1	PGB02	05/23/88	PGB02C		3 U	3 U	3 U	9 U	6 U	6 U	6 U	6 U
PSDDA1	PSR01	05/23/88	PSR01C		3 U	3 U	3 U	9 U	6 U	6 U	6 U	6 U
TPPS3AB	PM-71	10/01/82	2147		0.057 U							
TPPS3AB	PM-72	10/01/82	2146		0.057 U							
TPPS3AB	PM-73	10/01/82	2145		0.057 U							
TPPS3AB	PSD-11	03/04/81	561		0.057 U							

TABLE C-9. (Continued) CONCENTRATIONS OF PESTICIDES AND PCBS IN PUGET SOUND REFERENCE AREA SEDIMENT SAMPLES (ug/kg dry weight).

Survey	Station	Date	Sample	FieldRep	METHOXYCHLOR	TOXAPHENE	PCB-1016	PCB-1242	PCB-1248	PCB-1254	PCB-1260	POLYCHLORINATED BIPHENYLS
88PSRECN	DY-1	04/21/88	DY-1									0.6 G
88PSRECN	DY-2	04/21/88	DY-2									6 G
88PSRECN	DY-3	04/22/88	DY-3									1.7 G
88PSRECN	DY-4	04/22/88	DY-4									7.9 G
88PSRECN	DY-5	04/22/88	DY-5									4.5 G
88PSRECN	DY-6	04/22/88	DY-6									9 G
88PSRECN	OH-1	04/28/88	OH-1									8 U
88PSRECN	OH-2	04/28/88	OH-2									8 U
88PSRECN	OH-3	04/28/88	OH-3									8 U
88PSRECN	OH-4	04/28/88	OH-4									8.8 G
88PSRECN	OH-5	04/28/88	OH-5									6.1 G
88PSRECN	OH-6	04/28/88	OH-6									8 U
CBMSQS	CR-11	01/01/84	CR-11					7 U	7 U			7 U
CBMSQS	CR-12	01/01/84	CR-12					7 U	7 U			7 U
CBMSQS	CR-13	01/01/84	CR-13					7 U	7 U			7 U
CBMSQS	CR-14	01/01/84	CR-14					7 U	7 U			7 U
CBPRELIM	CR-03	03/01/84	CR-03					1	1	1	1	4
CBPRELIM	CR-04	03/01/84	CR-04					1	1	1	1	4
DUWRIV1	SQ-09	04/19/85	SQ-09									2.7
DUWRIV2	SQ-21	07/01/85	SEQUIM									37
EBCHEM	PS-01	10/12/85	PS-01	1								220 U
EBCHEM	PS-01	10/12/85	PS-01	2								170 U
EBCHEM	PS-02	10/12/85	PS-02									150 U
EBCHEM	PS-03	10/12/85	PS-03									140 U
EBCHEM	PS-04	10/12/85	PS-04									120 U
EBCHEM	PS-05	10/15/85	PS-05									330 U
EHCHEM	BH-01	06/01/85	B1									5 E
EHCHEM	BH-02	06/01/85	B1									5 U
EIGHTBAY	CS-01	05/29/84	CS-01									20 U
EIGHTBAY	CS-11	05/29/84	CS-11									20 U
EIGHTBAY	CS-15	05/29/84	CS-15									20 U
EIGHTBAY	CS-17	05/29/84	CS-17									20 U
EIGHTBAY	DB-01	05/22/84	DB-01									20 U
EIGHTBAY	DB-05	05/22/84	DB-05									20 U

06/14/89

TABLE C-9. (Continued) CONCENTRATIONS OF PESTICIDES AND PCBS IN PUGET SOUND REFERENCE AREA SEDIMENT SAMPLES (ug/kg dry weight).

Survey	Station	Date	Sample	FieldRep	METHOXYCHLOR	TOXAPHENE	PCB-1016	PCB-1242	PCB-1248	PCB-1254	PCB-1260	POLYCHLORINATED BIPHENYLS
EIGHTBAY	DB-07	05/22/84	DB-07									20 U
EIGHTBAY	DB-15	05/22/84	DB-15									20 U
EIGHTBAY	SM-01	04/24/84	SM-01									20 U
EIGHTBAY	SM-03	04/24/84	SM-03									20 U
EIGHTBAY	SM-07	04/24/84	SM-07									20 U
EIGHTBAY	SM-20	04/24/84	SM-20									20 U
EIGHTBAY	SQ-14	05/29/84	SQ-14									20 U
EIGHTBAY	SQ-17	05/29/84	SQ-17									20 U
EIGHTBAY	SQ-18	05/29/84	SQ-18									20 U
EIGHTBAY	SQ-20	05/29/84	SQ-20									20 U
EVCHEM	PS-02	10/13/86	PS-02G	PS02	50 U	100 U						50 U
EVCHEM	PS-03	10/13/86	PS-03G	PS03	5 U	10 U						50 U
EVCHEM	PS-04	10/10/86	PS-04G	PS04	5 U	10 U						50 U
LIBERT88	RP-CB	09/16/75	CB									0.013
MALINS	CS-62	01/01/79	12062									4.1
MALINS	CS-63	01/01/79	12063									0.57
MALINS	DI-41	09/01/80	02041									1.4 E
MALINS	PM-06	01/01/79	08106									9.08
MALINS	PM-07	01/01/79	08107									3.04
MALINS	PS-00	06/01/80	50200									7.8 E
MALINS	PS-25	06/01/80	50225									13 E
MISCREFS	CR-15	07/01/75	15									5.7
MISCREFS	CS-14	07/01/75	14									0.7
MISCREFS	NQ-8	07/01/75	8									2.6
MISCREFS	PR-1	12/01/83	PR-1									2.3 U
MISCREFS	TN-7	07/01/75	7									1.5
NOAA84	NISQ1	10/15/84	NISQ1	1								1.2
NOAA84	NISQ2	10/15/84	NISQ2	1								7.8
NOAA84	NISQ3	10/15/84	NISQ3	1								4.7
NOADW86	CARRINL	05/01/86	CARRINL									41
NOADW86	CPSD	05/01/86	CPSD									5
NOADW86	DABOB	05/01/86	DABOB									10
NOADW86	DISCOVRY	05/01/86	DISCOVRY									9

06/14/89

TABLE C-9. (Continued) CONCENTRATIONS OF PESTICIDES AND PCBS IN PUGET SOUND REFERENCE AREA SEDIMENT SAMPLES (ug/kg dry weight).

Survey	Station	Date	Sample	FieldRep	METHOXYCHLOR	TOXAPHENE	PCB-1016	PCB-1242	PCB-1248	PCB-1254	PCB-1260	POLYCHLORINATED BIPHENYLS
NOADW86	SAMISH	05/01/86	SAMISH									25
NOADW86	SEQUIM17	05/01/86	SEQUIM17									48
OAKHRBR	OH-B	02/26/85	OH-B							18		
OAKHRBR	OH-C	02/26/85	OH-C							20		
OAKHRBR	OH-C1	02/26/85	OH-C1							12		
OAKHRBR	OH-C2	02/26/85	OH-C2							12		
OAKHRBR	OH-C3	02/26/85	OH-C3							22		
OAKHRBR	OH-C4	02/26/85	OH-C4							12		
OAKHRBR	OH-D1	02/26/85	OH-D1							12		
OAKHRBR	OH-D2	02/26/85	OH-D2							9		
OLYHAR88	SQ-01	01/01/88	SQ-01									17
OLYHAR88	WB-01	01/01/88	WB-01									2
PSDDA1	CRR01	05/17/88	CRR01C		8 U	200 U	40 U	40 U	40 U	40 U	40 U	40 U
PSDDA1	PGB02	05/23/88	PGB02C		12 U	300 U	60 U	60 U	60 U	60 U	60 U	60 U
PSDDA1	PSR01	05/23/88	PSR01C		12 U	300 U	60 U	60 U	60 U	60 U	60 U	60 U
RILEY001	NG-10	08/01/82	NG-10	1								0.1 U
RILEY001	NG-10	08/01/82	NG-11	2								0.1 U
RILEY001	NG-12	08/01/82	NG-12									0.1 U
RILEY001	NG-13	08/01/82	NG-13A									0.1 U
RILEY001	NG-14	08/01/82	NG-14									0.1 U
RILEY001	NG-15	08/01/82	NG-15									0.1 U
RILEY001	NG-16	08/01/82	NG-16									0.1 U
RILEY001	NG-8	08/01/82	NG-8									0.1 U
RILEY001	NG-9	08/01/82	NG-9									0.1 U
TPPS3AB	PM-71	10/01/82	2147					3.7	3.7	7.5	4.5	19
TPPS3AB	PM-72	10/01/82	2146					7.2	7.2	10	5.8	30
TPPS3AB	PM-73	10/01/82	2145					26	26	18	18	88
TPPS3AB	PSD-11	03/04/81	561					1.6	1.6	5.9	6.8	16

06/14/89

TABLE C-10. CONCENTRATIONS OF VOLATILE ORGANIC COMPOUNDS IN PUGET SOUND REFERENCE AREA SEDIMENT SAMPLES (ug/kg dry weight).

Survey	Station	Date	Sample	FieldRep	TRICHLOROETHENE	TETRACHLOROETHYLENE	ETHYLBENZENE	TOTAL XYLENE
EIGHTBAY	CS-01	05/29/84	CS-01		14 U	14 U	14 U	
EIGHTBAY	CS-11	05/29/84	CS-11		14 U	14 U	14 U	
EIGHTBAY	CS-15	05/29/84	CS-15		17 U	17 U	17 U	
EIGHTBAY	CS-17	05/29/84	CS-17		18 U	18 U	18 U	
EIGHTBAY	DB-01	05/22/84	DB-01		7.2 U	7.2 U	7.2 U	
EIGHTBAY	DB-05	05/22/84	DB-05		7.9 U	7.9 U	7.9 U	
EIGHTBAY	DB-07	05/22/84	DB-07		10 U	10 U	10 U	
EIGHTBAY	DB-15	05/22/84	DB-15		16 U	16 U	16 U	
EIGHTBAY	SM-01	04/24/84	SM-01		4.1 U	4.1 U	4.1 U	
EIGHTBAY	SM-03	04/24/84	SM-03		13 U	13 U	13 U	
EIGHTBAY	SM-07	04/24/84	SM-07		4.3 U	4.3 U	4.3 U	
EIGHTBAY	SM-20	04/24/84	SM-20		4.5 U	4.5 U	4.5 U	
EIGHTBAY	SQ-14	05/29/84	SQ-14		13 U	13 U	13 U	
EIGHTBAY	SQ-17	05/29/84	SQ-17		13 U	13 U	13 U	
EIGHTBAY	SQ-18	05/29/84	SQ-18		13 U	13 U	13 U	
EIGHTBAY	SQ-20	05/29/84	SQ-20		15 U	15 U	15 U	
EPAPS88	WB	05/01/88	WB		2 U	2 U	2 U	2 U
EVCHEM	PS-02	10/13/86	PS-02G	PS02	3 U	3 U	3 U	3 U
EVCHEM	PS-03	10/13/86	PS-03G	PS03	3 U	3 U	3 U	3 U
EVCHEM	PS-04	10/10/86	PS-04G	PS04	3 U	3 U	3 U	3 U
NOADW86	CARRINL	05/01/86	CARRINL		50 U	50 U	50 U	50 U
NOADW86	CPSD	05/01/86	CPSD		50 U	50 U	50 U	50 U
NOADW86	DABOB	05/01/86	DABOB		50 U	50 U	50 U	50 U
NOADW86	DISCOVRY	05/01/86	DISCOVRY		50 U	50 U	50 U	50 U
NOADW86	SAMISH	05/01/86	SAMISH		50 U	50 U	50 U	50 U
NOADW86	SEQUIM17	05/01/86	SEQUIM17		50 U	50 U	50 U	50 U
OLYHAR88	SQ-01	01/01/88	SQ-01		2 U	2 U	2 U	5 U
OLYHAR88	WB-01	01/01/88	WB-01		0.6 U	0.5 U	0.9 U	2 U
PSDDA1	CRR01	05/17/88	CRR01C		0.9 U	0.7 U	1.2 U	2.6 U
PSDDA1	PGB02	05/23/88	PGB02C		1.3 U	1.1 U	1.7 U	3.8 U
PSDDA1	PSR01	05/23/88	PSR01C		1.2 U	1 U	1.6 U	3.7 U

06/13/89

TABLE C-11. CONVENTIONALS DATA FOR PUGET SOUND REFERENCE AREA SEDIMENT SAMPLES (mg/kg unless otherwise noted, dry weight).

Survey	Station	Date	Sample	FieldRep	PERCENT CLAY	PERCENT ROCKS	PERCENT SAND	PERCENT SILT	PERCENT FINES (CLAY + SILT)	SULFIDES	TOTAL ORGANIC CARBON (Percent)	TOTAL VOLATILE SOLIDS (Percent)	TOTAL SOLIDS*
88PSRECN	AD-S3E	04/26/88	S3E-2			18	42		40				
88PSRECN	AD-S3W	04/26/88	S3W-2			15	55		30				
88PSRECN	DI-S1	04/28/88	S1-1	1					100				
88PSRECN	DI-S1	04/28/88	S1-2	2		0.54	7.1		92				
88PSRECN	DY-1	04/21/88	DY-1		14	2.9	82	1.8	16		0.5		
88PSRECN	DY-2	04/21/88	DY-2		30	6.5	26	37.6	67		1.8		
88PSRECN	DY-3	04/22/88	DY-3		30	0	48	22.2	52		1.5		
88PSRECN	DY-4	04/22/88	DY-4		49	3.2	4	43.6	93		3		
88PSRECN	DY-5	04/22/88	DY-5		61	0.2	6.7	32.2	93		3.2		
88PSRECN	DY-6	04/22/88	DY-6		46	0	2.5	51.4	98		3.4		
88PSRECN	OH-1	04/28/88	OH-1		33	0	23	44.4	77		6.1		
88PSRECN	OH-2	04/28/88	OH-2		29	0.1	22	48.8	78		4.9		
88PSRECN	OH-3	04/28/88	OH-3		38	0.1	13	49.3	87		1.3		
88PSRECN	OH-4	04/28/88	OH-4		40	0.3	11	49	89		1.3		
88PSRECN	OH-5	04/28/88	OH-5		46	0	4	49.6	96		1.4		
88PSRECN	OH-6	04/28/88	OH-6		27	0.2	22	51.1	78		0.9		
88PSRECN	PM-S9	05/03/88	S9-1	1		0.52	75		24				
88PSRECN	PM-S9	05/03/88	S9-2	2		0.71	88		12				
88PSRECN	PM-S9	05/03/88	S9-3	3		0.95	48		51				
88PSRECN	PR-S10E	05/03/88	S10E-2			7.5	86		6.3				
88PSRECN	PR-S10W	05/03/88	S10W-1	1		0.2	99		0.7				
88PSRECN	PR-S10W	05/03/88	S10W-2	2		0.55	91		8.5				
88PSRECN	PR-S10W	05/03/88	S10W-3	3		0.3	94		5.6				
88PSRECN	PS-S6	05/02/88	S6-1	1		1.5	5.6		93				
88PSRECN	PS-S6	05/02/88	S6-3	2		1.8	5.6		93				
88PSRECN	PS-S7E	05/02/88	S7E-1	1		0.33	1.8		98				
88PSRECN	PS-S7E	05/02/88	S7E-2	2		0	99		0.6				
88PSRECN	PS-S7E	05/02/88	S7E-3	3		0.36	88		11				
88PSRECN	PS-S7W	05/02/88	S7W-1	1		0.87	78		21				
88PSRECN	PS-S7W	05/02/88	S7W-2	2		0.88	75		24				
88PSRECN	PS-S7W	05/02/88	S7W-3	3		0.61	70		29				
88PSRECN	SA-S4E	05/02/88	S4E-1	1		0.19	93		6.9				
88PSRECN	SA-S4E	05/02/88	S4E-2	2		0.389	94		6.4				

06/13/89

TABLE C-11. (Continued) CONVENTIONALS DATA FOR PUGET SOUND REFERENCE AREA SEDIMENT SAMPLES (mg/kg unless otherwise noted, dry weight).

Survey	Station	Date	Sample	FieldRep	PERCENT CLAY	PERCENT ROCKS	PERCENT SAND	PERCENT SILT	PERCENT FINES (CLAY + SILT)	SULFIDES	TOTAL ORGANIC CARBON (Percent)	TOTAL VOLATILE SOLIDS (Percent)	TOTAL SOLIDS*
88PSRECN	SA-S4E	05/02/88	S4E-3	3		0.21	91		8.4				
88PSRECN	SA-S4W	05/02/88	S4W-1	1		0.2	1.9		98				
88PSRECN	SA-S4W	05/02/88	S4W-2	2		0.21	93		7				
88PSRECN	SA-S4W	05/02/88	S4W-3	3		1.1	97		2.1				
88PSRECN	SA-S5	05/02/88	S5-1	1		0.98	10		89				
88PSRECN	SA-S5	05/02/88	S5-2	2		0.63	13		86				
88PSRECN	SA-S5	05/02/88	S5-3	3		1.3	32		69				
88PSRECN	WB	04/28/88	WB		1.5	4.5	94	0.4	1.9		0		
BARRICK	AD-62	01/01/76	62								1.2		
BARRICK	DBE	01/01/76	DBE								3.5		
BARRICK	ES-73	01/01/76	73								4.1		
BARRICK	NQ-82	01/01/76	82								0.77		
BARRICK	PD-78	01/01/76	78								2.4		
BARRICK	PO-52	01/01/76	52								1.7		
BARRICK	PS-98	01/01/76	98								2.7		
BARRICK	RS-65	01/01/76	65								1.1		
BARRICK	SK-95	01/01/76	95								0.35		
BROWN7	AB-01	01/01/79	AB-01								0.08		
BROWN7	AB-01	06/01/78	AB-01								0.18		
BROWN7	AB-01	09/01/78	AB-01								0.1		
BROWN7	BB-01	09/01/78	BB-01								0.31		
BROWN7	BB-01	01/01/79	BB-01								0.09		
BROWN7	BB-01	06/01/78	BB-01								0.18		
BROWN7	DS-01	06/01/78	DS-01								0.07		
BROWN7	DS-01	09/01/78	DS-01								0.13		
BROWN7	DS-01	01/01/79	DS-01								0.08		
CBMSQS	CR-11	01/01/84	CR-11		0	0.36	95.3	4.34	4.3	5.8 E	0.35	0.9	75.7
CBMSQS	CR-12	01/01/84	CR-12		0	0.11	87.1	12.8	12.8	0.7 U	0.26	1	75.6
CBMSQS	CR-13	01/01/84	CR-13		0	0.09	92.2	7.66	7.7	2.2 E	0.19	0.77	76.8
CBMSQS	CR-14	01/01/84	CR-14		2.7	0.05	77.4	19.9	22.6	2.6 E	0.43	1.2	73.8
CBPRELIM	CR-03	03/01/84	CR-03		4.21	0.01	80.9	14.9	19.1	1 U	0.48 M	1.3	71.2
CBPRELIM	CR-04	03/01/84	CR-04		0	0	91.6	8.44	8.44	1.4 U	0.32 M	1.29	72.3
DUWRIV1	SQ-09	04/19/85	SQ-09		68.8			4.5	73.3		1.4	7	

TABLE C-11. (Continued) CONVENTIONALS DATA FOR PUGET SOUND REFERENCE AREA SEDIMENT SAMPLES (mg/kg unless otherwise noted, dry weight).

Survey	Station	Date	Sample	Field Rep	PERCENT CLAY	PERCENT ROCKS		PERCENT SAND	PERCENT SILT	PERCENT FINES (CLAY + SILT)	SULFIDES	TOTAL ORGANIC CARBON (Percent)	TOTAL VOLATILE SOLIDS (Percent)	TOTAL SOLIDS*
EBCHEM	PS-01	10/12/85	PS-01	1	31.3	0		11.9	56.8	88.1	31	1.49 E	5.49	51.7
EBCHEM	PS-01	10/12/85	PS-01	2	31.5		M	11.6	56.9	88.4	31	1.5 E	5.5	52.6
EBCHEM	PS-02	10/12/85	PS-02		13.5	0		76.4	10.1	23.6	29	0.84 E	3.29	64.8
EBCHEM	PS-03	10/12/85	PS-03		7.49	0		87.8	4.7	12.2	10	0.39 E	2.23	73.6
EBCHEM	PS-04	10/12/85	PS-04		7.3	0.6		88.4	3.7	11	21	0.4 E	2.44	75
EBCHEM	PS-05	10/15/85	PS-05		7.6	23.5		67.4	1.5	9.1	27	0.35 E	2.04	81.9
EHCHEM	BH-01	06/01/85	B1							10.7	20	1.3		66.7
EHCHEM	BH-02	06/01/85	B1							10.8	10 U	2		68.8
EIGHTBAY	CS1	09/14/83	CS1							70				
EIGHTBAY	CS10	09/14/83	CS10							97				
EIGHTBAY	CS11	09/15/83	CS11							57				
EIGHTBAY	CS12	09/15/83	CS12							97				
EIGHTBAY	CS13	09/15/83	CS13							95				
EIGHTBAY	CS14	09/15/83	CS14							98				
EIGHTBAY	CS15	09/15/83	CS15							96				
EIGHTBAY	CS16	09/15/83	CS16							97				
EIGHTBAY	CS17	09/15/83	CS17							96				
EIGHTBAY	CS18	09/15/83	CS18							96				
EIGHTBAY	CS19	09/15/83	CS19							18				
EIGHTBAY	CS2	09/14/83	CS2							94				
EIGHTBAY	CS20	09/15/83	CS20							89				
EIGHTBAY	CS3	09/14/83	CS3							96				
EIGHTBAY	CS4	09/14/83	CS4							97				
EIGHTBAY	CS5	09/14/83	CS5							99				
EIGHTBAY	CS6	09/14/83	CS6							99				
EIGHTBAY	CS7	09/14/83	CS7							98				
EIGHTBAY	CS8	09/14/83	CS8							95				
EIGHTBAY	CS9	09/14/83	CS9							99				
EIGHTBAY	CS-01	05/29/84	CS-01		34.8				54.6	89.4		2.01	10.3	
EIGHTBAY	CS-11	05/29/84	CS-11		18				21	39		1.36	6.18	
EIGHTBAY	CS-15	05/29/84	CS-15		37.6				43.7	81.4		2.42	11.8	
EIGHTBAY	CS-17	05/29/84	CS-17		46.7				31.4	78.1		2.69	11.9	
EIGHTBAY	DB1	09/10/83	DB1							80				

06/13/89

TABLE C-11. (Continued) CONVENTIONALS DATA FOR PUGET SOUND REFERENCE AREA SEDIMENT SAMPLES (mg/kg unless otherwise noted, dry weight).

Survey	Station	Date	Sample	FieldRep	PERCENT CLAY	PERCENT ROCKS	PERCENT SAND	PERCENT SILT	PERCENT FINES (CLAY + SILT)	SULFIDES	TOTAL ORGANIC CARBON (Percent)	TOTAL VOLATILE SOLIDS (Percent)	TOTAL SOLIDS*
EIGHTBAY	DB14	09/09/83	DB14						97				
EIGHTBAY	DB15	09/09/83	DB15						94				
EIGHTBAY	DB16	09/09/83	DB16						98				
EIGHTBAY	DB17	09/08/83	DB17						9.4				
EIGHTBAY	DB18	09/08/83	DB18						30				
EIGHTBAY	DB19	09/08/83	DB19						43				
EIGHTBAY	DB2	09/10/83	DB2						98				
EIGHTBAY	DB20	09/08/83	DB20						5.2				
EIGHTBAY	DB21	09/08/83	DB21						14				
EIGHTBAY	DB22	09/08/83	DB22						2.4				
EIGHTBAY	DB23	09/09/83	DB23						2.2				
EIGHTBAY	DB24	09/09/83	DB24						3.2				
EIGHTBAY	DB25	09/09/83	DB25						2.7				
EIGHTBAY	DB26	09/09/83	DB26						4.5				
EIGHTBAY	DB3	09/10/83	DB3						99				
EIGHTBAY	DB4	09/10/83	DB4						91				
EIGHTBAY	DB5	09/10/83	DB5						32				
EIGHTBAY	DB6	09/10/83	DB6						46				
EIGHTBAY	DB7	09/10/83	DB7						83				
EIGHTBAY	DB-01	05/22/84	DB-01		7.82			12.4	20.2		0.83	4.14	
EIGHTBAY	DB-05	05/22/84	DB-05		10.4			13.3	23.7		1.39	5.51	
EIGHTBAY	DB-07	05/22/84	DB-07		24.5			24.5	49		2.14	7.66	
EIGHTBAY	DB-15	05/22/84	DB-15		40.3			49.4	89.7		2.65	13.2	
EIGHTBAY	SM1	08/06/83	SM1						88				
EIGHTBAY	SM10	08/08/83	SM10						93				
EIGHTBAY	SM11	08/08/83	SM11						23				
EIGHTBAY	SM12	08/08/83	SM12						25				
EIGHTBAY	SM13	08/09/83	SM13						4.8				
EIGHTBAY	SM14	08/09/83	SM14						4.1				
EIGHTBAY	SM15	08/09/83	SM15						7.5				
EIGHTBAY	SM16	08/09/83	SM16						89				
EIGHTBAY	SM17	08/09/83	SM17						6				
EIGHTBAY	SM18	08/09/83	SM18						93				

TABLE C-11. (Continued) CONVENTIONALS DATA FOR PUGET SOUND REFERENCE AREA SEDIMENT SAMPLES (mg/kg unless otherwise noted, dry weight).

Survey	Station	Date	Sample	FieldRep	PERCENT CLAY	PERCENT ROCKS	PERCENT SAND	PERCENT SILT	PERCENT FINES (CLAY + SILT)	SULFIDES	TOTAL ORGANIC CARBON (Percent)	TOTAL VOLATILE SOLIDS (Percent)	TOTAL SOLIDS*
EIGHTBAY	SM19	08/09/83	SM19						94				
EIGHTBAY	SM2	08/06/83	SM2						94				
EIGHTBAY	SM20	08/09/83	SM20						78				
EIGHTBAY	SM3	08/06/83	SM3						47				
EIGHTBAY	SM4	08/06/83	SM4						97				
EIGHTBAY	SM5	08/08/83	SM5						73				
EIGHTBAY	SM6	08/08/83	SM6						95				
EIGHTBAY	SM7	08/08/83	SM7						65				
EIGHTBAY	SM8	08/08/83	SM8						95				
EIGHTBAY	SM9	08/08/83	SM9						98				
EIGHTBAY	SM-01	04/24/84	SM-01		19.6			61.6	81.2		1.32	5.71	
EIGHTBAY	SM-03	04/24/84	SM-03		25.7			55.2	80.9		1.89	7.5	
EIGHTBAY	SM-07	04/24/84	SM-07		27.4			57.5	84.9		1.32	6.12	
EIGHTBAY	SM-20	04/24/84	SM-20		25.8			61.4	87.3		1.39	6.64	
EIGHTBAY	SQ1	08/15/83	SQ1						17				
EIGHTBAY	SQ10	09/17/83	SQ10						92				
EIGHTBAY	SQ11	09/17/83	SQ11						62				
EIGHTBAY	SQ12	09/17/83	SQ12						27				
EIGHTBAY	SQ13	09/17/83	SQ13						50				
EIGHTBAY	SQ14	09/18/83	SQ14						58				
EIGHTBAY	SQ15	09/18/83	SQ15						85				
EIGHTBAY	SQ16	09/18/83	SQ16						74				
EIGHTBAY	SQ17	09/18/83	SQ17						88				
EIGHTBAY	SQ18	09/18/83	SQ18						86				
EIGHTBAY	SQ19	09/18/83	SQ19						89				
EIGHTBAY	SQ2	08/15/83	SQ2						72				
EIGHTBAY	SQ20	09/18/83	SQ20						79				
EIGHTBAY	SQ3	08/15/83	SQ3						14				
EIGHTBAY	SQ4	08/15/83	SQ4						25				
EIGHTBAY	SQ5	08/16/83	SQ5						74				
EIGHTBAY	SQ6	08/16/83	SQ6						73				
EIGHTBAY	SQ7	09/17/83	SQ7						97				
EIGHTBAY	SQ8	09/17/83	SQ8						94				

06/13/89

TABLE C-11. (Continued) CONVENTIONALS DATA FOR PUGET SOUND REFERENCE AREA SEDIMENT SAMPLES (mg/kg unless otherwise noted, dry weight).

Survey	Station	Date	Sample	FieldRep	PERCENT CLAY	PERCENT ROCKS	PERCENT SAND	PERCENT SILT	PERCENT FINES (CLAY + SILT)	SULFIDES	TOTAL ORGANIC CARBON (Percent)	TOTAL VOLATILE SOLIDS (Percent)	TOTAL SOLIDS*
EIGHTBAY	SQ9	09/17/83	SQ9						81				
EIGHTBAY	SQ-14	05/29/84	SQ-14		28.7			35.2	63.9		2.09	9.19	
EIGHTBAY	SQ-17	05/29/84	SQ-17		35.3			47.8	83.1		2.3	10.4	
EIGHTBAY	SQ-18	05/29/84	SQ-18		33.9			45.5	79.5		2.28	11.6	
EIGHTBAY	SQ-20	05/29/84	SQ-20		35.5			48.4	83.9		2.23	9.55	
EPAPS88	WB	05/01/88	WB		1.55	4.47	93	0.4	1.95	23.7	0.04		
EVCHEM	PS-02	10/13/86	PS-02G	PS02	9.2	0.1	88.4	2.3	11.5	7 U	0.4		74.4
EVCHEM	PS-03	10/13/86	PS-03G	PS03	6.8	0.1	91.9	1.2	8	6 U	0.36		77.5
EVCHEM	PS-04	10/10/86	PS-04G	PS04	6.69	1.2	91.4	0.7	7.39	6 U	0.26		80.2
MALINS	CS-62	01/01/79	12062			5.93			94.07		3.1		
MALINS	CS-63	01/01/79	12063			89.75			10.25		0.36		
MALINS	PM-06	01/01/79	08106			45.5			54.49		1.26		
MALINS	PM-07	01/01/79	08107			78.65			21.33		0.41		
MISCREFS	DB-89	01/01/76	89								3.31		
MISCREFS	TN-59	01/01/76	59								0.37		
NOAA84	NISQ1	10/15/84	NISQ1	1					2.7		0.167		79.5
NOAA84	NISQ2	10/15/84	NISQ2	1					3.45		0.186		78.8
NOAA84	NISQ3	10/15/84	NISQ3	1					2.28		0.056		76.5
NOADW86	CARRINL	05/01/86	CARRINL			0.97	70.2		37.8	8 U		1.87	68.8
NOADW86	CPSD	05/01/86	CPSD			1.57	97.7		0.71			0.54	79.4
NOADW86	DABOB	05/01/86	DABOB			1.82	91.3		6.9	40		1.7	82.2
NOADW86	DISCOVRY	05/01/86	DISCOVRY			1.6	86.8		11.6	15		1.88	73
NOADW86	SAMISH	05/01/86	SAMISH			0.17	26.7		54.4	130		4.77	48.7
NOADW86	SEQUIM17	05/01/86	SEQUIM17			0.58	21.2		78.2	130		8.65	28.6
OAKHRBR	OH-A1	02/26/85	OH-A1							5 U			
OAKHRBR	OH-A2	02/26/85	OH-A2							5 U			
OAKHRBR	OH-A3	02/26/85	OH-A3							5 U			
OAKHRBR	OH-A4	02/26/85	OH-A4							12.3			
OAKHRBR	OH-B	02/26/85	OH-B		14.8	2.6	22	60.5	75.3		1.33		
OAKHRBR	OH-B1	02/26/85	OH-B1							59			
OAKHRBR	OH-B2	02/26/85	OH-B2							83			
OAKHRBR	OH-B3	02/26/85	OH-B3							74			
OAKHRBR	OH-B4	02/26/85	OH-B4							170			

06/13/89

TABLE C-11. (Continued) CONVENTIONALS DATA FOR PUGET SOUND REFERENCE AREA SEDIMENT SAMPLES (mg/kg unless otherwise noted, dry weight).

Survey	Station	Date	Sample	FieldRep	PERCENT CLAY	PERCENT ROCKS	PERCENT SAND	PERCENT SILT	PERCENT FINES (CLAY + SILT)	SULFIDES	TOTAL ORGANIC CARBON (Percent)	TOTAL VOLATILE SOLIDS (Percent)	TOTAL SOLIDS*
OAKHRBR	OH-C	02/26/85	OH-C		32	0.4	8.4	59.2	91		1.52		
OAKHRBR	OH-C1	02/26/85	OH-C1							11			
OAKHRBR	OH-C2	02/26/85	OH-C2							84			
OAKHRBR	OH-C3	02/26/85	OH-C3							130			
OAKHRBR	OH-C4	02/26/85	OH-C4							25			
OAKHRBR	OH-D1	02/26/85	OH-D1		30	0	9.4	60	90	75	1.33		
OAKHRBR	OH-D2	02/26/85	OH-D2		22	0	10.2	67.8	90	12	1.34		
OAKHRBR	OH-D3	02/26/85	OH-D3							38			
OAKHRBR	OH-D4	02/26/85	OH-D4							31			
OAKHRBR	SEQUIM	02/26/85	SEQUIM		25.7	0.5	11	62.3	88		2.5		
OLYHAR88	SQ-01	01/01/88	SQ-01						82.25				
OLYHAR88	WB-01	01/01/88	WB-01						4.52				
PSDDA1	CRR01	05/17/88	CRR01C		17	0.05	49	34	51	58	1.6	5.4	43
PSDDA1	PGB02	05/23/88	PGB02C		52	0	2	46	98	21	1.8	8.3	32
PSDDA1	PGB02	05/30/88	PGB02I	1	36	0.13	2.2	61	98		1.5		
PSDDA1	PSR01	05/23/88	PSR01C		23	0	0.91	76	99	49	1.6	7.9	32
PTGARQC*	SWIN-5	03/19/86	SWIN-5		0.7	2.2	97.1	0	0.7	5 U	0.22	1.18	81.4
PTGARQC*	SWIN-6	03/19/86	SWIN-6		0.7	3.6	95.7	0.1	0.8	5 U	0.2	0.95	86.72
PTGARQC*	SWIN-7	03/19/86	SWIN-7		0.8	4.3	94.8	0.2	1	5 U	0.24	1.16	77.38
PTGARQC*	SWIN-8	03/19/86	SWIN-8		0.8	0.1	99.1	0.1	0.9	5 U	0.19	1.1	80.39
QMHARBOR	QM-A	02/03/86	067312		2.2	0.82	82	14	16.2		0.9		
QMHARBOR	QM-B	02/03/86	067310		1.4	0.22	75	21	22.4		1.8		
QMHARBOR	QM-C	02/03/86	067311		2.4	15	71	10	12.4		1.5		
REFGRAIN	BB-93	11/24/81	BB-93				99.5		0.5			5.7	
REFGRAIN	BB-94	11/24/81	BB-94				99.2		0.8			1.8	
REFGRAIN	BB-95	11/24/81	BB-95				98.2		1.8			5.4	
REFGRAIN	BB-96	11/24/81	BB-96				98.6		1.4			1.3	
REFGRAIN	BB-97	11/24/81	BB-97				99.4		0.6			5.1	
REFGRAIN	DB-02	03/25/86	DB-02				1		99			8.1	
REFGRAIN	DB-14	03/25/86	DB-14				0.6		99.4			10.1	
REFGRAIN	DB-15	03/25/86	DB-15				20.7		79.3			9.5	
REFGRAIN	DB-18	03/25/86	DB-18				58.7		41.4			1.8	
REFGRAIN	PD-01	07/01/87	PD-01				51.7		48.3				

06/13/89

TABLE C-11. (Continued) CONVENTIONALS DATA FOR PUGET SOUND REFERENCE AREA SEDIMENT SAMPLES (mg/kg unless otherwise noted, dry weight).

Survey	Station	Date	Sample	FieldRep	PERCENT CLAY	PERCENT ROCKS	PERCENT SAND	PERCENT SILT	PERCENT FINES (CLAY + SILT)	SULFIDES	TOTAL ORGANIC CARBON (Percent)	TOTAL VOLATILE SOLIDS (Percent)	TOTAL SOLIDS*
REFGRAIN	PM-87	11/23/81	PM-87				78.6		21.4			8	
REFGRAIN	PM-88	11/23/81	PM-88				94.2		5.8			5.6	
REFGRAIN	PM-89	11/23/81	PM-89				49.9		50.1			2.2	
REFGRAIN	PM-90	11/23/81	PM-90				85.5		14.5			1.3	
REFGRAIN	PM-91	11/23/81	PM-91				69.4		29.7			1.2	
REFGRAIN	PM-92	11/23/81	PM-92				19		81			7.2	
REFGRAIN	SM-11	05/01/83	SM-11				78.4		21.33			3	
REFGRAIN	SM-12	05/01/83	SM-12				8.76		91.24			7.9	
RILEY001	NG-10	08/01/82	NG-10	1	20		45	35	55		1.5		41
RILEY001	NG-10	08/01/82	NG-11	2	2		37	61	63		1.4		31
RILEY001	NG-12	08/01/82	NG-12		22		29	49	71		0.25		65
RILEY001	NG-13	08/01/82	NG-13A		0		88	12	12		0.57		66
RILEY001	NG-14	08/01/82	NG-14		23		15	62	85		1.6		34
RILEY001	NG-15	08/01/82	NG-15		24		31	45	69		1.3		36
RILEY001	NG-16	08/01/82	NG-16		30		12	58	88		1.4		27
RILEY001	NG-8	08/01/82	NG-8		24		47	29	53		0.93		59
RILEY001	NG-9	08/01/82	NG-9		17		54	29	46		1.4		45
ROBERT74	AD-14	02/17/70	014		4.73	14.39	75.81	5.08	9.81				
ROBERT74	AD-S12	08/02/52	S12		0.55	45.02	53.69	0.74	1.29				
ROBERT74	CR-021	02/24/69	021		13.9	0	20.97	65.05	79.03				
ROBERT74	CR-022	02/24/69	022		26.4	0	13.02	60.55	86.98				
ROBERT74	CR-023	02/24/69	023		36.9	0	6.99	56.09	93				
ROBERT74	CS-005	02/17/70	005		18.0	0	30.97	51	69.03				
ROBERT74	CS-007	02/12/63	WAA	1	23.1	0.33	18.73	57.82	80.92				
ROBERT74	CS-007	02/12/63	WBA	2	29.1	0.08	11.19	59.57	88.67				
ROBERT74	CS-007	02/12/63	WCA	3	27.9	0.12	11.35	60.6	88.5				
ROBERT74	CS-008H	02/12/63	WAA	1	2	2.6	92.69	2.67	4.67				
ROBERT74	CS-008H	02/12/63	WBA	2	3.7	19.88	69.29	7.14	10.84				
ROBERT74	CS-008H	02/12/63	WCA	3	2.4	0.17	93.2	4.16	6.56				
ROBERT74	CS-008H	02/12/63	WDA	4	5.6	17.27	67.49	9.59	15.19				
ROBERT74	CS-009	02/24/69	009		15.0	0	45.64	39.31	54.36				
ROBERT74	CS-010	02/24/69	010		3.76	6.05	81.77	8.43	12.19				
ROBERT74	CS-011	02/24/69	011		42.6	0	5.26	52.07	94.74				

06/13/89

TABLE C-11. (Continued) CONVENTIONALS DATA FOR PUGET SOUND REFERENCE AREA SEDIMENT SAMPLES (mg/kg unless otherwise noted, dry weight).

Survey	Station	Date	Sample	FieldRep	PERCENT CLAY	PERCENT ROCKS	PERCENT SAND	PERCENT SILT	PERCENT FINES (CLAY + SILT)	SULFIDES	TOTAL ORGANIC CARBON (Percent)	TOTAL VOLATILE SOLIDS (Percent)	TOTAL SOLIDS*
ROBERT74	CS-034	08/10/72	034		25.4	0	10.5	64.02	89.51				
ROBERT74	CS-035	08/10/72	035		19.0	0	26.28	54.68	73.72				
ROBERT74	CS-036	08/10/72	036		13.4	0.08	56.45	29.98	43.46				
ROBERT74	DB-H16	08/01/52	H16		55.5	0	1.28	43.2	98.72				
ROBERT74	DB-H17	08/01/52	H17		36.7	0	8.7	54.53	91.3				
ROBERT74	DB-H18	08/02/52	H18		59.2	0	2.19	38.61	97.81				
ROBERT74	DI-1	10/19/59	001		6.9	0.34	57.04	35.71	42.61				
ROBERT74	DI-10	10/19/59	010		7.09	0	47.63	45.29	52.38				
ROBERT74	DI-11	10/19/59	011		14.1	0	6.93	78.92	93.07				
ROBERT74	DI-12	10/19/59	012		9.62	0.17	46.85	43.36	52.98				
ROBERT74	DI-13	10/19/59	013		8.91	0.03	50.44	40.62	49.53				
ROBERT74	DI-14	10/19/59	014		18.7	0	3.81	77.43	96.19				
ROBERT74	DI-15	10/19/59	015		17.6	0	3.55	78.8	96.44				
ROBERT74	DI-16	10/19/59	016		20.1	0	6.91	72.98	93.09				
ROBERT74	DI-17	10/19/59	017		18.6	0	4.56	76.78	95.44				
ROBERT74	DI-18	10/19/59	018		7.54	1.57	61.15	29.74	37.28				
ROBERT74	DI-19	10/19/59	019		3.43	0	83.88	12.7	16.1				
ROBERT74	DI-2	10/19/59	002		14.0	0	25.83	60.11	74.17				
ROBERT74	DI-20	10/19/59	020		21.1	0	5.6	73.27	94.4				
ROBERT74	DI-21	10/19/59	021		21.8	0	4.73	73.46	95.28				
ROBERT74	DI-22	10/19/59	022		18.9	0	7.58	73.51	92.42				
ROBERT74	DI-23	10/19/59	023		25.4	0	5.27	69.26	94.72				
ROBERT74	DI-24	10/19/59	024		23.8	0	6.35	69.77	93.65				
ROBERT74	DI-25	10/19/59	025		0.27	0.41	89.85	9.47	9.74				
ROBERT74	DI-26	10/19/59	026		17.2	0	2.07	80.69	97.93				
ROBERT74	DI-27	10/19/59	027		0.05	0.01	99.14	0.79	0.84				
ROBERT74	DI-28	10/19/59	028		0.06	0	97.96	1.99	2.05				
ROBERT74	DI-29	10/19/59	029		22.0	0.04	7.56	70.31	92.4				
ROBERT74	DI-3	10/19/59	003		1.21	39.62	44.8	14.37	15.58				
ROBERT74	DI-30	10/19/59	030		0	0.79	93.99	5.22	5.22				
ROBERT74	DI-31	10/19/59	031		0.04	0	98.62	1.34	1.38				
ROBERT74	DI-32	10/19/59	032		17.4	0	10.97	71.59	89.03				
ROBERT74	DI-33	10/19/59	033		0.14	0	98.37	1.49	1.63				

06/13/89

TABLE C-11. (Continued) CONVENTIONALS DATA FOR PUGET SOUND REFERENCE AREA SEDIMENT SAMPLES (mg/kg unless otherwise noted, dry weight).

Survey	Station	Date	Sample	FieldRep	PERCENT CLAY	PERCENT ROCKS	PERCENT SAND	PERCENT SILT	PERCENT FINES (CLAY + SILT)	SULFIDES	TOTAL ORGANIC CARBON (Percent)	TOTAL VOLATILE SOLIDS (Percent)	TOTAL SOLIDS*
ROBERT74	DI-34	10/19/59	034		0	0.39	97.72	1.9	1.9				
ROBERT74	DI-35	10/19/59	035		21.0	0	4.57	74.36	95.43				
ROBERT74	DI-36	10/19/59	036		0	46.58	52.59	0.83	0.83				
ROBERT74	DI-37	10/19/59	037		3.69	17.29	53.98	25.04	28.73				
ROBERT74	DI-38	10/19/59	038		16.8	0	10.21	72.97	89.79				
ROBERT74	DI-39	10/19/59	039		0	0.05	98.29	1.66	1.66				
ROBERT74	DI-4	10/19/59	004		4.14	0	68.07	27.78	31.92				
ROBERT74	DI-40	10/19/59	040		8.48	0	47.38	44.14	52.62				
ROBERT74	DI-41	10/19/59	041		12.3	0.07	6.94	80.64	92.98				
ROBERT74	DI-42	10/19/59	042		0	6.04	89.76	4.2	4.2				
ROBERT74	DI-43	10/19/59	043		0	0	98.42	1.58	1.58				
ROBERT74	DI-44	10/19/59	044		1.8	3.59	72.1	22.51	24.31				
ROBERT74	DI-45	10/19/59	045		16.4	0.46	17.99	65.14	81.55				
ROBERT74	DI-46	10/19/59	046		17.8	0	4.75	77.44	95.25				
ROBERT74	DI-47	10/19/59	047		0.55	0	76.79	22.66	23.21				
ROBERT74	DI-48	10/19/59	048		0	1.87	95.71	2.42	2.42				
ROBERT74	DI-49	10/19/59	049		0.03	0.52	86.55	12.9	12.93				
ROBERT74	DI-5	10/19/59	005		12.0	0.15	16.97	70.85	82.89				
ROBERT74	DI-6	10/19/59	006		3.93	0.14	75.96	19.97	23.9				
ROBERT74	DI-7	10/19/59	007		2.94	0.43	80.81	15.83	18.77				
ROBERT74	DI-8	10/19/59	008		15.0	0.16	6.51	78.32	93.33				
ROBERT74	DI-9	10/19/59	009		12.3	0.2	12.67	74.78	87.14				
ROBERT74	DY-019	02/24/69	019		2.82	3.92	89.84	3.42	6.24				
ROBERT74	DY-020	02/24/69	020		42.7	0	4.69	52.61	95.31				
ROBERT74	ES-173	03/28/66	173		23	0	15	62	85				
ROBERT74	ES-174	03/28/66	174		44	0	1	55	99				
ROBERT74	ES-6B	06/19/50	06B		19.1	0	26.99	53.82	73.01				
ROBERT74	ES-6C	06/19/50	06C		19.5	0	42.04	38.4	57.96				
ROBERT74	ES-7A	07/21/50	07A		57.1	0	8.33	34.49	91.67				
ROBERT74	ES-7B1	07/21/50	07B		19.0	0	31.98	48.97	68.01				
ROBERT74	ES-7B2	07/21/50	07B		61.2	0	8.1	30.64	91.9				
ROBERT74	ES-8A	08/02/50	08A		42.6	0	8.71	48.61	91.3				
ROBERT74	ES-8B	08/02/50	08B		32.2	0	5.51	62.21	94.49				

06/13/89

TABLE C-11. (Continued) CONVENTIONALS DATA FOR PUGET SOUND REFERENCE AREA SEDIMENT SAMPLES (mg/kg unless otherwise noted, dry weight).

Survey	Station	Date	Sample	FieldRep	PERCENT CLAY	PERCENT ROCKS	PERCENT SAND	PERCENT SILT	PERCENT FINES (CLAY + SILT)	SULFIDES	TOTAL ORGANIC CARBON (Percent)	TOTAL VOLATILE SOLIDS (Percent)	TOTAL SOLIDS*
ROBERT74	ES-8C	08/02/50	08C		20.9	0	22.07	57	77.93				
ROBERT74	ES-8D	08/02/50	08D		15.8	3.31	55.03	25.77	41.66				
ROBERT74	HC-011G	01/01/61	011		11.4	0	58.6	29.94	41.4				
ROBERT74	HC-011M	03/01/73	011		51.7	0	0.39	47.9	99.61				
ROBERT74	HC-012	03/01/73	012		49.6	0	3.8	46.58	96.2				
ROBERT74	HC-034	03/01/73	034		76.5	0	1.41	22.07	98.59				
ROBERT74	HC-H05	06/16/52	H05		56.0	0	1.75	42.24	98.25				
ROBERT74	HC-H06	06/16/52	H06		13.5	30.6	44.99	10.85	24.42				
ROBERT74	HC-H07	06/16/52	H07		53.5	0.000	0.75	45.66	99.25				
ROBERT74	HC-H08	06/16/52	H08		40.1	0	5.45	54.45	94.55				
ROBERT74	HC-H09	06/16/52	H09		23.4	0	37.61	38.94	62.39				
ROBERT74	HC-H15	07/31/52	H15		48.4	0	2.38	49.22	97.62				
ROBERT74	HI-007	02/24/69	007		32.2	0	4.7	63.11	95.31				
ROBERT74	HI-022	08/10/72	022		32.2	0.23	2.7	64.82	97.08				
ROBERT74	HP-001	04/13/66	001		6.17	0	79.65	14.18	20.35				
ROBERT74	HP-024	02/24/69	024		1.64	0	96.84	1.52	3.16				
ROBERT74	HP-E1	11/02/59	E1		19.6	0.01	30.03	50.32	69.96				
ROBERT74	NQ-006	05/02/63	WAA	1	6.1	2.24	77.32	14.26	20.36				
ROBERT74	NQ-006	05/02/63	WBA	2	5.5	12.79	54.91	26.73	32.23				
ROBERT74	NQ-008O	02/24/69	008		8.06	17.06	62.46	12.42	20.48				
ROBERT74	NQ-015	02/24/69	015		10.7	0.22	59.64	29.36	40.15				
ROBERT74	NQ-016	02/24/69	016		6.1	0	79.08	14.81	20.91				
ROBERT74	NQ-027	08/10/72	027		5.46	5.2	83.19	6.15	11.61				
ROBERT74	NQ-028	08/10/72	028		14.0	0.44	50.39	35.15	49.18				
ROBERT74	NQ-029	08/10/72	029		12.5	0	57.65	29.84	42.34				
ROBERT74	NQ-030	08/10/72	030		7.25	6.29	73.36	13.1	20.35				
ROBERT74	NQ-037	08/10/72	037		7.72	0.3	79.1	12.88	20.6				
ROBERT74	NQ-038	08/10/72	038		13.7	0	52.77	33.44	47.23				
ROBERT74	NQ-039	08/10/72	039		13.3	0	49.44	37.2	50.56				
ROBERT74	NQ-D01	01/01/61	D01		6.84	0	19.84	73.33	80.17				
ROBERT74	NQ-D02	01/01/61	D02		0	0	97.78	2.22	2.22				
ROBERT74	NQ-D03	01/01/61	D03		0.02	2.07	97.45	0.46	0.48				
ROBERT74	NQ-D05	01/01/61	D05		0.09	0.47	99.08	0.36	0.45				

06/13/89

TABLE C-11. (Continued) CONVENTIONALS DATA FOR PUGET SOUND REFERENCE AREA SEDIMENT SAMPLES (mg/kg unless otherwise noted, dry weight).

Survey	Station	Date	Sample	FieldRep	PERCENT CLAY	PERCENT ROCKS	PERCENT SAND	PERCENT SILT	PERCENT FINES (CLAY + SILT)	SULFIDES	TOTAL ORGANIC CARBON (Percent)	TOTAL VOLATILE SOLIDS (Percent)	TOTAL SOLIDS*
ROBERT74	NQ-D08	01/01/61	D08		4.15	0	30.77	65.08	69.23				
ROBERT74	NQ-D09	01/01/61	D09		0.3	0.29	98.87	0.54	0.84				
ROBERT74	NQ-D10	01/01/61	D10		0.24	2.9	96.68	0.18	0.42				
ROBERT74	NQ-D11	01/01/61	D11		0.34	0.79	98.53	0.34	0.68				
ROBERT74	NQ-D134	01/01/61	D13	1	0.05	0	92.41	7.54	7.59				
ROBERT74	NQ-D134	01/01/61	D14	2	0	0	97.11	2.89	2.89				
ROBERT74	NQ-DA7	01/01/61	DA7		1.62	0.73	86.06	11.59	13.21				
ROBERT74	NQ-DB7	01/01/61	DB7		0.63	0.46	94.32	4.59	5.22				
ROBERT74	NQ-DM	01/01/61	D04	1	3.73	0.67	88.68	6.92	10.65				
ROBERT74	NQ-DM	01/01/61	M01	2	1.55	0.5	40.72	57.23	58.78				
ROBERT74	NQ-DS	01/01/61	D12	1	0	0	95.99	4.01	4.01				
ROBERT74	NQ-DS	01/01/61	S20	2	0.14	0	93.76	6.1	6.24				
ROBERT74	NQ-I12	01/01/61	I01	1	0.11	2.4	94.79	2.7	2.81				
ROBERT74	NQ-I12	01/01/61	I02	2	1.19	0.54	94.22	4.05	5.24				
ROBERT74	NQ-M01	01/01/61	M01		1.96	0.02	38.75	59.27	61.23				
ROBERT74	NQ-N01	09/11/52	N01		10.2	0	72.39	17.37	27.62				
ROBERT74	NQ-N02	05/02/60	N02		6.33	1.23	84.93	7.51	13.84				
ROBERT74	NQ-N03	09/11/52	N03		0	0	99.99	0	0				
ROBERT74	NQ-N04	09/11/52	N04		0	0.88	98.13	0.99	0.99				
ROBERT74	NQ-N05	09/11/52	N05		2.99	0	76.27	20.74	23.73				
ROBERT74	NQ-R01	05/02/60	R01		0.81	0.09	81.44	17.66	18.47				
ROBERT74	NQ-R02	05/02/60	R02		0.01	0	99.04	0.95	0.96				
ROBERT74	NQ-R03	05/02/60	R03		0.04	0.06	99.24	0.66	0.7				
ROBERT74	NQ-R04	05/02/60	R04		2.22	0	83.23	14.55	16.77				
ROBERT74	NQ-R05	05/02/60	R05		2.71	0	82.59	14.7	17.41				
ROBERT74	NQ-R06	05/02/60	R06		0.32	0.37	98.78	0.53	0.85				
ROBERT74	NQ-R07	05/02/60	R07		0.76	0.91	99.09	0	0.76				
ROBERT74	NQ-R08	05/02/60	R08		0.73	0.28	98.31	0.68	1.41				
ROBERT74	NQ-R09	05/02/60	R09		2.45	38.77	51.76	7.02	9.47				
ROBERT74	NQ-R10	05/02/60	R10		6.02	0	60.27	33.71	39.73				
ROBERT74	NQ-R11	12/14/60	R11		0	0.07	98.71	1.22	1.22				
ROBERT74	NQ-R12	12/14/60	R12		0	0	98.78	1.22	1.22				
ROBERT74	NQ-R13	12/14/60	R13		0.02	0.19	99.17	0.62	0.64				

06/13/89

TABLE C-11. (Continued) CONVENTIONALS DATA FOR PUGET SOUND REFERENCE AREA SEDIMENT SAMPLES (mg/kg unless otherwise noted, dry weight).

Survey	Station	Date	Sample	FieldRep	PERCENT CLAY	PERCENT ROCKS	PERCENT SAND	PERCENT SILT	PERCENT FINES (CLAY + SILT)	SULFIDES	TOTAL ORGANIC CARBON (Percent)	TOTAL VOLATILE SOLIDS (Percent)	TOTAL SOLIDS*
ROBERT74	NQ-R14	12/14/60	R14		0.41	0	99.26	0.33	0.74				
ROBERT74	NQ-R15	12/14/60	R15		3.6	0.17	85.54	10.69	14.29				
ROBERT74	NQ-R16	12/14/60	R16		3.01	0.11	83.26	13.62	16.63				
ROBERT74	NQ-S01	01/01/61	S01		0.37	0.08	68.12	31.43	31.8				
ROBERT74	NQ-S02	01/01/61	S02		0	0.47	88.47	11.06	11.06				
ROBERT74	NQ-S03	01/01/61	S03		0.23	0.21	83.96	15.6	15.83				
ROBERT74	NQ-S04	01/01/61	S04		0.11	0	65.29	34.6	34.71				
ROBERT74	NQ-S06	01/01/61	S06		0	0	68.54	31.46	31.46				
ROBERT74	NQ-S07	01/01/61	S07		0.07	0	67.75	32.19	32.26				
ROBERT74	NQ-S08	01/01/61	S08		2.52	0	66.7	30.78	33.3				
ROBERT74	NQ-S09	01/01/61	S09		0.84	0.03	77.19	21.94	22.78				
ROBERT74	NQ-S10	01/01/61	S10		2.13	0	33.22	64.65	66.78				
ROBERT74	NQ-S11	01/01/61	S11		3.39	0	8.28	88.33	91.72				
ROBERT74	NQ-S12	01/01/61	S12		0.42	0.03	73.54	26.01	26.43				
ROBERT74	NQ-S13	01/01/61	S13		0.01	0	98.85	1.14	1.15				
ROBERT74	NQ-S14	01/01/61	S14		0.16	0	89.89	9.95	10.11				
ROBERT74	NQ-S15	01/01/61	S15		0.94	0	69.72	29.34	30.28				
ROBERT74	NQ-S16	01/01/61	S16		0.47	0.02	33.59	65.92	66.39				
ROBERT74	NQ-S17	01/01/61	S17		0.03	0.7	98.36	0.91	0.94				
ROBERT74	NQ-S18	01/01/61	S18		1.67	0	77.43	20.9	22.57				
ROBERT74	NQ-S2156	01/01/61	S21	1	1.53	0	45.66	52.81	54.34				
ROBERT74	NQ-S2156	01/01/61	S25	2	1.6	0	37.1	61.3	62.9				
ROBERT74	NQ-S2156	01/01/61	S26	3	1.14	0	39.66	59.2	60.34				
ROBERT74	NQ-S22	01/01/61	S22		0	0	90.52	9.48	9.48				
ROBERT74	NQ-S23	01/01/61	S23		0	0	95.69	4.31	4.31				
ROBERT74	NQ-S24	01/01/61	S24		1.08	0	42.64	56.28	57.36				
ROBERT74	PM1-141	11/04/66	001		3.74	0.2	89.52	6.54	10.28				
ROBERT74	PM1-255	04/08/60	001		1.17	0.72	74.99	23.12	24.29				
ROBERT74	PM1-303	03/16/62	001		1.26	0	93.09	5.66	6.92				
ROBERT74	PM1-321	04/13/63	001		23.6	0	36.05	40.3	63.95				
ROBERT74	PM2-255	04/08/60	002		10.3	0.92	54.28	34.44	44.8				
ROBERT74	PM2-303	03/16/62	002		2.41	0.25	88.65	8.69	11.1				
ROBERT74	PM3-283	04/14/61	003		6.42	21.16	48.75	23.67	30.09				

06/13/89

TABLE C-11. (Continued) CONVENTIONALS DATA FOR PUGET SOUND REFERENCE AREA SEDIMENT SAMPLES (mg/kg unless otherwise noted, dry weight).

Survey	Station	Date	Sample	FieldRep	PERCENT CLAY	PERCENT ROCKS	PERCENT SAND	PERCENT SILT	PERCENT FINES (CLAY + SILT)	SULFIDES	TOTAL ORGANIC CARBON (Percent)	TOTAL VOLATILE SOLIDS (Percent)	TOTAL SOLIDS*
ROBERT74	PM3-303	03/16/62	003		9.86	9.23	29.61	51.3	61.16				
ROBERT74	PM4-303	03/16/62	004		2.95	0.23	84.55	12.27	15.22				
ROBERT74	PM6-283	04/14/61	006		4.31	0	80.21	15.49	19.8				
ROBERT74	PM7-283	04/14/61	007		9.04	0.35	55.74	34.87	43.91				
ROBERT74	PM7-352	01/11/65	007		25.0	0	12.48	62.46	87.53				
ROBERT74	PM8-283	04/14/61	008		23.5	0	9.97	66.48	90.03				
ROBERT74	PM-00C	07/01/67	WAA	1	2.52	1.77	87.93	7.78	10.3				
ROBERT74	PM-00C	07/01/67	WBA	2	5.79	2.07	84.18	7.96	13.75				
ROBERT74	PM-00C	07/01/67	WCA	3	4.23	15.05	71.67	9.05	13.28				
ROBERT74	PM-012	04/14/61	012		1.17	3.49	89.91	5.43	6.6				
ROBERT74	PM-039	02/24/69	039		7.25	2.83	75.8	14.12	21.37				
ROBERT74	PM-040	02/24/69	OA403		4.3	0	71.57	24.14	28.44				
ROBERT74	PM-0AO	03/21/67	OA008	1	13.4	0.05	78.29	8.24	21.66				
ROBERT74	PM-0AO	02/27/63	HHWAA	1	3.3	0	86.42	10.18	13.48				
ROBERT74	PM-0AO	06/27/67	HH019	1	6.51	13.39	66.67	13.43	19.94				
ROBERT74	PM-0AO	10/21/65	A01	1	4.15	0	84.57	11.27	15.42				
ROBERT74	PM-0AO	09/15/66	HH066	1	5.61	4.39	81.59	8.4	14.01				
ROBERT74	PM-0AO	06/27/67	HH025	2	5.54	15.95	67.05	11.45	16.99				
ROBERT74	PM-0AO	10/21/65	A02	2	3.9	0	86.14	9.96	13.86				
ROBERT74	PM-0AO	09/15/66	HH073	2	15.8	4.78	62.59	16.75	32.64				
ROBERT74	PM-0AO	02/27/63	HHWBA	2	4.5	0	83.05	12.4	16.9				
ROBERT74	PM-0AO	03/21/67	OA068	2	12.1	3.65	77.34	6.87	19.01				
ROBERT74	PM-0AO	02/27/63	HHWCA	3	5.3	0	83.22	11.42	16.72				
ROBERT74	PM-0AO	06/27/67	HH032	3	5.75	11.66	71.67	10.92	16.67				
ROBERT74	PM-0AO	09/15/66	HH088	3	5.42	8	78.98	7.6	13.02				
ROBERT74	PM-0AO	03/21/67	OA094	3	17.4	2.82	68.7	11.01	28.48				
ROBERT74	PM-0AO	10/21/65	A03	3	1.99	0	95.12	2.88	4.87				
ROBERT74	PM-0AO	02/27/63	HHWDA	4	5.6	0	83.06	11.29	16.89				
ROBERT74	PM-0AO	10/21/65	A04	4	4.13	0.08	85.76	10.03	14.16				
ROBERT74	PM-0AO	10/21/65	A05	5	3.24	0.34	87.67	8.75	11.99				
ROBERT74	PM-0K0	10/21/65	K01	1	1.86	0.04	83.7	14.39	16.25				
ROBERT74	PM-0K0	01/09/63	WAA004	1	3.6	0.1	75.01	21.25	24.85				
ROBERT74	PM-0K0	07/31/67	WAA00D	1	2.62	0.07	73.99	23.32	25.94				

06/13/89

TABLE C-11. (Continued) CONVENTIONALS DATA FOR PUGET SOUND REFERENCE AREA SEDIMENT SAMPLES (mg/kg unless otherwise noted, dry weight).

Survey	Station	Date	Sample	FieldRep	PERCENT CLAY	PERCENT ROCKS	PERCENT SAND	PERCENT SILT	PERCENT FINES (CLAY + SILT)	SULFIDES	TOTAL ORGANIC CARBON (Percent)	TOTAL VOLATILE SOLIDS (Percent)	TOTAL SOLIDS*
ROBERT74	PM-0K0	10/21/65	K02	2	1.21	0.25	81.38	17.15	18.36				
ROBERT74	PM-0K0	01/09/63	WBA004	2	3.5	1.95	72.78	21.69	25.19				
ROBERT74	PM-0K0	07/31/67	WBA000	2	1.55	0	62.62	35.83	37.38				
ROBERT74	PM-0K0	01/09/63	WCA004	3	2.1	0.01	82	15.9	18				
ROBERT74	PM-0K0	10/21/65	K03	3	1.29	0	84.25	14.46	15.75				
ROBERT74	PM-0K0	01/09/63	WDA004	4	1.9	0.45	79.8	17.82	19.72				
ROBERT74	PM-0K0	10/21/65	K04	4	0.31	0	93.81	5.88	6.19				
ROBERT74	PM-0K0	10/21/65	K06	5	2.81	0	79.22	17.97	20.78				
ROBERT74	PM-0K0	01/09/63	WEA004	5	3.4	0	78.27	18.34	21.74				
ROBERT74	PM-0K0	01/09/63	WFA004	6	3	0.02	79.33	17.64	20.64				
ROBERT74	PM-120	04/08/67	120		37.5	0.1	6.41	55.91	93.49				
ROBERT74	PM-41	02/24/69	041		9.21	0.03	61.56	29.2	38.41				
ROBERT74	PM-A0	09/17/66	HH004	1	11.5	0	84.82	3.64	15.18				
ROBERT74	PM-A0	06/17/67	HH043	1	2.43	0	93.17	4.39	6.82				
ROBERT74	PM-A0	03/21/67	OA056	1	14.2	0.67	76.21	8.93	23.13				
ROBERT74	PM-A0	02/24/69	OA381	1	4.46	0.13	87.2	8.21	12.67				
ROBERT74	PM-A0	09/17/66	HH011	2	9.45	6.06	79.21	5.28	14.73				
ROBERT74	PM-A0	06/17/67	HH052	2	2.44	0	91.93	5.64	8.08				
ROBERT74	PM-A0	03/21/67	OA057	2	1.95	0	91.06	6.99	8.94				
ROBERT74	PM-A0	06/17/67	HH062	3	1.34	0	94.83	3.83	5.17				
ROBERT74	PM-A0	03/21/67	OA064	3	11.3	0	83.63	5.07	16.37				
ROBERT74	PM-A0	09/17/66	HH099	3	11.8	0	83.8	4.32	16.2				
ROBERT74	PM-A20	03/21/67	OA015	1	13.3	0.1	80.9	5.64	19.01				
ROBERT74	PM-A20	06/16/67	HH001	1	5.01	0	84.64	10.35	15.36				
ROBERT74	PM-A20	09/15/66	HH037	1	10.9	0	78.53	10.51	21.46				
ROBERT74	PM-A20	06/16/67	HH030	2	4.64	0.09	84.83	10.43	15.07				
ROBERT74	PM-A20	03/21/67	OA061	2	14.8	0.11	77.36	7.7	22.53				
ROBERT74	PM-A20	09/15/66	HH072	2	5.84	0.31	83.6	10.26	16.1				
ROBERT74	PM-A20	03/21/67	OA073	3	12.8	0.22	79.61	7.34	20.18				
ROBERT74	PM-A20	09/15/66	HH091	3	8.72	0.21	82.73	8.34	17.06				
ROBERT74	PM-A20	06/16/67	HH097	3	3.35	0	88.81	7.84	11.19				
ROBERT74	PM-A30	01/01/60	BW004	1	19.4	0.28	73.59	6.66	26.13				
ROBERT74	PM-A30	03/21/67	OA057	1	5.59	0	85.92	8.49	14.08				

06/13/89

TABLE C-11. (Continued) CONVENTIONALS DATA FOR PUGET SOUND REFERENCE AREA SEDIMENT SAMPLES (mg/kg unless otherwise noted, dry weight).

Survey	Station	Date	Sample	FieldRep	PERCENT CLAY	PERCENT ROCKS	PERCENT SAND	PERCENT SILT	PERCENT FINES (CLAY + SILT)	SULFIDES	TOTAL ORGANIC CARBON (Percent)	TOTAL VOLATILE SOLIDS (Percent)	TOTAL SOLIDS*
ROBERT74	PM-A30	06/16/67	HH003	1	4.09	0.35	83.13	12.43	16.52				
ROBERT74	PM-A30	01/01/60	BW028	2	4.2	0	87.76	8.04	12.24				
ROBERT74	PM-A30	06/16/67	HH006	2	2.98	0.17	90.67	6.19	9.17				
ROBERT74	PM-A30	03/21/67	OA061	2	4.19	0	87.77	8.05	12.24				
ROBERT74	PM-A30	06/16/67	HH029	3	4.24	0.08	82.87	12.81	17.05				
ROBERT74	PM-A30	01/01/60	BW087	3	4.02	0	86.72	9.26	13.28				
ROBERT74	PM-A60	04/08/67	A60		13.1	0	70.66	16.21	29.34				
ROBERT74	PM-A90	04/08/67	A90		35.2	0.12	14.75	49.83	85.09				
ROBERT74	PM-AA	10/21/65	AA1	1	1.29	0	89.35	9.37	10.66				
ROBERT74	PM-AA	10/21/65	AA2	2	0.92	0	92.05	7.03	7.95				
ROBERT74	PM-AA	10/21/65	AA3	3	0.01	0	98.04	1.95	1.96				
ROBERT74	PM-AA	10/21/65	AA4	4	1	0	91.44	7.56	8.56				
ROBERT74	PM-AA	10/21/65	AA6	5	1.29	0	90.77	7.94	9.23				
ROBERT74	PM-AB	10/21/65	AB1	1	2.61	0.11	90.86	6.42	9.03				
ROBERT74	PM-AB	10/21/65	AB2	2	3.73	0.05	87.94	8.29	12.02				
ROBERT74	PM-AB	10/21/65	AB3	3	3.01	0	91.34	5.65	8.66				
ROBERT74	PM-AB	10/21/65	AB4	4	6.83	0	86.39	6.78	13.61				
ROBERT74	PM-AB	10/21/65	AB6	5	3.51	0.12	89.95	6.41	9.92				
ROBERT74	PM-B10	06/26/67	HH054	1	0.54	0	98.76	0.69	1.23				
ROBERT74	PM-B10	06/26/67	HH074	2	2.55	0.14	96.82	0.48	3.03				
ROBERT74	PM-B10	06/26/67	HH077	3	0.69	0	98.42	0.9	1.59				
ROBERT74	PM-B20	06/27/67	HH014	1	2.92	0.35	90.69	6.04	8.96				
ROBERT74	PM-B20	06/27/67	HH034	2	2.6	0.33	90.48	6.58	9.18				
ROBERT74	PM-B20	06/27/67	HH047	3	3.51	0.54	89.37	6.58	10.09				
ROBERT74	PM-B30	06/27/67	014	1	4.46	0.12	85.19	10.23	14.69				
ROBERT74	PM-B30	06/27/67	019	2	5.78	0.75	82.58	10.89	16.67				
ROBERT74	PM-B30	06/27/67	021	3	4.24	0.85	84.92	9.99	14.23				
ROBERT74	PM-BCD	10/21/65	B01	1	4.13	0.02	82.26	13.59	17.72				
ROBERT74	PM-BCD	10/21/65	C06	10	0.81	0	95.66	3.53	4.34				
ROBERT74	PM-BCD	10/21/65	D02	11	5.45	0	63.1	31.45	36.9				
ROBERT74	PM-BCD	10/21/65	D03	12	6.57	0	59.24	34.19	40.76				
ROBERT74	PM-BCD	10/21/65	D04	13	5.99	0.03	63.37	30.61	36.6				
ROBERT74	PM-BCD	10/21/65	D05	14	6.25	0.12	61.43	32.19	38.44				

06/13/89

TABLE C-11. (Continued) CONVENTIONALS DATA FOR PUGET SOUND REFERENCE AREA SEDIMENT SAMPLES (mg/kg unless otherwise noted, dry weight).

Survey	Station	Date	Sample	FieldRep	PERCENT CLAY	PERCENT ROCKS	PERCENT SAND	PERCENT SILT	PERCENT FINES (CLAY + SILT)	SULFIDES	TOTAL ORGANIC CARBON (Percent)	TOTAL VOLATILE SOLIDS (Percent)	TOTAL SOLIDS*
ROBERT74	PM-BCD	10/21/65	D06	15	1.66	0	81.73	16.61	18.27				
ROBERT74	PM-BCD	10/21/65	B02	2	1.79	0.07	90.21	7.93	9.72				
ROBERT74	PM-BCD	10/21/65	B04	3	4.4	0.02	83.09	12.49	16.89				
ROBERT74	PM-BCD	10/21/65	B05	4	1.55	0	92.85	5.59	7.14				
ROBERT74	PM-BCD	10/21/65	B06	5	3.62	0	84.69	11.69	15.31				
ROBERT74	PM-BCD	10/21/65	C02	6	4.19	0.12	82.53	13.17	17.36				
ROBERT74	PM-BCD	10/21/65	C03	7	4.3	0.26	79.57	15.87	20.17				
ROBERT74	PM-BCD	10/21/65	C04	8	3.57	0.31	84.56	11.56	15.13				
ROBERT74	PM-BCD	10/21/65	C05	9	3.61	0	85.56	10.83	14.44				
ROBERT74	PM-C10	06/17/67	HH007	1	2.09	0	95.76	2.15	4.24				
ROBERT74	PM-C10	06/17/67	HH019	2	2.06	0.14	95.6	2.2	4.26				
ROBERT74	PM-C10	06/17/67	HH091	3	2.41	2.14	92.44	3.01	5.42				
ROBERT74	PM-C20	06/27/67	HH018	1	2.61	0.07	94.45	2.87	5.48				
ROBERT74	PM-C20	06/27/67	HH028	2	4.25	0.16	92.25	3.34	7.59				
ROBERT74	PM-C20	06/27/67	HH059	3	2.45	0.18	94.48	2.89	5.34				
ROBERT74	PM-C30	06/27/67	HH023	1	1.23	0.07	96.13	2.57	3.8				
ROBERT74	PM-C30	06/27/67	HH041	2	2.72	0.14	94.24	2.9	5.62				
ROBERT74	PM-C30	06/27/67	HH079	3	3.99	0.4	92.19	3.42	7.41				
ROBERT74	PM-EOF	10/21/65	E01	1	1.57	0	68.62	29.81	31.38				
ROBERT74	PM-EOF	02/17/70	001	1	8.98	0	53	38.02	47				
ROBERT74	PM-EOF	10/21/65	F06	10	6.8	0.01	50.48	42.72	49.52				
ROBERT74	PM-EOF	10/21/65	E02	2	6.22	0.08	51.27	42.43	48.65				
ROBERT74	PM-EOF	10/21/65	E03	3	6.48	0.06	52.78	40.68	47.16				
ROBERT74	PM-EOF	10/21/65	E04	4	6.38	0	48.48	45.14	51.52				
ROBERT74	PM-EOF	10/21/65	E05	5	6.64	0.01	49.16	44.19	50.83				
ROBERT74	PM-EOF	10/21/65	F01	6	5.17	0.03	54.43	40.38	45.55				
ROBERT74	PM-EOF	10/21/65	F02	7	5.55	0.4	50.98	43.08	48.63				
ROBERT74	PM-EOF	10/21/65	F03	8	2.12	0	67.73	30.15	32.27				
ROBERT74	PM-EOF	10/21/65	F04	9	6.74	0.1	51.97	41.19	47.93				
ROBERT74	PM-G	10/21/65	G02	1	0.05	0	92.11	7.84	7.89				
ROBERT74	PM-G	10/21/65	G03	2	2.96	0.02	81.22	15.8	18.76				
ROBERT74	PM-G	10/21/65	G04	3	2.41	0.02	82.89	14.68	17.09				
ROBERT74	PM-G	10/21/65	G05	4	2.5	0.11	79.63	17.76	20.26				

06/13/89

TABLE C-11. CONVENTIONALS DATA FOR PUGET SOUND REFERENCE AREA SEDIMENT SAMPLES (mg/kg unless otherwise noted, dry weight).

Survey	Station	Date	Sample	FieldRep	PERCENT CLAY	PERCENT ROCKS	PERCENT SAND	PERCENT SILT	PERCENT FINES (CLAY + SILT)	SULFIDES	TOTAL ORGANIC CARBON (Percent)	TOTAL VOLATILE SOLIDS (Percent)	TOTAL SOLIDS*
ROBERT74	PM-G	10/21/65	G06	5	2.7	0	81	16.3	19				
ROBERT74	PM-H	10/21/65	H01	1	3.5	0.04	75.3	21.17	24.67				
ROBERT74	PM-H	10/21/65	H03	2	3.53	0	76.48	19.99	23.52				
ROBERT74	PM-H	10/21/65	H04	3	3.28	0.01	76.86	19.86	23.14				
ROBERT74	PM-H	10/21/65	H05	4	4.3	0	7.03	24.67	28.97				
ROBERT74	PM-H	10/21/65	H06	5	0.88	0	89.69	9.43	10.31				
ROBERT74	PM-J	10/21/65	J01	1	3.26	0.02	77.55	19.18	22.44				
ROBERT74	PM-J	10/21/65	J03	2	3.53	0.04	76.68	19.75	23.28				
ROBERT74	PM-J	10/21/65	J04	3	3.22	0.03	77.15	19.59	22.81				
ROBERT74	PM-J	10/21/65	J05	4	3.45	0.04	75.36	21.15	24.6				
ROBERT74	PM-J	10/21/65	J06	5	2.36	0.06	77.42	20.17	22.53				
ROBERT74	PO-042	02/24/69	042		34.7	0	11.1	54.17	88.9				
ROBERT74	PO-043	02/24/69	043		36.8	0	13.51	49.65	86.49				
ROBERT74	PO-044	02/24/69	044		2.29	44.97	49.61	3.13	5.42				
ROBERT74	PP-001	06/19/64	OA012		0.55	7.17	87.9	4.39	4.94				
ROBERT74	PP-001	10/29/64	OA013		0.64	3.34	95.8	0.21	0.85				
ROBERT74	PP-001	03/03/66	OA080		1.64	0.91	97.03	0.41	2.05				
ROBERT74	PP-002	03/03/66	PIK		3.86	0	92.27	3.86	7.72				
ROBERT74	PP-008	05/02/63	WAA	1	1.9	4.84	87.19	5.97	7.87				
ROBERT74	PP-008	05/02/63	WBA	2	4.6	10.95	73.03	11.4	16				
ROBERT74	PP-008	05/02/63	WCA	3	4.6	12	73.19	10.21	14.81				
ROBERT74	PSD-019	03/01/73	019		69.8	0	1.24	28.96	98.77				
ROBERT74	PSD-033	02/24/69	332	1	41.4	0	7.57	50.97	92.43				
ROBERT74	PSD-033	02/24/69	333	2	38.3	0	10.08	51.57	89.92				
ROBERT74	PSD-E01	07/17/52	E01		41.3	0	5.28	53.38	94.72				
ROBERT74	PSD-E02	07/17/52	E02		8.89	10.98	70.39	9.74	18.63				
ROBERT74	PSD-E03	07/17/52	E03		14.5	2.32	61.92	21.17	35.76				
ROBERT74	PSD-E04	07/17/52	E04		5.41	0	76.83	17.76	23.17				
ROBERT74	PS-002	03/01/73	002		68.9	0	1.33	29.77	98.67				
ROBERT74	PS-E05	07/17/52	E05		30.8	0	8.94	60.17	91.06				
ROBERT74	QM-026	02/24/69	026		24.7	0.41	12.94	61.87	86.65				
ROBERT74	SA-003	03/01/73	003		71.5	0	0.68	27.75	99.32				
ROBERT74	SA-S07	06/29/52	S07		46.5	0	10.74	42.69	89.25				

06/13/89

TABLE C-11. (Continued) CONVENTIONALS DATA FOR PUGET SOUND REFERENCE AREA SEDIMENT SAMPLES (mg/kg unless otherwise noted, dry weight).

Survey	Station	Date	Sample	FieldRep	PERCENT CLAY	PERCENT ROCKS	PERCENT SAND	PERCENT SILT	PERCENT FINES (CLAY + SILT)	SULFIDES	TOTAL ORGANIC CARBON (Percent)	TOTAL VOLATILE SOLIDS (Percent)	TOTAL SOLIDS*
ROBERT74	SA-S08	06/29/52	S08		7.23	0.47	88.03	4.27	11.5				
ROBERT74	SA-S09	06/29/52	S09		61.7	0	1.31	36.92	98.69				
ROBERT74	SA-S10	06/29/52	S10		60.6	0	1.61	37.7	98.39				
ROBERT74	SK-005	03/01/73	005		2.53	0	90.69	6.77	9.3				
ROBERT74	SK-006	03/01/73	006		1.28	0	97.6	1.12	2.4				
ROBERT74	SM-122	07/17/60	122		2.67	0.25	77.78	19.3	21.97				
ROBERT74	SM-123	07/17/60	123		2.05	0.04	91.87	6.04	8.09				
ROBERT74	SM-124	07/17/60	124		2.23	0.06	90.5	7.21	9.44				
ROBERT74	SM-125	07/17/60	125		1.7	0.02	91.16	7.12	8.82				
ROBERT74	SM-127	07/17/60	127		4.94	0.16	59.03	35.87	40.81				
ROBERT74	SM-128	07/17/60	128		2.75	0.21	84.15	12.89	15.64				
ROBERT74	SM-129	07/17/60	129		3.56	0.15	81.69	14.6	18.16				
ROBERT74	SM-130	07/17/60	130		2.89	1.57	76.49	19.05	21.94				
ROBERT74	SM-131	07/17/60	131		1.39	0.07	92.54	6	7.39				
ROBERT74	SM-G3	11/02/59	G3		20.1	0.33	7.62	71.95	92.05				
ROBERT74	SM-G4	11/02/59	G4		14.8	0	20.05	65.13	79.95				
ROBERT74	SM-G5	05/21/60	G5		13.0	0.02	17.43	69.52	82.55				
ROBERT74	SM-H02	05/21/60	H02		25.2	9.33	1.42	64.03	89.25				
ROBERT74	SM-H03	11/02/59	H03		23.6	2.94	1.75	71.7	95.31				
ROBERT74	SM-H1	11/02/59	H1		22.9	4.19	6.08	66.76	89.73				
ROBERT74	SM-V01	04/19/60	V01		24.9	2.12	8.51	64.42	89.37				
ROBERT74	SM-V02	04/19/60	V02		24.5	7.15	1.82	66.44	91.03				
ROBERT74	SM-V03	04/19/60	V03		21.3	1.13	2.33	75.22	96.54				
ROBERT74	SM-V11	04/19/60	V11		18.0	0.18	7.58	74.22	92.24				
ROBERT74	SM-V12	04/19/60	V12		26.1	6.58	1.56	65.72	91.86				
ROBERT74	SM-V13	04/19/60	V13		25.6	2.85	1.37	70.16	95.78				
ROBERT74	SM-V14	04/19/60	V14		25.6	1.07	6.5	66.74	92.43				
ROBERT74	SM-V15	04/19/60	V15		23.7	0.99	2.12	73.1	96.89				
ROBERT74	TN-017	02/24/69	017		1.48	0	96.43	2.09	3.57				
ROBERT74	TN-N06	09/11/52	N06		8.09	28.94	51.2	11.77	19.86				
ROBERT74	WO-025	02/24/69	025		2.19	0	90.92	6.88	9.07				
SEAHBASE	QM-1	07/01/82	85		40	0	14	47	87				36
SEAHBASE	QM-2	07/01/82	86		27	0.15	14	60	87				45

06/13/89

TABLE C-11. (Continued) CONVENTIONALS DATA FOR PUGET SOUND REFERENCE AREA SEDIMENT SAMPLES (mg/kg unless otherwise noted, dry weight).

Survey	Station	Date	Sample	FieldRep	PERCENT CLAY	PERCENT ROCKS	PERCENT SAND	PERCENT SILT	PERCENT FINES (CLAY + SILT)	SULFIDES	TOTAL ORGANIC CARBON (Percent)	TOTAL VOLATILE SOLIDS (Percent)	TOTAL SOLIDS*
SEAHBASE	QM-D	02/01/84	5017		5.7	0.23	65	29	34.7				77
SEAHBASE	WB-18	02/01/84	5018						2.41				

* Dry weight as % of wet weight.

* PTGARQC survey composited sediment samples within regions; these data were included only in AET comparisons.

TABLE C-12. AMPHIPOD* MORTALITY BIOASSAY RESULTS FOR POTENTIAL PUGET SOUND REFERENCE STATIONS

* Amphipod used was Rhepoxynius abronius

Bay	Survey	Station	Date	Labrep	Percent Mortalit
BH	EHCHEM	BH-01		1	0
BH	EHCHEM	BH-01		2	0
BH	EHCHEM	BH-01		3	5
BH	EHCHEM	BH-01		4	5
BH	EHCHEM	BH-01		5	10
BH	EHCHEM	BH-01		Mean	4
BH	EHCHEM	BH-02		1	0
BH	EHCHEM	BH-02		2	5
BH	EHCHEM	BH-02		3	15
BH	EHCHEM	BH-02		4	15
BH	EHCHEM	BH-02		5	25
BH	EHCHEM	BH-02		Mean	12
CR	CBMSQS	CR-11		1	80
CR	CBMSQS	CR-11		2	15
CR	CBMSQS	CR-11		3	5
CR	CBMSQS	CR-11		4	15
CR	CBMSQS	CR-11		5	10
CR	CBMSQS	CR-11		Mean	25
CR	CBMSQS	CR-12		1	10
CR	CBMSQS	CR-12		2	5
CR	CBMSQS	CR-12		3	15
CR	CBMSQS	CR-12		4	10
CR	CBMSQS	CR-12		5	15
CS	DEWITO02	CS-08	03/01/86	1	15
CS	DEWITO02	CS-09	03/01/86	1	10
CS	DEWITO02	CS-10	03/01/86	1	20
CS	DEWITO02	CS-11	03/01/86	1	0
CS	DEWITO02	CS-12	03/01/86	1	15
CS	DEWITO02	CS-13	03/01/86	1	15
CS	DEWITO02	CS-14	03/01/86	1	0
CS	DEWITO02	CS-15	03/01/86	1	15
CS	DEWITO02	CS-16	03/01/86	1	0
CS	DEWITO02	CS-17	03/01/86	1	5
CS	DEWITO02	CS-18	03/01/86	1	0
CS	DEWITO02	CS-19	03/01/86	1	0
CS	DEWITO02	CS-2	03/01/86	1	5
CS	DEWITO02	CS-20	03/01/86	1	0
CS	DEWITO02	CS-21	03/01/86	1	5
CS	DEWITO02	CS-22	03/01/86	1	5
CS	DEWITO02	CS-23	03/01/86	1	5
CS	DEWITO02	CS-24	03/01/86	1	10
CS	DEWITO02	CS-25	03/01/86	1	0
CS	DEWITO02	CS-26	03/01/86	1	10
CS	DEWITO02	CS-27	03/01/86	1	15
CS	DEWITO02	CS-28	03/01/86	1	5
CS	DEWITO02	CS-29	03/01/86	1	5
CS	DEWITO02	CS-30	03/01/86	1	0
CS	DEWITO02	CS-3A	03/01/86	1	5
CS	DEWITO02	CS-4	03/01/86	1	0
CS	DEWITO02	CS-6	03/01/86	1	20
CS	DEWITO02	CS-7	03/01/86	1	20
CS	EIGHTBAY	CS-01	05/29/84	1	40
CS	EIGHTBAY	CS-01	05/29/84	2	30
CS	EIGHTBAY	CS-01	05/29/84	3	15
CS	EIGHTBAY	CS16	09/15/83	1	5
CS	EIGHTBAY	CS17	09/15/83	1	10
CS	EIGHTBAY	CS18	09/15/83	1	0
CS	EIGHTBAY	CS19	09/15/83	1	10
CS	EIGHTBAY	CS2	09/14/83	1	10
CS	EIGHTBAY	CS20	09/15/83	1	0
CS	EIGHTBAY	CS3	09/14/83	1	25
CS	EIGHTBAY	CS4	09/14/83	1	55
CS	EIGHTBAY	CS5	09/14/83	1	35
CS	EIGHTBAY	CS6	09/14/83	1	55
CS	EIGHTBAY	CS7	09/14/83	1	60
CS	EIGHTBAY	CS8	09/14/83	1	55

Bay	Survey	Station	Date	Labrep	Percent Mortality
CR	CBMSQS	CR-12		Mean	11
CR	CBMSQS	CR-13		1	10
CR	CBMSQS	CR-13		2	15
CR	CBMSQS	CR-13		3	5
CR	CBMSQS	CR-13		4	5
CR	CBMSQS	CR-13		5	0
CR	CBMSQS	CR-13		Mean	7
CR	CBMSQS	CR-14		1	5
CR	CBMSQS	CR-14		2	15
CR	CBMSQS	CR-14		3	15
CR	CBMSQS	CR-14		4	0
CR	CBMSQS	CR-14		5	15
CR	CBMSQS	CR-14		Mean	10
CR	NOADW86	CARRINL	06/01/86	Mean	12
CR	PSDDA1	CRR01	05/17/88	1	25
CR	PSDDA1	CRR01	05/17/88	2	25
CR	PSDDA1	CRR01	05/17/88	3	0
CR	PSDDA1	CRR01	05/17/88	4	10
CR	PSDDA1	CRR01	05/17/88	5	20
CR	PSDDA1	CRR01	05/17/88	Mean	16
CS	DEWITO02	CS-01	03/01/86	1	15
CS	DEWITO02	CS-03	03/01/86	1	5
CS	DEWITO02	CS-05	03/01/86	1	0
CS	EIGHTBAY	CS-01	05/29/84	4	35
CS	EIGHTBAY	CS-01	05/29/84	5	20
CS	EIGHTBAY	CS-01	05/29/84	Mean	28
CS	EIGHTBAY	CS-11	05/29/84	1	15
CS	EIGHTBAY	CS-11	05/29/84	2	20
CS	EIGHTBAY	CS-11	05/29/84	3	45
CS	EIGHTBAY	CS-11	05/29/84	4	35
CS	EIGHTBAY	CS-11	05/29/84	5	25
CS	EIGHTBAY	CS-11	05/29/84	Mean	28
CS	EIGHTBAY	CS-15	05/29/84	1	30
CS	EIGHTBAY	CS-15	05/29/84	2	30
CS	EIGHTBAY	CS-15	05/29/84	3	60
CS	EIGHTBAY	CS-15	05/29/84	4	55
CS	EIGHTBAY	CS-15	05/29/84	5	40
CS	EIGHTBAY	CS-15	05/29/84	Mean	43
CS	EIGHTBAY	CS-17	05/29/84	1	40
CS	EIGHTBAY	CS-17	05/29/84	2	25
CS	EIGHTBAY	CS-17	05/29/84	3	50
CS	EIGHTBAY	CS-17	05/29/84	4	45
CS	EIGHTBAY	CS-17	05/29/84	5	45
CS	EIGHTBAY	CS-17	05/29/84	Mean	41
CS	EIGHTBAY	CS1	09/14/83	1	70
CS	EIGHTBAY	CS1	09/14/83	2	50
CS	EIGHTBAY	CS1	09/14/83	3	30
CS	EIGHTBAY	CS1	09/14/83	Mean	50
CS	EIGHTBAY	CS10	09/14/83	1	35
CS	EIGHTBAY	CS11	09/15/83	1	60
CS	EIGHTBAY	CS12	09/15/83	1	35
CS	EIGHTBAY	CS13	09/15/83	1	10
CS	EIGHTBAY	CS14	09/15/83	1	15
CS	EIGHTBAY	CS15	09/15/83	1	30
DB	EIGHTBAY	DB-15	05/22/84	1	60
DB	EIGHTBAY	DB-15	05/22/84	2	35
DB	EIGHTBAY	DB-15	05/22/84	3	35
DB	EIGHTBAY	DB-15	05/22/84	4	30
DB	EIGHTBAY	DB-15	05/22/84	5	20
DB	EIGHTBAY	DB-15	05/22/84	Mean	36
DB	NOADW86	DABOB	06/01/86	Mean	12
DB	REFGRAIN	DB-02	03/25/86	1	60
DB	REFGRAIN	DB-02	03/25/86	2	40
DB	REFGRAIN	DB-02	03/25/86	3	35
DB	REFGRAIN	DB-02	03/25/86	4	10
DB	REFGRAIN	DB-02	03/25/86	5	30

TABLE C-12. AMPHIPOD* MORTALITY BIOASSAY RESULTS FOR POTENTIAL PUGET SOUND REFERENCE STATIONS

* Amphipod used was Rhepoxynius abronius

Bay	Survey	Station	Date	Labrep	Percent Mortalit
CS	EIGHTBAY	CS9	09/14/83	1	45
DB	EIGHTBAY	DB-01	05/22/84	1	5
DB	EIGHTBAY	DB-01	05/22/84	2	15
DB	EIGHTBAY	DB-01	05/22/84	3	15
DB	EIGHTBAY	DB-01	05/22/84	4	5
DB	EIGHTBAY	DB-01	05/22/84	5	10
DB	EIGHTBAY	DB-01	05/22/84	Mean	10
DB	EIGHTBAY	DB-05	05/22/84	1	10
DB	EIGHTBAY	DB-05	05/22/84	2	10
DB	EIGHTBAY	DB-05	05/22/84	3	10
DB	EIGHTBAY	DB-05	05/22/84	4	5
DB	EIGHTBAY	DB-05	05/22/84	5	0
DB	EIGHTBAY	DB-05	05/22/84	Mean	7
DB	EIGHTBAY	DB-07	05/22/84	1	20
DB	EIGHTBAY	DB-07	05/22/84	2	30
DB	EIGHTBAY	DB-07	05/22/84	3	25
DB	EIGHTBAY	DB-07	05/22/84	4	10
DB	EIGHTBAY	DB-07	05/22/84	5	45
DB	EIGHTBAY	DB-07	05/22/84	Mean	26
DB	REFGRAIN	DB-18	03/25/86	Mean	10
DI	NOADW86	DISCOVRY	06/01/86	Mean	6.2
OH	88PSRECN	OH-1	05/06/88	1	10
OH	88PSRECN	OH-1	05/06/88	2	15
OH	88PSRECN	OH-1	05/06/88	3	30
OH	88PSRECN	OH-1	05/06/88	4	10
OH	88PSRECN	OH-1	05/06/88	5	20
OH	88PSRECN	OH-1	05/06/88	Mean	17
OH	88PSRECN	OH-2	05/06/88	1	5
OH	88PSRECN	OH-2	05/06/88	2	30
OH	88PSRECN	OH-2	05/06/88	3	10
OH	88PSRECN	OH-2	05/06/88	4	20
OH	88PSRECN	OH-2	05/06/88	5	0
OH	88PSRECN	OH-2	05/06/88	Mean	13
OH	88PSRECN	OH-3	05/06/88	1	10
OH	88PSRECN	OH-3	05/06/88	2	10
OH	88PSRECN	OH-3	05/06/88	3	25
OH	88PSRECN	OH-3	05/06/88	4	10
OH	88PSRECN	OH-3	05/06/88	5	5
OH	88PSRECN	OH-3	05/06/88	Mean	12
OH	88PSRECN	OH-4	05/06/88	1	5
OH	88PSRECN	OH-4	05/06/88	2	25
OH	88PSRECN	OH-4	05/06/88	3	10
OH	88PSRECN	OH-4	05/06/88	4	5
OH	88PSRECN	OH-4	05/06/88	5	25
OH	88PSRECN	OH-4	05/06/88	Mean	14
OH	88PSRECN	OH-5	05/06/88	1	5
OH	88PSRECN	OH-5	05/06/88	2	5
OH	88PSRECN	OH-5	05/06/88	3	30
OH	88PSRECN	OH-5	05/06/88	4	20
OH	88PSRECN	OH-5	05/06/88	5	10
PS	EBCHEM	PS-01	10/12/85	3	15
PS	EBCHEM	PS-01	10/12/85	4	15
PS	EBCHEM	PS-01	10/12/85	5	10
PS	EBCHEM	PS-01	10/12/85	Mean	13
PS	EBCHEM	PS-02	10/12/85	1	35
PS	EBCHEM	PS-02	10/12/85	2	30
PS	EBCHEM	PS-02	10/12/85	3	20
PS	EBCHEM	PS-02	10/12/85	4	20
PS	EBCHEM	PS-02	10/12/85	5	15
PS	EBCHEM	PS-02	10/12/85	Mean	24
PS	EBCHEM	PS-03	10/12/85	1	20
PS	EBCHEM	PS-03	10/12/85	2	15
PS	EBCHEM	PS-03	10/12/85	3	10
PS	EBCHEM	PS-03	10/12/85	4	0
PS	EBCHEM	PS-03	10/12/85	5	5
PS	EBCHEM	PS-03	10/12/85	Mean	10
DB	REFGRAIN	DB-02	03/25/86	Mean	35
DB	REFGRAIN	DB-06	03/25/86	1	25
DB	REFGRAIN	DB-14	03/25/86	1	60
DB	REFGRAIN	DB-14	03/25/86	2	0
DB	REFGRAIN	DB-14	03/25/86	3	5
DB	REFGRAIN	DB-14	03/25/86	4	5
DB	REFGRAIN	DB-14	03/25/86	5	10
DB	REFGRAIN	DB-14	03/25/86	Mean	16
DB	REFGRAIN	DB-15	03/25/86	1	20
DB	REFGRAIN	DB-15	03/25/86	2	35
DB	REFGRAIN	DB-15	03/25/86	3	10
DB	REFGRAIN	DB-15	03/25/86	4	25
DB	REFGRAIN	DB-15	03/25/86	5	20
DB	REFGRAIN	DB-15	03/25/86	Mean	22
DB	REFGRAIN	DB-18	03/25/86	1	15
DB	REFGRAIN	DB-18	03/25/86	2	25
DB	REFGRAIN	DB-18	03/25/86	3	0
DB	REFGRAIN	DB-18	03/25/86	4	5
DB	REFGRAIN	DB-18	03/25/86	5	5
OH	88PSRECN	OH-5	05/06/88	Mean	14
OH	88PSRECN	OH-6	05/06/88	1	5
OH	88PSRECN	OH-6	05/06/88	2	5
OH	88PSRECN	OH-6	05/06/88	3	5
OH	88PSRECN	OH-6	05/06/88	4	5
OH	88PSRECN	OH-6	05/06/88	5	0
OH	88PSRECN	OH-6	05/06/88	Mean	4
OH	OAKHRBR	OH-B	02/26/85	1	20
OH	OAKHRBR	OH-B	02/26/85	2	25
OH	OAKHRBR	OH-B	02/26/85	3	5
OH	OAKHRBR	OH-B	02/26/85	4	10
OH	OAKHRBR	OH-B	02/26/85	5	25
OH	OAKHRBR	OH-B	02/26/85	Mean	17
OH	OAKHRBR	OH-C	02/26/85	1	20
OH	OAKHRBR	OH-C	02/26/85	2	10
OH	OAKHRBR	OH-C	02/26/85	3	15
OH	OAKHRBR	OH-C	02/26/85	4	20
OH	OAKHRBR	OH-C	02/26/85	5	20
OH	OAKHRBR	OH-C	02/26/85	Mean	17
OH	OAKHRBR	OH-D1	02/26/85	1	10
OH	OAKHRBR	OH-D1	02/26/85	2	15
OH	OAKHRBR	OH-D1	02/26/85	3	35
OH	OAKHRBR	OH-D1	02/26/85	4	15
OH	OAKHRBR	OH-D1	02/26/85	5	20
OH	OAKHRBR	OH-D1	02/26/85	Mean	19
PD	REFGRAIN	PD-01	07/01/87	1	5
PD	REFGRAIN	PD-01	07/01/87	2	15
PD	REFGRAIN	PD-01	07/01/87	3	5
PD	REFGRAIN	PD-01	07/01/87	Mean	8.3
PS	EBCHEM	PS-01	10/12/85	1	5
PS	EBCHEM	PS-01	10/12/85	2	20
PS	EVCHEM	PS-03	10/13/86	4	15
PS	EVCHEM	PS-03	10/13/86	5	25
PS	EVCHEM	PS-03	10/13/86	Mean	24
PS	EVCHEM	PS-04	10/10/86	1	10
PS	EVCHEM	PS-04	10/10/86	2	35
PS	EVCHEM	PS-04	10/10/86	3	5
PS	EVCHEM	PS-04	10/10/86	4	15
PS	EVCHEM	PS-04	10/10/86	5	35
PS	EVCHEM	PS-04	10/10/86	Mean	20
PS	PSDDA1	PSR01	05/23/88	1	40
PS	PSDDA1	PSR01	05/23/88	2	40
PS	PSDDA1	PSR01	05/23/88	3	30
PS	PSDDA1	PSR01	05/23/88	4	45
PS	PSDDA1	PSR01	05/23/88	5	30
PS	PSDDA1	PSR01	05/23/88	Mean	37
PSD	PSDDA1	PGB02	05/23/88	1	35

TABLE C-12. AMPHIPOD* MORTALITY BIOASSAY RESULTS FOR POTENTIAL PUGET SOUND REFERENCE STATIONS

* Amphipod used was Rhepoxynius abronius

Bay	Survey	Station	Date	Labrep	Percent Mortalit
SQ	EIGHTBAY	SQ16	09/18/83	1	25
SQ	EIGHTBAY	SQ17	09/18/83	1	25
SQ	EIGHTBAY	SQ18	09/18/83	1	5
SQ	EIGHTBAY	SQ19	09/18/83	1	0
SQ	EIGHTBAY	SQ2	08/15/83	1	10
SQ	EIGHTBAY	SQ20	09/18/83	1	40
SQ	EIGHTBAY	SQ3	08/15/83	1	5
SQ	EIGHTBAY	SQ4	08/15/83	1	10
SQ	EIGHTBAY	SQ5	08/16/83	1	5
SQ	EIGHTBAY	SQ6	08/16/83	1	5

Bay	Survey	Station	Date	Labrep	Percent Mortality
SQ	OAKHRBR	SEQUIM	02/26/85	4	35
SQ	OAKHRBR	SEQUIM	02/26/85	5	45
SQ	OAKHRBR	SEQUIM	02/26/85	Mean	37
WB	OAKHRBR	WHIDBEY	02/26/85	1	0
WB	OAKHRBR	WHIDBEY	02/26/85	2	5
WB	OAKHRBR	WHIDBEY	02/26/85	3	20
WB	OAKHRBR	WHIDBEY	02/26/85	4	20
WB	OAKHRBR	WHIDBEY	02/26/85	5	5
WB	OAKHRBR	WHIDBEY	02/26/85	Mean	10

TABLE C-12. AMPHIPOD* MORTALITY BIOASSAY RESULTS FOR POTENTIAL PUGET SOUND REFERENCE STATIONS

* Amphipod used was Rhepoxynius abronius

Bay	Survey	Station	Date	Labrep	Percent Mortality
PS	EBCHEM	PS-04	10/12/85	1	30
PS	EBCHEM	PS-04	10/12/85	2	25
PS	EBCHEM	PS-04	10/12/85	3	20
PS	EBCHEM	PS-04	10/12/85	4	10
PS	EBCHEM	PS-04	10/12/85	5	0
PS	EBCHEM	PS-04	10/12/85	Mean	17
PS	EVCHEM	PS-02	10/13/86	1	40
PS	EVCHEM	PS-02	10/13/86	2	20
PS	EVCHEM	PS-02	10/13/86	3	35
PS	EVCHEM	PS-02	10/13/86	4	30
PS	EVCHEM	PS-02	10/13/86	5	20
PS	EVCHEM	PS-02	10/13/86	Mean	29
PS	EVCHEM	PS-03	10/13/86	1	25
PS	EVCHEM	PS-03	10/13/86	2	40
PS	EVCHEM	PS-03	10/13/86	3	15
SM	EIGHTBAY	SM-01	04/24/84	Mean	31
SM	EIGHTBAY	SM-03	04/24/84	1	50
SM	EIGHTBAY	SM-03	04/24/84	2	40
SM	EIGHTBAY	SM-03	04/24/84	3	50
SM	EIGHTBAY	SM-03	04/24/84	4	50
SM	EIGHTBAY	SM-03	04/24/84	5	45
SM	EIGHTBAY	SM-03	04/24/84	Mean	47
SM	EIGHTBAY	SM-07	04/24/84	1	10
SM	EIGHTBAY	SM-07	04/24/84	2	35
SM	EIGHTBAY	SM-07	04/24/84	3	30
SM	EIGHTBAY	SM-07	04/24/84	4	15
SM	EIGHTBAY	SM-07	04/24/84	5	35
SM	EIGHTBAY	SM-07	04/24/84	Mean	25
SM	EIGHTBAY	SM-20	04/24/84	1	15
SM	EIGHTBAY	SM-20	04/24/84	2	40
SM	EIGHTBAY	SM-20	04/24/84	3	35
SM	EIGHTBAY	SM-20	04/24/84	4	35
SM	EIGHTBAY	SM-20	04/24/84	5	30
SM	EIGHTBAY	SM-20	04/24/84	Mean	31
SM	EIGHTBAY	SM1	08/06/83	1	20
SM	EIGHTBAY	SM10	08/08/83	1	45
SM	EIGHTBAY	SM11	08/08/83	1	30
SM	EIGHTBAY	SM12	08/08/83	1	10
SM	EIGHTBAY	SM13	08/09/83	1	0
SM	EIGHTBAY	SM14	08/09/83	1	5
SM	EIGHTBAY	SM15	08/09/83	1	0
SM	EIGHTBAY	SM16	08/09/83	1	20
SM	EIGHTBAY	SM17	08/09/83	1	0
SM	EIGHTBAY	SM18	08/09/83	1	50
SM	EIGHTBAY	SM19	08/09/83	1	25
SM	EIGHTBAY	SM2	08/06/83	1	25
SQ	EIGHTBAY	SQ-18	05/29/84	3	0
SQ	EIGHTBAY	SQ-18	05/29/84	4	0
SQ	EIGHTBAY	SQ-18	05/29/84	5	5
SQ	EIGHTBAY	SQ-18	05/29/84	Mean	11
SQ	EIGHTBAY	SQ-20	05/29/84	1	35
SQ	EIGHTBAY	SQ-20	05/29/84	2	20
SQ	EIGHTBAY	SQ-20	05/29/84	3	45
SQ	EIGHTBAY	SQ-20	05/29/84	4	20
SQ	EIGHTBAY	SQ-20	05/29/84	5	15
SQ	EIGHTBAY	SQ-20	05/29/84	Mean	27
SQ	EIGHTBAY	SQ1	08/15/83	1	10
SQ	EIGHTBAY	SQ1	08/15/83	2	35
SQ	EIGHTBAY	SQ1	08/15/83	3	25
SQ	EIGHTBAY	SQ1	08/15/83	Mean	23.3
SQ	EIGHTBAY	SQ10	09/17/83	1	15
SQ	EIGHTBAY	SQ11	09/17/83	1	40
SQ	EIGHTBAY	SQ12	09/17/83	1	45
SQ	EIGHTBAY	SQ13	09/17/83	1	5
SQ	EIGHTBAY	SQ14	09/18/83	1	5
SQ	EIGHTBAY	SQ15	09/18/83	1	5
PSD	PSDDA1	PGB02	05/23/88	2	55
PSD	PSDDA1	PGB02	05/23/88	3	85
PSD	PSDDA1	PGB02	05/23/88	4	40
PSD	PSDDA1	PGB02	05/23/88	5	40
PSD	PSDDA1	PGB02	05/23/88	Mean	51
PV	88PSRECN	POVERTY	05/12/88	1	5
PV	88PSRECN	POVERTY	05/12/88	2	0
PV	88PSRECN	POVERTY	05/12/88	3	20
PV	88PSRECN	POVERTY	05/12/88	4	5
PV	88PSRECN	POVERTY	05/12/88	Mean	7.5
SM	EIGHTBAY	SM-01	04/24/84	1	15
SM	EIGHTBAY	SM-01	04/24/84	2	50
SM	EIGHTBAY	SM-01	04/24/84	3	25
SM	EIGHTBAY	SM-01	04/24/84	4	30
SM	EIGHTBAY	SM-01	04/24/84	5	35
SM	EIGHTBAY	SM20	08/09/83	1	15
SM	EIGHTBAY	SM3	08/06/83	1	10
SM	EIGHTBAY	SM4	08/06/83	1	30
SM	EIGHTBAY	SM5	08/08/83	1	20
SM	EIGHTBAY	SM6	08/08/83	1	10
SM	EIGHTBAY	SM7	08/08/83	1	35
SM	EIGHTBAY	SM7	08/08/83	2	10
SM	EIGHTBAY	SM7	08/08/83	3	15
SM	EIGHTBAY	SM7	08/08/83	Mean	20
SM	EIGHTBAY	SM8	08/08/83	1	15
SM	EIGHTBAY	SM9	08/08/83	1	60
SM	NOADW86	SAMISH	06/01/86	Mean	20
SQ	DUWRIV2	SEQUIM	09/13/86	1	17
SQ	DUWRIV2	SEQUIM	09/16/86	2	4
SQ	DUWRIV2	SEQUIM	10/04/86	3	14
SQ	DUWRIV2	SEQUIM	10/07/86	4	11
SQ	DUWRIV2	SEQUIM	10/07/86	Mean	11.5
SQ	EIGHTBAY	SQ-14	05/29/84	1	5
SQ	EIGHTBAY	SQ-14	05/29/84	2	20
SQ	EIGHTBAY	SQ-14	05/29/84	3	5
SQ	EIGHTBAY	SQ-14	05/29/84	4	20
SQ	EIGHTBAY	SQ-14	05/29/84	5	10
SQ	EIGHTBAY	SQ-14	05/29/84	Mean	12
SQ	EIGHTBAY	SQ-17	05/29/84	1	20
SQ	EIGHTBAY	SQ-17	05/29/84	2	0
SQ	EIGHTBAY	SQ-17	05/29/84	3	15
SQ	EIGHTBAY	SQ-17	05/29/84	4	5
SQ	EIGHTBAY	SQ-17	05/29/84	5	10
SQ	EIGHTBAY	SQ-17	05/29/84	Mean	10
SQ	EIGHTBAY	SQ-18	05/29/84	1	25
SQ	EIGHTBAY	SQ-18	05/29/84	2	25
SQ	EIGHTBAY	SQ7	09/17/83	1	5
SQ	EIGHTBAY	SQ8	09/17/83	1	15
SQ	EIGHTBAY	SQ9	09/17/83	1	20
SQ	EVERETT1	SQ-1	06/06/85	1	5
SQ	EVERETT1	SQ-1	06/06/85	2	10
SQ	EVERETT1	SQ-1	06/06/85	3	5
SQ	EVERETT1	SQ-1	06/06/85	4	5
SQ	EVERETT1	SQ-1	06/06/85	5	5
SQ	EVERETT1	SQ-1	06/06/85	Mean	6
SQ	KENM86	SEQUIM		1	25
SQ	KENM86	SEQUIM		2	35
SQ	KENM86	SEQUIM		3	15
SQ	KENM86	SEQUIM		4	35
SQ	KENM86	SEQUIM		5	20
SQ	KENM86	SEQUIM		Mean	26
SQ	NOADW86	SEQUIM17	05/01/86	Mean	25
SQ	NOADW86	SEQUIM17	06/01/86	Mean	11.7
SQ	OAKHRBR	SEQUIM	02/26/85	1	35
SQ	OAKHRBR	SEQUIM	02/26/85	2	40
SQ	OAKHRBR	SEQUIM	02/26/85	3	30

TABLE C-12. BIVALVE* ABNORMALITY BIOASSAY RESULTS FOR POTENTIAL PUGET SOUND REFERENCE STATIONS

* Species used was Crassostrea gigas, except for PSDDA1 survey which used Mytilus edulis.

Bay	Survey	Station	Date	Labrep	Percent Abnormality
CR	CBMSQS	CR-11		1	20.7
CR	CBMSQS	CR-11		2	12.8
CR	CBMSQS	CR-11		Mean	16.8
CR	CBMSQS	CR-12		1	9.4
CR	CBMSQS	CR-12		2	13.1
CR	CBMSQS	CR-12		Mean	11.3
CR	CBMSQS	CR-13		1	10.8
CR	CBMSQS	CR-13		2	8.9
CR	CBMSQS	CR-13		Mean	9.9
CR	CBMSQS	CR-14		1	14.8
CR	CBMSQS	CR-14		2	13.7
CR	CBMSQS	CR-14		Mean	14.3
CR	PSDDA1	CRR01	05/17/88	1	0
CR	PSDDA1	CRR01	05/17/88	2	0
CR	PSDDA1	CRR01	05/17/88	3	16.7
CR	PSDDA1	CRR01	05/17/88	4	16.7
CR	PSDDA1	CRR01	05/17/88	5	7.4
CR	PSDDA1	CRR01	05/17/88	Mean	8.16
PS	PSDDA1	PSR01	05/23/88	1	13.3
PS	PSDDA1	PSR01	05/23/88	2	17.1
PS	PSDDA1	PSR01	05/23/88	3	40
PS	PSDDA1	PSR01	05/23/88	4	27.3
PS	PSDDA1	PSR01	05/23/88	5	17.6
PS	PSDDA1	PSR01	05/23/88	Mean	3.06
PSD	PSDDA1	PGB02	05/23/88	1	30
PSD	PSDDA1	PGB02	05/23/88	2	9.1
PSD	PSDDA1	PGB02	05/23/88	3	0
PSD	PSDDA1	PGB02	05/23/88	4	33.3
PSD	PSDDA1	PGB02	05/23/88	5	0
PSD	PSDDA1	PGB02	05/23/88	Mean	4.48

TABLE C-12. MICROTOX LUMINESCENCE BIOASSAY RESULTS (EC50) FOR ORGANIC AND SALINE EXTRACT OF POTENTIAL PUGET SOUND REFERENCE STATIONS

Bay	Survey	Station	Date	Labrep	Organic EC50
CR	NOADW86	CARRINL	06/01/86	Mean	1630
DB	NOADW86	DABOB	06/01/86	Mean	3820
DI	MISCREFS	DI-1		Mean	0.36
DI	NOADW86	DISCOVRY	06/01/86	Mean	597
OH	OAKHRBR	OH-B	02/26/85	4	5.51
OH	OAKHRBR	OH-C	02/26/85	4	6.42
OH	OAKHRBR	OH-C1	02/26/85	1	1.15
OH	OAKHRBR	OH-C2	02/26/85	2	1.62
OH	OAKHRBR	OH-C3	02/26/85	3	0.83
OH	OAKHRBR	OH-C3	02/26/85	Mean	2.51
OH	OAKHRBR	OH-D1	02/26/85	4	2.17
PR	MISCREFS	PR-1		Mean	5.69
SM	NOADW86	SAMISH	06/01/86	Mean	496
SQ	DUWRIV2	SEQUIM		1	69.5
SQ	KENM86	SEQUIM		1	1.6
SQ	KENM86	SEQUIM		2	0.4
SQ	KENM86	SEQUIM		3	0.3
SQ	KENM86	SEQUIM		Mean	0.77
SQ	NOADW86	SEQUIM17	05/01/86	Mean	70.7
SQ	OAKHRBR	SEQUIM	02/26/85	1	1.6
SQ	OAKHRBR	SEQUIM	02/26/85	2	0.4
SQ	OAKHRBR	SEQUIM	02/26/85	3	0.3
SQ	OAKHRBR	SEQUIM	02/26/85	Mean	0.77
US	MISCREFS	US-1		Mean	7.37

Bay	Survey	Station	Date	Labrep	Saline EC50
CR	CBMSQS	CR-11		Mean	1a
CR	CBMSQS	CR-12		Mean	-0.4a
CR	CBMSQS	CR-13		Mean	0.9a
CR	CBMSQS	CR-14		Mean	1.3a
CR	PSDDA1	CRR01	05/17/88	Mean	>1000
PS	PSDDA1	PSR01	05/23/88	Mean	>1000
PSD	PSDDA1	PGB02	05/23/88	Mean	>1000
SQ	OLYHAR88	SQ-01	12/14/88	Mean	9.1a

a Nontoxic; value shown is mean percent decrease in luminescence at highest concentration of extract.

TABLE C-13. BENTHIC INFAUNA ABUNDANCE PER SQUARE METER BY INDIVIDUAL GRAB FOR POTENTIAL PUGET SOUND REFERENCE STATIONS

Bay	Survey	Station	Sample	Labrep	Polychaete Abundance
CR	CBMSQS	CR-11	S03B	1	4583.33
CR	CBMSQS	CR-11	S04B	2	766.67
CR	CBMSQS	CR-11	S05B	3	1566.67
CR	CBMSQS	CR-11	S06B	4	2650
CR	CBMSQS	CR-12	S01B	1	1433.33
CR	CBMSQS	CR-12	S02B	2	1816.67
CR	CBMSQS	CR-12	S03B	3	1516.67
CR	CBMSQS	CR-12	S04B	4	1283.33
CR	CBMSQS	CR-13	S03B	1	2016.67
CR	CBMSQS	CR-13	S04B	2	1616.67
CR	CBMSQS	CR-13	S05B	3	1100
CR	CBMSQS	CR-13	S06B	4	1200
CR	CBMSQS	CR-14	S01B	1	1133.33
CR	CBMSQS	CR-14	S02B	2	1466.67
CR	CBMSQS	CR-14	S03B	3	1083.33
CR	CBMSQS	CR-14	S04B	4	1066.67
PS	EBCHEM	PS-01	PS-01	1	3950
PS	EBCHEM	PS-01	PS-01	2	2150
PS	EBCHEM	PS-01	PS-01	3	610
PS	EBCHEM	PS-01	PS-01	4	740
PS	EBCHEM	PS-01	PS-01	5	1390
PS	EBCHEM	PS-02	PS-02	1	2070
PS	EBCHEM	PS-02	PS-02	2	4190
PS	EBCHEM	PS-02	PS-02	3	3070
PS	EBCHEM	PS-02	PS-02	4	2650
PS	EBCHEM	PS-02	PS-02	5	3610
PS	EBCHEM	PS-03	PS-03	1	1400
PS	EBCHEM	PS-03	PS-03	2	860
PS	EBCHEM	PS-03	PS-03	3	1080
PS	EBCHEM	PS-03	PS-03	4	1440
PS	EBCHEM	PS-03	PS-03	5	1240
PS	EBCHEM	PS-04	PS-04	1	1440
PS	EBCHEM	PS-04	PS-04	2	570
PS	EBCHEM	PS-04	PS-04	3	1660
PS	EBCHEM	PS-04	PS-04	4	2070
PS	EBCHEM	PS-04	PS-04	5	2920
PS	EVCHEM	PS-02	PS-02G	1	760
PS	EVCHEM	PS-02	PS-02G	2	1330
PS	EVCHEM	PS-02	PS-02G	3	890
PS	EVCHEM	PS-02	PS-02G	4	900
PS	EVCHEM	PS-02	PS-02G	5	1130
PS	EVCHEM	PS-03	PS-03G	1	1890
PS	EVCHEM	PS-03	PS-03G	2	1790
PS	EVCHEM	PS-03	PS-03G	3	1180
PS	EVCHEM	PS-03	PS-03G	4	1380
PS	EVCHEM	PS-03	PS-03G	5	1540
PS	EVCHEM	PS-04	PS-04G	1	1600
PS	EVCHEM	PS-04	PS-04G	2	2740
PS	EVCHEM	PS-04	PS-04G	3	2420
PS	EVCHEM	PS-04	PS-04G	4	1650
PS	EVCHEM	PS-04	PS-04G	5	2350
PSD	PSDDA1	PGB02	PGB02I	1	383.33
PSD	PSDDA1	PGB02	PGB02I	2	483.33
PSD	PSDDA1	PGB02	PGB02I	3	483.33
PSD	PSDDA1	PGB02	PGB02I	4	550
PSD	PSDDA1	PGB02	PGB02I	5	466.67

Bay	Survey	Station	Sample	Labrep	Gastropod Abundance
CR	CBMSQS	CR-11	S03B	1	950
CR	CBMSQS	CR-11	S04B	2	616.67
CR	CBMSQS	CR-11	S05B	3	533.33
CR	CBMSQS	CR-11	S06B	4	300
CR	CBMSQS	CR-12	S01B	1	16.67
CR	CBMSQS	CR-12	S02B	2	50
CR	CBMSQS	CR-12	S03B	3	0
CR	CBMSQS	CR-12	S04B	4	66.67
CR	CBMSQS	CR-13	S03B	1	333.33
CR	CBMSQS	CR-13	S04B	2	366.67
CR	CBMSQS	CR-13	S05B	3	450
CR	CBMSQS	CR-13	S06B	4	383.33
CR	CBMSQS	CR-14	S01B	1	116.67
CR	CBMSQS	CR-14	S02B	2	150
CR	CBMSQS	CR-14	S03B	3	233.33
CR	CBMSQS	CR-14	S04B	4	116.67
PS	EBCHEM	PS-01	PS-01	1	340
PS	EBCHEM	PS-01	PS-01	2	270
PS	EBCHEM	PS-01	PS-01	3	210
PS	EBCHEM	PS-01	PS-01	4	300
PS	EBCHEM	PS-01	PS-01	5	230
PS	EBCHEM	PS-02	PS-02	1	90
PS	EBCHEM	PS-02	PS-02	2	80
PS	EBCHEM	PS-02	PS-02	3	40
PS	EBCHEM	PS-02	PS-02	4	70
PS	EBCHEM	PS-02	PS-02	5	130
PS	EBCHEM	PS-03	PS-03	1	130
PS	EBCHEM	PS-03	PS-03	2	120
PS	EBCHEM	PS-03	PS-03	3	30
PS	EBCHEM	PS-03	PS-03	4	210
PS	EBCHEM	PS-03	PS-03	5	10
PS	EBCHEM	PS-04	PS-04	1	80
PS	EBCHEM	PS-04	PS-04	2	60
PS	EBCHEM	PS-04	PS-04	3	190
PS	EBCHEM	PS-04	PS-04	4	100
PS	EBCHEM	PS-04	PS-04	5	240
PS	EVCHEM	PS-02	PS-02G	1	10
PS	EVCHEM	PS-02	PS-02G	2	10
PS	EVCHEM	PS-02	PS-02G	3	10
PS	EVCHEM	PS-02	PS-02G	4	30
PS	EVCHEM	PS-02	PS-02G	5	20
PS	EVCHEM	PS-03	PS-03G	1	50
PS	EVCHEM	PS-03	PS-03G	2	100
PS	EVCHEM	PS-03	PS-03G	3	50
PS	EVCHEM	PS-03	PS-03G	4	40
PS	EVCHEM	PS-03	PS-03G	5	140
PS	EVCHEM	PS-04	PS-04G	1	40
PS	EVCHEM	PS-04	PS-04G	2	100
PS	EVCHEM	PS-04	PS-04G	3	10
PS	EVCHEM	PS-04	PS-04G	4	60
PS	EVCHEM	PS-04	PS-04G	5	80
PSD	PSDDA1	PGB02	PGB02I	1	50
PSD	PSDDA1	PGB02	PGB02I	2	33.33
PSD	PSDDA1	PGB02	PGB02I	3	50
PSD	PSDDA1	PGB02	PGB02I	4	16.67
PSD	PSDDA1	PGB02	PGB02I	5	33.33

Bay	Survey	Station	Sample	Labrep	Amphipod Abundance
CR	CBMSQS	CR-11	S03B	1	216.67
CR	CBMSQS	CR-11	S04B	2	83.33
CR	CBMSQS	CR-11	S05B	3	533.33
CR	CBMSQS	CR-11	S06B	4	250
CR	CBMSQS	CR-12	S01B	1	83.33

Bay	Survey	Station	Sample	Labrep	Bivalve Abundance
CR	CBMSQS	CR-11	S03B	1	600
CR	CBMSQS	CR-11	S04B	2	816.67
CR	CBMSQS	CR-11	S05B	3	916.67
CR	CBMSQS	CR-11	S06B	4	800
CR	CBMSQS	CR-12	S01B	1	733.33

CR	CBMSQS	CR-12	S02B	2	33.33	CR	CBMSQS	CR-12	S02B	2	1050
CR	CBMSQS	CR-12	S03B	3	50	CR	CBMSQS	CR-12	S03B	3	1266.67
CR	CBMSQS	CR-12	S04B	4	66.67	CR	CBMSQS	CR-12	S04B	4	1200
CR	CBMSQS	CR-13	S03B	1	183.33	CR	CBMSQS	CR-13	S03B	1	616.67
CR	CBMSQS	CR-13	S04B	2	266.67	CR	CBMSQS	CR-13	S04B	2	483.33
CR	CBMSQS	CR-13	S05B	3	100	CR	CBMSQS	CR-13	S05B	3	650
CR	CBMSQS	CR-13	S06B	4	100	CR	CBMSQS	CR-13	S06B	4	216.67
CR	CBMSQS	CR-14	S01B	1	183.33	CR	CBMSQS	CR-14	S01B	1	583.33
CR	CBMSQS	CR-14	S02B	2	2333.33	CR	CBMSQS	CR-14	S02B	2	516.67
CR	CBMSQS	CR-14	S03B	3	166.67	CR	CBMSQS	CR-14	S03B	3	366.67
CR	CBMSQS	CR-14	S04B	4	100	CR	CBMSQS	CR-14	S04B	4	750
PS	EBCHEM	PS-01	PS-01	1	2030	PS	EBCHEM	PS-01	PS-01	1	990
PS	EBCHEM	PS-01	PS-01	2	1560	PS	EBCHEM	PS-01	PS-01	2	1330
PS	EBCHEM	PS-01	PS-01	3	1350	PS	EBCHEM	PS-01	PS-01	3	1120
PS	EBCHEM	PS-01	PS-01	4	1060	PS	EBCHEM	PS-01	PS-01	4	1170
PS	EBCHEM	PS-01	PS-01	5	1460	PS	EBCHEM	PS-01	PS-01	5	1750
PS	EBCHEM	PS-02	PS-02	1	280	PS	EBCHEM	PS-02	PS-02	1	3110
PS	EBCHEM	PS-02	PS-02	2	310	PS	EBCHEM	PS-02	PS-02	2	3430
PS	EBCHEM	PS-02	PS-02	3	50	PS	EBCHEM	PS-02	PS-02	3	2970
PS	EBCHEM	PS-02	PS-02	4	230	PS	EBCHEM	PS-02	PS-02	4	2920
PS	EBCHEM	PS-02	PS-02	5	360	PS	EBCHEM	PS-02	PS-02	5	3460
PS	EBCHEM	PS-03	PS-03	1	80	PS	EBCHEM	PS-03	PS-03	1	2660
PS	EBCHEM	PS-03	PS-03	2	70	PS	EBCHEM	PS-03	PS-03	2	2300
PS	EBCHEM	PS-03	PS-03	3	40	PS	EBCHEM	PS-03	PS-03	3	2490
PS	EBCHEM	PS-03	PS-03	4	20	PS	EBCHEM	PS-03	PS-03	4	2860
PS	EBCHEM	PS-03	PS-03	5	50	PS	EBCHEM	PS-03	PS-03	5	3120
PS	EBCHEM	PS-04	PS-04	1	110	PS	EBCHEM	PS-04	PS-04	1	2890
PS	EBCHEM	PS-04	PS-04	2	70	PS	EBCHEM	PS-04	PS-04	2	2250
PS	EBCHEM	PS-04	PS-04	3	100	PS	EBCHEM	PS-04	PS-04	3	2820
PS	EBCHEM	PS-04	PS-04	4	70	PS	EBCHEM	PS-04	PS-04	4	1310
PS	EBCHEM	PS-04	PS-04	5	120	PS	EBCHEM	PS-04	PS-04	5	1150
PS	EVCHEM	PS-02	PS-02G	1	140	PS	EVCHEM	PS-02	PS-02G	1	1690
PS	EVCHEM	PS-02	PS-02G	2	110	PS	EVCHEM	PS-02	PS-02G	2	3000
PS	EVCHEM	PS-02	PS-02G	3	80	PS	EVCHEM	PS-02	PS-02G	3	2760
PS	EVCHEM	PS-02	PS-02G	4	30	PS	EVCHEM	PS-02	PS-02G	4	3240
PS	EVCHEM	PS-02	PS-02G	5	90	PS	EVCHEM	PS-02	PS-02G	5	2860
PS	EVCHEM	PS-03	PS-03G	1	30	PS	EVCHEM	PS-03	PS-03G	1	880
PS	EVCHEM	PS-03	PS-03G	2	40	PS	EVCHEM	PS-03	PS-03G	2	1170
PS	EVCHEM	PS-03	PS-03G	3	10	PS	EVCHEM	PS-03	PS-03G	3	1180
PS	EVCHEM	PS-03	PS-03G	4	20	PS	EVCHEM	PS-03	PS-03G	4	1480
PS	EVCHEM	PS-03	PS-03G	5	30	PS	EVCHEM	PS-03	PS-03G	5	1350
PS	EVCHEM	PS-04	PS-04G	1	80	PS	EVCHEM	PS-04	PS-04G	1	640
PS	EVCHEM	PS-04	PS-04G	2	30	PS	EVCHEM	PS-04	PS-04G	2	970
PS	EVCHEM	PS-04	PS-04G	3	70	PS	EVCHEM	PS-04	PS-04G	3	810
PS	EVCHEM	PS-04	PS-04G	4	70	PS	EVCHEM	PS-04	PS-04G	4	650
PS	EVCHEM	PS-04	PS-04G	5	90	PS	EVCHEM	PS-04	PS-04G	5	730
PSD	PSDDA1	PGB02	PGB02I	1	83.33	PSD	PSDDA1	PGB02	PGB02I	1	16.67
PSD	PSDDA1	PGB02	PGB02I	2	150	PSD	PSDDA1	PGB02	PGB02I	2	116.67
PSD	PSDDA1	PGB02	PGB02I	3	166.67	PSD	PSDDA1	PGB02	PGB02I	3	100
PSD	PSDDA1	PGB02	PGB02I	4	283.33	PSD	PSDDA1	PGB02	PGB02I	4	216.67
PSD	PSDDA1	PGB02	PGB02I	5	166.67	PSD	PSDDA1	PGB02	PGB02I	5	150

Bay	Survey	Station	Sample	Labrep	Total Abundance
CR	CBMSQS	CR-11	S03B	1	7150
CR	CBMSQS	CR-11	S04B	2	4966.67
CR	CBMSQS	CR-11	S05B	3	5100
CR	CBMSQS	CR-11	S06B	4	6566.67
CR	CBMSQS	CR-12	S01B	1	3183.33
CR	CBMSQS	CR-12	S02B	2	3583.33
CR	CBMSQS	CR-12	S03B	3	3416.67
CR	CBMSQS	CR-12	S04B	4	3400
CR	CBMSQS	CR-13	S03B	1	3283.33
CR	CBMSQS	CR-13	S04B	2	2866.67
CR	CBMSQS	CR-13	S05B	3	2400
CR	CBMSQS	CR-13	S06B	4	1950
CR	CBMSQS	CR-14	S01B	1	2350
CR	CBMSQS	CR-14	S02B	2	4633.33
CR	CBMSQS	CR-14	S03B	3	1966.67
CR	CBMSQS	CR-14	S04B	4	2116.67

PS	EBCHEM	PS-01	PS-01	1	7700
PS	EBCHEM	PS-01	PS-01	2	5810
PS	EBCHEM	PS-01	PS-01	3	3420
PS	EBCHEM	PS-01	PS-01	4	3500
PS	EBCHEM	PS-01	PS-01	5	5360
PS	EBCHEM	PS-02	PS-02	1	6140
PS	EBCHEM	PS-02	PS-02	2	8550
PS	EBCHEM	PS-02	PS-02	3	6800
PS	EBCHEM	PS-02	PS-02	4	6320
PS	EBCHEM	PS-02	PS-02	5	8320
PS	EBCHEM	PS-03	PS-03	1	5450
PS	EBCHEM	PS-03	PS-03	2	4180
PS	EBCHEM	PS-03	PS-03	3	4350
PS	EBCHEM	PS-03	PS-03	4	5560
PS	EBCHEM	PS-03	PS-03	5	5660
PS	EBCHEM	PS-04	PS-04	1	6350
PS	EBCHEM	PS-04	PS-04	2	4430
PS	EBCHEM	PS-04	PS-04	3	6650
PS	EBCHEM	PS-04	PS-04	4	5220
PS	EBCHEM	PS-04	PS-04	5	6100
PS	EVCHEM	PS-02	PS-02G	1	3220
PS	EVCHEM	PS-02	PS-02G	2	5080
PS	EVCHEM	PS-02	PS-02G	3	4410
PS	EVCHEM	PS-02	PS-02G	4	4860
PS	EVCHEM	PS-02	PS-02G	5	4520
PS	EVCHEM	PS-03	PS-03G	1	4160
PS	EVCHEM	PS-03	PS-03G	2	4150
PS	EVCHEM	PS-03	PS-03G	3	3340
PS	EVCHEM	PS-03	PS-03G	4	3980
PS	EVCHEM	PS-03	PS-03G	5	4120
PS	EVCHEM	PS-04	PS-04G	1	3750
PS	EVCHEM	PS-04	PS-04G	2	5290
PS	EVCHEM	PS-04	PS-04G	3	4370
PS	EVCHEM	PS-04	PS-04G	4	3730
PS	EVCHEM	PS-04	PS-04G	5	4760
PSD	PSDDA1	PGB02	PGB02I	1	750
PSD	PSDDA1	PGB02	PGB02I	2	1050
PSD	PSDDA1	PGB02	PGB02I	3	983.33
PSD	PSDDA1	PGB02	PGB02I	4	1333.33
PSD	PSDDA1	PGB02	PGB02I	5	966.67

TABLE C-14. LOCATIONS AND ELEVATIONS FOR POTENTIAL PUGET SOUND REFERENCE STATIONS.

Basin Code	Survey	Station	Latitude Degrees	Minutes	Seconds	Longitude Degrees	Minutes	Seconds	State Plane Coordinates South Zone East	North	Elevation (meters)
SUBTIDAL STATIONS											
AD	88PSRECN	AD-S3E	48	13	7.2	122	46	47.4	--	--	-17.4
AD	88PSRECN	AD-S3W	48	8	52.2	122	50	4.2	--	--	-19.2
AD	BARRICK	AD-62	--	--	--	--	--	--	--	--	--
AD	CREC72	AD-01	48	--	48	122	38	--	--	--	-120
AD	ROBERT74	AD-14	48	--	48	122	38	--	--	--	-120
AD	ROBERT74	AD-S12	48	1	18	122	37	6	--	--	-137
BB	REFGRAIN	BB-93	48	55	19.8	122	44	39	--	--	--
BB	REFGRAIN	BB-94	48	56	0.6	122	44	49.8	--	--	--
BB	REFGRAIN	BB-95	48	56	15.6	122	45	7.8	--	--	--
BB	REFGRAIN	BB-96	48	56	34.8	122	46	3	--	--	--
BB	REFGRAIN	BB-97	48	55	43.8	122	44	40.8	--	--	--
BH	EHCHEM	BH-01	--	--	--	--	--	--	1586400	221843	-10
BH	EHCHEM	BH-02	--	--	--	--	--	--	1588462	221601	-17.7
CR	CBMSQS	CR-11	--	--	--	--	--	--	1458050	721700	--
CR	CBMSQS	CR-12	--	--	--	--	--	--	1458500	724750	--
CR	CBMSQS	CR-13	--	--	--	--	--	--	1439750	715750	--
CR	CBMSQS	CR-14	--	--	--	--	--	--	1438800	714750	--
CR	CBPRELIM	CR-03	--	--	--	--	--	--	--	--	--
CR	CBPRELIM	CR-04	--	--	--	--	--	--	--	--	--
CR	CREC72	CR-01	47	18	24	122	42	36	--	--	-78
CR	MISCREFS	CR-15	--	--	--	--	--	--	--	--	--
CR	NOADW86	CARRINL	47	17	54	122	40	56	--	--	--
CR	PSDDA1	CRR01	47	13	11.4	122	37	27	--	--	-150
CR	RILEY001	NG-11	47	13	18	122	37	54	--	--	-143
CR	RILEY001	NG-10	47	13	18	122	37	54	--	--	-143
CR	RILEY001	NG-9	47	17	18	122	42	24	--	--	-91
CR	ROBERT74	CR-021	47	22	24	122	38	6	--	--	-14
CR	ROBERT74	CR-022	47	20	36	122	41	24	--	--	-50
CR	ROBERT74	CR-023	47	17	54	122	42	48	--	--	-77
CS	CREC72	CS-02	47	18	6	122	49	12	--	--	-32
CS	CREC72	CS-03	47	11	36	122	49	12	--	--	-60
CS	EIGHTBAY	CS-01	47	14	27.6	122	51	8.4	--	--	-40.5
CS	EIGHTBAY	CS-11	47	18	47.4	122	50	18	--	--	-21.3
CS	EIGHTBAY	CS-15	47	19	30	122	47	52.2	--	--	-28.3
CS	EIGHTBAY	CS-17	47	20	49.2	122	48	39.6	--	--	-24.1
CS	MALINS	CS-62	--	--	--	--	--	--	--	--	-32.5
CS	MALINS	CS-63	--	--	--	--	--	--	--	--	-37.5
CS	MISCREFS	CS-14	--	--	--	--	--	--	--	--	--
CS	RILEY001	NG-15	47	13	12	122	49	12	--	--	-82
CS	RILEY001	NG-16	47	17	48	122	49	18	--	--	-30
CS	ROBERT74	CS-005	47	11	42	122	48	42	--	--	-70
CS	ROBERT74	CS-007	47	13	18	122	49	36	--	--	-70
CS	ROBERT74	CS-008H	47	15	12	122	50	6	--	--	-16
CS	ROBERT74	CS-009	47	11	36	122	49	12	--	--	-55
CS	ROBERT74	CS-010	47	15	12	122	50	18	--	--	-15
CS	ROBERT74	CS-011	47	18	12	122	48	48	--	--	-31
CS	ROBERT74	CS-034	47	12	12	122	49	30	--	--	-42
CS	ROBERT74	CS-035	47	11	42	122	48	54	--	--	-58
CS	ROBERT74	CS-036	47	11	48	122	48	12	--	--	-91

TABLE C-14. (Continued) LOCATIONS AND ELEVATIONS FOR POTENTIAL PUGET SOUND REFERENCE STATIONS.

Basin			Latitude			Longitude			State Plane Coordinates South Zone		
Code	Survey	Station	Degrees	Minutes	Seconds	Degrees	Minutes	Seconds	East	North	Elevation (meters)
DB	BARRICK	DBE	--	--	--	--	--	--	--	--	--
DB	EIGHTBAY	DB-01	47	41	15.9	122	52	18.7	--	--	-112.8
DB	EIGHTBAY	DB-05	47	42	8.4	122	52	31.9	--	--	-88.4
DB	EIGHTBAY	DB-07	47	42	40.5	122	52	40.4	--	--	-97.5
DB	EIGHTBAY	DB-15	47	46	21	122	51	12.6	--	--	-109.7
DB	MISCREFS	DB-89	--	--	--	--	--	--	--	--	--
DB	NOADW86	DABOB	47	41	15	122	53	13	--	--	--
DB	REFGRAIN	DB-02	47	41	31.1	122	52	6.9	--	--	-129.8
DB	REFGRAIN	DB-14	47	46	6.5	122	51	15.1	--	--	-109.7
DB	REFGRAIN	DB-15	47	46	21	122	51	12.6	--	--	-109.7
DB	REFGRAIN	DB-18	47	49	30.5	122	49	4.5	--	--	-32.6
DB	ROBERT74	DB-H16	47	46	18	122	50	18	--	--	-168
DB	ROBERT74	DB-H17	47	40	48	122	50	18	--	--	-98
DB	ROBERT74	DB-H18	47	44	48	122	50	12	--	--	-183
DI	88PSRECN	DI-S1	48	2	13.2	122	50	4.8	--	--	-31.1
DI	88PSRECN	DI-S1	48	2	13.2	122	50	4.8	--	--	-31.1
DI	MALINS	DI-41	--	--	--	--	--	--	--	--	-32
DI	MISCREFS	DI-1	--	--	--	--	--	--	--	--	--
DI	NOADW86	DISCOVRY	48	--	30	122	51	36	--	--	--
DI	ROBERT74	DI-1	48	5	42	122	54	42	--	--	-64
DI	ROBERT74	DI-10	48	4	30	122	53	36	--	--	-47
DI	ROBERT74	DI-11	48	4	18	122	54	24	--	--	-52
DI	ROBERT74	DI-12	48	3	54	122	55	30	--	--	-28
DI	ROBERT74	DI-13	48	3	36	122	54	54	--	--	-29
DI	ROBERT74	DI-14	48	4	--	122	53	48	--	--	-48
DI	ROBERT74	DI-15	48	4	30	122	52	54	--	--	-52
DI	ROBERT74	DI-16	48	4	12	122	52	18	--	--	-51
DI	ROBERT74	DI-17	48	3	48	122	52	48	--	--	-50
DI	ROBERT74	DI-18	48	3	24	122	53	48	--	--	-39
DI	ROBERT74	DI-19	48	3	12	122	53	6	--	--	-37
DI	ROBERT74	DI-2	48	5	54	122	53	54	--	--	-105
DI	ROBERT74	DI-20	48	3	30	122	52	30	--	--	-46
DI	ROBERT74	DI-21	48	3	48	122	51	42	--	--	-49
DI	ROBERT74	DI-22	48	3	30	122	51	18	--	--	-47
DI	ROBERT74	DI-23	48	3	12	122	51	54	--	--	-49
DI	ROBERT74	DI-24	48	3	--	122	52	42	--	--	--
DI	ROBERT74	DI-25	48	2	36	122	52	12	--	--	--
DI	ROBERT74	DI-26	48	2	48	122	51	30	--	--	-46
DI	ROBERT74	DI-27	48	3	--	122	50	30	--	--	-8
DI	ROBERT74	DI-28	48	2	48	122	40	48	--	--	-15
DI	ROBERT74	DI-29	48	2	30	122	50	54	--	--	-41
DI	ROBERT74	DI-3	48	6	6	122	53	12	--	--	-21
DI	ROBERT74	DI-30	48	2	18	122	51	54	--	--	-11
DI	ROBERT74	DI-31	48	2	--	122	51	42	--	--	-8
DI	ROBERT74	DI-32	48	2	6	122	50	48	--	--	-44
DI	ROBERT74	DI-33	48	2	12	122	49	54	--	--	-17
DI	ROBERT74	DI-34	48	1	42	122	50	--	--	--	-12
DI	ROBERT74	DI-35	48	1	36	122	50	36	--	--	-40
DI	ROBERT74	DI-36	48	1	30	122	51	24	--	--	-11
DI	ROBERT74	DI-37	48	1	--	122	51	6	--	--	-24
DI	ROBERT74	DI-38	48	1	6	122	50	36	--	--	-38

TABLE C-14. (Continued) LOCATIONS AND ELEVATIONS FOR POTENTIAL PUGET SOUND REFERENCE STATIONS.

Basin			Lattitude			Longitude			State Plane Coordinates South Zone		
Code	Survey	Station	Degrees	Minutes	Seconds	Degrees	Minutes	Seconds	East	North	Elevation (meters)
DI	ROBERT74	DI-39	48	1	6	122	50	--	--	--	-11
DI	ROBERT74	DI-4	48	5	48	122	52	54	--	--	-51
DI	ROBERT74	DI-40	48	--	36	122	50	6	--	--	-18
DI	ROBERT74	DI-41	48	--	42	122	50	48	--	--	-41
DI	ROBERT74	DI-42	48	--	42	122	51	30	--	--	-12
DI	ROBERT74	DI-43	48	--	30	122	51	36	--	--	-17
DI	ROBERT74	DI-44	48	--	18	122	51	12	--	--	-32
DI	ROBERT74	DI-45	48	--	6	122	50	36	--	--	-20
DI	ROBERT74	DI-46	47	59	54	122	51	--	--	--	-26
DI	ROBERT74	DI-47	47	59	54	122	51	30	--	--	-16
DI	ROBERT74	DI-48	48	--	12	122	51	48	--	--	-11
DI	ROBERT74	DI-49	47	59	54	122	52	6	--	--	-12
DI	ROBERT74	DI-5	48	5	30	122	54	6	--	--	-58
DI	ROBERT74	DI-6	48	5	12	122	55	--	--	--	-32
DI	ROBERT74	DI-7	48	4	30	122	55	12	--	--	-25
DI	ROBERT74	DI-8	48	4	54	122	54	12	--	--	-58
DI	ROBERT74	DI-9	48	4	30	122	53	--	--	--	-53
DY	88PSRECN	DY-1	47	35	2.4	122	39	21	--	--	-5.8
DY	88PSRECN	DY-2	47	35	22.2	122	40	48	--	--	-6.7
DY	88PSRECN	DY-3	47	35	40.2	122	40	45	--	--	-9.1
DY	88PSRECN	DY-4	47	36	52.2	122	41	42.6	--	--	-11.3
DY	88PSRECN	DY-5	47	38	28.8	122	41	27.6	--	--	-9.1
DY	88PSRECN	DY-6	47	38	33.6	122	40	50.4	--	--	-9.1
DY	ROBERT74	DY-019	47	37	--	122	40	54	--	--	-33
DY	ROBERT74	DY-020	47	37	54	122	41	18	--	--	-14
ES	BARRICK	ES-73	--	--	--	--	--	--	--	--	--
ES	ROBERT74	ES-173	48	35	--	122	51	42	--	--	-28
ES	ROBERT74	ES-174	48	39	--	122	53	12	--	--	-29
ES	ROBERT74	ES-6B	48	35	12	122	51	18	--	--	-27
ES	ROBERT74	ES-6C	48	35	42	122	50	30	--	--	-38
ES	ROBERT74	ES-7A	48	41	12	122	53	54	--	--	-23
ES	ROBERT74	ES-7B1	48	35	--	122	51	12	--	--	-30
ES	ROBERT74	ES-7B2	48	40	--	122	53	48	--	--	-28
ES	ROBERT74	ES-8A	48	38	36	122	52	42	--	--	-25
ES	ROBERT74	ES-8B	48	37	6	122	51	18	--	--	-27
ES	ROBERT74	ES-8C	48	35	42	122	50	48	--	--	-23
ES	ROBERT74	ES-8D	48	33	42	122	50	24	--	--	-40
HC	CREC72	HC-01	47	41	--	122	45	48	--	--	-83
HC	CREC72	HC-02	47	40	24	122	52	30	--	--	-138
HC	CREC72	HC-03	47	28	42	123	3	54	--	--	-155
HC	CREC72	HC-04	47	23	36	122	56	6	--	--	-25
HC	LIBERT88	HC-MP	--	--	--	--	--	--	--	--	--
HC	ROBERT74	HC-011G	47	40	42	122	48	42	--	--	--
HC	ROBERT74	HC-011M	47	40	24	122	52	30	--	--	-138
HC	ROBERT74	HC-012	47	41	--	122	45	48	--	--	-83
HC	ROBERT74	HC-034	47	28	42	123	3	54	--	--	-155
HC	ROBERT74	HC-H05	47	28	12	123	4	24	--	--	-152
HC	ROBERT74	HC-H06	47	32	54	123	--	30	--	--	-149
HC	ROBERT74	HC-H07	47	36	36	122	56	36			-165
HC	ROBERT74	HC-H08	47	39	54	122	51	54	--	--	-148
HC	ROBERT74	HC-H09	47	40	36	122	47	42	--	--	-124

TABLE C-14. (Continued) LOCATIONS AND ELEVATIONS FOR POTENTIAL PUGET SOUND REFERENCE STATIONS.

Basin			Latitude			Longitude			State Plane Coordinates South Zone		
Code	Survey	Station	Degrees	Minutes	Seconds	Degrees	Minutes	Seconds	East	North	Elevation (meters)
HC	ROBERT74	HC-H15	47	37	36	122	55	42	--	--	-165
HI	RILEY001	NG-14	47	9	24	122	49	48	--	--	-12
HI	ROBERT74	HI-007	47	8	48	122	49	48	--	--	-12
HI	ROBERT74	HI-022	47	9	30	122	50	--	--	--	-7
HPF	ROBERT74	HP-024	47	15	30	122	36	12	--	--	-5
HPL	ROBERT74	HP-001	48	44	--	122	41	--	--	--	--
HPL	ROBERT74	HP-E1	48	41	24	122	37	54	--	--	-38
NQ	BARRICK	NQ-82	--	--	--	--	--	--	--	--	--
NQ	CREC72	NQ-01	47	8	24	122	45	18	--	--	-70
NQ	MISCREFS	NQ-8	--	--	--	--	--	--	--	--	--
NQ	NOAA84	NISQ1	47	4	15.6	122	25	4.8	--	--	--
NQ	NOAA84	NISQ2	47	4	19.2	122	24	46.8	--	--	--
NQ	NOAA84	NISQ3	47	4	19.2	122	24	25.2	--	--	--
NQ	RILEY001	NG-13	47	8	30	122	41	24	--	--	-8
NQ	RILEY001	NG-13	47	8	30	122	41	24	--	--	-8
NQ	RILEY001	NG-13	47	8	30	122	41	24	--	--	-8
NQ	ROBERT74	NQ-006	47	10	36	122	48	48	--	--	-34
NQ	ROBERT74	NQ-006	47	10	36	122	48	48	--	--	-34
NQ	ROBERT74	NQ-0080	47	10	48	122	48	42	--	--	-34
NQ	ROBERT74	NQ-015	47	10	30	122	47	30	--	--	-92
NQ	ROBERT74	NQ-027	47	11	--	122	49	--	--	--	-29
NQ	ROBERT74	NQ-028	47	11	--	122	48	24	--	--	-44
NQ	ROBERT74	NQ-029	47	11	12	122	48	36	--	--	-77
NQ	ROBERT74	NQ-030	47	11	12	122	49	--	--	--	-68
NQ	ROBERT74	NQ-037	47	11	12	122	47	42	--	--	-110
NQ	ROBERT74	NQ-038	47	10	30	122	47	36	--	--	-86
NQ	ROBERT74	NQ-039	47	10	--	122	47	12	--	--	-84
NQ	ROBERT74	NQ-016	47	7	18	122	45	24	--	--	-33
NQ	ROBERT74	NQ-D01	47	6	--	122	43	--	--	--	--
NQ	ROBERT74	NQ-D02	47	6	6	122	42	6	--	--	--
NQ	ROBERT74	NQ-D03	47	5	42	122	41	42	--	--	--
NQ	ROBERT74	NQ-D05	47	5	42	122	41	18	--	--	--
NQ	ROBERT74	NQ-D08	47	5	54	122	43	12	--	--	--
NQ	ROBERT74	NQ-D09	47	5	54	122	42	--	--	--	--
NQ	ROBERT74	NQ-D10	47	6	--	122	42	12	--	--	--
NQ	ROBERT74	NQ-D11	47	6	6	122	42	18	--	--	--
NQ	ROBERT74	NQ-D134	47	6	36	122	42	18	--	--	--
NQ	ROBERT74	NQ-DA7	47	6	6	122	43	30	--	--	--
NQ	ROBERT74	NQ-DB7	47	6	24	122	43	24	--	--	--
NQ	ROBERT74	NQ-DM	47	5	36	122	41	42	--	--	--
NQ	ROBERT74	NQ-DS	47	6	18	122	42	18	--	--	--
NQ	ROBERT74	NQ-I12	47	7	36	122	42	18	--	--	--
NQ	ROBERT74	NQ-M01	47	5	12	122	42	18	--	--	--
NQ	ROBERT74	NQ-N01	47	7	54	122	40	24	--	--	-132
NQ	ROBERT74	NQ-N02	47	7	24	122	41	54	--	--	-66
NQ	ROBERT74	NQ-N03	47	7	6	122	41	54	--	--	-66
NQ	ROBERT74	NQ-N04	47	6	42	122	41	48	--	--	-7
NQ	ROBERT74	NQ-N05	47	6	12	122	41	42	--	--	-5
NQ	ROBERT74	NQ-R01	47	6	54	122	40	48	--	--	--
NQ	ROBERT74	NQ-R02	47	6	48	122	42	24	--	--	--
NQ	ROBERT74	NQ-R03	47	7	--	122	43	18	--	--	-11

TABLE C-14. (Continued) LOCATIONS AND ELEVATIONS FOR POTENTIAL PUGET SOUND REFERENCE STATIONS.

Basin Code	Survey	Station	Latitude Degrees	Latitude Minutes	Latitude Seconds	Longitude Degrees	Longitude Minutes	Longitude Seconds	State Plane Coordinates South Zone East	State Plane Coordinates South Zone North	Elevation (meters)
NQ	ROBERT74	NQ-R04	47	7	12	122	45	12	--	--	--
NQ	ROBERT74	NQ-R05	47	7	30	122	44	30	--	--	--
NQ	ROBERT74	NQ-R06	47	7	30	122	43	18	--	--	--
NQ	ROBERT74	NQ-R07	47	7	12	122	42	12	--	--	-37
NQ	ROBERT74	NQ-R08	47	7	30	122	40	36	--	--	-55
NQ	ROBERT74	NQ-R09	47	7	24	122	39	42	--	--	-37
NQ	ROBERT74	NQ-R10	47	8	30	122	39	48	--	--	--
NQ	ROBERT74	NQ-R11	47	6	42	122	42	--	--	--	--
NQ	ROBERT74	NQ-R12	47	6	42	122	42	6	--	--	--
NQ	ROBERT74	NQ-R13	47	6	48	122	42	12	--	--	--
NQ	ROBERT74	NQ-R14	47	7	--	122	42	12	--	--	--
NQ	ROBERT74	NQ-R15	47	7	42	122	41	6	--	--	--
NQ	ROBERT74	NQ-R16	47	8	--	122	40	30	--	--	--
NQ	ROBERT74	NQ-S01	47	6	42	122	43	18	--	--	--
NQ	ROBERT74	NQ-S02	47	6	42	122	43	12	--	--	--
NQ	ROBERT74	NQ-S03	47	6	36	122	43	6	--	--	--
NQ	ROBERT74	NQ-S04	47	6	24	122	43	--	--	--	--
NQ	ROBERT74	NQ-S06	47	6	18	122	43	--	--	--	--
NQ	ROBERT74	NQ-S07	47	6	18	122	43	6	--	--	--
NQ	ROBERT74	NQ-S08	47	6	12	122	43	6	--	--	--
NQ	ROBERT74	NQ-S09	47	6	12	122	43	18	--	--	--
NQ	ROBERT74	NQ-S10	47	6	--	122	43	6	--	--	--
NQ	ROBERT74	NQ-S11	47	5	54	122	43	18	--	--	--
NQ	ROBERT74	NQ-S12	47	6	36	122	43	30	--	--	--
NQ	ROBERT74	NQ-S13	47	6	48	122	43	24	--	--	--
NQ	ROBERT74	NQ-S14	47	6	42	122	42	36	--	--	--
NQ	ROBERT74	NQ-S15	47	6	24	122	42	36	--	--	--
NQ	ROBERT74	NQ-S16	47	6	42	122	42	24	--	--	--
NQ	ROBERT74	NQ-S17	47	6	42	122	42	12	--	--	--
NQ	ROBERT74	NQ-S18	47	6	36	122	41	48	--	--	--
NQ	ROBERT74	NQ-S2156	47	6	12	122	42	6	--	--	--
NQ	ROBERT74	NQ-S22	47	6	12	122	42	12	--	--	--
NQ	ROBERT74	NQ-S23	47	6	--	122	42	24	--	--	--
NQ	ROBERT74	NQ-S24	47	6	12	122	42	18	--	--	--
OH	88PSRECN	OH-1	48	16	19.8	122	38	39.6	--	--	-13.7
OH	88PSRECN	OH-2	48	16	40.2	122	38	58.8	--	--	-3.7
OH	88PSRECN	OH-3	48	17	2.4	122	38	43.8	--	--	-4.6
OH	88PSRECN	OH-4	48	16	59.4	122	38	25.2	--	--	-3.7
OH	88PSRECN	OH-5	48	17	1.2	122	38	9.6	--	--	-4
OH	88PSRECN	OH-6	48	17	7.8	122	38	15	--	--	-5.2
OH	OAKHRBR	OH-A1	--	--	--	--	--	--	--	--	-0.4
OH	OAKHRBR	OH-A2	--	--	--	--	--	--	--	--	-0.5
OH	OAKHRBR	OH-A3	--	--	--	--	--	--	--	--	-0.5
OH	OAKHRBR	OH-A4	--	--	--	--	--	--	--	--	-2.2
OH	OAKHRBR	OH-B	--	--	--	--	--	--	--	--	--
OH	OAKHRBR	OH-B1	--	--	--	--	--	--	--	--	-2.2
OH	OAKHRBR	OH-B2	--	--	--	--	--	--	--	--	-2
OH	OAKHRBR	OH-B3	--	--	--	--	--	--	--	--	-2.2
OH	OAKHRBR	OH-B4	--	--	--	--	--	--	--	--	-2
OH	OAKHRBR	OH-C	--	--	--	--	--	--	--	--	--
OH	OAKHRBR	OH-C1	--	--	--	--	--	--	--	--	-3

TABLE C-14. (Continued) LOCATIONS AND ELEVATIONS FOR POTENTIAL PUGET SOUND REFERENCE STATIONS.

Basin Code	Survey	Station	Latitude Degrees	Minutes	Seconds	Longitude Degrees	Minutes	Seconds	State Plane Coordinates South Zone East	North	Elevation (meters)
OH	OAKHRBR	OH-C2	--	--	--	--	--	--	--	--	-3.2
OH	OAKHRBR	OH-C3	--	--	--	--	--	--	--	--	-3
OH	OAKHRBR	OH-C4	--	--	--	--	--	--			-3
OH	OAKHRBR	OH-D1	--	--	--	--	--	--	--	--	-2.6
OH	OAKHRBR	OH-D2	--	--	--	--	--	--	--	--	-2.9
OH	OAKHRBR	OH-D3	--	--	--	--	--	--	--	--	-3
OH	OAKHRBR	OH-D4	--	--	--	--	--	--	--	--	-3
PD	BARRICK	PD-78	--	--	--	--	--	--	--	--	--
PD	REFGRAIN	PD-01	--	--	--	--	--	--	--	--	--
PP	ROBERT74	PP-001	47	15	42	122	55	18	--	--	--
PP	ROBERT74	PP-002	47	17	36	122	52	48	--	--	--
PP	ROBERT74	PP-008	47	15	12	122	50	6	--	--	-16
PM	88PSRECN	PM-S9	47	43	59.4	122	31	45.6	--	--	-29.9
PM	MALINS	PM-06	--	--	--	--	--	--	--	--	-210
PM	MALINS	PM-07	--	--	--	--	--	--	--	--	-22.5
PM	REFGRAIN	PM-87	47	42	40.8	122	31	33	--	--	-15
PM	REFGRAIN	PM-88	47	43	13.2	122	32	24	--	--	-18
PM	REFGRAIN	PM-89	47	44	6.6	122	32	30	--	--	-28
PM	REFGRAIN	PM-90	47	44	33	122	31	36	--	--	-18
PM	REFGRAIN	PM-91	47	43	24	122	31	16.8	--	--	-61
PM	REFGRAIN	PM-92	47	43	37.2	122	30	36	--	--	-88
PM	ROBERT74	PM1-141	47	44	6	122	30	18	--	--	-24
PM	ROBERT74	PM1-255	47	42	48	122	31	24	--	--	-4
PM	ROBERT74	PM1-303	47	44	--	122	32	--	--	--	-25
PM	ROBERT74	PM1-321	47	43	18	122	31	30	--	--	-60
PM	ROBERT74	PM2-255	47	43	18	122	30	18	--	--	-84
PM	ROBERT74	PM2-303	47	43	36	122	32	24	--	--	-38
PM	ROBERT74	PM3-283	47	42	42	122	30	6	--	--	-38
PM	ROBERT74	PM3-303	47	43	6	122	30	54	--	--	-63
PM	ROBERT74	PM4-303	47	44	6	122	30	24	--	--	-18
PM	ROBERT74	PM6-283	47	43	12	122	32	6	--	--	-27
PM	ROBERT74	PM7-283	47	44	--	122	31	30	--	--	-64
PM	ROBERT74	PM7-352	47	43	30	122	29	30	--	--	--
PM	ROBERT74	PM8-283	47	43	12	122	29	24	--	--	-134
PM	ROBERT74	PM-00C	47	44	6	122	31	48	--	--	-26
PM	ROBERT74	PM-012	47	44	6	122	29	6	--	--	-15
PM	ROBERT74	PM-039	47	44	--	122	31	54	--	--	-22
PM	ROBERT74	PM-040	47	44	30	122	32	36	--	--	-10
PM	ROBERT74	PM-0A0	47	44	6	122	31	54	--	--	-22
PM	ROBERT74	PM-0K0	47	44	30	122	32	42	--	--	-12
PM	ROBERT74	PM-120	47	43	12	122	30	--	--	--	-129
PM	ROBERT74	PM-41	47	42	54	122	32	12	--	--	-24
PM	ROBERT74	PM-A0	47	44	24	122	30	--	--	--	-10
PM	ROBERT74	PM-A20	47	44	12	122	30	--	--	--	-20
PM	ROBERT74	PM-A30	47	44	6	122	30	--	--	--	-30
PM	ROBERT74	PM-A60	47	43	54	122	30	--	--	--	-60
PM	ROBERT74	PM-A90	47	43	42	122	30	--	--	--	-90
PM	ROBERT74	PM-AA	47	44	36	122	32	42	--	--	-2
PM	ROBERT74	PM-AB	47	44	6	122	32	--	--	--	-25
PM	ROBERT74	PM-B10	47	44	12	122	30	48	--	--	-10
PM	ROBERT74	PM-B20	47	44	6	122	30	48	--	--	-20

TABLE C-14. (Continued) LOCATIONS AND ELEVATIONS FOR POTENTIAL PUGET SOUND REFERENCE STATIONS.

Basin Code	Survey	Station	Latitude Degrees	Latitude Minutes	Latitude Seconds	Longitude Degrees	Longitude Minutes	Longitude Seconds	State Plane Coordinates South Zone East	State Plane Coordinates South Zone North	Elevation (meters)
PM	ROBERT74	PM-B30	47	43	48	122	30	48	--	--	-30
PM	ROBERT74	PM-BCD	47	44	12	122	32	6	--	--	-30
PM	ROBERT74	PM-C10	47	44	24	122	29	42	--	--	-10
PM	ROBERT74	PM-C20	47	44	12	122	29	48	--	--	-20
PM	ROBERT74	PM-C30	47	44	6	122	29	48	--	--	-30
PM	ROBERT74	PM-E0F	47	44	12	122	32	12	--	--	-32
PM	ROBERT74	PM-G	47	44	24	122	32	24	--	--	-23
PM	ROBERT74	PM-H	47	44	24	122	32	30	--	--	-18
PM	ROBERT74	PM-J	47	44	30	122	32	36	--	--	-14
PM	TPPS3AB	PM-71	47	44	18	122	32	19	--	--	-18
PM	TPPS3AB	PM-72	47	44	5	122	32	18	--	--	-37
PM	TPPS3AB	PM-73	47	43	31	122	30	12	--	--	-92
PO	BARRICK	PO-52	--	--	--	--	--	--	--	--	--
PO	ROBERT74	PO-042	47	41	--	122	35	42	--	--	-16
PO	ROBERT74	PO-043	47	38	12	122	35	--	--	--	-40
PO	ROBERT74	PO-044	47	34	48	122	35	12	--	--	-43
PR	88PSRECN	PR-S10E	47	46	45.6	122	23	56.4	--	--	-20.7
PR	88PSRECN	PR-S10W	47	46	19.8	122	28	16.2	--	--	-20.7
PR	MISCREFS	PR-1	--	--	--	--	--	--	--	--	--
PS	88PSRECN	PS-S6	48	9	54.6	122	25	1.8	--	--	-42.7
PS	88PSRECN	PS-S6	48	9	54.6	122	25	1.8	--	--	-42.7
PS	88PSRECN	PS-S7E	48	4	47.4	122	19	19.2	--	--	-16.2
PS	88PSRECN	PS-S7W	48	3	40.8	122	21	15	--	--	-16.2
PS	CREC72	PS-01	48	8	56	122	24	12	--	--	-116
PS	CREC72	PS-02	48	7	30	123	24	36	--	--	-14
PS	EBCHEM	PS-01	--	--	--	--	--	--	1601400	432100	--
PS	EBCHEM	PS-02	--	--	--	--	--	--	1613900	418700	--
PS	EBCHEM	PS-03	--	--	--	--	--	--	1618600	411600	--
PS	EBCHEM	PS-04	--	--	--	--	--	--	1602250	406300	--
PS	EVCHEM	PS-02	48	8	8.72	122	26	13.18	--	--	--
PS	EVCHEM	PS-03	48	6	57.77	122	24	46.36	--	--	--
PS	EVCHEM	PS-04	48	5	59.54	122	23	25.88	--	--	--
PS	PSDDA1	PSR01	48	5	19.8	122	21	10.8	--	--	-127
PS	ROBERT74	PS-002	48	8	42	122	24	12	--	--	-116
PS	ROBERT74	PS-E05	48	2	36	122	18	24	--	--	-101
PSD	BARRICK	PS-98	--	--	--	--	--	--	--	--	--
PSD	CREC72	PSD-1	47	55	24	122	20	48	--	--	-186
PSD	MALINS	PS-00	--	--	--	--	--	--	--	--	-14
PSD	MALINS	PS-25	--	--	--	--	--	--	--	--	-25
PSD	PSDDA1	PGB02	47	58	30	122	20	--	--	--	-163
PSD	ROBERT74	PSD-019	47	55	24	122	20	48	--	--	-186
PSD	ROBERT74	PSD-033	47	53	6	122	21	24	--	--	-214
PSD	TPPS3AB	PSD-11	47	49	48	122	23	45	--	--	--
QM	CREC72	QM-01	47	22	54	122	28	6	--	--	-14
QM	CREC72	QM-02	47	22	24	122	28	24	--	--	-14
QM	QMHARBOR	QM-A	--	--	--	--	--	--	--	--	-4
QM	QMHARBOR	QM-B	--	--	--	--	--	--	--	--	-5.5
QM	QMHARBOR	QM-C	--	--	--	--	--	--	--	--	-4.9
QM	ROBERT74	QM-026	47	22	42	122	28	18	--	--	-18
QM	SEAHBASE	QM-1	47	23	57	122	27	29	--	--	-7
QM	SEAHBASE	QM-2	47	22	28	122	28	18	--	--	-16.2

TABLE C-14. (Continued) LOCATIONS AND ELEVATIONS FOR POTENTIAL PUGET SOUND REFERENCE STATIONS.

Basin Code	Survey	Station	Latitude Degrees	Latitude Minutes	Latitude Seconds	Longitude Degrees	Longitude Minutes	Longitude Seconds	State Plane Coordinates South Zone East	State Plane Coordinates South Zone North	Elevation (meters)
RP	LIBERT88	RP-CB	--	--	--	--	--	--	--	--	--
RS	BARRICK	RS-65	--	--	--	--	--	--	--	--	--
SK	BARRICK	SK-95	--	--	--	--	--	--	--	--	--
SK	CREC72	SK-01	48	20	30	122	32	6	--	--	-30
SK	CREC72	SK-02	48	17	48	122	29	12	--	--	-25
SK	PTGARQC	SWIN-5	--	--	--	--	--	--	--	--	--
SK	PTGARQC	SWIN-6	--	--	--	--	--	--	--	--	--
SK	PTGARQC	SWIN-7	--	--	--	--	--	--	--	--	--
SK	PTGARQC	SWIN-8	--	--	--	--	--	--	--	--	--
SK	ROBERT74	SK-005	48	17	48	122	29	12	--	--	-25
SK	ROBERT74	SK-006	48	20	30	122	32	6	--	--	-30
SM	EIGHTBAY	SM-01	48	38	38	122	31	5	--	--	-13.4
SM	EIGHTBAY	SM-03	48	37	52	122	29	22	--	--	-10.1
SM	EIGHTBAY	SM-07	48	36	31	122	32	12	--	--	-23.5
SM	EIGHTBAY	SM-20	48	36	2	122	32	39	--	--	-30.5
SM	NOADW86	SAMISH	48	36	10	122	32	37	--	--	--
SM	REFGRAIN	SM-11	48	37	29	122	29	24	--	--	-14.8
SM	REFGRAIN	SM-12	48	36	38	122	29	33	--	--	-16.1
SQ	DUWRIV1	SQ-09	--	--	--	--	--	--	--	--	--
SQ	DUWRIV2	SQ-21	--	--	--	--	--	--	--	--	--
SQ	EIGHTBAY	SQ-14	48	4	34	123	1	25	--	--	-23.8
SQ	EIGHTBAY	SQ-17	48	3	41	123	1	20	--	--	-25.6
SQ	EIGHTBAY	SQ-18	48	3	25	123	1	28	--	--	-24.7
SQ	EIGHTBAY	SQ-20	48	2	50	123	1	21	--	--	-18.9
SQ	KENM86	SEQUIM	--	--	--	--	--	--	--	--	--
SQ	NOADW86	SEQUIM17	48	3	33	123	1	16	--	--	--
SQ	OAKHRBR	SEQUIM	--	--	--	--	--	--	--	--	--
SQ	OLYHAR88	SQ-01	--	--	--	--	--	--	--	--	--
TN	CREC72	TN-01	47	12	54	122	37	18	--	--	-140
TN	CREC72	TN-02	47	11	24	122	37	18	--	--	-180
TN	MISCREFS	TN-59	--	--	--	--	--	--	--	--	--
TN	MISCREFS	TN-7	--	--	--	--	--	--	--	--	--
TN	RILEY001	NG-12	47	10	30	122	39	12	--	--	-148
TN	ROBERT74	TN-017	47	10	48	122	38	54	--	--	-163
TN	ROBERT74	TN-N06	47	10	42	122	38	18	--	--	-179
WB	88PSRECN	WB	--	--	--	--	--	--	--	--	--
WB	EPAPS88	WB	--	--	--	--	--	--	--	--	--
WB	KENM86	WHIDBEY	--	--	--	--	--	--	--	--	--
WB	NOADW86	CPSD	48	23	35	122	39	51	--	--	--
WB	OAKHRBR	WHIDBEY	--	--	--	--	--	--	--	--	--
WB	OLYHAR88	WB-01	--	--	--	--	--	--	--	--	--
WO	RILEY001	NG-8	47	16	48	122	35	36	--	--	-18
WO	ROBERT74	WO-025	47	16	48	122	35	36	--	--	-16
										0	
INTERTIDAL STATIONS										0	
										0	
AB	BROWN7	AB-01	--	--	--	--	--	--	--	--	0.6
AB	BROWN7	AB-01	--	--	--	--	--	--	--	--	0.6
AB	BROWN7	AB-01	--	--	--	--	--	--	--	--	0.6
BB	BROWN7	BB-01	--	--	--	--	--	--	--	--	0.6
BB	BROWN7	BB-01	--	--	--	--	--	--	--	--	0.6

TABLE C-14. (Continued) LOCATIONS AND ELEVATIONS FOR POTENTIAL PUGET SOUND REFERENCE STATIONS.

Basin Code	Survey	Station	Latitude			Longitude			State Plane Coordinates South Zone		Elevation (meters)
			Degrees	Minutes	Seconds	Degrees	Minutes	Seconds	East	North	
BB	BROWN7	BB-01	--	--	--	--	--	--	--	--	0.6
DS	BROWN7	DS-01	--	--	--	--	--	--	--	--	0.6
DS	BROWN7	DS-01	--	--	--	--	--	--	--	--	0.6
DS	BROWN7	DS-01	--	--	--	--	--	--	--	--	0.6
PS	EBCHEM	PS-05	--	--	--	--	--	--	1602250	426650	0
QM	SEAHBASE	QM-D	47	21	18	122	28	56	--	--	0
WB	SEAHBASE	WB-18	--	--	--	--	--	--	--	--	0

APPENDIX D

COMPARISON OF HISTORICAL CHEMICAL DATA TO SEDIMENT QUALITY VALUES

SEDIMENT QUALITY VALUES COMPARISON

Date: 06/10/89

1988 LAET (lowest of Amphipod toxicity, Benthic infauna abundance, Microtox bioassay, and Oyster larvae bioassay AET) and PSDDA Screening Level (PSL) predicting effects at all reference area stations.

The sediment quality criteria used for the test are:
- Amphipod toxicity AET.
- Benthic infauna abundance AET.
- Lowest of AMPT, BENA, MICB, and OYST.
- Microtox bioassay AET.
- Oyster larvae toxicity AET.
- PSDDA Screening Level.

The values used are based on:
- Original values, no modification or transformation.

Data columns in the output identify, in order from left to right:
- Chemical name
- Concentration
- Measurement units
- Qualifier code of the chemical measurement
- Measurement basis
- Factor by which the concentration exceeds the AET

If an asterisk appears, the AET value was qualified with a "G."

Survey: EHCHEM Station: BH-01

Date: 06/01/85 Sample ID: B1

Lowest of AMPT, BENA, MICB, and OYST.

BUTYL BENZYL PHTHALATE	160	PPB Q	DRY	2.54

PSDDA Screening Level.

DIETHYL PHTHALATE	130	PPB	DRY	1.34
FLUORENE	130	PPB	DRY	2.03
POLYCYCLIC AROMATIC HYDROCARBON-LIGHT	750	PPB	DRY	1.23
PHENANTHRENE	340	PPB	DRY	1.06
PHENOL	190	PPB	DRY	1.58

Survey: EHCHEM Station: BH-02

Date: 06/01/85 Sample ID: B1

Lowest of AMPT, BENA, MICB, and OYST.

BUTYL BENZYL PHTHALATE	140	PPB Q	DRY	2.22

PSDDA Screening Level.

2,4-DIMETHYL PHENOL	18	PPB	DRY	1.80
DIETHYL PHTHALATE	200	PPB	DRY	2.06

Survey: DYES88 Station: DY-2

Date: 04/21/88 Sample ID: DY-2

PSDDA Screening Level.

CADMIUM	1.1	PPM	DRY	1.15
INDENO(1,2,3-CD)PYRENE	86	PPB	DRY	1.25
MERCURY	0.39	PPM	DRY	1.86
NICKEL	43	PPM	DRY	1.54

Survey: DYES88 Station: DY-3

Date: 04/22/88 Sample ID: DY-3

PSDDA Screening Level.

MERCURY	0.32	PPM	DRY	1.52
NICKEL	42	PPM	DRY	1.50

Survey: DYES88 Station: DY-4

Date: 04/22/88 Sample ID: DY-4

Lowest of AMPT, BENA, MICB, and OYST.

MERCURY	0.72	PPM	DRY	1.76

PSDDA Screening Level.

ACENAPHTHYLENE	87	PPB	DRY	1.36
CADMIUM	0.97	PPM	DRY	1.01
COPPER	90	PPM	DRY	1.11
INDENO(1,2,3-CD)PYRENE	160	PPB	DRY	2.32
LEAD	79	PPM	DRY	1.20
MERCURY	0.72	PPM	DRY	3.43
NICKEL	60	PPM	DRY	2.14

ZINC	170	PPM	DRY	1.06

Survey: DYES88 Station: DY-5

Date: 04/22/88 Sample ID: DY-5

Lowest of AMPT, BENA, MICB, and OYST.

MERCURY	0.66	PPM	DRY	1.61

PSDDA Screening Level.

CADMIUM	1.4	PPM	DRY	1.46
INDENO(1,2,3-CD)PYRENE	94	PPB	DRY	1.36
MERCURY	0.66	PPM	DRY	3.14
NICKEL	58	PPM	DRY	2.07

Survey: DYES88 Station: DY-6

Date: 04/22/88 Sample ID: DY-6

Lowest of AMPT, BENA, MICB, and OYST.

MERCURY	0.79	PPM	DRY	1.93

PSDDA Screening Level.

CADMIUM	1.1	PPM	DRY	1.15
INDENO(1,2,3-CD)PYRENE	120	PPB	DRY	1.74
LEAD	74	PPM	DRY	1.12
MERCURY	0.79	PPM	DRY	3.76
NICKEL	62	PPM	DRY	2.21

Survey: 88PSRECN Station: DY-1

Date: 04/21/88 Sample ID: DY-1

PSDDA Screening Level.

INDENO(1,2,3-CD)PYRENE	86	PPB	DRY	1.25

Survey: 88PSRECN Station: DY-2

Date: 04/21/88 Sample ID: DY-2

PSDDA Screening Level.

CADMIUM	1.1	PPM	DRY	1.15
MERCURY	0.39	PPM Z	DRY	1.86
NICKEL	43	PPM	DRY	1.54

Survey: 88PSRECN Station: DY-3

Date: 04/22/88 Sample ID: DY-3

PSDDA Screening Level.

MERCURY	0.32	PPM Z	DRY	1.52
NICKEL	42	PPM	DRY	1.50

Survey: 88PSRECN Station: DY-4

Date: 04/22/88 Sample ID: DY-4

Lowest of AMPT, BENA, MICB, and OYST.

MERCURY	0.72	PPM Z	DRY	1.76

PSDDA Screening Level.

ACENAPHTHENE	87	PPB	DRY	1.38
CADMIUM	0.97	PPM	DRY	1.01
COPPER	90	PPM	DRY	1.11
POLYCYCLIC AROMATIC HYDROCARBON-HEAVY	2300	PPB	DRY	1.28
INDENO(1,2,3-CD)PYRENE	160	PPB	DRY	2.32
LEAD	79	PPM	DRY	1.20
MERCURY	0.72	PPM Z	DRY	3.43
NICKEL	60	PPM	DRY	2.14
ZINC	170	PPM	DRY	1.06

Survey: 88PSRECN Station: DY-5

Date: 04/22/88 Sample ID: DY-5

Lowest of AMPT, BENA, MICB, and OYST.

MERCURY	0.66	PPM Z	DRY	1.61

PSDDA Screening Level.

CADMIUM	1.4	PPM	DRY	1.46

INDENO(1,2,3-CD)PYRENE	94	PPB	DRY	1.36
MERCURY	0.66	PPM Z	DRY	3.14
NICKEL	58	PPM	DRY	2.07

Survey: 88PSRECN Station: DY-6

Date: 04/22/88 Sample ID: DY-6

Lowest of AMPT, BENA, MICB, and OYST.

MERCURY	0.79	PPM Z	DRY	1.93

PSDDA Screening Level.

CADMIUM	1.1	PPM	DRY	1.15
INDENO(1,2,3-CD)PYRENE	120	PPB	DRY	1.74
LEAD	74	PPM	DRY	1.12
MERCURY	0.79	PPM Z	DRY	3.76
NICKEL	62	PPM	DRY	2.21

Survey: MALINS Station: PM-06

Date: 01/01/79 Sample ID: 08106

Lowest of AMPT, BENA, MICB, and OYST.

CADMIUM	6.3	PPM	DRY	1.24

PSDDA Screening Level.

CADMIUM	6.3	PPM	DRY	6.56
NICKEL	42	PPM	DRY	1.50
SILVER	2.0	PPM	DRY	1.67

Survey: MALINS Station: PM-07

Date: 01/01/79 Sample ID: 08107

PSDDA Screening Level.

CADMIUM	3.1	PPM	DRY	3.23
SILVER	1.5	PPM	DRY	1.25

Survey: TPPS3AB Station: PM-71

Date: 10/01/82 Sample ID: 2147

Lowest of AMPT, BENA, MICB, and OYST.

DI-N-OCTYL PHTHALATE	2200	PPB	DRY	88.00
DI-N-BUTYL PHTHALATE	3900	PPB	DRY	2.79

PSDDA Screening Level.

DI-N-BUTYL PHTHALATE	3900	PPB	DRY	2.79
INDENO(1,2,3-CD)PYRENE	98	PPB	DRY	1.42

Survey: TPPS3AB Station: PM-72

Date: 10/01/82 Sample ID: 2146

Lowest of AMPT, BENA, MICB, and OYST.

DI-N-OCTYL PHTHALATE	710	PPB	DRY	28.40

Survey: TPPS3AB Station: PM-73

Date: 10/01/82 Sample ID: 2145

Lowest of AMPT, BENA, MICB, and OYST.

DI-N-OCTYL PHTHALATE	3200	PPB	DRY	128.00

PSDDA Screening Level.

INDENO(1,2,3-CD)PYRENE	77	PPB L	DRY	1.12
NICKEL	30	PPM	DRY	1.07

Survey: MISCREFS Station: PR-1

Date: 12/01/83 Sample ID: PR-1

PSDDA Screening Level.

ANTHRACENE	150	PPB	DRY	1.15

Survey: EBCHEM Station: PS-01

Date: 10/12/85 Sample ID: PS-01 Field rep: 1

PSDDA Screening Level.

ANTIMONY (SB)	2.7	PPM	DRY	1.04
NICKEL	140	PPM	DRY	5.00

Date: 10/12/85 Sample ID: PS-01 Field rep: 2

PSDDA Screening Level.

ANTIMONY (SB)	2.9	PPM	DRY	1.12
NICKEL	140	PPM	DRY	5.00

Survey: EBCHEM Station: PS-02

Date: 10/12/85 Sample ID: PS-02

Lowest of AMPT, BENA, MICB, and OYST.

DI-N-OCTYL PHTHALATE	56	PPB E	DRY	2.24

PSDDA Screening Level.

NICKEL	82	PPM	DRY	2.93

Survey: EBCHEM Station: PS-03

Date: 10/12/85 Sample ID: PS-03

PSDDA Screening Level.

NICKEL	66	PPM	DRY	2.36

Survey: EBCHEM Station: PS-04

Date: 10/12/85 Sample ID: PS-04

PSDDA Screening Level.

NICKEL	63	PPM	DRY	2.25

Survey: EBCHEM Station: PS-05

Date: 10/15/85 Sample ID: PS-05

Lowest of AMPT, BENA, MICB, and OYST.

DIBENZO(A,H)ANTHRACENE	390	PPB E	DRY	1.70
ANTHRACENE	1100	PPB	DRY	1.15
BENZO(A)ANTHRACENE	2500	PPB	DRY	1.92
BENZO(A)PYRENE	1900	PPB E	DRY	1.19
BENZO(G,H,I)PERYLENE	1300	PPB E	DRY	1.94
CHRYSENE	6000	PPB	DRY	4.29
FLUORANTHENE	5000	PPB	DRY	2.94
POLYCYCLIC AROMATIC HYDROCARBON-HEAVY	28000	PPB E	DRY	2.33
INDENO(1,2,3-CD)PYRENE	1000	PPB E	DRY	1.67
PYRENE	4500	PPB	DRY	1.73
TOTAL BENZOFLUORANTHENES (B + K)	5200	PPB	DRY	1.63

PSDDA Screening Level.

2-METHYLNAPHTHALENE	75	PPB E	DRY	1.12
DIBENZO(A,H)ANTHRACENE	390	PPB E	DRY	3.25
ACENAPHTHENE	130	PPB E	DRY	2.06
ACENAPHTHYLENE	490	PPB E	DRY	7.66
ANTHRACENE	1100	PPB	DRY	8.46
BENZO(A)ANTHRACENE	2500	PPB	DRY	5.56
BENZO(A)PYRENE	1900	PPB E	DRY	2.79
BENZO(G,H,I)PERYLENE	1300	PPB E	DRY	2.41
CHRYSENE	6000	PPB	DRY	8.96
DIBENZOFURAN	130	PPB E	DRY	2.41
FLUORANTHENE	5000	PPB	DRY	7.94
FLUORENE	270	PPB E	DRY	4.22
POLYCYCLIC AROMATIC HYDROCARBON-HEAVY	28000	PPB E	DRY	15.56
INDENO(1,2,3-CD)PYRENE	1000	PPB E	DRY	14.49
POLYCYCLIC AROMATIC HYDROCARBON-LIGHT	3600	PPB E	DRY	5.90
NICKEL	100	PPM	DRY	3.57
PHENANTHRENE	1500	PPB	DRY	4.69
PHENOL	400	PPB E	DRY	3.33
PYRENE	4500	PPB	DRY	10.47
TOTAL BENZOFLUORANTHENES (B + K)	5200	PPB	DRY	6.50

Survey: EVCHEM Station: PS-02

Date: 10/13/86 Sample ID: PS-02G Field rep: PS02

PSDDA Screening Level.

4-METHYL PHENOL	290	PPB	DRY	2.42
NICKEL	59	PPM	DRY	2.11
PHENOL	200	PPB Z	DRY	1.67

Survey: EVCHEM Station: PS-03

Date: 10/13/86 Sample ID: PS-03G Field rep: PS03

PSDDA Screening Level.

NICKEL	65	PPM	DRY	2.32

Survey: EVCHEM Station: PS-04

Date: 10/10/86 Sample ID: PS-04G Field rep: PS04

PSDDA Screening Level.

4-METHYL PHENOL	140	PPB	DRY	1.17
NICKEL	41	PPM	DRY	1.46
PHENOL	140	PPB Z	DRY	1.17

Survey: PSDDA1 Station: PSR01

Date: 05/23/88 Sample ID: PSR01C

Lowest of AMPT, BENA, MICB, and OYST.

SULFIDES	49	PPM	DRY	1.09

PSDDA Screening Level.

NICKEL	100	PPM	DRY	3.57

Survey: LIBERT88 Station: RP-CB

Date: 09/16/75 Sample ID: CB

PSDDA Screening Level.

ANTIMONY (SB)	3.5	PPM	DRY	1.35
CADMIUM	1.0	PPM	DRY	1.04

Survey: OAKHRBR Station: WHIDBEY

Date: 02/26/85 Sample ID: WHIDBEY

PSDDA Screening Level.

CHRYSENE	690	PPB	DRY	1.03

Survey: EPAPS88 Station: WB

Date: 05/01/88 Sample ID: WB

PSDDA Screening Level.

NICKEL	35	PPM	DRY	1.25

Survey: OLYHAR88 Station: WB-01

Date: 01/01/88 Sample ID: WB-01

PSDDA Screening Level.

NICKEL	33	PPM	DRY	1.18

Survey: EIGHTBAY Station: DB-05

Date: 05/22/84 Sample ID: DB-05

PSDDA Screening Level.

NICKEL	30	PPM	DRY	1.07

Survey: EIGHTBAY Station: DB-07

Date: 05/22/84 Sample ID: DB-07

PSDDA Screening Level.

NICKEL	33	PPM	DRY	1.18

Survey: EIGHTBAY Station: DB-15

Date: 05/22/84 Sample ID: DB-15

PSDDA Screening Level.

NICKEL	46	PPM	DRY	1.64

Survey: NOADW86 Station: DABOB

Date: 05/01/86 Sample ID: DABOB

PSDDA Screening Level.

NICKEL	31	PPM	DRY	1.11

Survey: NOADW86 Station: DISCOVRY

Date: 05/01/86 Sample ID: DISCOVRY

PSDDA Screening Level.

CADMIUM	1.0	PPM	DRY	1.04

Survey: PSDDA1 Station: PGB02

Date: 05/23/88 Sample ID: PGB02C

PSDDA Screening Level.

NICKEL	55	PPM	DRY	1.96

Survey: MALINS Station: PS-00

Date: 06/01/80 Sample ID: 50200

Lowest of AMPT, BENA, MICB, and OYST.

MERCURY	0.58	PPM E	DRY	1.41

PSDDA Screening Level.

MERCURY	0.58	PPM E	DRY	2.76

Survey: MALINS Station: PS-25

Date: 06/01/80 Sample ID: 50225

PSDDA Screening Level.

MERCURY	0.36	PPM E	DRY	1.71

Survey: TPPS3AB Station: PSD-11

Date: 03/04/81 Sample ID: 561

PSDDA Screening Level.

ANTIMONY (SB)	13	PPM	DRY	5.00
NICKEL	33	PPM	DRY	1.18

Survey: BARRICK Station: PS-98

Date: 01/01/85 Sample ID: 98

Lowest of AMPT, BENA, MICB, and OYST.

PERYLENE	260	PPB	DRY	1.13

Survey: LIBERT88 Station: HC-MP

Date: 09/16/75 Sample ID: MP

PSDDA Screening Level.

CADMIUM	1.2	PPM	DRY	1.25
NICKEL	51	PPM	DRY	1.82

Survey: NOAA84 Station: NISQ1

Date: 10/15/84 Sample ID: NISQ1 Field rep: 1

Lowest of AMPT, BENA, MICB, and OYST.

MERCURY	0.94	PPM	DRY	2.29

PSDDA Screening Level.

MERCURY	0.94	PPM	DRY	4.48
SILVER	3.9	PPM	DRY	3.25

Survey: NOAA84 Station: NISQ2

Date: 10/15/84 Sample ID: NISQ2 Field rep: 1

PSDDA Screening Level.

NICKEL	37	PPM	DRY	1.32

Survey: NOAA84 Station: NISQ3

Date: 10/15/84 Sample ID: NISQ3 Field rep: 1

PSDDA Screening Level.

NICKEL	29	PPM	DRY	1.04
SILVER	2.8	PPM	DRY	2.33

Survey: OAKHRBR Station: OH-B1

Date: 02/26/85 Sample ID: OH-B1

Lowest of AMPT, BENA, MICB, and OYST.

SULFIDES	59	PPM	DRY	1.31

Survey: OAKHRBR Station: OH-B2

Date: 02/26/85 Sample ID: OH-B2

Lowest of AMPT, BENA, MICB, and OYST.

SULFIDES	83	PPM	DRY	1.84

Survey: OAKHRBR Station: OH-B3

Date: 02/26/85 Sample ID: OH-B3

Lowest of AMPT, BENA, MICB, and OYST.

SULFIDES	74	PPM	DRY	1.64

Survey: OAKHRBR Station: OH-B4

Date: 02/26/85 Sample ID: OH-B4

Lowest of AMPT, BENA, MICB, and OYST.

SULFIDES	170	PPM	DRY	3.78

Survey: OAKHRBR Station: OH-C2

Date: 02/26/85 Sample ID: OH-C2

Lowest of AMPT, BENA, MICB, and OYST.

SULFIDES	84	PPM	DRY	1.87

Survey: OAKHRBR Station: OH-C3

Date: 02/26/85 Sample ID: OH-C3

Lowest of AMPT, BENA, MICB, and OYST.

MERCURY	0.62	PPM	DRY	1.51
SULFIDES	130	PPM	DRY	2.89

PSDDA Screening Level.

MERCURY	0.62	PPM	DRY	2.95

Survey: OAKHRBR Station: OH-D1

Date: 02/26/85 Sample ID: OH-D1

Lowest of AMPT, BENA, MICB, and OYST.

SULFIDES	75	PPM	DRY	1.67

PSDDA Screening Level.

PYRENE	780	PPB	DRY	1.81

Survey: OAKHRBR Station: OH-D2

Date: 02/26/85 Sample ID: OH-D2

PSDDA Screening Level.

PYRENE	670	PPB	DRY	1.56

Survey: OAKHRBR Station: OH-AL

Date: 02/26/85 Sample ID: OH-AL

Lowest of AMPT, BENA, MICB, and OYST.

PERYLENE	370	PPB	DRY	1.61

PSDDA Screening Level.

PYRENE	720	PPB	DRY	1.67

Survey: OAKHRBR Station: OH-B

Date: 02/26/85 Sample ID: OH-B

PSDDA Screening Level.

PYRENE	670	PPB	DRY	1.56

Survey: OAKHRBR Station: OH-C

Date: 02/26/85 Sample ID: OH-C

Lowest of AMPT, BENA, MICB, and OYST.

BENZO(A)ANTHRACENE	1400	PPB	DRY	1.08
CHRYSENE	1600	PPB	DRY	1.14
FLUORANTHENE	4600	PPB	DRY	2.71
POLYCYCLIC AROMATIC HYDROCARBON-HEAVY	16000	PPB	DRY	1.33
PYRENE	4100	PPB	DRY	1.58

PSDDA Screening Level.

BENZO(A)ANTHRACENE	1400	PPB	DRY	3.11
BENZO(A)PYRENE	1100	PPB	DRY	1.62
CHRYSENE	1600	PPB	DRY	2.39
FLUORANTHENE	4600	PPB	DRY	7.30
POLYCYCLIC AROMATIC HYDROCARBON-HEAVY	16000	PPB	DRY	8.89

POLYCYCLIC AROMATIC HYDROCARBON-LIGHT	720	PPB	DRY	1.18
MERCURY	0.4	PPM	DRY	1.90
PHENANTHRENE	720	PPB	DRY	2.25
PYRENE	4100	PPB	DRY	9.53
TOTAL BENZOFLUORANTHENES (B + K)	2900	PPB	DRY	3.63

Survey: 88PSRECN Station: OH-1

Date: 04/28/88 Sample ID: OH-1

PSDDA Screening Level.

MERCURY	0.28	PPM Z	DRY	1.33

Survey: 88PSRECN Station: OH-2

Date: 04/28/88 Sample ID: OH-2

PSDDA Screening Level.

MERCURY	0.25	PPM Z	DRY	1.19
NICKEL	35	PPM	DRY	1.25

Survey: 88PSRECN Station: OH-3

Date: 04/28/88 Sample ID: OH-3

PSDDA Screening Level.

NICKEL	79	PPM	DRY	2.82

Survey: 88PSRECN Station: OH-4

Date: 04/28/88 Sample ID: OH-4

PSDDA Screening Level.

NICKEL	78	PPM	DRY	2.79

Survey: 88PSRECN Station: OH-5

Date: 04/28/88 Sample ID: OH-5

PSDDA Screening Level.

NICKEL	71	PPM	DRY	2.54

Survey: 88PSRECN Station: OH-6

Date: 04/28/88 Sample ID: OH-6

PSDDA Screening Level.

NICKEL	45	PPM	DRY	1.61

Survey: EIGHTBAY Station: SM-01

Date: 04/24/84 Sample ID: SM-01

Lowest of AMPT, BENA, MICB, and OYST.

DI-N-OCTYL PHTHALATE	69	PPB	DRY	2.76
BIS(2-ETHYLHEXYL)PHTHALATE	2800	PPB	DRY	2.15

Survey: EIGHTBAY Station: SM-03

Date: 04/24/84 Sample ID: SM-03

Lowest of AMPT, BENA, MICB, and OYST.

DI-N-OCTYL PHTHALATE	160	PPB	DRY	6.40

Survey: EIGHTBAY Station: SM-20

Date: 04/24/84 Sample ID: SM-20

Lowest of AMPT, BENA, MICB, and OYST.

DI-N-OCTYL PHTHALATE	100	PPB	DRY	4.00

Survey: NOADW86 Station: SAMISH

Date: 05/01/86 Sample ID: SAMISH

Lowest of AMPT, BENA, MICB, and OYST.

SULFIDES	130	PPM	DRY	2.89

PSDDA Screening Level.

CADMIUM	0.99	PPM	DRY	1.03

Survey: EIGHTBAY Station: SQ-14

Date: 05/29/84 Sample ID: SQ-14

PSDDA Screening Level.

NICKEL	37	PPM	DRY	1.32

Survey: EIGHTBAY Station: SQ-17

Date: 05/29/84 Sample ID: SQ-17

PSDDA Screening Level.

NICKEL	41	PPM	DRY	1.46

Survey: EIGHTBAY Station: SQ-18

Date: 05/29/84 Sample ID: SQ-18

PSDDA Screening Level.

CADMIUM	1.1	PPM	DRY	1.15
NICKEL	39	PPM	DRY	1.39

Survey: EIGHTBAY Station: SQ-20

Date: 05/29/84 Sample ID: SQ-20

PSDDA Screening Level.

NICKEL	38	PPM	DRY	1.36

Survey: NOADW86 Station: SEQUIM17

Date: 05/01/86 Sample ID: SEQUIM17

Lowest of AMPT, BENA, MICB, and OYST.

COPROSTANOL	410	PPB	DRY	2.93
SULFIDES	130	PPM	DRY	2.89

PSDDA Screening Level.

CADMIUM	1.7	PPM	DRY	1.77
NICKEL	33	PPM	DRY	1.18

Survey: KENM86 Station: SEQUIM

Date: 07/31/85 Sample ID: SEQUIM Field rep: 1

Lowest of AMPT, BENA, MICB, and OYST.

2,6-DIMETHYL NAPTHALENE	290	PPB	DRY	2.90

PSDDA Screening Level.

2-METHYLNAPHTHALENE	160	PPB	DRY	2.39

Survey: OAKHRBR Station: SEQUIM

Date: 02/26/85 Sample ID: SEQUIM

Lowest of AMPT, BENA, MICB, and OYST.

2,6-DIMETHYL NAPTHALENE	290	PPB	DRY	2.90

PSDDA Screening Level.

2-METHYLNAPHTHALENE	160	PPB	DRY	2.39

Survey: OLYHAR88 Station: SQ-01

Date: 01/01/88 Sample ID: SQ-01

PSDDA Screening Level.

4-METHYL PHENOL	560	PPB	DRY	4.67

CADMIUM	0.97	PPM	DRY	1.01
NICKEL	35	PPM	DRY	1.25

Survey: PTGARQC Station: SWIN-5

Date: 03/19/86 Sample ID: SWIN-5

PSDDA Screening Level.

NICKEL	33	PPM	DRY	1.18

Survey: PTGARQC Station: SWIN-6

Date: 03/19/86 Sample ID: SWIN-6

PSDDA Screening Level.

NICKEL	30	PPM	DRY	1.07

Survey: PTGARQC Station: SWIN-7

Date: 03/19/86 Sample ID: SWIN-7

PSDDA Screening Level.

NICKEL	29	PPM	DRY	1.04

Survey: CBMSQS Station: CR-11

Date: 01/01/84 Sample ID: CR-11

PSDDA Screening Level.

CADMIUM	1.1	PPM	DRY	1.15

Survey: CBMSQS Station: CR-12

Date: 01/01/84 Sample ID: CR-12

PSDDA Screening Level.

BENZOIC ACID	430	PPB	DRY	1.95
CADMIUM	1.4	PPM	DRY	1.46

Survey: CBMSQS Station: CR-13

Date: 01/01/84 Sample ID: CR-13

PSDDA Screening Level.

CADMIUM	1.1	PPM	DRY	1.15

Survey: CBMSQS Station: CR-14

Date: 01/01/84 Sample ID: CR-14

PSDDA Screening Level.

CADMIUM	1.5	PPM	DRY	1.56

Survey: CBPRELIM Station: CR-04

Date: 03/01/84 Sample ID: CR-04

Lowest of AMPT, BENA, MICB, and OYST.

PHENOL	1800	PPB	DRY	4.29

PSDDA Screening Level.

PHENOL	1800	PPB	DRY	15.00

Survey: PSDDA1 Station: CRR01

Date: 05/17/88 Sample ID: CRR01C

Lowest of AMPT, BENA, MICB, and OYST.

SULFIDES	58	PPM	DRY	1.29

PSDDA Screening Level.

ANTIMONY (SB)	4.5	PPM E	DRY	1.73
CADMIUM	4.5	PPM LM	DRY	4.69
NICKEL	33	PPM	DRY	1.18

Survey: RILEY001 Station: NG-9

Date: 08/01/82 Sample ID: NG-9

PSDDA Screening Level.

NICKEL	41	PPM	DRY	1.46

Survey: RILEY001 Station: NG-10

Date: 08/01/82 Sample ID: NG-10

PSDDA Screening Level.

ANTIMONY (SB)	9.5	PPM	DRY	3.65
MERCURY	0.23	PPM	DRY	1.10
NICKEL	39	PPM	DRY	1.39

Survey: RILEY001 Station: NG-11

Date: 08/01/82 Sample ID: NG-11

PSDDA Screening Level.

ANTIMONY (SB)	7.8	PPM	DRY	3.00
NICKEL	41	PPM	DRY	1.46

Survey: EIGHTBAY Station: CS-01

Date: 05/29/84 Sample ID: CS-01

Lowest of AMPT, BENA, MICB, and OYST.

PHENOL	560	PPB	DRY	1.33

PSDDA Screening Level.

PHENOL	560	PPB	DRY	4.67

Survey: EIGHTBAY Station: CS-15

Date: 05/29/84 Sample ID: CS-15

PSDDA Screening Level.

CADMIUM	1.1	PPM	DRY	1.15
NICKEL	33	PPM	DRY	1.18

Survey: EIGHTBAY Station: CS-17

Date: 05/29/84 Sample ID: CS-17

PSDDA Screening Level.

CADMIUM	1.9	PPM	DRY	1.98
NICKEL	31	PPM	DRY	1.11

Survey: RILEY001 Station: NG-15

Date: 08/01/82 Sample ID: NG-15

PSDDA Screening Level.

NICKEL	35	PPM	DRY	1.25

Survey: RILEY001 Station: NG-16

Date: 08/01/82 Sample ID: NG-16

PSDDA Screening Level.

NICKEL	46	PPM	DRY	1.64

Survey: MALINS Station: CS-62

Date: 01/01/79 Sample ID: 12062

Lowest of AMPT, BENA, MICB, and OYST.

CADMIUM	7.6	PPM	DRY	1.49

PSDDA Screening Level.

CADMIUM	7.6	PPM	DRY	7.92

NICKEL	47	PPM	DRY	1.68
SILVER	2.3	PPM	DRY	1.92

Survey: MALINS Station: CS-63

Date: 01/01/79 Sample ID: 12063

PSDDA Screening Level.

CADMIUM	3.2	PPM	DRY	3.33
SILVER	1.8	PPM	DRY	1.50

Survey: EIGHTBAY Station: CS6

Date: 09/14/83 Sample ID: CS6

PSDDA Screening Level.

MERCURY	0.22	PPM	DRY	1.05

Survey: RILEY001 Station: NG-14

Date: 08/01/82 Sample ID: NG-14

PSDDA Screening Level.

NICKEL	41	PPM	DRY	1.46

Survey: SEAHBASE Station: QM-D

Date: 02/01/84 Sample ID: 5017

Lowest of AMPT, BENA, MICB, and OYST.

DI-N-OCTYL PHTHALATE	780	PPB	DRY	31.20

PSDDA Screening Level.

SILVER	1.5	PPM	DRY	1.25

Survey: SEAHBASE Station: QM-1

Date: 07/01/82 Sample ID: 85

Lowest of AMPT, BENA, MICB, and OYST.

DI-N-OCTYL PHTHALATE	280	PPB	DRY	11.20
FLUORENE	1000	PPB M	DRY	1.85
MERCURY	0.42	PPM	DRY	1.02

PSDDA Screening Level.

CADMIUM	1.3	PPM	DRY	1.35
FLUORENE	1000	PPB M	DRY	15.63
POLYCYCLIC AROMATIC HYDROCARBON-HEAVY	2300	PPB	DRY	1.28
INDENO(1,2,3-CD)PYRENE	190	PPB	DRY	2.75
POLYCYCLIC AROMATIC HYDROCARBON-LIGHT	1100	PPB	DRY	1.80
MERCURY	0.42	PPM	DRY	2.00
NICKEL	42	PPM	DRY	1.50
PYRENE	530	PPB	DRY	1.23
SILVER	2.5	PPM	DRY	2.08

Survey: SEAHBASE Station: QM-2

Date: 07/01/82 Sample ID: 86

Lowest of AMPT, BENA, MICB, and OYST.

DI-N-OCTYL PHTHALATE	270	PPB	DRY	10.80

PSDDA Screening Level.

INDENO(1,2,3-CD)PYRENE	80	PPB	DRY	1.16
POLYCYCLIC AROMATIC HYDROCARBON-LIGHT	830	PPB	DRY	1.36
MERCURY	0.38	PPM	DRY	1.81
NICKEL	40	PPM	DRY	1.43
PHENANTHRENE	690	PPB	DRY	2.16
SILVER	2.7	PPM	DRY	2.25

Survey: QMHARBOR Station: QM-8

Date: 02/03/86 Sample ID: 067310

Lowest of AMPT, BENA, MICB, and OYST.

DI-N-OCTYL PHTHALATE	580	PPB	DRY	23.20

Survey: CREC72 Station: QM-01

Date: 01/01/72 Sample ID: QM-01

PSDDA Screening Level.

ANTIMONY (SB)	3.6	PPM	DRY	1.38

Survey: RILEY001 Station: NG-12

Date: 08/01/82 Sample ID: NG-12

PSDDA Screening Level.

NICKEL	35	PPM	DRY	1.25

Survey: CREC72 Station: TN-01

Date: 01/01/72 Sample ID: TN-01

PSDDA Screening Level.

ANTIMONY (SB)	12	PPM	DRY	4.62

Survey: RILEY001 Station: NG-8

Date: 08/01/82 Sample ID: NG-8

PSDDA Screening Level.

NICKEL	32	PPM	DRY	1.14

APPENDIX E

FIELD STUDIES WORK PLAN

FIELD STUDIES WORK PLAN

INTRODUCTION

The field studies outlined in this work plan are designed to fill data gaps and to support further development of performance standards for sediments in selected reference areas of Puget Sound. This plan delineates procedures for quantifying biological, physical, and chemical characteristics in subtidal marine, subtidal low salinity (<25 ppt salinity), and intertidal environments. Specific variables to be examined are:

- **Sediment chemistry**—concentrations of chemical contaminants (Table E-1)
- **Ancillary physical/chemical variables**—interstitial water salinity and the conventional variables of grain size composition (percent fine-grained material), TOC and nitrogen content, cyanide, and sulfides (Table E-1)
- **Amphipod bioassay**—percent mortality of *Rhepoxynius abronius*
- **Bivalve larvae bioassay**—percent abnormal development of *Crassostrea gigas* or *Mytilus edulis*.
- **Microtox**—EC_{50} (i.e., effective concentration for a 50 percent response) and percent decrease in luminescence for concentrated extract (saline and organic extracts)
- **Juvenile polychaete bioassay**—percent decrease in growth and percent mortality of *Neanthes arenaceodentata*
- **Benthic macroinvertebrates**—species abundances and taxonomic richness (i.e, total number of taxa); abundances of higher taxa.

The proposed interim reference areas are Carr Inlet, Dabob Bay, Samish Bay, and Sequim Bay. Reconnaissance surveys of other areas are also recommended below. The following sections of this field studies work plan address sampling design, locations of sampling stations, precruise coordination and logistics planning, mobilization, field sampling, sample analysis, QA/QC review and data analysis, and data reporting.

GENERAL STUDY DESIGN

The sampling design for investigating reference areas includes three elements: 1) marine subtidal, 2) marine intertidal, and 3) low salinity environments. Data from these studies should be used to:

- Verify that interim reference areas cover the range of sediment conditions and benthic macroinvertebrate communities appropriate for comparison with contaminated sites throughout Puget Sound
- Fill data gaps on chemical coverage in each reference area
- Determine relationships among P-2 variables to refine the performance standards system
- Develop reference area performance standards for the bivalve larvae bioassay, Microtox bioassays, juvenile polychaete bioassay, and benthic macroinvertebrate communities
- Evaluate effects of grain size on bioassays to refine bioassay testing techniques

TABLE E-1. CHEMICAL AND CONVENTIONAL VARIABLES

METALS

- Antimony
- Arsenic
- Cadmium
- Chromium
- Copper
- Lead
- Mercury
- Nickel
- Silver
- Thallium
- Zinc

ORGANIC COMPOUNDS

Low Molecular Weight Aromatic Hydrocarbons

- Naphthalene
- Acenaphthylene
- Acenaphthene
- Fluorene
- Phenanthrene
- Anthracene
- 2-Methylnaphthalene
- 2,6-Dimethylnaphthalene[a]
- 2,3,5-Trimethylnaphthalene[a]
- 1-Methylphenanthrene[a]
- 2-Methylphenanthrene[a]
- 3-Methylphenanthrene[a]

High Molecular Weight Aromatic Hydrocarbons

- Fluoranthene
- Pyrene
- Benzo(a)anthracene
- Chrysene
- Benzofluoranthenes
- Benzo(a)pyrene
- Indeno(1,2,3,-c,d)pyrene
- Dibenzo(a,h)anthracene
- Benzo(g,h,i)perylene
- 1-Methylpyrene[a]
- 2-Methylpyrene[a]

ORGANIC COMPOUNDS (continued)

Chlorinated Hydrocarbons

- 1,3-Dichlorobenzene
- 1,4-Dichlorobenzene
- 1,2-Dichlorobenzene
- 1,2,4-Trichlorobenzene
- Hexachlorobenzene
- Hexachlorobutadiene
- Tri, tetra-, and pentachlorobutadienes[a]
- Pentachlorocyclopentane isomer[a]

Phthalates

- Dimethyl phthalate
- Diethyl phthalate
- Di-n-butyl phthalate
- Butyl benzyl phthalate
- Bis(2-ethylhexyl)phthalate
- Di-n-octyl phthalate

Phenols

- Phenol
- 2-Methylphenol
- 4-Methylphenol
- 2,4-Dimethylphenol
- 2,4-Dichlorophenol
- 2,4,5-Trichlorophenol
- 2,4,6-Trichlorophenol
- Pentachlorophenol
- 2-Methoxyphenol[a]

Miscellaneous Polar Compounds

- Benzyl alcohol
- Benzoic acid
- Hexadecanoic acid[a]
- Hexadecanoic acid methyl ester[a]
- Hexadecanoic acid methyl ester[a]
- Abietic acid
- Dehydroabietic acid
- Coprostanol[a]
- Cholesterol[a]

ORGANIC COMPOUNDS (continued)

Miscellaneous Nonpolar Compounds

- Dibenzofuran
- Dibenzothiophene[a]
- Biphenyl[a]
- Carbazole
- Hexachloroethane
- N-Nitrosodiphenylamine
- 2,3,7,8-TCDD (dioxin)
- Cymene isomer[a]
- Retene[a]
- Kaur-16-ene (or related diterpenoid hydrocarbon)[a]
- Isopimaradiene[a]
- 1,2,4-Trithiolane[a]

Pesticides

- p,p'-DDT
- p,p'-DDD
- p,p'-DDE
- Aldrin
- Chlordane
- Dieldrin
- Heptachlor
- Lindane

Total PCB

CONVENTIONAL VARIABLES

- Sulfides
- Total organic carbon
- Total volatile solids
- Nitrogen
- Cyanide
- Sediment grain size

ORGANOMETALLIC COMPOUNDS

- Tributyltin[b]

[a] Tentatively identified organic compound.

[b] One station per reference area.

- Evaluate additional potential reference areas in the central Puget Sound region
- Develop interim performance standards for low salinity habitats and intertidal habitats.

A description of the sampling design specific to each of these elements follows.

Marine Subtidal

Interim Reference Areas—The objective of the study design is to characterize sediment variables for the subtidal marine areas in each of the proposed interim reference areas. Data should be collected on sediment conventional variables, sediment chemistry, sediment grain size, sediment bioassays, and benthic macroinvertebrates. Sediment chemistry analyses should be done for all chemicals of concern in Puget Sound (Becker et al. 1989), including tributyltin but excluding volatile organic compounds (Table E-1).

One main objective of the sediment sampling is to expand the database on benthic communities in reference areas. To achieve adequate characterization of benthic communities that occur in each reference area, stations that represent various water depths and grain-size distributions should be sampled. Sampling should be concentrated in the 0-50 meter zone. Stations should be located at depth ranges of 5-15 meters, 16-25 meters, and 26-50 meters. For each depth zone, a range of grain sizes should be sampled (i.e., 0-25 percent, 26-50 percent, 51-75 percent, 76-100 percent). For example, if sampling occurs at 10, 20, and 40 meters, then at least four stations would be needed at each depth to ensure that a range of grain sizes are represented. Thus, at least 12 stations are recommended for each reference area. The actual number of stations may vary in each reference area based on available grain sizes, depths, and benthic communities. Locations of sampling stations relative to sediment grain size composition should be determined in the field by a preliminary analysis of percent fine-grained material (see Sampling Methods and Replication). It may be necessary to go out of the specific geographic limits of a reference area so that adequate depths or grain sizes can be obtained. The boundaries of reference areas are not precisely fixed at this time. Reconnaissance surveys will likely be necessary to determine areas of appropriate depth and grain size for each interim reference area.

Timing of sampling is important to ensure reliable measurement of benthic community variables. Benthic macroinvertebrate sampling must occur at least four times over a 12-month period to accommodate seasonal variability in species diversity and abundance (Tetra Tech 1987). Benthic macroinvertebrate populations in the early spring represent stable adult populations which have successfully overwintered and do not yet reflect juvenile recruitment (PSWQA 1988). Timing of one benthic sampling event should occur in the early spring (March-April) so that PSAMP reference area data may be integrated into the P-2 reference area database.

Reconnaissance of New Reference Areas—The objective of this study design is to fill data gaps concerning reference areas that are located in the vicinity of the central basin of Puget Sound. Many areas in the central basin of Puget Sound show high levels of anthropogenic impacts. The task of this reconnaissance study is to examine and characterize biological and physical environments that are within the biogeographic region of the central basin, yet are not expected to exhibit anthropogenic impacts.

Useless Bay and Mutiny Bay both may have biological and physical characteristics similar to shallow water areas of the central basin and associated bays with contaminated sediments. In addition, they are believed to be minimally impacted by anthropogenic disturbances. The biological, chemical, and physical characteristics of the two embayments should be investigated by measuring distribution of sediment conventional variables, sediment chemistry, sediment grain size, sediment bioassays, and benthic macroinvertebrates. The number of samples and timing of

sampling should follow the design described in the preceding section (Marine Subtidal, Interim Reference Areas).

Marine Intertidal

The objective of this study design is to characterize sediment variables for marine intertidal areas in each of the interim reference areas. Sampling variables should include sediment conventional variables, sediment chemistry, and sediment bioassays (i.e., amphipod, oyster larvae, and Microtox). Sediment chemistry analyses should be done for all chemicals of concern in Puget Sound (Becker et al. 1989), including tributyltin but excluding volatile organic compounds.

Final locations of intertidal sampling stations should be determined in the field. Initially, four stations in each interim reference area should be chosen from the list of 10 potential intertidal sampling stations described below (see Sampling Station Locations). Each of four grain size ranges (i.e., 0-25 percent, 26-50 percent, 51-75 percent, and 76-100 percent fines) should be represented by an intertidal sampling station location in each interim reference area. The location of each station should be based on a preliminary analysis of percent fine-grained material in the field (see Sampling Methods and Replication). If contaminant concentrations for one or more of the intertidal stations exceed the maximum of the range of chemical concentrations observed for all subtidal marine samples from the reference area, then a second field survey should be performed to collect intertidal sediment data. A minimum of six additional stations should be sampled based on recommendations outlined below (see Sampling Station Locations). Sampling should occur near the high low water mark which is wetted by each tidal cycle. Sampling should occur at the same time as the marine subtidal sampling event (i.e., March-April).

Low Salinity Environments

The objective of this study design is to characterize sediment variables for low salinity (<25 ppt salinity) subtidal areas. Stations within reference areas that have low interstitial water salinity should be determined through quarterly reconnaissance surveys and research on stream discharges. These methods would be used to identify zones of various interstitial water salinities at various times of the year. Variables to be examined in each zone of salinity include sediment conventional variables, sediment chemistry, and sediment bioassays (oyster larvae and Microtox). Sediment chemistry and bioassay information should be taken to document contamination and biological effects. Some reconnaissance work may be necessary for each sampling event because interstitial water salinities are likely to exhibit temporal and spatial changes. The plan should not be to establish fixed, precise station locations, but rather to define zones of probable salinity ranges. Following recommendations of Becker et al. (1989), the sampling design should include measurement of bottom-water salinity (i.e., salinity within 1 meter of water overlying the sediments). The timing of the spring sampling period should occur at the same time as the marine subtidal sampling event (i.e, March-April).

SAMPLING STATION LOCATIONS

The proposed locations of sampling stations in marine subtidal, marine intertidal, and low salinity habitats are described in the following sections.

Marine Subtidal Stations

Interim Reference Areas—In the interim reference areas (i.e., Carr Inlet, Dabob Bay, Sequim Bay, and Samish Bay), subtidal sampling stations were selected from the stations sampled in previous studies (Figures E-1, E-2, E-3, and E-4) according to the following criteria:

- For each area, a station from each of the depth ranges of 5-15 meters, 15-25 meters, and 25-50 meters should be sampled
- For each depth range within each area, a station exhibiting percent fines content in each of the ranges 0-25 percent, 25-50 percent, 50-75 percent, and 75-100 percent should be sampled.
- Each station should represent the midpoints of the combination of a depth range and a grain size range.

Ideally, by these criteria 12 existing reference stations would be selected from each bay, one to cover each of the combinations of depth and grain size ranges specified above. In practice this was not possible because of either limitations in the scope of existing data sets (i.e., not enough stations were sampled to cover the full range of depths and grain sizes), or limitations in the reference area itself (i.e., a given depth and grain size combination may not exist in the reference area). In cases where stations for a given depth-grain size combination were not found, an additional region or transect within the reference area in question was proposed. A summary of stations identified for each depth-grain size combination in each interim reference area is shown in Table E-2.

Carr Inlet Reference Stations: Due to limited grain size data in Carr Inlet, only two potential stations were identified from the existing studies. For 5-15 meter depths and 75-100 percent fines, Station CR-021 (Roberts 1974) was identified. For 25-50 meter depths and 75-100 percent fines, Station CR-022 (Roberts 1974) was identified. During PSDDA Phase II sampling efforts (Johns et al. unpublished), a transect ranging from a station at 10-meter depth with 0-25 percent fines to a station at 30-meter depth with 75-100 percent fines has been tentatively identified in the inlet directly north of Raft Island. As such, it is recommended that sampling at depths of 5-15 meters with 0-50 percent fines, depths of 15-25 meters with 25-100 percent fines, and depths of 25-50 meters with 50-100 percent fines be performed along this transect. For sampling depths of 5-15 meters with 50-75 percent fines, the area offshore from Forest Beach is recommended. For station depths of 15-25 meters with 0-25 percent fines and 25-50 meters with 0-50 percent fines, sampling is recommended off the southwest shore of Fox Island.

Dabob Bay Reference Stations: The majority of existing stations in Dabob Bay have been located at depths exceeding 50 meters. However, nine stations were identified in the depth range 25-50 meters, and one station was identified in the depth range of 15-25 meters. For station depths of 5-15 meters with 0-100 percent fines, sampling is recommended along a transect extending directly west of Long Spit (0-25 percent fines) up into Tarboo Bay northwest of Long Spit (75-100 percent fines). For sampling depths of 15-25 meters with 0-25 percent fines, Station DB-26 (Battelle 1986) has been identified. Sampling is recommended east of Broad Spit for depths of 15-25 meters with 25-50 percent fines. For sampling depths of 15-50 meters with 50-100 percent fines, sampling is recommended along a transect starting southwest of Long Spit (50-75 percent fines) and heading north towards Tarboo Bay to just west of Long Spit (75-100 percent fines). For sampling depths of 25-50 meters with 0-25 percent fines, Station DB21 (Battelle 1986) is recommended. Station DB18 is a suitable station for the sampling depth 25-50 meters with 25-50 percent fines (Battelle 1986).

Samish Bay Reference Stations: Samish Bay has been extensively sampled for the full range of depths up to 25 meters. As such, a suitable reference station was identified for all four grain size ranges for depths of 5-15 meters and 15-25 meters. For depths exceeding 25 meters with 0-75 percent fines, sampling areas at the mouth of Samish Bay are proposed. For depths of 25-50 meters with 75-100 percent fines, four suitable stations were available.

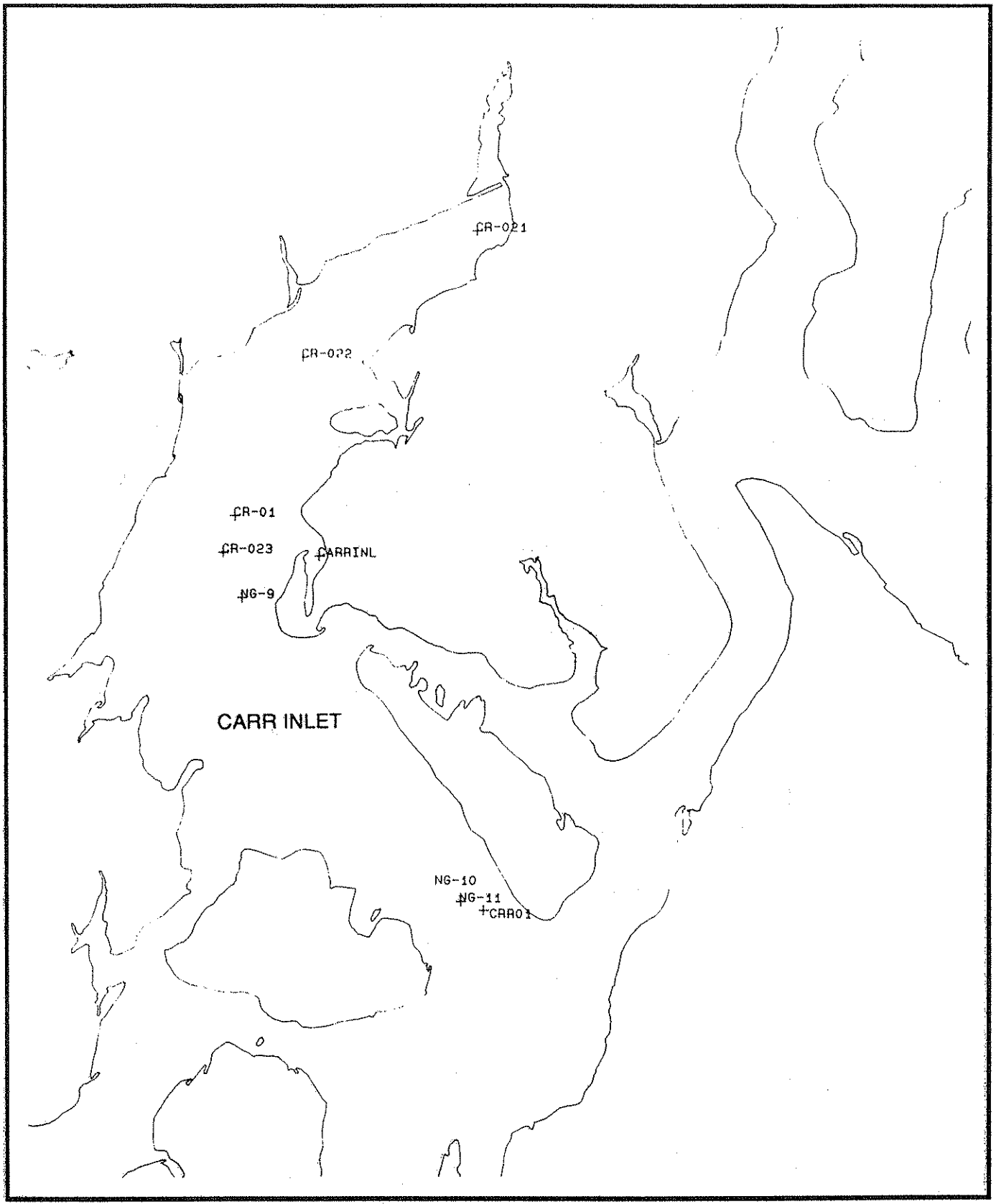


Figure E-1. Sampling station locations for Carr Inlet

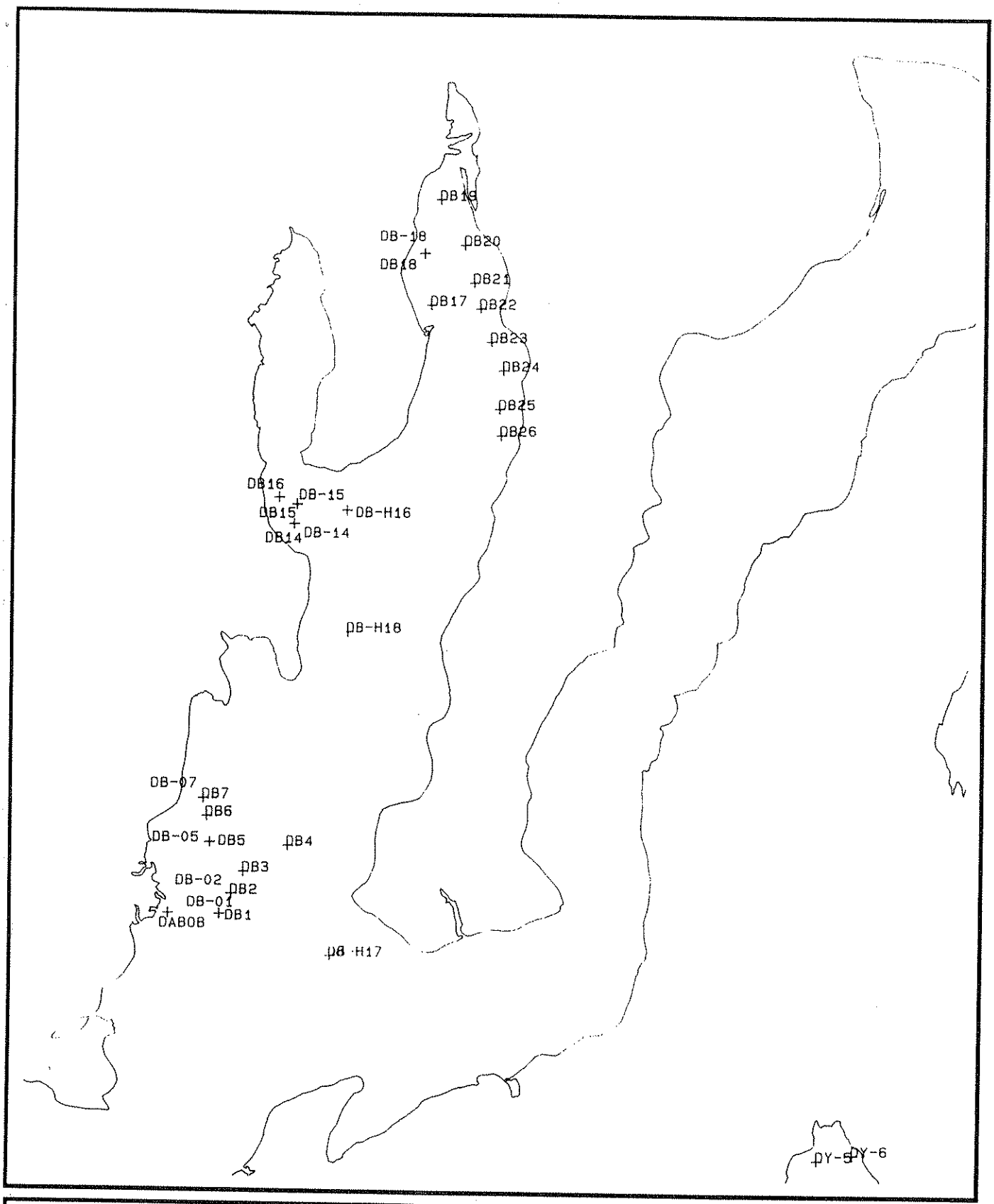


Figure E-2. Sampling station locations for Dabob Bay

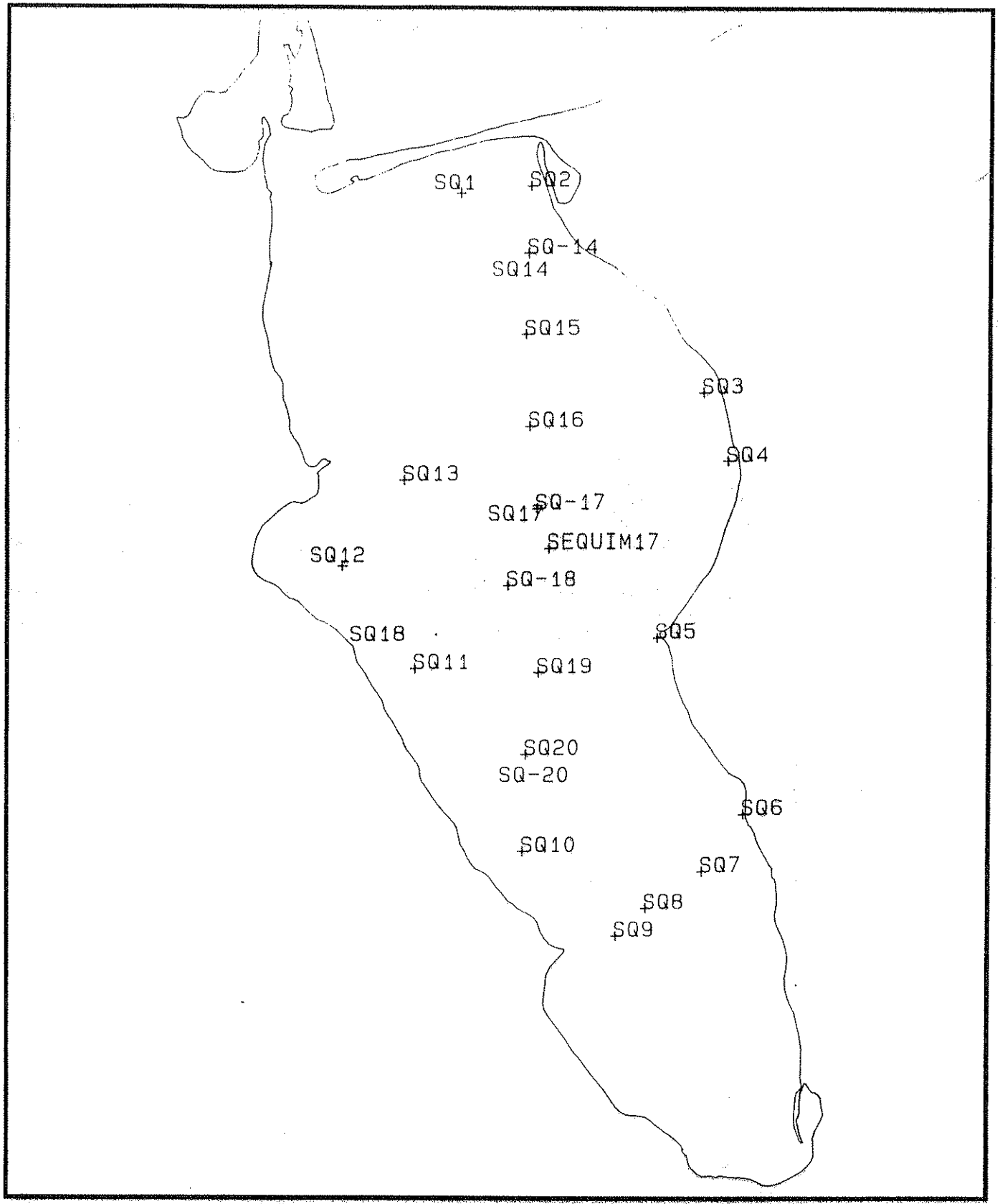


Figure E-3. Sampling station locations for Sequim Bay

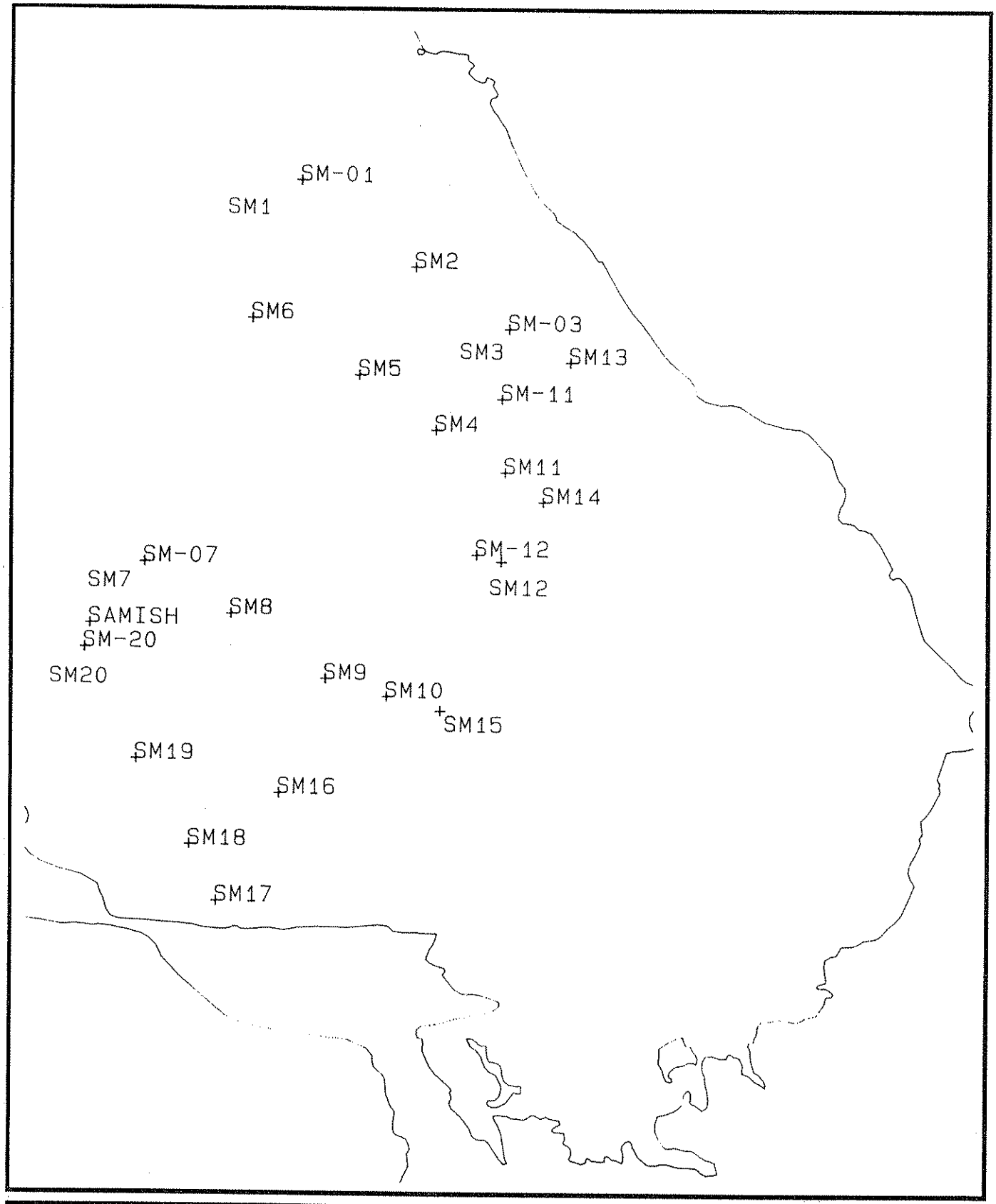


Figure E-4. Sampling station locations for Samish Bay

TABLE E-2. SUMMARY OF STATIONS IDENTIFIED FOR EACH COMBINATION OF DEPTH AND GRAIN SIZE FOR EACH INTERIM REFERENCE AREA

Depth Range	Percent Fines			
	0 to 25%	25 to 50%	50 to 75%	75 to 100%
Carr Inlet Reference Stations				
5 to 15 m	N. of Raft Island	N. of Raft Island	Off Forest Beach	CR-021[a]
15 to 25 m	S.E. of Fox Island	N. of Raft Island	N. of Raft Island	N. of Raft Island
25 to 50 m	S.E. of Fox Island	S.E. of Fox Island	N. of Raft Island	CR-022[a]
Dabob Bay Reference Stations				
5 to 15 m	Tarboo Bay, West of Long Spit			
15 to 25 m	DB26[b]	E. of Broad Spit	S.W. of Long Spit	
25 to 50 m	DB25[b]	DB19[b]	S.W. of Long Spit	
	DB22[b]	DB18[b]	S.W. of Long Spit	
	DB23[b]			
	DB24[b]			
	DB20[b]			
	DB17[b]			
	DB21[b]			
Sequim Bay Reference Stations				
5 to 15 m	SQ1[b]	SQ12[b]	SQ2[b]	SQ9[b]
			SQ6[b]	SQ8[b]
				SQ7[b]
15 to 25 m	SQ3[b]	Transect between	SQ5[b]	SQ18[b]
	SQ4[b]	SQ3[b] and SQ15[b]	SQ11[b]	SQ20[b]
			SQ14[b]	SQ19[b]
			SQ16[b]	SQ15[b]
				SQ10[b]
25 to 50 m	N.E. of Pitship Point and N. of SQ13[b]	SQ13[b]	E. of Pitship Point and S.E. of SQ13[b]	SQ17[b]
Samish Bay Reference Stations				
5 to 15 m	SM11[c]	SM3[b,c]	SM6[b]	SM3[b,c]
		SM12[b,e]		SM1[b]
				SM16[b]
				SM-V01[a]
15 to 25 m	SM122[a]	SM7[b,d]	SM5[b]	SM7[b,d]
	SM123[a]			SM10[b]
	SM131[a]			SM18[b]
				SM19[b]
				SM2[b]
				SM4[b]
				SM8[b]
				SM9[b]
				SM12[e]
				SM-G4[a]
				SM-H03[a]
				SM-V02[a]
				SM-V03[a]
				SM-V12[a]
				SM-V13[a]

TABLE E-2. (Continued)

Depth Range	Percent Fines			
	0 to 25%	25 to 50%	50 to 75%	75 to 100%
Samish Bay Reference Stations (continued)				
25 to 50 m	N.W. of Williams Point	N.E. of Williams Point	N.E. of Williams Point	SM20[b] SM-G5[a] SM-V11[a] SM-V15[a]

[a] Roberts 1974.

[b] Battelle 1988.

[c] This station exhibited 47.5 percent fines in 1983 and 80.9 percent fines in 1984.

[d] This station exhibited 49.4 percent fines in 1983 and 84.9 percent fines in 1984.

[e] Broad et al. (1983).

Sequim Bay Reference Stations: Due to extensive past sampling efforts in Sequim Bay, suitable sampling stations have been identified for nine of the 12 depth-grain size combinations proposed in this section. For sampling depths of 5-15 meters with 0-25 percent fines, 25-50 percent fines, 50-75 percent fines, and 75-100 percent fines, Stations SQ1, SQ2, SQ6, and SQ9 (Battelle 1986), respectively, have been identified. For sampling depths of 15-25 meters with 0-25 percent fines, Station SQ3 (Battelle 1986) has been identified. For sampling depths of 15-25 meters with 25-50 percent fines, sampling is recommended along a transect between Stations SQ3 and SQ5 (Battelle 1986). For depths of 15-25 meters with 50-75 and 75-100 percent fines, sampling is recommended at Stations SQ16 and SQ15 (Battelle 1986), respectively. For depths of 25-50 meters, sampling is recommended northeast of Pitship Point, directly north of Station SQ13 (Battelle 1986). Station SQ13 has been identified as a suitable station for sampling depths of 25-50 meters, and grain size composition of 25-50 percent fines. For depths of 25-50 meters with 50-75 percent fines, sampling is recommended southeast of Station SQ13, due east from Pitship Point. For depths of 25-50 meters with 75-100 percent fines, sampling is recommended at Station SQ17 (Battelle 1986).

For sampling depths of 5-15 meters with grain size ranges 0-25, 25-50, 50-75, and 75-100 percent fines, sampling at Stations SM11, SM3, SM6, and SM1 (Battelle 1986) is recommended. For sampling depths of 15-25 meters with grain size ranges 0-25, 25-50, 50-75, and 75-100 percent fines, sampling at Stations SM122 (Roberts 1974), SM7, SM5, and SM19 (Battelle 1986), respectively, is recommended. For sampling depths of 25-50 meters with grain size ranges 0-75 percent fines, sampling is recommended along a transect from northwest of Williams Point (0-25 percent fines) to northeast of Williams Point (50-75 percent fines). For grain sizes of 75-100 percent fines at these depths, sampling at Station SM6 (Roberts 1974) is recommended.

Reconnaissance of New Reference Areas—A reconnaissance survey of Useless Bay and Mutiny Bay should be performed to characterize their biological, chemical, and physical characteristics. Transects perpendicular to contour lines should be taken to determine grain size variables in the two bays. Using field methods for preliminary grain size determination (as described in Sampling Methods and Replication), 12 station locations should be identified for each combination of depth and grain size categories.

Marine Intertidal Stations

Sampling station locations for intertidal environments should be positioned at or near the high low water mark (±0.5 meters). There should be four stations in each embayment, chosen from the 10 potential stations listed below for each interim reference area (see discussion in General Study Design). Selection of the four stations will be based on a preliminary analysis of grain size. Potential station locations for each interim reference area are as follows:

- Sequim Bay

    1. Along Travis Spit near Klapot Point
    2. Near Pitship Point
    3. Near Sequim State Park
    4. Near Schoolhouse Point
    5. Near Blyn
    6. North of Blyn along the eastern shore of Sequim Bay
    7. Near Goose Point
    8. Just south of Hardwick Point
    9. North of Hardwick Point
    10. In the vicinity of Paradise Cove

- Carr Inlet

    1. Near or at Delano Beach
    2. Near Green Point
    3. Near Baldwin Point
    4. Along the southeast shore of Fox Island
    5. South of Thompson Spit
    6. North of Glen Cove
    7. South of Allen Point
    8. At Kopachuck State Park
    9. In Horseshoe Bay
    10. At Penrose Point State Park

- Samish Bay

    1. At or near Williams Point
    2. On north side of Fish Point
    3. On south side of Scotts Point
    4. On island between the mouths of the Samish River
    5. South of the mouth of Colony Creek
    6. Near Windy Point
    7. Near Pigeon Point
    8. Near picnic area on Samish Island
    9. North of the mouth of Edison Slough
    10. West of the mouth of Samish River

- Dabob Bay

    1. Near or at Pleasant Harbor State Marine Park
    2. Near Dosewallips State Park
    3. Near Seal Rock
    4. Near Camp Parsons
    5. Near Whitney Point
    6. Near Lindsay Beach
    7. In Tarboo Bay
    8. Near Camp Discovery
    9. Near Camp Harmony
    10. Near Tskutsko Point.

Low Salinity Stations

Sampling station locations for low salinity environments should be based on reconnaissance studies. In general, these stations should be located seaward of freshwater inputs to each interim reference area.

The following areas should be examined to identify locations of sediments with low salinity interstitial water:

- Carr Inlet—in May and Van Goldern Cove, and east of Raft Island
- Dabob Bay-off the mouth of Dosewallips River
- Samish Bay—off the mouth of the Samish River, and off the mouth of Edison Slough
- Sequim Bay—off the mouth of Jimmycomelately Creek
- South Puget Sound—McAllister Creek, located in the Nisqually River Delta region.

In some cases, it may be necessary to wade small streams to find low salinity sediment environments. Sampling methods would have to be modified to accommodate these conditions.

PRECRUISE COORDINATION AND LOGISTICS PLANNING

Precruise coordination and logistics planning are crucial to the overall success of the reference area sampling effort. Logistically, the sampling requirements are complex and should require accurate planning. The precruise activities discussed below are necessary to ensure successful reference area investigations.

Specify and Distribute Standard Operating Procedures

It is important to select or develop standard operating procedures, QA/QC procedures, chain-of-custody operations, and cruise safety plans. PSEP protocols (PSEP 1986) and standard regional procedures (e.g., PTI 1989a) should be used whenever possible and modified as necessary to meet the needs of the potential reference areas, sampling efforts, and Ecology requirements. A QA/QC plan, chain-of-custody operations, and cruise safety plan should be developed and documented.

Plan Cruise Logistics

It is important to ensure efficient use of vessel and personnel time during field sampling. A visit should be made to the sampling vessel to plan the deck layout. Visits should also be made to the potential reference area sites to locate suitable shore stations for navigational transmitters. A location should be deemed suitable if it has been surveyed, and if it provides protection from potential tampering or vandalism. Development of the most effective sampling sequence and assignment of personnel and responsibilities should be made during this phase of planning. Contingency plans should be developed to ensure the continued collection of critical data during inclement weather, equipment failure, or in the event of injury to personnel.

MOBILIZATION

All necessary equipment and materials for performance of field operations should be assembled during this phase. This includes obtaining all sampling gear and other collection and storage equipment, reservation of accommodations and transportation, and final review of the logistics plan.

Procurement and Organization of Gear and Supplies

During this phase, arrangements should be made for the use of large sampling gear (van Veen grab, sieve boxes, and tables), and for the purchase, assembly, and organization of other equipment and supplies. Necessary equipment and supplies should include sampling jars, sorting equipment, preservatives, decontamination solvents, coolers, tools, buckets, gear boxes, and miscellaneous items such as spare parts, gloves, hoses, and handling lines.

Accommodations and Transportation

Arrangements for lodging, meals, and transportation for the sampling crew should be made during this phase. Motel accommodations should be provided for remote sampling locations (away from the Seattle/Bellevue area). One meal should be provided on board the sampling vessel during the 12-hour workday. Arrangements should also be made to fund breakfast and dinner expenses. Transportation for crew rotations and distribution of collected samples should also be arranged.

Review of Methodologies and Logistics

Immediately prior to commencement of sampling all personnel should review the sampling plans, operating procedures, schedules, and safety and contingency plans. This should provide a final opportunity for coordinating tasks and schedules to ensure that sampling proceeds in a smooth and rapid manner.

FIELD SAMPLING

Field operations at the potential reference area sites will be the most time consuming and resource-intensive phase of these investigations. Close coordination between shore-based and shipboard crews should be required to ensure rapid response to operational changes and to accomplish the reference area studies.

Transportation of Gear and Personnel

Collection, transport, and loading of the large gear should be carried out immediately prior to commencement of sampling. Resources available to perform this task should also be used to transport crew to remote sites and to provide crew rotations as necessary.

Vessel Positioning (subtidal marine and low salinity)

Vessel positioning within each potential reference area should be achieved by the use of a microwave navigation system. Both absolute and repeatable accuracy (±1-3 meters) can be achieved with this type of navigation system (Tetra Tech 1986b; PTI 1988). Precise determination of the station location during the potential reference area field investigations will ensure that the same stations can be reoccupied during subsequent studies. Three microwave transponder shore stations should be used at each potential reference area. These shore stations should either be located at a U.S. Geological Survey (USGS) benchmark, or at a surveyed location. During most operational periods, two transponder shore stations should be sufficient to provide accurate station positioning, providing that the shore stations are in line-of-sight and not at oblique angles to each other. The third station acts as a back-up in the event that one of the other stations fails during sampling. It may also be used to verify station locations that have been determined by the other two-shore stations. Radar ranges to prominent shore features and LORAN C readings should be recorded at each station location.

Intertidal Stations

Intertidal stations should be occupied by referring to USGS and local highway site sampling maps. Station position should be documented by triangulation of local landmarks and information should be recorded in a logbook.

SAMPLING METHODS AND REPLICATION

A modified van Veen grab sampler should be used to collect all subtidal surficial sediments for analysis of the variables set forth in the introduction. This is the most common subtidal surficial sediment sampler used in Puget Sound (Tetra Tech 1986a), and allows for comparison with past studies. Another advantage to using a modified van Veen is its ability to seal tightly in a variety of sediment types (e.g., sands, silts, clays). Some samplers do not seal completely in coarser sediment environments, resulting in potentially compromised sample quality. Replication schemes should follow PSEP protocols (PSEP 1986) recommendations for P-2 sediment variables.

Intertidal sediments are collected using a large stainless steel spoon to scoop sediment into a stainless steel bowl. Both spoon and bowl should be decontaminated prior to sample collection. Sample handling, sample collection methods, and replication are described in Puget Sound Protocols (PSEP 1986) for all variables set forth in the introduction, with the exception of interstitial water salinities and *Neanthes* bioassay.

Interstitial water salinity can be measured by liberating water from the sediment sample after overlying water has been decanted (siphoned off). A drop of the liberated water is then placed on a salinity refractometer and measured. This value is recorded in the field logbook under the appropriate sampling station location designation. Three readings of salinity should be taken at each station. Johns et al. (1989) describes the protocol for collection of sediments for the *Neanthes* bioassay.

To determine if sediment grain sizes are appropriate, a preliminary analysis of percent fine-grained material should be performed in the field. This analysis involves collecting a 50 mL aliquot from each grab sample. Each aliquot should be sieved through a 63 μm sieve, and the retained material transferred to a graduated cylinder. The mean volume of the retained material should provide an estimate of the sand/gravel fraction of the sediment.

SAMPLE HANDLING AND STORAGE REQUIREMENTS

Sample handling and storage requirements are described in PSEP protocols (Tetra Tech 1986a) for all variables of concern except interstitial water salinities, tributyltin, and the *Neanthes* bioassay. Sample handling for interstitial water salinity analysis is described in the previous section. There are no storage requirements for this variable. Johns et al. (1989) describes sample handling and storage requirements of sediments collected for the *Neanthes* bioassay. Sample handling and storage requirements of sediments collected for tributyltin analysis will be described in a forthcoming revision of the PSEP protocols (PSEP 1986).

ANALYTICAL TECHNIQUES

Techniques for analysis of all variables mentioned in the introduction are described in the PSEP protocols (Tetra Tech 1986a) with the exception of interstitial water salinities, *Neanthes* bioassay, and tributyltin. The analytical technique for interstitial water salinity is described in the sample handling and replication section. Johns et al. (1989) describes the analytical techniques associated with the *Neanthes* bioassay. The analytical technique for tributyltin will be described in a forthcoming revision of the PSEP protocols (PSEP 1986).

DATA QA/QC REQUIREMENTS

QA/QC procedures are necessary to ensure that environmental data achieve an acceptable level of quality and that the level of quality attained is adequately documented. The QA/QC procedures performed on reference area data are of particular importance because of the significance of the data to the overall success of the program. QA/QC procedures should be performed on all environmental data collected during these investigations. Data QA/QC requirements for all variables are described in PSEP protocols (PSEP 1986), Johns et al. (1989), and PTI (1989a).

GENERAL DATA REPORTING AND ANALYSIS APPROACHES

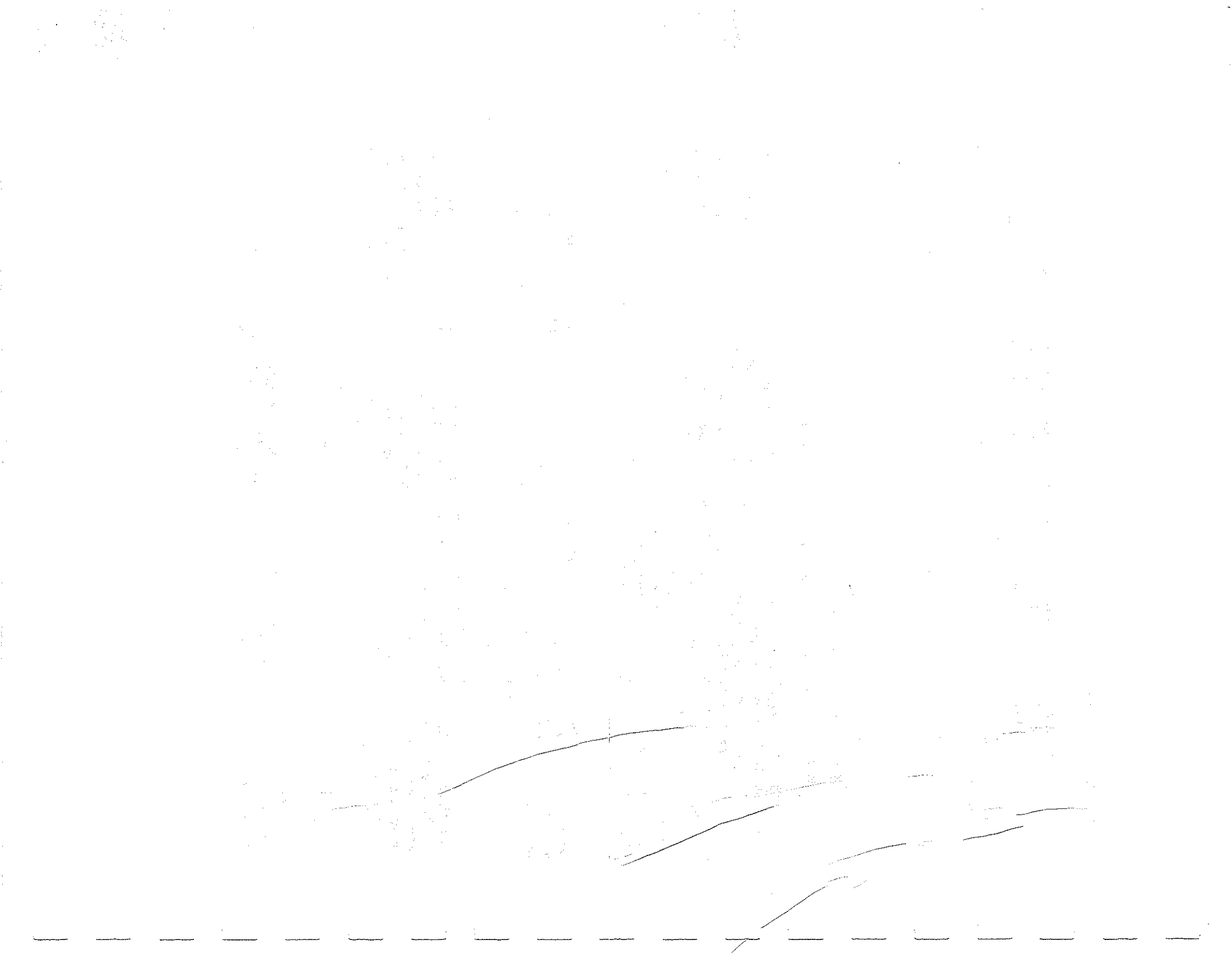
Data generated from the interim reference area studies should be incorporated into the P-2 reference area database along with PSDDA II and PSAMP data. Performance standards analyses should be conducted on all appropriate data sets to provide a comparison of the available reference data among surveys. Summaries of the mean (or median) and range for each variable and area should be prepared. Based on these comparisons, the importance of spatial variability in reference conditions can be evaluated.

The data analysis steps described below should be performed to achieve the following objectives:

- Fill data gaps
- Characterize relationships among P-2 variables
- Refine the proposed structure of the performance standards system
- Refine the reference area performance standards.

In Step 1, cluster analysis (and Bray-Curtis similarity indices) can be used to define station groups on the basis of similarity of benthic macroinvertebrate assemblages. This is an important step for defining community types that may be related to habitat characteristics (e.g., grain size, depth). Groups may also be defined based on higher taxa data. For sediment chemistry data, a similar analysis should be conducted using Euclidean distance as the measure of similarity between sites based on their chemical assemblages. For each kind of bioassay, groups of sites should be identified from modes in the frequency distribution of values for response variables. However, it should be noted that bioassay response is expected to be a continuous variable and that multimodal distributions may simply be an indication of data gaps. Step 1 provides an initial indication of the discreetness of reference conditions and the amount of data available for each discrete reference area grouping.

In Step 2, inverse classification analysis should be used to define assemblages of benthic macroinvertebrate and relate them to their respective station groupings. Similarly, chemical assemblages should be defined. The characteristics of each assemblage should be described. The results of Steps 1 and 2 should be used to identify unique stations or unusual groups of stations. Single stations or groups that are clearly not representative of undisturbed areas of Puget Sound may be excluded from subsequent analyses.

In Step 3, key habitat variables that can be used to discriminate among reference site groups/assemblages should be identified using multiple discriminant analysis (MDA). For example, certain variables such as grain size and depth are expected to be important for predicting the kind of benthic macroinvertebrate community that should be found at a site. MDA helps to identify these variables and determine their relative importance. It should also indicate the range of each variable for each site group/assemblage. Data for chemistry, toxicity, and benthic macroinvertebrate should be analyzed separately using MDA. For benthic macroinvertebrate, the results may have to be stratified by season before applying MDA. The adequacy of current measures of grain size should be addressed relative to the effects of sediment texture and physical disturbance on benthic communities.

In Step 4, the results for different data types can be integrated to refine the performance standards system. Also, the model of DeWitt et al. (1988) relating amphipod to percent fine-grained material in sediment should be verified using an independent data set for reference areas in Puget Sound.