Appendix T

EAST WATERWAY, EVERETT, WASHINGTON
TECHNICAL DOCUMENT REVIEW

Review of:

TECHNICAL APPENDICES

United States Department of Navy, 1985, Final Environmental Impact Statement, Carrier Battle Group Puget Sound Region Ship Homeporting Project, United States Department of Navy, Western Division, Naval Facilities Engineering Command, San Bruno, California.

Contract No. C0089007

Document Control No. WD4030.1.0-T

Janaury 1991

Prepared For:

WASHINGTON STATE DEPARTMENT OF ECOLOGY
Toxics Cleanup Program

ecology and environment, inc.

101 YESLER WAY, SEATTLE, WASHINGTON, 98104, TEL. 206/624-9537

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EAST WATERWAY, EVERETT, WASHINGTON
TECHNICAL DOCUMENT REVIEW

Review of:

APPENDIX A: SEDIMENT MOVEMENT EVALUATION

Layton & Sell, Inc., August 31, 1984, Navy Homeport EIS: Sedimentation Evaluation.

Contract No. C0089007

Document Control No. WD4030.1.0-T1

Janaury 1991

Prepared For:

WASHINGTON STATE DEPARTMENT OF ECOLOGY
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EAST WATERWAY TECHNICAL DOCUMENT REVIEW

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1.0 INTRODUCTION AND CHRONOLOGY OF EVENTS

The report reviewed, Appendix A of the United States Navy (Navy) Homeport Environmental Impact Statement (EIS), evaluates the effects that sediment transport and deposition from the Snohomish River will have on the Navy's proposed Homeport in Port Gardner. Prepared by Layton and Sell, Inc. of Redmond, Washington, the report uses available data from the United States Army Corps of Engineers (COE), the National Ocean Survey, and historical aerial photographs to provide a qualitative assessment of river sedimentation processes.

2.0 LEGAL AND REGULATORY ISSUES

N/A

3.0 DEMOGRAPHICS AND LAND USE

N/A

4.0 POTENTIALLY LIABLE PERSONS

N/A

5.0 IDENTIFICATION OF POLLUTION POINT SOURCES

N/A

6.0 IDENTIFICATION OF POLLUTION NON-POINT SOURCES

N/A

7.0 CHEMICAL DATA

N/A

8.0 BIOLOGICAL DATA (FLORA/FAUNA)

N/A

9.0 DATA QUALITY

N/A

10.0 HYDROLOGIC AND HYDRODYNAMIC INFORMATION

Aerial Photographs

Aerial photographs from 1947, 1965, and 1983 were reviewed to assess historic sedimentation patterns. Sedimentation increased between 1947 and 1965 in the area along the river dike. By 1965, sand deposits were visible along almost the entire length of the dike, extending to nearly the mouth of the river. In addition, a fill area for the marina at the foot of 14th Street was evident in the 1965 photograph. Although the sand deposits along Jetty Island did not increase from 1965 to 1983, the 1983 photographs showed a substantial increase in the vegetation covering the deposits. Fill areas for the Norton Avenue Terminal and expansion of the 14th Street marina were also evident in the 1983 photograph.

Navigation Charts

Historical navigation charts for the area from 1884, 1927, and 1954 were reviewed at the National Ocean Survey office in Seattle. In 1884, there was no substantial development along the Everett waterfront. A large delta at the mouth of the Snohomish River was charted on the maps. By 1927, some of the tidal areas along the shoreline had been filled and developed. In addition, an offshore jetty had been constructed from the mouth of Snohomish River delta to the southern end of the harbor development in Everett. The 1954 chart showed increased development of the shoreline and completion of the East Waterway.

Sedimentation Rates

In the Everett Harbor Report to Congress (January 1960), the COE made the following estimates of sedimentation rates in the Snohomish River:

- Approximately 500,000 yd^3 of bedload material is transported in the Snohomish River above Ebey Slough each year, 200,000 yd^3 of which is transported below the head of Steamboat Slough.

- The annual suspended sediment load transported in the Snohomish River above Ebey Slough is approximately 1,000,000 yd^3. Only about 400,000 yd^3 enter the river channel and only 10 percent (40,000 yd^3 per year) are deposited in the Snohomish River below Steamboat Slough.

- Of the total 240,000 yd^3 of sediment (bedload and suspended material) that is transported by the river each year, only about 160,000 yd^3 enters the harbor area adjacent to Everett. The remainder exits the confined channel through a gap in the training dike and enters the sound via the original river channel.

- During periods of major flooding, sediment transport in the river may be about double the average, or 480,000 yd^3.

Sedimentation estimates have been verified using dredging records. Between 1931 and 1971, 75,000 to 500,000 yd^3 (average of 180,000 yd^3) of sediment has been removed each year from the upper settling basin and main navigation channel in Everett Harbor.

Shoaling Observations

The report identified the following four depositional areas:

Southwest of Jetty Island. This area southwest of the southern end of the training dike on Jetty Island was last dredged in 1937. An estimated 700,000 yd^3 of sediment has deposited in this area, reducing channel depths by up to 20 ft. In addition, the COE has had to extend the navigation channel an additional 1,000 ft out into Port Gardner to maintain the required 15 ft depth.

South of East Waterway. Sediment deposits in this area immediately south of the Port of Everett's (the Port) East Waterway fill are 4 to 10 ft deep.

East Waterway. The COE first dredged the East Waterway in 1978, removing an estimated 132,000 yd^3 of silt and clay. It is estimated that approximately 3,000 yd^3 of sediment has deposited in East Waterway each year.

Snohomish Channel from Port Gardner to 17th Street. The Port deepened approximately 5,000 ft of the Snohomish channel between Port Gardner and 14th Street from 15 ft to 35 ft in 1978. Since then, 15 to 18 ft (average of 10 ft) of sediment has deposited in the upper 3,000 ft of the channel. The downstream reach has not changed significantly since 1978.

11.0 DREDGING AND DISPOSAL ISSUES AND DATA

COE

The COE is responsible for maintaining certain minimum channel depths and widths in the lower Snohomish River and East Waterway as shown below (Figure 2):

- o Maintain a 150- to 425-ft wide channel, 15 ft deep at Mean Lower Low Water (MLLW) from Port Gardner Bay to the 14th Street dock in Everett.
- o Maintain a settling basin (700 by 1,200 by 20 ft deep) immediately upstream of the 14th Street marina.
- o Maintain a 150-ft wide, 8-ft deep channel from the settling basin to the head of Steamboat Slough (6.3 mi).
- o Maintain a 1,000,000 yd^3 settling basin at river mile 6 (30 by 1,740 by 40 ft).

- o Maintain the East Waterway to a depth of 30 ft MLLW. (The East Waterway has been dredged only once, in 1978, when approximately 132,000 yd^3 were removed.)

- o Maintain approximately 12,550 ft of training dikes along the western boundary of the Snohomish River from Port Gardner to near Preston Point.

A graphic presentation of the maintenance dredging program for the snohomish review is provided in Attachment A.

Various reaches of the system have been dredged routinely at 2- to 3-yr intervals since about 1931. Dredge spoils have been deposited on land adjacent to the river at several points between Preston Point and the head of Steamboat Slough. Several million cubic yards of dredge material was pumped to the west side of the training dike to form Jetty Island. The COE and the Washington State Department of Natural Resources have also established a permanent disposal site on Smith Island, where sediment may be stockpiled for eventual reuse as fill or building material.

The Port constructed the East Waterway in the 1930s using dredge material from the Snohomish River. Between 1946 and 1958, the Port constructed the 14th Street terminal and harbor which required extensive dredging and filling in the Snohomish River channel. The Port expanded the 14th Street yacht basin in 1978. Dredge material was used to construct the Norton Avenue Terminal. As part of this project, the Port also deepened the Snohomish Channel between Port Gardner and the 14th Street terminal from 15 ft to 35 ft below MLLW. The Port assumed responsibility for maintaining the extra 20 ft of depth in this portion of the river.

12.0 ENVIRONMENTAL IMPACTS

The Navy (as of August 1984) proposes to complete the following dredge/fill projects to construct the homeport facilities:

- o Dredge the existing 30-ft deep East Waterway to a depth of 42 ft MLLW.

- o Construct a 1,500-ft long breakwater from the existing fill on the East Waterway, extending southwesterly into Port Gardner.

- o Construct a new 1,500-ft long pier parallel to the proposed breakwater. The pier will be approximately 600 ft east of the breakwater. The western face of the pier will be dredged to a depth of 42 ft MLLW. Water depth on the eastern face will be 55 ft. A new entrance to the East Waterway, located about 400 ft east of the new pier, will be dredged to a depth of 47 ft.

(Note: Since issuance of the EIS, the Navy has modified its dredging plan for the Homeport facility. Under its current plan, the Navy proposes to dredge only noncontaminated sediments from the western and southern edge of the peninsula that forms the East Waterway. The East Waterway will not be dredged. Dredging of the southern area was completed in 1990.)

Estimated impacts on sedimentation from the proposed project are summarized below:

- The proposed 1,500-ft long breakwater extension will further channelize the Snohomish River. This increase in channelization is expected to increase the discharge velocity during ebb tide, which will reduce the amount of sedimentation in this area. No prediction of possible increases in flow velocities is provided. The report recommends using a hydraulic model to predict velocity increases.

- The report predicts that if the Snohomish channel is maintained at a depth of 35 ft and the settling basins are dredged regularly, there will be no significant increase in sedimentation within the proposed harbor expansion. The 35-ft deep channel is expected to function as a third sedimentation basin in the lower Snohomish River.

- The extension of the existing breakwater by 1,500 ft is expected to increase the deposition of coarse grained sediments at the seaward end of the breakwater. However, because the water at the end of the breakwater (55 ft) will initially exceed the required 42-ft berth depth, this additional deposition is not expected to significantly affect the moorage area. It is estimated that maintenance dredging will be required on the order of every 5 to 10 years.

13.0 INTERIM MEASURES/SPILL AND POLLUTION PREVENTION MEASURES

N/A

14.0 COMMUNITY RELATIONS INFORMATION

N/A

15.0 RECOMMENDATIONS

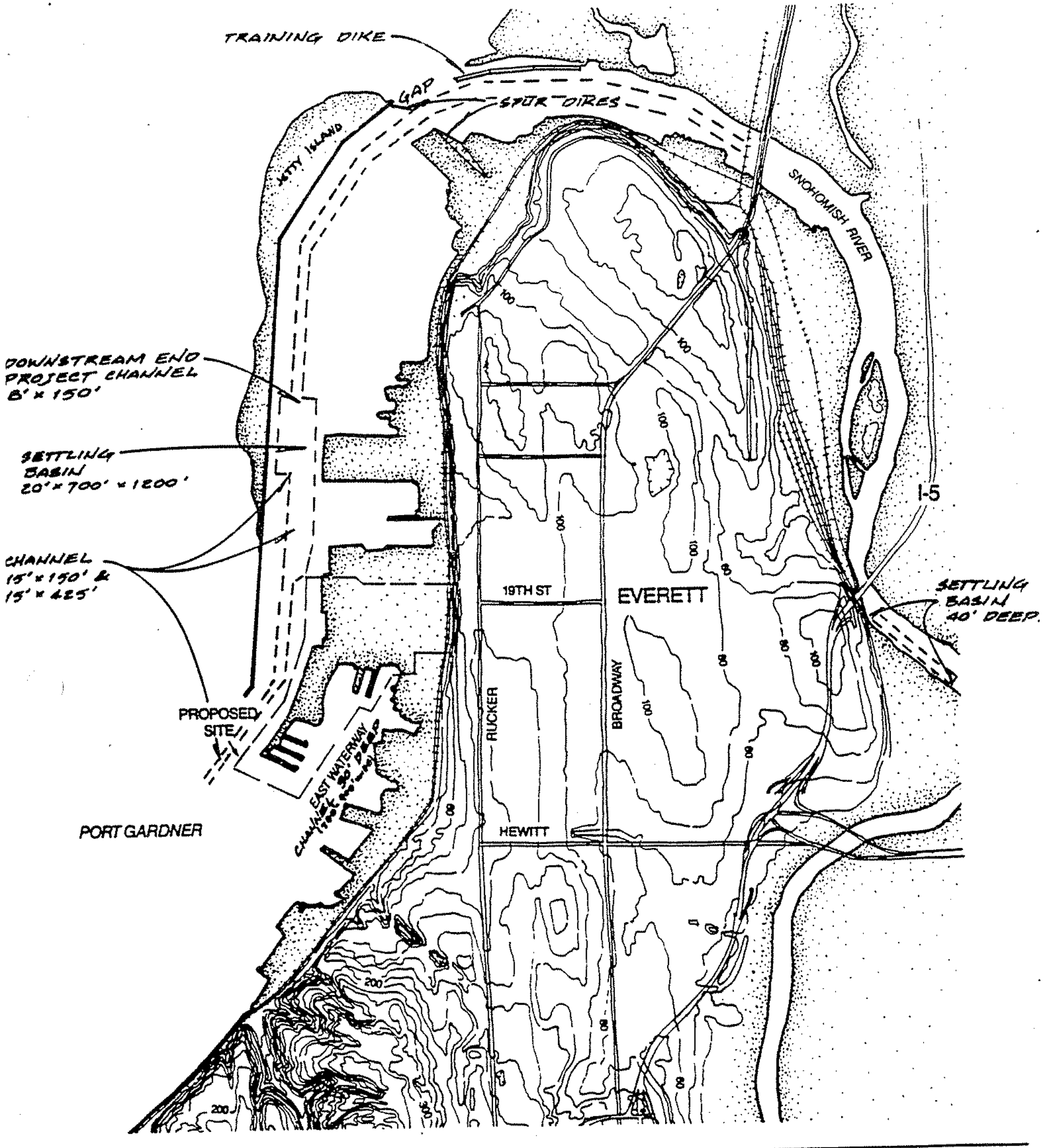
The report provides a general description of dredging and development activities in the Snohomish River channel and East Waterway. Sedimentation rate estimates described in the report that were calculated based on historical information should be compared with more recent data, if available. In addition, detailed descriptions of past dredging activities in Port Gardner/East Waterway should be obtained from the COE to aid in the interpretation of sediment quality data.

16.0 FINAL COMMENTS

This report is suitable for identifying depositional areas within the Port Gardner-East Waterway study area. However, little quantitative information is provided.

Attachment A

COE MAINTENANCE DREDGING PROGRAM



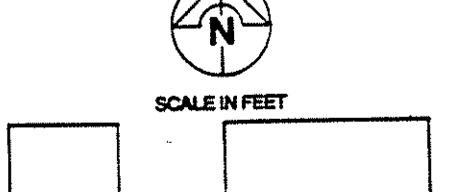


FIGURE 2:
CORPS OF ENGINEERS'
MAINTENANCE DREDGING PROGRAM
FOR THE SNOHOMISH RIVER

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EAST WATERWAY, EVERETT, WASHINGTON
TECHNICAL DOCUMENT REVIEW

Review of:

APPENDIX B: BIOLOGICAL SPECIES LISTS

Contract No. C0089007

Document Control No. WD4030.1.0-T2

January 1991

Prepared For:

WASHINGTON STATE DEPARTMENT OF ECOLOGY
Toxics Cleanup Program

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EAST WATERWAY TECHNICAL DOCUMENT REVIEW

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1.0 INTRODUCTION AND CHRONOLOGY OF EVENTS

The document reviewed was one of the technical appendices of an Environmental Impact Statement (EIS) prepared by the United States Department of the Navy (Navy) for its Carrier Battle Group Puget Sound Region Ship Homeporting Project. It comprises lists of species either found or expected to inhabit the EIS preferred and alternative sites. The lists were compiled from the EIS investigations and literature reviews.

2.0 LEGAL AND REGULATORY ISSUES

N/A

3.0 DEMOGRAPHICS AND LAND USE

N/A

4.0 POTENTIALLY LIABLE PERSONS

N/A

5.0 IDENTIFICATION OF POLLUTION POINT SOURCES

N/A

6.0 IDENTIFICATION OF POLLUTION NON-POINT SOURCES

N/A

7.0 CHEMICAL DATA

N/A

8.0 BIOLOGICAL DATA (FLORA/FAUNA)

The following species lists were provided in this appendix:

- o Plant species observed at Jetty Island;
- o Plant species observed at Sand Point Naval Station Seattle;
- o Upland birds presumed to inhabit areas adjacent to Port Gardner and the Snohomish River;

- Species of terrestrial mammals, reptiles, and amphibians discussed in Chapter III of the EIS;
- Marine mammals known to inhabit Coastal or "inside" waters of Washington State;
- Waterbirds actually observed in the East Waterway, Port Gardner or the lower Snohomish River estuary. This list includes some information regarding foraging strategies, habitat selection, and life history characteristics;
- Bird species that may inhabit the Sand Point site;
- Mammals, reptiles, and amphibians that may be present at the Sand Point site;
- Benthic and fish species which occur in the vicinity of Port Gardner and Elliott Bay including terminal 91 and East Waterway. (This list includes an indication of relative abundance. However, very little information is provided for East Waterway. Habitat type by species is also included.);
- Phytoplankton species observed in Puget Sound;
- Periphyton species found on various substrates near terminal 91 and their relative abundance;
- Marine macrophytes and their relative abundance from exposed beaches in Puget Sound; and
- Zooplankton species observed in Puget Sound.

Sources of the information included in the species lists were provided only for zooplankton, macrophytes, periphyton, and phytoplankton and primarily were from 1967 and 1978 literature. There was; however, one 1931 and one 1983 reference for the phytoplankton. Much of the information presented in these lists was not specifically related to the EIS preferred site of Port Gardner, and very little information was included that actually addressed the East Waterway.

9.0 DATA QUALITY

The quality of information included in the species lists cannot be evaluated without proper source of information citations. In addition, those citations that were included were, for the most part, out of date.

10.0 HYDROLOGIC AND HYDRODYNAMIC INFORMATION

N/A

11.0 DREDGING AND DISPOSAL ISSUES AND DATA

N/A

12.0 ENVIRONMENTAL IMPACTS

N/A

13.0 INTERIM MEASURES/SPILL AND POLLUTION PREVENTION MEASURES

N/A

14.0 COMMUNITY RELATIONS INFORMATION

N/A

15.0 RECOMMENDATIONS

Species lists that are specific to the East Waterway and Port Gardner area should be compiled. If additional work on the Navy port development project has generated further biological community information, it should be obtained for use on this project. Additional literature reviews may be necessary as well as perhaps sample collection and observation during any sediment cleanup or remedial investigation.

16.0 FINAL COMMENTS

The reviewer has no additional comments.

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EAST WATERWAY, EVERETT, WASHINGTON
TECHNICAL DOCUMENT REVIEW

Review of:

APPENDIX C: 1984 JUVENILE SALMONID STUDY

Parametrix, Inc., 1985, Juvenile Salmonid Study, Everett Harbor, 1984, Final Report, prepared for the United States Department of Navy, Western Division, Naval Facilities Engineering Command, San Bruno, California.

Contract No. C0089007

Document Control No. WD4030.1.0-T3

January 1991

Prepared For:

WASHINGTON STATE DEPARTMENT OF ECOLOGY
Toxics Cleanup Program

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EAST WATERWAY TECHNICAL DOCUMENT REVIEW

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ATTACHMENTS

1.0 INTRODUCTION AND CHRONOLOGY OF EVENTS

The document reviewed is an appendix of an Environmental Impact Study (EIS) prepared by the United States Department of the Navy, Western Division, for the proposed aircraft carrier Homeporting project. It presents results of a juvenile salmonid study in Everett Harbor, Washington, conducted by Parametrix, Inc., in 1984 (see sampling locations and descriptions in Attachment A). In the study, timing, distribution, species composition, and habitat selection of juvenile salmonids in the East Waterway area of Everett Harbor, Washington, were examined. Information was collected biweekly at 14 stations from March 27 to July 10, 1984, to determine the potential impacts of the proposed naval facilities on juvenile salmonid populations.

Chronology of Events

- Beach and Purse seining twice per week from March 27 through July 10, 1984, at a total of 14 stations; and
- Analytical comparison of taxonomy, fish size, and sampling station (habitat)--no statistical tests were performed.

2.0 LEGAL AND REGULATORY ISSUES

N/A

3.0 DEMOGRAPHICS AND LAND USE

This information was not provided. However, from the figure depicting the study area shoreline, it appears that the majority of the shoreline in this part of East Waterway is zoned industrial for shipping firms.

4.0 POTENTIALLY LIABLE PERSONS

N/A

5.0 IDENTIFICATION OF POLLUTION POINT SOURCES

N/A

6.0 IDENTIFICATION OF POLLUTION NON-POINT SOURCES

N/A

7.0 CHEMICAL DATA

No chemical data were reported. Sampling for temperature, salinity, and dissolved (DO) oxygen should have been conducted at the time of sampling for background information.

8.0 BIOLOGICAL DATA (FLORA/FAUNA)

This qualitative study was designed to determine the presence, size, and habitat preference of juvenile salmonids in the East Waterway area. Four abundant salmonid species were present in the spring of 1984. Samples were collected from 14 stations twice per week using both beach and purse seine methods. However, the seines had different mesh sizes and, therefore, sampled slightly different size classes. Also seines covered a different size area during sampling because nets were of different sizes. Fish caught in the seining were anesthesized for identification. Fork length was measured, but only up to 15 fish per species were measured at any one time. Fish not used in stomach analyses were released.

Results

Approximately 6,279 juvenile pink salmon were captured with peak abundance occurring in mid-April. A total of 1,429 juvenile Chum salmon were captured with peak abundance occurring in mid-May. A total of 2,135 juvenile Chinook salmon were captured with peak abundance in mid- to late June. Only 446 juvenile Coho salmon were captured with peak abundance in early June. Searun cutthroat trout, steelhead trout, and Dolly Vardon char also were collected but in very low numbers. The investigators plotted mean size of each species over all sampling times. However, because the sample sizes were small (less than or equal to 15 individuals measured during each sampling) and different sized nets were used, comparisons between species cannot be tested statistically.

General Findings

Besides the general peak abundance of juvenile fish for each species (listed above), the investigators also commented on size of individuals caught in nearshore habitats (beach seine) versus deeper shoreline habitats (purse seine). Larger fish were found in deeper habitats. However, this would be expected since the purse seine mesh size is more than twice as large as the mesh size on the beach seine.

Data Quality

The procedures used were adequate to determine the descriptive nature of juvenile salmonid populations in and around the East Waterway area. Sampling was adequate to reveal species composition and appearance of juvenile populations. However, sampling was not adequate to determine the preference between nearshore and shoreline habitat areas, or to determine size distribution changes over time.

The sampling methods used for shoreline (3.2 mm mesh size) and nearshore (9.5 mm mesh size) areas differed resulting in differences in sizes of fish caught during each sampling event. This, coupled with the fact that no more than 15 fish of any one species were measured during each sampling gives little confidence in the precision of the mean fish size calculated. Size data also were not provided in this report, making it difficult to review the range of values for each set of measurements. Therefore, fish size preference information relative to shoreline versus nearshore areas, as well as fish within each habitat, are vague at best. Physical descriptions of each sampling station would be needed to better characterize the differences between locations. Information such as the depth from which samples were taken, characterization of sampling substrate, and physiochemical conditions (temperature, salinity and DO) of each station would provide more useful descriptors of each sampling location than what is provided in the report.

Comparisons of species data of this study to other time periods and/or other areas in Puget Sound also would be helpful in determining the relative value of the data collected.

9.0 DATA QUALITY

Justification of sampling methodology, locations, and species measurements were not provided. Although standard sampling techniques were used, no mention of mesh size differences, sampling station choice, or measurement of 15 only fish per sampling event is made. Information provided was insufficient to evaluate overall data quality.

10.0 HYDROLOGIC AND HYDRODYNAMIC INFORMATION

No hydrologic or hydrodynamic information was provided. Some information should have been provided on tidal flows around each station, especially when seining occurred. Also, some indication of mean flow from the Snohomish River would have been useful.

11.0 DREDGING AND DISPOSAL ISSUES AND DATA

N/A

12.0 ENVIRONMENTAL IMPACTS

No environmental impacts were assessed.

13.0 INTERIM MEASURES/SPILL AND POLLUTION PREVENTION MEASURES

N/A

14.0 COMMUNITY RELATIONS INFORMATION

N/A

15.0 RECOMMENDATIONS

This study should be considered a preliminary evaluation of the juvenile salmonids found in the East Waterway area since it was a 1-year study and the data cannot be validated with the information provided in the report. A more thorough literature review in the introduction covering the historical abundances in the East Waterway area and other nearby areas is needed to provide a reference for the data presented in this study and any future work. If other studies cannot be found during the literature review, additional studies would be needed to provide better temporal resolution on the abundance data provided in this report. Also, more detailed information concerning nearby hatcheries and their releases would be useful in evaluating the abundances and timing reported in this study and any future study.

Size distribution data also should be collected with comparable sampling methods between sampling locations and with adequate sample size. Abundance data, species composition, and fish community diversity and evenness indices (all fish not just salmonids) should then be compared over time by station, and between stations. Comparisons would include covariates of the physical nature of each station such as temperature, salinity, DO, and a ranking value of the fish habitat value (e.g., mud bottom versus rocky bottom). This would provide a more meaningful evaluation of species habitat preference and provide an indication of some of the physical parameters related to species composition, abundance, and habitat preference, as well as how salmonid populations vary with other fish species over time.

Complete background information should be collected if no adequate literature exists for the study area. This would be necessary before completion of the remedial phase of investigation to develop a complete ecological risk assessment work plan.

16.0 FINAL COMMENTS

The report provides adequate quantitative information to describe the juvenile salmonid populations found in the East Waterway area. This information can be used as a baseline to design other studies to further evaluate salmonid populations in the East Waterway area.

Attachment A

LOCATION MAP AND SAMPLE DESCRIPTIONS

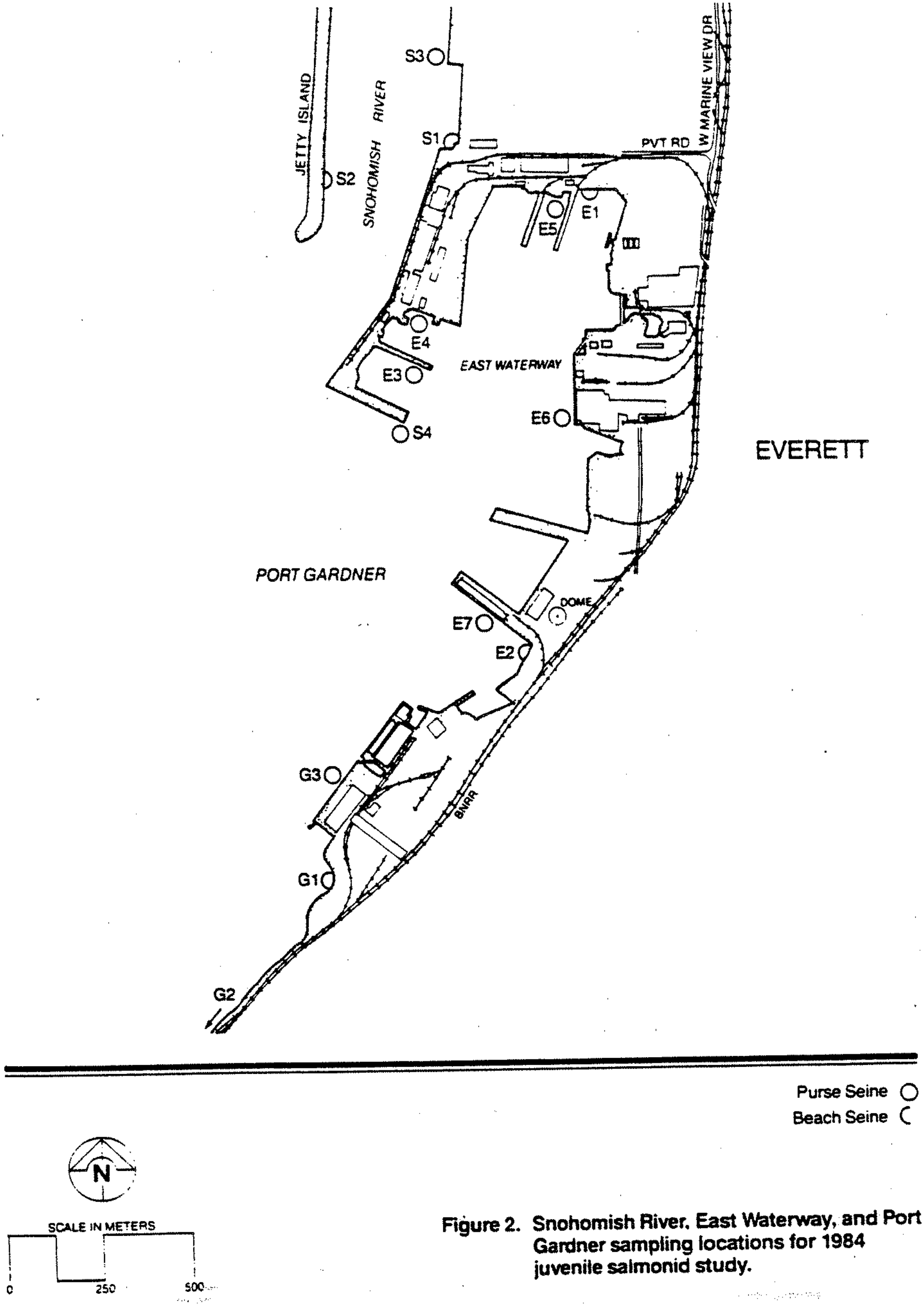

Figure 2. Snohomish River, East Waterway, and Port Gardner sampling locations for 1984 juvenile salmonid study.

Table 1. Description of beach seine sampling stations.

Station	DESCRIPTION
S1	Predominantly gravel with cobbles and scattered small boulders. Mud at shallow sub-tidal level.
S2	Entirely sand and muddy sand.
E1	Steep slope beach with riprap at higher tide levels and cobbles and gravel at lower tide elevations.
E2	Sandy gravel and scattered large wood debris at higher intertidal elevations. Predominantly muddy sand at lower intertidal and shallow subtidal levels.
G1	Gently sloping sand beach with sand and gravel at higher elevations.
G2	Predominantly sand beach with sand and gravel at higher elevations.

Table 2. Location of purse seine sampling stations.

Station	Location	Pier Type
S3	Norton Ave. Terminal	Concrete pile
S4	Jetty South of Pier B	Log boom
E3	Pier B	Wood pile
E4	Foss Tug dock	Log boom/wood pile
E5	Pier Apron between Piers D and E	Wood pile
E6	Pier Apron Scott Paper	Wood pile
E7	Pier 1	Wood pile
G3	Terminal 1	Concrete pile

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EAST WATERWAY, EVERETT, WASHINGTON
TECHNICAL DOCUMENT REVIEW

Review of:

APPENDIX D: CORRESPONDENCE FROM THE
WASHINGTON STATE OFFICE OF HISTORIC PRESERVATION

Contract No. C0089007

Document Control No. WD4030.1.0-T4

January 1991

Prepared For:

WASHINGTON STATE DEPARTMENT OF ECOLOGY
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EAST WATERWAY TECHNICAL DOCUMENT REVIEW

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1.0 INTRODUCTION AND CHRONOLOGY OF EVENTS

The appendix of the Final Environmental Impact Statement (EIS) for the Carrier Battle Group Puget Sound Region Ship Homeporting Project comprised a single one-page letter to Bulkis Onat Applied Sciences, Inc. from the State of Washington Office of Archaeology and Historic Preservation. A formal review has not been prepared for the appendix.

The letter documented the Office's review of the draft EIS. No significant comments were offered by this office.

2.0 LEGAL AND REGULATORY ISSUES

N/A

3.0 DEMOGRAPHICS AND LAND USE

N/A

4.0 POTENTIALLY LIABLE PERSONS

N/A

5.0 IDENTIFICATION OF POLLUTION POINT SOURCES

N/A

6.0 IDENTIFICATION OF POLLUTION NON-POINT SOURCES

N/A

7.0 CHEMICAL DATA

N/A

8.0 BIOLOGICAL DATA (FLORA/FAUNA)

N/A

9.0 DATA QUALITY

N/A

10.0 HYDROLOGIC AND HYDRODYNAMIC INFORMATION

N/A

11.0 DREDGING AND DISPOSAL ISSUES AND DATA

N/A

12.0 ENVIRONMENTAL IMPACTS

N/A

13.0 INTERIM MEASURES/SPILL AND POLLUTION PREVENTION MEASURES

N/A

14.0 COMMUNITY RELATIONS INFORMATION

N/A

15.0 RECOMMENDATIONS

N/A

16.0 FINAL COMMENTS

N/A

T5

EAST WATERWAY, EVERETT, WASHINGTON
TECHNICAL DOCUMENT REVIEW

Review of:

APPENDIX J: WATER QUALITY DATA

Paramatrix Inc., 1985, Water Quality Data, prepared for United States Department of the Navy, Western Divison, Naval Facilities Engineering Command, San Bruno, California.

Contract No. C0089007

Document Control No. WD4030.1.0-T5

January 1991

Prepared For:

WASHINGTON STATE DEPARTMENT OF ECOLOGY
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EAST WATERWAY TECHNICAL DOCUMENT REVIEW

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	Section 14.0	COMMUNITY RELATIONS INFORMATION
X	Section 15.0	RECOMMENDATIONS
	Section 16.0	FINAL COMMENTS

1.0 INTRODUCTION AND CHRONOLOGY OF EVENTS

The data presented in the reviewed appendix are raw data only and are not accompanied by supporting text. Because the accompanying text (the final Environmental Impact Statement [EIS] for the Carrier Battle Group Puget Sound Region Ship Homeporting Project [1985] of the United States Department of the Navy [Navy]) was not available for review, the context in which these data are used and presented cannot be evaluated.

2.0 LEGAL AND REGULATORY ISSUES

Presented as part of this appendix are the Washington State Department of Ecology Water Quality Standards (WAC 173-201). These standards are dated June 2, 1982 and as such are outdated. The most current standards should be consulted to determine if the data presented and conclusions made are pertinent to existing regulatory requirements.

3.0 DEMOGRAPHICS AND LAND USE

N/A

4.0 POTENTIALLY LIABLE PERSONS

N/A

5.0 IDENTIFICATION OF POLLUTION POINT SOURCES

N/A

6.0 IDENTIFICATION OF POLLUTION NON-POINT SOURCES

N/A

7.0 CHEMICAL DATA

N/A

8.0 BIOLOGICAL DATA (FLORA/FAUNA)

N/A

9.0 DATA QUALITY

N/A

10.0 HYDROLOGIC AND HYDRODYNAMIC INFORMATION

N/A

11.0 DREDGING AND DISPOSAL ISSUES AND DATA

N/A

12.0 ENVIRONMENTAL IMPACTS

N/A

13.0 INTERIM MEASURES/SPILL AND POLLUTION PREVENTION MEASURES

N/A

14.0 COMMUNITY RELATIONS INFORMATION

N/A

15.0 RECOMMENDATIONS

The Navy Homeport EIS text pertaining to these appendix data should be reviewed to determine the context in which these data are presented. Also, updated water quality regulations should be consulted to determine if the conclusions regarding potential impacts remain valid for any future dredging activities that may occur as part of the Remedial Investigation/Feasibility Study.

16.0 FINAL COMMENTS

N/A

T6

EAST WATERWAY, EVERETT, WASHINGTON
TECHNICAL DOCUMENT REVIEW

Review of:

APPENDIX L: REGIONAL DISTRIBUTION OF WATERBIRDS

Parametrix, Inc., 1985, Regional Distribution of Waterbirds, prepared for United States Department of the Navy, Western Division, Naval Facilities Engineering Command, San Bruno, California.

Contract No. C0089007

Document Control Number WD4030.1.0-T6

January 1991

Prepared For:

WASHINGTON STATE DEPARTMENT OF ECOLOGY
Toxics Cleanup Program

ecology and environment, inc.
101 YESLER WAY, SEATTLE, WASHINGTON, 98104, TEL. 206/624-9537
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EAST WATERWAY TECHNICAL DOCUMENT REVIEW

TABLE OF CONTENTS CHECKLIST

ATTACHMENTS

1.0 INTRODUCTION AND CHRONOLOGY OF EVENTS

The report reviewed summarizes bird surveys conducted in the Puget Sound region by the Washington State Department of Game (Game Department) and the United States Fish and Wildlife between 1982 and 1983. The Game Department also identified fragile areas in Puget Sound where bird populations are sensitive to oil pollution.

2.0 LEGAL AND REGULATORY ISSUES

N/A

3.0 DEMOGRAPHICS AND LAND USE

N/A

4.0 POTENTIALLY LIABLE PERSONS

N/A

5.0 IDENTIFICATION OF POLLUTION POINT SOURCES

N/A

6.0 IDENTIFICATION OF POLLUTION NON-POINT SOURCES

N/A

7.0 CHEMICAL DATA

N/A

8.0 BIOLOGICAL DATA (FLORA/FAUNA)

N/A

9.0 DATA QUALITY

The data indicate that, with the exception of mallard and Canadian geese, most waterbirds overwinter, but do not breed in Puget Sound. The number of waterbirds present in each subregion is highest in October and decreases from late fall through early spring.

Washington State Department of Game

In the winter of 1982/1983, the Game Department conducted a survey of waterbirds in the following five areas of Puget Sound (see Figure L-1, Attachment A):

- o Southern Admiralty Inlet,
- o Possession Sound,
- o Northern Puget Sound,
- o North Central Puget Sound, and
- o Central Puget Sound.

The results summarized in Table L-1 (Attachment B) indicate that December bird counts are greatest in southern Admiralty Inlet and Possession Sound. In four of the five areas surveyed, the number of birds declined by 37 to 59 percent between December and February. Bird counts increased by approximately 55 percent during this same period in north Puget Sound. Alcids were most abundant waterbird species in Admiralty Inlet and North Central Puget Sound; ducks were the most abundant in Possession Sound and Central Puget Sound; and grebes and alcids were the most abundant in Northern Puget Sound.

Birds that are sensitive to oil pollution were identified using the Bird Oil Index (BOI) (Manuwal et al. 1979 [reference not provided]). The BOI evaluates the following three traits to determine oil sensitivity:

- o Habitat of species as it relates to exposure to oil,
- o Pollution characteristics, and
- o Significance of censused populations to total population.

Results of the ranking for the five Puget Sound areas evaluated presented in Table L-2 (Attachment B) show that southern Admiralty Inlet is the most fragile subarea. North Central and Central Puget Sound support birds that are relatively oil-tolerant and therefore have low BOI values.

Wahl and Spreich (1983) (no reference provided) conducted a bird census during the summer and found that only 14 species associated with marine waters breed in Puget Sound (Table L-5, Attachment B). Nine of these species were found in the eastern Puget Sound subregion.

United States Fish and Wildlife Service

The United States Fish and Wildlife Service surveyed all waterbirds in the inland waters of Puget Sound in 1982 to 1983. (The United States Fish and Wildlife apparently used different survey methods than the Game Department, but the methods are not described in the report.) American wigeon, mallard, and Northern pintail were the most abundant waterbirds in the greater Puget Sound region, while western grebe and cormorant were the least abundant (Table L-3, Attachment B). The distribution of various bird species by Puget Sound subregion is summarized in Table L-4 (Attachment B).

10.0 HYDROLOGIC AND HYDRODYNAMIC INFORMATION

N/A

11.0 DREDGING AND DISPOSAL ISSUES AND DATA

N/A

12.0 ENVIRONMENTAL IMPACTS

N/A

13.0 INTERIM MEASURES/SPILL AND POLLUTION PREVENTION MEASURES

N/A

14.0 COMMUNITY RELATIONS INFORMATION

N/A

15.0 RECOMMENDATIONS

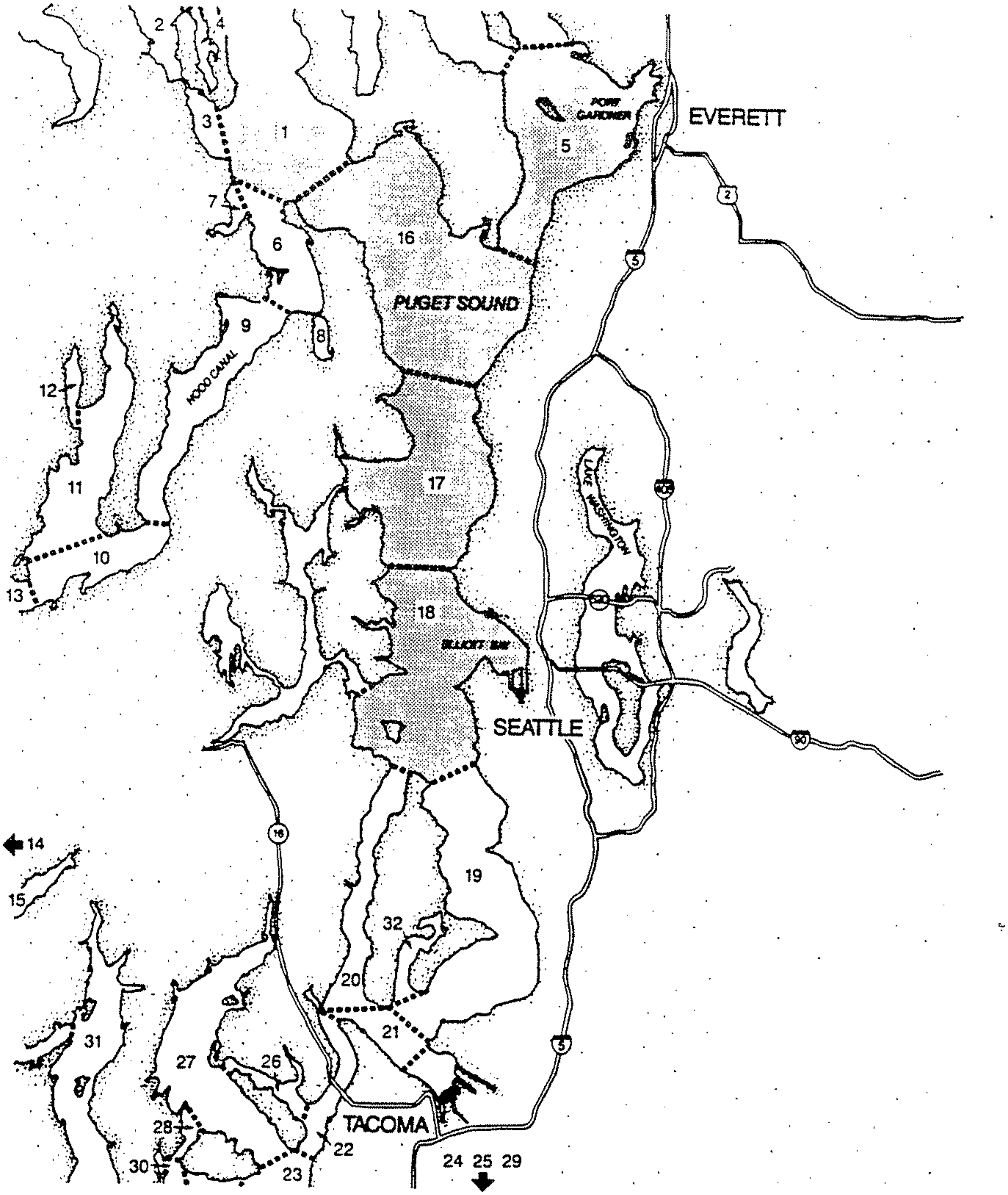
The data presented in this report are from surveys conducted in 1982 to 1983. More recent data, if available, should be reviewed to determine if there have been any changes in the number and distribution of waterbirds in the Puget Sound region.

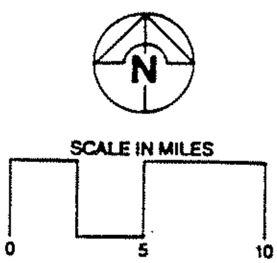
16.0 FINAL COMMENTS

The bird counts indicate that the number of waterbirds present in Puget Sound is highest during the fall and winter and declines in the summer months. Therefore, to minimize potential impacts on birds, it is recommended that site remediation be conducted in the summer months when bird counts are lowest.

Attachment A

SITE MAP





1 South Admiralty Inlet
2 Port Townsend
3 Oak Bay
4 Killisut Harbor
5 Possession Sound
6 Hood Canal Entrance
7 Port Ludlow
8 Port Gamble
9 Northern Hood Canal
10 Central Hood Canal
11 Dabob Bay
12 Quilcene Bay
13 South Central Hood Canal
14 Anna's Bay
15 Great Bend
16 North Puget Sound
17 North Central Puget Sound
18 Central Puget Sound
19 East Passage
20 Colvos Passage
21 Dalco Passage
22 Narrows
23 Steilacoom
24 Nisqually
25 Treble-Johnson
26 Hale Passage South
27 Carr Inlet
28 Pitt Passage
29 Balch Passage
30 Drayton Passage
31 Case Inlet
32 Quartermaster Harbor

Figure L-1. Boundaries and names of subregions surveyed for waterbirds in December 1982 and February 1983.

Source: Washington State Department of Game. 1983.

Attachment B

BIRD COUNT DATA

Table L-1. Estimated number of birds by subregion in December, 1982, and Febuary, 1983.

Subregion	LOON[1]		GREB		CORM		GBHE		DUCK		GULL		ALCI		TOTAL	
	82	83	82	83	82	83	82	83	82	83	82	83	82	83	82	83
S. Admiralty Inlet		20	600	100	40	40	20		1,700	700	4,400	2,000	2,700	1,000	9,460	3,860
Possession Sound		4	2,000	2,800	60	8	2		3,000	70	2,000	1,000	4	200	7,066	4,082
Northern Puget Sound	4	10	1,000	500	9	30			500	600	1,000	3,500	1,000	800	3,513	5,440
North Central Puget Sound	2	4	100	300	30	30	2		400	300	3,000	2,000	1,000	70	4,534	2,704
Central Puget Sound	4	6	300	100	60	20			2,000	500	2,000	2,000	300	300	4,664	2,926

Source: Washington Department of Game, 1983.

[1] Key

LOON = Loons
GREB = Grebes
CORM = Cormorant
GBHE = Great Blue Heron
DUCK = All Ducks
GULL = All Gulls
ALCI = Alcids

Table L-2. Estimated BOI family values of birds by subregion in December, 1982, and Febuary, 1983.

Subregion	LOON[1]		GREB		CORM		GBHE		DUCK		GULL		ALCI		Approximate TOTAL		BOI/KM2		Ranking Ou of Surveyed SUBREGION	
	82	83	82	83	82	83	82	83	82	83	82	83	82	83	82	83	82	83	82	83
Admiralty Inlet	FI	FI	10	2	1	1	1	FI	14	6	66	30	100	37	191	76	1.2	0.5	17	21
Possession Sound	FI	FI	34	47	1	FI	FI	FI	25	1	30	15	FI	7	90	70	0.8	0.6	20	20
Northern Puget Sound	FI	FI	17	8	FI	FI	FI	FI	4	5	15	52	37	30	73	96	0.3	0.5	29	24
North-Central Puget Sound	FI	FI	2	5	1	FI	FI	FI	3	3	45	30	37	3	88	41	0.7	0.3	21	28
Central Puget Sound	FI	FI	5	2	1	FI	FI	FI	17	4	30	30	11	11	64	48	0.5	0.4	27	26

Source: Washington State Department of Game, 1983.

[1] Key

LOON = Loons
GREB = Grebes
CORM = Cormorant
GBHE = Great Blue Heron
DUCK = All Ducks
GULL = All Gulls
ALCI = Alcids

Table L-3. Ranking by abundance of Puget Sound waterbirds as estimated by October 1983 aerial surveys.

	Waterfowl	
1.	American Wigeon	54,705
2.	Mallard	45,360
3.	Pintail	26,720
4.	Surf Scoter	18,170
5.	Green-winged Teal	15,660
6.	Snow Goose	14,003
7.	Greater Scaup	11,605
8.	White-winged Scoter	10,630
9.	Ruddy Duck	2,545
10.	Ring-necked Duck	1,345
	Birds Other than Waterfowl	
1.	Western Grebe	7,346
2.	Small Shorebirds	2,835
3.	Unknown Gulls	2,000*
4.	Double-crested Cormorants	1,068
5.	Pelagic Cormorant	619
	Sensitive/Endangered Species	
	Common Loon	376
	Bald Eagle	20

*Incomplete count - very low.

Source: U.S. Fish & Wildlife Service, 1984.

Table L-4. Waterbird counts by subregions of Puget Sound.

Date:	1983			1982								
	October 17 to 20, 1983			December 13, 1982			November 29, 1982			October 29, 1982		
Subregion:	Brown's Pt. to Alki Pt.	Elliott Bay to Port Gardner	Port Gardner	Brown's Pt. to Alki Pt.	Elliott Bay to Port Gardner	Port Gardner	Brown's Pt. to Alki Pt.	Elliott Bay to Port Gardner	Port Gardner	Brown's Pt. to Alki Pt.	Elliott Bay to Port Gardner	Port Gardner
Canada Goose					31	5						
Mallard	500	25		117	14	68	141	45	112	1,136	8	175
Gadwall												
Wigeon	3,500	1,300	1,300	406	132	1,962	2,822	1,291	1,640	5,368	1,182	3,805
G-w Teal			250									
Pintail			25				35				5	10
Wood Duck												
Unid. Dabbler												
TOTAL DABBLERS	4,000	1,325	1,575	523	146	2,030	2,998	1,336	1,752	6,504	1,195	3,990
Scaup		10		44	99	10						
Goldeneye				93	69	13	25					
Bufflehead				2			5			3		
TOTAL DIVERS		10		139	168	23	30			3		
Scoter	1,325	125	25	360	618	5	354	215	10	359	45	10
Merganwer	25	40		16	9		25	13	5	29	1	
TOTAL DUCKS	1,350	165	25	376	627	5	379	248	15	388	46	10
Other:												
Western Grebe	159	364	37	10	128	428	105	436	15	18	131	
Loon		2							1	1	2	3
Cormorant	16	33	7	5	39	3	26	16	14	8	14	3
Great Blue Heron	6	6	16	2			5	5	7	1	2	3
Pigeon Guillemot		11						1				
Bald Eagle					1							
TOTAL OTHER	181	416	60	17	168	431	136	458	37	28	149	9
TOTAL WATERBIRDS	5,531	1,916	1,660	1,055	1,140	2,494	3,543	2,042	1,804	6,923	1,390	4,009

Source: U. S. Fish and Widlife Services, 1982 and 1983.

Table L-5. Abundance of breeding bird species by selected subregions in Puget Sound.

Subregion	Great Blue Heron	Canada Goose	Mallard	Kill-deer	Glaucous winged Gull	Pigeon Guillo-mot	Marbled Murrelet	Belted King-fisher	North-western Crow
Possession Sound	16				300	8	24	1	4
Southern Admiralty Inlet	3					44	20		4
Northern Puget Sound	28	2	10			12	1		4
North-Central Puget Sound	9			2	2	32	4	1	37
Central Puget Sound	5		4			15	12	1	18
Elliott Bay	11	20	30	2	28	1			

Source: Wahl and Speich, in press.

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EAST WATERWAY, EVERETT, WASHINGTON
TECHNICAL DOCUMENT REVIEW

Review of:

APPENDIX M: GUIDELINES FOR SPECIFICATION OF DISPOSAL SITES FOR DREDGED OR FILL MATERIAL

Contract No. C0089007

Document Control No. WD4030.1.0-T7

January 1991

Prepared For:

WASHINGTON STATE DEPARTMENT OF ECOLOGY
Toxics Cleanup Program

ecology and environment, inc.
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EAST WATERWAY TECHNICAL DOCUMENT REVIEW

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1.0 INTRODUCTION AND CHRONOLOGY OF EVENTS

Appendix M of the Navy Environmental Impact Statement (EIS) for the Carrier Battle Group Puget Sound Homeporting Project consisted of a copy of the Federal Register, Wednesday, December 24, 1980, Part IV, Environmental Protection Agency, Guidelines for Specification of Disposal Sites for Dredged or Fill Material (Part 230-404[b][1]). The 404(4)(1) guidelines provide criteria to be used in evaluating discharges of dredged or fill material as a part of the requirements of Section 404 of the Clean Water Act.

2.0 LEGAL AND REGULATORY ISSUES

N/A

3.0 DEMOGRAPHICS AND LAND USE

N/A

4.0 POTENTIALLY LIABLE PERSONS

N/A

5.0 IDENTIFICATION OF POLLUTION POINT SOURCES

N/A

6.0 IDENTIFICATION OF POLLUTION NON-POINT SOURCES

N/A

7.0 CHEMICAL DATA

N/A

8.0 BIOLOGICAL DATA (FLORA/FAUNA)

N/A

9.0 DATA QUALITY

N/A

10.0 HYDROLOGIC AND HYDRODYNAMIC INFORMATION

N/A

11.0 DREDGING AND DISPOSAL ISSUES AND DATA

N/A

12.0 ENVIRONMENTAL IMPACTS

N/A

13.0 INTERIM MEASURES/SPILL AND POLLUTION PREVENTION MEASURES

N/A

14.0 COMMUNITY RELATIONS INFORMATION

N/A

15.0 RECOMMENDATIONS

Although reviewed, no formal review summary was prepared for this document. The information should be considered along with Puget Sound Dredged Disposal Analysis (PSDDA) requirements during any future feasibility studies for the East Waterway site.

16.0 FINAL COMMENTS

N/A

T8

EAST WATERWAY, EVERETT, WASHINGTON
TECHNICAL DOCUMENT REVIEW

Review of:

APPENDIX N: DISTRIBUTION OF CONTAMINANTS IN EVERETT HARBOR

Pacific Northwest Laboratory, Battelle Northwest, Marine Research Laboratory, 1984, Distribution of Contaminants in Everett Harbor, prepared for the U.S. Army Corps of Engineers.

Contract No. C0089007

Document Control Number WD4030.1.0-T8

January 1991

Prepared For:

WASHINGTON STATE DEPARTMENT OF ECOLOGY
Toxics Cleanup Program

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EAST WATERWAY TECHNICAL DOCUMENT REVIEW

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	Section 5.0	IDENTIFICATION OF POLLUTION POINT SOURCES
	Section 6.0	IDENTIFICATION OF POLLUTION NON-POINT SOURCES
	Section 7.0	CHEMICAL DATA
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	Section 9.0	DATA QUALITY
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	Section 11.0	DREDGING AND DISPOSAL ISSUES AND DATA
	Section 12.0	ENVIRONMENTAL IMPACTS
	Section 13.0	INTERIM MEASURES/SPILL AND POLLUTION PREVENTION MEASURES
	Section 14.0	COMMUNITY RELATIONS INFORMATION
X	Section 15.0	RECOMMENDATIONS
	Section 16.0	FINAL COMMENTS

1.0 INTRODUCTION AND CHRONOLOGY OF EVENTS

The data presented in the reviewed appendix are raw data only and are not accompanied by any supporting text. Most of these data were previously reported by Anderson and Crecelius (1985). Because the accompanying text (the final Environmental Impact Statement [EIS] for the Carrier Battle Group Puget Sound Region Ship Homeporting Project [1985] of the United States Department of the Navy [Navy]) was not available for review, the context in which these data are used and presented cannot be evaluated.

2.0 LEGAL AND REGULATORY ISSUES

N/A

3.0 DEMOGRAPHICS AND LAND USE

N/A

4.0 POTENTIALLY LIABLE PERSONS

N/A

5.0 IDENTIFICATION OF POLLUTION POINT SOURCES

N/A

6.0 IDENTIFICATION OF POLLUTION NON-POINT SOURCES

N/A

7.0 CHEMICAL DATA

N/A

8.0 BIOLOGICAL DATA (FLORA/FAUNA)

N/A

9.0 DATA QUALITY

N/A

10.0 HYDROLOGIC AND HYDRODYNAMIC INFORMATION

N/A

11.0 DREDGING AND DISPOSAL ISSUES AND DATA

N/A

12.0 ENVIRONMENTAL IMPACTS

N/A

13.0 INTERIM MEASURES/SPILL AND POLLUTION PREVENTION MEASURES

N/A

14.0 COMMUNITY RELATIONS INFORMATION

N/A

15.0 RECOMMENDATIONS

The Navy Homeport EIS text pertaining to these appendix data should be reviewed to determine if any new information is presented beyond that in the Anderson and Crecelius (1985) report. Also, the context in which these data are presented should be evaluated.

16.0 FINAL COMMENTS

N/A

T9

EAST WATERWAY, EVERETT, WASHINGTON
TECHNICAL DOCUMENT REVIEW

Review of:

APPENDIX R: JUVENILE SALMONID STOMACH CONTENT STUDY

Parametrix, Inc., February 1985, Juvenile Salmonid Stomach Content Study, Everett Harbor, 1984, prepared for the Department of Navy, Western Division, Naval Facilities Engineering Command, San Bruno, California.

Contract No. C0089007

Document Control No. WD4030.1.0-T9

January 1991

Prepared For:

WASHINGTON STATE DEPARTMENT OF ECOLOGY
Toxics Cleanup Program

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EAST WATERWAY TECHNICAL DOCUMENT REVIEW

TABLE OF CONTENTS CHECKLIST

1.0 INTRODUCTION AND CHRONOLOGY OF EVENTS

The document reviewed was an appendix to an Environmental Impact Study (EIS) prepared by the United States Navy, Western Division, for the proposed aircraft carrier homeporting project. This study is a continuation of the juvenile salmonid fish study (Appendix C) and covers analysis of stomach contents performed by Parametrix, Inc. in 1984. The study identified food types, and enumerated, weighed, and analyzed the data using an Index of Relative Importance (IRI) for each prey type found in juvenile salmonid stomachs. Although not explicitly defined, stomach analyses were grouped by species and habitat over all sampling dates and sizes. Results indicate that juvenile pink, chum, and chinook salmon consume a variety of prey as they move through a variety of habitats.

Chronology of Events

- o Beach and Purse seining from March 27 through July 10, 1984.
- o (Implied) stomach content analysis, summer and fall 1984.

2.0 LEGAL AND REGULATORY ISSUES

N/A

3.0 DEMOGRAPHICS AND LAND USE

N/A

4.0 POTENTIALLY LIABLE PERSONS

N/A

5.0 IDENTIFICATION OF POLLUTION POINT SOURCES

N/A

6.0 IDENTIFICATION OF POLLUTION NON-POINT SOURCES

N/A

7.0 CHEMICAL DATA

No chemical data were reported. Physical and chemical data such as temperature, salinity, and dissolved oxygen should have been collected during the seining study.

8.0 BIOLOGICAL DATA (FLORA/FAUNA)

This study was designed to provide a qualitative assessment of juvenile salmonid food types and relative importance of prey that are consumed in the East Waterway area (see Attachment A containing the sample station location map and description tables). Fish were collected and preserved during the juvenile salmonid survey as described in Appendix C of the EIS. How fish were chosen, from all individuals collected during the seining, for stomach content analysis from each of the 31 sampling dates was not specified. It is apparent that the investigators were grouping individuals by species and sampling gear types used to collect them. However, no effort was made to examine each species by size class for each month studied.

Methods

Fish were preserved, stomachs dissected, contents identified and counted, and biomass calculated. It is not known if dry weight or wet weight was measured. A modified version of the IRI was used to determine juvenile salmonid feeding habitats and prey preferences. The index is calculated as follows:

IRI = Frequency of prey occurrence × (% of prey group number to total of all prey groups + % of prey group weight to weight of all prey groups).

Analysis of each species was by sampling gear type (beach versus purse seine) and area sampled (East Waterway, Port Gardner, and Snohomish River with seven, three, and four stations respectively) (see prey group summaries and IRI diagrams, Attachment B).

Since data were grouped across size classes, there is no way to break out size limited prey selection (e.g., mouth gape). Also, there is no breakdown of analysis over time since samples were grouped over the 3-month sampling period. These two shortcomings lead one to assume the prey were equally available over the study period and fish were not size restricted in consuming any prey type found in the study. These assumptions are erroneous with what other fish studies have reported in the recent literature.

There is a definite size-selective consumption of prey as fish grow. Feeding occurs not only in different habitats for each size class, but on different prey items, mostly because of restrictions in mouth gape. Also, prey availability varies considerably over time, especially with planktonic organisms, and stomach contents may not reflect prey selection, but availability of food items.

Data were also grouped by location (Attachment A), with three to seven stations in each location. However, this grouping format may have been erroneous since habitat varied considerably among stations within a location. It would have been more appropriate to group the samples by habitat type (e.g., rocky bottom versus sandy bottom) rather than only by location.

Results

Number of stomachs examined were as follows (grouped across all stations within a location):

Location	Gear Type	Pink	Chum	Chinook	Coho
Snohomish River	Beach	43	36	19	*
	Purse	10	5	14	
East Waterway	Beach	38	29	32	
	Purse	65	64	20	
Port Gardner	Beach	29	41	31	
	Purse	10	14	17	

* All juvenile coho grouped across sample areas and gear type because of small number caught per station.

As evident in this table, very few stomachs were examined at each location. This is surprising because of the relatively large number of juveniles reported in the survey sampling results. Since these fish were migrating through many habitats, it would have been preferable to group each species by sampling gear, and eliminate location grouping. Such grouping also would have been appropriate considering the variability of habitat within each location.

Prey items were identified to the lowest taxonomic level possible. However, it is apparent that in most cases, family and order are the best level the investigators obtained. From these broad taxonomic classifications, the investigators stated whether the prey were primarily benthic or pelagic organisms. According to some of the major taxonomic descriptions, some of the taxonomic groups identified in this study encompass both pelagic- and benthic-dwelling species and not exclusively one or the other. Without better taxonomic identification, it is not entirely useful to categorize prey as benthic or pelagic organisms, especially considering the fish mobility and ability to feed anywhere.

Crustaceans compose the majority of juvenile salmonid diets. Of this food type, the major categories appeared to be amphipods, cumaceans, calanoid copepods, cyclopoids, and diptera. The investigators determined that purse-seined fish fed predominantly on pelagic organisms in certain locations, but because of sample pooling and other analytical problems mentioned previously, it would be difficult to subdivide the analysis any further than comparing beach and purse-seined fish.

General Findings

The procedures used were adequate to conduct a descriptive study of juvenile salmonid stomach contents during the spring of 1984. Analyses of prey consumed, using the IRI, revealed a diet of a wide variety of crustaceans from a variety of habitats.

Data Quality

The IRI used is adequate to provide a general description of food types. However, the detailed analyses conducted in the study to examine differences in diet between locations and sampling gear types were inadequate because of low sample number, In addition, data should have been grouped together by sample gear to examine differences between fish caught by the two different methods. As discussed earlier, grouping fish collections by fish size class over the 3-month sampling period would have added diet diversity to results. Artificial grouping of this nature would tend to reduce the resolution of comparisons within a fish species.

The IRI is adequate for examining fish diet. However, more details are needed on prey availability to determine feeding preference. Stomach analyses only reflect what was eaten, not prey preference. Concurrent prey abundance studies should be conducted to determine if preference or random feeding is used by the fish species.

Other accepted analytical approaches are more robust in examining fish diet differences, but require adequate numbers of fish per size class per month. For example, cluster analyses determine the similarity of diet within size classes, locations, time, or any other variable. Better documentation of prey habitat or better taxonomic identification of prey also would be required to determine where the prey was actually living.

9.0 DATA QUALITY

Insufficient information was provided to evaluate the overall data quality. Neither justification of sample grouping over the 3-month sampling period nor number of fish preserved for stomach analysis at each sampling period was provided. The reported total number of fish preserved in this study differs from the reported total number of fish preserved in the juvenile salmonid survey study.

10.0 HYDROLOGIC AND HYDRODYNAMIC INFORMATION

N/A

11.0 DREDGING AND DISPOSAL ISSUES AND DATA

N/A

12.0 ENVIRONMENTAL IMPACTS

None were assessed.

13.0 INTERIM MEASURES/SPILL AND POLLUTION PREVENTION MEASURES

N/A

14.0 COMMUNITY RELATIONS INFORMATION

N/A

15.0 RECOMMENDATIONS

This study can be used to provide a general description of juvenile food consumption should further study be deemed necessary during future remedial study. To document prey selection and diet of juvenile salmonids in the East Waterway area, it would be appropriate to perform a year-long or two-season study to examine the diet of each species by size, class, and habitat type over time. This would require adequate replicates to perform a more detailed statistical analysis using such techniques as cluster analysis. This kind of information would be useful in determining possible pathways of contamination if sediments were found to be contaminated in the East Waterway area, especially if an ecological risk assessment is required.

16.0 FINAL COMMENTS

The study provides a basic understanding of juvenile salmonid diet in the East Waterway area. This information reveals that the diet of salmonids varies as they migrate through different habitat types.

Attachment A

SAMPLE LOCATION MAP AND DESCRIPTIONS

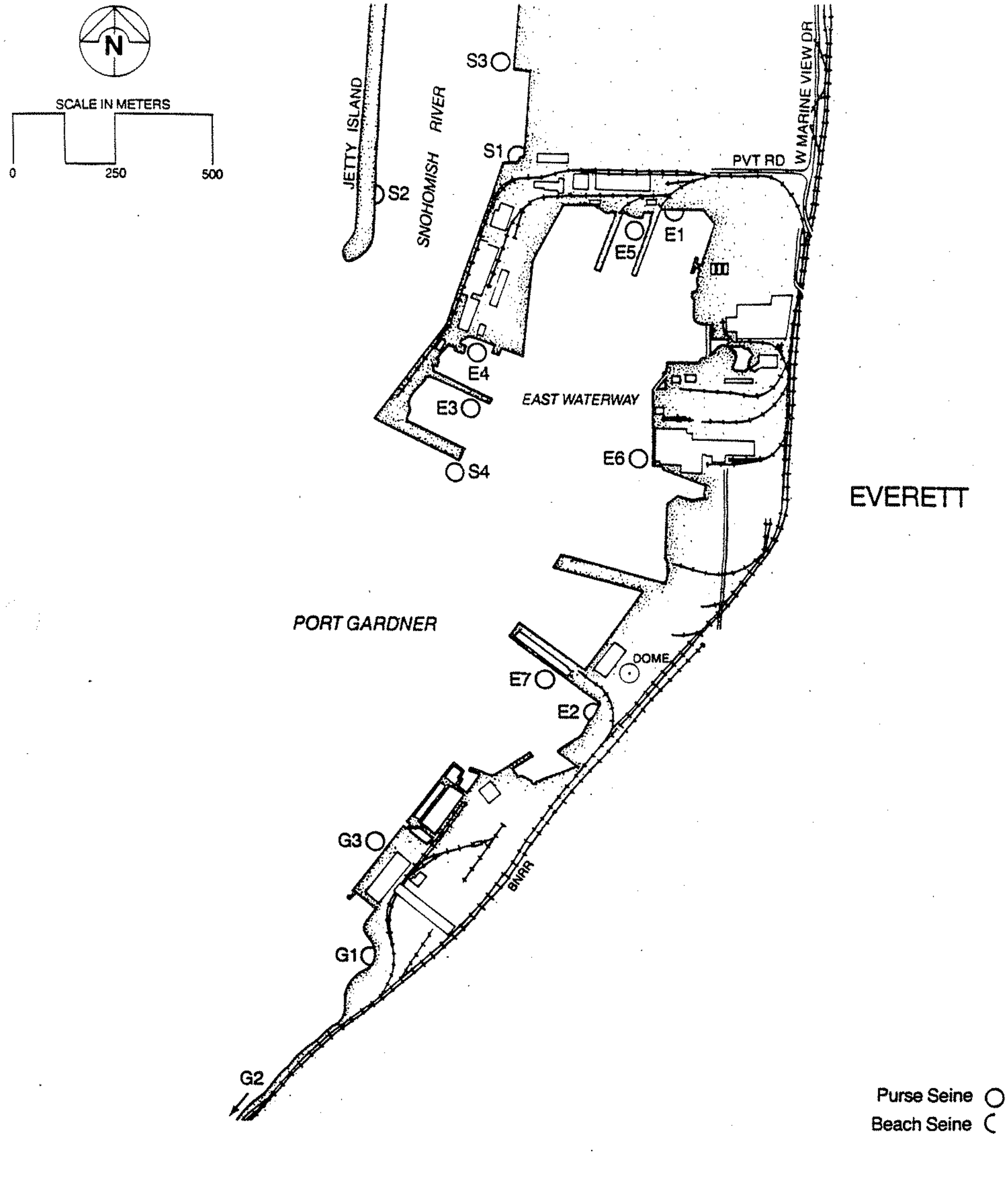

Figure 2. Snohomish River, East Waterway, and Port Gardner sampling locations for 1984 juvenile salmonid study.

Table 1. Description of beach seine and purse sampling stations.

Beach Seine:

Station	Location	Beach Description
S1	Norton Avenue Terminal	Intertidal gravel with cobbles and scattered small boulders. Mud at shallow sub-tidal level.
S2	Jetty Island	Sand and muddy sand.
E1	Northeast end of East Waterway	Steep slope beach with small riprap at intertidal elevations, cobbles and gravel at shallow subtidal elevations.
E2	Weyerhaeuser Site	Sandy gravel and scattered large wood debris at higher intertidal elevations. Muddy sand at lower intertidal and shallow subtidal levels.
G1	Adjacent Terminal 1	Gently sloping sand beach with some gravel at higher intertidal elevations
G2	Port Gardner	Sand beach with some gravel at higher intertidal elevations.

Purse Seine:

Station	Location	Pier Type
S3	Norton Avenue Terminal	Concrete Pile
S4	Jetty South of Pier B	Log Boom
E3	Pier B	Wood pile
E4	Foss Tug Dock	Log boom/wood pile
E5	Pier Apron between Piers D and E	Wood pile
E6	Pier Apron Scott Paper	Wood pile
E7	Pier 1, Weyerhaeuser site	Wood pile
G3	Terminal 1	Concrete pile

Table 3. Numbers of juvenile salmon collected for stomach content analysis and stations where they were collected.

Station	Gear Type	PINK	CHUM	CHINOOK	COHO
S-1	Beach	33	22	14	2
S-2	Beach	12	15	5	
S-3	Purse	4		5	
S-4	Purse	7	6	11	2
		58	43	35	4
E-1	Beach	21	11	17	
E-2	Beach	20	18	17	2
E-3	Purse	31	17	9	
E-4	Purse	8	9	0	
E-5	Purse	13	14	6	
E-6	Purse	12	10	4	
E-7	Purse	4	14	4	4
		109	93	57	6
G-1	Beach	20	20	23	2
G-2	Beach	11	23	11	4
G-3	Purse	12	15	18	2
		43	58	52	8

TOTAL PINK:	210
TOTAL CHUM:	194
TOTAL CHINOOK:	144
TOTAL COHO:	18
TOTAL FISH:	566

Attachment B

PREY GROUP SUMMARIES AND IRI DIAGRAMS

Table 4. Summary of the dominant prey groups present in the stomachs of juvenile chum salmon

Station	Prey group	% Total IRI	Bottom (B) or Pelagic (P)
Beach Seine:			
Snohomish River	Gammaridea	49	B
(N = 37)	Harpacticoida	41	B
(Empty Stomachs = 1)	Diptera	5	P
East Waterway	Gammaridea	50	B
(N = 29)	Diptera	23	P
(Empty Stomachs = 0)	Harpacticoida	11	B
	Calanoida	13	P
Port Gardner	Gammaridea	26	B
(N = 43)	Harpacticoida	20	B
(Empty Stomachs = 2)	Larvacea-Copelata	15	P
	Diptera	13	P
	Cumacea	9	B
Purse Seine:			
Snohomish River	Larvacea-Copelata	71	P
(N = 6)	Harpacticoida	15	B
(Empty Stomachs = 1)	Cyclopoida	6	P
	Diptera	5	P
East Waterway	Gammaridea	22	B
(N = 64)	Calanoida	17	P
(Empty Stomachs = 0)	Larvacea-Copelata	16	P
	Diptera	13	P
Port Gardner	Amphipoda-Hyperiidea	56	P
(N = 15)	Euphausiacea	14	P
(Empty Stomachs = 1)	Cyclopoida	6	P
	Diptera	5	P

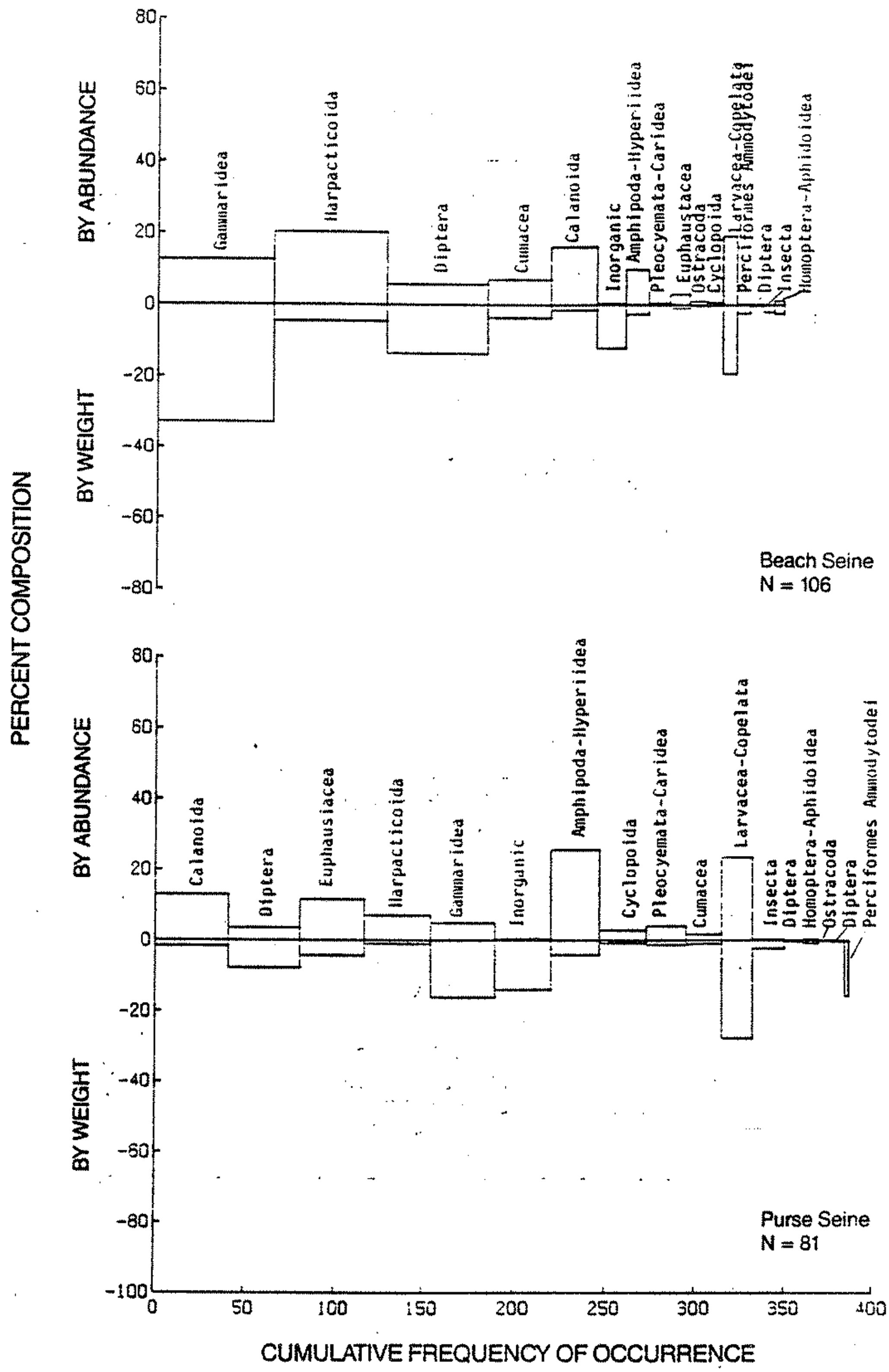

Figure 4. Chum salmon stomach contents, Everett Harbor, 1984, Index of Relative Importance diagram.

Table 5. Summary of the dominant prey groups present in the stomachs of juvenile pink salmon.

Station	Prey group	% Total IRI	Bottom (B) or Pelagic (P)
Beach Seine:			
Snohomish River	Gammaridea	49	B
(N = 46)	Harpacticoida	22	B
(Empty Stomachs = 3)	Diptera	17	P
East Waterway	Gammaridea	38	B
(N = 41)	Calanoida	30	P
(Empty Stomachs = 3)	Harpacticoida	26	B
Port Gardner	Harpacticoida	26	B
(N = 31)	Gammaridea	19	B
(Empty Stomachs = 2)	Cumacea	17	B
	Calanoida	17	P
Purse Seine:			
Snohomish River	Cyclopoida	75	P
(N = 11)	Gammaridea	7	B
(Empty Stomachs = 1)	Harpacticoida	4	B
	Calanoida	3	P
East Waterway	Calanoida	46	P
(N = 68)	Cyclopoida	24	P
(Empty Stomachs = 3)	Inorganic	11	-
	Gammaridea	10	B
Port Gardner	Euphausiacea	26	P
(N = 12)	Calanoida	23	P
(Empty Stomachs = 2)	Pleocyemata-Caridea	16	B
	Inorganic	12	-
	Cyclopoida	9	B

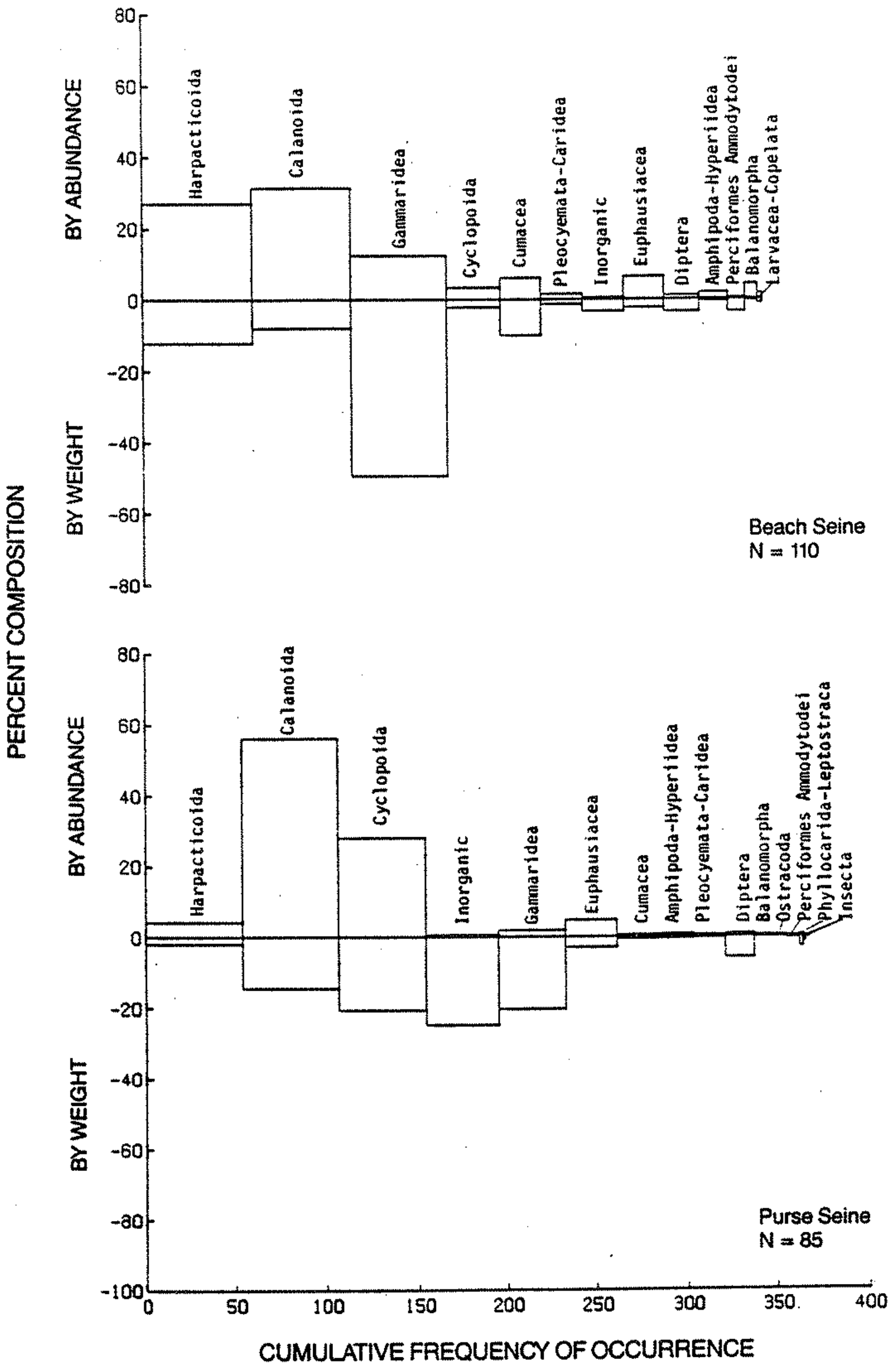

Figure 5. Pink salmon stomach contents, Everett Harbor, 1984, Index of Relative Importance diagram.

Table 6. Summary of the dominant prey groups present in the stomachs of juvenile chinook salmon.

Station	Prey group	% Total IRI	Bottom (B) or Pelagic (P)
Beach Seine:			
Snohomish River (N = 19) (Empty Stomachs = 0)	Gammaridea	75	B
	Cumacea	8	B
	Insecta	7	P
	Diptera	7	P
East Waterway (N = 34) (Empty Stomachs = 2)	Gammaridea	54	B
	Perciformes-Ammodytodei	26	P
	Diptera	10	P
	Inorganic	5	-
Port Gardner (N = 34) (Empty Stomachs = 3)	Cumacea	40	B
	Gammaridea	37	B
	Perciformes-Ammodytodei	7	P
	Inorganic	5	-
Purse Seine:			
Snohomish River (N = 16) (Empty Stomachs = 2)	Cladocera-Eucladocera	36	P
	Cancrideacoida	20	P
	Gammaridea	18	B
	Insecta	7	P
	Diptera	6	P
East Waterway (N = 23) (Empty Stomachs = 3)	Perciformes-Ammodytodei	31	P
	Gammaridea	20	B
	Balanomorpha	14	P
	Inorganic	12	-
	Cancridea	11	P
Port Gardner (N = 18) (Empty Stomachs = 1)	Inorganic	36	-
	Cancridea	14	P
	Balanomorpha	14	P
	Diptera	10	P

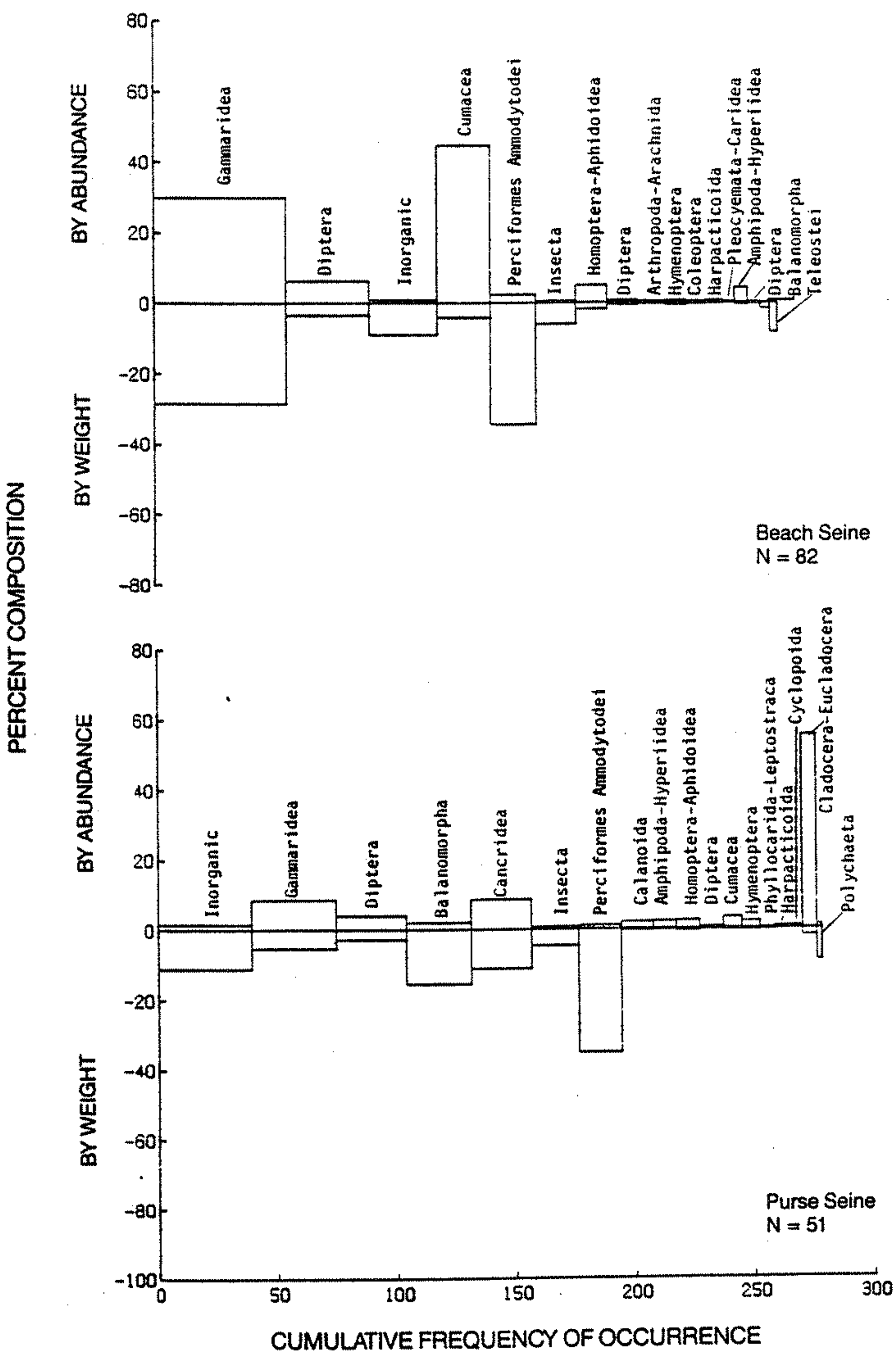

Figure 6. Chinook salmon stomach contents, Everett Harbor, 1984, Index of Relative Importance diagram.

T10

EAST WATERWAY, EVERETT, WASHINGTON
TECHNICAL DOCUMENT REVIEW

Review of:

APPENDIX S: BENTHICS

Parametrix, Inc., February 1985, Benthos of Everett Harbor, 1984, Draft Report to United States Department of the Navy, Western Division, Naval Facilities Engineering Command, San Bruno, California.

Contract No. C0089007

Document Control No. WD4030.1.0-T10

January 1991

Prepared For:

WASHINGTON STATE DEPARTMENT OF ECOLOGY
Toxics Cleanup Program

ecology and environment, inc.

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EAST WATERWAY TECHNICAL DOCUMENT REVIEW

TABLE OF CONTENTS CHECKLIST

ATTACHMENTS

1.0 INTRODUCTION AND CHRONOLOGY OF EVENTS

The document reviewed was one of the technical appendices of an Environmental Impact Statement (EIS) prepared by the United States Department of the Navy for its Carrier Battle Group Puget Sound Region ship Homeporting project. It presented results of a study conducted by Parametrix, Inc. in 1984, to characterize benthic infaunal invertebrate communities in Everett Harbor. Community structure was described in terms of species abundance, dominance (biomass), diversity, and relative health. Information generated as a part of this investigation was to be used to conduct the impact assessment for benthic communities in the harbor. Attachments to this review either have been excerpted directly or prepared using data from the review document.

Chronology of Events

Chronological events associated with the study were:

- o Field sampling conducted in spring 1984;
  - Nine sampling stations,
  - Five grabs per station;

- o Analytical/statistical testing;
  - Taxonomy,
  - Density,
  - Biomass,
  - Diversity:
    - Shannon-Weaver Index,
    - Simpson Index,
  - Infaunal Trophic Index (ITI).

2.0 LEGAL AND REGULATORY ISSUES

Although existing contamination at various sampling locations was cited as having a deleterious effect on benthic community structure in the harbor, regulatory issues associated with these findings were not discussed.

3.0 DEMOGRAPHICS AND LAND USE

N/A

4.0 POTENTIALLY LIABLE PERSONS

N/A

5.0 IDENTIFICATION OF POLLUTION POINT SOURCES

Benthic infaunal community structure at the East Waterway stations was determined to be stressed as a result of existing and past industrial and municipal use. No specific industries were cited as contributing to this circumstance; however, three main factors were identified as exerting an influence on the benthic biota:

- o Wood waste;
- o Organic enrichment from pulp mills or combined sewer/overflow outfalls; and
- o Addition of toxic substances from unknown sources.

6.0 IDENTIFICATION OF POLLUTION NON-POINT SOURCES

N/A

7.0 CHEMICAL DATA

N/A

8.0 BIOLOGICAL DATA

Methods

Sample Collection. Benthic sampling station locations are provided in Attachment A. Five of the nine stations (E-1 through E-5) were located in the East Waterway, three (PG-1 through PG-3) were in Port Gardner, and one (S-1) was in the Snohomish River (see Attachment A). A VanVeen grab with a 0.1 m^2 opening was used to collect five replicates at each station which were subsequently sieved using a 1.0 mm mesh sieving device. Contents remaining in the sieve were preserved in a 10% formalin/seawater solution and then later transferred to 70% ethanol and stained with rose bengal in the laboratory.

Sample Analysis

Taxonomy. Organisms were hand sorted from the sample into the following taxonomic groups:

- o Polychaetes,
- o Molluscs,
- o Crustaceans, and
- o Miscellaneous taxa.

Organisms in each group were then identified to the lowest practical taxonomic level.

Quality Control. A 20% aliquot was taken from each sample and resorted. If the number of organisms obtained from the resort was greater than 10%, the entire sample was resorted.

Biomass. Biomass measurements procedures were taken as wet weight for the four taxonomic groups.

Biological Indices. Two species diversity indices, the Shannon-Weaver Index and the Simpson Index, were calculated using data collected for the polychaete, molluscan, and crustacean taxonomic groups. The Infaunal Trophic Index (ITI) was used to numerically describe community behavior based on feeding strategies. Infauna were assigned to group assemblages based on the following dominance classifications:

- o Group I - Suspension feeders,
- o Group II - Suspension and surface detritus feeders,
- o Group III - Deposit feeders, and
- o Group IV - Subsurface detritus feeders.

Results

Taxonomy. A total of 193 species were identified from the study area; 90 polychaete species, 74 crustacean species, and 29 molluscan species (Attachment B). Four miscellaneous groups were identified: Peisidicidae, Nemertea, Nemertea (Heteronemertea), and Nematoda. Species-specific distribution and densities were not reported.

Species Abundance and Dominance. Species abundance was determined to be greatest in the Snohomish River (S-1) and outside the East Waterway (Port Gardner stations). The overall trend was a decrease in abundance from the mouth to the head of the East Waterway. On a species basis, Capitella capitata, a pollution tolerant polychaete species, was the dominant organism at all East Waterway stations.

Stations PG-1 and S-1 had the greatest biomass values. In terms of taxonomic group biomass, S-1 was dominated by molluscan species, PG-1 and PG-2 by polychaetes, and PG-3 by crustaceans (Attachment C).

Biological Indices. Diversity exhibited similar trends with S-1 high and East Waterway stations lower and decreasing in diversity toward the head of the waterway (Attachment D). General trends indicated by the ITI were that outer areas of the study site primarily support communities dominated by surface deposit and detritus feeding organisms, while habitat sampled within the East Waterway was inhabited by subsurface detritus feeders (Attachment E).

General Findings

The report stated that "biomass values, species diversity indices, and the ITI, all indicate strongly that serious perturbations presently exist in the East Waterway." Whereas, "Healthy benthic communities exist at stations PG1, PG2, and S1."

Data Quality

Procedures used to collect, analyze, and assess, the data were in keeping with standard techniques for benthic biological investigations. The following deficiencies in information, as presented, make evaluation of overall data quality difficult.

Sampling Methods. The sampling efficiency of the VanVeen grab with respect to substrate sampled was not discussed in the report. The methodology is generally considered quantitative to semiquantitative based upon this efficiency. Determination of sample size (i.e., number of grabs required to adequately assess community structure at a given location) was based upon studies conducted in the New York Bight. Because this estimation is site-specific in nature, it would have been more desirable to use sample size requirements calculated for Puget Sound. In the absence of existing information to make this determination, species area curves could have been used to evaluate whether or not the sample size used was adequate for the purposes of the study. While this is an important consideration for quantitative studies, it is the reviewers opinion that the information gathered was more than adequate to comparatively evaluate the various habitats of the harbor.

An additional concern is the use of the 1.0 mm mesh sieve. In general, infaunal macroinvertebrate studies are conducted using a 0.5 mm mesh screen for sieving purposes.

Analytical Methods. Raw data used to calculate biological indices and evaluate abundance distributions were not included in the report. Quality control methodology associated with biomass weight measurements was not discussed. Quality of this data cannot be evaluated. Verification of taxonomic identifications was not discussed. Assignment of taxa to feeding groups for the ITI analysis was not discussed. Because complete information on species-specific feeding strategy is not well documented in the scientific literature, a knowledge of how this aspect of the investigation was accomplished would be important to the interpretation and verification of ITI analytical results.

9.0 DATA QUALITY

Information included in the report was insufficient to evaluate overall data quality.

10.0 HYDROLOGIC AND HYDRODYNAMIC INFORMATION

N/A

11.0 DREDGING AND DISPOSAL ISSUES AND DATA

The report stated that impacts on benthic communities in the harbor would be adverse short term effects. In general, literature supports this conclusion.

12.0 ENVIRONMENTAL IMPACTS

In addition to information included in Section 4.0 of this review, the discussion section of the report suggests a link between the occurrence of opportunistic species, such as C. capitata and various nematodes, to high levels of organic enrichment or high percentages of wood wastes. A high percentage of wood materials in the sediments was proposed as a possible explanation as to why the ITI value at station PG-3 was lower than the other PG stations.

13.0 INTERIM MEASURES/SPILL AND POLLUTION PREVENTION

The conclusion of the report states that "removal of contaminated sediments would probably benefit the community on a long term basis."

14.0 COMMUNITY RELATIONS INFORMATION

N/A

15.0 RECOMMENDATIONS

Information presented in the report should be considered a preliminary evaluation of benthic communities in the harbor since data included were compiled from a single sampling effort in 1984 and the validity of results cannot be substantiated from available data. If more recent studies are not encountered during the literature review process, verification of conditions in the East Waterway will be necessary to establish a data base representative of current community structure. This will be especially important since development and dredging have taken place in the vicinity of the waterway since the data in this report were collected.

An evaluation of sample size required to adequately describe the East Waterway benthic community structure should be undertaken, unless estimates appropriate to the Northwest and specifically Puget Sound are encountered in the literature. In addition, environmental parameters, such as salinity and dissolved oxygen, should be collected in conjunction with collection of benthic invertebrate samples.

16.0 FINAL COMMENTS

The document provides sufficient information, based on relatively standard sampling and analytical techniques, for qualitative evaluation of benthic communities, and to propose that the East Waterway does not support a healthy benthic invertebrate population. Information presented can serve as the basis from which to proceed if it becomes necessary to further evaluate the system.

Attachment A

SAMPLING STATION LOCATIONS

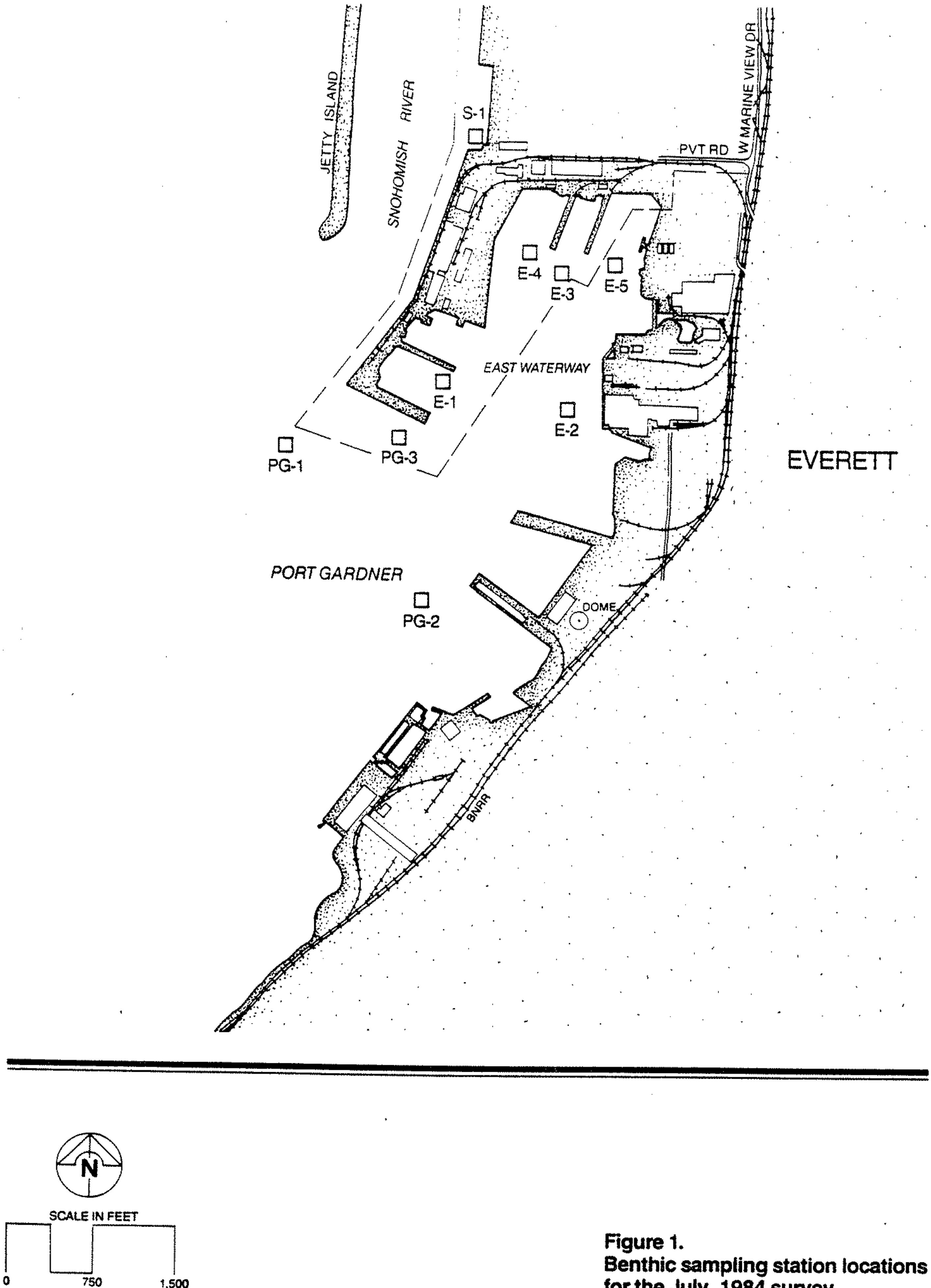


Figure 1.
Benthic sampling station locations for the July, 1984 survey.

Attachment B

SPECIES LIST

Table 2. Everett Harbor benthic species list.

Polychaeta

Polychaeta finmarchica
Ampharetidae
Anobothrus gracilis
Arabellidae
Aricidea nr. suecica
Armandia brevis
Barantolla americana
Capitella capitata
Caulleriella sp.
Chaetozone sp.
Chone dunneri
Cirratulidae
Cossura soyeri
Decamastus gracilis
Diopatra ornata
Dorvillea psuedorubrovittata
Eteone longa
Eteone californica
Eteone sp.
Eteone spetsbergensis
Eumida sanguinea
Eumida sp.
Euchone sp.
Gattyana cirrosa
Glycera capitata
Glycinde armigera
Glycinde picta
Glycinde sp.
Harmothoe imbricata
Hesionidae
Heteromastus filoformis
Heteromastus filobranchus
Heteromastus sp.
Isocirrus longiceps
Lanassa sp.
Laonice cirrata
Leitoscoloplos pugettensis
Levinsenia gracilis
Lumbrineris cruzensis
Lumbrineris luti
Lumbrineris sp.
Lysilla sp.
Lysippe labiata
Maldanidae
Mediomastus ambiseta
Mediomastus californiensis
Mediomastus sp.
Megalomma splendida
Melinna elisabethae
Micropodarke dubia
Myriochele oculata
Neoamphitrite edwardsi
Nephtys cornuta franciscanum
Nephtys ferruginea
Nephtys sp.
Nereis grubei
Onuphis elegans
Ophelina acuminata

Ophryotrocha sp.
Orbiniidae
Parandalia fauveli
Paraprionospio pinnata
Pectinaria californiensis
Pectinaria granulata
Pholoe minuta
Pholoides aspera
Phyllodoce (Anaitides) groenlandica
Phyllodoce (Anaitides) sp.
Phyllodocidae
Pista cristata
Pista sp.
Platynereis bicanaliculata
Podarkeopsis brevipalpa
Polycirrus sp.
Polydora socialis
Polydora sp.
Polynoidae
Prionospio (Minuspio) cirrifera
Prionospio steenstrupi
Praxillella sp.
Rhodine bitorquata
Schistocomus hiltoni
Schistomeringos annulata
Schistomeringos cacca
Schistomeringos japonica
Schistomeringos rudolphi
Scoloplos acmeceps
Scoloplos armigera
Sigalionidae
Sphaerosyllis brandhorsti
Spiochaetopterus costarum
Spio filicornis
Spio sp.
Spionidae
Spiophanes berkeleyorum
Steggoa sp.
Syllidae
Syllis elongata
Terebellidae
Terebellides stroemi
Tharyx multifilis
Tharyx sp.
Thelepus japonica
Polychaeta

Crustacea

Acarina

Acrenhydrosoma karlingi

Amphiascoides subdebilis

Amphiascus sp. B-minutus group

Amphiascus undosus

Anisogammarus pugettensis

Anonyx lilljeborgi

Aoroides inermis

Aoroides spinosus

Aoroides sp.

Balanus crenatus

Balanus sp.

Bopyridae

Bulbamphiascus imus

Callianassa californiensis

Cancer magister

Cancer oregonensis

Cancer productus

Cancer sp.

Caprella laeviascula

Chironomidae

Cirripedia, Balanomorpha

Clausidium vancouverense

Coleoptera

Copepoda, Calanoida

Copepoda, Cyclopoida

Copepona, Harpacticoida

Corophium acherusicum

Corophim insidiosum

Corycaneus anglicus

Crangonidae

Cumella vulgaris

Cylindroleberididae

Dactylopodia crassipes

Dactylopodia sp. A.

Darcythompsonia cf. neglectum

Diastylis sp.

Dulichia sp.

Dyopedos sp.

Enhydrosoma hopkinsi

Eogammarus confervicolus

Eudorella pacifia

Euphilomedes carcharodonta

Euphilomedes producta

Gastropoda

Halacaridae

Halectinosoma sp.

Hemicyclops subadhaerens

Hemigrapsus oregonensis

Heptacarpus brevirostris

Heterolaophonte discophora

Hippolytidae

Laophontodes sp.

Leimia vaga

Leptochelia dubia

Leucon nasica

Limnoria lignorum

Lophopanopeus bellus bellus

Melita californica

Melita dentata

Metaphoxus frequens

Monoculodes sp.

Nebalia pugettensis

Nitocra sp.

Normanella confluens

Ostracoda, Podocopa

Paracalanus sp.

Paralaophonte pacifica

Paralaophonte sp.

Parapleustes pugettensis

Photis bifurcata

Photis brevipes

Photis sp.

Phyllodorus abdominalis

Pinnixa schmitti

Pleurogonium rubicundum

Pleusymptes subglaber

Pseudonychocamptus paraproximus

Pseudonychocamptus sp. A.

Robert gurneya hopkinsi

Stenhelia sp.

Stenothoidae

Synchelidium shoemakeri

Tachidius triangularis

Tegastidae

Tritella pilimana

Typhlamphiascus pectinifer

Upogebia pugettensis

Westwoodilla caecula

Zaus sp.

Mollusca

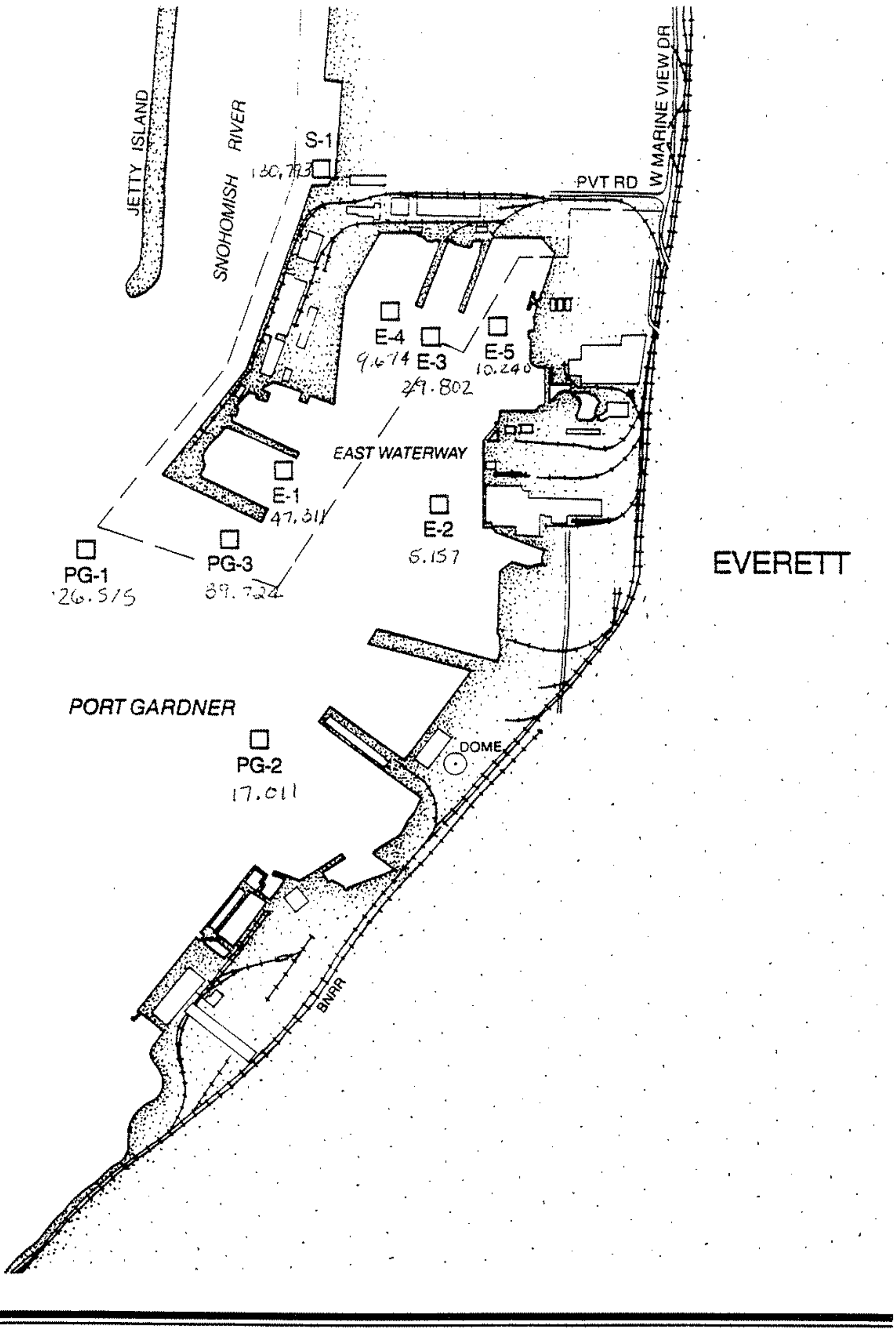
Axinopsida serricata
Bankia setacea
Cephalaspidea sp.
Clinocardium sp.
Compsomyax subdiaphana
Cryptomya californica
Kellia laperousi
Lucinoma acutilineata
Lynosia arenosa
Macoma carlottensis
Macoma elimnata
Macoma irus (=inquinata)
Macoma nasuta
Macoma obliqua
Macoma sp.
Mitrella gouldi
Modiolus sp.
Mya arenaria
Mysella tumida
Mytilus edulis
Nucula tenuis
Odostomia (Chrysallidae) sp.
Odostomia (Odostomia) sp.
Onchidorididae
Parvilucina tenuisculpta
Psephidia lordi
Solemya johnsoni
Solen sicarius
Tellina modesta
Turbonillan sp.

Miscellaneous

Peisidicidae
Nemertea
Nemertea (Heteronemertea)
Nematoda

Attachment C

BIOMASS



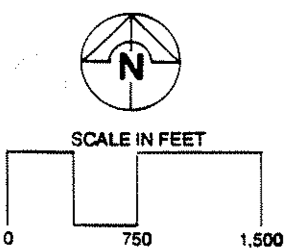
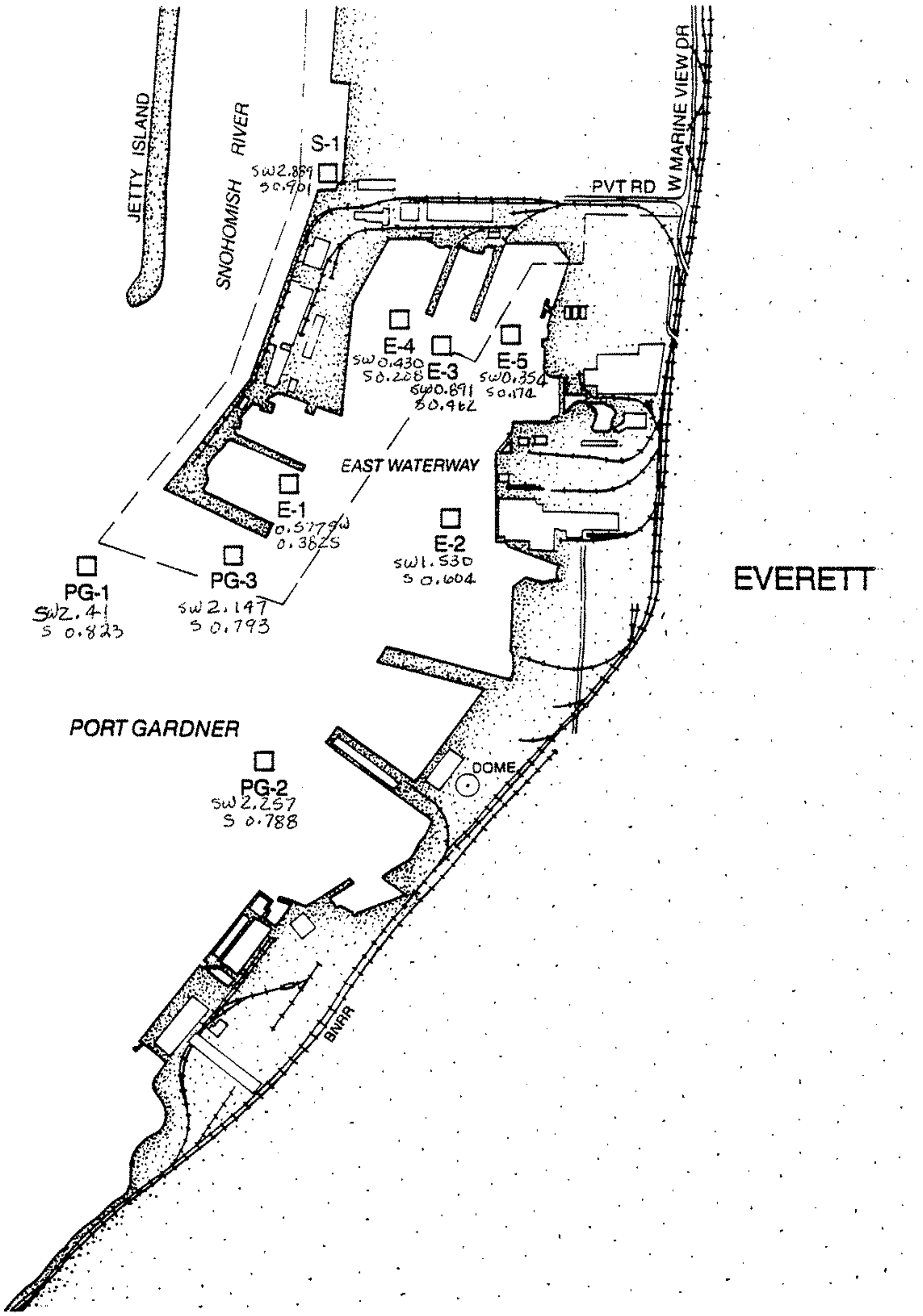


Figure 1.
Benthic sampling station locations for the July, 1984 survey.

Attachment D

DIVERSITY



SW - Shannon-Weaver Index
S - Simpson Index

Diversity

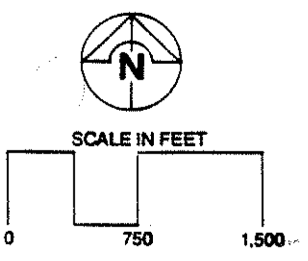
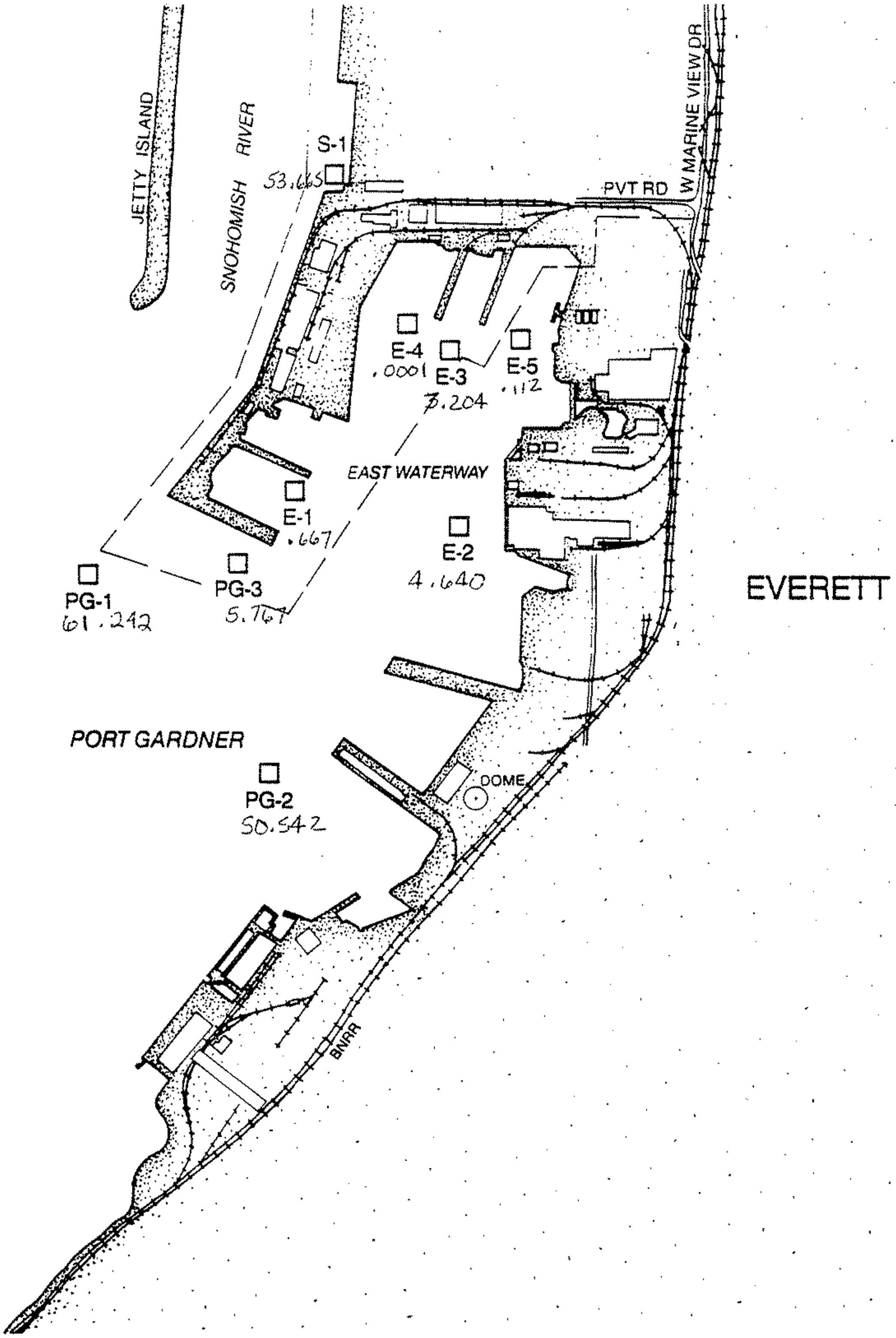


Figure 1.
Benthic sampling station locations for the July, 1984 survey.

Attachment E

INFAUNAL TROPHIC INDEX



ITI

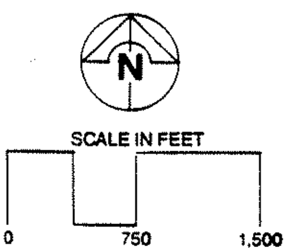


Figure 1.
Benthic sampling station locations for the July, 1984 survey.

T11

EAST WATERWAY, EVERETT, WASHINGTON
TECHNICAL DOCUMENT REVIEW

Review of:

APPENDIX T: EPIBENTHICS

Parametrix, Inc., February 1985, Epibenthos of Everett Harbor 1984, Draft Report to United States Department of the Navy, Western Division, Naval Facilities Engineering Command, San Bruno, California.

Contract No. C0089007

Document Control No. WD4030.1.0-T11

January 1991

Prepared For:

WASHINGTON STATE DEPARTMENT OF ECOLOGY
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EAST WATERWAY TECHNICAL DOCUMENT REVIEW

TABLE OF CONTENTS CHECKLIST

ATTACHMENTS

1.0 INTRODUCTION AND CHRONOLOGY OF EVENTS

The document reviewed was one of the technical appendices of an Environmental Impact Statement (EIS) prepared by the United States Department of the Navy for its Carrier Battle Sound Group Puget Sound Region Homeporting project. It presented results of a study conducted by Parametrix, Inc. to characterize epibenthic invertebrate communities in Everett Harbor and determine the occurrence and abundance of juvenile salmonid preferential prey organism. Community structure was described in terms of taxa present, abundance, species diversity, and similarity. Information generated as a part of this investigation was to be used to conduct the impact assessment for epibenthic communities, and together with the salmonid stomach content analysis study (Appendix R of the aforementioned EIS), determine the potential impacts on juvenile salmonid populations in the harbor. Attachments to this review have been excerpted directly from the review document.

Chronology of Events

Only chronological events associated with the study were discussed. These included the following:

- o Field sampling conducted in the Spring of 1984;
  - Ten sampling stations,
  - Two to five replicate samples per station;

- o Analytical/statistical testing;
  - Taxonomy,
  - Density,
  - Diversity:
    - Shannon-Weaver Index,
    - Simpson Index,
  - Numerical classification analysis.

2.0 LEGAL AND REGULATORY ISSUES

Other than the brief discussion of potential impacts to biological community structure associated with dredging operations (Sections 11.0 and 12.0 of this review), the report did not address legal or regulatory issues.

3.0 DEMOGRAPHICS AND LAND USE

N/A

4.0 POTENTIALLY LIABLE PERSONS

N/A

5.0 IDENTIFICATION OF POLLUTION POINT SOURCES

The following point source discharges and/or contaminants were identified as having a potential effect on the epibenthic communities in the East Waterway:

- Pulp mill discharge; and
- Combined sewer/overflow - heavy metals, polycyclic aromatic hydrocarbon (PAHs), and organic enrichment.

Supporting documentation for these assertions was not provided in the report.

6.0 IDENTIFICATION OF POLLUTION NON-POINT SOURCES

N/A

7.0 CHEMICAL DATA

N/A

8.0 BIOLOGICAL DATA

Methods

Sample Collection. Epibenthic sampling station locations are provided in Attachment A. Nine of the 10 stations (E-1 through E-9) were located in the East Waterway and one (S-1) was in the Snohomish River (see Attachment A). Two to five replicate samples were each collected to a depth of 2 cm over an area of 0.1 m^2 at each sampling location using a diver-operated Venturi suction sampler and 0.25 mm^2 mesh sieve bags. Depth of water for sample collections ranged from +3 feet to -6 feet mean low low water. Contents remaining in the sieve were preserved in a 10% formalin/seawater solution and then later transferred to 70% ethanol and stained with rose bengal in the laboratory. These are not entirely standard techniques for the collection of epibenthic invertebrates.

Sample Analysis. Samples were split with a Jones-type splitter to obtain a 25% to 50% representative portion of the original sample. Organisms were hand sorted from the sediments and shipped to taxonomists for identification. Taxonomic experts used for this task were not identified in the report. With the exception of taxonomy and total density measurements, analytical and statistical procedures provided in the report were based on only crustacean species.

Quality Control. Each split sample was completely resorted by a second sorter.

Taxonomy. A taxonomic list, including all species collected during the study, was compiled.

Density. Total density and the densities of harpacticoid copepods, cumaceans, tanaids, and gammarid amphipods were calculated for each replicate at each station location. Total average and group average densities at each station also were computed.

Diversity. Two species diversity indices were calculated using the epibenthic crustacean data: the Shannon-Weaver Index and the Simpson Index.

Numerical Classification Analysis. Similarity among stations was evaluated using the techniques of Bray-Curtis (1957). Dissimilarity measurements for all pairs of sampling stations were calculated. Group average sorting was used to construct a dendrogen for visual presentation of these analysis.

Results

Taxonomy. A total of 103 invertebrate species were identified from the study area (Attachment B). In addition to the four main taxonomic groups of crustaceans (harpacticoid copepods, cumaceans, tanaids and gammarid amphipods), isopods, and calanoid and cyclopoid copepods also were found.

Abundance and Dominance. Harpacticoid copepods and gammarid amphipods were found to dominant at most stations. Station S-1 exhibited the most even distribution among taxonomic groups. Ranges in average abundance were from 17,000 to 148,000 individuals per square meter. Highest abundance was encountered at the stations on the west side of the East Waterway. Calculated densities are included in Attachment C.

Diversity. Average Shannon-Weaver indices ranged from 1.558 to 2.553 (possible range 0 to 5, with 5 being most diverse). Average Simpson Index values ranged from 0.607 to 0.865 (possible range 0 to 1, with 1 being most diverse). These values were considered high to medium-high by the investigators. No trends were established between location, depth, or substrate type. Results are provided in Attachment D.

Numerical Classification Analysis. No apparent trends were established by these analyses. The dendrogram included in the report is provided in Attachment E.

General Findings

Densities were reported as being somewhat higher than densities observed at other Puget Sound stations. It was noted that both the harpacticoid copepod Bulbamphiascus imus and leptostracan Nebalia pugettensis, found in the study area, are tolerant of anoxic conditions associated with industrial wastes and organic enrichment. Further, it was hypothesized that the "inner harbor environment" is stressed by "pulp mill discharge, heavy metal and PAH contamination, and organic enrichment from a combined sewer/overflow outfall." Chemical data to support these findings are not included in this report nor is another source referenced.

In conjunction with results of the salmonid stomach contents study, it was determined that "there is an abundant food source in the Everett Harbor and that juvenile salmonids are using the area and feeding on the abundant benthic crustacea."

Data Quality

Reference to formal sampling protocol was not included in the report. Literature citations, however, were included for the dissimilarity analysis and dendrogram construction. The following deficiencies in presented information made evaluation of overall data quality difficult.

Sampling Methods

- The sampling technique used to collect the epibenthos is one that is not specifically biased toward the collection of epibenthos. Sieving was accomplished using 0.25 mm^2 mesh sieve bags which are normally used to sample meiofaunal components of the benthic community and the organisms retained by this technique included species that are often considered components of the infaunal community.

- Sampling depth (water) variability among stations was not discussed, and information on tidal stage at the time of sample collection was not provided.

- Samples were split to what was perceived as a manageable size of at least 100 individuals. Precision of the splitting technique and an assessment of the representativeness of the sampling technique were not considered in the study design or discussed in the report.

- Variability in the number of replicates taken at each sampling location was not discussed in the report.

Analytical Methods

- Analytical techniques were standard to the evaluation of benthic invertebrate populations. However, raw data used to perform diversity calculations and to measure similarity were not included in the report. Therefore, quality of the statistical results could not be evaluated.

9.0 DATA QUALITY

Information included in the report was insufficient to evaluate overall data quality. Sampling techniques and selective location of sampling stations in shallow water environments limit the use of this data for characterization of the epibenthic communities in the waterway.

10.0 HYDOLOGIC AND HYDRODYNAMIC INFORMATION

N/A

11.0 DREDGING AND DISPOSAL ISSUES AND DATA

Results of the study indicate that there is an abundant population of crustaceans in the upper 2 cm of the East Waterway that could serve as a food supply for juvenile salmonids. The occurrence of juvenile salmonids in the waterway would be expected to coincide with population peaks for these invertebrates, which normally takes place during April and May each year. It was recommended that dredging and construction operations associated with the Navy's Homeport facility be conducted at another time of the year when both salmonid and crustacean populations would be naturally lower.

12.0 ENVIRONMENTAL IMPACTS

Environmental impacts on invertebrate communities were only briefly discussed. The report states that "perturbations from dredging and construction operations" related to the Navy's Homeport project "could severely alter the epibenthic community structure." Supporting documentation for this conclusion was not provided.

13.0 INTERIM MEASURES/SPILL AND POLLUTION PREVENTION MEASURES

N/A

14.0 COMMUNITY RELATIONS INFORMATION

N/A

15.0 RECOMMENDATIONS

As a stand-alone document, information presented in the report should be considered a limited preliminary evaluation of benthic communities in the harbor. Because this information was generated in 1984, was restricted to shallow water environments, and employed techniques not normally used to measure epibenthic communities, additional information would be required to completely describe the epibenthic populations in the waterway.

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When reviewed in conjunction with the juvenile salmonid stomach content study, this investigation did accomplish the primary objective which was to determine whether or not juvenile salmonid prey organisms were present in the study area. However, prey preference and habitat preference were not established (see the Recommendations and Final Comment sections of the Technical Document Review for the EIS, Appendix R--Juvenile Salmonid Stomach Analysis). Current status of the community and juvenile salmonid populations should be verified rather than accepting these findings as representative. Future investigations designed to completely characterize the epibenthic community structure would require additional sampling over a greater depth range and different sampling gear.

It is evident from this study and the benthic community study, also conducted for the Navy Homeport EIS (Technical Appendix S), that the benthic populations in the East Waterway may be suffering from varying degrees of environmental stress. Neither of these documents has attempted to link the stress to specific environmental conditions. Further investigation would be required to accomplish this task. Recommendations to do this are not appropriate at this time, since further review of existing literature and evaluation of the overall issues in the waterway will be necessary before decisions regarding this can be made.

16.0 FINAL COMMENTS

The document provided sufficient documentation to conclude that benthic communities important as a food supply for juvenile salmonid are present in the waterway. Characterization of the epibenthic community in the East Waterway would require further work.

Attachment A

SAMPLING STATIONS

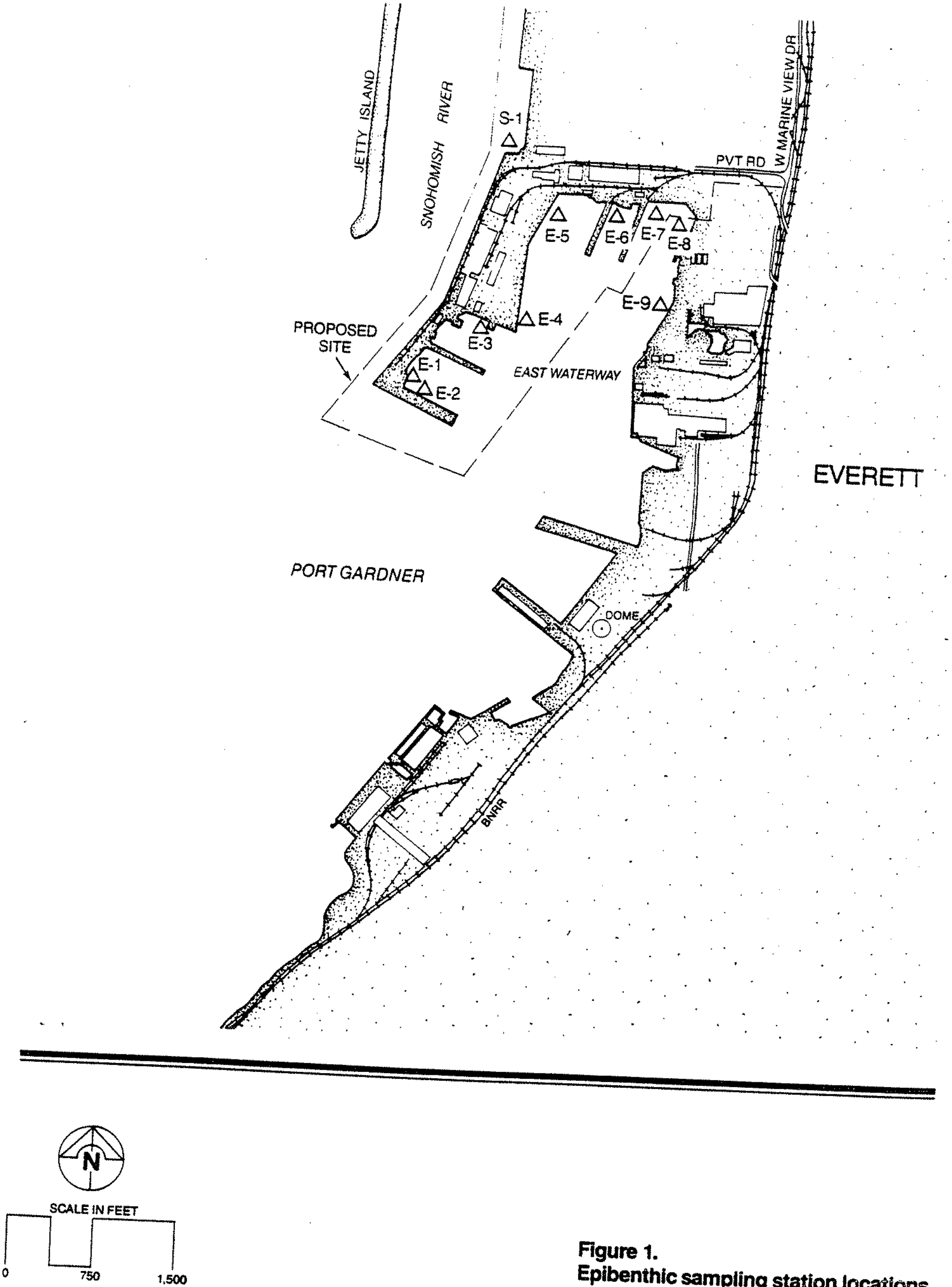

Figure 1.
Epibenthic sampling station locations for the July, 1984 survey.

Attachment B

SPECIES LIST

Table 1. Everett Harbor epibenthic species list

Acari-Halacaridae	Euphilomedes carcharodonta
Acartia clausi	Eurytemora americana
Acartia longiremis	Gammaridea
Acrenhydrosoma karlingi	Gnorimosphaeroma oregonense
Alienacanthomysis macropsis	Halectinosoma sp.
Allorchestes angusta	Harpacticus arcticus
Ameira longipes	Harpacticus spinulosus
Ameira minuta	Harpacticus sp.
Ameira sp.A.	Harpacticus uniremis
Ameiridae	Herpacticus sp.A-uniremis group
Amonardia normani	Hemicyclops subadhaerens
Amphiascoides subdebilis	Hemigrapsus oregonensis
Amphiascoides sp.	Heptacarpus sp.
Amphiascus minutus (Sars)	Heptacarpus brevirostris
Amphiascus minutus (Lang)	Heterolaophonte discophora
Amphiascus sp.B-minutus group	Heterolaophonte hamondi
Amphiscus undosus	Heterolaophonte longisetigera
Amphithoe sp.	Heterolaophonte sp.A.
Anisogammarus pugettensis	Huntemannia jadensis
Aoroides spinosus	Hyale plumulosa
Bopyridae	Ianiropsis kincaidi
Bulbamphiascus imus	Ischyrocerus cf. anguipes
Calanoida	Laophonte inopinata
Calanus sp.	Laophonte elongata
Cancer oregonensis	Laophonte sp.B.
Cancer sp.	Laophonte sp.C.
Cancer products	Laophontodes sp.A
Centropages abdominalis	Laophontidae
Cirripedia	Leimia vaga
Collembola	Lichomolgidae
Corophium insidiosum	Limnoria lignorum
Corycaeus anglicus	Melita californica
Chironomidae	Mesochra
Crangon sp.	Microarthridion littorale
Cumella vulgaris	Microcalanus sp.
Cyclopina sp.	Nannopus palustris
Cyclopoida	Nebalia pugettensis
Dactylopodia crassipes	Neomysis mercedis
Dactylopodia sp.A.	Nitocra spinipes
Dactylopodia vulgaris	Nitocra sp.A.
Darcythompsoni cf.neglecta	Normanella confluens
Diarthrodes sp.	Oithona similis
Diosaccus spinatus	Oithona spinirostris
Diptera	Paracalanus sp.
Enhydrosoma hopkinsi	Paradactylopodia cf. brevicornis
Eobrolgus spinosus	Paralaophonte cf. meinerti
Eogammarus confervicolus	Paramoera sp.
Euphausiacea	Parathalestris californica

Table 1. Everett Harbor epibenthic species list (cont'd.)

Phyllodurus abdominalis
Pinnotheridae
Pleusymptes subglaber
Podocopida
Podon leuckarti
Protomedia sp.
Pseudocalanus sp.
Pseudonychocamptus paraproximus
Pseudonychocamptus spinifer
Pseudonychocamptus sp.A.
Robertsonia sp.A.
Rutiderma lomae
Schizopera knabeni
Scottolana canadensis
Stenhelia peniculata
Stenhelia sp.A.
Tachidius triangularis
Tanais sp.
Thysanoptera
Tisbe furrata
Tisbe spp.
Typhlamphiascus pectinifer
Unidentified genus, sp.A.
Upogebia pugettensis
Zaus sp.
Thalestridae
Ampithoe Plumulosa

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Attachment C

DENSITY

Table 2. Density (total number/m^2) and percent total abundance of major species for the Everett Harbor epibenthic sampling stations.

		HARPACT (% Total)	CUMACEA (% Total)	TANAID (% Total)	GAMMARID (% Total)	TOTAL/m^2 NUMBER
E1	+2	48.5	23.2	5.9	21.0	174,080
	0	80.0	16.1	1.0	3.1	214,400
	-3	89.1	3.3	0.5	4.9	117,120
	-5	95.5	0.6	0.0	2.8	57,280
AVE		78.3	10.8	1.9	8.0	140,720
E2	+2	57.1	19.7	2.0	13.3	64,960
	-2	88.0	7.0	0.7	3.0	196,480
AVE		72.6	13.4	1.4	8.2	130,720
E3	+3	41.9	3.6	0.0	45.5	26,720
	+2	37.5	3.6	0.0	55.0	25,600
	-1	77.6	8.6	0.0	1.7	9,280
	-4	80.5	4.5	0.0	2.0	64,000
AVE		59.4	5.1	0.0	26.1	17,000
E4	+2	28.1	0.0	0.4	56.7	42,080
	-2	58.4	1.8	0.0	12.4	9,040
	-3	30.1	1.3	0.0	24.7	11,680
	-5	41.4	1.6	0.0	10.2	10,240
AVE		39.5	1.2	0.1	26.0	18,260
E5	+2	94.9	0.0	0.3	3.4	224,000
	-1	93.0	1.0	0.4	18.7	174,720
	-4	90.7	0.0	0.0	7.0	86,400
	-6	93.3	0.5	0.2	5.5	107,680
AVE		93.0	0.4	0.2	8.7	148,200
E6	+2	20.9	0.0	0.0	9.3	6,880
	+1	12.4	0.1	0.0	68.4	28,640
	-2	58.6	2.0	0.0	6.1	15,840
	-4	60.7	0.6	0.6	3.4	25,840
	-5	56.1	1.8	0.0	4.4	18,240
AVE		41.7	0.9	0.1	18.3	17,888

Table 2. Density (total number/M^2) and percent total abundance of major species for the Everett Harbor epibenthic sampling stations. (Con't.)

		HARPACT (% Total)	CUMACEA (% Total)	TANAID (% Total)	GAMMARID (% Total)	TOTAL/M^2 NUMBER
E7	+2	77.6	0.0	0.0	2.2	14,640
	0	28.4	0.5	0.0	4.1	15,800
	-3	46.1	0.7	0.0	28.9	24,320
	-4	53.2	0.6	0.0	17.9	37,120
	-5	53.3	0.0	0.0	12.6	28,800
AVE		51.7	0.4	0.0	12.6	24,136
E8	+2	21.5	0.0	16.0	46.4	37,920
	-1	37.3	0.0	2.5	13.6	9,440
	-4	35.1	0.3	1.5	10.5	27,520
	-5	54.9	0.6	0.6	7.9	13,120
AVE		37.2	0.2	5.2	19.6	22,000
E9	+1	49.0	0.2	0.0	9.2	32,320
	0	60.3	0.0	0.0	14.1	10,480
	-3	84.4	0.0	1.7	1.2	6,920
	-4	88.5	0.0	0.7	1.4	11,840
AVE		70.6	0.1	0.6	6.5	15,390
S1	+2	25.4	30.2	0.6	37.0	42,160
	-1	6.9	4.4	1.9	49.4	12,800
	-2	9.2	3.8	5.4	51.5	10,400
	-5	14.0	7.0	1.0	51.0	16,000
AVE		13.9	11.4	2.2	47.2	20,340

Attachment D

DIVERSITY

Table 3. Shannon-Weaver[1] and Simpson[2] diversity index values for the Everett Harbor epibenthic sampling stations

Station	Value	Shannon-Weaver Range	Average	Std. Dev.	Station	Value	Simpson Range	Average	Std. Dev.
E1 +2	2.289	1.557-2.289	1.951	0.317	E1 +2	0.865	0.605-0.865	0.733	0.099
E1 0	1.721				E1 0	0.679			
E1 -3	1.557				E1 -3	0.605			
E1 -5	2.237				E1 -5	0.784			
E2 +2	2.399	1.841-2.399	2.12	0.279	E2 +2	0.873	0.741-0.873	0.807	0.066
E2 -2	1.841				E2 -2	0.741			
E3 +3	2.441	2.079-2.698	2.426	0.222	E3 +3	0.831	0.784-0.883	0.844	0.040
E3 +2	2.079				E3 +2	0.784			
E3 -1	2.487				E3 -1	0.881			
E3 -4	2.698				E3 -4	0.883			
E4 +2	2.059	2.059-2.781	2.551	0.287	E4 +2	0.684	0.684-0.921	0.858	0.100
E4 -2	2.711				E4 -2	0.913			
E4 -3	2.653				E4 -3	0.914			
E4 -5	2.781				E4 -5	0.921			
E5 +2	1.462	1.399-1.832	1.558	0.165	E5 +2	0.663	0.563-0.663	0.607	0.043
E5 -1	1.399				E5 -1	0.566			
E5 -4	1.542				E5 -4	0.563			
E5 -6	1.832				E5 -6	0.638			
E6 +2	2.597	2.013-2.853	2.553	0.310	E6 +2	0.901	0.713-0.921	0.855	0.075
E6 +1	2.013				E6 +1	0.713			
E6 -2	2.452				E6 -2	0.841			
E6 -4	2.851				E6 -4	0.899			
E6 -5	2.853				E6 -5	0.921			

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Table 3. Shannon-Weaver[1] and Simpson[2] diversity index values for the Everett Harbor epibenthic sampling stations (cont'd.)

Station	Value	Shannon-Weaver Range	Average	Std. Dev.	Station	Value	Simpson Range	Average	Std. Dev.
E7 +2	1.099	1.099-2.727	2.205	0.570	E7 +2	0.423	0.423-0.898	0.767	0.174
E7 0	2.361				E7 0	0.852			
E7 -3	2.511				E7 -3	0.856			
E7 -4	2.328				E7 -4	0.806			
E7 -5	2.727				E7 -5	0.898			
E8 +2	2.216	2.216-2.665	2.433	0.186	E8 +2	0.826	0.826-0.902	0.865	0.029
E8 -1	2.564				E8 -1	0.902			
E8 -4	2.665				E8 -4	0.883			
E8 -5	2.288				E8 -5	0.851			
E9 +1	2.971	1.854-2.971	2.519	0.487	E9 +1	0.931	0.716-0.931	0.845	0.094
E9 0	2.905				E9 0	0.917			
E9 -3	2.867				E9 -3	0.918			
E9 -4	1.998				E9 -4	0.743			
E9 -6	1.854				E9 -6	0.716			
S1 +2	2.158	2.158-2.468	2.295	0.112	S1 +2	0.825	0.796-0.871	0.883	0.027
S1 -1	2.301				S1 -1	0.842			
S1 -2	2.254				S1 -2	0.796			
S1 -5	2.468				S1 -5	0.871			

1) Possible values range from 0 to 5, with 5 being most diverse
2) Possible values range from 0 to 1, with 1 being most diverse

Attachment E

DENDROGRAM

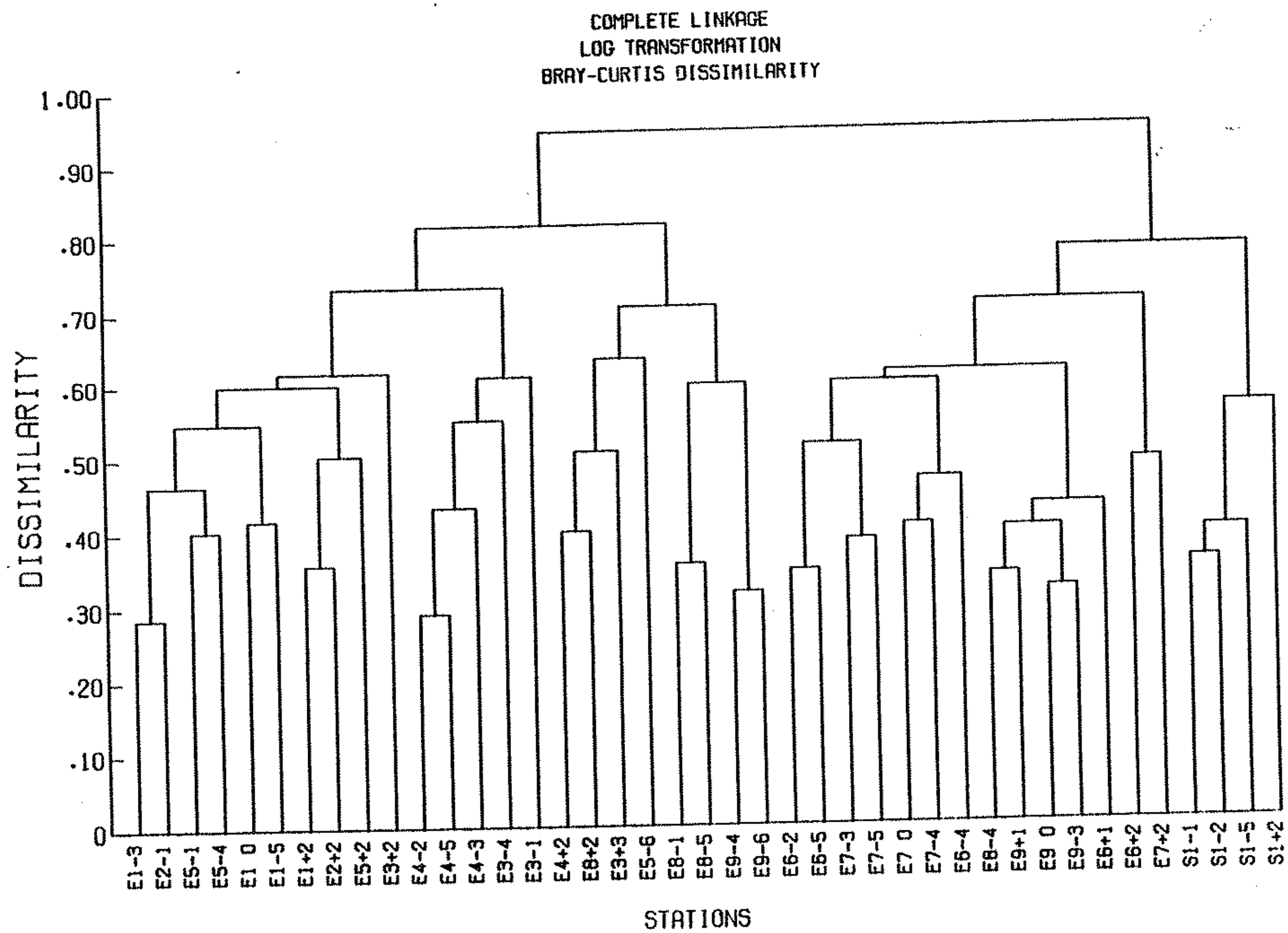

Figure 2.
Dendrogram resulting from the classification of the East Waterway, Port Gardner and Snohomish River sampling sites by the macrofaunal epibenthos at each site.

T12

EAST WATERWAY, EVERETT, WASHINGTON
TECHNICAL DOCUMENT REVIEW

Review of:

APPENDIX U: DEMERSAL FISH

Parametrix, Inc., February 28, 1985, Demersal Fish Survey of Everett Harbor, 1984, prepared for the Department of Navy, Western Division, Naval Facilities Engineering Command, San Bruno, California.

Contract No. C0089007

Document Control No. WD4030.1.0-T12

January 1991

Prepared For:

WASHINGTON STATE DEPARTMENT OF ECOLOGY
Toxics Cleanup Program

ecology and environment, inc.

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EAST WATERWAY TECHNICAL DOCUMENT REVIEW

TABLE OF CONTENTS CHECKLIST

ATTACHMENTS

1.0 INTRODUCTION AND CHRONOLOGY OF EVENTS

The document reviewed was an appendix to an Environmental Impact Study (EIS) prepared by the United States Navy, Western Division, for the proposed aircraft carrier homeporting project. This document represents a continuation of the juvenile salmonid study conducted by Parametrix, Inc., as reported in Appendix C of the EIS (see Attachment A for sample locations and descriptions). The study was performed in conjunction with the juvenile salmonid study conducted during the spring of 1984. Over a 3-month period from March 27 to July 10, 1984, nonsalmonid fishes were collected, identified, and enumerated in the same biweekly beach seine and purse seine sampling efforts conducted for juvenile salmonids. Additional gill net sampling was conducted to adequately sample the benthic fish populations during the fall of 1984. Four gill net sampling events took place from October 2 to 5, 1984, with each gill net sample in the water at least 20 hours. Fish were identified and counted, and totals for each sampling type (over time) compared between locations. However, no comparative methods were used between location and sampling gear.

2.0 LEGAL AND REGULATORY ISSUES

N/A

3.0 DEMOGRAPHICS AND LAND USE

N/A

4.0 POTENTIALLY LIABLE PERSONS

N/A

5.0 IDENTIFICATION OF POLLUTION POINT SOURCES

N/A

6.0 IDENTIFICATION OF POLLUTION NON-POINT SOURCES

N/A

7.0 CHEMICAL DATA

No chemical data were reported. Sampling for temperature, salinity, and dissolved oxygen should have been conducted at the time of sampling for background information.

8.0 BIOLOGICAL DATA (FLORA/FAUNA)

A total of 43 fish species representing 23 different families of fish were collected from 14 beach and purse seine stations over a 3-month period from March 27 to July 10, 1984 (total of 65,456 non-salmonid individuals), and 4 gill net stations sampled over a 3-day period from October 2 to 5, 1984 (total of 575 individuals). Comparisons of species abundance and composition between locations and within a sampling gear type were made without statistical testing by the investigators.

Methods

Beach and purse seine sampling efforts were the same sampling efforts and equipment as used in the juvenile salmonid study. All nonsalmonid species were identified and enumerated for all 14 stations and all sampling dates. The document discusses the problems associated with seining over rocky and debris-strewn shoreline and the likely possibility that many fish were lost sampling in this habitat. This point was not presented in the juvenile salmonid study paper.

Gill netting was accomplished using a diving variable-mesh gill net to sample the bottom dwelling fish species. The gill net was composed of 6 panels, each 10 meters long, attached in series to make a net 60 meters long and 2.4 meters high. Each panel has a different mesh size, ranging from 1.5 to 4 inches, to capture different size fish. The nets were left overnight for 21.25 to 35 hours, with repeated net checks to remove fish. Sampling was conducted at four different locations in the East Waterway area. No replicates were collected and sampling was conducted once at each location. All fish were identified and enumerated, their final disposition unknown.

Results

Gill Nets. Gill nets captured 13 to 22 fish species at the different locations. Data were normalized to number of fish per 24-hour period to compare locations. However, locations were sampled over different days, and no replication was performed to determine average numbers per 24-hour period. Therefore, actual differences between locations cannot be established without statistical tests.

Because there were no replicates taken, the reviewer performed a nonparametric analysis of the ranked abundance of fish species for each sampling location using the Friedman rank sums distribution-free test. Abundance of fish were ranked across locations and rank sums statistically prepared. The analysis indicated that there was no statistical difference in the ranked abundance of fish species across the four sampling locations. However, it is noted by the reviewer that the sampling location furthest from inner East Waterway had the greatest diversity of fish (22 species) and most even distribution of abundance of all sampling stations. All inner East Waterway stations had only 13 to 15 species, some with very high abundances, revealing an uneven distribution of abundance.

Beach and Purse Seine. Beach and purse seine sampling captured 23 and 15 fish species, respectively. The data presented for beach and purse seining can be used for qualitative descriptions of fish found in the East Waterway area. Differences in numbers of fish for each species was inconsistent between tables for the same sampling method. For example, beach seining data were presented two ways: for all stations grouped together showing species abundance by sampling date (Table 5) and for all sampling dates grouped together showing species abundance by sampling station (Table 6) (see Attachment B tables). Totals for each species differed between these two tables for 11 of the 22 species. In addition, sums within a table were erroneous. This resulted in a difference of over 600 fish (2% of total) between the two tables, even changing the ranked abundance of one species. Reporting problems similar to those encountered in the beach seining data also were found in the purse seining results. This lends little credence to any sort of comparison between stations in the East Waterway area. The data reported, however, do provide a baseline of species present and an indication of relative abundance in the East Waterway area.

Data Quality

Problems mentioned previously are the main areas which would need to be addressed in any future sampling efforts. Sampling should be replicated at each station for each sampling date to make adequate comparisons between locations over time. Sampling also should not be limited to sporadic sampling over the year, but performed monthly for one or more years, and should take tidal stage into account.

9.0 DATA QUALITY

Overall data quality is probably good; however, inconsistencies in the reporting of data makes one skeptical of data quality. Lack of replication prevents comparison of fish abundance between stations. Any future investigation of contamination in the East Waterway area should address this issue before designing any biological sampling program as part of an ecological risk assessment.

10.0 HYDROLOGIC AND HYDRODYNAMIC INFORMATION

N/A

11.0 DREDGING AND DISPOSAL ISSUES AND DATA

N/A

12.0 ENVIRONMENTAL IMPACTS

The authors compare the data in their study to other bays in Puget Sound and believe that the East Waterway fish community shows signs of a stressed environment with fewer species and lower diversity. Statistical comparisons cannot be made between the studies, and although differences may exist, it is difficult to make any judgment with the data as presented.

13.0 INTERIM MEASURES/SPILL AND POLLUTION PREVENTION MEASURES

N/A

14.0 COMMUNITY RELATIONS INFORMATION

N/A

15.0 RECOMMENDATIONS

The results of this study can be used as the baseline information for designing a fish community analysis to better determine abundance over time, as well as differences between the inner and outer areas of East Waterway. A better-designed study also could be conducted to examine the populations using the benthic versus pelagic habitats.

16.0 FINAL COMMENTS

Although the report contained data discrepancies and pursued limited data evaluation approaches, it includes useful baseline fish community data. Because of discrepancies in data reporting, comparisons could not reliably be made between habitats with any degree of accuracy. General comparisons with the data provided give some preliminary indications that species abundance among sites were not very different. Future studies should examine the location of sampling stations to ensure useful fish community comparisons.

Attachment A

SAMPLE LOCATIONS AND DESCRIPTIONS

Table 2. Description of beach seine sampling stations.

Station	DESCRIPTION
S1	Predominantly gravel with cobbles and scattered small boulders. Mud at shallow sub-tidal level.
S2	Entirely sand and muddy sand.
E1	Steep slope beach with riprap at higher tide levels and cobbles and gravel at lower tide elevations.
E2	Sandy gravel and scattered large wood debris at higher intertidal elevations. Predominantly muddy sand at lower intertidal and shallow subtidal levels.
G1	Gently sloping sand beach with sand and gravel at higher elevations.
G2	Predominantly sand beach with sand and gravel at higher elevations.

Table 3. Location of purse seine sampling stations.

Station	Location	Pier Type
S3	Norton Ave. Terminal	Concrete pile
S4	Jetty South of Pier B	Log boom
E3	Pier B	Wood pile
E4	Foss Tug Dock	Log boom/wood pile
E5	Pier Apron between Piers D and E	Wood pile
E6	Pier Apron Scott Paper	Wood pile
E7	Pier 1	Wood pile
G3	Terminal 1	Concrete pile

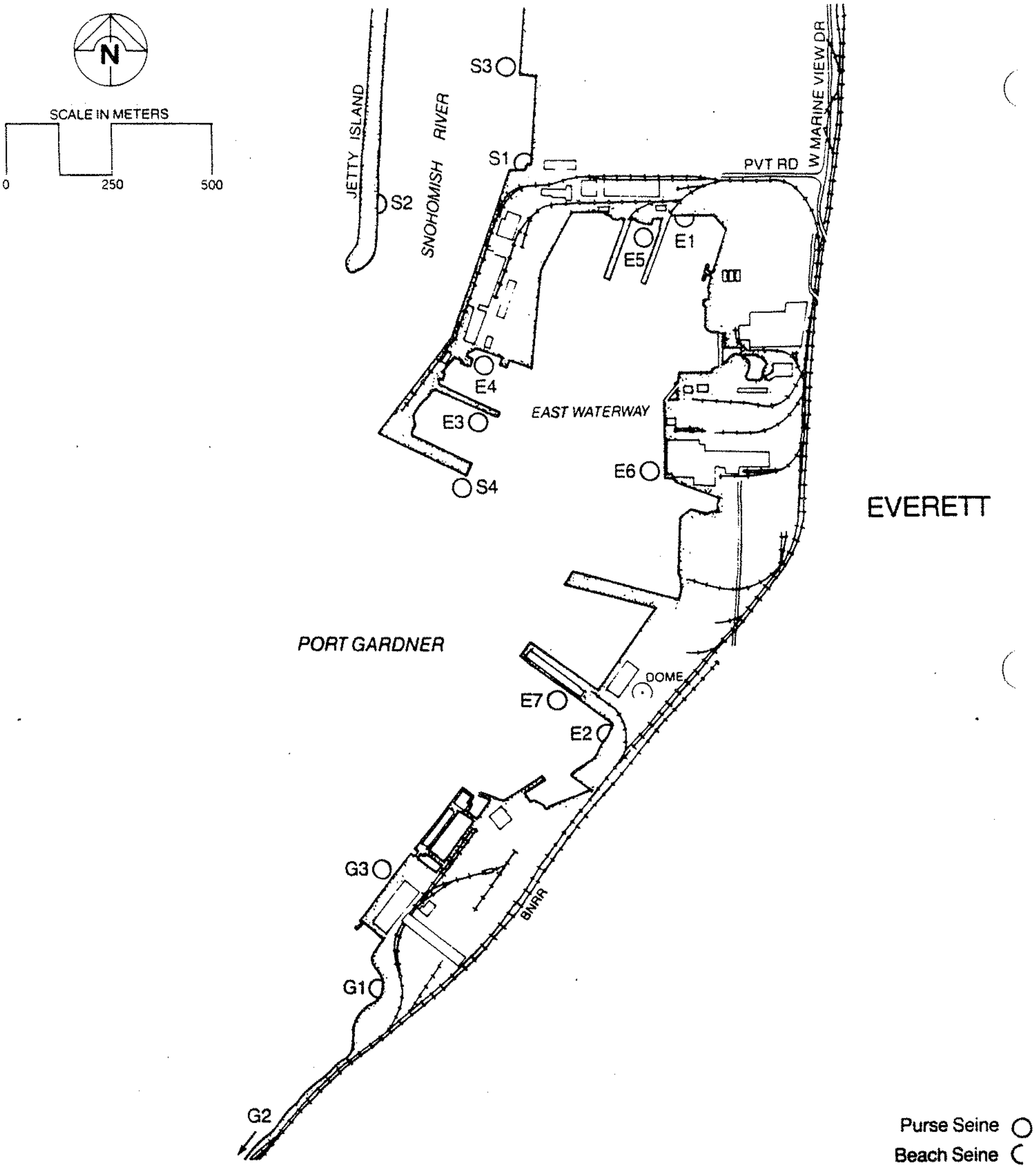

Figure 2. Snohomish River, East Waterway, and Port Gardner sampling locations for 1984 juvenile salmonid study.

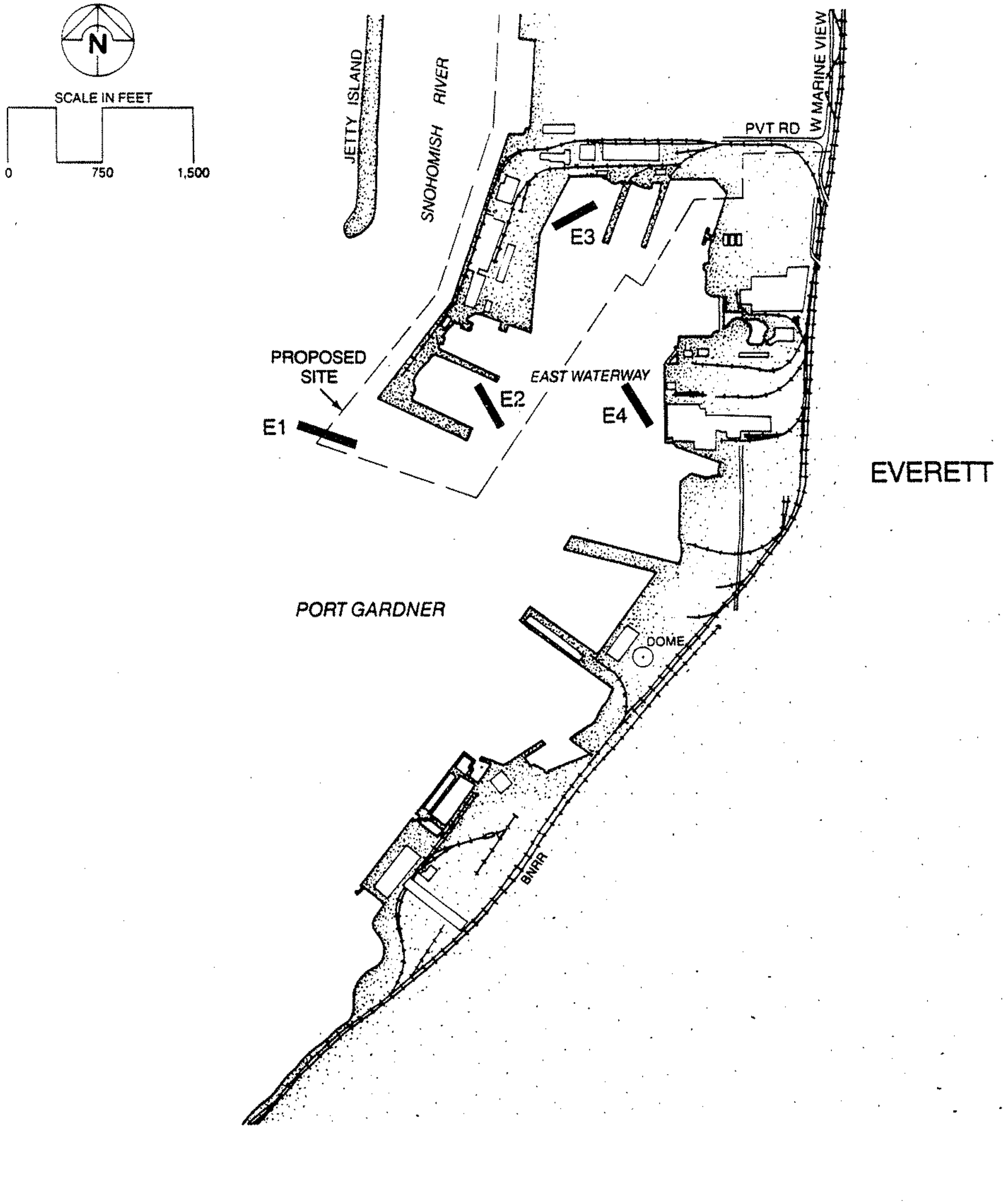

Figure 3. Demersal fish survey sampling locations in the East Waterway, Everett, Washington, 1984.

Attachment B

FISH COUNT TABLES

Table 4. Summary of diving gillnet capture rates for demersal and pelagic fish in the vicinity of East Waterway, Everett, Washington, October 2-5, 1984.

Station	CPUE (#/24 hr.) E1	E2	E3	E4	CPUE X	Rank
Pacific staghorn sculpin	25.78	34.97	73.41	76.36	52.63	1
Shiner perch	5.33	47.31	29.36	19.64	25.41	2
Striped seaperch	2.67	6.86	18.07	7.64	8.81	3
Pacific hake	19.56	9.60	2.26	3.27	8.67	4
English sole	4.44	2.06	7.91	15.27	7.42	5
walleye pollock	17.78	.69	1.13	8.73	7.08	6
Pacific tomcod	2.67	7.54	3.39	12.00	6.40	7
copper rockfish	8.00	2.74	1.13		2.97	8
ratfish	5.33	.69	2.26	2.18	2.62	9
Pacific herring	6.22	.69	1.13		2.01	10
spiny dogfish	6.22				1.56	11
pile perch	3.56	.69	1.13		1.35	12
Pacific cod	2.67			2.18	1.21	13
great sculpin	.89	.69	1.13	1.09	.95	14
sand sole	2.67			1.09	.94	15
starry flounder	.89	.69		2.18	.94	16
Pacific sanddab	2.67				.67	17
rock sole	1.78				.45	18
buffalo sculpin		.69		1.09	.45	19
giant sculpin	.89	.69			.40	20
plainfin midshipman			1.13		.28	21
sailfin sculpin				1.09	.27	22
sablefish	.89				.22	23
chinook salmon	.89				.22	24
greenling	.89				.22	25
	122.67	115.89	143.44	153.82		

Table 5. Total numbers of non-salmonid fishes collected by beach seine at all stations, Everett, Washington, 1984.

Species	March					April									May									June						July		
	27	30	3	6	10	13	17	20	24	27	1	4	8	11	15	18	22	25	29	1	5	8	11	15	19	22	26	29	3	6	10	Total
Shiner perch				1												42		61	414	42	90	30		86	16	49	44	25	8	14	21	943
Striped perch			2	2	9			1				2	6	3	3	11	13	3	3		1	1			5	4						69
Pile perch													1	1			5	1								7						15
Pacific sand lance			5				2501	6		2101	215	2502	51	1000	106	3	1	2700	30	11	100	6		61	2			1				11,402*
Northern anchovy																													1	10,000	500	10,501*
Pacific herring													10	100		20	405	500	91							5	15	1	1000			2,147*
American shad										1																1						2
Surf smelt	1		2	13				2	2					1						2	2							1				26
Bay goby		1	1				1			1																						4
Three-spined																																
stickleback	1			1			1	1		1	3			2		3			1		13					20			3	1		51
Pacific staghorn																																
sculpin	3	13	11	3	5		8	54	37	1	76		18	15	13	10	8	55	26	205	175	52		180	132	61	25	70	36	37	40	1,311*
Buffalo sculpin				1																												1
Great sculpin																																0
Sailfin sculpin																2																2
Pacific cod																		1	1													2
Starry flounder	1	8	5	4	6			5	2	7	57	3	3	11	6	2	8	15	43	62	20		3	2		11	8	12	6	18	9	337
Rock sole			16							25					1						1	30			11	2		4				90
C-O sole																				1												1
Sand sole										4	25							2		2	7			10		4	1	8	15			78
Pacific sanddab																	2															2
Snake prickleback			5												1			1			1				1		3	9	3			23
Gunnel	1						1		2		4				2		2	5	17	31	1			23	8	10	2	13	4	5		131
Pipefish																			2						1				2			5
Pacific lamprey										1																					2	3
																																27,146

*denotes that on one or more occasions excessive numbers of fish were estimated

Table 6. Numbers of non-salmonid fishes caught in beach seines, Everett, March-July, 1984.

	River		East Waterway	Port Gardner				
	S1	S2	E1	E2	G1	G2	Total	Rank
Shiner perch	3	1	49	637	184	701	944	5
Striped perch	3		4	22	9	29	67	10
Pile perch			1	2	3	9	15	
Pacific sand lance	50	142	5,320	108	3220	2502	11,342*	1
Northern anchovy			10,500	1			10,501	2
Pacific herring		75	257	1000	400	415	2,147*	3
American shad			1				1	
Surf smelt	1	3	2		19	3	25	
Bay goby		2			2		7	
Three-spined stickleback		3	44	3	1		51	
Pacific staghorn sculpin	24	150	3	492	534	169	1,272	4
Buffalo sculpin			1				1	
Great sculpin								
Sailfin sculpin				2			2	
Pacific cod		1		+			1	
Starry flounder	9	46		86	139	59	339	6
Rock sole		4		56	19	10	89	8
C-O sole						1	1	
Sand sole		8		3	29	38	78	9
Pacific sanddab					2		2	
Snake prickleback	5	4		8		6	23	
Gunnel	2	3	16	15	23	68	127	7
Pipefish		2		1		2	5	
Pacific lamprey		1	2				3	
Total	97	445	16,200	2436	4583	3380	27,140	

*denotes instances where on one or more occasions excessive numbers were estimated

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EAST WATERWAY, EVERETT, WASHINGTON
TECHNICAL DOCUMENT REVIEW

Review of:

APPENDIX V: MARINE MAMMAL STUDY

Parametrix, Inc., May 1985, Marine Mammal Study, Everett Harbor and Vicinity, Winter, 1984-1985, prepared for Department of the Navy, Western Division, Naval Facilities Engineering Command, San Bruno, California.

Contract No. C0089007

Document Control No. WD4030.1.0-T13

January 1991

Prepared For:

WASHINGTON STATE DEPARTMENT OF ECOLOGY
Toxics Cleanup Program

ecology and environment, inc.

101 YESLER WAY, SEATTLE, WASHINGTON, 98104, TEL. 206/624-9537

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EAST WATERWAY TECHNICAL DOCUMENT REVIEW

TABLE OF CONTENTS CHECKLIST

1.0 INTRODUCTION AND CHRONOLOGY OF EVENTS

The report reviewed is an appendix of an Environmental Impact Study (EIS) prepared by the United States Navy, Western Division, for the proposed aircraft carrier homeporting project. The report documents a marine mammal survey in and near Everett Harbor conducted by Parametrix, Inc., in 1984 and 1985 (see location map in Attachment A). A standard census of marine mammals was conducted weekly (concurrently with marine bird censuses) from October 1984 to March 1985. Separate marine mammal censuses were conducted weekly from April to June 1985.

Species of marine mammals and counts of individuals on a species-specific basis, as determined both from the boat and from photographs of groups of mammals, were documented.

2.0 LEGAL AND REGULATORY ISSUES

N/A

3.0 DEMOGRAPHICS AND LAND USE

N/A

4.0 POTENTIALLY LIABLE PERSONS

N/A

5.0 IDENTIFICATION OF POLLUTION POINT SOURCES

N/A

6.0 IDENTIFICATION OF POLLUTION NON-POINT SOURCES

N/A

7.0 CHEMICAL DATA

N/A

8.0 BIOLOGICAL DATA (FLORA/FAUNA)

Information collected included weekly counts of marine mammals, and detailed hourly records of marine mammal behavior during peak abundance.

Methods

"Standard boat transects" were used to survey an area including eastern Possession Sound, East Waterway, Lower Snohomish River, and Everett Harbor. However, the report did not describe the number, length, or location of the transects. From the data set presented, it is assumed that general survey counts were made at areas known as resting spots for the species found in the area. Photographic counts were made to augment field visual counts.

Also, on several days of peak California sea lion abundance, sea lion behavior over different periods of the day was recorded. Information recorded included behavior, time of day, tidal stage, and weather conditions. No replication effort was made to test the trends observed.

Results

Survey results indicated that California sea lions were the most abundant group of marine mammals in the area. Harbor seals and Northern sea lions also were observed in very small numbers (2 to 4). Survey data indicate that sea lions were present in low numbers from October to January, increasing gradually through February to peak at 500 to 600 individuals in March and April. Comparison of these results with surveys conducted in other years revealed that California sea lions have been increasing in the Possession Sound at 30 to 40 percent per year. Very few (less than 10) seals or sea lions were sighted in East Waterway. Most sightings and beaching areas for all species identified were found west of Jetty Island (the western side of the lower Snohomish River).

General Findings

Populations of California sea lions have been increasing in the Possession Sound area steadily since 1981. Very few have been sighted in the East Waterway area and, therefore, they should not be impacted by the proposed construction and operation activities associated with the Navy homeporting project.

Data Quality

Visual counts were well presented and are consistent with the literature. The investigators employed good quality assurance methods to verify all counts made. Replication of sea lion behavior over several days would have been ideal to compare behavior trends statistically within and between days with various physical parameters (e.g., temperature); however, the data provided do support the trends noted in the literature and additional information on sea lion behavior is not essential for the main purpose of the study.

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9.0 DATA QUALITY

Based on information presented in the document, data quality appears to be good. However, mention was made of standard transect techniques in the methodology section, but the data were not presented in transect format. Further evaluation of the study would require more specific survey information than presented in the document.

10.0 HYDROLOGIC AND HYDRODYNAMIC INFORMATION

N/A

11.0 DREDGING AND DISPOSAL ISSUES AND DATA

N/A

12.0 ENVIRONMENTAL IMPACTS

Discussion of impacts in the East Waterway area from the Navy project on marine mammals focused on both construction and operation impacts to sea lion populations.

Noise from site construction and operation, as well as bottom disturbance from construction and maintenance of the terminal facilities will cause some impact to marine mammals found in and around the eastern Possession Sound and East Waterway. The investigators did not quantify the impacts, other than to say they should be minor, and did not discuss cumulative impacts of the proposed project to disturbance already present in the study area.

13.0 INTERIM MEASURES/SPILL AND POLLUTION PREVENTION MEASURES

N/A

14.0 COMMUNITY RELATIONS INFORMATION

N/A

15.0 RECOMMENDATIONS

Additional data do not need to be collected to characterize the marine mammal populations in and around the East Waterway area. Review of recent literature or agency file searches will provide an update of recent censusing efforts in the area.

16.0 FINAL COMMENTS

See Recommendations.

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Attachment A

CENSUS SUBREGIONS MAP

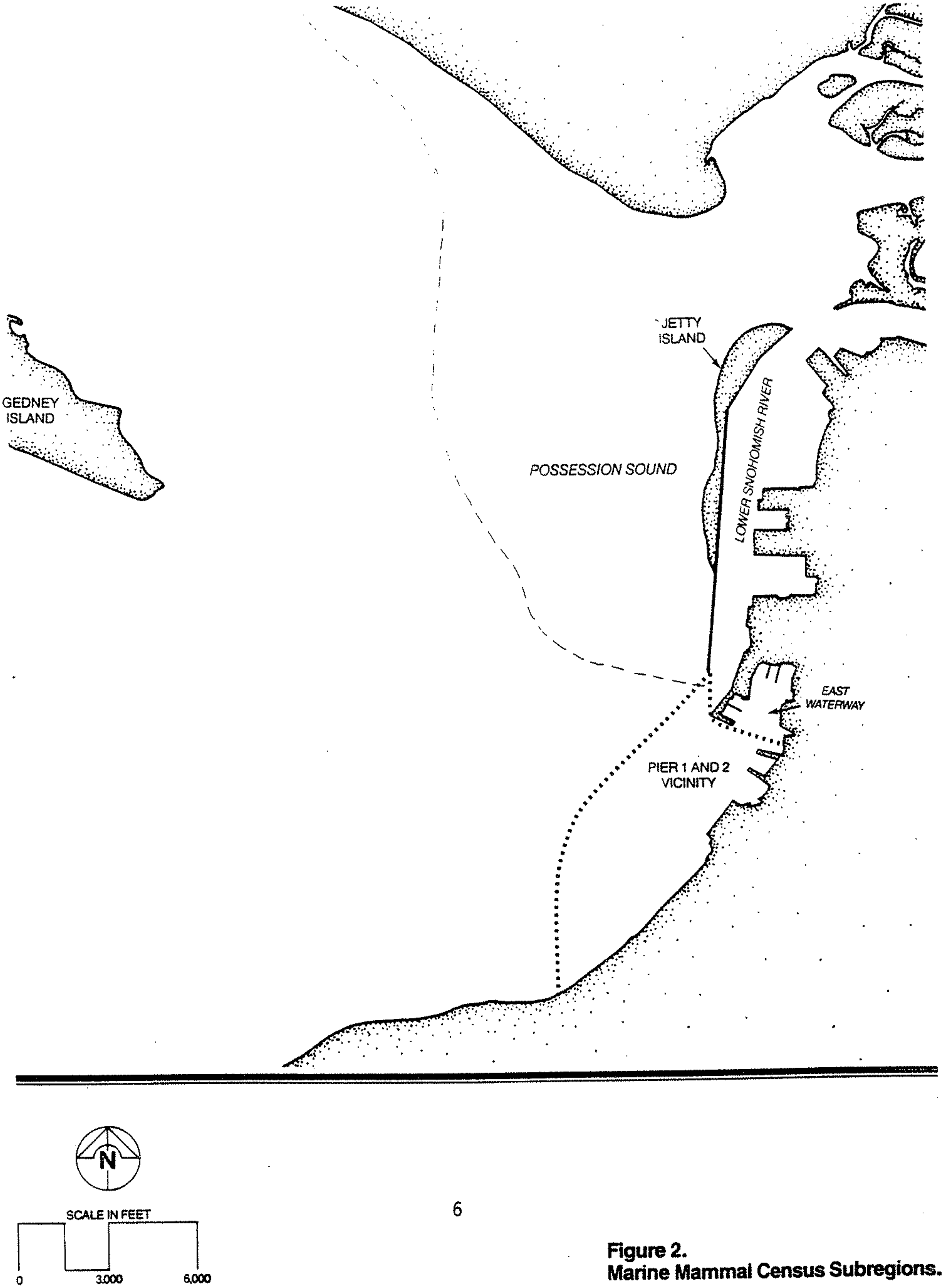

Figure 2.
Marine Mammal Census Subregions.

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EAST WATERWAY, EVERETT, WASHINGTON
TECHNICAL DOCUMENT REVIEW

Review of:

APPENDIX W: WATERBIRD STUDY

Parametrix, Inc., May 1985, Waterbird Study, Everett Harbor and Vicinity, Winter 1984-1985, prepared for the Department of Navy, Western Division, Naval Facilities Engineering Command, San Bruno, California.

Contract No. C0089007

Document Control No. WD4030.1.0-T14

January 1991

Prepared For:

WASHINGTON STATE DEPARTMENT OF ECOLOGY
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EAST WATERWAY TECHNICAL DOCUMENT REVIEW

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	Section 2.0	LEGAL AND REGULATORY ISSUES
	Section 3.0	DEMOGRAPHICS AND LAND USE
	Section 4.0	POTENTIALLY LIABLE PERSONS
	Section 5.0	IDENTIFICATION OF POLLUTION POINT SOURCES
	Section 6.0	IDENTIFICATION OF POLLUTION NON-POINT SOURCES
	Section 7.0	CHEMICAL DATA
X	Section 8.0	BIOLOGICAL DATA (FLORA/FAUNA)
X	Section 9.0	DATA QUALITY
	Section 10.0	HYDROLOGIC AND HYDRODYNAMIC INFORMATION
	Section 11.0	DREDGING AND DISPOSAL ISSUES AND DATA
X	Section 12.0	ENVIRONMENTAL IMPACTS
	Section 13.0	INTERIM MEASURES/SPILL AND POLLUTION PREVENTION MEASURES
	Section 14.0	COMMUNITY RELATIONS INFORMATION
X	Section 15.0	RECOMMENDATIONS
X	Section 16.0	FINAL COMMENTS

1.0 INTRODUCTION AND CHRONOLOGY OF EVENTS

The document reviewed was an appendix of an Environmental Impact Statement (EIS) prepared by the United States Navy, Western Division, for the proposed aircraft carrier homeporting project. The appendix (Appendix W) consisted of a marine bird census study conducted by Parametrix, Inc. The study was conducted to examine the migrating and permanent bird populations found in Everett Harbor and the vicinity and to determine what impact the proposed construction and operation of the homeporting project will have on these bird populations.

Chronology of Events

September 1984 to April 1985	Bird censuses conducted weekly in Everett Harbor.

2.0 LEGAL AND REGULATORY ISSUES

N/A

3.0 DEMOGRAPHICS AND LAND USE

N/A

4.0 POTENTIALLY LIABLE PERSONS

N/A

5.0 IDENTIFICATION OF POLLUTION POINT SOURCES

N/A

6.0 IDENTIFICATION OF POLLUTION NON-POINT SOURCES

N/A

7.0 CHEMICAL DATA

N/A

8.0 BIOLOGICAL DATA (FLORA/FAUNA)

In this study, bird populations in six areas of Everett Harbor and the vicinity were counted weekly. The six areas included in the study were East Waterway, Everett Pier 1 and 2, Pigeon Creek Delta, Possession

Sound, Lower Snohomish River, and Upper Snohomish River. This review will focus on the results for the East Waterway and adjacent survey areas.

Methods

The bird censuses were conducted by investigators in a boat traveling along transects across each survey area. Details on transect length, location, etc. are not presented in the document, and the data are presented as total counts, not averaged over transects. Therefore, it is assumed that transects were not replicated for each census trip. Birds were identified, counted, and their behavior and habitat were noted during each census. If census data were missing for a week, the investigators averaged the data from the preceding and following weeks to fill in the data gap. Total counts were averaged over each month and compared between months to provide general descriptive patterns of abundance and species composition over time.

Results

A total of 33,411 birds were identified in Everett Harbor from September 1984 through April 1985. This represents an average of 1,044 birds per census, and 138 birds per square kilometer. The Lower Snohomish River had the largest counts of birds of any of the six survey areas. The East Waterway area had an average of 98 birds per census with an estimated 223 birds per square kilometer.

A total of 45 bird species were identified in Everett Harbor; 23 species were identified in the East Waterway area. Sixteen of the 45 species were identified as key species, or species indicative of large overwintering populations.

The most abundant species found overwintering in the East Waterway area were the Barrow's Goldeneye, Western Grebe, Double-crested Cormorant, Great Blue Heron, and Red-necked Grebe. Species identified as sensitive or proposed monitor species by the State of Washington in the East Waterway area are the Great Blue Heron, Western Grebe, Marbled Murrelet, and Horned Grebe. The consistent numbers of grebe species and Barrow's Goldeneye observed during the study suggest that the East Waterway area serves as an area of resting and feeding, and not as a temporary refuge, for these birds.

General Findings

Because of the relatively high number of birds using the East Waterway area, it is believed that some impact of bird displacement will occur during the construction and operation of the proposed Navy project. The investigators believe that the impact will be short-lived for birds tolerant of human intrusion. But sensitive species such as Barrow's Goldeneye, Double-crested Cormorant, and Great Blue Heron are expected to move into other areas of Everett Harbor to avoid human intrusion. Dredging activities will remove food sources for birds in the East Waterway area, and birds may move to other regions of Everett Harbor to find better food sources. Bird populations in areas adjacent to the proposed navy project also will be impacted by construction and operation, but to a lesser degree. The birds in adjacent areas impacted by human intrusion will most likely move to other areas of Everett Harbor.

9.0 DATA QUALITY

Data quality appears to be good, but it cannot be evaluated properly without knowing the expertise of the investigators conducting the surveys and studying the raw transect data. Without the raw data, it is difficult to evaluate the results presented.

10.0 HYDROLOGIC AND HYDRODYNAMIC INFORMATION

N/A

11.0 DREDGING AND DISPOSAL ISSUES AND DATA

N/A

12.0 ENVIRONMENTAL IMPACTS

The investigators believe that sensitive bird species in the East Waterway area will be forced out of the area by the construction and operation activities of the proposed homeporting project. These bird populations are expected to relocate to other areas of Everett Harbor for feeding and resting.

13.0 INTERIM MEASURES/SPILL AND POLLUTION PREVENTION MEASURES

N/A

14.0 COMMUNITY RELATIONS INFORMATION

N/A

15.0 RECOMMENDATIONS

The study provides a good background data set for use in developing future survey efforts for the East Waterway area. Future studies could focus on the sensitive bird species using the area, and changes in population density and species composition since the 1984 survey.

16.0 FINAL COMMENTS

The data presented in the document will be useful in determining which bird species to concentrate on during an ecological assessment of the contamination found in the sediments of East Waterway. Most of the birds identified in this study are bottom feeders, or feeders of fish species known to feed on benthic organisms. Birds in this area could then represent one of the upper trophic levels suspectible to contaminant biomagnification for the East Waterway area. The survey results presented provide useful baseline data for the design of future monitoring or assessment studies.

Appendix U

EAST WATERWAY, EVERETT, WASHINGTON
TECHNICAL DOCUMENT REVIEW

Review of:

Washington State Department of Ecology and City of Everett, 1986, Draft Supplemental Environmental Impact Statement for U.S. Navy's proposed Everett "Homeport", Northwest Regional Office, Washington State Department of Ecology, Redmond, Washington, and City of Everett, Washington.

Contract No. C0089007

Document Control No. WD4030.1.0-U

January 1991

Prepared For:

WASHINGTON STATE DEPARTMENT OF ECOLOGY
Toxics Cleanup Program

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EAST WATERWAY TECHNICAL DOCUMENT REVIEW

TABLE OF CONTENTS CHECKLIST

<u>ATTACHMENTS</u>

1.0 INTRODUCTION AND CHRONOLOGY OF EVENTS

The Washington State Department of Ecology (Ecology) supplemental environmental impact statement (SEIS) was prepared to address certain site specific issues (i.e., water quality impacts from dredging, dredged material disposal, proposed oil transfer and storage facilities, graywater, and use of organotin antifoulent paint; nuclear hazards; transportation issues; and air quality related to the United States Navy's [Navy] proposed Homeport facility in Everett) that were not described in the Navy's Final Environmental Impact Statement (FEIS). (A second SEIS was prepared by the U.S. Army Corps of Engineers [COE 1986]). The COE's SEIS addressed similar issues, and also presented data that were not available at the time that Ecology's SEIS was prepared.)

A brief summary of events leading to the preparation of Ecology's SEIS is presented below:

- o Fall 1982: Navy announces that it plans to site a Homeport for a Carrier Battle Group in the Puget Sound region.
- o April 1984: Navy selects Everett's Norton Avenue Terminal as the preferred site with Seattle's Pier 90-91 as an alternative.
- o November 1984: Navy issues draft EIS for public comment.
- o December 11, 1984: Public hearing on draft EIS is held.
- o June 1985: Navy issues the final EIS.
- o September 6, 1985: Record of Decision is published, selecting Everett as the site of the Homeport.
- o October 16, 1985: Ecology and the City of Everett adopt the National Environmental Policy Act (NEPA) EIS as adequate for programmatic decisions, but determine that a supplemental EIS is required to address site-specific issues.

2.0 LEGAL AND REGULATORY ISSUES

This document was prepared in accordance with State Environmental Policy Act (SEPA) policy and procedures. It describes site-specific environmental impacts that would be associated with proposed dredging for construction of the Homeport and with operations after construction (i.e., fuel storage, graywater disposal). The Navy is not subject to Coast Guard regulations. Therefore, spills occurring at the Homeport facility would be handled according to Navy policy and procedures. U.S. Coast Guard assistance would only be requested in an extreme emergency.

The report identifies a potential conflict between federal and state policy concerning discharge of graywater from ships to waters of the state. It is the Navy's position that discharge of graywater is not prohibited by the Clean Water Act. However, state law (RCW 90.48.080), clearly prohibits the discharge of "polluting matter" to waters of the state. The SEIS interprets "polluting matter" to include graywater discharges.

The report also identifies several other programs whose activities could affect the proposed Homeport plans. The two most likely to affect the Homeport project are listed below:

- Puget Sound Water Quality Authority (PSWQA). The PSWQA is authorized to develop plans to address water and sediment contamination within Puget Sound. The Homeport project would be subject to these plans, as well as any resulting standards that may be established. At the time the SEIS was written, the sediment quality standards and cleanup levels established under Ecology's sediment management standards rule had not yet been completed. The final draft of this rule was published on September 10, 1990. The final rule was scheduled to be adopted on December 18, 1990.

- Puget Sound Dredged Disposal Analysis (PSDDA). PSDDA establishes standards for open water disposal of uncontaminated dredge material and identifies unconfined aquatic dredge disposal sites in Puget Sound. The Port Gardner area has been identified as a high priority site.

3.0 DEMOGRAPHICS AND LAND USE

N/A

4.0 POTENTIALLY LIABLE PERSONS

N/A

5.0 IDENTIFICATION OF POLLUTION POINT SOURCES

N/A

6.0 IDENTIFICATION OF POLLUTION NON-POINT SOURCES

N/A

7.0 CHEMICAL DATA

The SEIS summarizes data collected by the Navy and the COE. The following sediment and water analyses have been performed to evaluate different dredge disposal options:

- Sediment

  - Bulk chemistry: A single composite sediment sample was analyzed for metals, volatile organic compounds, extractable organic compounds, polychlorinated biphenyls (PCBs), and pesticides. No station location description is provided in the report. The results of chemical analysis are provided in Attachment A.

  - Standard and modified elutriate tests: Standard elutriate tests were conducted to estimate the release of dissolved contaminants during open water placement of dredge material. Modified elutriate tests were conducted to determine the concentration of contaminants (both dissolved and particulate-bound) that would be present in the effluent discharged from confined (upland or intertidal) sites during filling operations. The results of the elutriate tests conducted by the COE are provided in Attachment B.

- Water

  - Surface Runoff Tests: The COE used a rainfall simulator-lysimeter system to estimate the chemical composition of runoff from an upland confined disposal site. Tests are conducted on wet, anaerobic sediment and dry, oxidized sediment. Results are presented in Attachment C.

8.0 BIOLOGICAL DATA (FLORA/FAUNA)

The SEIS summarizes results of studies conducted after the release of the FEIS. These later studies were conducted to obtain information on Dungeness crab, shrimp, and bottom fish present at the confined aquatic disposal site.

The Navy and the COE contracted with the University of Washington to evaluate biological resources in the Port Gardner area. Four trawls, one in February, April, summer, and fall, were completed. At the time the SEIS was published, only the crab data from the February trawl were available.

Dungeness crab samples were collected at 56 stations using a 3-meter beam trawl. The trawl was towed approximately 232 meters at a speed of 1.5 to 2.0 knots. Three sampling stations were established in each of the three alternative aquatic disposal sites. In addition, five transects were established at 1-kilometer intervals across Port Gardner (see Attachment D). Two additional transects were sited near the Navy and PSDDA 1 disposal sites.

The results indicate that Dungeness crab were not evenly distributed throughout Port Gardner. Distribution varied according to sex and to reproductive state for females. Eighty-five percent of the male crabs were found in shallow water less than 20 meters deep; 98 percent were in water less than 40 meters deep. In comparison, gravid females were found in deeper water, with 73 percent recovered from depths of 40 meters or greater and 16 percent recovered from depths of 100 to 160 meters.

Average crab densities found at each of the three aquatic disposal sites are summarized below:

- o Deep Delta Site 22.4 +/- 9.8
- o PSDDA Site 1 0.6 +/- 1.1
- o PSDDA Site 3 0.0 +/- 0.0

Field data from the shrimp trawl indicate that abundance and species diversity of shrimp is greatest at intermediate depths. Very few commercial shrimp were found in shallow water. Of the three aquatic disposal sites, shrimp were most abundant at the Deep Delta site, extending into the eastern part of PSDDA site 1.

Although results were not available at the time the SEIS was released, field notes indicate that the largest number of bottomfish were found at the Deep Delta site, followed by PSDDA Site 1, and PSDDA Site 3. Because the proposed sites are located at different depths, the species composition varied at each site.

9.0 DATA QUALITY

The SEIS summarizes data generated by other investigations, but does not present any quality assurance (QA) information for these data. Therefore, the data quality cannot be evaluated. It is recommended that the original reports be reviewed to validate the data.

10.0 HYDROLOGIC AND HYDRODYNAMIC INFORMATION

Bathymetric, physical, and geophysical surveys were conducted at the Navy's preferred confined aquatic disposal site, the Deep Delta site. In addition, the SEIS summarizes data generated by the PSDDA program for two other recommended confined aquatic disposal sites (PSDDA Site 1 and PSDDA Site 3). The three sites are described below:

- o Deep Delta site

  The Deep Delta site is located 3,000 feet west of East Waterway in water approximately 250 feet deep. Bottom slopes are between 1:20 and 1:50. The highest current speeds occur near the surface (medial speed = 8.0 cm/sec; maximum speed = 50 cm/sec). Below 100 feet, medial speeds are approximately 3.5 cm/sec (maximum speed = 18 cm/sec). Deposition rate is estimated at 0.25 in/yr.

- o PSDDA Site 1

  PSDDA Site 1 is located approximately 3 miles southwest of East Waterway in approximately 400 feet of water. The site is characterized as a depositional area and has been identified under PSDDA for disposal of clean dredge material. Maximum near-bottom current velocities are approximately 32.5 cm/sec.

- o PSDDA Site 3

  PSDDA Site 3 is located approximately 4 miles west of East Waterway in approximately 525 feet of water. Current velocities are similar to PSDDA Site 1.

11.0 DREDGING AND DISPOSAL ISSUES AND DATA

The Navy estimates that 3,305,000 cubic yards of material would be dredged from East Waterway, approximately 1/3 of which would be contaminated, and therefore, unsuitable for unconfined open water disposal. Dredging is to be completed in several stages, including demolition of existing structures, three-phase dredging of East Waterway, followed by construction of breakwater, moles, and upland facilities. The proposed dredging schedule is summarized below:

	FISCAL YEAR		
	1987	1988	TOTAL
Contaminated (yd^3)	97,000	831,000	928,000
Uncontaminated (yd^3)	739,000	1,638,000	2,377,000
Total (yd^3)	836,000	2,469,000	3,305,000
Debris Removal (tons)	22,500	85,000	107,500

The SEIS evaluated the following three general categories of disposal sites:

- o Confined aquatic disposal (CAD),
- o Confined nearshore and intertidal disposal, and
- o Confined upland disposal.

Locations of potential dredge disposal sites in the vicinity of the proposed Homeport are shown in Attachment E.

Confined Aquatic Disposal

Deep Delta Site. The Deep Delta site, the Navy's preferred site, is located at a depth of approximately 250 feet. The Navy later identified two sites immediately adjacent to the Deep Delta site that would be more suitable because they contained fewer crabs, and therefore, would have fewer environmental concerns (U.S. Army Corps of Engineers 1986). Environmental impacts are discussed in the following section. Three different methods of placing dredge material were evaluated: 1) bottom dump with no provisions for lateral containment,

2) bottom dump with underwater berms for lateral containment, and 3) discharge dredge material down a vertical pipe with no provision for lateral containment.

Studies conducted by the COE indicate that underwater berms would be required to contain the dredge material within the disposal area boundaries. Berms could be constructed either by controlled surface discharge or a vertical downpipe. The COE also recommended a minimum cap thickness of 2.5 feet over the contaminated dredge material. The Navy proposes to place the cap either using a vertical downpipe or surface disposal in two 5-foot lifts.

Suspension and subsequent loss of dredged material during placement was evaluated using a computer model. Assuming that a 4,000 cubic yard bottom dump barge was used, approximately 1.3 to 4.7 percent of the dredge material remained in suspension. With a vertical downpipe, an insignificant amount of material would be subject to off-site transport during placement.

Alternate Aquatic Disposal Sites. PSDDA Sites 1 and 3 were identified as potential aquatic disposal sites. Because these two sites are located at greater depths (400 to 525 feet) than the Deep Delta site, placement of dredge material would be more difficult and less precise. In addition, more material would be subject to off-site transport due to entrainment in the water column.

Confined Nearshore and Intertidal Disposal

The following four nearshore/intertidal disposal sites were identified (Attachment E):

- o Weyerhaeuser site,
- o Snohomish Channel site,
- o South Jetty site, and
- o Proposed Everett Jetty State Park.

Based on information provided in the Navy's FEIS, the SEIS identifies the Snohomish Channel site as the most feasible and provides information related to dredge disposal at this site. The remaining three sites are not described in detail.

The Snohomish Channel site represents 7.7 percent of the intertidal mudflat present in the Snohomish Estuary. Although its habitat value is currently affected because it is used as a log storage area, the SEIS identifies this site as potentially valuable habitat for juvenile salmonids, small estuarine fish, and shore birds. Use of this area for dredge disposal also would reduce the Port of Everett's storage capacity for log rafts and could limit its ability to load ships.

Assuming the entire 178-acre site is used and filled to a minimum of 19 feet, it could hold approximately 5.7 million cubic yards. It is estimated that 100 acres would be required for disposal of contaminated sediments and an additional 40 acres would be required for uncontaminated sediments. A containment berm and cap would be constructed of either clean upland fill or clean dredged material.

Confined Upland Disposal

The following three upland disposal sites were evaluated in the Navy's FEIS:

- o Tulalip Landfill,
- o Smith Island Site, and
- o Weyerhaeuser Site.

The FEIS identified the Smith Island site as the most feasible. No additional information is provided in the SEIS.

12.0 ENVIRONMENTAL IMPACTS

Dredging and Dredged Material Disposal

Confined Aquatic Disposal. The preferred method of dredging contaminated materials is with a clamshell. Although impacts would be less than with a hydraulic dredge, a clamshell would have significant impacts on turbidity, dissolved oxygen, sulfides, and other contaminants. Ecology typically establishes a 45-meter dilution zone around a clamshell dredge. The elutriate tests conducted by the COE indicate that lead, nickel, and PCB Aroclor 1254 released from the sediments during dredging operations may cause local exceedances of federal water quality criteria.

Dredged material disposal also will affect water quality near the confined aquatic disposal site. The COE estimates that approximately 3 percent of the material dumped will remain in the water column. Localized exceedances of nickel, lead, and PCB Aroclor 1254 are predicted. However, these exceedances are expected to rapidly dissipate due to mixing.

Dredge disposal will destroy most of the bottom dwelling invertebrates. In addition, there is a potential for long term displacement of Dungeness crabs from the disposal site. The highest concentration of female crabs was found at the Navy's preferred Deep Delta site. As a result of this finding, the COE evaluated two additional confined aquatic disposal sites that are adjacent to the Navy's Deep Delta site (U.S. Army Corps of Engineers 1986). These two sites are located at slightly greater depths than the Deep Delta site and have lower concentrations of Dungeness crab.

Confined Nearshore and Intertidal Disposal. The SEIS evaluated potential impacts at the preferred Snohomish Channel site. The elutriate analyses showed that nickel, lead, chromium, and PCB Aroclor 1254 would exceed the background conditions (as defined by East Waterway near the Weyerhaeuser dock) in the vicinity of the disposal area. Of these five contaminants, nickel, lead, and PCB Aroclor 1254 exceeded the water quality criteria for chronic toxicity.

Surface runoff tests predicted that the potential for contaminant release increases as the dredged material dries. Runoff contained high concentrations of suspended solids (1,000 mg/L) and particulate-bound metals. The COE concluded that control measures would be required to reduce suspended solids and chromium concentrations in runoff from the dredged material.

Long term impacts related to the loss of habitat and possible leachate generation from contaminated dredge materials also were predicted. The COE conducted leachate tests; however, the results were not available at the time the SEIS was released.

Confined Upland Disposal. Potential impacts from confined upland disposal were predicted to be less than with nearshore/intertidal disposal. Impacts could be significantly reduced if a clamshell was used to dredge and unload the contaminated material instead of a hydraulic dredge. Capping also would minimize contamination of surface runoff from the site.

Graywater

The Navy's proposal includes berthing four ships that would discharge graywater directly to the harbor. Total estimated discharge rate is approximately 12,143 gal/day. Data on the chemical composition of graywater from a ship similar to those that would be berthed at the Homeport indicated that direct discharge to the harbor would not be a significant problem (Navy 1985). However, the SEIS concluded that graywater does pose a potential threat due to the uncontrolled nature of this discharge and the inability to regulate what is discharged. The report identifies the following alternatives to eliminate graywater discharge:

- Retrofit ships with appropriate piping.
- Collect graywater externally.
- Assign only ships with appropriate piping systems to the Homeport facility.
- Require collection of graywater while standing in and out of port.

Oil Transfer and Storage

The Navy plans to store fuel on-site in four aboveground tanks: two 840,000-gallon tanks for jet turbine fuel and two 1,260,000 gallon tanks for marine diesel fuel. The tanks would be located along the Snohomish River side of the site and would be surrounded by earthen dikes large enough to contain the tank's volume. Tanks would be filled by barge.

The Navy estimates that spills greater than 100 gallons would occur approximately once every 13 months. However, records from 1982 through 1984 show 25 spills of 100 gallons or more at three naval facilities with fuel handling operations similar to those planned for the Everett Homeport. In addition, spills occurring in the river during barge off-loading would be difficult to contain with oil containment booms because of the high currents. Finally, because it is not subject to Coast Guard regulations, it is the navy's policy to handle spills according to their own procedures without involving outside help, except in extreme circumstances. The SEIS offers the following alternatives to reduce the potential for oil spills:

- o Do not store fuel on-site.
- o Move barge off-loading facility to East Waterway where spills could be more easily contained.
- o Relocate and/or line fuel storage area to prevent leaks and spills from entering the river.

Organotin

The Navy proposes to use a non-sloughing paint containing cuprous oxide and tributyltin (TBT) to prevent biofouling. These additives are toxic to marine organisms that would otherwise attach to the ship's hull, resulting in a decrease in maximum speed and an increase in fuel consumption.

TBT has been implicated as a possible cause of shell malformations observed in Pacific oysters at marinas in France. High levels of TBT were found in the affected oysters. In 1986, the United States Environmental Protection Agency initiated a study of TBT pesticide compounds to evaluate the potential hazard to marine organisms. The results of this study were not available at the time the SEIS was released.

13.0 INTERIM MEASURES/SPILL AND POLLUTION PREVENTION MEASURES

The SEIS states that "precautions will be taken" to prevent spills from the Homeport's fuel storage and transfer facility, but it does not provide a description of specific control and countermeasure procedures. It refers to the FEIS for an explanation of the Navy's plan.

14.0 COMMUNITY RELATIONS INFORMATION

The SEIS was co-authored by Ecology and the City of Everett. In addition, two advisory groups were formed: one to discuss transportation issues and the other to address general issues related to the Homeport. These advisory groups consisted of local agency personnel and representatives from community organizations.

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15.0 RECOMMENDATIONS

The SEIS identifies issues and concerns related to the Navy's proposed Homeport in Everett, based on the plan described in the Navy's 1985 FEIS. However, since issuance of the SEIS, the Navy's plans concerning dredging and dredge disposal have changed. In addition, the Navy has dredged some of the uncontaminated sediments at the proposed Homeport site. Because of these changes, it is recommended that more recent reports be reviewed to obtain information on current conditions at the site and status of the Homeport project.

The SEIS summarizes data generated by other investigations, but typically does not provide a detailed description of sampling methods, analytical procedures, or QA. The original studies should be reviewed to evaluate data quality and determine whether these data are suitable for use in the Remedial Investigation/Feasibility Study.

16.0 FINAL COMMENTS

The SEIS summarizes data generated by other investigations and describes environmental issues related to the Navy's proposed siting of a Homeport facility in Everett. It does not provide any original data that could be used to characterize environmental conditions in the East Waterway-Port Gardner.

Attachment A

BULK SEDIMENT ANALYSIS DATA SUMMARY

TABLE 2 **Bulk Sediment Analyses of Composite Sediment Sample**

Parameter	Concentration mg/kg
Arsenic	5.73
Copper	73.4
Nickel	21.4
Cadmium	3.30
Lead	48.1
Zinc	148.5
Chromium	39.7
Mercury	0.201
Iron	7864.
Aldrin	<0.0002
Manganese	237.
G-BHC	<0.0002
Total Phosphorus	789.
A-BHC	<0.0002
D-BHC	<0.0002
Ammonia Nitrogen	167.
B-BHC	<0.0002
Chlordane	<0.002
PPDDD	<0.0002
Dieldrin	<0.0002
Endosulfan Sulfate	<0.0002
PPDDE	<0.0002
A-Endosulfan	<0.0002
Endrin	<0.0002
PPDDT	<0.0002
B-Endosulfan	<0.0002
Endrin Aldehyde	<0.0002
Heptachlor	<0.0002
Heptachlor Epoxide	<0.0002
PCB-1221	<0.002
PCB-1248	<0.002
PCB-1232	<0.002
PCB-1254	0.25
PCB-1016	<0.002
PCB-1242	<0.002
PCB-1260	<0.002
Toxaphene	<0.002
2-Nitrophenol	<1.
4-Chloro-3-Methylphenol	<1.
Phenol	<1.
2 4-Dimethylphenol	<1.
2 4 6-Trichlorophenol	<1.
2-Chlorophenol	<1.
2 3-Dichlorophenol	<1.
2 4 Dinitrophenol	<10

Parameter	Concentration mg/kg
4-Nitrophenol	<1.
Chloromethane	<0.025
Chlordethane	<0.025
2-Mthyl-4 6-Dinitrophenol	<10.
Bromomethane	<0.025
Methylene Chloride	<0.025
Pentachlorophenol	<1.
Vinyl Chloride	<0.025
1 1-Dichloroethene	<0.025
1 1-Dichloroethane	<0.025
1 2-Dichloroethane	<0.025
Bromodichloromethane	<0.025
Trans-1 2-Dichloroethene	<0.025
1 1 1-Trichloroethane	<0.025
1 2 Dichloropropane	<0.025
Chloroform	<0.025
Carbon Tetrachloride	<0.025
Trans-1 3-Dichloropropene	<0.025
Trichloroethene	<0.025
1 1 2-Trichloroethane	<0.025
Bromoform	<0.025
Dibromochloromethane	<0.025
Benzene	<0.025
1 1 2 2-Tetrachloroethane	<0.025
Cis-1 3-Dichloropropene	<0.025
2-Chloroethylvinylether	<0.025
Tetrachloroethene	<0.025
Toluene	<0.025
Acrolein	<0.25
Bis(2-Chloroisopropyl)ether	<1.
Chlorobenzene	<0.025
Acrylonitrile	<0.25
N-Nitroso-di-n-propylamine	<1.
Ethylbenzene	<0.025
N-Nitrosodimethylamine	<1.
Nitrobenzene	<1.
Isophorone	<1.
2 4-Dinitrotoluene	<1.
3 3-Dichlorobenzioine	<5.
Bis(2-Chloroethoxy)Methane	<1.
2 6-Dinitrotoluene	<1.
Benzidine	<10.
1 3-Dichlorobenzene	<1.

Parameter	Concentration mg/kg
1 4-Dichlorobenzene	<1.
1 2 4-Trichlorobenzene	<1.
Hexachlorocyclopentadiene	<1.
1 2-Dichlorobenzene	<1.
Naphthalene	8.2
2-Chloronaphtahlene	<1.
Hexachloroethane	<1.
Hexachlorobutadiene	<1.
Acenaphthylene	<1.
Dimethyl Phthalate	<1.
Diethyl Phthalate	<1.
4-Bromophenyl Ether	<1.
Acenaphthene	2.0
4-Chlorophenyl Phenyl Ether	<1.
Hexachlorobenzene	<1.
Fluorene	2.2
N-Nitrosodiphenyl Amine	<1.
Phenanthrene	5.7
Anthracene	1.5
Pyrene	4.0
Benzo(A)Anthracene	2.1
Dibutylphthalate	<1.
Butylbenzylphthalate	<1.
Bis(20Ethylhexyl)Phthalate	<1.
Fluoranthene	4.5
Chrysene	1.8
Di-N-Octylphthalate	<1.
Benzo(B)Fluoranthene	2.5
Indeno(1 2 3-C D)Pyrene	<1.
Total Organic Carbon	71.540
Benzo(K)Fluoranthene	2.5
Dibenzo(A H)Anthracene	<1.
Benzo(A)Pyrene	1.4
Benzo(G H I)Perylene	<1.
Total Phenol	<17.1

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TABLE 3 Everett Harbor Site Water Chemistry

Parameter	Concentration ppm
Arsenic	<0.005
Copper	0.007
Nickel	0.007
Cadmium	0.0006
Lead	<0.001
Zinc	<0.030
Chromium	0.004
Mercury	0.0067
PCB-1016	<0.0002
PCB-1221	<0.0002
PCB-1248	<0.0002
PCB-1232	<0.0002
PCB-1254	<0.0002
PCB-1242	<0.0002
PCB-1260	<0.0002
Acenaphthylene	<0.005
Naphthalene	<0.005
Acenaphthene	<0.005
Fluorene	<0.005
Fluoranthene	<0.005
Phenanthrene	<0.005
Pyrene	<0.005
Benzo(B)Fluoranthene	<0.005
Anthracene	<0.005
Chrysene	<0.005
Benzo(K)Fluoranthene	<0.005
Benzo(A)Pyrene	<0.005
Benzo(G H I)Perylene	<0.005
1-Methylnaphthalene	<0.005
Indeno(1 2 3-C D)Pyrene	<0.005
2-Methylnaphthalene	<0.005
Dibenzo(A H)Anthracene	<0.005

Note: Concentrations of this Everett Harbor site water sample were specified by the Seattle District for use as Port Gardner background or reference.

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Attachment B

ELUTRIATE TEST RESULTS

TABLE 4 **Summary of Dissolved Concentrations for Standard Elutriate Tests and Criteria**

Parameter	Dissolved Concentration ppm	Site Water Concentration ppm	Federal WQ Criteria ppm chronic	Federal WQ Criteria ppm acute	Remarks
Copper	.007	.007	.004	.023	Test < background
Nickel	.015	.007	.007	.140	Test < acute criteria
Cadmium	.003	.0006	.0045	.059	Test < chronic criteria
Lead	.028	<.001	.025	.668	Test > background
Chromium	.008	.004	.018	1.2	Test < chronic criteria
Mercury	.0066	.0067	.000025	.0037	Test < background
PCB-1254	.0004	<.0002	.00003	.00003	Dilution factor = 13

Summary of Dissolved Concentrations for Modified Elutriate Tests and Criteria

Parameter	Dissolved Concentration ppm	Site Water Concentration ppm	Federal WQ Criteria ppm chronic	Federal WQ Criteria ppm acute	Remarks
Copper	.006	.007	.004	.023	Test < background
Nickel	.018	.007	.007	.140	Test < acute criteria
Cadmium	.0002	.0006	.0045	.059	Test < background
Chromium	.003	.004	.018	1.2	Test < background
PCB1254	.0004	<.0002	.00003	.00003	Dilution factor = 13

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Attachment C

SURFACE RUNOFF TESTS RESULTS

TABLE 5 CONTINUED

Contaminant Loads in Surface Runoff from Wet, Oxidized Sediment During a 5 cm/hr, 30 min. Storm Event, (Runoff Volume = 187 l)

Parameter	Filt. Conc. (mg/l)	Load (mg)	Load (mg/Ha)
PAH	0.0004	0.075	134
Cd	0.0002	0.037	67.1
Cu	0.005	0.935	1677
Pb	0.004	0.748	1342
SS	6900	1.29 kg	2315 kg/Ha

Lysimeter Surface Runoff Water Quality During The Dry, Oxidized Stage

Parameter	Original Sediment Conc. (ug/g)	Mean Unfil. Runoff Conc. (mg/l)	Mean.Filt. Runoff Conc. (mg/l)	EPA Maximum Criteria	Port Gardner Reference
pH	7.18	7.0	7.1	N	N
conductivity mmV/cm	81	3.3	3.4	N	N
Salinity	180 mg/g	2 g/l	2 g/l	N	N
SS	N	1000	N	N	N
PAH (Total)	N	0.0065	0.0002	N	<0.005
Naphthalene	N	0.0006	0.0002	N	N
Acenaphthylene	N	0.0001	<0.005	N	N
Acenaphthene	N	0.0003	<0.005	N	N
Fluorene	N	0.0001	<0.005	N	N
Phenanthrene	N	0.0020	<0.005	N	N
Fluoranthene	N	0.0020	<0.005	N	N
Pyrene	N	0.0014	<0.005	N	N
Heavy Metals					
Cadmium	N	0.035	0.018 A*	0.0015-0.0024	0.0006
Copper	N	0.217	0.007 *	0.012-0.043	0.007
Zinc	N	1.20	0.335 *	0.180-0.570	<0.001
Lead	N	0.237	0.002	0.074-0.400	<0.001
Mercury	N	0.0022	<0.0004	0.0017	0.0067
Arsenic	N	<0.025	<0.005	0.440	<0.005

N No values available
* Concentrations Exceed US EPA Maximum Water Quality Criteria for Protection of Aquatic Life
A Filtered Concentrations are not Statistically Significantly Different from Unfiltered Concentrations

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TABLE 5 <u>Lysimeter Surface Runoff Water Quality During The Early, Wet, Unoxidized Stage</u>

Parameter	Original Sediment Conc. (ug/g)	Mean Unfil. Runoff Conc. (mg/l)	Mean Fil. Runoff Conc. (mg/l)	EPA Maximum Criteria	Port Gardner Reference
pH	8.1	8.0	N	N	N
Conductivity	N	4.0 mmV/cm	N	N	N
Salinity	N	3 g/l	3 g/l	N	N
SS	N	6900	N	N	N
PCB	<0.002	<0.0002	<0.0002	0.014	<0.0002
PAH	37.4	0.077	0.004	N	<0.005
Naphthalene	8.2	0.0085	0.0019	N	
Acenaphthene	2.1	0.005	0.0008	N	
Fluorene	2.2	0.006	<0.005	N	
Phenanthrene	5.9	0.015	0.0014	N	
Anthracene	1.5	0.0025	<0.005	N	
Fluoranthene	4.5	0.013	<0.005	N	
Pyrene	4.1	0.011	<0.005	N	
Chrysene	1.8	0.0034	<0.005	N	
Benzo (A) Anthracene	2.1	0.0030	<0.005	N	
Benzo (B) Fluoranthene	2.5	0.0048	<0.005	N	
Benzo (K) Fluoranthene	2.5	0.0048	<0.005	N	
Heavy Metals					
Cadmium	3.30	0.029	0.0002	0.0015-0.0024	0.0006
Copper	73.4	1.153	0.005	0.012-0.043	0.007
Zinc	148.5	1.78	0.034	0.180-0.570	<0.03
Lead	48.1	0.540	0.004	0.074-0.400	<0.001
Mercury	0.201	0.0025	<0.0002	0.0017	0.0067
Arsenic	5.73	0.010	<0.005	0.440	<0.005
Oil and Grease	N	47	<7	N	N
TKN	N	38	4.35	N	N
NO3	N	8.46	11.4	N	N
NH4	167	3.78	3.11	N	N
TP	789	9.16	0.14	N	N
TOC	71.5	290	15	N	N
COD	N	3260	429	N	N

N No Values Are Available

* Concentrations Equal or Exceed EPA Maximum Water Quality Criteria for Protection of Aquatic Life

A Filtered Concentrations are not Statistically Significantly Different from Unfiltered Concentrations

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Attachment D

TRAVEL TRANSECT LOCATIONS

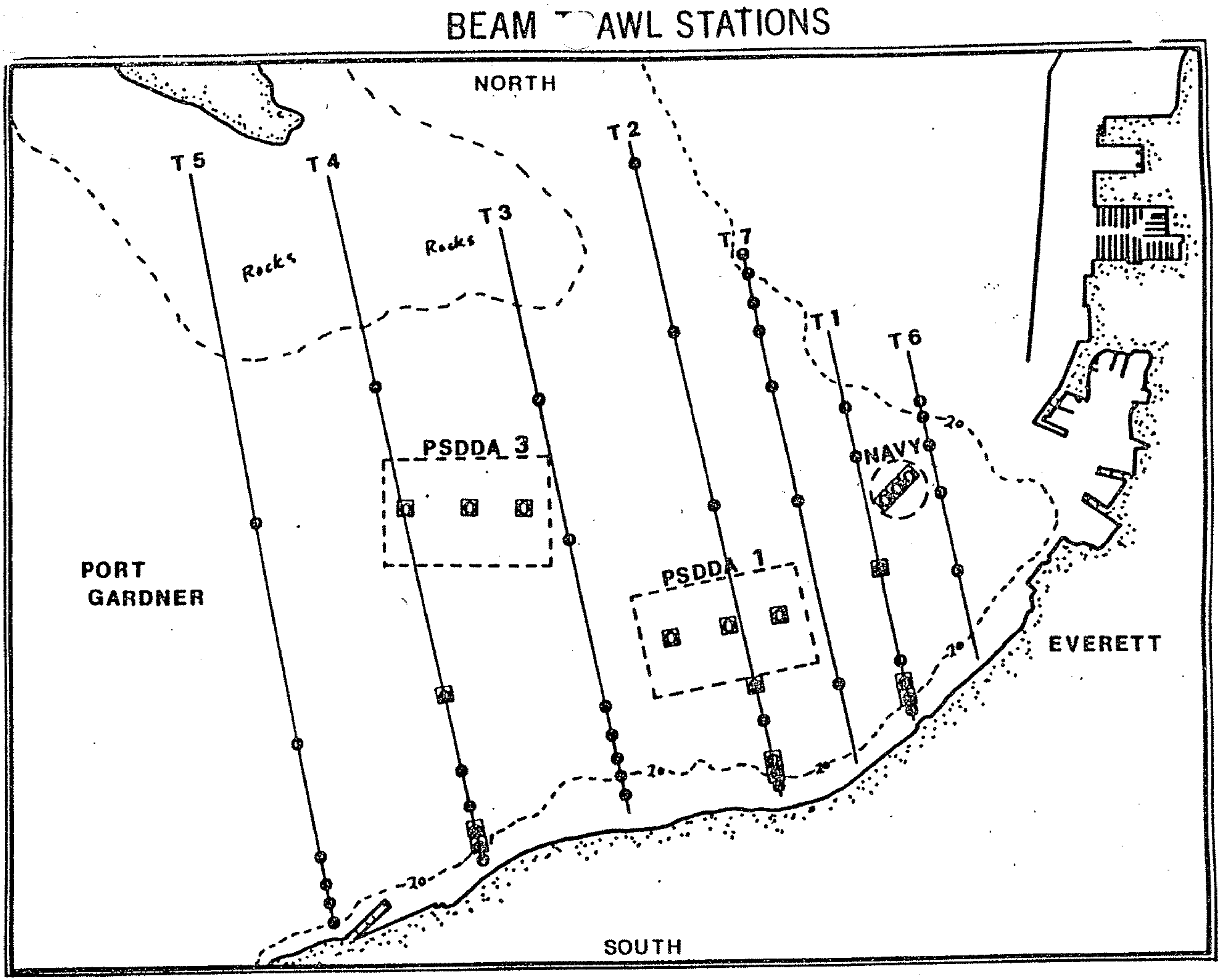

Figure 3. Map of Port Gardner showing beam trawl (o) and otter trawl (□) stations.

Attachment E

POTENTIAL DREDGE DISPOSAL SITES

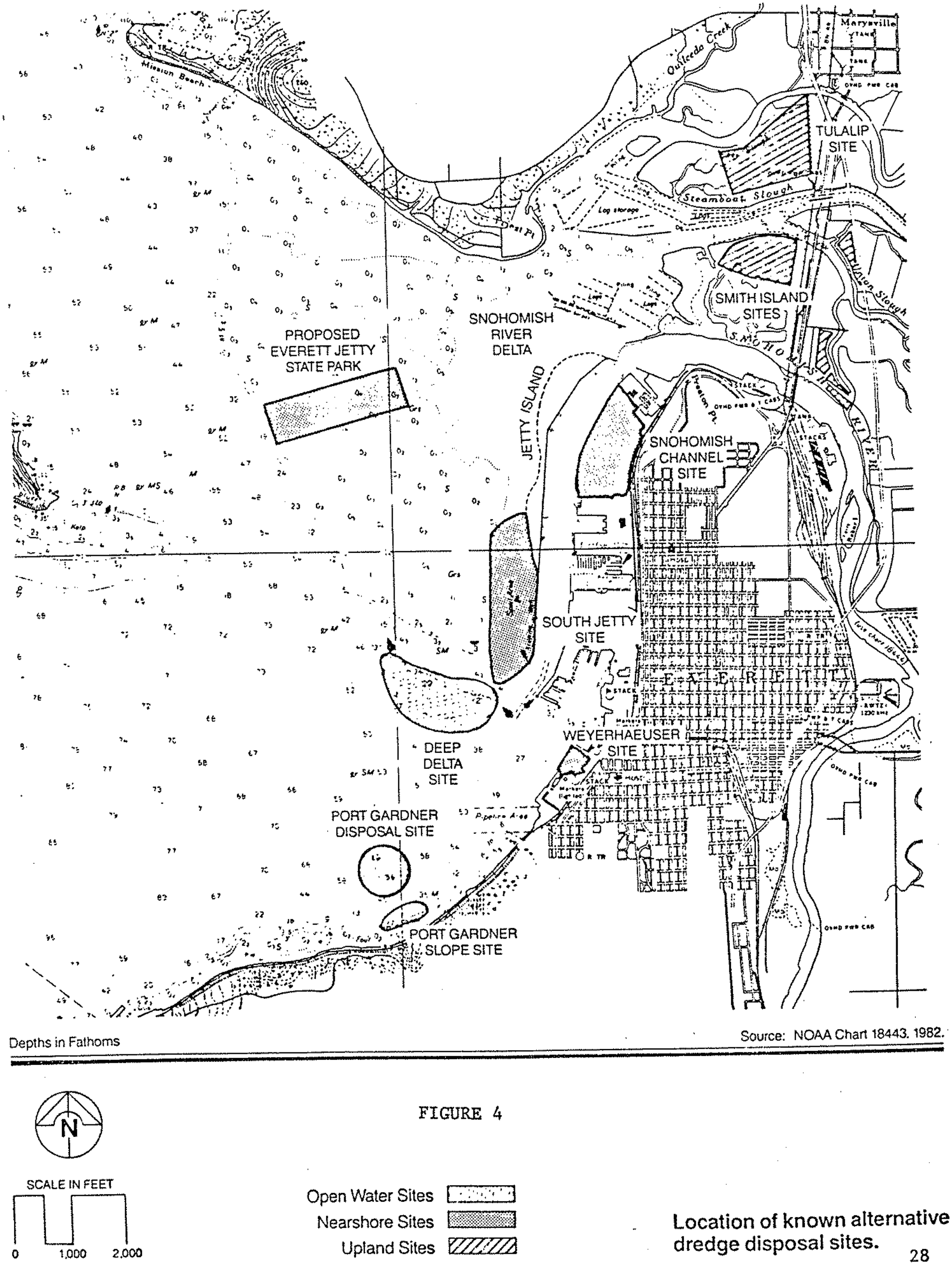

FIGURE 4

Location of known alternative dredge disposal sites.