US Army Corps
of Engineers
Seattle District

PSDDA Reports

Puget Sound Dredged Disposal Analysis

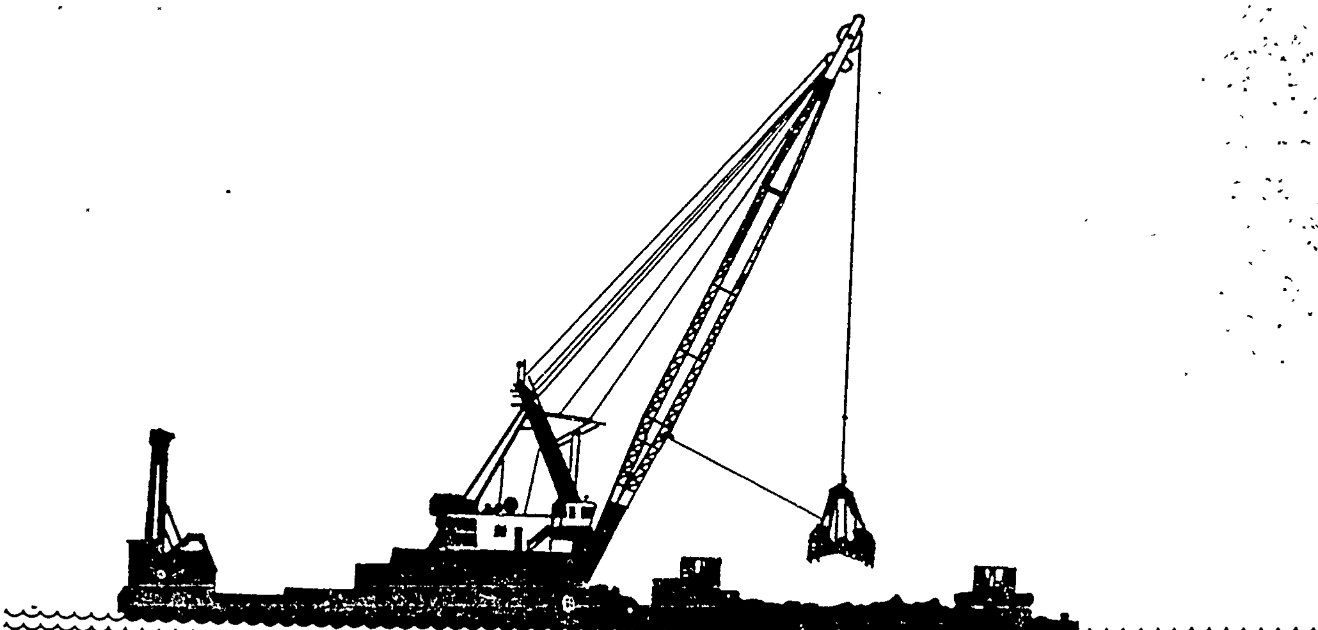
Washington State Dept.
of Natural Resources

FINAL ENVIRONMENTAL IMPACT STATEMENT

UNCONFINED OPEN-WATER DISPOSAL FOR DREDGED MATERIAL, PHASE II

(NORTH AND SOUTH PUGET SOUND)

(NEPA/SEPA)



SEPTEMBER 1989

EPA
Region 10

ECOLOGY

NEPA/SEPA
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Principal Agencies.

U.S. Army Corps of Engineers, Seattle District (Corps)
U.S. Environmental Protection Agency, Region X (EPA)
Washington Department of Natural Resources (DNR)
Washington Department of Ecology (Ecology)

Proposed Date for Implementation. November 1989.

Lead and Cooperating Agencies for National Environmental Policy Act/State Environmental Policy Act Action. The FEIS was prepared as a joint National Environmental Policy Act (NEPA)/State Environmental Policy Act (SEPA) action by the principal agencies (pursuant to 33 CFR 230.20).

NEPA Lead Agency:	Corps	NEPA Cooperating Agency:	EPA
SEPA Lead Agency:	DNR	SEPA Cooperating Agency:	Ecology

Responsible Officials.

Corps: Colonel Philip L. Hall
District Engineer
Seattle District, Corps of Engineers

DNR: Brian Boyle, Commissioner of Public Lands
Washington Department of Natural Resources

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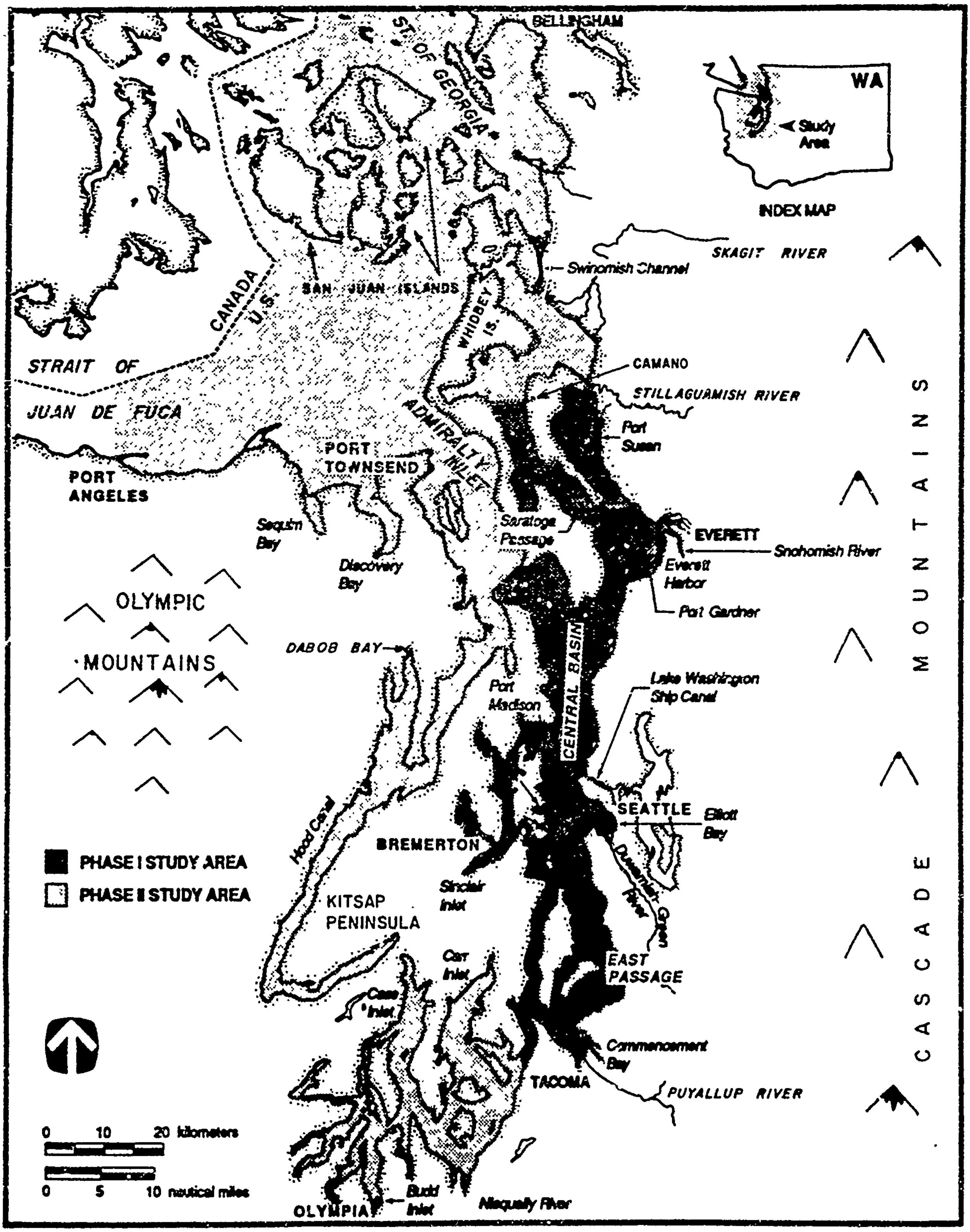

Figure CPFS.1Study area -
Puget Sound Dredged Disposal Analysis

EPA:	Robie G. Russell Regional Administrator EPA, Region X	Ecology:	Christine O. Gregoire, Director Washington Department of Ecology

Contact Persons.

Corps:	Frank J. Urabeck, Director Puget Sound Dredged Disposal Analysis Seattle District, Corps of Engineers Post Office Box C-3755 Seattle, Washington 98124 Telephone (206) 764-3708	DNR:	Steve Tilley, Asst. Mgr. Aquatic Lands Division DNR M/S QW-21 Olympia, Washington 98504 Telephone (206) 586-6375

Additional Actions Required. Designation and eventual use of the sites will require the following actions:

Responsible Entity	Action
U.S. Army Corps of Engineers, Seattle District	40 CFR 230.80 - Federal Advanced Identification of Disposal Sites
	Sections 10 and 404 Permits for Specific Dredging Projects (for disposal site use)
U.S. Environmental Protection Agency, Region X	40 CFR 230.80 - Federal Advanced Identification of Disposal Sites
Washington Department of Natural Resources	Dredged Material Disposal Permits for Specific Dredging Projects (for disposal site use)
Washington Department of Ecology	Section 401 Water Quality Certifications for Specific Dredging Projects (for disposal site use)
Washington Departments of Fisheries and Wildlife	Hydraulics Project Approvals for Specific Dredging Projects (for disposal site use)
Whatcom, Skagit, Clallam, and Pierce Counties	Shoreline Substantial Development Permits for the Disposal Sites Within Each Jurisdiction

Subsequent Environmental Review. After completion of the Phase II portion of the PSDDA study, individual dredging projects where unconfined, open-water disposal at the identified sites is being proposed, will be reviewed for compliance with the appropriate regulatory requirements, as specified above.

Authors - Principal Contributors to the Final EIS. Staff of the Corps prepared the Phase II PSDDA FEIS with advice and input from other PSDDA and resource agencies, local governments, ports, Indian tribes, various organizations, and private citizens who served on three technical work groups. See section 6 of the FEIS for a list of specific contributors.

Cost of Reports. This FEIS is available at no charge by writing to the address shown below.

SEND COMMENTS TO: Frank J. Urabeck
Seattle District, Corps of Engineers
Post Office Box C-3755
Seattle, Washington 98124

Management Plan Report and FEIS Issue Date: Publication of Notice of Availability in Federal Register (anticipated September 29, 1989).

Time and Place of Final Public Meetings. The final meetings for the Phase II EIS and supporting documents were held at:

7:30 p.m., Tuesday April 18, 1989 Steilacoom Community Center 2301 Worthington Street Steilacoom, Washington	7:30 p.m., Wednesday April 19, 1989 Bellingham City Council Chambers 210 Lottie Street Bellingham, Washington	7:30 p.m., Thursday April 20, 1989 Port of Port Angeles 338 West First Street Port Angeles, Washington

Date Final Action Planned:

Federal Agencies - Completion of the Federal Record of Decision (fall 1989)

State Agencies - Issuance of the shoreline permits for the selected disposal sites (winter 1989).

SUMMARY

This final Environmental Impact Statement (FEIS) evaluates alternatives considered in selecting public multiuser unconfined, open-water sites for the disposal of dredged material in the Phase II area of the Puget Sound Dredged Disposal Analysis (PSDDA), a comprehensive study of unconfined dredged material disposal in deep waters of Puget Sound. The study is being undertaken as a cooperative effort by the U.S. Army Corps of Engineers (Corps), U.S. Environmental Protection Agency (EPA), and the State of Washington Departments of Natural Resources (DNR) and Ecology (Ecology). A management plan for the Phase II area (north and south Puget Sound) has been prepared which identifies selected unconfined, open-water disposal sites, evaluation procedures for dredged material being considered for disposal at these sites and site management considerations including environmental monitoring. This summary contains information from both the environmental impact statement and the Phase II Management Plan Report (MPR) and Disposal Site Selection Technical Appendix which are adopted as part of the FEIS by reference. Also adopted by reference are the Phase I (central Puget Sound) FEIS and other program documents (Phase I MPR, Evaluation Procedures Technical Appendix, Disposal Site Selection Technical Appendix, and Management Plan Technical Appendix).

The Corps EPA, DNR, and Ecology began the PSDDA study in April 1985. The study is a 4-1/2-year-long effort being conducted in two overlapping phases, each about 3-1/2 years in length. As shown in figure 1, Phase I covered central Puget Sound, including the Sound's major urban centers, Tacoma, Seattle, and Everett. Draft Phase I documents were prepared and distributed during January of 1988 for public review and comment. The final Phase I documents were released in June 1988. Phase II, initiated in April 1986, covers the north and south Sound areas, including Olympia, Port Townsend, Port Angeles, Anacortes, Bellingham, and other locations of dredging activity. This report covers the final findings for the Phase II area. Draft Phase II documents were released for public review in March 1989.

PUGET SOUND NAVIGATION AND DREDGING

Navigation waterways of Puget Sound have played a vital role in the region's economic development and growth. There are 34 port districts serving the region. Some 50 miles of navigation channels, about 50 miles of port terminal ship berths, and more than 200 small boat harbors must be periodically dredged to maintain the commercial and recreational services provided by these facilities. Over the period 1970-1985, an estimated 24.8 million cubic yards (c.y.) of sediments were removed from Puget Sound harbors and waterways by various dredgers. These included private developers and public entities (e.g., Federal and State agencies, ports, and local governments) responsible for funding and undertaking dredging projects. To place this activity in some perspective, periodic dredging for navigation improvement and maintenance projects occurred in only an estimated 0.08 percent or less than 2 square miles of the total 2,500-square-mile surface area of Puget Sound.

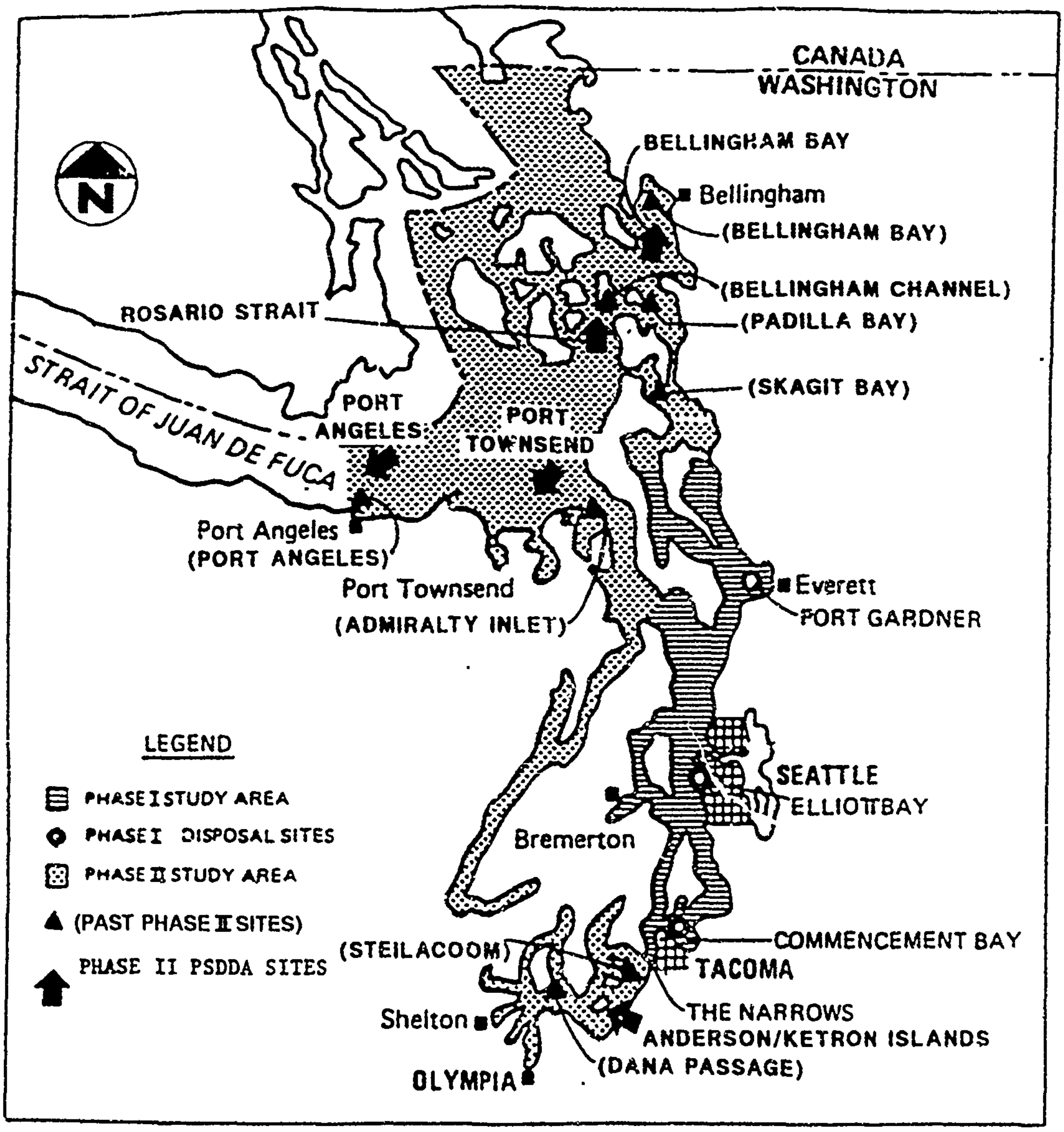

Figure S.1 Puget Sound Dredged Disposal Analysis. Location of past and PSDDA Phase II selected disposal sites.

PUGET SOUND DREDGED MATERIAL DISPOSAL

Historic Practice. During early development of Puget Sound waterways, dredged material was often used as a convenient source of fill material for associated harbor and terminal improvements. This practice has continued, but at a much lesser rate in recent years, as public policy has been to protect environmentally important tidal areas, wetlands, and marshes. Consequently, nearshore disposal options are limited. Upland disposal is quite costly and may also have adverse environmental impacts. In the future, for many projects, disposal in deep and relatively deep marine waters is expected to be a preferred option for environmental, as well as economic, reasons.

Public Unconfined, Open-Water Disposal Sites. Until 1970, dredged material was discharged at Puget Sound sites generally selected by each dredger. At that time, disposal site designation guidelines were formulated by an interagency committee chaired by DNR, and more than 10 specific public multiuser disposal sites were established. Nearly all unconfined, open-water disposal has since occurred at these sites. In the 1970-1985 period, about 9 million cubic yards or approximately 36 percent of the total material dredged was released at the designated disposal sites with most of the remaining material used as an economic source of landfill even though much of it would have been acceptable for open-water disposal. When compared with the 250-300 million c.y. of sediment that were discharged by the rivers flowing into Puget Sound over this same period, it can be concluded that only about 3 percent of the total annual sediment loading was due to dredged material disposal.

Key Regulatory Authorities. Section 404 of the Federal Water Pollution Control Act (FWPCA) Amendments of 1972 established a permit program, administered by the Secretary of the Army. This program is used to regulate the discharge of dredged material into waters of the United States. It also is used to specify disposal sites in accordance with Section 404(b)(1) Guidelines developed in interim final form by EPA in 1975. The Guidelines concentrated on specifying the tools to be used in evaluating and testing the impact of dredged or fill material discharges on waters of the United States. In 1977, the FWPCA was substantially amended as the Clean Water Act (CWA) which was further amended in 1988. In 1980, EPA, in conjunction with the Corps published final Guidelines for the specification of disposal sites for dredged or fill material. These specify that the disposal of dredged material must not result in an "unacceptable adverse impact" to aquatic ecosystems. Simultaneously, proposed rules for testing requirements were published. Although final rulemaking has not taken place, the testing requirements and procedures have been implemented by the Corps as a matter of policy.

Congress granted to the States the responsibility for certifying under Section 401 of the CWA that a proposed discharge, resulting from a project described in a Corps public notice issued under Section 404 of the CWA, will comply with the applicable provisions of the State and Federal water quality laws. This certification is required for any Federal activity, and from any applicant for a Federal permit to conduct any activity, which may result in any discharge into State waters. Compliance with Section 401 also ensures that any such discharge will comply with the applicable provisions of Sections 301, 302, 303, 306, and 307 of the CWA and relevant State laws.

Dredged Material Research. Considerable nationwide research has been accomplished since the early 1970's through the Corps' Dredged Material Research Program (DMRP) in assessing the environmental effects of dredged material disposal. This research has been used by the Corps in making decisions on dredged material disposal. DMRP has shown that most dredged material is acceptable for open-water disposal and can have many beneficial uses, including fish and wildlife habitat development. As part of the DMRP, studies were conducted in Elliott Bay and elsewhere in Puget Sound. Puget Sound examples of beneficial use of dredged material in Puget Sound include Jetty Island at Everett, clam habitat development at Oak Bay Canal, and a beach feed erosion control project at Keystone Harbor on Whidbey Island.

SITUATION LEADING TO PUGET SOUND DREDGED DISPOSAL ANALYSIS

Closure of Disposal Sites. In the Phase I area, the Elliott Bay Fourmile Rock and Port Gardner disposal sites were closed in 1984, due in part to public controversy associated with use of these particular locations. While the Fourmile Rock site was reopened in 1985, it closed again in June 1987 when the shoreline permit for the site expired. The Commencement Bay site closed in June 1988. New Phase I area disposal sites became available in December 1988 at Commencement Bay and Port Gardner, and in March 1989 at Elliott Bay. Use of these sites is subject to compliance with the dredged material management plan adopted by the PSDDA agencies in June 1988.

By May 1989, there were no disposal sites available in the Phase II area. The Admiralty Inlet, Bellingham Bay, Bellingham Channel, Padilla Bay, Skagit Bay, Port Angeles, and Steilacoom sites in use prior to that time had all been closed. This condition has created uncertainty with regard to future disposal of dredged material in the Phase II area and highlights the urgency of having an acceptable dredged material disposal management plan for this area.

Past Dredged Material Evaluation. Until 1984, Puget Sound dredged material sampling, testing, and test interpretation requirements were established on a project-by-project basis. EPA and the Corps, in cooperation with Ecology, assessed non-Corps dredging projects. The Corps conducted the evaluations for Federally authorized Corps navigation projects. (For the purposes of this report, Federally authorized navigation projects include Corps projects authorized under various River and Harbor Acts as well as all other Federally operated channels such as Navy, U.S. Coast Guard, NOAA, etc.) In the case of Corps navigation projects, Seattle District developed testing procedures for each project in cooperation with Ecology and EPA. These procedures, developed programmatically for Corps projects, were also required, as appropriate, for non-Corps permit applicants.

Case-by-case evaluations did not provide local authorities with sufficient assurance that aquatic resources at the disposal sites were being adequately protected. The Puget Sound area is unique relative to other regions of the Nation in that local governments also play a key role in dredged material disposal, through their shoreline master programs under the State shoreline permit process. Local jurisdictions can condition or restrict dredging and dredged material disposal.

The lack of fully consistent evaluation procedures, or specific objective decision criteria led, in part, to the establishment of interim disposal criteria by EPA and Ecology for the Fourmile Rock disposal site in Seattle's Elliott Bay in 1984 and the Port Gardner site near Everett in 1985. The Fourmile Rock criteria became a condition of the local shoreline permit issued by the city of Seattle and the Port Gardner criteria a condition of the city of Everett permit for the existing Port Gardner site. Subsequently, in 1985, Ecology developed the Puget Sound Interim Criteria (PSIC) to ensure that the other Puget Sound disposal sites did not experience similar problems. These criteria, which expire in 1989, have been used in the interim pending development of regional soundwide guidelines for dredged material disposal.

<u>Puget Sound Pollution and Contaminated Sediments</u>. The past practice of discharging untreated or only partially treated industrial and municipal effluent into Puget Sound, combined with potentially harmful chemicals from a variety of other point and nonpoint sources, has resulted in the degradation over time of the water and sediment quality in some areas of Puget Sound. Increasing scientific evidence about the harmful effects of pollution on the estuary has served to heighten public and agency concern about the long term environmental health of the estuary and the impact that various activities can have on the sound's ecosystem. Recent efforts to establish better regulatory control of pollutants at their source have resulted in general improvements in water quality. Additionally, ongoing planning and cleanup actions by the Puget Sound Water Quality Authority (PSWQA), Ecology, EPA, local governments, and others are expected to further improve the marine environment. Concerns remain, however, because the sediments near industrialized and developed areas may remain contaminated from past waste discharge practices. This is because potentially harmful and persistent chemicals tend to bind to the sediment particles and settle to the bottom. While considerable source control has occurred, more is needed.

Data indicate that pollutants which enter major harbor areas through various sources, have accumulated over time in a variety of shoreline areas, including navigation channels and vessel berthing locations. Dredging to maintain the sound's navigation system, must sometimes involve the removal and disposal of contaminated sediments.

The PSDDA study has recognized the requirement for dealing with contaminated sediments. However, the study focus has been primarily on disposal of the majority of dredged material which is expected to be found relatively "clean" and therefore acceptable for unconfined, open-water disposal at designated public multiuser sites. These are locations where any dredger can dispose of dredged material, provided that the material has been evaluated and disposal approved by the appropriate regulatory agencies. A separate study by the State of Washington is underway which addresses the specific requirements of dredged material found unacceptable for disposal at the PSDDA designated sites.

PUGET SOUND DREDGED DISPOSAL ANALYSIS (PSDDA)

Environmental and economic considerations support the need for long range regional planning as a lasting, effective solution for dredged material disposal problems. PSDDA was established because disposal alternatives no longer can be planned independently for multiple projects in a given area. A regional dredged material disposal management program offers a much greater opportunity for environmental protection, reasonable project costs, and greater public accepcance than case-by-case decisionmaking. A dredged material disposal management plan for unconfined, open-water disposal was completed in June 1988 for the Phase I area. A plan for the Phase II area has also been developed through the PSDDA study. These plans are unique to the Puget Sound area because the data supporting many elements of the plans are Puget Sound based. Also, the plans reflect the social values of this region and are responsive to the unique role from a national perspective, of local government, in the management of open-water dredged material disposal sites. The Phase I and II plans are meant to be viewed as part of a single overall plan for the entire Puget Sound area.

Study Goal and Objectives. The goal of PSDDA is to provide publicly acceptable guidelines governing environmentally safe unconfined, open-water disposal of dredged material, thereby improving consistency and predictability in the decisionmaking process. Public acceptability involves consideration of a wide range of factors. Among these are technically sound evaluation procedures and practicability, which includes cost effectiveness. Study objectives are to: (1) identify acceptable public multiuser unconfined, open-water disposal sites; (2) define consistent and objective evaluation procedures for dredged material to be placed at those sites; and (3) formulate site use management plans that will ensure adequate site use controls and program accountability.

Study Limitations. The PSDDA Federal and State agencies have identified disposal sites and site management plans only for unconfined, open-water disposal. Locations for conventional upland/nearshore sites or confined disposal sites (confined aquatic or upland/nearshore) have been specified. There are several reasons for this. First, disposal in Puget Sound waters principally involves Federal and State authorities while, disposal on land (especially for contaminated material) is closely associated with local government decisions regarding land uses. And second, the State of Washington, in a study initiated in 1988, is addressing confined disposal options and associated testing procedures, building on PSDDA studies.

An evaluation comparing the potential impact of dredged material disposal to the impacts of other water-related activities in Puget Sound is beyond the scope of this study. However, it is recognized that the limited quantities to be dredged and the conditions imposed by regulatory agencies make it very likely that dredged material disposal at unconfined, open-water sites will have little potential for affecting the ecosystem of Puget Sound. This conclusion is supported by information derived from PSDDA studies and presented in various program documents.

PSDDA PHASE II (NORTH AND SOUTH PUGET SOUND)

Study Findings. The following are key findings of the PSDDA study for the Phase II area:

- About 7.2 million cubic yards (c.y.) of bottom sediments could be dredged from Phase II area harbors and waterways over the period 1985-2000 as compared to the 7.9 million c.y. removed between the years 1970 to 1985.

- The Phase II management plan addresses the needs of unconfined, open-water disposal including (a) disposal site locations, (b) dredged material evaluation procedures, (c) disposal site management, (d) disposal site environmental response monitoring, and (e) dredged material data management.

- Specific project by project evaluations, to be made under the Section 404(b)(1) Guidelines and Section 401 Water Quality Certification review, will establish actual dredged material volumes that can be placed in unconfined, open-water disposal sites. However, through the year 2000, based on PSDDA projections and estimates, about 6.2 million c.y. of future Phase II dredged material is expected to be found acceptable for unconfined, open-water disposal. This compares with 3.2 million c.y. of dredged material actually placed in Phase II waters from 1970 through 1985. In the past, not all acceptable material was placed at public open-water disposal sites. Much was used for landfill or other beneficial purposes. This is anticipated in the future, too.

- The PSDDA Phase II disposal sites can accommodate the projected volumes of acceptable dredged material well beyond the year 2000 (the period of projection).

- More extensive dredged material sampling and testing will be required than in the past, as well as improved disposal site management, including increased permit compliance inspections and environmental monitoring of site impacts. Overall, the cost of dredged material disposal is anticipated to be higher than it was prior to the establishment of the EPA/Ecology PSIC, but less than that experienced under PSIC. More dredged material is expected to be found acceptable for unconfined, open-water disposal under PSDDA evaluation procedures as compared to the interim criteria. Other disposal options, including confined aquatic capped, nearshore, and upland disposal are generally much more expensive because of greater handling and transport requirements, and the increasing difficulty in securing acceptable site locations. From a regional standpoint, the reduced disposal costs are expected to more than compensate for increased costs of sampling, testing, and disposal site management.

• Overall, more extensive and rigorous testing and monitoring resulting from PSDDA is expected to be less costly than if the PSIC were used entirely throughout Puget Sound. However, the PSDDA testing and monitoring costs and costs associated with more material requiring confined disposal than was the case prior to PSIC, will be significantly higher. The aggregate of these increased costs may result in some projects either not being dredged in the future or dredged at a reduced level. This could have a disruptive or adverse impact on the affected interests. Similarly, depending on the specific port or commodity(ies) involved, there is a potential for commodity and route shifts which may in turn have localized economic and social impacts. Such impacts will be less than if "No Action" or PSIC were to be implemented. It is not possible to quantify either the impacted interests nor the magnitude of the economic or social impacts.

• Environmental consequences were considered as various elements of the management plan were addressed. This is reflected in the locations chosen for the selected disposal sites, as well as the disposal guidelines chosen for site management. Environmental impacts resulting from disposal at the preferred sites are not expected to be significant, as discussed in this PSDDA Phase II FEIS.

• The Phase II plan fully complies with the objectives of the Clean Water Act to restore and to maintain the environmental quality of the Nation's waters. Also, it is consonant with all applicable State and Federal laws and the adopted PSWQA 1987 Puget Sound Water Quality Management Plan.

• Indian treaty fishing rights and protection of those rights were addressed and documented as part of the PSDDA process.

<u>Management Plan</u>. Key elements of the PSDDA Management Plan for the Phase II area are:

• <u>Public Multiuser Unconfined, Open-Water Disposal Sites</u>. Five public multiuser unconfined, open-water disposal sites have been identified as preferred. Selection and approval of these sites will partially satisfy the future dredged material disposal needs of the Phase II area. The Phase II area is generally less urbanized and industrialized than the Phase I area, and generally has fewer significant waste discharges into marine waters. Accordingly, over 85 percent of future dredged material volumes is expected to be found suitable for unconfined, open-water disposal. This contrasts with about 60 percent in the Phase I area and 90 percent nationally. The estimate of acceptable material for the Phase II area is based on existing (primarily surface) sediment data which may reflect areas of higher contamination. Actual volumes found suitable for disposal may be more or less, and will depend on test results and subsequent evaluations by regulatory agencies.

Phase I sites are all in nondispersive locations; that is, materials disposed at the sites are generally expected to stay onsite. Nondispersive Phase II sites for unconfined, open-water disposal have been identified in south sound in the Nisqually reach between Anderson and Ketron Islands, and in north sound in Bellingham Bay. The Anderson-Ketron Island site is located in an area relatively free of important biological resources and human use activities. The Bellingham Bay site is near important fishery resources and human use activities. Dispersive, unconfined, open-water disposal sites have been identified in Rosario Strait, near Port Angeles, and near Port Townsend. A dispersive site is one in which materials will rapidly move offsite due to energetic currents. It was necessary in Phase II to select some dispersive sites as all nondispersive environments in the vicinity of the Rosario Strait, Port Angeles, and Port Townsend sites are generally inshore and in shallow water where resource values are relatively high. The selected and alternate sites considered for each area vary in size due to depths and tidal current regimes.

The Anderson Island/Ketron Island selected nondispersive site is approximately 3 nautical miles (nm) west-southwest of the town of Steilacoom, between Anderson and Ketron Islands. The Bellingham Bay selected nondispersive site is approximately 3.5 nm south-southwest of the city of Bellingham and 1.2 nm west of Post Point. The Rosario Strait selected dispersive site is approximately 2 nm south of Cypress Island and 1.8 nm west of Fidalgo Island. The Port Angeles selected dispersive site is approximately 3 nm north of Ediz Hook. The Port Townsend selected dispersive site is approximately 6 nm north of Discovery Bay or 6.5 nm northeast of Dungeness Spit.

All sites have been chosen to avoid natural and human resources to the maximum extent practicable. This document concludes that disposal at the selected sites will not cause significant adverse impacts.

- Evaluation Procedures. Comprehensive dredged material evaluation procedures governing sampling, testing, and test interpretation (disposal guidelines) were developed through PSDDA to ensure that conditions at the disposal sites are consistent with site management objectives. The evaluation procedures are intended to be used, as appropriate, in support of assessments of specific projects conducted under the Federal Section 404(b)(1) Guidelines and under the State of Washington guidelines used in evaluating projects for Section 401 Water Quality Certifications. Other provisions of the CWA confirm the authority of the Secretary of the Army to maintain navigation by stating that this authority is not affected or impaired by provisions of the Act (33 U.S.C.A. 1344(t) and 33 U.S.C.A. 1371(a)).

- Site Management Plans. Disposal site management plans have been formulated to address navigation and discharge conditions and subsequent disposal site environmental monitoring. The Phase II monitoring plan is intended to ensure that acceptable conditions at the sites are maintained and to provide a basis for any necessary adjustments to site management plans.

Alternatives. This FEIS describes, identifies, and evaluates selected and alternative disposal sites. Site management at the selected sites will include the application of PSDDA evaluation procedures to assess the acceptability of dredged material for unconfined, open-water disposal. Evaluation procedures are described in the accompanying FMPR and in the Phase I MPR and Evaluation Procedure Technical Appendix (EPTA). A no-action alternative, which would continue use by Ecology and EPA of the PSIC for determining suitability of dredged material for disposal at single-user sites is presented in the FEIS. This alternative would result in very limited unconfined, open-water disposal in southern and northern Puget Sound due to the application of the restrictive PSIC and discontinuation of public multiuser disposal sites in the Phase II area. The latter would likely occur because local governments have established shoreline permit conditions for multiuser sites that probably could not be met by most dredgers. These conditions require that environmental documentation, and site and material evaluations be accomplished as was done by PSDDA. Few dredgers have the necessary resources to accomplish this.

The no-action alternative could result in no dredging for some projects as other disposal options may be cost prohibitive. Social impacts could include lost employment and reduced property values. Some adverse environmental impacts may also occur during the construction of new facilities even if those areas with channel dependent marine facilities are relocated to waters accessible to navigation without dredging.

- Disposal Guidelines at Alternative Disposal Sites. The intent for Phase II was to preferentially locate nondispersive sites where all disposed dredged material would be confined onsite due to weak currents in naturally depositional areas or by a confining bottom bathymetry. Zones of siting feasibility (ZSF) were sought that would maintain a minimum buffer distance from shorelines and human use functions (for a fuller description of this process, see section 2 and Phase II DSSTA). However, it soon became evident that it was not possible to identify more than one such site in the south sound and one in the north sound. Thus, only two nondispersive areas were identified where material would generally be retained. Accordingly, in order to satisfy regional needs for reasonably accessible disposal sites, it was necessary to identify in the other three disposal areas dispersive sites where disposed materials would be expected to erode and be borne away rapidly by strong currents. The Phase II nondispersive sites were similar in current regime to the Phase I sites; therefore, the Phase I disposal guidelines have been adopted for the Bellingham Bay and Anderson Island/Ketron Island sites. The disposal guidelines assure that discharged material will not cause unacceptable adverse effects at the sites or in the adjacent environments. Monitoring will be used to verify these expectations. In dispersive sites it is difficult to monitor effects since the material will move away rapidly. A more restrictive disposal guideline has therefore been established for the Port Angeles, Port Townsend, and Rosario Strait sites.

- Alternative Nondispersive Disposal Sites. The alternative south sound disposal site is located between Anderson Island and Devils Head (southeastern tip of Kitsap Peninsula). The center of the disposal zone is in 238 feet of water in a relatively flat area. The alternative site has somewhat higher currents than the selected site and is considered marginal in nondispersive character. Weaker bottom tidal current (nondispersive) areas tend to be locations where sediments naturally settle out of the water. Therefor., dredged material placed at these depositional locations would tend to stay there. Grain size and other characteristics of disposal site sediments support the premise that the area is depositional. However, the Anderson Island/Ketron Island site was selected because the site is in a natural bowl-shaped depression and studies have shown the location to be depositional. Also the selected site has fewer commercially valuable benthic invertebrate resources. While neither the selected nor alternate sites has Dungeness crab, the Devils Head site has relatively more pandalid shrimp and a valuable herring fishery.

The alternative disposal site (A-2) in Bellingham Bay lies 2 nm southwest of DNR's existing disposal site in the inner bay in waters of 96 feet deep. A second (A-1) alternative site is located 3.5 nm southwest of Bellingham Harbor in waters 95 feet deep. Site A-1 was originally preferred, but it was found to be in conflict with bottomfish trawling. The Washington Department of Fisheries (WDF) recommended a site (selected location) between the two alternative sites as the best overall location that minimizes conflicts with commercial trawling vessles and avoids significant adverse effects to shrimp and crab resources. All sites (alternate and selected) are in areas that are clearly depositional (nondispersive). Also, site use restrictions (site closed November 1 to June 15) are proposed to further protect Dungeness crab resources and flatfish spawning activity. (Crab and shrimp resources were observed to be lowest in the "open period" between June 16 and October 31.) The selected site along with seasonal restriction represents an acceptable compromise between natural resource concerns and the needs of navigation dredging.

- Alternative Dispersive Disposal Sites. The Rosario Strait ZSF is located in the most energetic area studied. The selected site is near the center of the ZSF and the alternative site lies to the east and overlaps the site perimeter of the selected site. Natural resource studies on and around the ZSF indicated that, while neither site had Dungeness crab resources, the alternate site had some shrimp resources and the prefered site had none. Accordingly, the preferred site was selected because it has fewer fishery resources of concern.

The Port Angeles selected disposal site lies at a depth of approximately 435 feet. The alternative site at a depth of 445 feet. Because of relatively small differences in the estimated seasonal densities of scallops and pandalid shrimp resources, neither site has an advantage over the other from a resource impact standpoint. Accordingly, the selected site was chosen based on the fact that it is about 1.5 nm closer to Port Angeles than the alternative site. A site use restriction has been proposed by WDF and adopted by the PSDDA that will close the site from September 1 to November 30 to avoid impacting peak shrimp populations.

The selected Port Townsend site lies on the edge of the ZSF as site adjustments were made to reduce the potential conflict with oceangoing vessels using the U.S. Coast Guard designated navigation lanes.

The center of the disposal zones of the selected and alternate sites are at a depth of 360 feet. The selected site, while slightly less energetic, was chosen because pandalid shrimp and scallop resources are less abundant than at the alternative site. A site use restriction of September 1 to November 30 has also been adopted at the Port Townsend site to avoid impacts to peak shrimp populations.

Environmental Analysis. The disposal sites were selected after careful consideration of a number of factors, including biological resources, human uses, physical parameters and haul distances from dredging projects. The selected sites are in locations where significant adverse environmental impacts to the quality of the natural and human environment (per NEPA) are not anticipated and human use conflicts have been minimized to the maximum extent practicable. A full discussion of the environmental impacts associated with the alternatives is contained in this FEIS. An EIS has been prepared to "encourage and facilitate public involvement in decisions which affect the quality of the human environment" (40 CFR 1500.2).

The five sites selected for the Phase II area are intended to meet the disposal needs of the north and south sound dredging areas. The environmental consequences of the selected alternatives are summarized below.

Some localized reductions in air quality may occur in the vicinity of the unconfined, open-water disposal sites, primarily due to exhaust emissions from the internal combustion engines of the disposal equipment. Localized increases in noise levels may also occur during disposal operations. These adverse effects from noise and on air quality at the disposal sites will be short-term, intermittent, and relatively buffered from other human uses, and are not considered significant. Long-term or persistent adverse effects are not anticipated.

Only temporary reductions in water quality at and around the disposal sites are expected during disposal operations. These include minor depression of dissolved oxygen, short-term increases in turbidity, and insignificant release of organic matter and sediment-associated chemicals of concern. These effects will be primarily associated with the disposal plume. Though they may be measurable throughout the water column, the effects will be most noticeable in the bottom layer, near the sediment/water interface (the nepheloid layer). For dredged material that is acceptable for unconfined, open-water disposal, these adverse effects to water quality will be minor and temporary, with rapid dilution or dispersion subsequent to disposal. In general, turbidity associated with disposal operations is substantially less than that occurring during riverine, high-water discharge periods, or from vessel passage in navigation channels, when a vessel propeller approaches the bottom of a waterway. Significant or unacceptable effects are not anticipated.

Depending on the concentrations of chemicals in existing sediments the quality of sediments may either decrease, remain the same, or increase at the disposal sites. For the Anderson Island/Ketron Island site, an increase in sediment chemical concentrations is expected, given the relatively undisturbed existing nature of this area. However, at the Bellingham Bay site the sedimentary chemical concentrations are expected to remain the same, or perhaps improve.

The PSDDA disposal guidelines would allow chronic sublethal effects to occur at the Anderson-Ketron Island and the Bellingham Bay disposal sites due to the presence of chemicals in dredged material. However, most of the dredged material discharged at the sites is not expected to produce those effects. As with the Phase I nondispersive sites, monitoring will be performed to verify that unacceptable conditions are not developing at these sites. Disposal guidelines for the three dispersive sites are more restrictive because biological and chemical monitoring cannot be accomplished at these sites due to the strong currents which will rapidly disperse the deposited dredged material.

State water quality standards (WAC 173-201) will be met at all sites. At each nondispersive disposal site a dilution zone will be established. The dilution zone will include the disposal site and area between the disposal site boundary and the perimeter line established for monitoring the disposal site. Individual project water quality certifications which authorize the discharges will reference the calculated dilution zone, wherein no acute conditions to the aquatic biota will be allowed (WAC 173-201-035(4)(a)). In summary, adverse effects on water quality and biota from dredged material chemicals are not expected to be significant.

Portions of the disposal sites will be physically impacted by the discharging of dredged material. During this periodic physical disruption, the impacted areas will be temporarily removed from benthic production. These losses should not be significant, as the sites have been located and would be managed to minimize adverse effects on significant biological resources. At the dispersive sites, tidal energetics will prevent material from accumulating and local physical effects will be minimized by requiring the tug and barge to continue moving during the dump, further spreading the material.

Benthic, sessile (immobile) species present at the center of the nondispersive, unconfined, open-water sites will be buried during placement of dredged material. This will result in a loss of some organisms, especially in those areas of the disposal site where the burial depths are greater than that which the organisms can penetrate. Continued physical disruption of the site could impair any substantial recovery in these areas while the site is in use. However, some site recolonization by benthic species will be likely between disposal operations. Some recolonizers may experience minor increases in body burden levels of chemicals within the site. These levels will not result in significant acute toxicity to these species, nor will the levels exceed values considered to be harmful to human health. Though reduced annual benthic production in the sites is considered to be long-term, sites have been located and will be managed to prevent significant adverse effects to the aquatic ecosystem as a whole. By contrast, relatively little burial is expected to occur at the dispersive sites due to their size, the energetic current transport mechanisms, the "spread out" means of disposal, and (except for Rosario Strait), the relatively small amount of material that is destined for disposal. A larger volume of dredged material will be placed at Rosario Strait. However, this site has the most energetic environment and material will move away quickly.

The bottom-feeding fish and mobile shellfish (crabs and shrimp) utilizing the nondispersive, unconfined, open-water disposal sites are expected to be physically damaged by falling material, or temporarily displaced from where disposal has most recently occurred. Displaced epifauna could experience some reduced fitness and suffer some moralities since the ecosystems in the vicinity of the sites are considered to be at carrying capacity. In addition, less mobile individuals within the sites (or perhaps partially dug into the surface of the site) could be buried and lost. As the nondispersive sites have been located in areas which are generally or seasonally relatively free of commercially and ecologically important species and as timing restrictions have been applied to avoid higher seasonal populations or breeding populations, this displacement and resulting effects should not be significant. At several of the dispersive sites, epifaunal species (principally shrimp and scallops) could be physically affected by falling or current-borne material and by suspended particles associated respiratory problems. These impacts would be transitory and not significant due to the low chemical levels of the dredged material, the small volumes that are projected for the sites, and the seasonal site use restrictions that would avoid peak populations.

Disposal activities, with barge and tug passage and associated noise, will displace birds found at the disposal sites during the very short time of individual disposal operations. Though much less common, any marine mammals found in the area will also be temporarily displaced. Given the existing level of navigation traffic found at and near the sites, this temporary displacement is not expected to result in significant effects to these species.

Compared to the no-action alternative, tug and barge traffic to and from the disposal sites will have a slightly greater potential for conflicts with recreational and commercial fishing traffic at all sites. All five preferred sites are located within usual and accustomed fishing grounds (as of 1974) of Puget Sound Indian tribes. The potential conflicts with Indian fishing activities have been addressed in this FEIS, and, as appropriate project-specific actions will be taken to avoid any conflicts with tribal fishing operations no significant impacts to these operations are expected.

Table 1a presents an assessment of dredging volumes that would be suitable for unconfined, open-water disposal under the no-action alternative. Under the action alternative, the estimated maximum volumes of dredged material that might be discharged at the preferred disposal sites are shown in table 1b. The volumes shown in table 1b include dredged material that would be considered for unconfined, open-water disposal at the Phase II sites. In reality it is highly unlikely that all material that would be acceptable for discharge at the sites would be placed there. As in the past, some of the material could be used for upland fill or construction. Estimated maximum volumes that would be suitable for discharge at the Phase II unconfined, open-water disposal sites represents about 83 percent of the volume that could likely be considered for disposal at these sites over the next 15 years in central Puget Sound. Table 1c presents a forecast of volumes that are probable at the Phase II sites. These volumes were used in the impact assessments.

TABLE 1a

EFFECTS OF THE NO-ACTION ALTERNATIVE ON FUTURE DREDGING VOLUMES (1985-2000)

NO-ACTION ALTERNATIVE 1/

Disposal Site	Projected Total Dredge Volume 4/5/	Volume Expected to Pass PSIC 2/	Volume for Confined Disposal or Beneficial Use 3/
Anderson Island/ Ketron Island	1,337,000	0	1,337,000
Bellingham Bay	1,607,000 5/	0	1,607,000
Rosario Strait	1,801,000	1,801,000	0
Port Angeles	285,000	0	285,000
Port Townsend	687,000	265,000	422,000
TOTAL	5,717,000 5/	2,066,000	3,651,000

1/For the no-action alternative, public multiuser sites for unconfined, open-water disposal of dredged material would not be designated. Disposal of material acceptable for unconfined, open-water disposal under this alternative could occur within the Phase II area wherever allowable by local governments and State and Federal regulatory agencies. This could include beneficial use projects and/or at other areas selected on a project-by-project basis.

2/PSIC: Puget Sound Interim Criteria. Estimated volume of future dredged material that could be discharged at the selected sites (once permitted).

3/Confined disposal can include upland, nearshore, and/or confined aquatic disposal methods.

4/Only those projects where unconfined open-water disposal is likely to be proposed.

5/Does not include initial dredging for Lummi Bay Marina project where material is proposed for marina construction or related upland development.

TABLE 1b

EFFECTS OF ACTION ALTERNATIVES ON
FUTURE DREDGING VOLUMES (1985-2000)

ACTION ALTERNATIVES

Disposal Site	Projected Total Dredge Volume	Volume Expected to Pass PSDDA Guidelines	Volume for Confined Disposal or Beneficial Use
Anderson Island/ Ketron Island	1,337,000	785,000	552,000
Bellingham Bay	1,607,000	1,181,500	425,500
Rosario Strait	1,801,000	1,801,000	0
Port Angeles	285,000	285,000	0
Port Townsend	687,000	687,000	0
TOTAL	5,717,000	4,739,500	977,500

TABLE 1c

PROJECTED FUTURE DISPOSAL VOLUMES (1985-2000)

Disposal Site	Unconfined Open-Water Disposal	Confined Disposal or Beneficial Use
Anderson Island/ Ketron Island	217,500	1,119,500
Bellingham Bay	550,500	1,056,500
Rosario Strait	1,315,000	486,000
Port Angeles	143,000	142,000
Port Townsend	159,000	528,000
TOTAL	2,385,000	3,332,000

• Mitigation Measures and Their Effectiveness. The selected sites have been located to avoid significant adverse effects (per NEPA) while meeting the in-water disposal needs of Puget Sound dredging. Site location and site management provisions (e.g., timing restrictions) are expected to mitigate any potential biological resource and human use conflict problems. Only acceptable dredged material will be discharged into the Phase II area disposal sites. Chemical, biological, and physical monitoring of the nondispersive disposal sites will allow verification of predicted site conditions and provide a basis for site management changes if the monitoring demonstrates changes are needed. Only periodic physical monitoring has been identified as necessary at the dispersive sites due to the more restrictive disposal guideline established for dredged material discharged at these sites.

The primary mitigation feature of PSDDA is embodied in the siting process. Site locations were sought that were physically removed from shorelines, important resources, and other amenities to preserve and maintain these resources by avoiding adverse effects due to dredged material disposal. For some sites seasonal restrictions were also used to reduce resource impacts. Where complete avoidance of all resources was not possible (e.g., benthic invertebrates), the sites were located to minimize possible adverse effects. A minimum number of sites were identified to minimize the possible extent of bottom impacts throughout the north and south Puget Sound. (There will be three fewer disposal sites with PSDDA than historically existed in the Phase II area.) Where possible, sites were located in relatively nondispersive areas to minimize the risk of effects extending beyond the disposal sites (including the dilution zone) via sediment transport. When this was not possible, highly dispersive sites (with a more restrictive disposal guideline) were chosen.

The disposal guidelines for the nondispersive and the dispersive disposal sites preclude discharge of dredged material that could produce unacceptable adverse effects. Chemical impacts on biological resources at the nondispersive disposal sites should be limited to chronic/sublethal effects. Acute toxicity is expected to only a few onsite very sensitive species. At the dispersive sites, no chemically caused biological effects should occur due to the more restrictive disposal guidelines. The disposal guidelines for both dispersive and nondispersive sites fully comply with applicable provisions of the State Water Quality Standards.

Another important mitigation feature of the plan is the chemical, biological, and physical monitoring to be performed at each nondispersive disposal site and the physical monitoring at the dispersive sites. Environmental monitoring is intended to provide verification of that site management conditions have not been exceeded.

Implementation. The Corps, EPA and the State of Washington will share responsibility for implementation of the PSDDA management plan for the Phase II area. DNR and Ecology, as well as Pierce, Clallam, Skagit, and Whatcom Counties will perform the non-Federal functions. DNR will obtain shoreline management permits from the counties for the selected sites.

Responsibility for site management will be shared by DNR and the Corps, with DNR generally performing chemical and biological environmental monitoring. In addition to being responsible for physical monitoring of the disposal sites, the Corps will include the Phase II area in the dredged material data management system developed under Phase I for Puget Sound.

Responsibilities of each of the PSDDA regulatory agencies under Section 404 or Section 401 of the CWA will be accomplished in accordance with each agency's authorities and policies. The PSDDA dredged material evaluation procedures will be applied by each regulatory agency consistent with these authorities and policies. These procedures provide the basis for an overall approach which can meet the case-by-case requirements of both Section 404 and Section 401. Most elements of the PSDDA procedures are common to both authorities. However, as described in the Phase I Management Plan Report (June 1988), some elements are unique to either Section 404 or Section 401 requirements. Those seeking approval for unconfined, open-water disposal will need to meet both requirements, i.e., undertake the full suite of PSDDA tests, as each agency determines is applicable.

The Corps requirements for the evaluation of dredged material proposed for unconfined disposal in Puget Sound waters, as specified in Subpart G of the Section 404(b)(1) Guidelines, will be met primarily by the Section 404 components of the PSDDA evaluation procedures. The Section 404 component of the PSDDA procedures is being applied in a manner consistent with the national Corps process. The Corps will address other aspects of the Section 404(b)(1) compliance, such as impacts on navigation and national commerce and avoidance and minimization of impacts, including mitigation of unavoidable impacts and alternatives analysis, on a case-by-case basis. Required national Corps procedures for implementation are reflected in 33 CFR Parts 209, 335, 336, 337 and 338 dated April 20, 1988 for Corps projects, and 33 CFR 320-330 for the Corps regulatory program.

EPA will rely on the PSDDA evaluation procedures as the basis for preventing significant degradation of the aquatic environment, as required by Section 404(b)(1) Guidelines. These procedures represent the testing approaches and procedures, allowed under the Guidelines, which EPA would require during the evaluation of dredged material. Other aspects of the Section 404(b)(1) compliance, such as avoidance and minimization of impacts, including mitigation of unavoidable impacts, will also be addressed by EPA, during comprehensive reviews, on a case-by-case basis.

Ecology will apply the appropriate PSDDA evaluation procedures in assessing applications for Section 401 Water Quality Certification.

Implementation of the PSDDA Phase I Management Plan began in December 1988, when the Federal Record of Decision (ROD) was signed. Implementation of the Phase II plan is expected to begin by the winter of 1989, after Phase II ROD is signed and shoreline permits for the Phase II sites have been approved by the counties and Ecology.

Advance identification of the PSDDA disposal sites has been accomplished by EPA and the Corps under subpart I of the Section 404(b)(1) Guidelines (40 CFR 230.80). Under this action a determination will be made as to whether the selected Phase II disposal sites are suitable for future disposal of dredged material (exhibit B). This FEIS contains the advance identification of disposal sites.

Details of PSDDA Phase II implementation are provided in the Management Plan Report (MPR).

Review and Revisions. The PSDDA agencies recognize that the state-of-the-art of dredged material testing and test interpretation is rapidly changing. Accordingly, provision is made in the management plan for annual assessments of the data obtained through the regulatory actions on specific dredging projects, as well as the information gained from environmental monitoring of the disposal sites after they have been in use. These assessments will be conducted by the PSDDA agencies with opportunities provided for participation by other interested agencies, organizations, and private citizens. The assessments will provide the basis for appropriate revisions to the PSDDA management plan. Dredged material evaluation procedures, site environmental monitoring, and cost aspects of the plan will be reexamined. One result could be a reduction in the level of testing and monitoring, if that is possible without compromising the environmental mandate of the CWA and applicable State authorities. However, in Phase II, only disposal site location is viewed by the PSDDA agencies as the key alternative for purposes of NEPA/SEPA compliance. Any site location change has the potential for significant effects on the environment and may require preparation of a supplemental EIS to this document, should future changes be proposed. The other elements of the Phase II Management Plan, e.g., dredged material evaluation procedures, environmental monitoring, etc., are solely intended to be the means by which compliance with applicable Federal and State law is maintained. Accordingly, any changes to these other elements are not anticipated to require preparation of a supplemental EIS.

Areas of Controversy and Unresolved Issues. Public controversy concerning disposal site locations and lack of consistent site management among regional regulatory agencies was instrumental in initiating PSDDA. The PSDDA study resolved siting concerns by conducting an intensive disposal site selection process with disposal activities relocated to more suitable areas. The study addressed site management concerns by developing site-specific management plans.

The only unresolved issue that is known at this time is acceptability of the Bellingham Bay disposal site to the Lummi Tribe. Coordination is ongoing with the Lummi Tribe to resolve tribal concerns.

Relationship to Environmental Protection Statutes and Other Environmental Requirements. The selected disposal sites and disposal guidelines fully comply with pertinent Federal, State, and local environmental statutes and requirements, or will be in full compliance on completion of this NEPA/SEPA

EIS, signing of the Record of Decision and finalization of the shoreline permits. Table 2 summarizes and documents compliance.

Study Documents. The Phase II PSDDA study documents include a report containing the Phase II management plan, a site selection technical appendix which provides detailed information in support of the plan, and this FEIS. The reader is referred to the Phase I documents (June 1988) for further details on specific aspects of nondispersive site disposal guidelines and related matters.

- Phase II Management Plan Report - Unconfined, Open-Water Disposal of Dredged Material, Phase II Area (North and South Puget Sound). This document describes the study authorities, background, objectives, and planning process which resulted in the Phase II PSDDA Management Plan. The plan is presented with expanded coverage given to major program elements, including a discussion of implementation of the management plan.

- Phase II Disposal Site Selection Technical Appendix - Phase II (North and South Puget Sound). A detailed description is given of the disposal site selection process for future dredged material disposal, along with information on alternative sites considered.

TABLE 2

RELATIONSHIP OF SELECTED ALTERNATIVES TO ENVIRONMENTAL PROTECTION STATUTES
AND OTHER ENVIRONMENTAL REQUIREMENTS,
SELECTED UNCONFINED, OPEN-WATER DISPOSAL SITES FOR
DREDGED MATERIAL, PHASE II (SOUTH AND NORTH PUGET SOUND),
PUGET SOUND DREDGED DISPOSAL ANALYSIS

NOTES: The compliance categories used in this table were assigned based on the following definitions:
a. Full Compliance - All the requirements of the statute, executive order, and related regulations have been met.
b. Partial Compliance - Some requirements of the statute, executive order, or other policy and related regulations remain to be met (see footnotes).
c. Noncompliance - None of the requirements of the statute, executive order, or other policy and related regulations have been met.
d. Not Applicable (N/A) - Statute, executive order, or other policy not applicable.
e. Most of the statutes and policies are fully applicable to, and must be addressed separately for, future individual dredging projects.

ENVIRONMENTAL STATUTES	No Action	Anderson Island/ Ketron Island Selected Site	Bellingham Bay Selected Site	Rosario Strait Selected Site	Port Angeles Selected Site	Port Townsend Selected Site
Federal Statutes						
American Indian Religious Freedom Act of 1978, 42 U.S.C. 1996.	Full	Full	Full	Full	Full	Full
Archeological and Historic Preservation Act of 1974, 16 U.S.C. 469 et seq., Public Law 93-291.	Full	Full	Full	Full	Full	Full
Clean Air Act, as amended, 42 U.S.C. 7401 et seq.	Full	Full	Full	Full	Full	Full
Coastal Zone Management Act of 1972, as amended, 16 U.S.C. 1451 et seq.	Partial 1/	Partial 1/	Partial 1/	Partial 1/	Partial 1/	Partial 1/

1/Full compliance with receipt of disposal site shoreline permit by DNR

TABLE 2 (con.)

ENVIRONMENTAL STATUTES	No Action	Anderson Island/ Ketron Island Selected Site	Bellingham Bay Selected Site	Rosario Strait Selected Site	Port Angeles Selected Site	Port Townsend Selected Site
Federal Statutes (con.)						
Deepwater Port Act of 1974, as amended, 33 U.S.C. 1501 et seq.	Full	Full	Full	Full	Full	Full
Endangered Species Act of 1973, as amended, 16 U.S.C. 1531 et seq., Public Law 97-304.	Full	Full	Full	Full	Full	Full
Estuary Protection Act, 16 U.S.C. 1221 et seq.	Full	Full	Full	Full	Full	Full
Federal Water Pollution Control Act, as amended by the Clean Water Act of 1977, 33 U.S.C 1251 et seq.	Partial 1/	Partial 1/	Partial 1/	Partial 1/	Partial 1/	Partial 1/
Federal Water Project Recreation Act, as amended, 16 U.S.C. 4601-12 et seq.	Full	Full	Full	Full	Full	Full
Fish and Wildlife Coordination Act of 1956, as amended, 16 U.S.C. 661 et seq.	Full	Full	Full	Full	Full	Full
Land and Water Conservation Fund Act of 1965, as amended, 16 U.S.C. 460d, 4601-4604 et seq.	Full	Full	Full	Full	Full	Full
Marine Mammal Protection Act of 1972, as amended, 16 U.S.C. 1361 et seq.	Full	Full	Full	Full	Full	Full

1/Permits required for individual future projects.

TABLE 2 (con.)

ENVIRONMENTAL STATUTES	No Action	Anderson Island/ Ketron Island Selected Site	Bellingham Bay Selected Site	Rosario Strait Selected Site	Port Angeles Selected Site	Port Townsend Selected Site
Federal Statutes (con.)						
Marine Protection, Research, and Sanctuaries Act of 1972, as amended, 33 U.S.C. 1401 et seq.	N/A	N/A	N/A	N/A	N/A	N/A
National Environmental Policy Act of 1969, as amended, 42 U.S.C. 4321 et seq.	Partial 1/	Partial 2/	Partial 1/	Partial 1/	Partial 1/	Partial 1/
National Historic Preservation Act of 1966, Public Law 89-665, 16 U.S.C. 470 et seq., as amended by Public Law 96-515, December 12, 1980.	Full	Full	Full	Full	Full	Full
Rivers and Harbors Appropriations Act of 1899, 33 U.S.C. 401 et seq.	Full	Full	Full	Full	Full	Full
Watershed Protection and Flood Prevention Act, as amended 16 U.S.C., 1001, et seq.	N/A	N/A	N/A	N/A	N/A	N/A
Wild and Scenic Rivers Act of 1968, as amended, 16 U.S.C. 1271 et seq.	N/A	N/A	N/A	N/A	N/A	N/A

1/With the no-action alternative, it would likely be necessary to write SEPA or NEPA/SEPA environmental assessments or environmental impact statements for individual future dredging disposal in the Phase II area.

2/Full compliance with completion of the Federal Record of Decision

TABLE 2 (con.)

ENVIRONMENTAL STATUTES	No Action	Anderson Island/ Ketron Island Selected Site	Bellingham Bay Selected Site	Rosario Strait Selected Site	Port Angeles Selected Site	Port Townsend Selected Site
Executive Orders and Regulations						
Economic and Environmental Principles and Guidelines for Water and Related Land Resource Implementations Studies, 48 CFR 10249-10258, 10 March 1983.	N/A	N/A	N/A	N/A	N/A	N/A
Environmental Effects Abroad of Major Federal Actions EO 12114.	N/A	N/A	N/A	N/A	N/A	N/A
Floodplain Management, EO 11988, 24 May 1977.	Full	Full	Full	Full	Full	Full
Navigable Waters, Discharge of Dredged or Fill Material, 40 CFR 230. Environmental Protection Agency.	Full	Full	Full	Full	Full	Full
Protection of Wetlands, EO 11990.	Full	Full	Full	Full	Full	Full
Regulatory Programs of the Corps of Engineers. 33 CFR 320-330, 22 July 1982.	N/A 1/	N/A 1/	N/A 1/	N/A 1/	N/A 1/	N/A 1/
Regulations for Implementing the Procedural Provisions of the National Environmental Policy Act of 1969, 40 CFR 1500-1508, 29 November 1978. Council on Environmental Quality.	Full	Full	Full	Full	Full	Full

1/Permits required for future, individual dredging projects.

TABLE 2 (con.)

ENVIRONMENTAL STATUTES	No Action	Anderson Island/ Ketron Island Selected Site	Bellingham Bay Selected Site	Rosario Strait Selected Site	Port Angeles Selected Site	Port Townsend Selected Site
State and Local Policies						
Multiple Use Concept in Management and Administration of State Owned Lands (RCW 79.68.060).	Full	Full	Full	Full	Full	Full
State Environmental Policy Act of 1971 (RCW 43.21).	Full	Full	Full	Full	Full	Full
Water Resources Act of 1971 (RCW 90.54).	Full	Full	Full	Full	Full	Full
Shoreline Management Act of 1971 (RCW 90.58) and related Shoreline Master Programs.	Full	Partial 1/	Partial 1/	Partial 1/	Partial 1/	Partial 1/
Water Pollution Control Act (RCW 90.48).	Full	Full	Full	Full	Full	Full
Puget Sound Water Quality Authority Comprehensive Plan	Full	Full	Full	Full	Full	Full
- Washington Department of Natural Resources Disposal Site Management Policy (WAC 332-30-166)	Full 2/	Partial 1/	Partial 1/	Partial 1/	Partial 1/	Partial 1/
- Washington Department of Ecology Water Quality Certification	N/A 1/	N/A 1/	N/A 1/	N/A 1/	N/A 1/	N/A 1/

1/Full compliance with receipt of disposal site shoreline permits by DNR.

TABLE 2 (con.)

ENVIRONMENTAL STATUTES	No Action	Anderson Island/ Ketron Island Selected Site	Bellingham Bay Selected Site	Rosario Strait Selected Site	Port Angeles Selected Site	Port Townsend Selected Site
Land Use Plans						
Whatcom County Master Program	Partial 1/	Partial 1/	Partial 1/	Partial 1/	Partial 1/	Partial 1/
City of Port Angeles Shoreline Master Program	Partial 1/	Partial 1/	Partial 1/	Partial 1/	Partial 1/	Partial 1/
Pierce County Shoreline Master Program	Partial 1/	Partial 1/	Partial 1/	Partial 1/	Partial 1/	Partial 1/
City of Port Townsend Shoreline Master Program	Partial 1/	Partial 1/	Partial 1/	Partial 1/	Partial 1/	Partial 1/
Clallam County Shoreline Master Program	Partial 1/	Partial 1/	Partial 1/	Partial 1/	Partial 1/	Partial 1/
Skagit County Shoreline Master Program	Partial 1/	Partial 1/	Partial 1/	Partial 1/	Partial 1/	Partial 1/

1/Full compliance with issuance of disposal site shoreline permits to DNR.

UNCONFINED, OPEN-WATER DISPOSAL SITES FOR DREDGED MATERIAL
PHASE II AREA, NORTH AND SOUTH PUGET SOUND
PUGET SOUND DREDGED DISPOSAL ANALYSIS
PHASE II AREA
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SECTION 1. PURPOSE AND NEED FOR ACTION

1.01 General. This final environmental impact statement (FEIS) presents the alternatives considered in identifying the public multiuser unconfined, open-water sites selected for the disposal of dredged material in the Phase II area (see figure 1-1) of the Puget Sound Dredged Disposal Analysis (PSDDA) study. This study was conducted by the U.S. Army Corps of Engineers, Seattle District (Corps); the Environmental Protection Agency, Region X (EPA); and Washington Departments of Natural Resources (DNR) and Ecology (Ecology). The Phase II study overlapped the study of the Phase I area. Information and analyses contained in the Phase I reports are included here by reference, in accordance with 40 CFR, Part 1502.21, the Council on Environmental Quality's Regulations Implementing the Procedural Provisions of the National Environmental Policy Act. Referenced reports are available at agency and public libraries including the Corps of Engineer's Seattle District office. The Phase I and II plans are meant to be viewed as parts of a single overall plan for the entire Puget Sound area.

The recognized need for dredging and dredged material disposal in Puget Sound and the following conditions led to the PSDDA study:

- Two of the three existing central Puget Sound disposal sites were closed when the Phase I study began due in part to public concerns over site management.

- There were agency and public concerns with regard to proper disposal site locations.

- The lack of fully consistent evaluation procedures, or specific objective decision criteria led, in 1985, to the establishment of Puget Sound Interim Criteria (PSIC) first for central Puget Sound and then at the other Puget Sound disposal sites. The PSIC have been used pending development of regional soundwide guidelines for dredged material disposal. (PSIC has expired, and all multiuser north and south Puget Sound unconfined disposal sites excluding the central sound PSDDA sites discussed below were closed by April 1989.)

- There were no disposal site management plans nor overall disposal site management policy nor adequate monitoring by either Federal or State agencies.

- PSDDA Phase I, whose initiation and implementation is described in the Phase I documents (June 1988), addressed these concerns for the urbanized central sound bays. North and south Puget Sound areas were addressed by the Phase II studies.

In August 1984, the Regional Administrator for EPA asked the Corps to lead a soundwide study on dredged material disposal that would produce a programmatic EIS. The request was supported by the Washington State Governor, members of the State Congressional Delegation, the Director of Ecology, the Commissioner of Public Lands for DNR, and many others, including the Puget Sound Water

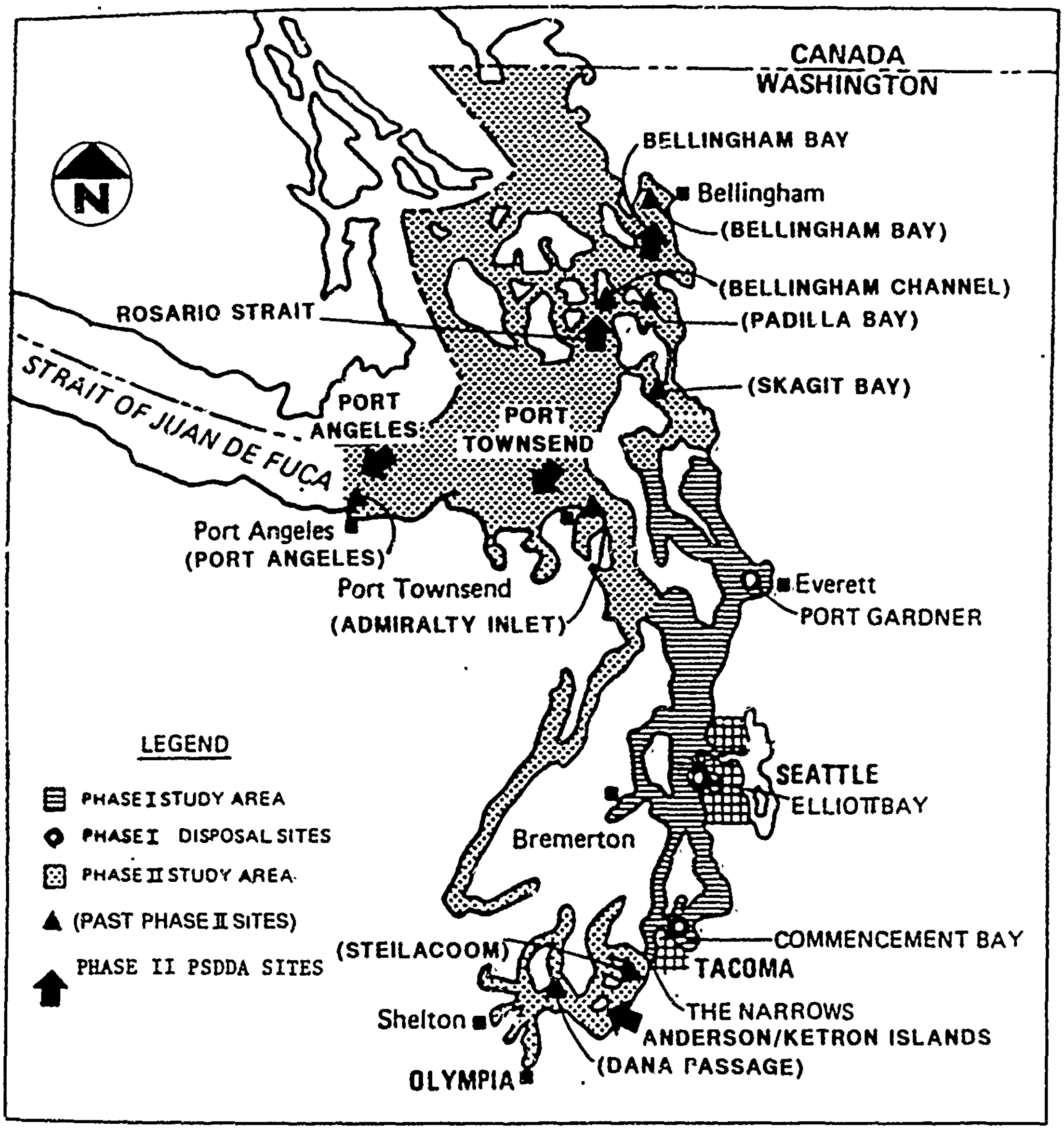


Figure 1.1 Puget Sound Dredged Disposal Analysis. Location of past and PSDDA Phase II selected disposal sites.

Quality Authority (PSWQA), by letters and personal contacts. In December 1985, the Corps, EPA, Ecology, and DNR began a period of intensive technical discussions to develop a joint study plan. The culmination of these efforts was the PSDDA Plan of Study, agreed to by the agencies in March 1985, which established the basis for the cooperative effort. The PSDDA study was initiated in April 1985.

The FEIS for Phase I, completed in June 1988, detailed the alternatives for, and environmental consequences of, disposal of acceptable dredged material at PSDDA-identified, unconfined, open-water sites in central Puget Sound pursuant to the National and State Environmental Policy Acts (NEPA and SEPA, respectively). The Phase I area of PSDDA encompassed the central basin of Puget Sound, which included the major urban embayments of Seattle, Tacoma, and Everett. The balance of the Puget Sound region is the subject of this FEIS.

While the PSDDA study includes designation of disposal sites and an environmental evaluation of their use, it does not address the dredging and disposal aspects of specific projects nor disposal options for a given project. At the time of public and agency review of permit applications for each project, documents must be prepared by the applicant that present the alternatives considered for that project and include an evaluation of anticipated environmental effects of dredging and disposal.

The reader is referred to the Phase I Management Plan Report (June 1988) for a discussion of the dredged material evaluation procedures that are common to disposal at both Phase I and Phase II nondispersive unconfined, open-water sites. Some of these procedures have been modified through the Phase II study, as described in the Phase II Management Plan Report (MPR). Additional information specific to Phase II is identified and evaluated throughout this FEIS and Phase II MPR.

The selected multiuser disposal sites for unconfined, open-water disposal in the Phase II area are shown in figure 2.1. Both environmental and economic considerations were taken into account in selecting these sites. Conflicts with important marine resources and human uses such as ship traffic in Puget Sound waters have been avoided to the maximum extent practicable.

In contrast to the Phase I disposal sites, which are all located in areas of low bottom currents (nondispersive sites), the Phase II sites include both high bottom current (dispersive) and nondispersive environments. Nondispersive sites are preferable because the dredged material is expected to generally stay within the site boundaries, which allows follow-up environmental monitoring. Monitoring provides a check on predicted conditions at and near the sites and enables regulatory agencies to make appropriate changes in site management, if warranted. A nondispersive site was located in the south sound between Anderson and Ketron Islands. However, the only north Sound nondispersive site that was found that had low currents and was also relatively free of significant fish and shellfish resources and human use conflicts was Bellingham Bay. Therefore, in order to meet the need for disposal sites located at reasonable haul distances from dredging areas, the PSDDA study team, with input from resource agencies and public interest groups, selected dispersive sites in the Strait of Juan de Fuca near Port Angeles and Port Townsend, and in Rosario Strait near Anacortes. At these locations, discharged dredged material will be rapidly dispersed by strong currents both while the material is falling through the water column and after it reaches the bottom.

Because monitoring of chemical and biological conditions is not practicable at dispersive sites, a more restrictive disposal guideline has been adopted for the dispersive sites than that selected in the Phase I documents for Puget Sound nondispersive sites.

Preliminary characterization (Corps, 1988) of the dredged material expected to be considered for discharge at Phase II disposal sites suggests that the material is generally quite clean and most of the material would not present significant environmental problems whether discharged at either the dispersive or nondispersive sites.

1.02 Issues and Concerns.

a. Dredging and Disposal in Puget Sound. Throughout the 2,500 square miles of water area in Puget Sound, there are 34 port districts serving the region, 54 miles of Federal navigation channels, 52 miles of port terminal ship berths along these channels, and more than 200 small boat harbors that must be periodically dredged to maintain the commercial and recreational services provided by these facilities. The Federal navigation channels occupy about 1.5 square miles (0.06 percent of sound's water surface), though only about 0.02 square miles (0.0008 percent of the sound) are dredged annually.

Dredging and disposal of dredged material has been a common and longstanding practice in Puget Sound waters, typically associated with the development of waterborne commerce and recreational boating. In addition to new port and harbor construction, maintenance dredging to ensure safe water depths in existing shipping channels and dock areas produces large volumes of dredged material. Historically, much of this material was deposited along the shoreline to produce new land. However, a significant portion is increasingly being placed in the sound due to the limited availability and high costs of acceptable land or nearshore disposal sites.

The anticipated dredging volume in the Phase II area for the next 15 years is 7.2 million cubic yards, in comparison with the 7.9 cubic yards dredged during the past 15 years, a slight decrease in dredging activity. Not all material that is dredged will be allowed to go to the five selected Phase II disposal sites, although the sites could easily accommodate these forecasted volumes. While most material is expected to be clean enough by PSDDA guidelines for disposal at these sites, some material may actually be used for other purposes such as port terminal and industrial land developments. Material not clean enough for disposal at PSDDA sites will require placement at confined sites.

In the Phase I area, there has been a clear trend toward increased open-water disposal of dredged materials. In the Phase II area, open-water disposal is also expected to be the preferred option for most dredgers. Disposal at confined in-water or upland sites is estimated to cost from 3 to 10 times more per cubic yard than present open-water disposal. These cost differences greatly affect the feasibility of many dredging projects. Also, confined disposal can have significant environmental impacts including loss of wetlands or tidal and subtidal areas.

b. Problem Sediments, Resource Values, and Public Concerns. The location of several of the existing Phase II disposal sites has been questioned by local governments, citizens, and resource agencies.

Measurable levels of some chemicals of concern are found in all Puget Sound sediments; however, relatively high concentrations of potentially harmful chemicals have been noted in urban and industrialized waterways where tumors and other biological abnormalities are found with a greater than normal frequency in certain fish and shellfish. Such chemicals, which enter the sound from a variety of point and nonpoint sources, bind to particles and settle to the bottom. This has caused the public and the agencies to be concerned about potential impacts associated with the disposal of sediments dredged from these waterways. Since 1985 several Federal and State agency programs have sought to further reduce chemical discharges into the sound. Over the longer term, these programs are expected to result in improved waterway sediments.

While many of the effects of dredged material disposal have been studied and are well understood (Saucier, et al., 1980), information addressing the long-term consequences (chronic effects) of contaminated sediments has been less intensive. As a result, public pressure was exerted in the mid-1980's to severely restrict or prohibit dredged material disposal in Puget Sound, even leading to closures of key open-water disposal sites near the major dredging areas of Seattle and Everett. Such closures delayed maintenance dredging of shipping harbors and channels and increased the cost of harbor improvement projects. Consequently, disposal of dredged sediments removed from waterways for channel maintenance or for new port construction became a major management problem.

PSDDA Phase I addressed this problem for central Puget Sound by identifying new disposal sites based on detailed site identification studies, and by specifying disposal guidelines that would prevent unacceptable biological effects from occurring at the new sites.

Although the PSDDA Phase II areas are contiguous with the Phase I areas, the sediments that would potentially be considered for disposal at Phase II sites are generally much cleaner, due to fewer urban and industrial pollution sources. At the same time, resource values are generally higher than in the Phase I area. Accordingly, Phase II studies focused on documenting these values, identifying sites with sparse resources and establishing site use conditions as means to avoid or minimize adverse impacts to resources. Phase II studies included fish and shellfish assessments, bottomfish food assessments, assessments of current and historic human use, and considerations of endangered species.

c. Regulatory Consistency and Predictability. Not all dredging projects have the same potential for adverse impacts. Large volumes of dredged sediments in Puget Sound have a low potential for adverse effects, and are suitable for unconfined, open-water disposal. In addition, the availability of the sediment chemicals for uptake by aquatic organisms varies depending on physical characteristics such as grain size and total organic content. Accordingly, decisions on dredged material must be made on a case-by-case basis within an overall decision-making framework. Consistency in permit issuance and site administration is needed among the various regulatory agencies overseeing dredged material disposal in order to meet environmental goals cost-effectively. Consistency is also important to the private sector, where investment risk assessment is often critical, and the governmental evaluation process is viewed with concern.

The PSIC guidelines until recently governed the disposal of dredged materials in the Phase II area. However, while these guidelines generally accepted as a useful interim management tool, a number of concerns were expressed over their use. They were based on only a comparison of chemical concentrations in dredged material to chemical concentrations in reference sediment. Accordingly, the potential for sediment chemicals to cause adverse effects to biological resources was not directly assessed. As a result, when a relatively pristine area was used as a reference, the criteria were overly restrictive giving rise to unnecessary costs to the dredger who had to find an alternative means of disposal. When previously used disposal sites were taken as the reference areas there was a concern that an existing adverse situation might be allowed to persist.

1.03 Goal and Objectives. The overall goal of PSDDA was to provide publicly acceptable guidelines governing environmentally safe, unconfined open-water disposal of dredged material in Puget Sound, improving consistency and predictability in the site management process. Public acceptability includes consideration of a wide range of factors. Among these are scientifically sound procedures and practicability (cost effectiveness and the extent and permanence of beneficial and/or detrimental effects). This goal is consistent with Section 404 of the Federal Clean Water Act (CWA) and the Section 404(b)(1) Guidelines (40 CFR Part 230). The purpose of the referenced guidance is to restore and maintain the chemical, physical, and biological integrity of waters of the United States through the control of discharges of dredged or fill material.

The major issue addressed in the FEIS is the identification of acceptable unconfined, open-water disposal sites.

1.04 Relation of Study to Federal and State Authorities. The specific authorities by which the Corps, EPA, DNR, and Ecology are participating in the PSDDA study and which will govern their actions during implementation of the management plan are briefly described here. A more detailed discussion is contained in the Phase II draft Management Plan Report (MPR).

a. Federal Authorities. The Corps regulatory authority over waters of the United States includes disposal of dredged materials in navigable waters such as Puget Sound. The Corps authority to issue or deny permit applications stems from Section 404 of the CWA (Public Law 92-500, as amended). Section 404 authorizes the Secretary of the Army, acting through the Corps, to issue permits for the discharge of dredged or fill material into waters of the United States. These permits specify disposal sites for dredged material determined to be suitable for discharge into waters of the United States in accordance with the Section 404(b)(1) Guidelines (discussed below). Section 404(b)(2) allows the Corps to issue permits otherwise prohibited by the Guidelines, based on consideration of the economics of anchorage and navigation. The public interest review process used by the Corps provides for consideration of a number of factors in permit and project decisions. Permit decisions will be based on an evaluation of probable impacts, including cumulative impacts, of the proposed activity and its intended use on the public interest (33 CFR 320.4). Via this weighing and balancing process, a permit decision is influenced by broad considerations. For activities involving 404 discharges, a permit will be denied if the discharge that would be authorized by such a permit would not comply with the 404(b)(1) Guidelines (subject to the 404(b)(2) exception).

EPA, in conjunction with the Corps, develops guidelines for the specification and use of disposal sites under Section 404(b)(1) of the CWA. EPA is authorized by Section 404(c), after notice and opportunity for public hearings, to prohibit or restrict the use of a disposal site whenever it determines that the discharge of such materials will have "unacceptable adverse impacts" on municipal water supplies, shellfish beds and fishery areas, wildlife, or recreational areas. Further, the State of Washington is authorized by Section 401 of the CWA to make determinations regarding a water quality certification prior to issuance of a Federal permit for, or conduct of a Federal project involving, dredged material disposal in waters of the United States.

The overall guidelines for specification of disposal sites for dredged material are the Section 404(b)(1) Guidelines (40 CFR Part 230). These guidelines require consideration of numerous factors prior to allowing disposal of dredged material in waters of the United States. Subpart G of the Section 404(b)(1) Guidelines provides guidance for evaluation and testing of dredged material to be disposed into waters of the United States. Per the Guidelines, specific evaluation procedures are furnished by the Corps and EPA as "interim guidance" (40 CFR 230.61). In 1980, EPA, in conjunction with the Corps published final Guidelines for the specification of disposal sites for dredged or fill material. These specify that the disposal of dredged material must not result in an "unacceptable adverse impact" to aquatic ecosystems. Simultaneously, proposed rules for testing requirements were published. Although final rulemaking has not taken place, the testing requirements and procedures have been implemented by the Corps as a matter of policy.

Advance identification of the PSDDA Phase II disposal sites was accomplished concurrent with public review of the Phase II documents by EPA and the Corps under subpart I of the Section 404(b)(1) Guidelines (40 CFR 230.80). Under this action a determination was made of the suitability of the selected Phase II disposal sites for future disposal of dredged material.

The National Environmental Policy Act (NEPA) requires all Federal agencies to assess the environmental impacts of major Federal actions significantly affecting the quality of the human environment and to consider all reasonable alternatives. The Coastal Zone Management Act (CZMA) (Public Law 92-583) requires that Federal projects be consistent to the maximum extent practicable, with the State's coastal zone management program (CZMP). For non-Federal projects, consistency requirements are more rigorous.

b. State Authorities. Congress granted to the States the responsibility for certifying under Section 401 of the CWA that a proposed discharge, resulting from a project described in a Corps public notice issued under Section 404 of the CWA, will comply with all applicable provisions of State and Federal water quality laws. Ecology has interpreted these laws to include sediment quality as an aspect of water quality. This certification is required from any applicant for a Federal permit (or Federal project) to conduct any activity which may result in any discharge into State waters. Compliance with Section 401 also ensures that any such discharge will comply with the applicable provisions of Sections 301, 302, 303, 306, and 307 of the CWA. In particular, Section 303 allows States to establish water quality standards and provides that discharges meet these standards.

Ecology also establishes guidelines for State and local administration of the Washington Shoreline Management Act (SMA) (RCW 90.58). Ecology ensures that permits issued by local governments are consistent with the intent of the act.

DNR is the State proprietary land agency that manages State-owned tidelands and bottom lands of Puget Sound, including the disposal sites. DNR designates unconfined, open-water disposal sites, secures local shoreline permits for site use, issues site permits to dredgers (other than the Corps), and manages site use. DNR site designation has been historically accomplished by an interagency siting committee. The Corps participates on this committee and utilizes the State-designated sites for Federal dredging projects.

c. Implementation of the PSDDA Evaluation Procedures. Responsibilities of each of the PSDDA regulatory agencies under Section 404 or Section 401 of the CWA will be accomplished in accordance with each agency's authorities and policies. The PSDDA dredged material evaluation procedures will be applied by each regulatory agency consistent with these authorities and policies. These procedures are described in the Phase I and Phase II MPR and the Phase I Evaluation Procedures Technical Appendix (EPTA), both of which are incorporated into this FEIS by reference in accordance with 40 CFR, part 1502.21. The procedures provide the basis for an overall approach which can meet the case-by-case requirements of both Section 404 and Section 401. Most elements of the PSDDA procedures are common to both authorities. However, some elements are unique to either Section 404 or Section 401 requirements. Those seeking approval for unconfined, open-water disposal will need to meet both requirements, i.e., undertake the full suite of PSDDA tests, as each agency determines is applicable.

The Corps requirements for the evaluation of dredged material proposed for unconfined disposal in Puget Sound waters, is as specified in Subpart G of the Section 404(b)(1) Guidelines, will be met primarily by the Section 404 components of the PSDDA evaluation procedures. The Section 404 component of the PSDDA procedures are, and will be, applied consistent with the national Corps procedures. The Corps will address other aspects of the Section 404(b)(1) compliance, such as impacts on navigation and national commerce and avoidance and minimization of impacts, including mitigation of unavoidable impacts and alternatives analysis on a case-by-case basis. Required national Corps procedures for implementation are reflected in 51 FR 19694 dated May 30, 1986 for Corps projects and 33 CFR 320-330 for the Corps regulatory program.

The EPA will rely on the PSDDA evaluation procedures as the basis for preventing sediment degradation of the aquatic environment, as required by Section 404(b)(1) Guidelines. These procedures represent the testing approaches and procedures, allowed under the Guidelines, which EPA would require during the evaluation of dredged material. Other aspects of the Section 404(b)(1) compliance, such as avoidance and minimization of impacts, including mitigation of unavoidable impacts, will also be addressed by EPA, during comprehensive reviews, on a case-by-case basis.

Ecology will apply the appropriate PSDDA evaluation procedures in assessing applications for Section 401 Water Quality Ceritification. Initially, the procedures will be treated as guidelines. However, the PSDDA evaluation procedures may later be adopted as a State regulation.

The State Environmental Policy Act (SEPA) (RCW 43.21c) requires consideration of environmental impacts in taking "actions" as defined by the regulations. Adoption of the PSDDA program is considered to be a nonproject action and is subject to SEPA.

d. NEPA and SEPA Requirements. Both NEPA and SEPA call for the integration of environmental considerations into the planning process concurrent with the evaluation of economic, social, and technological aspects of a proposal or plan. The procedural requirements of these laws specify the documentation and disclosure of this integrated assessment when recommending or proposing an agency action (unless such action is of minor consequence to the environment and is categorically excluded from this assessment). The extent of the documentation is dependent on the degree of potential adverse environmental effects resulting from the proposal. Per NEPA, an EIS is required "in every recommendation or report on proposals for legislation and other major Federal actions significantly affecting the quality of the human environment" (40 CFR 1502.3). The term "significantly" requires consideration of both "context" (affected region, affected interests, and locality) and "intensity" (degree, controversy, persistence, geographic extent, etc.) of effects (40 CFR 1598.27). An EIS may be needed for each specific project proposal, or may be prepared for broad Federal actions (such as the adoption of programs that affect larger geographic areas (i.e., a large water body such as Puget Sound), or that generically involve many similar actions (40 CFR 1502.4)). The SEPA requirements are very similar to those of NEPA. Pursuant to SEPA, an EIS is required once a responsible official has determined that a proposal may have "probable significant adverse environmental impact" (WAC 197-11-360). However, EIS's may be prepared for other purposes, as was done in the case of PSDDA.

NEPA includes "planning to avoid and minimize adverse effects" as one aspect of "mitigation." The PSDDA Phase I and II plans avoid and minimize potential adverse effects. Consequently, plan elements are, in part, mitigation features of dredged material management. The goal of environmental protection and the objectives of the CWA have been met by the plans. Under both NEPA and SEPA, mitigation that reduces the probable adverse impact to less than significant levels can be a basis for deciding that an EIS is not warranted (as long as the mitigation is an integral part of the original proposal), though NEPA rules discourage this approach.

The decision to prepare an EIS for each phase of the PSDDA study was not based on an *a priori* determination that any resulting adverse effects would be "significant." It was recognized that the environmental impacts of the plans will depend on where disposal sites are located and the dredged material that will be discharged at those sites. Accordingly, the agencies participating in the PSDDA study agreed to prepare an EIS to "encourage and facilitate public involvement in decisions which affect the quality of the human environment" (40 CFR 1500.2) (emphasis added). The March 1985 PSDDA plan of study notes that the EIS will provide a "a formal and accepted means to involve the public" and "the basis for subsequent implementing actions" by the PSDDA agencies.

1.05 Relationship to Other Documents. The PSDDA Phase II EIS provides an assessment of probable impacts resulting from the selected alternatives. It systematically presents alternative unconfined, open-water siting options. Options not deemed feasible or environmentally appropriate are identified and then dropped from final consideration. Information is presented in the selection of unconfined, open-water disposal sites. The Phase I EIS and MPR considered alternative site locations in central Puget Sound and site managment conditions at nondispersive disposal sites. This EIS incorporates the Phase I dredged material evaluation procedures, including the disposal guidelines, for the two Phase II nondispersive sites.

In Phase II, disposal site locations are viewed as the key alternatives for the comparisons leading to assessments for NEPA/SEPA compliance. Any change to these elements of the Phase II management plan has the potential for significant effects on the environment and may require preparation of a supplemental EIS, should future changes be proposed. The other elements of the management plan, e.g., dredged material evaluation procedures, environmental monitoring, etc., are solely intended to be the means by which the stated site management condition for each site is controlled. Accordingly, any changes to these other elements are not anticipated to require preparation of a supplemental EIS.

PSDDA Technical Reports. Bound separately and referenced in the above documents are many technical reports prepared through the PSDDA study. These reports provide the details of the scientific analysis, field studies, and public involvement in support of the PSDDA findings.

Dredged Material Research Program (DMRP) Reports. The PSDDA study has recognized the considerable nationwide research which has been accomplished since the early 1970's through the Corps' Dredged Material Research Program (DMRP). This program has assessed the environmental effects of dredged material disposal (Saucier et al., 1980). As part of the DMRP, studies were conducted in Elliott Bay and elsewhere in Puget Sound. The research has been used by the Corps in making decisions on dredged material disposal. DMRP has shown that most dredged material nationwide is acceptable for open-water disposal and can have many potential beneficial uses, including fish and wildlife habitat development. Puget Sound examples of beneficial uses of dredged material include Jetty Island at Everett, clam habitat development at Oak Bay Canal, and a beach feed erosion control at Keystone Harbor on Whidbey Island. DMRP reports were prepared and published by the Corps Waterways Experiment Station (WES) located in Vicksburg, Mississippi. Research and development continues on all aspects of dredged material disposal through the Corps' Environmental Effects of Dredging Programs, administered by the Corps' WES (Engler et al., 1987).

Puget Sound Water Quality Authority (PSWQA) 1987 Water Quality Management Plan. A final Puget Sound Water Quality Management Plan, adopted by PSWQA in December 1986, proposed various actions to control and prevent pollution soundwide. According to legislative mandate, the plan contains recommendations addressing a variety of pollution related issues including nonpoint source pollution management, industrial pretreatment of toxic wastes, dredged material disposal management, and the protection, preservation, and restoration of wetlands, wildlife habitat, and shellfish beds. (For detailed information about comprehensive pollution control efforts, see the 1987 Puget Sound Water Quality Management Plan (PSWQA, January 1987) and the Final Environmental Impact Statement and Revised Preferred Plan (PSWQA, December 1986). Also see the 1989 Puget Sound Water Quality Management (PSWQA, October 1988) for an update of programs identified in the 1987 plan and a discussion of issues that could not be addressed in the 1987 plan.

PSDDA is acknowledged by PSWQA as the appropriate effort for dealing with unconfined, open-water disposal of dredged material. The PSDDA Phase II program may be incorporated in an amended PSWQA Water Quality Management Plan. The evaluation of dredging and disposal of dredged material containing contaminated sediments has also been addressed in the Puget Sound Water Quality Management Plan. The PSWQA plan calls for Ecology to "develop and adopt by regulation, criteria for identifying and designating sediments that have observable acute or chronic adverse effects on biological resources or pose a significant health risk to humans. Sediments that exceed the criteria are defined as 'sediments having adverse effects.'" However, the plan notes that "these sediment criteria will not necessarily be directly applied to decisions on dredged material disposal or the cleanup of contaminated sediment sites. PSDDA is expected to recommend criteria for environmentally safe and publicly acceptable unconfined aquatic disposal of dredged material that allow some material with adverse effects to be disposed of in open water."

1.06 Study Coordination/Public Involvements. Extensive coordination occurred during the course of the PSDDA Phase II study and many opportunities were provided for public involvement. This is fully described in section 5.

1.07 Units of Measure. In this EIS, it has been necessary to use units of both English system (inches, cubic yards, acre, mile) and SI (centimeter, cubic meter, hectare, and kilometer) because of commonplace expression of commercial/navigational quantities and scientific quantities. The following conversion table is provided to minimize the inconvenience of the two measurement modes.

CONVERSION FACTORS FOR UNITS OF MEASUREMENT

Multiply	By	To Obtain
cubic feet	0.02831685	cubic meters
cubic feet	28.316847	liters
cubic yards	0.7645549	cubic meters
cubic feet per second	0.02831685	cubic meters per second
feet	0.3048	meters
feet per second	0.3048	meters per second
feet per second	0.5921	knots
grams per sq cm	0.01	ounces (Avdp) per square inch
grams	0.03527396	ounce
cm	2.54	inch
fathoms	6.00	feet
square meters	0.0001	hectare
hectare	2.47	acres
nautical mile (int.)	1.82	kilometers
nautical mile (int.)	1.1507794	miles (statute)

SECTION 2. ALTERNATIVES

2.01 Introduction. The specific unconfined, open-water disposal site alternatives are developed in this section and their relationship to environment and laws and regulations are addressed in sections 3 and 4 of the EIS. Phase II of PSDDA focuses on dredging activities in the northern and southern areas of Puget Sound, including maintenance navigation dredging and dredging for new port facilities. The alternatives addressed in this EIS were formulated to meet site identification and management objectives of the PSDDA study. The environmental consequences are primarily associated with the location of the disposal sites relative to resource concerns.

Features of site management include the necessary activities for proper site control and program administration by the various regulatory agencies. These features are viewed primarily as implementing or management activities which support the use of the disposal sites and site management conditions. The supporting elements of the management plan do not differ greatly among the dispersive and nondispersive sites considered. Accordingly, site management features are not addressed as alternatives in the EIS. Common features of site management that are directly pertinent to the environmental consequences of PSDDA are summarized in section 2.05.

In this EIS, five disposal sites are identified that are located near the cities of Port Angeles, Port Townsend, Anacortes, Bellingham, and Olympia (table 2.1). The largest quantities of future Phase II dredged material are generally expected to be generated in and near these developed areas. The remainder of future dredging activity is projected to be sporadic in nature and generally consists of lesser quantities, except for the Swinomish Channel connecting Skagit and Padilla Bays.

TABLE 2.1

PHASE II
DISPOSAL SITES AND MAJOR DREDGING AREAS

Locations of Disposal Sites		Major Dredging Areas
Nondispersive		
North Sound:	Bellingham Bay	Bellingham Bay Fidalgo Bay Lummi Bay
South Sound:	Anderson Island/ Ketron Island	Olympia/Budd Inlet Shelton/Oakland Bay Pickering Pass Tacoma Narrows Steilacoom

TABLE 2.1 (con.)

Locations of Disposal Sites	Major Dredging Service Areas
Dispersive	
Port Angeles	Port Angeles
Port Townsend	Port Townsend Admiralty Inlet Hood Canal
Rosario Strait	San Juan Islands Swinomish Channel Whidbey Island Blaine Anacortes - Fidalgo Island

During 1970-1985 approximately 7.9 million cubic yards were disposed in open water in the Phase II area. There are a number of Federal navigation projects in the Phase II area that require periodic maintenance dredging. It is expected that over the next 15-year period (1985-2000), total volume will be about 7.2 million cubic yards, or about 9 percent less than the prior period.

Dredgers of most existing navigation projects have used unconfined, open-water disposal. In the future dredgers are expected to seek this option even more often. Most dredging activity is highly dependent on the availability of nearby disposal sites because of economic considerations. Alternative disposal sites are generally not available without considerable increases in costs. Disposal at confined, in-water or upland sites, while dependent on the specific project, is estimated to cost from 2 to 10 times more per cubic yard than present unconfined open-water disposal. These cost differences affect the feasibility of many dredging projects.

From the Dredged Material Inventory (Envirosphere, 1986) it has been estimated that of the total of 7.9 million cubic yards dredged during the 15-year period from 1970 to 1985, approximately 36 percent of this total (200,000 c.y. annually) was deposited at DNR designated unconfined, open-water disposal sites. The remainder of dredged material was deposited at other open-water locations or at nearshore or upland disposal sites.

The Dredged Material Inventory data base was used in conjunction with information on currently planned projects to project the future volumes of sediment to be dredged in the Phase II area during the 15-year period from 1985 to 2000. A 15-year planning horizon (starting in 1985) was used for all known major navigation projects and is the maximum forecasting period that the PSDDA study team felt could be established with reasonable certainty. The PSDDA disposal sites can accommodate projected dredged material well beyond the 15-year planning horizon.

Most future dredging activity will occur in five areas: Budd Inlet, Swinomish Channel, Bellingham Bay, Fidalgo Bay, and Lummi Bay. Much of this dredging will be done by the Corps of Engineers for navigation channel maintenance and most of these projects have historically used open-water disposal sites. Trends in 404 permit applications also indicate that there will be a continued demand for open-water disposal sites. Without the availability of the relatively less expensive open-water sites, some of these projects may not be economically feasible.

Although the PSDDA agencies have not addressed in detail other methods of dredged material disposal (i.e., upland, confined nearshore, or confined open-water) as specific alternatives in either the Phase I EIS or this EIS, these other disposal methods are treated on a conceptual comparative basis in the impact analysis. However, in considering what material is acceptable for unconfined, open-water disposal at the newly identified sites, no attempt was made to resolve what should be done with material that is found not acceptable for unconfined, open-water disposal. There were several reasons for this. First, while disposal in Puget Sound revolves around many regionwide and statewide issues, disposal on land (especially for material containing elevated levels of chemicals of concern) is highly dependent on decisions of local governments regarding land uses. Second, the regulatory authorities of the PSDDA agencies are not directly applicable to land, while several other entities (e.g., county Public Health Districts and the Washington Department of Social and Health Services) do have major responsibilities for land disposal. Finally, in 1988 the State of Washington initiated a study which considers confined disposal options and associated testing procedures and builds on the work done through PSDDA. This study addresses the PSWQA Water Quality Management Plan elements S-4 and S-6, confined disposal options (open-water, nearshore, and upland) and siting of such confined facilities, respectively.

Phase I nondispersive sites were located in or near urbanized, low energy embayments. Phase II site selection began with the acknowledgement that Phase II areas are much more hydrodynamically complex areas than the Phase I areas (Phase II DSSTA). A priori consideration was given to locating sites in nondispersive areas when possible, and dispersive sites were considered as alternatives only in the absence of viable areas for nondispersive sites. In highly dispersive, resource rich environments such as the Straits of Juan de Fuca and Georgia, it was recognized that acceptable nondispersive areas for siting consideration would be difficult (if not impossible) to find, and that dispersive locations might be the only possibility to avoid significant natural resource conflicts.

The general philosophy formulated by the PSDDA agencies for the Phase I sites was also used for the Phase II sites, with one addition (h, below) to encompass dispersive sites:

a. Full compliance with 404(b)(1) guidelines.

b. Disposal of dredged material should avoid unacceptable adverse resource impacts.

c. Only material suitable for unconfined disposal should be allowed at the sites.

d. Nondispersive sites should be located in a highly nondispersive environment.

e. When site use is discontinued, eventual recovery to ambient conditions should occur.

f. Sites should have no unacceptable adverse impacts on food fish, shellfish, and marine mammals.

g. Minimize interference on human uses. (Shipping lanes and anchorages may have U.S. Coast Guard restrictions.)

h. Dispersive sites should be located in a highly dispersive environment.

The Phase I EIS and MPR presented a systematic approach for designating disposal sites. Although the Phase I documents focused on central Puget Sound, PSDDA was established as a general or soundwide program. Accordingly, much of the Phase I documentation is appropriate to the Phase II area, including the dredged material evaluation procedures, even though more restrictive disposal guidelines have been proposed for the Phase II dispersive disposal sites. Therefore, alternatives considered for the nondispersive sites in the Phase II area are limited to the siting alternatives.

Sediment pretreatment options, physical and chemical separation of contaminants, immobilization or incineration, were discussed in the Phase I EIS, section 2.01. They are generally costly and/or not field tested for dredged material. Pretreatment is not recommended for wide application in Puget Sound due to these factors, the unavailability of equipment, and the highly project-specific nature of the chemical pretreatment process.

2.02 No-Action Alternative. The regulations established for implementation of the National Environmental Policy Act (NEPA) and the State of Washington Environmental Policy Act (SEPA) require consideration of reasonable alternative actions. The no-action alternative is mandatory in this analysis. Several no-action alternatives potentially exist, and are described below. All of these reflect what could be the situation in the absence of PSDDA being applied to the Phase II area. The most realistic no-action alternative is continued dredging with unconfined, open-water disposal being provided by numerous single user-designated sites. The Puget Sound Interim Criteria (PSIC) would be used as the basis for disposal decisions. This contrasts to the action alternative with relatively few multiuser, unconfined, open-water disposal sites and PSDDA disposal guidelines.

a. No Dredging. Under this possible no-action alternative, the problem of disposing of dredged material in the Phase II area would be handled by precluding dredging projects. However, this scenario is not reasonable for several reasons. First, existence of open Phase I area sites would allow unconfined, open-water disposal at designated public multiuser sites for projects for which it is economically feasible to transport sediments into the Phase I area. Second, upland disposal options would still exist, although they would be more costly on the whole than unconfined, open-water disposal. Third, should dredging be made infeasible, most harbors and waterways that were developed through dredging would eventually experience shoaling to the point that commercial and recreational traffic would be impaired, causing severe socioeconomic hardships to the private and public sectors. Foregone benefits for new navigation projects and economic impacts for maintenance of existing projects of not dredging would be significant. With available information, it is not possible to quantify the project specific effects of discontinuing dredging in the Phase II area. Qualitatively, potential loss of marine commerce and other related economic activities could result in social disruption from loss of jobs and loss of property tax revenue. Dredging of existing and future navigation channels and berths is widely regarded as essential to Puget Sound area ports, marinas, and other marine activities.

In conclusion, the "no dredging" alternative is not considered to be a realistic option for the Phase II area of Puget Sound as it does not serve the overall public interest and would have unacceptable adverse economic impacts. Accordingly, this alternative was dropped from further consideration.

b. Continue Past Management Practices. Disposal site designation in the past has been accomplished by DNR in accordance with established regulations (WAC 332-30-166), and with the approval of local shoreline jurisdictions which grant a shoreline permit to DNR. DNR has previously designated multiuser sites near several of the major dredging areas in the Phase II area.

Prior to implementation of PSDDA Phase I in 1988, Puget Sound dredged material sampling, testing, and test interpretation requirements were established on a project-by-project basis. EPA and the Corps, in cooperation with Ecology, assessed non-Corps dredging projects. The Corps conducted the evaluations for federally authorized Corps navigation projects. (For the purposes of this EIS, federally authorized navigation projects include Corps projects authorized under various River and Harbor Acts as well as all other federally operated channels such as Navy, U.S. Coast Guard, NOAA, etc.) In the case of Corps navigation projects, Seattle District testing procedures, developed programmatically for Corps projects, were also frequently required of non-Corps permit applicants.

Case-by-case evaluations did not provide local authorities with sufficient assurance that aquatic resources at the disposal sites were being adequately protected. The Puget Sound area is unique relative to other regions of the Nation in that local governments also play a key role in open-water and nearshore dredged material disposal through their shoreline master programs as part of the State shoreline permit process. Local jurisdictions can condition or restrict dredging and dredged material disposal.

The lack of fully consistent evaluation procedures, or specific objective decision criteria led, in part, to the establishment of interim disposal criteria by EPA and Ecology for the Fourmile Rock disposal site in Seattle's Elliott Bay in 1984 and the Port Gardner site near Everett in 1985. The Fourmile Rock criteria became a condition of the local shoreline permit issued by the city of Seattle to DNR and the Port Gardner criteria a condition of the city of Everett permit for the existing Port Gardner site. Subsequently, in 1985, Ecology developed the Puget Sound Interim Criteria (PSIC) to ensure that the other Puget Sound disposal sites did not experience similar problems. These criteria have been used in the interim pending development of regional soundwide guidelines for dredged material disposal.

An analysis of historical trends in costs of dredged material testing and disposal costs was provided in section 5.02 of the Phase I EIS. Costs increased significantly after 1984 due to the PSIC.

With the incorporation of PSDDA into the PSWQA Management Plan and signing of the Record of Decision in December 1988 for PSDDA Phase I, a strong commitment was made for a soundwide program for the siting of unconfined, open-water dredged material disposal areas and for evaluating dredged material proposed for discharge at these sites. In other words, PSDDA Phase I was the beginning of a programmatic process leading to a consistent soundwide management plan, including the Phase II area; PSDDA now <u>encompasses</u> past management practices.

However, for purposes of assessing the "continue past management practices" option for the no-action alternative, it was assumed that the PSIC would be continued for all DNR disposal sites in the Phase II area. While the PSIC has expired, it could be renewed. However, because of PSDDA, Ecology has not promulgated new criteria. Accordingly, it is reasonable for this analysis to assume that the PSIC would continue to be the operating criteria in the absence of PSDDA.

The locations of the multiuser sites in existence prior to PSDDA are shown in figure 2.1. Admiralty Inlet, Bellingham Bay, Bellingham Channel, Padilla Bay, Skagit Bay, Port Angeles, and Steilacoom sites all were closed by April 1989 and can not be reopened without undergoing the permit processes and environmental documentation steps that have been accomplished for the PSDDA Phase II sites. While, it was assumed for purposed of this EIS that the past disposal sites could be reopened with new shoreline permits granted by local jursidictions without any special conditions of site use, this assumption is questionable. As noted in the Phase I FEIS, discussions with local shoreline jurisdictions indicate that in the absence of a PSDDA Phase II or comparable comprehensive regional study there is little likelihood that new shoreline permits would be issued. In the absence of new local shoreline permits, the past DNR disposal sites would not be available.

Continuing past management practices perpetuates known problems. Concerns have been raised about using the existing DNR disposal sites for a variety of reasons. Gillnet and bottom fishermen reported gear losses and trawl fouling from debris such as logs, cable, and other obstructions while fishing near the past DNR disposal site in Bellingham Bay. In Mason County, a decision by the Shoreline Hearing Board closed the Dana Passage disposal site. The shoreline permit for the Admiralty Inlet disposal site in Island County states that measurement of sediment movements must be taken; however, the cost associated with this condition disallowed most use of this site. Continuing past management practices is therefore not considered an appropriate definition of no action as the premises are viewed as unrealistic.

c. No Designation of Public Multiuser Unconfined, Open-Water Disposal Sites. The no-action alternative that has been carried forward for the PSDDA study is "no designation of public multiuser unconfined, open-water disposal sites." This option is the best assessment of the no-action alternative, which would be the likely future in the absence of Phase II of PSDDA based on discussions with affected local shoreline jurisdictions, PSWQA, and the Washington Public Ports Association. The problems that led to PSDDA Phases I and II would still exist in the absence of PSDDA Phase II, with local shoreline jurisdictions expected to deny shoreline permits for public multiuser sites until a comprehensive regional plan for dredged material management is completed. However, limited single-user, unconfined, open-water disposal could continue on a project-by-project basis should dredged material meet the PSIC guidelines for disposal, and should local shoreline jurisdictions be willing to grant conditional use permits. This would likely occur in cases where the disposal either will have beneficial effects or where environmental impact studies are undertaken. Disposal would likely occur at project-sponsor identified sites, where environmental impacts are deemed acceptable and the need for disposal is adequately demonstrated. All other dredged material would require placement in the nearshore or upland environments. (Confined aquatic disposal is unlikely under no-action since the same site location requirements would apply to CAD sites as to unconfined, open-water sites.) Under the no-action alternative, dredged material in the Phase II area passing PSIC could be used to create nearshore wetland environments as well as underwater reefs and island habitats. Also, dredged sediments could be used as clean fill material, or as a cap for isolating sediments containing chemicals of concern from interaction with aquatic biota. For some of this material an option also exists for disposal at a PSDDA Phase I site, with substantially higher transportation costs.

The dredging volumes to be discharged at unconfined, open-water areas under this alternative were estimated from an assessment of the dredged materials expected to meet PSIC. They amount to 2 million cubic yards in the period 1985 to 2000. This is 35 percent of the projected 5.7 million cubic yards of material that could be considered for unconfined open-water disposal over this period. Unconfined open-water disposal would be likely for only those projects that would use these materials for "beneficial uses" such as habitat development, beach stabilization or capping of relatively contaminated areas, and those projects that are sufficiently in the public interest to warrant approval of unconfined, open-water disposal at other locations. As considerable expense is associated with disposal site studies, only the larger projects would be likely to have the resources needed to gain approval for disposal in open-water areas of north and south Puget Sound. Ecology, as part of implementing PSWQA Plan Element S-4, is developing regulations for beneficial uses independent of PSDDA planning alternatives.

This no-action alternative complies with the Council on Environmental Quality regulations and provides a benchmark for comparing the environmental effects of the action alternatives.

Selection of the no-action alternative for PSDDA Phase II could result in a number of potentially severe economic and environmental consequences which are detailed in section 4 of this FEIS. In general, most dredged material under this alternative (estimated to be about 65 percent of forecasted volume that may be considered for unconfined, open-water disposal) would require confined disposal on land or at nearshore sites. Locating and developing acceptable confined upland and nearshore disposal sites is a complex and expensive task. Public and agency approval is increasingly difficult to achieve for any disposal site located near residential or recreational areas. Potential adverse effects to intertidal habitat, wetlands, land habitat and ground water resources are major considerations for siting and construction of nearshore and upland disposal sites. Dredgers seeking permits for development of confined disposal sites have found the process expensive and subject to significant delays. It will be several years before Ecology has completed documentation and implementation of its PSWQA Management Plan elements S-4 and S-6 tasks which would result in multiuser, confined aquatic (deepwater or nearshore) and confined terrestrial sites.

2.03 <u>Identification of Unconfined Open-Water Disposal Sites</u>.

a. <u>Overview of Site Identification Process</u>. The site identification process employed by PSDDA utilized existing information in combination with field studies to identify alternative disposal sites. The approach used is similar to that described in the EPA and Corps publication "General Approach to Designation Studies for Ocean Dredged Material Disposal Sites" (EPA/Corps, 1984). Steps of the site identification process were as follows:

(1) Define general siting philosophy. This step addressed disposal philosophy (i.e., whether sites should be dispersive or nondispersive), general siting locations (i.e., ocean, strait, or sound), and number of disposal sites.

(2) Identify selection factors to delineate Zones of Siting Feasibility (ZSF's). This step used existing information on biological resources and human use activities to identify general areas where disposal sites might be appropriately located.

(3) Conduct field studies on the ZSF's. Field and numerical studies were conducted to fill key data gaps and gather information on the physical and biological conditions of the ZSF's.

(4) Identify preliminary sites within the ZSF's. Information from the ZSF studies was used to identify preliminary locations for disposal sites within the ZSF's.

(5) Conduct field studies on the sites. Field and numerical model studies were conducted to obtain needed physical and biological information for the preliminary sites. These studies are referred to as "site-specific studies."

(6) Identify preferred sites. Information from the site-specific studies were used to identify preferred and alternative sites.

Detailed descriptions of the site identification process, study results and ZSF and site conditions are contained in the Phase II Disposal Site Selection Technical Appendix (Phase II DSSTA).

Existing DNR disposal sites were considered in the disposal site identification process when they met site identification factors discussed below. It was agreed at the beginning of the PSDDA study that no special _a priori_ status would be given to the existing sites since the intent was to establish the best possible locations for dredged material disposal. An objective site identification process was used to minimize environmental and human usage conflicts as much as possible, and existing sites adequately meeting the site identification factors and constraints were given equal consideration with other potential sites.

b. _Disposal Philosophy_. During the Phase I study it was decided that the unconfined, open-water disposal sites should be located where bottom tidal currents are generally low; i.e., in areas where sediments tend to accumulate and where dredged material would tend to stay. Such areas are defined as "nondispersive environments." Placing dredged material in nondispersive sites gives managers the ability to maintain control of biological effects and to assure accountability through monitoring of conditions at the site (e.g., chemical levels, biological indexes, or mound dimensions). This is particularly important when chemicals of concern may be present in the dredged material and when it is necessary to minimize the exposure of important resources to these chemicals. However, highly dispersive sites promote rapid dilution of chemicals and result in less physical impacts to benthic communities than would the case if the same material was discharged at a nondispersive site. Based on this philosophy, PSDDA agencies first attempted to identify nondispersive locations, using an objective reference mapping and comparison technique which is described in the following sections. Dispersive sites were chosed after it was learned there were significant natural resource concerns for possible nondispersive sites in several north sound service areas: Rosario Strait, Port Angeles and Port Townsend.

c. _General Siting Locations_. General areas available for unconfined, open-water disposal include the Pacific Ocean, the Strait of Juan de Fuca, and north and south Puget Sound. Discussions of each area follow.

(1) _Ocean Disposal_. While disposal of dredged material within State waters is governed by the CWA and the Section 404(b)(1) Guidelines, disposal beyond State controlled waters (usually 3 miles off the coast in the open ocean), is regulated by guidelines developed under the Marine Protection,

Research and Sanctuaries Act (Public Law 92-532, as amended). The ocean dumping regulations require application of specified criteria to evaluate dredged material and the use of formally designated disposal sites. At the present time, the closest U.S. designated ocean disposal site in the Pacific Ocean west of Cape Flattery is off Willapa Bay, at a distance from Cape Flattery of about 116 nautical miles.

The EPA ocean dumping criteria (40 CFR, Part 228) state that final site designation under Section 102(c) (applicable to Section 103) of the Marine Protection, Research, and Sanctuaries Act of 1972 must be based on environmental studies of each site. These criteria are described in the Phase I FEIS 2.03c(1).

The costs associated with barge transport of dredged material to the ocean are extremely high. Estimated unit costs of barge transport (based on a transport cost range of $0.10 to $0.30/c.y./nautical mile ignoring ineffeciency introduced by transport times) to potential ocean disposal sites 10 nmi off Cape Flattery range as follows: Port Angeles, $5.00 to $15.00 per cubic yard; Bellingham Bay, $10.00 to $30.00 per cubic yard; Olympia, $16.00 to $48.00 per cubic yard. These costs are in addition to dredging costs. Therefore, ocean disposal is a method that not currently available within cost-effective distances from any of the Phase II areas.

Prior to any disposal, permitting and EIS documentation procedures similar to PSDDA would be required for site designation and use. Additionally, site management conditions for ocean disposal are comparable to those which have been developed by the PSDDA agencies. It is unlikely that dredged material evaluation procedures used for ocean disposal would be less restrictive than those adopted for the Phase II area. Environmental benefits or savings which might offset transportation costs have not been identified. Another problem with conducting disposal operations in the open ocean environment results from unsafe conditions associated with high winds/waves and storm activity during the fall, winter, and early spring seasons. In summary, this method is not considered to be a reasonable option because of decreased safety, increased costs, and lack of offsetting environmental benefits. Phase I Evaluation Procedures Technical Appendix (EPTA), Part II, Section 10.4, contains an additional discussion and cost analysis for the ocean disposal method.

(2) Disposal Outside Puget Sound, Near the Mouth of Cape Flattery. Disposal of dredged material in the Strait of Juan de Fuca to a location just west of Port Angeles is regulated under Section 404 of CWA; further oceanward, the Marine Protection, Research and Sanctuaries Act prevails. Concerns for this option are similar to those stated above for open ocean disposal. Dredged material evaluation procedures would probably resemble PSDDA procedures and therefore no difference is expected in dredging volumes that would be acceptable for unconfined, open-water disposal.

Additionally, disposal at the mouth of the straits near the United States-Canadian border, requires added coordination with the Canadian authorities. The transport costs for this option are also very high.

Estimated unit costs (based on a transport cost range of $0.10 to $0.30/cubic yard/nautical mile depending on complications and ineffeciencies to the dredging and disposal operations) of barge transport from the Phase II areas to a potential disposal site at the mouth of Cape Flattery within the Strait of Juan de Fuca are estimated as: Port Angeles, $4.50 to $13.50 per c.y.; Bellingham, $9.00 to $27.00 per c.y.; Olympia, $15.30 to $45.90 per c.y. Frequent winter storms would again cause disposal operations to be more hazardous than in the more sheltered areas of Puget Sound.

Accordingly, disposal outside Puget Sound in the outer Strait of Juan de Fuca was rejected as a reasonable alternative to the Phase II disposal sites because of decreased safety and lack of environmental benefits which could offset the much higher transportation costs.

(3) Puget Sound. The remaining potential open-water disposal sites are located within Puget Sound. Transportion of dredged material from either the northern or southern sound (Phase II areas) to central Puget Sound (Phase I area), in most instances would be more expensive then local confined disposal. Table 2.2 provides estimates of additional costs per cubic yard for such transport. Furthermore, there is no known resulting gain in environmental benefits that would offset such increased costs. PSDDA was undertaken to provide disposal sites throughout Puget Sound that are relatively convenient to areas of major dredging activity. In conclusion, only dredging and open-water disposal sites within the confines of the PSDDA Phase II areas have been considered in detail.

d. Number of Sites. To determine the number of sites needed, areas of major dredging activity were identified for the Phase II area. Review of dredging records indicates that the largest quantities of future Phase II area dredged material will be generated from navigation projects located at Port Angeles, Port Townsend, Bellingham, Anacortes, Blaine, Swinomish Channel, and Olympia. Dredging projects at other Phase II areas are expected to generate substantially less volumes of material. The PSDDA Disposal Site Working Group determined that dredging service areas in five locations as shown in table 2.1.

e. Zones of Siting Feasibility (ZSF's) in Phase II Area.

(1) Identification and Description of the Nondispersive and Dispersive ZSF's. Zones of Siting Feasibility (ZSF) are identified areas which have the potential to accommodate open-water disposal activities. In general, they are areas which have the least conflict with the selection factors. The process utilized to identify ZSF's involved four discrete steps:

Step 1. Define general ZSF selection factors.

Step 2. Define and map specific ZSF selection factors.

Step 3. Apply constraints to the identified ZSF's.

TABLE 2.2

COSTS ASSOCIATED WITH TRANSPORTING PHASE II DREDGED MATERIAL TO THE NEAREST PHASE I PSDDA SITE 1/

Major Dredging Area	Probable UCOWD 2/ Site Under PSDDA Phase II	Haul Distance (NM)	Nearest Phase I PSDDA Site	Haul Distance (NM)	Transport Difference (NM)	Cost Added (at $0.10-$0.30/c.y./nm) 3/
Bellingham Bay	Bellingham Bay	2.7	Port Gardner	78.7	76	$7.60-$22,80
Fidalgo Bay	Bellingham Bay	11.9	Port Gardner	66.8	54.9	$5.49-$16.47
Lummi Bay	Bellingham Bay	11.3	Port Gardner	73.8	62.5	$6.25-$18.75
Port Angeles	Port Angeles	4.1	Port Gardner	60	55.9	$5.59-$16.77
Port Townsend	Port Townsend	14.4	Port Gardner	35	20.6	$2.06-$6.18
Admiralty Inlet	Port Townsend	18.5	Port Gardner	19.7	1.2	$0.12-$0.36
Hood Canal	Port Townsend	37	Port Gardner	37.2	0.2	$0.02-$0.06
Olympia/Budd Inlet	Nisqually	18.5	Commencement Bay	43.1	24.6	$2.46-$7.38
Tacoma Narrows	Nisqually	8.9	Commencement Bay	10	1.1	$0.11-$0.33
Shelton/Oakland	Nisqually	21.2	Commencement Bay	45.8	24.6	$2.46-$7.38
Pickering Pass	Nisqually	9.5	Commencement Bay	34.1	24.6	$2.46-$7.38
Steilacoom	Nisqually	4.5	Commencement Bay	29.1	24.6	$2.46-$7.38

1/Costs do not include normal cost of dredging nor associated costs of obtaining DNR, ERA, Corps, and shoreline jurisdiction site-use condition costs.

2/UCOWD = unconfined, open-water disposal.

3/This figure is based on analysis of haul costs in Phase II DSSTA.

Step 4. Prioritize ZSF's for purposes of field studies.

These steps are further described below, and are addressed in detail in the Phase II DSSTA.

(a) General ZSF Selection Factors. Four general ZSF selection factors were identified for the PSDDA Phase II study area. It was determined that ZSF's should, to the maximum extent possible, be located as follows:

- In nondispersive sites having relatively low energy in order to contain dredged material as much as possible within the disposal site.

- If nondispersive sites not available then dispersive sites would be considered, which have relatively high energy that would maximally disperse dredged material beyond the disposal site area.

- To avoid unacceptable adverse impacts on foodfish, shellfish, marine mammals, and marine birds.

- To minimize interference with human uses to the maximum practicable extent.

(b) Specific ZSF Selection Factors. The three general ZSF selection factors were further delineated by the specific selection factors shown in table 2.3. Most of these factors are identified in Federal and State regulations relating to dredged material disposal sites.

Categories of information on these factors were displayed on large, transparent maps of north and south Puget Sound. By overlaying these maps, it was possible to identify "windows" or areas between resources that might lend themselves to disposal siting with a minimum of conflict with ecological resources and human uses of the sound. This mapping overlay process was used to determine where the disposal site ZSF's should be located. Subsequent to this analysis, additional constraints were applied to specifically determine the ZSF boundaries.

TABLE 2.3

MAPPED OVERLAY EVALUATION/SELECTION CRITERIA/FACTORS
FOR PHASE II AREAS

Human Uses:

(1) Political Boundaries
(2) Navigation Lanes
(3) Utility Corridors
(4) Dredged Disposal Areas

TABLE 2.3 (con.)

Marine Fish Resources:

(5) Smelt Spawning
(6) Pacific Herring Spawning
(7) Pacific Herring Holding Area
(8) Groundfish (Major Resource/Fishery Area)
(9) Aquaculture Sites (Commercial and Public)

Shellfish Resources:

(10) Dungeness Crab
(11) Shrimp
(12) Clams and Oysters
(12) Subtidal Clams
(14) Geoducks (Commercial/Sport)
(15) Salmon Resources (Commercial and Sportfishing Areas)
(16) Nesting Seabird Sites
(17) Marine Mammals
(18) Bathymetry

(c) Constraints to Identified ZSF's. The following constraints were considered to guide the selection of the least impactful ZSF's and sites:

Nondispersive ZSF's

- ZSF's would be located a minimum (water surface) distance of 2,500 feet (757m) from adjacent shorelines to provide a buffer from noise and adverse environmental effects.

- ZSF's should be buffered from vulnerable biological resources by a minimum water surface distance of 2,500 feet.

- ZSF's should be located in water depths greater than 120 feet (36.4 m). Water depths of less than 120 feet are generally more productive and of major importance to many of Puget Sound's important commercial fish species.

- ZSF's should be located in water depths of less than 600 feet (182 m). Based on model results, water depths greater than 600 feet could result in substantially more dispersion of the dredged material during descent through the water column.

- The ZSF's should be located in relatively low energy areas where the 1 percent peak current speed [1] does not exceed 25 cm/sec (c. 10 in./sec), and the sediment has small grain size and (nondispersive) areas. Other indicators included percent volatile solids, BOD, percent water, and total organic carbon. Nondispersive ZSF's identified from this process were located in the Nisqually delta region of south Puget Sound and in Bellingham Bay (figure 2.2). The final alternative sites were chosen following the field studies and meetings with agencies, Indian tribes, and interest groups. Table 2.3 gives the final disposal site location coordinates for each site. The sites are shown on figures throughout this report as a convenience to the reader, so that the final sites can be related to the ZSF data gathered. Each ZSF is described in the following paragraphs, and shown in general on figure 2.1.

Dispersive ZSFs

- Maximum dispersion of the material is desired, therefore the ZSF should be in an area of high current (i.e., average current speed > 25 cm/sec).

- The ZSF should be buffered by a minimum of 1 nautical mile from shorelines and human use areas as measured from the edge of the disposal zone.

- The ZSF should be located at a minimum depth of 180 feet to avoid sensitive biological resources.

- The ZSF should be located so that the ultimate fate of dispersed material will not have a significant adverse impact on natural resources.

Details concerning this process are provided in the Phase II DSSTA. It is important to note that the selection factors and constraints were based on the professional judgments of the PSDDA Disposal Site Work Group (DSWG). They were used for planning purposes, and are not regarded as inviolate standards or criteria. As studies revealed new information about the ZSF's, adjustment to boundaries and later to site locations were made.

(2) Description of Nondispersive ZSF's.

(a) South Sound: McNeil Island ZSF 1. The McNeil Island ZSF was located in the center of the channel between McNeil Island and Steilacoom. This ZSF was eliminated following literature review of currents

1/The 1 percent peak current speed is defined as the threshold speed attained or exceeded 1 percent of the time. Such a measure is used to express a reasonably high, near-maximum speed that might occur enough of the time to affect the conditions at the site.

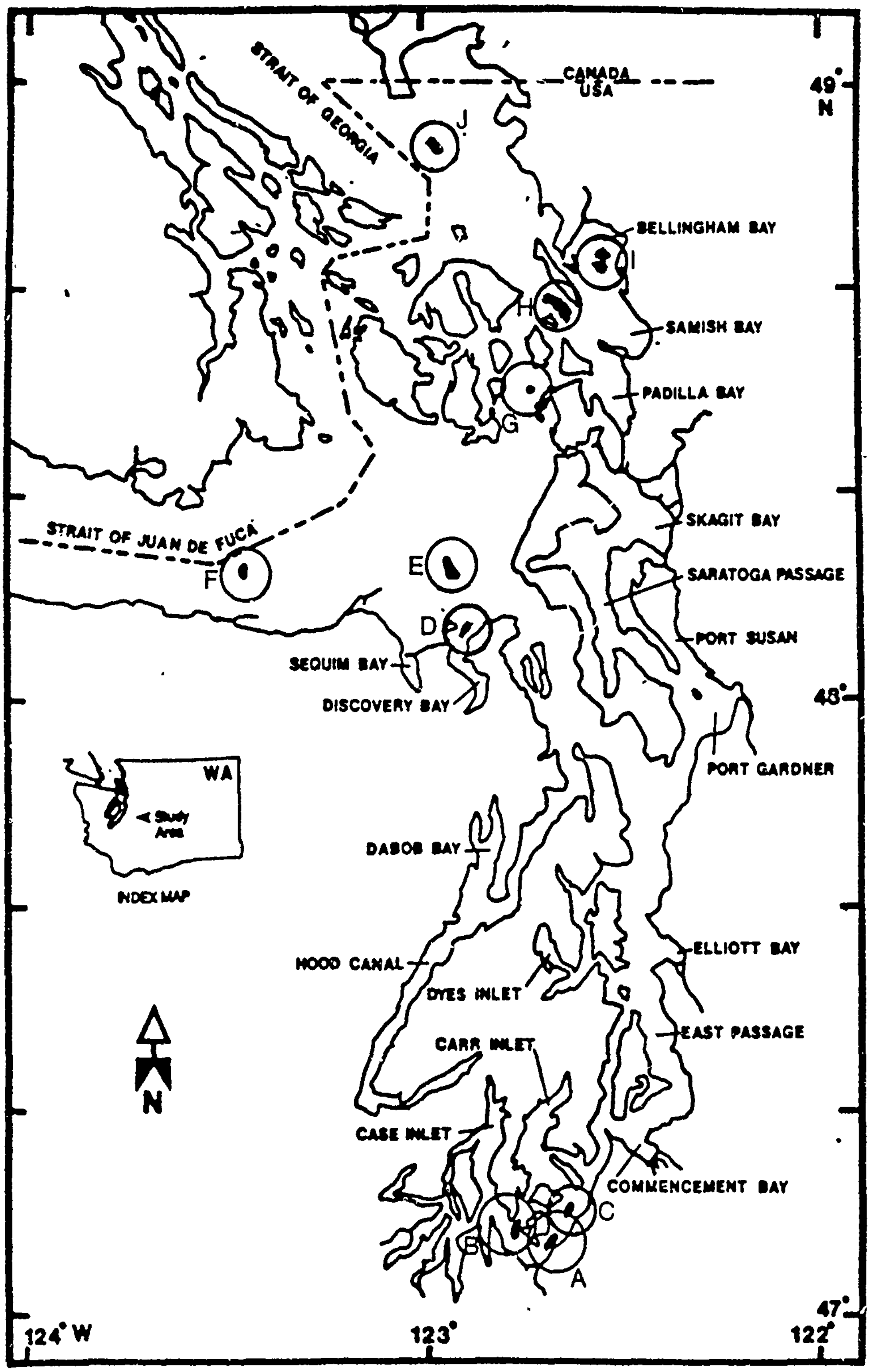


Figure 2.1 Principal Zones of Siting Feasibility in Phase II PSDDA Area.

From south to north, ZSF's (which are dark areas within circles to highlight them) are A: Anderson Island/Ketron Island, B: Devils Head/Ketron Island, C: McNeil Island, D: East of Protection Island near Port Townsend, E: final Port Townsend ZSF, F: Port Angeles, G: Rosario Straits, H: Lummi Island/Sinclair Island, I: Bellingham Bay, and J: Point Roberts. Further ZSF's were initially identified but were dropped from consideration (see Phase II DSSTA and PSDDA report titled Literature Review of Tidal Currents and Marine Sediment Studies in Regards to the Proposed Phase II Disposal Sites.)

From south to north, ZSF's (which are dark areas within circles to highlight them) are A: Anderson Island/Ketron Island, B: Devils Head/Ketron Island, C: McNeil Island, D: East of Protection Island near Port Townsend, E: final Port Townsend ZSF, F: Port Angeles, G: Rosario Straits, H: Lummi Island/Sinclair Island, I: Bellingham Bay, and J: Point Roberts. Further ZSF's were initially identified but were dropped from consideration (see Phase II DSSTA and PSDDA report titled Literature Review of Tidal Currents and Marine Sediment Studies in Regards to the Proposed Phase II Disposal Sites.) and resources and depositional analysis (Evans-Hamilton, Inc., 1986) due to coarse bottom sediments (suggesting the site was too energetic), and its proximity to a known sport fishing area.

(b) South Sound: Anderson/Ketron Island ZSF 2. The Anderson/Ketron Island ZSF is located midway between these two islands (figure 2.2). The boundary configuration was drawn so that the ZSF follows the naturally confining bathymetric features of the bottom. This ensures the restriction of disposed dredged material to the site. This was ultimately selected as the preferred ZSF for south Puget Sound. The selected disposal site is located at the north end of the site, at a depth of 442 feet.

(c) South Sound: Anderson Island/Devils Head ZSF 3. The ZSF boundary was located at the south end of Drayton Passage, between Devils Head and Treble Point, and extends into Nisqually Reach (figure 2.3). This is the alternate ZSF for south Puget Sound. Note that the constraint of a 2,500-foot buffer zone was relaxed in this case because potential conflicts with herring and groundfish resources could be avoided or minimized by site management (i.e., restriction of site use to times of year when herring are not using the site). The disposal zone is located at a depth of 238 feet.

(d) North Sound: Bellingham Bay. The south ZSF (alternative site A-1) is located between Portage Island and the mainland (figure 2.4). The boundaries of this ZSF were selected to avoid as much as possible the navigation lanes, utilities, and marine fish and shellfish resources. This ZSF originally contained the preferred site, but it was found to conflict with established bottomfish trawl areas. The depth of the Bellingham Bay ZSF's are approximately 100 feet, shallower than the 120 foot miminum depth guideline. The 120-foot-minimum depth guideline was relaxed to allow consideration of a nondispersive ZSF in the Bellingham Bay area, and because the PSDDA agencies believed that site management would minimize the resource conflicts that were the initial esaons for depth constraint.

The northeastern ZSF (alternative site A-2) in Bellingham Bay is located near south Bellingham and was the less preferred alternative ZSF site. The Bellingham Groundfish Trawlers Association suggested this ZSF as an alternative to the original ZSF due to potential trawling conflicts with the above ZSF. However, it was ultimately rejected as the preferred location by DSWG because of higher crab and shrimp resources than in the south ZSF.

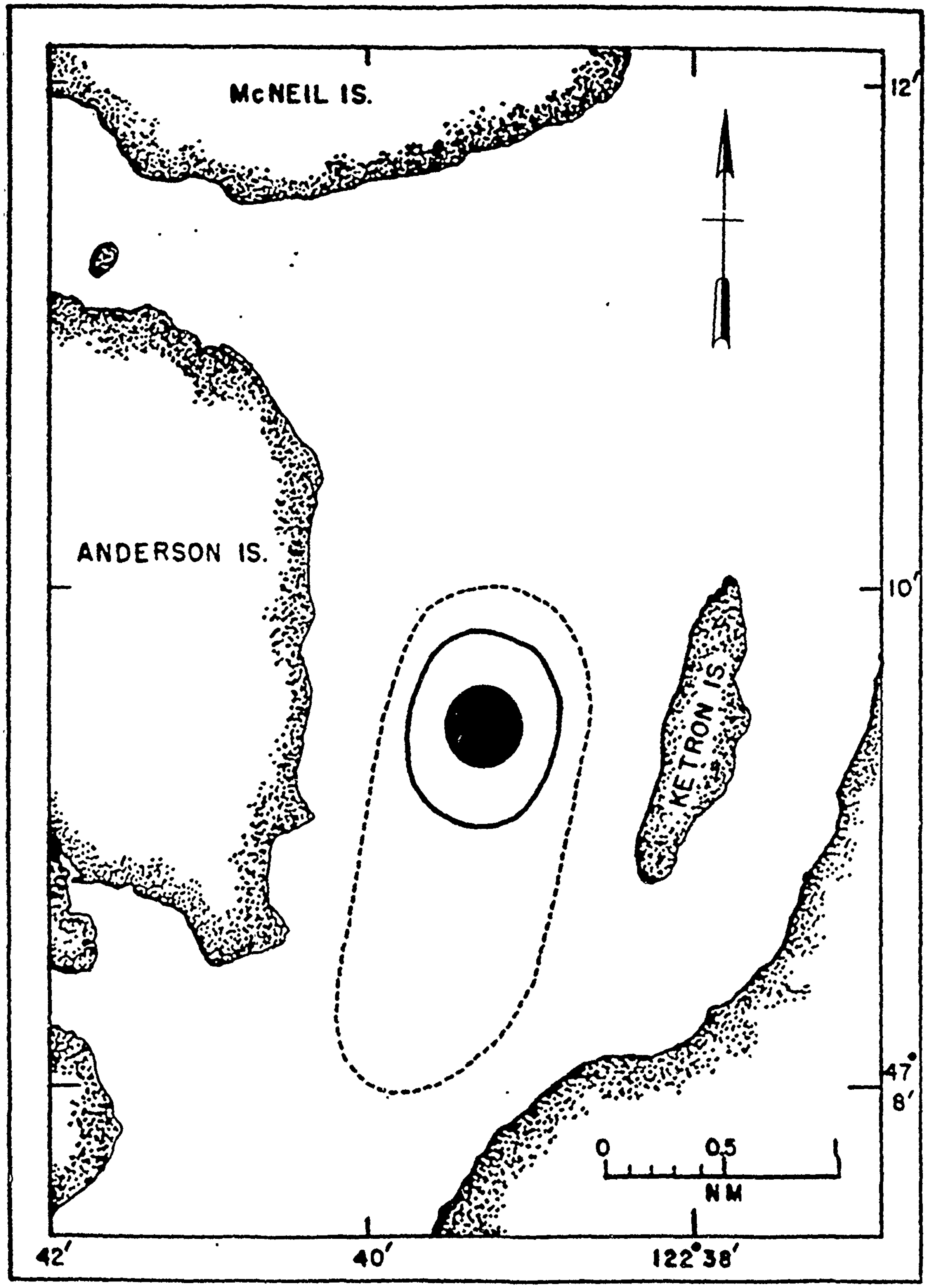


Figure 2.2 The selected Anderson/Ketron Island ZSF (dashed line), site perimeter (solid line) and disposal zone (solid circle).

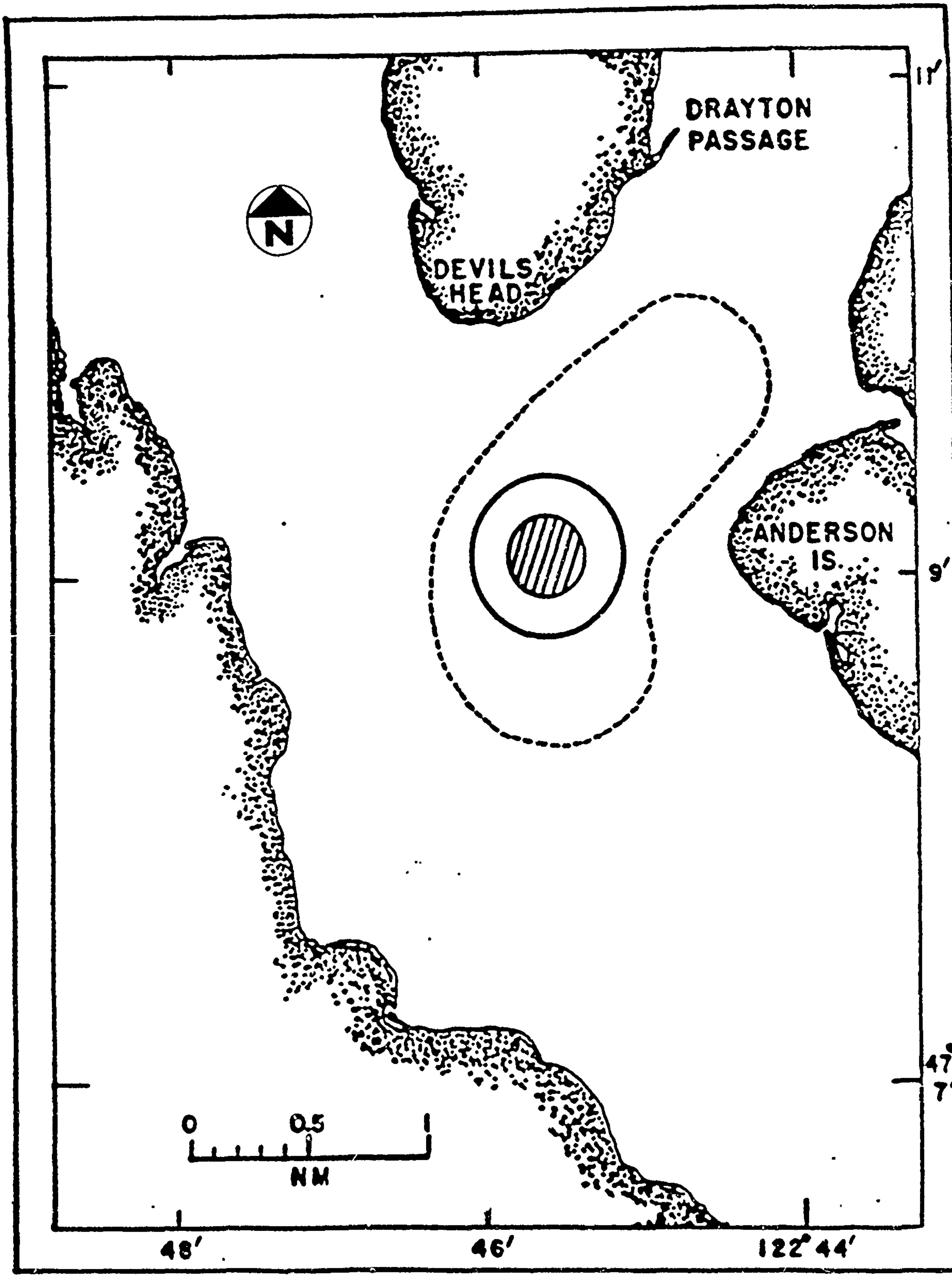


Figure 2.3 The Anderson Island/Devil's Head ZSF (dashed line), disposal site boundary (solid line), and disposal zone (circle).

The selected disposal site was recommended to DSWG by the Washington Department of Fisheries (WDF) (by letter of July 19, 1988 see exhibit D). It is located midway between the two alternative sites and is approximately 0.9 nautical mile west of Post Point. The selected disposal site is closer to denser populations of Dungeness crab than those which occur at the southern site. However, to minimize potential impacts on crab, WDF also proposed a site use restriction which would prohibit disposal operations from November 1 through February 28 each year. This 4-month restriction is in addition to the normal 3-month dredging closure period that extends from March 15 to June 15 each year when salmon and steelhead smolts are outmigrating. Accordingly, to avoid impacts to Dungeness crab, shrimp, and anadromous fish resources during critical spawning and migration periods the PSDDA agencies have established a 7.5-month disposal site closure period (November 1 through June 15). The site move was also recommended by WDF to avoid potential conflicts with bottomfish trawlers who operate in the vicinity of the southern site (A-1). Natural resources in the selected site are comparable to those in the formerly preferred site.

(e) North Sound: Lummi/Sinclair Island. The Lummi/Sinclair Island ZSF was defined using the constraints of political boundaries, navigation lanes, utility corridors, and marine fish and shellfish resources. This ZSF was proposed as a nondispersive site although it was subsequently found to be unsatisfactory in terms of the depositional criteria: average current speeds of 25.3 cm/sec exceed the 25 cm/sec/percent peak speed constraint, and sandy bottom sediments suggest that currents might move disposed material offsite. The results of the Depositional Analysis (DA) (Evans-Hamilton, Inc., 1987a) sampling indicated that the eastern portion of the ZSF was hard rock and/or a cobble/shell bottom. The northern portion of the ZSF contained relatively high densities of scallops (two to three scallops/0.1 square meter). On the basis of the resource and physical studies, PSDDA dropped this ZSF because it was highly erosive in winter.

(f) North Sound: East of Protection Island near Port Townsend. This site was briefly considered as a nondispersive ZSF. It appeared to have low bottom currents, but was eliminated from further consideration because of its proximity to the U.S. Fish and Wildlife Service (FWS) wildlife refuge on Protection Island.

(3) Identification of Dispersive ZSF's. Four potential dispersive ZSF's were identified based on considerations for marine shellfish and fisheries resources and human use concerns. The dispersive ZSF's are located in the Strait of Juan de Fuca, Rosario Strait, the southern Strait of Georgia and near Point Roberts. Subsequently, the Point Roberts ZSF was dropped due to resource concerns and potential conflicts with a deep-water trawl fishery. Following field studies and reviews of existing data, alternative sites were selected within each ZSF and prioritized after reviewing natural and human resource concerns.

(4) Description of the Dispersive ZSF's.

(a) Point Roberts (Strait of Georgia). The northern border of the Point Roberts ZSF was located approximately 5 nautical miles southeast of Point Roberts at a depth of 720 feet. The Bellingham Groundfish Trawlers Association proposed an alternative ZSF located approximately 6 nautical miles to the southwest. After coordination with WDF, Marine Fish Division, the alternative ZSF was not accepted because it is in a rocky bottom area which is also a popular recreational sport fishing area. The Point Roberts ZSF, located in a high intensive bottomfish trawling area, was dropped from final consideration due to conflicts with bottomfish trawlers. Also the one dredging project, identified as a possible user of a disposal site in this ZSF, was found to be able to transport its dredged material to the Rosario Strait Site.

(b) Rosario Strait. The northern border of the Rosario Strait ZSF is located about 1 nautical mile south of Cypress Island (figure 2.5). This location was adjusted slightly to the north and east of the original site to move it out of a cable crossing area. The selected site is located in the center of the ZSF whereas the alternative site is located approximately 0.5 nautical mile to the east. Both sites are located in about 230 feet of water.

(c) Lopez Island. The northern border of the ZSF was located about 3 nautical miles south of Lopez Island in water depths approximately 300 feet. This site was dropped from further consideration due to concerns for pelagic fish and birds, including bald eagle and peregrine falcon nesting sites.

(d) Port Townsend. The southern boundary of the ZSF is located approximately 4.6 nautical miles from the tip of Ediz Hook. The bottom topography at this site is highly variable. The depth at the center of the ZSF is approximately 420 feet (figure 2.6). The selected disposal site is located along the southwest border of the ZSF in about 361 feet of water. The alternative disposal site is located along the eastern ZSF border at the same depth.

(e) Port Angeles. The southern boundary of the ZSF is located about 4 nautical miles north of Port Angeles (figure 2.7). The eastern one-half of the originally circular site was eliminated to provide a buffer between the ZSF and a popular bottomfish trawl fishery in a rock outcropping area, called the Rockpile, located to the northeast. The selected disposal site is at the southern tip of the ZSF in about 435 feet of water. The alternative disposal site is closer to the ZSF center at a depth of 445 feet.

f. ZSF Studies and Selection Process. Literature review and resource overlay mapping was performed first. During preparation of the map overlays, an intensive literature search was made to compile the information which was used to construct the maps (see "Bibliography and Maps pertinent to the Selection of Open Water Dredge Disposal Sites in the Greater Puget Sound Region," Evans-Hamilton, Inc., 1985, on file at the Corps of Engineers Seattle

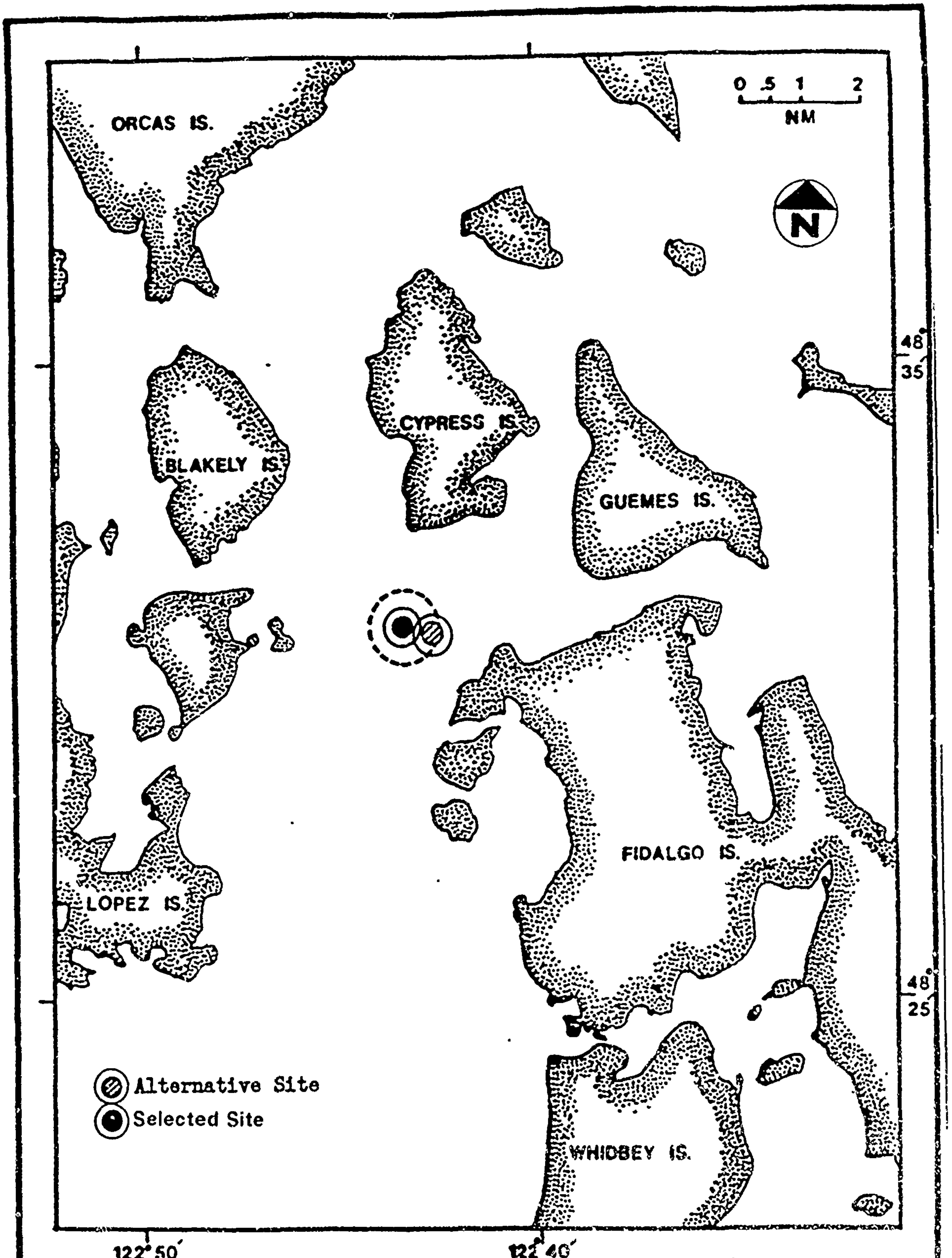


Figure 2.5 Rosario Strait ZSF (dashed line), disposal site boundary (solid line) and disposal zone (solid circle for selected and hatched circle for alternate site).

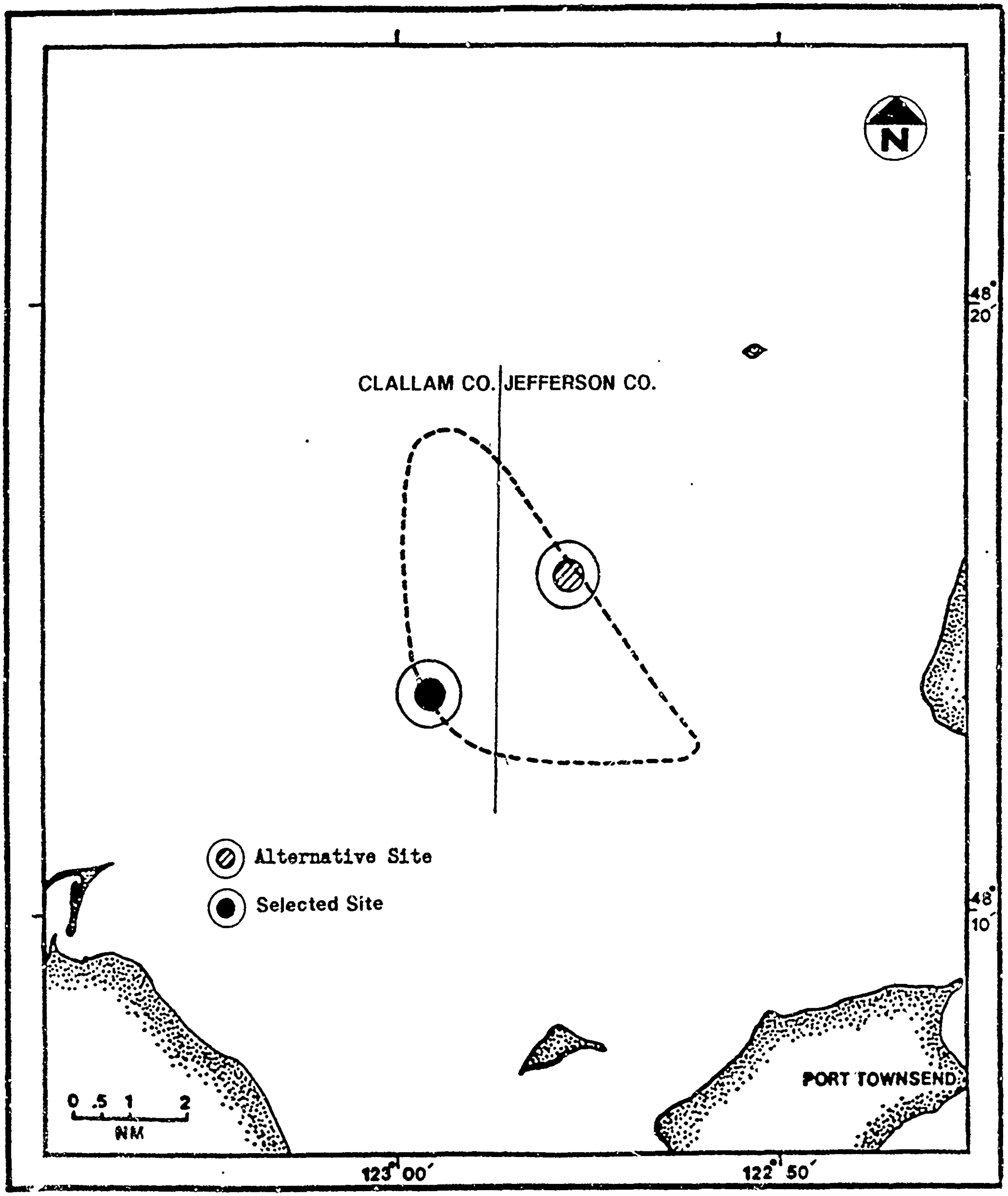


Figure 2.6 Port Townsend ZSF (dashed line), disposal site boundary (solid line), and disposal zone (solid circle for selected and hatched circle for alternate site).

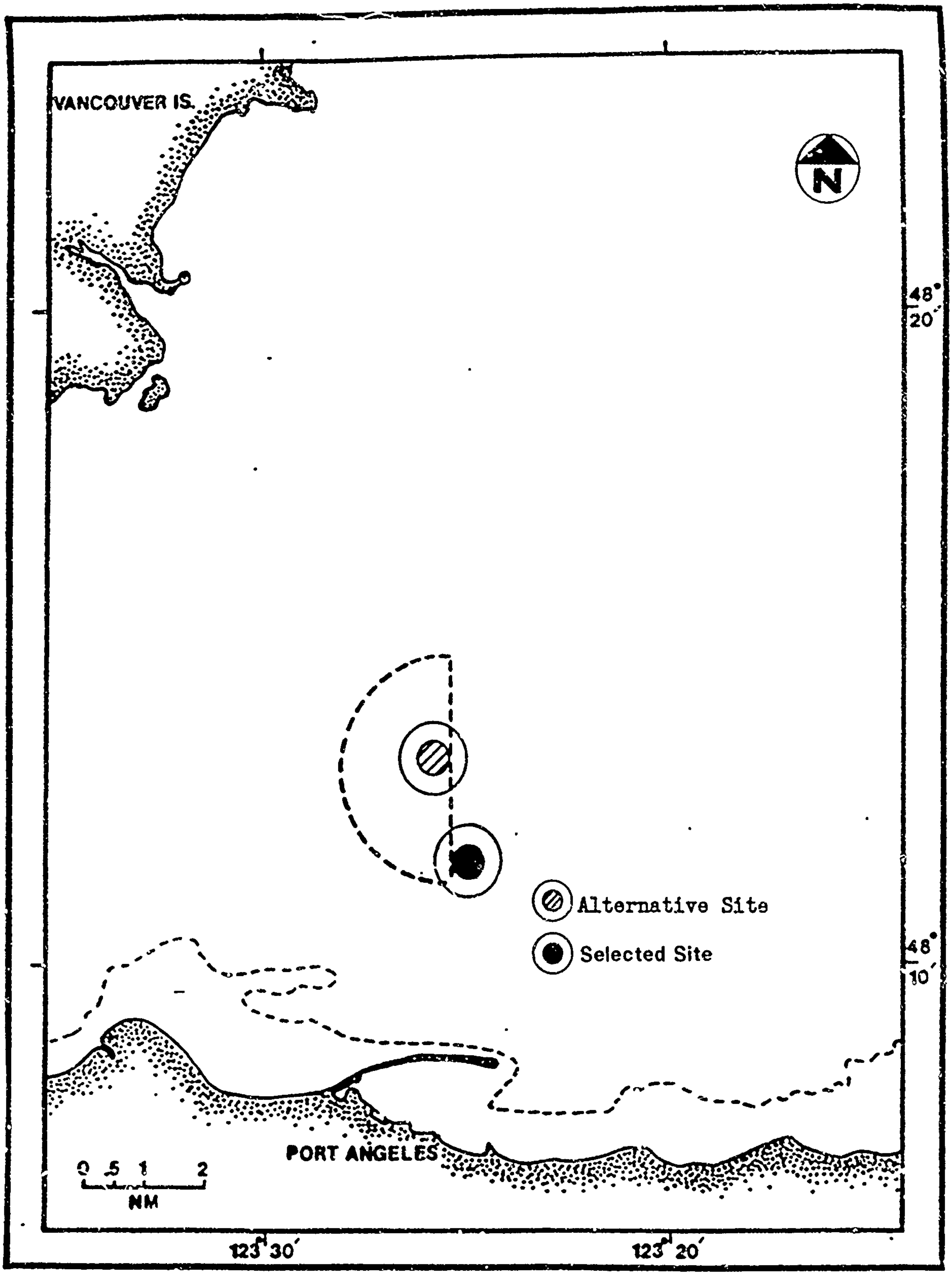


Figure 2.7 Port Angeles ZSF (dashed line), disposal site boundary (solid line) and disposal zone (solid circle for selected, hatched for alternate).

District library). The geographic area covered in the search included Puget Sound, the Strait of Juan de Fuca east of Port Angeles, and the Strait of Georgia south of the Canadian border. The overlay maps were used to locate ZSF's in areas of minimal conflict with known major navigation, shoreline, and shallow water uses and natural resources.

Field studies, involving additional natural resource data collection were also undertaken to provide additional necessary information in locating specific disposal sites. Studies focused on two issues:

- What is the depositional/erosional (nondispersive/dispersive) nature of areas within each ZSF? Can acceptable nondispersive sites be identified?

- What is the value of the ZSF's to biological resources of concern (e.g., crab, bottomfish, and shrimp). Emphasis was given to species which would be in direct contact with the dredged material on the sea floor.

To investigate the depositional nature of each ZSF, current strengths were determined by an examination and analysis of historical field data, and predicated current velocities were identified and mapped. Results indicated that both Bellingham Bay ZSF's lay in relatively low current velocity areas. Currents were also found to be relatively low in both of the south sound nondispersive ZSF's. The south sound ZSF boundaries were adjusted to encompass the entire impact area of a disposal site located in the ZSF. The disposal site (i.e., impact area) was drawn to follow the naturally confining bathymetric features of the bottom that indicates where the material will remain. Material disposed at sites in the nondispersive ZSF's is not expected to move out of the site boundaries based on numerical model studies (see Phase II DSSTA). All of the north sound dispersive ZSF's are located in areas where currents are so strong that most sediments are expected to erode and disperse rapidly to surrounding areas.

Resource mapping and literature review revealed several key information gaps for ZSF's. In order to better define characteristics of potential disposal sites within ZSF's, a series of site specific field studies were undertaken. Sediments in and near the candidate nondispersive sites in southern Puget Sound and Bellingham Bay were sampled and analyzed in order to identify and locate depositional zones and to identify and quantify seasonal abundance and distribution of biological resources such as bottomfish, crabs, shrimp, sea urchins, and sea cucumbers. Benthic resources were also quantified in the nondispersive study areas, and bottomfish feeding habitat assessments were made. Fishery resource investigations of a more limited scope were also performed at four dispersive ZSF's during spring and fall of 1987.

(1) Site Indentification and ZSF Specific Studies.

Overview. Preliminary disposal site locations within the ZSF's were identified using information obtained from literature, calculation and field studies. Two factors were emphasized in locating the nondispersive disposal sites: (1) a low abundance of commercially important animals (e.g., small numbers of crab, shrimp, and bottomfish) and (2) nondispersive characteristics (e.g., sediment and current characteristics indicating that sediments would stay within the disposal site). Dispersive ZSF's were identified because of the need for reasonably accessible sites throughout the Phase II area. It was not possible to locate more than one nondispersive disposal area in the north sound. Two factors were emphasized in locating the dispersive disposal sites: (1) considerations for marine shellfish and fisheries resources and other natural resources and human use concerns (i.e., pelagic bird communities and trawling areas) and (2) the presence of a highly dispersive area (i.e., sediment and current characteristics indicating that disposed sediments would eventually move off the disposal site). Studies involved biological resources in/near the ZSF's, investigations relating to the dispersive or nondispersive nature of the areas represented by the ZSF's, and studies to determine the fate of the material to be disposed at sites located in these conditions. Preliminary sites were identified in all of the ZSF's after field studies were completed. Preferred and alternative sites were ultimately selected within each of the ZSF's. Further studies were undertaken to establish the appropriate disposal zone and primary bottom impact areas, for the disposal sites.

The following paragraphs describe field, literature and numerical studies.

(a) Biological Resources. Specific studies were conducted for the sites including trawls accounting for the seasonal abundance of critical resources such as crab, shrimp, and bottomfish. Also, boxcore sampling was accomplished to quantify and assess the benthic habitat values and estimate bottomfish foraging habitat potential with the Benthic Resources Assessment Technique (BRAT) at the nondispersive sites. Bottom conditions at the dispersive sites make BRAT studies, which investigate organisms living within the sediments, infeasible and uninformative. In dispersive locations, these infauna are virtually absent and the bottom sediments are frequently too difficult to penetrate for conventional animal sampling techniques to work. In addition, the principal kind of benthic organisms at these sites are epifaunal, living on the surface; these include crab, shrimp, urchins and scallops, which were studied via the trawling studies. Data were utilized to assess each of the disposal zones relative to natural resources. Maps developed for these determinations were overlaid on other usage maps, e.g., navigation lane maps, to identify disposal sites that best fit the desired site conditions.

(b) Nondispersive Versus Dispersive Probability. The likelihood that dredged material would remain within the disposal site was evaluated using a number of approaches.

First, the maximum currents within each ZSF were mapped using historical data. These results were compared with speeds that were observed during special field studies in Dana Passage (Sternberg and Collias, 1973) to mobilize and transport sediment. In this study, dredged material was observed to be resuspended and transported at speeds above approximately 0.5 knot (25 cm/sec).

Second, using a technique called depositional analysis (Evans-Hamilton, Inc., 1987a), four sediment characteristics within the ZSF's, grain size, sediment biochemical oxygen demand, percent moisture, and percent volatile solids, were mapped and analyzed for significant differences using a statistical technique. An area was classified as nondispersive and depositional in character if its sediments had the following characteristics: small grain size, high biological oxygen demand, high percent water, and high volatile solids. This technique is described in detail in Phase II DSSTA, and is summarized in 2.03f(2)(a), below.

Third, the potential fate of resuspended materials was evaluated within the ZSF's to avoid impacts downstream on sensitive habitats.

(c) Size of the Disposal Site. A numerical model called DIFID (disposal from an instantaneous dump) (Trawle and Johnson, 1986a) was used to simulate dredged material disposal in an unconfined, open-water environment as it passes through the water column for a variety of possible water depths, current speeds, and sediment types. For information on the model, see section 2.03f(2)(b). The size of the disposal zone, where the material would likely land, and the disposal site, which represents the limits of the model to predict a measurable thickness of material accumulation, was generated for each preferred and alternate site. The model predicts these dimensions based on bottom physical effects that would result from repeated dumps. For nondispersive sites, and 1,800-foot-diameter disposal zone and a variable disposal site diameter (for Bellingham Bay, 3,800 diameter feet, slightly more in the case of the Nisqually sites) were predicted (see table 2.4). For a dispersive site, a 3,000-foot-diameter disposal zone for a dispersive site and either a 6,000- or a 7,000-foot disposal site diameter resulted from the runs of the model.

(2) Physical and Numerical Studies.

(a) Nondispersive versus Dispersive Site Characters.

1. Depositional Analysis/Sediment Characterization in Nondispersive ZSF's. The objective was to locate large enough areas within the nondispersive ZSF's to encompass preliminary disposal sites where sediments tend to deposit rather than erode. These determinations were made from maps and statistical evaluations of sediment characteristics. Previous work by Word, et al. (1984a), indicate that sediments in Puget Sound tend to accumulate where existing sediments meet four criteria when compared to sediments at similar depths: (1) small grain size, (2) statistically elevated volatile solids, (3) statistically elevated five-day biochemical oxygen demand (BOD_5), and (4) statistically elevated water content. During PSDDA field studies measurements were made in the ZSF's at a total of 251 stations in order to provide the data for the dispositional analysis.

TABLE 2.4

LOCATIONS AND DIMENSIONS OF SITES FOR PHASE II

Site	Latitude Deg	Latitude Min	Longitude Deg	Longitude Min	Depth (Ft) (MLLW)	Disposal Site Dimensions (Diameter) (Ft)	Disposal Site Area Acres
Anderson/Ketron Island							
Selected	47	09.43	122	39.40	442	4400 x 3600 1/	318
Alternate	47	09.06	122	45.61	238	4200	318
Bellingham Bay							
Selected	48	42.83	122	33.03	96	3800	260
Alternate 1	48	41.83	122	33.60	98	3800	260
Alternate 2	48	43.82	122	32.50	95	3800	260
Rosario Strait							
Selected	48	30.88	122	43.48	230	6000	650
Alternate	48	30.70	122	42.73	230	6000	650
Port Townsend							
Selected	48	13.62	122	58.95	361	7000	884
Alternate	48	15.28	122	55.60	361	7000	884
Port Angeles							
Selected	48	11.68	123	24.86	435	7000	884
Alternate	48	13.20	123	25.65	435	7000	884

1/This site is oval, the rest are circular.

The assessment of depositional potential was determined from characteristics of the sediments in the ZSF's. The analysis is shown in Evans-Hamilton, Inc. (1987a) and Phase II DSSTA, and is summarized here. The maps prepared for these conventional parameters were derived from the upper two centimeters of sediment. As sediments deposit naturally at the rate of 0.5 to 2 centimeters per year (Lavelle, et al., 1986), the depth sampled by conventional methods represents approximately 2 years of accumulated sediment. Sediment characteristics were assesed to locate depositional sites because they provide a longer period of sediment accumulation than did the REMOTS (a photographic benthic survey technique), which was used in Phase I (see Phase I DSSTA). In preparing the maps, a statistical method was employed to determine if individual stations in the original ZSF's were more depositional in nature than other stations at a similar depth. The mean, standard deviation, and 95 percent confidence interval, were calculated for each sediment parameter for each depth using data from all 251 stations as described by Word et al. (1984a,b). A station was considered depositional if the percent volatile solids (%VS), BOD_5, or percent water exceeded the 95 percent confidence limit for the depth contour on which the station was located. In addition, the sediment grain size had to have a mean size of 7 percent fine silt, 8 percent very fine silt, or 9 percent clay to be considered depositional. The results from the depositional analysis are shown below, and repeated as appropriate in sections 3 and 4 to characterize the environment and impacts.

- McNeil Island ZSF. The field data for the McNeil Island ZSF in south Puget Sound showed it to be unsuitable for use as a nondispersive site, and the entire ZSF was removed from further consideration.

- Anderson/Ketron Island ZSF 2. The median grain size at the extreme northern and southern parts of the study area was predominantly medium to very fine sand with percentages of clay ranging from 4 to 8 percent. Areas containing higher organic content and smaller grain sizes overlay much of the ZSF. This indicates a low energy area where sediments are being deposited naturally. The suitability of this site for the disposal of dredge material appeared to be very good, for dredge material which has erodability characteristics similar to those of the existing bottom sediment. The area that appears to be the most depositional is situated between Anderson Island and the southern end of Ketron Island in the center of the basin, where the site was ultimately located. The %VS throughout the study area ranged from less than 1 percent to 4 percent. The greatest amount of organic material was found at the base of slopes between the Anderson and Ketron Islands. Low BOD_5 values occured at relatively shallow depth along the margin of the two islands. Low values also occured at the northern and southern margins of the ZSF. Elevations in BOD_5 beyond the 95 percent confidence interval were found throughout most of the ZSF and along the western edge of the study area and ZSF. Trends in percent water were similar to those seen for BOD_5 and %VS.

- Anderson Island/Devils Head ZSF 3. The data tended to indicate that the site was marginal or mixed in terms of nondispersive characteristics. Low levels of both BOD_5 and %VS occured in the south end of the ZSF and high values occured to the northwest towards Drayton Passage. The percentages of water in the sediments in the study area surrounding the ZSF ranged from 30 percent to over 50 percent. The median grain size consisted of medium sand southeast of the ZSF grading to very fine sand and fine silt within the ZSF. Coarse to fine silt predominated in the two areas with elevated amounts of organic material and a greater percent water. The area of lowest energy in the study area appeared to be located at the entrance to Drayton Passage, where the alternate site was located. This area contained the greatest amount of organic material.

- Bellingham Bay. The study area had all the attributes of a very low energy, depositional environment. The area that appeared to be the most depositional in the study area was roughly 0.5 nautical miles due north of the south ZSF. The grain size was predominantly silt in this area and percent clay ranged from 18 to 20 percent. The %VS and BOD_5 showed increasing concentrations from the southwest to the north and from the northeast into the center of the study area. Both measures showed a high and uniform concentration throughout the center of the bay and in the ZSF. Percent water shows the same pattern as seen in the BOD_5 and %VS. Percent water values increase from approximately 30 percent at the western and northwestern edges to over 60 percent in the center and southeastern portions of the study area. The median grain size patterns in Bellingham Bay are medium sand grading to very fine sand off the eastern shore and the south end of Portage Island. The amount of clay increased from the east and west sides of the bay towards the center of the area, and is roughly constant at 16 to 18 percent within the ZSF. It was evident that the sediments in the Bellingham Bay ZSF contain a large amount of organic material. The BOD_5 concentrations were high, and ranged from 2,000 to 2,500 mg/kg of sediment, and %VS were in excess of 8 percent while percent water ranged around 70 percent.

- Lummi/Sinclair Island. Field data indicated that there was a large component of sand at all but two stations in the ZSF, and three to four live scallops in each $0.1m^2$ van Veen grab sample. The obvious lack of clay/silt sediments and the presence of scallops indicate high current areas; hence this ZSF was removed from further consideration as a potential nondispersive disposal site.

2. Current Studies. In these studies, the central questions were: (1) will the dredged material remain in the nondispersive areas, or (2) will it erode from the dispersive areas? Newly deposited dredged material containing substantial amounts of silts and clays begins to erode when the current speed exceeds a threshold of approximately 25 cm/sec (0.5 knot or 0.85 feet per second). Dispersive ZSF areas were sought where average current speeds were well in excess of 25 cm/sec. Maps of current strength and direction were also prepared for the nondispersive ZSF's to verify that extreme (1 percent peak) speeds were less than 25 cm/sec to ensure that sediments tend to accumulate. Current strength in each of the ZSF's was determined using current meter data. When possible these data were supplemented using data obtained from drifting objects. In addition, estimates were generated with a numeric model for the dispersive ZSF's.

Several hundred current meter records were reviewed. Statistical computations were made for those records which met the following criteria: (1) the measurements were taken at fixed locations; (2) both speed and direction were recorded; (3) the speed measurement was consistently above the minimal recording value of the instrument; and (4) the measurements lasted one tidal cycle (24.84 hours). A computer model was also used to fill in gaps between field data. The model used was developed by Crean (1983) and was a numerical hydrodynamic model that simulates tides within the Straits of Georgia-Juan de Fuca system.

a. Nondispersive ZSF's. The strength of currents in Puget Sound have been estimated in a number of ways. Various investigators have examined mean speed (mean of all speeds in a current meter record regardless of direction), total variance, root-mean-square speed and peak speeds (Cox, et al., 1984); Ebbesmeyer, et al., 1984). The interrelationship of various current parameters for Puget Sound are described in Phase I DSCTA. From the correlations amongst the measures of current strength, linear regression models were utilized to predict extremes. The results are summarized below and repeated as appropriate in sections 3 and 4 for the specific sites.

- Anderson/Ketron Island ZSF 2. Few current meter records are available from the reach between the Nisqually River delta and Tacoma Narrows. Fortunately, two records were obtained within the disposal area. Deeper records at each site, which were above the bottom by a minimum of 15 meters, were used to evaluate currents in the ZSF. The results indicate that currents in this disposal site can be near or above the threshold for fine particle transport. However, the meters were measuring mid- to lower water column and not the bottom current conditions. Also, depositional analysis is more relevant to bottom conditions, and the above results indicate all the features of a depositional environment. Thus it was concluded that the area has a nondispersive character and that material placed at the site should stay there.

b. Dispersive ZSF's. Mean current speeds were calculated from both field measurements and Crean's (1983) model results. Using the desired relationship between mean speed and 1 percent peak speed, mean speeds exceeding 9 cm/s should indicate the presence of current speeds in excess of 25 cm/s (sediment movement threshold speed) during at least 1 percent of the time; therefore, at areas with mean speeds exceeding 9 cm, sediment resuspension should occur to some extent. Depth-averaged maximum tidal currents (spring and neap tides) were also estimated.

- Rosario Strait. Mean speeds surrounding the Rosario Strait ZSF range from 36 to 69 centimeters per second, and maximum or peak speeds are approximately 100 cm/sec, capable of flowing in many directions. The area displays a predominantly single layer southern (seaward) flow with net speeds between 10-30 cm/sec.

- Port Townsend. Data show highest speeds north of Port Townsend at the entrance to Admiralty Inlet, decreasing nearer the ZSF. Field data indicate mean speeds within the ZSF range from the 30 to 50 centimeters per second, whereas Cran's model values range from 20-25 cm/sec. The spring ebb is the strongest tidal current with a peak speed around 100 cm/sec. The neap flood has a peak speed of approximately 75 cm/sec. The ebb tides flow westerly and the flood tides flow easterly. The area shows a predominantly two-layered flow, with shallower than 50 meter water flowing approximately 30 cm/sec seaward and the deeper water flowing soundward at a slower rate.

- Port Angeles. No field data are available in the ZSF, but extrapolating from existing current meter data, it appears that the mean speed is between 40 and 50 cm/sec; using the numerical model, a somewhat lower value of 35 cm/sec is obtained. Spring ebb and neap flood tidal currents have peak speeds of about 125 cm/sec, and the other extreme tides range down to about 65 cm/sec (neap ebb). The ebb tides flow westerly and the flood tides flow easterly. The flow is two-layered, seaward near the surface and soundward in the lower depths below approximately 30-50 meters.

(b) Size of Disposal Site and Fate of Material.

1. Numerical Dredged Material Disposal Model (DIFID). The objective of the dredged material disposal modeling effort was to predict the short-term fate of dredged material which may be disposed in the Phase II area. These estimates, combined with an estimate of the target (drop) zone diameter, provided an initial assessment of the sediment pattern that might be caused by repeated disposal operations within a nondispersive ZSF and the pattern from a single disposal at a dispersive ZSF. A dredged material disposal event is separated into three physical phases. The first is convective descent, during which the fluid jet of dredged material falls from a bottom dump barge to the bottom under the influence of gravity. It occurs rapidly, since the terminal velocity of dredged material in water may exceed 10 feet per second and, at the depths of the PSDDA sites, is completed in less than 2 minutes. In the environmental analysis, this phase is used to characterize the area of "killing velocity," since the impact is too fast to be avoided even by mobile bottom-dwelling animals at ground zero. Second, a dynamic collapse phase occurs when the jet of material impacts the bottom. This occurs more slowly, and spreads the material laterally in several hours to several days. This kind of movement could cover and smother nonmobile benthic organisms that are unable to avoid the material. However, many invertebrates are known to be able to "dig out" of the material when it is not too deep or has not fallen directly on top of them. The third phase could take days or weeks in a nondispersive site, but would probably not have a chance to occur in a dispersive site. This is the long-term passive diffusion phase of the material, which causes it to assume a thin pancake-like shape in a nondispersive site. The model runs of DIFID give information on spreading of the dredged material after all phases have occurred.

The final size, orientation, and configuration of the disposal site were based on the results of the disposal model with those of depositional analysis, current characteristics, and bottom topography. The initial estimates of disposal zone size were also used to determine the regional sampling plans for mapping biological resources. The numerical dredged material disposal model DIFID (Trawle and Johnson, 1986a) was used to simulate the barge disposal of dredged material. The model predicted the pattern of disposed material on the bottom for each of a number of test conditions. The input data required for DIFID fall into four groups: (1) a description of the ambient environment at the disposal site, (2) characterization of the dredged material, (3) data describing the disposal operations, and (4) model coefficients.

The test conditions included water depth, ambient current, material dumped, and bulk density of the material in the barge. The dumping of two types of material was simulated by the model in these tests. These types were chosen to represent the most representative materials dumped into Puget Sound. The primary material tested consisted of 25 percent fine sand and 75 percent clay/silt. The clay/silt fraction was modeled both as cohesive and noncohesive material. The other material consisted of 50 percent fine sand and 50 percent medium sand with no clay/silt. For a description of the model and test results see Trawle and Johnson (1986a) and Phase I DSSTA.

2. Preliminary Disposal Site Dimensions. The disposal zones of the nondispersive disposal sites are circular areas measuring 1,800 feet in diameter. This area circumscribes the DNR prescribed "disposal zone" for a disposal barge, or the area within which the dredged material must be released at the water surface. To evaluate the effects of dredged material on bottom dwelling animals, it was necessary to define a larger impact area within which the material would be deposited, based on a series of dumps, integrated by numerous runs of numerical dredged material disposal model. To plan the PSDDA field studies, preliminary dimensions were chosen, later modified as a result of the field studies. A typical PSDDA nondispersive disposal site consists of three elements (figure 2-8). The target area A and disposal zone B lie within long-term bottom impact Area C, defined as the disposal site. The disposal barges should open their hoppers within the target area, but allowing for some error or maneuverability problems within an area no larger than the disposal zone.

For a nondispersive site, the disposal site circumscribes the horizontal spread over a period of repeated dumps of the dredged material after it is released at different locations within the disposal zone during both flood and ebb tides (assuming a current speed of 0.5 knot or 0.85 feet per second at the time of disposal). The dimensions of the dump site were chosen using results corresponding to typical water depths and currents envisioned for the disposal sites. Based on model test for 400 feet water depth and a 0.5 knot current (0.85 feet per second), test results indicated a horizontal spread of approximately 1,000 feet downstream from the dump spot and 600 feet to either side. As a precaution, 600 feet and 1,000 feet were added to the short and long (tidal current direction) dimensions, respectively, to arrive at the size (3,000 by 3,800 feet) of the ellipse shown in figure 2.8 for a typical site located on a flat bottom with back-and-forth tidal currents.

For a dispersive site, the disposal site circumscribes the horizontal spread of a single dump of dredged material released within the disposal zone. The use of a single dump instead of repeated dumps reflects the dispersive nature of the site which was expected to rapidly move material offsite. (This is borne out by the calculations shown in section 2.03f(2)(b)2.) The distance required for a dump is 3,000 feet, assuming an average tow speed of 3 knots (5.07 feet per second) during the dump and a time of 10 minutes required for a dump. Based on a water depth of 400 feet and an average current of 1 knot (1.69 feet per second). Results indicate a horizontal spread of approximately 2,000 feet downstream from the dump spot and 1,000 feet to either side. The calculated disposal site ellipse has a size of 5,000 to 7,000 feet as shown in figure 2.9. The dimensions of the disposal site vary with the site bathymetry and water depth. Figure 2.10 shows the site dimensions for the three Phase II preferred dispersive sites.

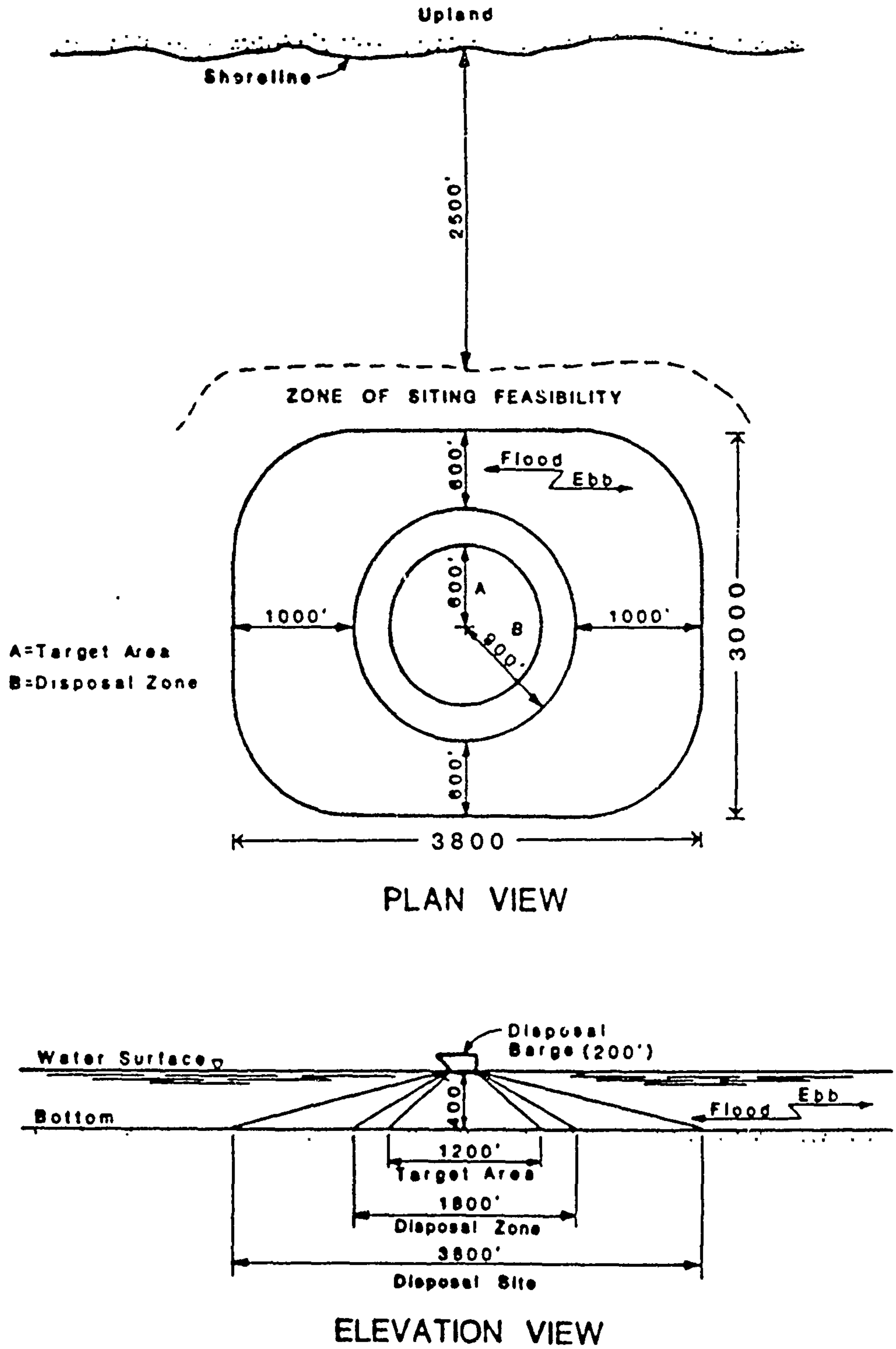


Figure 2.8 Typical Site Dimensions for a Nondispersive Site

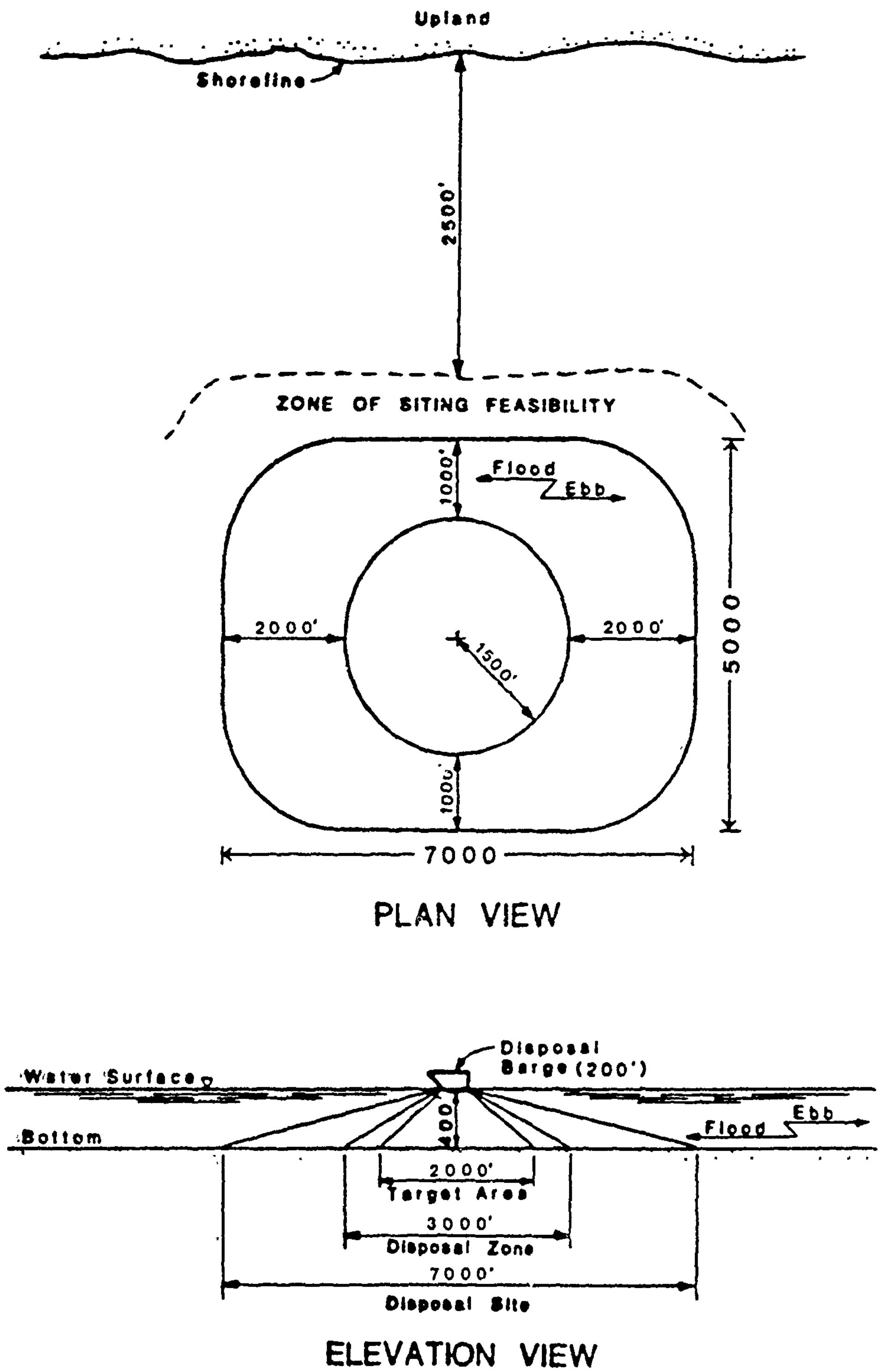


Figure 2.9 Typical Site Dimensions for a Dispersive Site

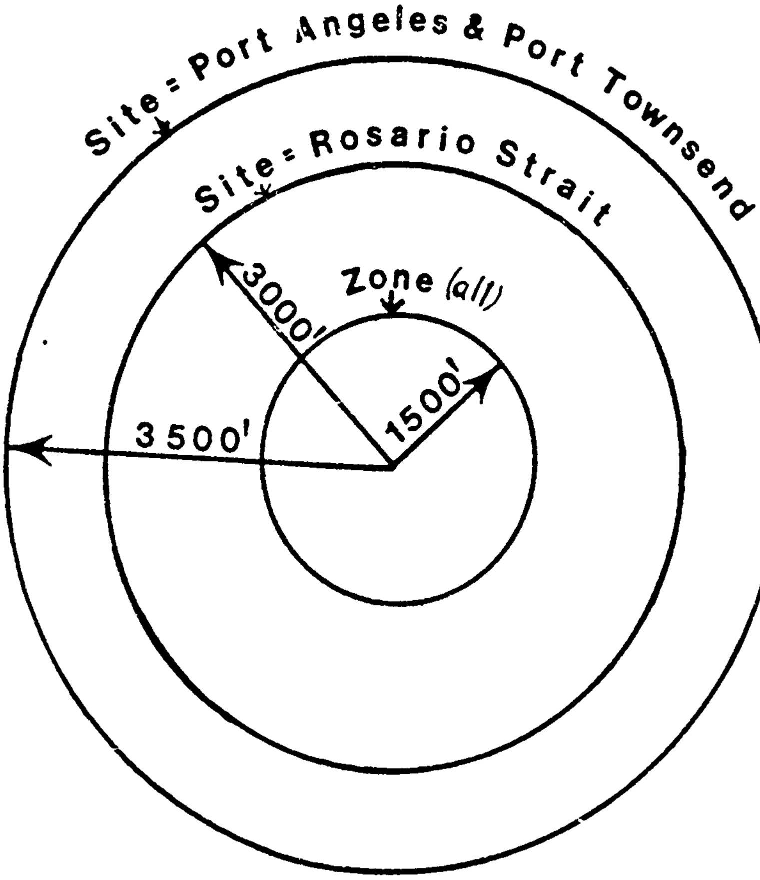


Figure 2.10 Calculated Site dimensions for Phase II Dispersive Sites

3. Fate of Dredged Material. Although the purpose of locating nondispersive sites is to find areas in which the disposal material will not be transported away from the site, the fate of that dredged material is also important. Undoubtedly a small, probably undetectable, fraction of the disposal material deposited in the nondispersive ZSF's could also be transported beyond the disposal site boundaries. Transport offsite can occur through transport offsite by prevailing currents of the 1 to 5 percent of the material remaining suspended in the water column after the main mass of material reaches the bottom (Phase I DSSTA). This would also occur in a dispersive site. Additionally, at a dispersive site, the majority of the mean current speeds through the dispersive ZSF areas are greater than the threshold speed (25 cm/sec) above which sediment that reaches the bottom becomes transported. Therefore, all of the clay/silt fraction that reaches the bottom at a dispersive site will eventually become resuspended and transported with the prevailing current. Unusually strong currents in the nondispersive ZSF's may resuspend a small portion of the disposal material; however, this should occur very infrequently.

The composition of the sediment being disposed is an important factor in determining sediment fate. During the dredging operation the clamshell dredge can deliver sediments in a "clumpy" condition which allows the disposal operations to be more predictable, with sediment fate more easily controlled. Tests have shown that material disposed by a bottom dump barge tends to remain intact and falls to the bottom as a mass at a high rate of speed. These clumps attain terminal velocity quickly after release. After impact, the material breaks up and its ultimate dispersion is dependent on currents and bed slope at the point of impact. Field measurements by Gorden (1974), Sustar and Wakeman (1977), Bokuniewics, et al. (1978), and Tavolaro (1982, 1984) indicate that 1 to 5 percent of the material is stripped from the descending jet. The rest falls to the bottom immediately below the disposal barge. Based on the numerical model study conducted for PSDDA Phase I by Trawle and Johnson (1986a), most of the material is expected to settle within 1 hour within a 600-foot radius of the center of the dump.

The velocity of water currents also affects the distribution of sediment particle sizes in unconsolidated soft bottom material. Coarser sediments occur in higher current environments, while fine-grained sediments occur in lower energy environments. For example, a current velocity of 0.4 knot (20.6 cm/sec) will shift ordinary sand along the bottom, while a current of 1 knot (51.5 cm/sec) will shift fine gravel. A current of 2.15 knots (111 cm/sec) will move coarse gravel 2.5 cm in diameter, and 3.5 knots (180 cm/sec) will move angular stones up to 3.8 cm in diameter (Moore, 1958). Therefore, to a substantial degree currents determine the grain size distribution of sediments.

The historical current data were examined to determine possible pathways by which the suspended sediment may be carried by prevailing currents. Current meter records previously examined for current strength were used to compute prevailing net current speeds and directions. The following sections describe the thickness of disposed sediments based on the WES model and on measurements of natural deposition rates. When natural sediment rates were available, computation was made to estimate approximate resulting sediment thickness. In addition, the dispersion of suspended and resuspended materials specific to each ZSF are compared with naturally occurring sediments and transport processes.

4. Thickness of Disposed Sediments at Nondispersive ZSF's. Sediment thickness calculations are discussed in detail in Phase II DSSTA, section 7. In areas of low current, most of the suspended material will eventually settle in the disposal site. Thicknesses stated below assume a worst-case scenario in which the suspended material equals 5 percent and a thin layer settles in an area adjacent to the disposal site. The depths are based on 15-year projections (1985-2000) of dredged material that would be considered for discharge at these sites and that would likely pass the PSDDA disposal guidelines (for which, see table 2.8). (Actual volumes placed at the sites are expected to be significantly less as the projections include speculative projects and some of the clean materials will be used for landfill.)

- Anderson/Ketron Island ZSF 2. The disposal zone depth averages 442 feet. The WES model (simulating a 400-foot disposal depth) yields dredged material accumulation rates varying between 0.167 to 0.459 gm/cm^2. Based on ambient data, the natural sediment accumulation rate is approximately .00559 gm/cm^2/year, or 3.3 to 1.2 percent of that expected if all acceptable dredged material were discharged at the site. This amounts to 1.6 percent of the natural accumulation estimated by the Carpenter, et al. (1985), study.

- Anderson Island/Devils Head ZSF 3. The average water depth at the Devils Head disposal zone is 238 feet. The closest depth simulated by the WES model is 200 feet. Mass accumulation rates using the model ranged from 0.458 to 0.995 gm/cm^2. The thickness of the initially 5 percent suspended sediment is estimated at 0.00856. This value is about 2.5 to 1 percent of the model rates from Carpenter, et al. (1985).

- Bellingham Bay. All of the alternative Bellingham Bay disposal zones average 98 feet, the shallowest of all PSDDA sites. The closest WES model run is at 200 feet with sediment accumulation rates of 0.458 to 0.995 gm/cm^2 per year for projections of dredged material that could be discharged at the site. This is approximately equivalent to natural deposition in a year.

5. Anticipated Effect of Dredged Material Disposal at Nondispersive ZSF's. Assuming that 95 percent of the dredged material settles to the bottom and that particles settle at a slow speed of 0.0017 feet per second, a time of about 10 hours is required for the remaining 5 percent to be deposited on the bottom. In a site that has a radius of approximately 2,000 feet, with the disposal zone at the center, and a bottom current of 0.1 feet per second (3 cm per second), a time of about 5.5 hours would be required to transport a sediment particle out of the site. Thus, an additional 2 to 3 percent of the dredge material will be deposited within the site, leaving 2 to 3 percent that could be transported beyond the site.

6. Thickness of Disposed Sediments at Dispersive ZSF's. Sediment thickness is discussed below as determined from the WES model and the natural deposition rate. The depositional patterns will vary depending upon the phase and type of tide during which disposal occurs. Slack and major floods represent the extremes. During slack water, the possibility of current reversal could cause larger thicknesses than estimated.

- Rosario Strait. The average water depth of the Rosario Strait ZSF is 180 feet, the shallowest of the dispersive ZSF's. Dredged material deposition rates are estimated at 0.076 $gm/cm^2/year$, or about 6 to 13 times greater than Carpenter's (1958) estimated range of the natural deposition rates in this area.

- Port Townsend. The average water depth is 420 feet. (It is not possible to estimate the natural deposition rates in this area.) The WES model yielded a range from 0.167 gm/cm^2 to 0.459 gm/cm^2 for projected dredged material.

- Port Angeles. The average water depth is 420 feet. (It is not possible to estimate natural deposition rates at this site.) The WES model calculates a mass per unit area ranging from 0.167 gm/cm^2 to 0.459 gm/cm^2.

7. Anticipated Effect of Dredged Material Disposal at Dispersive Sites. Because the mean current speeds lie substantially above the threshold speed above which fine sediment becomes eroded, the disposal sediments in the three dispersive ZSF's where sites have been selected will resuspend and move with the prevailing currents. These materials were considered along with the other materials that were initially suspended in the water column in relation to naturally occurring materials.

The seasonal distributions of total suspended solids were determined by Baker, et al. (1978) for the area north of Admiralty Inlet, east of Port Angeles, and south of the Fraser River betwen November 1976 and August 1977. Values typically ranged from 0.5 to 2 milligrams per liter throughout most of the area. The highest concentrations were observed near the Fraser River (8 milligrams per liter) and Deception Pass (2 to 3 milligrams per liter) during November 1976 and August 1977. Vertical distributions of suspended particulate matter showed highest concentrations in the surface and near bottom waters. (These high surface concentrations are believed to be due to both freshwater runoff and phytoplankton.) Seasonal variability was insignificant on a regional basis except for areas directly influenced by river runoff. Day-to-day variability was most pronounced near major sediment sources and at stations characterized by large tidal excursions. Elevated levels near the bottom are probably related to resuspension processes.

A considerable amount of sediment is discharged by local rivers. The Fraser and Skagit Rivers discharge approximately 24 million metric tons annually (Baker, et al., 1978). If all of this material were to deposit on the bottom at the high bulk density seen in dredging disposal operations (1.35 g/cc), this mass of material would be equivalent to 57 million c.y. of dredged material. Additional sediment is contributed by erosion from local cliffs. The amount of sediment discharged by the rivers may be compared with estimates of the sediment accumulating on the bottom. In general, the accumulation rates in northern Puget Sound appear to be approximately 200 to 300 milligrams per square cm per year.

An important selection factor for the Phase II dispersive ZSF's was that the ZSF's be located where the disposed sediment would be dispersed rapidly over a wide region. The circulation data presented above, combined with the results of numerical modeling studies, provide information to allow a rough check on the dispersive nature of the Phase II sites and the effects of disposal operations on natural conditions.

8. Effect of Disposal on Suspended Solids Concentrations. The following estimates of the short-term effects due to the disposal of dredged material assume that the dredging operations are conducted using a clamshell dredge and bottom dump barge. When dredged material is released from a barge, it descends through the water column as a dense fluid like jet. When this jet hits the bottom it collapses. At a nondispersive site, where peak current speeds are less than about 25 cm/sec, little, if any, further movement of the material is expected. However, peak current speeds at all the Phase II dispersive sites greatly exceed 25 cm/sec. These currents will erode the mound of deposited material at a rate dependent on the mound area, current speed, and material type. Trawle and Johnson (1986b) estimated the erosion potential of dredged material as a function of the current speed. Using this information, estimates were made of both the suspended particulate concentration immediately after a disposal operation, and the dispersion rate of material that is deposited on the bottom. This is summarized in the following paragraphs.

A rough estimate of the increase in suspended sediment concentrations due to the disposal of a barge load of dredged material was made. The assumptions made in the calculations are as follows:

- Fifteen hundred c.y. capacity barge (1.1×10^6 liters)

- Twenty-one percent of this load (by volume 2.3×10^5 liters) is sediment; the rest is water. At a specific gravity of 2.6 for the solids alone (average density of 2,600 grams per liter), the mass of the suspended sediment is 6×10^8 grams.

- Five percent of the disposed sediment remains suspended after 1 hour (3×10^{10} milligrams).

- The disposal takes place at the beginning of a flood or ebb tide.

- The average current speed during, and for 6 hours after the disposal, is 1 ft/sec (30 cm/sec).

- The disposed material spreads out in a wedge shape, 45 degrees to either side of the current flow.

- The average water depth is 400 feet.

- The material is distributed evenly throughout the wedge.

Immediately after the disposal operation, elevated concentrations of suspended sediment may be evident at selected depths in the water column. At the end of 1 hour, only 5 percent of the material is expected to remain in the water column. This material will have traveled 3,600 feet and is assumed to be distributed evenly throughout the volume of a "wedge" downstream from the dump site. The volume of this "wedge" at 1 hour after the dump is equal to 0.25 of a cylinder that has a radius of 3,600 feet and is 400 feet high, or 4.1×10^{9} cubic feet (1.2×10^{11} liters). Dividing the quantity of suspended sediment by the "wedge" volume gives a concentration of 0.25 milligrams per liter which is approximately 0.25 of background concentrations.

After 6 hours (one flood or ebb tide) the material will have traveled a distance of 21,600 feet (6 hours x 3,600 sec/hr x 1 ft/sec). The volume of the "wedge" is equal to the volume of 0.25 of a cylinder that has a radius of 21,600 feet and is 400 feet high, or 1.5×10^{11} cubic feet (4.2×10^{12} liters) and the concentration of suspended sediment in the "wedge" will be 0.00007 milligram/liter (3×10^{10} milligrams/4.2×10^{12} liters). Thus, within one tide cycle, the average suspended sediment concentration due to the disposal of dredged material will drop to less than 1/100 of the background concentration levels found throughout most of Puget Sound if the material disperses evenly within this volume.

It is evident from current information that the material should be widely dispersed after several days. For purposes of comparing the combined impact of a year's worth of disposal operations at the three northern ZSF's within the inner Strait of Juan de Fuca to background suspended sediment concentrations in the inner strait, calculations were made which assumed all the suspended particulate material remaining in the water column after each dump (5 percent) stayed suspended for a year and did not exit the inner Strait of Juan de Fuca. (This calculation is highly conservative as currents would most likely remove a great deal of the suspended material from the inner strait.) The calculations were made based on the following assumptions:

- Twenty thousand c.y. of material were dumped at each ZSF annually for a total of 60,000 c.y. (4.6×10^{7} liters).

- Twenty-one percent of the disposed amount by volume is sediment (1.3×10^{4} c.y.; 9.6×10^{6} liters).

- Five percent of the disposed sediments (6.5×10^{2} c.y.; 4.8×10^{5} liters) became dispersed over the area of the inner Strait of Juan de Fuca.

- The specific gravity of the suspended material is 2.6 for solids (2,600 grams per liter).

Using these assumptions, 1.2×10^9 grams of material would remain suspended. Assuming that the material is evenly distributed through the volume of the inner strait (1.4×10^{14} liters), then the concentration would be approximately 0.009 milligrams per liter. At that time, the natural concentrations would exceed that from disposal operations by approximately two orders of magnitude.

9. Effect of Disposal on Dispersion and Accumulaticn of Bottom Sediments. As stated earlier, a numerical model (DIFID) study conducted for PSDDA Phase I (Trawle and Johnson, 1986a) indicated that a large percentage of the material disposed by a bottom dump barge will be deposited within a relatively small area. For depths less than 600 feet and current speeds less than 1 foot per second, assuming the material is a slurry with no clumps, the mound from one 1,500 c.y. disposal will have a radius of approximately 600 feet and a height of less than 1 inch.

Trawle and Johnson (1986d) investigated the erosion potential of dredged material as a function of current speed. A calculation can be made of the time required to erode one barge load of dredged material from each ZSF for median (measured) and peak (calculated) tidal current conditions. Assuming 95 percent of the material from a 1,500 c.y. dump reaches the bottom, and 90 percent of the material that reaches the bottom is deposited within a 600-foot radius of the disposal location, the initial disposal mound contains 1,280 c.y. At a bulk density in the barge of 1.15 tons/c.y. (1.35 gm/cc), this quantity of dredged material has a mass of 1,500 tons, or 3×10^6 pounds. The erosion time is determined by dividing the mass of the mound by the product of the erosion rate times the area of the mound (1.1×10^6 square feet), i.e., t = mound mass (erosion rate x mound area). Complete erosion probably would thus occur over a single flood or ebb at the Rosario Strait, Port Townsend, and Port Angeles sites.

The above estimate assumes that the disposed material is a slurry composed of clay/silt and fine sand (< 0.2 mm), with no clumps and that the material does not remain undisturbed on the bottom long enough to consolidate. Experience at the Alcatraz disposal site in San Francisco Bay indicates that dredged material composed of clumps of coarse sand is very resistant to erosion. Material that does not erode within one or two tidal cycles appears to become "hardened" and can resist erosion by currents as high as 150 cm/sec. To avoid accumulating material, disposal methods which maximize dispersion will be used. These methods will include requiring the barge to remain in motion during the disposal operation to increase the area of coverage.

Over the period of a year, material that is eroded will be spread far beyond the site boundaries. An estimate of the effect the disposed material on overall accumulation of bottom sediments can be made for the anticipated annual disposal of 20,000 c.y. at each ZSF. If, as stated previously, 21 percent of the dredged material, or 4,200 c.y. (3.2×10^6 liters) is solids and the rest is water, and at a specific gravity of 2.6 for the solids (2,600 gm/l), approximately 8.6×10^6 grams (8.6×10^{12} milligrams) of sediment would be placed in the ZSF. If the material is spread evenly over the average area of the ZSF's (approximately 10 square miles, or 2.6×10^{11} square cm), the accumulation rate of the sediment would amount to 33 milligrams/cm^2/year. This is about 1/100 of the natural accumulation rate that now takes place throughout most of northern Puget Sound.

The impact of far field dispersion was also assessed by reviewing the movement of materials released in or near each ZSF (Evans-Hamilton, Inc., 1987b). Lagrangian drift observations have been used to examine possible far field dispersion of suspended material. In addition, Crean's (1983) model was used to trace the movement of a particle released at the center of each ZSF during both a neap and spring tide. Since PSDDA sought erosional areas in Phase II, the particle release time was chosen as the slack at the higher low of a tidal cycle (which occurs prior to the lowest tidal energy regime and simulates a worst-case condition). Particle movement following release was traced over a 25-hour period, the approximate length of a tidal day.

- Rosario Strait ZSF. The prevailing net flows are directed southward throughout the water column. These strong currents are able to transport suspended material on average at the rate of 10 miles per day. During both neap and spring tide conditions using Crean's model, the particles moved into Guemes Channel, then headed south toward Rosario Strait. Particles released during the spring tide reached farther north into the channel between Cypress and Guemes Islands before heading south. After entering Rosario Strait, particle movement was north-south. The net movement of the particle during the neap tide was southward approximately 1.5 nautical miles, whereas during the spring tide it moved southward nearly 4 nautical miles.

On April 25, 1971 an oil spill occurred in Fidalgo Bay near the end of a major flood during a spring flood tide. As it spread the oil was tracked from the time of spill over the following 41.5 hours. The pattern of oil movement in the area of the Guemes Island ZSF follows a similar pattern as that seen for a particular release in the model during a spring tide. The oil continued to move south in Rosario Strait and into the Strait of Juan de Fuca. From here the oil traveled west within the Strait and northward through the San Juan Islands. Local winds may have aided in the dispersal of the oil. Although the winds at the time of the oil spill are not known, except through local newspaper reports (Evans-Hamilton, Inc., 1987b), the pattern of movement shown on that occasion probably represents the movement expected through the water column. Given the high mean and net current speeds, it is reasonable to expect that a substantial amount of the disposal material will be quickly transported throughout the area covered by the oil spill.

- Port Townsend ZSF. A deep channel traverses the center between two shallow subsurface banks. This ZSF lies approximately 10 miles to the northwest of Admiralty Inlet. Vigorous tidal mixing in proximity to Admiralty Inlet significantly affects the dipersion of materials.

At the deepest portion of the channel the new currents are directed toward Admiralty Inlet in the lower half of the water column, and toward Vancouver

Island in the upper portion of the water column. In both parts of the water column, the net speeds reach values of approximately 10 miles per day. At these speeds the prevailing currents can carry resuspended material to the mouth of Admiralty Inlet in approximately 1 day. Resuspended materials mixed into the upper layer within this sill zone can reach Vancouver Island in approximately 2 days.

Undoubtedly some of the resuspended material will be carried inland into the central basin of Puget Sound. An example of this bottom transport was provided by the movement of a sea bed drifter which was initially released on the Washington/Oregon Coast (C.A. Barnes, personal communication). That drifter was carried northward along the Pacific Coast until it entered the mouth of the Strait of Juan de Fuca. Subsequently, it traversed the Strait of Juan de Fuca, moving inland with the bottom current, and most likely passing through the Port Townsend ZSF. The drifter passed through Admiralty Inlet and eventually was found south of the Hood Canal Bridge.

Some of the very fine resuspended material from the disposal site will be mixed into the upper layer by tidal currents in Admiralty Inlet and transported seaward. This material and suspended material may then settle out as it is carried by the prevailing currents. The wide dispersion of surface materials originating within or near this ZSF is illustrated by the recovery positions of drift cards released there. The recoveries of these cards show that the cards reached nearly all beaches within the inner Strait of Juan de Fuca. Dredged materials residing in the surface microlayer can be expected to do the same.

A modeled particle trajectory during a neap tide oscillates in an east-west direction and never leaves the ZSF during the first 25 hours. The net movement over 25 hours was 1.0 nautical mile westward. A particle released during a spring tide exited the ZSF after only 9 hours. The particle eventually reentered the ZSF and its net movement was 1.5 nautical miles westward, similar to that for the neap tide.

- Port Angeles ZSF. Like the Port Townsend ZSF, the Port Angeles ZSF also lies in a hydrographic region in which there are two flow layers. The lower layer of this ZSF lies immediately west, approximately 10 miles from the sill zone that stretches from the vicinity of Dungeness Spit to Victoria. The material that is resuspended will be carried via the prevailing currents in the lower layer to this sill zone. Although the turbulence over this sill is not as strong as at Admiralty Inlet, observed surface patterns suggest that occasion tidal currents occasionally mix bottom water up to the surface. Thus, some of the resuspended material may be mixed into the upper layer and carried westward by the prevailing outflow from the inner Strait of Juan de Fuca. The resuspended material that remains in the lower soundward flowing circulatory layer will be carried inland, over time probably entering the Strait of Georgia via Haro Strait and Puget Sound via Admiralty Inlet. This process is the same as that which occurs at the Port Townsend site.

Recovery positions of drift cards released in this ZSF vicinity indicate surfaceborne materials are spread over a wide pattern of the Strait of Juan de Fuca and into the San Juan Islands. Under these conditions, all but a few of the recovered cards were found east of Port Angeles, with a large percentage landing on Dungeness Spit.

Movements of drift sheets released in April 1978 in the vicinity of the ZSF indicate that any material remaining at the surface may move out of the ZSF region within a few hours (Ebbesmeyer, et al., 1978). Several of these drift sheets traversed the area of the ZSF in less than 3 hours. These trajectories were observed primarily during a major spring floodtide; however, two of the drift sheets observed during a weak ebb tide show significant movement although at slower speeds. Results of a release during a weak ebb tide, during which the sheets were allowed to drift for nearly 2 days before their final observation showed that the probable paths of the drift sheets before their recovery were in an east-west oscillation towards the south (Cox, et al., 1978). Particle trajectories during a neap tide from Crean's model indicate the tidal circulation is entirely east-west in this region and that, over a 25-hour period, the particle returned to its original release position. Within 9 hours the particle moved outside of the ZSF; however, the particle was outside the ZSF for only 9 of the 25 hours of the trajectory. Particles released during a spring tide move much faster, exiting the ZSF in 4 hours. The particle's movement was also east-west, and the net movement placed the particle slightly northwest of its release position. This east-west movement was the same indicated for drift sheet releases.

- Collection Zones. Throughout Puget Sound and the Strait of Juan de Fuca areas exist where surface borne materials tend to collect. Tide rips containing flotsam exemplify this. Previous studies (Ebbesmeyer, et al, 1979; Cox, et al., 1978) have identified at least one such surface collection area located midway between the Port Angeles and Port Townsend ZSF's. Drift sheets released over an approximately 20 kilometer area tended to move together to form a patch of 10 to 20 drift sheets north of Dungeness Spit. This patch oscillated east-west for a number of days, collecting additional drift sheets each day. A number of tide rips containing flotsam were found in this area (figure 2.11).

(3) Biological Resource Studies

(a) Crab, Shrimp, and Bottomfish Trawling Studies.

1. Overview of Studies. The reasons for evaluating biological resources at ZSF's are two-fold: (1) a favored substrate type may be altered or (2) food resources may be affected. It is important to document the presence and/or absence of crab, shrimp, and bottomfish resources and their relative abundance compared to other areas since, for example, Dungeness crab have been shown to aggregate in certain areas relative to size, molting, and egg bearing (Armstrong, et al., 1986). Crab selection of habitat depends upon food present or on sediment consistency for burial to avoid predation,

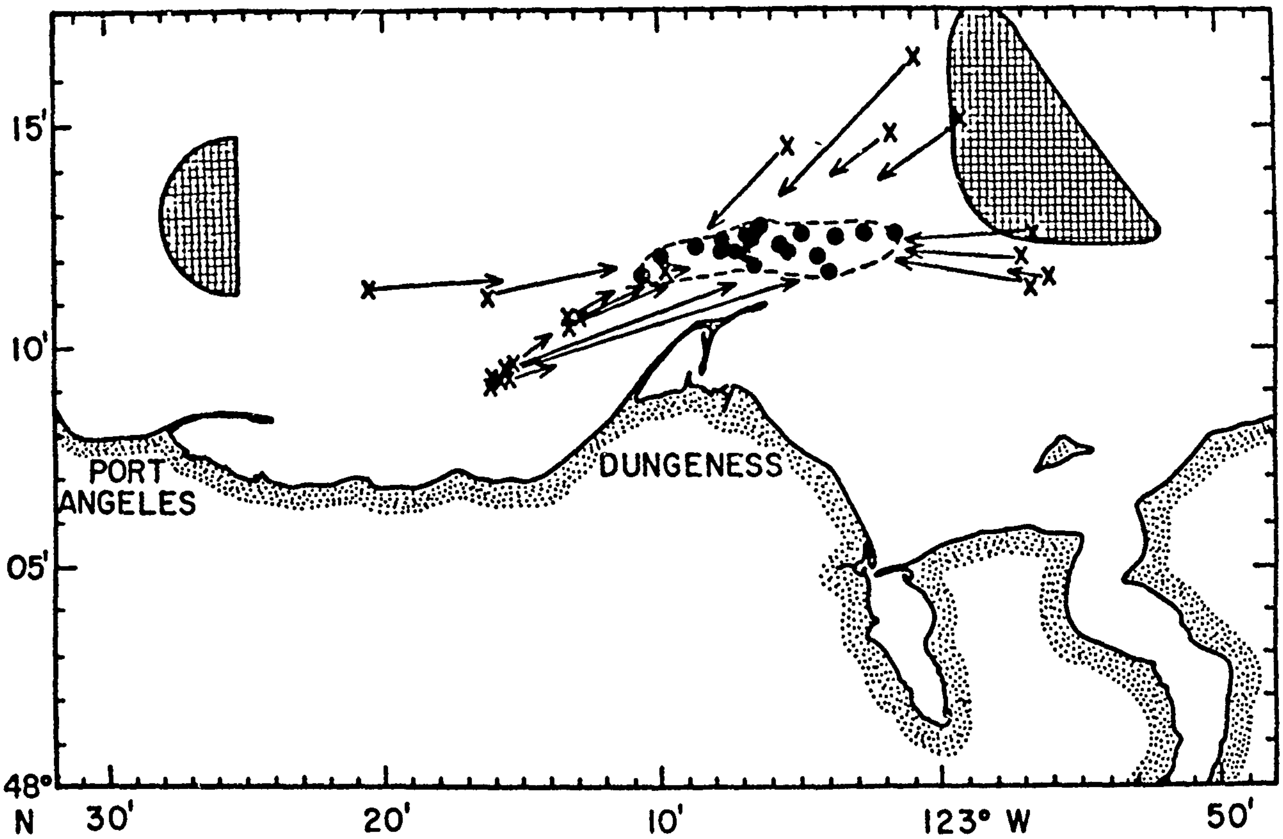


Figure 2.11 Convergence of 20 Drift Sheets into a Patch Off Dungeness Spit.

From Cox, et al., 1978. X indicates the launch positions of the drift sheets; arrows signify direction of movement; dots indicate position of drift sheets that formed patch.

especially during molting or egg carrying. Changes in sediment quality as a result of disposal of dredged material may reduce the suitability for these purposes. There is concern about depositing muddy dredged material on a sandy bottom, but less concern for depositing mud on a muddy bottom. In general for dispersive ZSF's, the preferred approach was to deposit dredged materials in areas where there are comparable grain size sediments. The results of the following studies are used to identify portion of the ZSF's where resource levels are presently low.

The distributions of Dungeness crab, shrimp, and bottomfish were mapped in the ZSF's from data obtained during cruises in February, April, May, July, and October 1987. The objective was to select disposal sites in areas having a minimal impact on populations of these animals. Additionally, the Benthic Resources Assessment Technique (BRAT) was used to predict impacts relating to food resources for commercially and ecologically important demersal (bottom dwelling or feeding) fish. These last studies are summarized in 2.03f(g).

A critical concern during PSDDA was the level at which animal populations become significant resources. This is a complex issue which is difficult to address. There was a notable lack of basic information available. Considerations are shown below.

<u>2</u>. <u>Crab</u>. Dungeness crab (<u>Cancer magister</u>) have been the object of commercial and sports fisheries on the west coast of the United States since 1848 (Dahlstrom and Wild, 1983). Most studies on Dungeness crab densities have been conducted in the last 20 years. Mayer (1973) and English (1976) addressed the locally important crab resources of the inland waters of Puget Sound. These areas have experienced some of the greatest increases of urbanization, industrial development, pollution, and fishing pressure.

The dramatic depression of crab resources in the San Francisco Bay area from the early 1960's to the present shows that these fishery stocks can be fragile. Although the decline in San Francisco Bay crab stocks may be partially attributable to changing natural oceanographic conditions (Wild, et al., 1983), other impacts have been identified which relate to loss of nursery habitats and pollution (Wild and Tasto, 1983; Armstrong, 1983).

Though Dungeness crab are widely distributed in Puget Sound and constitute a commercial fishery of 1.3 to 2 million pounds annually (Pacific Marine Fisheries Center, 1982), little is known concerning their distribution and habitat preference. Studies of northern Puget Sound have shown that several life stages also utilize bottom areas to depths of 400 feet (Dinnel, et al., 1985a). These life stages include growing and molting young and mature adults, females with and without eggs, and possibly mating pairs. The northern Puget Sound data also suggest that certain habitats attract aggregations of crab for unknown reasons, although studies indicate a strong dependence of small juveniles on habitat in coastal estuaries (e.g., Armstrong and Gundersen, 1985).

After a review of available data (e.g., Cahill, 1986), University of Washington scientists David Armstrong and Paul Dinnel (personal communication in Phase II DSSTA) determined that the average northern Puget Sound background concentration of crab is approximately 10 crab per 1,000 square meters (0.247 acres) or 100 crab per hectare (2.47 acres). They state that there will not be a time or place where there will be no crab, thus open-water dredged disposal operations will inevitably impact crab populations. For the straits of Juan de Fuca and south sound, crab densities are generally less (Baumgarner, personal communication, 1989).

3. Shrimp. The extent of commercial or recreational shrimp resources in the ZSF's was unknown, although little or no commercial shrimp fishing occurs in or near the ZSF's. Estimates of average shrimp catches from otter trawls in selected areas of Hood Canal and Puget Sound in and near historical commercial shrimp activity areas generally show a range of 2.7-10 kg/ha (Hood Canal) and 2.4-15.1 kg/ha (Puget Sound). An assessment of potentially commercially harvestable species was made at several seasons of the year.

4. Bottomfish. A variety of bottomfish species of commercial and recreational importance are known to inhabit Puget Sound (English, 1976; Miller and Borton, 1980), and a commercial trawl fishery for bottomfish is known to exist in Bellingham Bay and the Strait of Georgia. A recent study has shown that fish species diversity can be large between depths of 150 to 300 feet in Puget Sound (Donnelly, et al., 1984). In these studies estimates were made of harvestable (and harvested) population densities of fish during several seasons of the year, and an assessment is performed of the feeding habits of the bottom feeders that are relevant to impacts from benthic community alterations that might occur as a result of dredged material disposal.

5. Other Resources. Other commercially harvested species were also assessed. These include urchins, sea cucumbers, and a noncommercial but scientifically interesting large nudibranch mollusk, Tritonia. (In what follows, these other invertebrate species will be combined with discussions of crab and shrimp resources.) Also, the taxonomy and sediment depth structure of the benthic communities were determined.

(b) Survey Cruises. Full details of methods are given in Phase II DSSTA (section II.8.4), in Dinnel, et al. (1988) and Donnelly, et al. (1988). Trawl cruises were conducted in 1987: 9 February to 1 March (nondispersive sites only), 6 to 20 April (dispersive sites only); 1 to 13 May (nondispersive sites only); 8 to 24 July (nondispersive sites), and 12 to 31 October (all sites). Sampling was conducted in the vicinity of preliminary disposal sites in the two nondispersive ZSF's in south sound and four dispersive ZSF's in north sound. Bellingham Bay sampling stations were selected to give general coverage to the entire Bay.

1. Crab. Dungeness crab were sampled with a three meter beam trawl. The beam trawl was towed 1/8 nautical mile to yield an area swept by

the net of 534 square meters (640.8 square yards). All crabs caught in the trawls were measured, sex determinations made, and assessed for molt condition (degree of shell softness) and reproductive condition (females with or without eggs) before returning them to the water. Catches of shrimp and fish from the beam trawls were preserved for later processing in the laboratory. Other demersal resources such as scallops, sea cucumbers, sea urchins, mussels, and starfish were counted and returned to the water.

A rock dredge was used to sample Rosario Strait and a few stations in the Strait of Georgia due to the presence of rock and/or cobble on the bottom. The dredge was towed approximately 185 meters (0.1 nautical mile) unless obstacles necessitated a shorter distance. The large mesh of the rock dredge bag was lined with a 5 mm mesh. The catches made with the rock dredge are only viewed qualitatively since its sampline efficiency is unknown and probably quite variable depending on bottom type. All animals caught in the rock dredge were processed as noted above for the beam trawl.

Regardless of the accuracy in calculating "area swept" for the bottom trawl, no trawl is 100 percent efficient at catching the animals in its path, which means that the faunal densities are almost always underestimated, the degree of underestimation dependent upon animal species and bottom type. The terms "density" or "estimated density" (e.g., crab/ha) are used with the assumption of a net capture efficiency of 100 percent and should be regarded only as an index which provides a relative measure of resources and trends in abundances among different areas between seasons and between years.

2. Shrimp. Shrimp were collected as incidental catches from both the beam trawls for crab and otter trawls for bottomfish. Specific stations for shrimp sampling were not established. Shrimp were preserved for later processing ashore which included identification of commercially important species, measurement of carapace length, and state of reproduction.

3. Bottomfish. Bottomfish were sampled with a 7.6 meter otter trawls. The otter trawls stations occurred on beam trawl stations. The otter trawl was towed approximately 370 meters at a ground speed of 2.5 to 3 knots.

(c) Results. Results are given in full in section 3 (affected environment) and section 4 (impacts of alternatives) but are summarized here.

Location	Section
Nisqually Region	
Anderson/Ketron Island ZSF 2	3.02b(1) and 4.03b(1)
Anderson/Ketron Island ZSF 3	3.02b(1) and 4.03b(1)
Bellingham Bay, All Sites	3.03b(1) and 4.06b(1)
Rosario Strait, All Sites	3.04b(1) and 4.09b(1)
Port Angeles, All Sites	3.05b(1) and 4.12b(1)
Port Townsend, All Sites	3.06b(1) and 4.15b(1)

1. Nisqually ZSF's. Six stations each were sampled by beam and otter trawl in each of the two south sound ZSF's during each season.

- Anderson/Ketron Island (ZSF 2).

Crab. Dungeness crab (*Cancer magister*) were absent from all trawls at this ZSF during all collections seasons, but some were caught in small numbers outside the ZSF boundary. The average estimated density for all seasons and stations combined was three crab/ha, decreasing from five crab/ha in February to one crab/ha in October. Rock crabs (*Cancer productus* and *C. gracilis*) were more plentiful (average for all beam trawls = 156 crab/ha). In general, *C. gracilis* outnumbered *C. productus* by roughly 10-fold in the catches. *C. productus* is utilized for food by some sport crabbers and divers while the more plentiful *C. gracilis* is generally not fished because of its smaller size. Rock crabs tend to be relatively more important in the sport catches when Dungeness crab are unavailable. *C. productus* is also a potential commercial species; the large claws of this species now appear in California fish markets. Both male and female *C. productus* occurred in depths greater than 100 meters (330 feet) without favoring a specific depth. *C. gracilis* males and females were caught in equal numbers in February and May while the catches were dominated by males in July and October. Gravid females and juvenile crabs were caught during each season. The area was also very rich in other invertebrate fauna, including a wide variety of species of starfish, sessile tunicates, anemones, brachiopods, and gastropods. An occasional pink scallop was also caught along the west side of Ketron Island.

Shrimp. Small numbers of pandalid shrimp (prawns) were caught throughout the Nisqually region in all seasons (average 75 shrimp/ha). The highest shrimp catches were in July and October, with the bulk of these shrimp being *Pandalus danae* caught in shallow areas away from the deeper disposal ZSF's. Gravid females of *P. danae* and *P. borealis* were found only in the February trawls. The south sound region was identified by Smith (1937) as important for smooth pink shrimp (*P. jordani*) production, although little information exists which identifies specific shrimp producing areas within this region. Most of the historical (1973-1976) south sound shrimping efforts were focused in the Carr and Case Inlet areas and not in the Nisqually region (R. Baumgarner, WDF, personal communication, 1989).

Bottomfish. Fifty-one species of fish were caught in the eastern Nisqually region during all four seasons. Twenty-seven of these species were captured in ZSF 2 during the study. Almost one-half of the species occurred during either three or four of the sampling periods. Abundance catch per unit effort (CPUE) ranged from 12 to 775 fish, biomass CPUE ranged from 1 kg to 61 kg. ZSF 2 had the highest abundance values and biomass values during spring and autumn. Pacific hake was found in all seasons except winter, while blacktip poacher, brown rockfish, Dover sole, English sole, longnose skate, Pacific tomcod, plainfin midshipman, quillback rockfish, ratfish, rex sole, and slender sole were found throughout the year. English sole and slender sole were the dominant species, together they accounted for 35 to 80 percent of the relative abundance during each season.

ZSF 2 had high species diversity compared with surrounding stations during winter and the low during spring. Abundance (by individuals) and biomass peaked at 40 to 50 meters (132 to 165 feet) depths, and was high in comparison to other stations.

English sole dominated the commercial catches in the Nisqually area (Pattie, 1985). English sole also play an important role in the ecology of the marine community. The largest catches of English sole occurred at ZSF 2 in autumn and spring, and especially at the 60 meter (198 foot) depth during winter and spring. The 20 meter (66 feet) depth consistently had the lowest abundance of English sole. English sole seemed to undergo migrations between shallow and deep water. Generally the younger fish were found in the shallow strata, while the older ones were found at greater depths. This suggests that English sole moved into deeper water as they aged. Sole up to 7 years of age were captured in this ZSF. Since English sole are known to undergo migrations between different areas (Kechen, 1950), the decline in abundance at all depths during the summer may indicate outmigration. In Puget Sound, English sole spawn from January through April (Smith, 1936). The low abundance in winter and the lack of ripe females suggests that the ZSF was not being used as a spawning area. Dover sole, English sole, flathead sole, rex sole, and rock sole all showed indications of blood worm infestations. One liver tumor was found in a rex sole during spring in the ZSF. There were no observed fin erosion nor skin tumors.

- Devils Head (ZSF 3).

Crab. Dungeness crab were also absent from this ZSF as were sea cucumbers. The faunal densities of rock crab, shrimp, and starfish were substantially less in Ketron Island (ZSF 2) than Devils Head (ZSF 3) or the estimated average abundances for the Nisqually area in general. ZSF 3 is a distinctly richer area than the deeper ZSF 2. Of the rock crabs, *C. gracilis* was present all four seasons up to 172 individuals/ha; *C. productus* was also present all year up to 17 crab/ha.

The primary invertebrate species of commercial potential are Dungeness and rock crab, pandalid shrimp, and sea cucumbers. Dungeness crab were sparse yet important for two reasons: (1) crabs were caught near the south boundaries of both ZSF's and (2) this population of crab supports a small sport fishery in the Nisqually delta region (Ron Westley, personal communication, 1988). The larger sizes of Dungeness crab from the Nisqually together with their general appearance of good health suggest that the Nisqually area could support more Dungeness crab if recruitment of larvae or juvenile survival were greater.

Shrimp. Shrimp densities were higher for this ZSF compared to ZSF 2 primarily consisting of *P. borealis*, *P. jordani*, and *P. danae*, with peak abundance of 33-50 individuals/ha. This suggest that invertebrate resources would be more impacted by location of a disposal site in ZSF 3 (Devils Head).

Bottomfish. Forty-four species of fish were caught in the western Nisqually region. Thirty-five of these species were captured in ZSF 3 during the study. Abundance ranged from 31 to 516 fish, biomass catch per unit effort (CPUE) ranged from 3 kg to 23 kg. Based on previous studies, the ZSF 3 site appeared to be typical of other locations in Puget Sound at their respective depths (Lauth, et al., 1988; Donnelly, et al., 1984a and 1984b). These studies found abundance and biomass to be generally low at depths of 100 meters (330 feet) or more.

Blackberry eelpout and English sole dominated spring and with the addition of Pacific tomcod also dominated the rest of the year. The abundance of English sole is ZSF 3 was generally intermediate in value except during autumn when the ZSF 3 abundance was high. In contrast to ZSF 2, where fish to 7 years of age were found, ZSF 2 had 1 to 2 year old fish, with the older large fish at greater depths. The highest species diversity was found at 20 meters during summer and the lowest at 20 meters during autumn.

2. Bellingham Bay ZSF's.

Crab. Bellingham Bay proved to be a rich area for several biological resources. Five stations each were sampled each season by beam trawl in (or close to) each of the two ZSF's in Bellingham Bay. The average annual estimated densities (all seasons and stations combined) for each of the invertebrate resources show that Dungeness crab were least plentiful in the south ZSF, rock crabs and Tritonia (a large nudibranch) roughly the same in each ZSF, and shrimp and starfish (Luidia foliolata) in greater abundance in the south ZSF. Dungeness crab were generally abundant in most areas of Bellingham Bay and the average estimated density is 83 crabs/ha in a range of 56 (February) to 108/ha (May). The highest catches of Dungeness crab were consistently made at 10 to 20 meter depths near Post Point (north of Chuckanut Bay) and Portage Inland. The lowest crab catches were generally at the midbay stations, especially in the general area of the south ZSF. Dungeness crab outnumbered both species of rock crab in the Bellingham Bay beam trawl catches by 3-4:1, except in October when a relatively large number of recently settled juvenile C. gracilis were caught.

Females dominated the catches in all seasons by a factor of two to four times the catch of males and relatively few juveniles were caught. Gravid females were caught in February with egg masses. Male crab showed some molting activity (i.e., soft shells) February through May while the females showed only slight signs of molting in July. Very few juvenile Dungeness crab were caught. The 1987 settlement took place between the July and October sampling.

Dungeness crab inhabited all depths in Bellingham Bay but the females favored the deeper areas during February and the shallower areas (15 to 20 meters) in October. Post Point appears to be a favored area for the females during the egg incumbation period. Males were caught only in shallow areas near shore in May but at all depths during the other three seasons.

Rock crab (*C. productus* and *C. gracilis*) were roughly one-half as plentiful (overall average of 40 crab/ha) as Dungeness crab in Bellingham Bay. The only gravid female for the species was caught in May and had a spent egg mass. Settlement of the 1987 juvenile occurred between July and October. The bulk of *C. productus* were caught at shallow (10 to 15 meter) depths near shore. The majority of the rock crabs caught in Bellingham Bay were *C. gracilis*. Gravid females were found in February. Relatively few *C. gracilis* over 60 mm were found in Bellingham Bay in contrast to populations over 60 mm in the Nisqually area. The reason for the different age structure between the two areas is unknown. The distribution of *C. gracilis* was limited primarily to shallow areas in February and May, but covered all depths in July and October due to settlement.

Tanner crab (*Chinoecetes bairdi*), also commercially known as snow crab, were found in small numbers in the Bellingham Bay samples, but this species does not support any fishery in the inland waters. The individuals caught in Bellingham Bay were mostly juveniles. Males generally outnumbered the females and overall distribution was deep (25 to 30 meters) and restricted to the midbay area.

Shrimp. Bellingham Bay also proved to be relatively rich in commercial shrimp resources compared to many other areas of Puget Sound. All seven species of pandalid shrimp which were recorded in this study occurred in Bellingham Bay, although the spot prawn (*P. platyceros*) and the pink shrimp (*P. jordani*) were scarce. The bay was especially rich in *P. hypsinotus*, *P. danae*, and *P. borealis*. The overall average estimated density was 600 shrimp/ha with a seasonal range of 413 shrimp/ha (May) to 942 shrimp/ha (February). Shrimp were caught at most stations in Bellingham Bay with the highest density generally being caught in the deeper (25 to 30 meter) midportions of the bay, except for substantial catches of juvenile *P. danae* in July and October at some of the shallow areas (10 to 20 meters) in the Post Point area. Only in the case of shrimp (in south ZSF) and the noncommercial large pink nudibranch *Tritonia* (south ZSF) did resource densities in the ZSF's exceed the baywide averages. Relatively few *P. platyceros* and *P. jordani* were caught.

Pandalid shrimp were abundant in Bellingham Bay in comparison to the Nisqually region. Three species, *P. danea*, *P. hypsinotus*, and *P. borealis*, were abundant enough to be considered resources with future harvest potential. Past surveys in Bellingham Bay also noted large numbers of shrimp in the catches. Webber (1975), sampling nine stations in Bellingham Bay with a 3 meter fry net, found the approximately 50 percent of all invertebrates caught were pandalid shrimp. Similar studies by CH_2M Hill (1984) found that shrimp also dominated their catches (77 percent of all invertebrates caught were shrimp).

Selection of an appropriate ZSF in Bellingham Bay was more difficult than for the Nisqually region because of two factors: (1) Dungeness crab and shrimp are generally much more plentiful and (2) there is no clear biological basis for selecting one ZSF over the other. Comparisons of the beam and otter trawl catches between the two ZSF's suggested that Dungeness crab may be more plentiful in the north ZSF but that shrimp are more abundant in the south ZSF. Tritonia catches were patchy but roughly equal between the two ZSF's. One important factor is the relative densities of the starfish *Ludia foliolata*, which has recently become a serious nuisance in harvests of commercial fish trawls in some areas of Bellingham and Samish Bays. The highest beam trawl catches of this pest were in the south central portion of the bay and the estimated densities in the two ZSF's showed higher numbers in the south ZSF in four seasons. For further discussion see section 2.03(j).

Bottomfish. Bellingham Bay is biologically rich and productive and has numerous species of fish. Many of these appear to use Bellingham Bay as both a spawning and a nursery area. Overall, there was similarity in all measures of fin fish resources at all stations and depths below 20 meters in depth. Fifty-seven species of fish were caught in Bellingham Bay during the course of this study. Abundance CPUE ranged from 16 during autumn to 1,592 in the summer, biomass CPUE ranged from less than 1 kg in winter to 66 kg during the same period.

The ecological measures used (abundance, species richness, and species diversity) indicated that ZSF 1, ZSF 2, and all baywide samples taken at depths exceeding 20 meters were similar. However, in terms of biomass, ZSF 1 always had higher values than ZSF 2 at depths exceeding 20 meters. The shallowest depths sampled (15 meters to 20 meters in depth) generally had lowest values. The ZSF's in Bellingham Bay are approximately 30 meters deep. Previous studies in Puget Sound have generally shown that similar fish assemblages occur at similar depths within such homogeneous areas.

The peaks in abundance and biomass that occurred during the year were due in large measure to relatively high concentrations of longfin smelt; however, other species such as blackbelly eelpout, English sole, Pacific tomcod, and shimer perch showed occasional peaks in abundance. Abundance and biomass were generally lowest during the spring. Forty-three species were captured in the ZSF 1 during the study. The dominant species throughout the year was longfin smelt, with blackbelly eelpout and English sole contributing to the catch during spring.

Thirty-two species were found within ZSF 2 during the study. The dominant species throughout the year was longfin smelt. Two other species that contributed were shiner perch in winter and blackbelly eelpout in spring.

Butter sole appear to undergo migrations within the study area, moving offshore during autumn and winter, possibly for spawning purposes, and into shallow water during summer. They spawn from February through late April. Gravid female butter sole were found during the winter sampling period. Several year classes, up to and possibly exceeding 4 years, were present in the study area.

Relatively high concentrations of English sole were found at ZSF 1 during winter and spring. Abundances at other times of the year were low, suggesting little of no migration between different areas (Ketchen, 1950), the decline in abundance at all depths during summer and autumn may indicate migration out of the area. In Puget Sound, English sole spawn from January through April (Smith, 1936); therefore, the high abundance in winter and the presence of gravid females found during field sampling suggests that ZSF 1, ZSF 2, and depths at or greater than 20 meters may be used as spawning areas.

Flathead sole were found in the greatest abundance during spring through autumn in the two ZSF's and depths exceeding 20 meters. Miller (1969) reported that flathead sole in ZSF 1 during winter, at the same time gravid females were found. These results suggested a concentration of individuals for spawning. However, the number of individuals involved was not large (approximately 30) and therefore additional observations are needed to confirm this hypothesis.

Relatively high concentrations of starry flounder were found in ZSF 1 and ZSF 2 during winter. Abundance levels at other times of the year were low, suggesting little or no migration within the study area, but possibly migration into and out of the area. Starry flounder are known to spawn in shallow water in Puget Sound during the winter, which may suggest a spawning aggregation since individuals were captured containing eggs that were nearly ripe. No gravid females were seen during the course of this study.

Longfin smelt were the most abundant species in Bellingham Bay. High numbers occurred in the two ZSF's during most seasons. Longfin smelt in Puget Sound are anadromous and spawn and die at the end of 2 years (Hart, 1973). ZSF 1, ZSF 2, and samples from 20 meters all contained what appeared to be a 2 year olds, while ZSF 2 and 20 meter depth also contained young of the year. The occurrence of both juveniles and adults together, in high numbers, suggests the bay is being used as a nursery area for the young and a forage area for adults. Longfin smelt appear to prefer the deeper portions of Bellingham Bay.

Butter sole, English sole, flathead sole, and starry flounder are caught by commercial and sport fisheries in Bellingham Bay and other locations in Puget Sound. Longfin smelt are captured by a fishery in the Nooksak River. Starry flounder dominate the catches of flatfish in Bellingham Bay (Pattie, 1986). The order of importance, based on catches, of the other flatfish species is English sole, butter sole, and flathead sole. While all five species are exploited, they also play a role in the ecology of the marine community.

Other species such as larger skates, ratfish, and other flatfish are also exploited as incidental catch when fishing for the species mentioned above.

A comparison of these data to results of other studies shows general agreement except for the species composition found by Palmisano (1984) and the dominant species found by Webber (1975). The reason for the differences may be due to differing sampling designs and locations of sample stations. Most of the work of the two studies concentrated in the inner part of the bay near the city of Bellingham and Post Point. The present study was spread over a larger area and sampling was done away from the shoreline.

3. Rosario Strait ZSF.

Crab. Eleven stations in Rosario Strait were sampled by rock dredge during April and October 1987. Each tow with the rock dredge was roughly 0.1 nautical mile. No attempts were made to estimate resource densities from the rock dredge tows since the sampling efficiency of a rock dredge bouncing on a rocky bottom is poor. Dungeness and rock crabs (except for small and plentiful *Cancer oregonensis*) were absent from the rock dredge samples during both seasons.

Shrimp. A relatively large number of small, nonpanadalid shrimp were caught in the rock dredge but only small numbers of panadalid shrimp (mostly small *P. danae*) were caught at all stations except for the most northerly station. These findings suggest that the best location for a disposal site would be at the north end of Rosario Strait where the ZSF is located.

Bottomfish. Few species of individuals were captured at any of the Rosario Strait sampling stations. One large catch of 66 ringtail snailfish was collected at a station about 0.4 nautical mile north of the ZSF with a beam trawl. The catches from the rock dredge were small and contained few species of commercial interest. A comparison of catches by rock dredge and the research otter trawl is not possible; however, it is clear that the rock dredge was a much less efficient sampler of fish. Based on this study, the proposed ZSF in Rosario Strait does not contain fish resources that would be of concern to the disposal of clean dredge materials.

4. Port Angeles ZSF.

Crab. Six locations were sampled in and around the ZSF in April and October 1987 using both beam and otter trawls. The station depths ranged from 110 to 136 meters and the bottom type was apparently a sand/gravel mix with some shell. As with the Port Townsend site, no crabs were caught in the Port Angeles ZSF.

Shrimp. Few shrimp (average density 53 shrimp/ha) were caught in the trawls in April. Approximately 90 percent of those that were caught were *P. borealis*. However, catches of shrimp in October were more than 10 times greater (average estimated density 6,775 shrimp/ha) due to young-of-the-year *P. borealis*. The balance of the shrimp catch at Port Angeles consisted of a few *P. dispar* and *P. goniurus*. Not enough stations were sampled for shrimp to provide sufficient information to select a preferred disposal site within the Port Angeles ZSF based only on resource density estimates.

Bottomfish. Twelve species were caught during each sampling period, resulting in a combined total of 21 species for the entire study. Nine of the twelve species were unique to each season. Forty individuals were caught in the spring while 991 fish were captured during autumn. Subadult walleye pollock dominated the catches during autumn (936 were caught).

Walleye pollock were caught in substantial numbers at all stations except at a station about 5 nautical miles east of the ZSF. Few species or number of individuals were found within the ZSF during either season except for walleye pollock. Walleye pollock are sport fished in the Port Angeles area. The total catch of walleye pollock was 936 for the autumn sampling, of which 871 were caught within the ZSF.

5. Port Townsend ZSF.

Crab. Six stations were sampled in and around the ZSF with both beam and otter trawls, except for three stations which were not sampled by beam trawl in April due to high winds and rough seas. The depths ranged from 70 to 150 meters. The bottom was a mixture of sand, small gravel, and shell. No Dungeness, rock, or tanner crabs were caught in this area during sampling.

Shrimp. The Port Townsend ZSF was fairly rich in shrimp (especially juvenile *P. danae* and *P. borealis*), pink scallops, and sea urchins. A modest average density in April of 236 shrimp/ha was estimated for this area. The average density of shrimp estimated from the October otter trawl catches increased to 6,802 shrimp/ha primarily due to an influx of young *P. danae* and *P. borealis*. The distribution of shrimp in the Port Townsend area were similar for each of the two seasons sampled with the highest catches being made at stations closest to Port Townsend. These catches were dominated by *P. danae*. Fewer shrimp were caught offshore. *Pandalus platyceros*. *P. jordani*, and *P. hypsinotus* were absent from this area area relatively few *P. dispar* and *P. goniurus* were found in the catches. Not enough shrimp samples were collected to discern which area would be preferable for locating a disposal site.

Bottomfish. Twenty-seven species were found in the Port Townsend area during the April and October 1987 beam and otter trawl tows. Eight species and a total of 12 specimens were captured during spring while 23 species and 382 individuals were caught during autumn. The number of species and their abundance increased in the ZSF and adjacent stations from spring to autumn. Walleye pollock dominated the catches during autumn. In contrast, only one walleye pollock was captured in the spring.

The area from Port Townsend to Port Angeles reach is an important sport fishery area. There is a limited commercial trawl fishery in the Strait of Juan de Fuca for true cod with incidental catches of English sole and rockfish. Several species of interest to sport and commercial fisheries were captured during this study (English sole, Dover sole, quillback rockfish, and walleye pollock). All of the fished species except walleye pollock were in low abundance. The presence of walleye pollock in substantial numbers during autumn in the Strait of Juan de Fuca may suggest in-migration from the Strait of Georgia during summer.

g. Benthic Resources Analysis Technique (BRAT).

(1) Introduction. The relative amount of trophic support that a given benthic habitat provides demersal (bottom-feeding) fishes is an important aspect of benthic habitat quality. A procedure called the Benthic Resources Assessment Technique (BRAT) developed by the Corps Waterways Experiment Station (Lunz and Kendall, 1982), was used to quantify the food value of bottom-dwelling organisms within soft-bottom habitats to bottom-feeding fishes. Food web linkages between benthic organisms, key demersal fish and shellfish, and ultimately humans via commercial and recreational fisheries offers a means to assign comparative resource values to alternative disposal sites. Through BRAT, estimates can be made of which organisms at a given site are both vulnerable and available to selected foraging fish species. For a detailed description of the technique see Lunz and Kendall (1982), Clark and Lunz (1985), and Clark and Kendall (1987). The results which are summarized here are given in full in Phase II DSSTA.

Different species of bottom-feeding fishes can detect, capture, and ingest only a portion of the available benthos. They will consume different prey at different locations and seasons, reflecting the availability of vulnerable prey. In BRAT, vulnerability is taken to be a function of the size of the benthic food item, and availability of the prey's location below the sediment-water interface. Both factors are estimated from an examination of the diets of target predatory fish, and confirmed by a paralled examination of vulnerable and available prey in the local benthic environment.

BRAT analysis involves the collection of two data sets; one which describes benthic biomass in terms of size and vertical distribution in sediments at selected sites, and another which describes the foraging depth and prey size exploitation pattern of demersal fishes occurring at the sites. BRAT estimates the portion of the total benthic infaunal biomass that is available to predation by target fishes. Results from BRAT are used in two ways: to fine tune the selection of the alternative disposal site locations, and to indicate the habitat quality of the sediment for bottom-feeding fish.

(2) Sampling Locations and Analysis Methods. BRAT was only undertaken at the nondispersive sites because the dispersive site bottom conditions (coarse, hard sediments) make it difficult to sample and the technique is geared to infauna feeding fish. During the period of 14 to 23 July 1987, 41 benthic box core and otter trawl samples were collected at three areas: Nisqually/Devils Head (ZSF 3), Nisqually/Ketron Island (ZSF 2), and Bellingham Bay.

(3) Benthic Sample Processing. Retrieved cores were cut into 0-, 2-5, 5-10, and 10-15 cm sections, each of which were sieved through a 0.25 mm sieve (top section only) or a 0.50 mm sieve, fixed, and taken to a laboratory for sorting into major taxonomic groups (taxon) separated into standard size groups, and tared for wet weight which is then used to calculate total weight of each major taxon at each depth per square meter. Examples of major taxa are: bivalve molluscs, polychaete annelids, ophiuroid echinoderms, and ostracod crustaceans. All samples taken were achieved, to permit rechecking and reanalysis by scientists.

(4) Fish Sampling and Sample Processing. A total of 27 otter trawl samples were obtained. Fish collections were conducted using a 25-foot otter trawl at each of the study sites concurrently with the benthic sampling. Sampling was allocated as follows: Nisqually/Devils Head (ZSF 3), 8 trawls; Nisqually/Ketron Island (ZSF 2), 7 trawls; and Bellingham Bay, 12 trawls.

Trawls were short to minimize deterioration and regurgitation of the gut contents due to disturbing the fish. Benthic feeding fish species representative of demersal fishes utilizing each site was English sole (*Parophrys vetulus*), Dover sole (*Microstomus pacificus*), rex sole (*Glyptocephalus zachirus*), rock sole (*Lepidopsetta bilineata*), and snake prickleback (*Lumpenus saitta*). Fishes collected along each transect were processed as follows: (1) demersal bottomfeeding fishes were separated from pelagic fishes, which latter are not considered in the analysis; (2) the demersal fish catch was sorted by species and each species was divided into standard length size classes; and (3) pooled individuals of the same species and size class captured at the same location were analyzed for gut content accordig to the procedures described in Borgeson (1963) to determine the diet of an average individual feeding at a particular site. Stomach contents representing individual species size class samples were picked and sorted to major taxonomic categories (Annelida, Crustacea, etc.).

Wet sieving was used to separate taxa to standard size intervals. Wet weights were recorded and the sample returned to a labeled container and archived. Weights were tabulated by site, predator species, major taxon, and sieve size category.

(5) Analysis. Based on examination of the fish food habit, the component of the total benthic biomass that is both available and vulnerable to predation by the target fish species is estimated. This determination assigns each fish size class sample to a group based upon their particular prey size exploitation pattern. Then, from the prey size exploitation data, an estimate of the size range of prey utilized by or vulnerable to predators was obtained. The stomach contents data were also used to estimate the foraging depth of each species size class sample by examination of the composition of benthic prey in each food habits sample in comparison to the vertical distribution of prey in the box corer collections.

(6) Summary of Results. The results are given in detail in sections 3 (affected environment) and section 4 (impacts) as they relate to site selection and impact assessment of implementing disposal at the sites.

ZSF	Section
Nisqually Region	
Anderson/Ketron Island ZSF 2	3.02b(1) and 4.03b(1)
Anderson/Ketron Island ZSF 3	3.02b(1) and 4.04b(1)
Bellingham Bay	
Northeast and South ZSF's	3.03b(1) and 4.06b(1)

h. Disposal Guidelines for Nondispersive and Dispersive Sites and Their Effects on Volumes Disposed. Table 2.5 summarizes general site characteristics of the nondispersive and dispersive disposal sites. At the Phase II nondispersive sites, disposal guidelines established for the Phase I nondispersive sites will apply (PSDDA Phase I MPR, June 1988).

TABLE 2.5

COMPARISON OF NONDISPERSIVE TO DISPERSIVE SITE CHARACTERISTICS

	Nondispersive Sites (Phases I and II)	Dispersive Sites (Phase II)
Bottom Sediments		
Grain sizes	More clays	More sands, rock
Percent water	Less	More
Percent volatile solids	More	Less
Percent organic material	More	Less
Currents at Bottom		
Current action	Depositional	Erosive
Mean Speeds	Less than/equal to 10 cm/sec	Greater than 25 cm/sec
1% Peak Speeds	Less than 25 cm/sec	Much greater than 25 cm/sec
Biological Communities		
Soft-bottom species	Yes	No
Crab and shrimp	Yes	Mostly, yes
Bottomfish	Yes	Yes
Scallops	No	Some, yes
Salmonids	Yes	Yes

At nondispersive sites, unacceptable adverse impacts can be identified and controlled via monitoring, thereby providing accountability and public acceptability. However, dispersive site monitoring and consequent modification of disposal practices is much more difficult, costly, and of low utility since the dredged material does not remain onsite and may not cause changes seen during monitoring. Dilution and dispersion should quickly reduce the concentrations of chemicals found on dredged material discharged at these sites, thereby reducing the potential for adverse biological effects.

Due primarily to the difficulties in verification studies, the PSDDA agencies decided that a more restrictive disposal guideline would be used for the dispersive sites. Table 2.6 shows this guideline compared to the Nondispersive Guideline. See Phase II MPR chapter 5 and exhibit A for a more definitive discussion of the PSDDA disposal guidelines.

TABLE 2.6

COMPARISON OF DISPOSAL GUIDELINES FOR PHASE II SITES

Testing	Nondispersive Guideline	Dispersive Guideline
Chemical	As in Phase I (modified by Phase II) 1/	As in nondispersive guideline
Biological Test Species	As in Phase I (modified by Phase II) 2/	As in nondispersive guideline, except Microtox not used
Performance Guidelines	As in Phase I (modified by Phase II) 3/	As in nondispersive guideline
Interpretive Guidelines:		
Two-hit	As in Phase I	As in nondispersive guideline
Single-hit	For amphipod, juvenile infaunal species or sediment larval bioassay: any one bioassay mean response statistically significant, greater than 20% over control, and greater than 30% over reference	For amphipod and juvenile infaunal species, any one bioassay mean response statistically significant, greater than 20% over control, and greater than 10% over reference; for larval sediment test, as above, but greater than 15% over reference

1/The chemical changes are specified in the Phase II MPR, section 5.2.

2/The addition of Neanthes as the test for juvenile infaunal species has also been made in the Phase II MPR, section 5.3.

3/The two changed performance or quality control guidelines are: amphipod (Phase II MPR, section 5.6) and sediment larval (section 5.3).

The biological testing guidelines differ under the one bioassay failure rule for the dispersive sites only in that no more than a 10 percent mortality (absolute) over reference response is allowed versus 30 percent for nondispersive sites and that Microtox is not used as a decision-making test. Under the two bioassays failure rule there is no difference between the guidelines for the dispersive and nondispersive sites; if more than one (of four) bioassays is statistically significant relative to reference than the material is unsuitable for unconfined open-water disposal.

The PSDDA agencies consider the dispersive disposal guidelines highly protective of environmental values; accordingly, neither chemical nor biological monitoring of the sites is required. (This contrasts with the nondispersive sites, where monitoring will be accomplished). However, limited physical monitoring of dispersive sites is planned to verify predictions that the disposed material erodes and does not accumulate. This should reduce concerns by commercial trawl fishermen over formation of a mound that could impact net movements.

Table 2.7a indicates volume forecasts over formation of resulting from applying the dispersive and nondispersive guidelines in the Phase II area, by disposal site and prospective dredging area. Table 2.7a assumes that all planned projects (including speculative ones) are implemented. It is comparable to volumes in 2.7b (No-action Alternative or PSIC). Table 2.7c presents unadjusted and adjusted forecasts of likely volumes (by site) that could be experienced at the disposal sites. The latter reflects removal of speculative projects and some volume that may be given beneficial use. Volumes in Table 2.7c are considered in the EIS impact analysis. Impacts of large speculative new construction projects that might increase volumes disposed at the sites would be evaluated separately in pertinent, project-specific environmental documents prepared by the dredger.

2.04 Final Alternatives.

a. Disposal Sites. The action alternatives which are presented in this Phase II EIS are five selected disposal sites and alternative site locations to these sites (Bellingham has two alternatives). The Anderson Island/Ketron Island and Bellingham Bay selected sites are categorized as nondispersive and the Rosario Strait, Port Angeles, and Port Townsend sites are dispersive. All sites except for Bellingham Bay are generally located in areas relatively free of important biological resources and human use activities. Selected and alternate sites considered for each area vary in size due to depths and tidal current regimes, shown in table 2.4.

TABLE 2.7a

DREDGED MATERIAL VOLUMES (C.Y.)
THAT COULD BE ALLOWED AT PUBLIC, MULTIUSER, PSDDA
UNCONFINED, OPEN-WATER DISPOSAL SITES IN
PHASE II STUDY AREA DURING 1985-2000

	Area 1/	Volumes For Nondispersive Sites 2/	Volumes For Dispersive Sites 3/	Total Dredging Volume
North Sound:				
Bellingham Bay	(B)	756,000		756,000
Fidalgo Bay	(B)	384,000		768,000 4/
Hood Canal	(PT)		144,000	144,000
Lummi Bay	(B)	41,500		1,553,000 5/
Port Angeles	(PA)		285,000	285,000
Port Townsend	(PT)		422,000	422,000
San Juan Islands	(R)		165,000	165,000
Swinomish Channel	(R)		1,179,000	1,179,000
Whidbey Island	(R)		107,00	107,000
Admiralty Inlet	(PT)		121,000	121,000
Blaine	(R)		350,000	350,000
Subtotal		1,181,500	2,773,000	5,850,000
South Sound:				
Steilacoom	(AK)	43,000		43,000
Shelton	(AK)	33,500		67,000 4/
Pickering Pass	(AK)	104,000		104,000
Tacoma Narrows	(AK)	86,000		86,000
Olympia/ Budd Inlet	(AK)	518,500		1,037,000
Subtotal		785,000		1,337,000
Total Phase II Volumes		1,966,500	2,773,000	7,187,000 5/

% Total Dredge Volume Suitable for Open-Water Disposal of material that might be proposed for open-water disposal. 83.0

1/Denotes service areas for dredged material disposal: (B) = Bellingham Bay; (AK) = Anderson/Ketron Island; (PA) = Port Angeles; (PT) = Port Townsend, (R) = Rosario Strait.

2/For this estimation, volumes suitable for disposal at nondispersive sites were determined as mean of volumes passing ML1 plus volumes passing ML2. Actual volumes will depend upon biological testing (see section 2.04 and EPTA).

3/For this estimation, it was assumed that material passing the lowest apparent effects threshold would be suitable for dispersive disposal. Actual volumes will depend on biological testing.

4/50 percent of these volumes are likely to need confined disposal.

5/This includes 1,470,000 c.y. of dredging for the initial construction of the Lummi Bay marina project which will be placed onsite and 41,500 of dredged material from the Lummi Bay area that is expected to require confined disposal.

TABLE 2.7b

DREDGED MATERIAL VOLUMES
THAT COULD BE ALLOWED AT SINGLE USER,
UNCONFINED, OPEN-WATER DISPOSAL SITES UNDER
PUGET SOUND INTERIM CRITERIA (NO ACTION) DURING 1985-2000

	Area 1/	Volumes That Pass PSIC	Total Dredging Volume Forecast
North Sound:			
Bellingham Bay	(B)		735,000
Fidalgo Bay 4/	(B)		768,000
Hood Canal	(PT)	144,000	144,000
Lummi Bay 4/	(B)		1,553,000
Port Angeles	(PA)		285,000
Port Townsend	(PT)		422,000
San Juan Islands	(R)	165,000	165,000
Swinomish Channel	(R)	1,179,000	1,179,000
Whidbey Island	(R)	107,000	107,000
Admiralty Inlet	(PT)	121,000	121,000
Blaine	(R)	350,000	350,000
Subtotal		2,066,000	5,850,000
South Sound:			
Steilacoom	(AK)		43,000
Shelton	(AK)		67,000
			104,000
Pickering Pass	(AK)		86,000
Tacoma Narrows	(AK)		1,037,000
Olympia/ Budd Inlet	(AK)		
Subtotal		0	1,337,000
Total Phase II		2,066,000	7,187,000
% Total Dredge Volume Suitable for Unconfined, Open-Water Disposal			36

1/Denotes service areas for dredged material disposal: (B) = Bellingham Bay; (AK) = Anderson/Ketron Island; (PA) = Port Angeles; (PT) = Port Townsend, (R) = Rosario Strait.

TABLE 2.7c

DISPOSAL
OF FUTURE DREDGING VOLUMES (BY SELECTED SITE) UNDER PSDDA

ALL PROJECTS 1/

Disposal Site	Dredged Material That Could be Considered for Open-Water Disposal	Volume Passing PSDDA Guidelines That Would go to Open-Water	Volume for Confined Disposal or Beneficial Use
Anderson/Ketron Island	1,337,000	785,000	552,000
Bellingham	1,607,000 1/	1,181,500	425,500
Rosario	1,801,000	1,801,000	0
Port Angeles	285,000	285,000	0
Port Townsend	687,000	687,000	0
TOTAL	5,717,000 1/	4,739,500	977,500

	Dredged Material That Could be Considered for Open-Water Disposal	Volume Passing PSDDA Guidelines and Adjusted for Speculative Projects of Beneficial Use	Volume for Confined Disposal, Beneficial Use or Speculative Projects That May Not Occur
Anderson/Ketron Island	1,337,000	217,500	1,119,500
Bellingham	1,607,000 1/	550,500	1,056,500
Rosario	1,801,000	1,315,000	486,000
Port Angeles	285,000	143,000	142,000
Port Townsend	687,000	159,000	528,000
TOTAL	5,717,000 1/	2,385,000	3,332,000

1/Excludes 1,470,000 c.y. of dredged material to be removed during construction of the proposed Lummi Bay Marina project.

The Anderson Island/Ketron Island selected nondispersive site is approximately 3 nautical miles (nm) west-southwest of the town of Steilacoom, between Anderson and Ketron Islands. The Bellingham Bay selected nondispersive site is approximately 3.5 nm south-southwest of the city of Bellingham and 1.2 nm west of Post Point. The Rosario Strait selected dispersive site is approximately 2 nm south of Cypress Island and 1.8 nm west of Fidalgo Island. The Port Angeles selected dispersive site is approximately 4 nm north of Ediz Hook. The Port Townsend selected dispersive site is approximately 6 nm north of Discovery Bay or 6.5 nm northeast of Dungeness Spit.

For the Phase II nondispersive sites (which were all nondispersive), the Phase I disposal guidelines will be used, as modified through Phase II (see Phase II MPR). Discharge at the dispersive sites, will require passing the dispersive disposal guideline. A detailed assessment of the environmental consequences for the action and no-action alternatives are shown in table 2.8. This table briefly describes the consequences of each of the alternatives to provide an overview of the more detailed discussions in section 4 of this EIS.

Generally, natural resources are higher in the Phase II area than in that of Phase I, and this strongly influenced the choice of dispersive ZSF's and sites to avoid high resource values. Environmental impacts of the final alternatives are primarily dependent on the location of the sites to maximize nondispersive or dispersive characteristics, to avoid natural resources and potential human use conflicts, and on site use timing conditions.

Disposal Sites. The final alternatives (table 2.8) including the no action alternative are listed along with the potential environmental effects. This table briefly describes the consequences of each of the final alternatives for purposes of overview comparisons relative to major issues. Detailed discussion of these issues is contained in section 4 of the EIS. All potential sites have been assessed for habitat values; choice of alternative disposal sites have been made in most cases on the basis of differences seen. Where there was no discernible difference between sites in resource values, other factors (such as disposal barge haul distances) were used in selecting a site. The environmental consequences of site selection and disposal implementation for the Phase II area are addressed in detail in section 4 of the EIS.

b. Environmental Monitoring and Permit Compliance Inspections. Environmental monitoring and permit compliance inspections, also part of disposal site management, are described in the Phase II MPR. Responsibilities of the PSDDA agencies in monitoring and compliance inspections are given in the MPR. In general, the environmental monitoring for Phase II nondispersive sites resembles that for Phase I sites, and includes chemical, biological and physical monitoring. However, in the dispersive sites, only physical and compliance monitoring will be performed. This is because the restrictive disposal guideline for these sites precludes chemical effects on biota; physical monitoring will be used only to verify that no significant accumulation (mounding) of dredged material is occurring.

TABLE 2.8

COMPARISON OF FINAL ALTERNATIVES

Action Alternative	1. IMPACTED HABITAT a. Aquatic/Subtidal (acres)	b. Land/Shore 1/ (acres)
Anderson/Ketron Is. (Selected)	318	34.1
Anderson/Devil's Head (Alternative)	318	34.1
Bellingham Bay		
Selected Sites	260	26.3
Alternate Sites	260	26.3
Rosario Strait		
Selected	650	0
Alternate	650	0
Port Angeles		
Selected	884	0
Alternate	884	0
Port Townsend		
Selected	884	0
Alternate	884	0
No-Action Alternative		
Nisqually Region 2/	Short-term physical impacts on benthic habitat in unknown area, depending on how many separate disposal areas are identified; area would likely be much larger than in action alternatives. Estimates range from 9,000 to 24,000 acres (see Section 4.02b(3) for all disposal).	82.7

1/Estimates of habitat impacted resulting from confined disposal of material found unsuitable for unconfined, open-water disposal.

2/Some loss of aquatic subtidal habitat is expected from disposal of dredged material that meets PSIC when necessary permits are obtained for unconfined, open-water disposal on an individual, case-by-case basis. These figures do not quantify this loss, and also assume no transport to Phase I PSDDA sites.

TABLE 2.8 (con.)

No-Action Alternative (con.)	1. IMPACTED HABITAT a. Aquatic/Subtidal (acres)	b. Land/Shore (acres)
Bellingham	As above.	34.1
Rosario Strait Region	As above.	0
Port Angeles Region	As above.	17.6
Port Townsend Region	As above.	26.1
Action Alternative	c. Aquatic/Subtidal (descriptive)	b. Land/Shore (descriptive)
Anderson/Ketron Is. (Selected)	Minor loss of benthic invertebrates and displacement of fish and shellfish. Minor adverse impacts due to chemicals.	Moderate loss of land invertebrates and displacement of land/shore vertebrate species. Moderate chemical risk at confined site.
Anderson/Devil's Head (Alternate)	As above.	As above.
Bellingham Bay		
Selected	As above.	As above.
Alternate	As above.	As above.
Rosario Strait		
Selected	Minor loss of benthic invertebrates and displacement of fish and shellfish.	No loss nor displacement of these species.
Alternate	As above.	As above.
Port Angeles		
Selected	As above.	As above.
Alternate	As above.	As above.

TABLE 2.8 (con.)

	2. FAUNA	
	a. Aquatic/Subtidal	b. Land/Shore
Action Alternative (con.)		
Port Townsend		
Selected	As above.	As above.
Alternate	As above.	As above.
No-Action Alternative		
Nisqually Region	Minor loss of benthic invertebrates and temporary displacement of fish and shellfish.	Major loss of land/shore invertebrates and displacement of vertebrate species over a significant area. Moderate chemical risk to fauna at confined sites.
Bellingham Region	As above.	As above.
Rosario Strait Region	As above.	No confined sites, so no loss of species.
Port Angeles Region	As above.	Major loss of land/shore invertebrates and displacement of vertebrates over an unknown area. Moderate chemical risk to fauna near confined sites.
Port Townsend Region	As above.	As above.

TABLE 2.8 (con.)

Action Alternative	3. WATER AND SEDIMENT QUALITY a. Aquatic/Subtidal	b. Land/Shore
Anderson/Ketron Is. (Selected)	Short-term water quality effects. Minor adverse effects to sediment and effects to sediment quality within site.	Moderate chemical risks to ground water shoreline water.
Anderson/Devil's Head (Alternate)	As above.	As above.
Bellingham Bay		
Selected	As above.	As above.
Alternate Sites	As above.	As above.
Rosario Strait		
Selected	Short-term water quality effects within site, dispersing downcurrent. No long-term sediment quality impacts.	No effects: all material goes to open water.
Alternate	As above.	As above.
Port Angeles		
Selected	As above.	As above.
Alternate	As above.	As above.
Port Townsend		
Selected	As above.	As above.
Alternate	As above.	As above.
No-Action Alternative		
Nisqually Region	Minor short-term impacts to water quality; minor short-term impacts to sediment at individual sites.	Major chemical risks to ground water and water quality.

TABLE 2.8 (con.)

No-Action Alternative (con.)	3. WATER AND SEDIMENT QUALITY a. Aquatic/Subtidal	b. Land/Shore
Bellingham Region	Impacts as above.	As above.
Rosario Strait Region	Short-term water quality effects, associated with very minor sediment quality effects onsite. No impacts to sediment quality.	As above.
Port Angeles Region	As above.	As above.
Port Townsend Region	As above.	As above.

Action Alternative	4. NAVIGATION/DREDGING a. Volumes Suitable for Unconfined, Open-Water Disposal (cubic yards)	b. Volumes Requiring Confined Disposal 1/ (cubic yards)
Anderson/Ketron Is. (Selective)	785,000	552,000
Anderson/Devil's Head (Alternate)	785,000	552,000
Bellingham Bay		
Selected	1,181,500	425,500
Alternate	1,181,500	425,500
Rosario Strait		
Selected	1,801,000	0
Alternate	1,801,000	0
Port Angeles		
Selected	285,000	0
Alternate	285,000	0
Port Townsend		
Selected	687,000	0
Alternate	687,000	0

1/Unadjusted for beneficial uses. (See table 2.7c)

TABLE 2.8 (con.)

4. NAVIGATION/DREDGING		
No-Action Alternative	a. Volumes Suitable for Unconfined, Open-Water Disposal (cubic yards)	b. Volumes Requiring Confined Disposal 1/ (cubic yards)
Nisqually Region	0	1,337,000
Bellingham Region	0	1,607,000
Rosario Strait Region	1,801,000	0
Port Angeles Region	0	285,000
Port Townsend Region	265,000	422,000

1/ Estimated volumes of future dredged material the could be discharged at selected sites, once permitted, under the PSIC.
2/ The assumption is made in this table that confined aquatic disposal is not economic; accordingly, all confined disposal would be upland.

c. Advance Federal Identification of Sites. Pursuant to 40 CFR 230.80, and through the PSDDA process, the Corps and EPA were engaged in identifying the sites specified in this EIS as generally suitable for future disposal of dredged material. The final determination has been based on technical information developed through the PSDDA studies and presented in the Phase II EIS. The 230.80 determination of site suitability is attached to the Phase II final EIS. The initial advance identification was published in April 1988. The determination of suitability for disposal of dredged material in waters of north and south Puget Sound is displayed in exhibit B.

d. Native American Fishing.

(1) Introduction. The rights of Native American tribes to fish at all "usual and accustomed grounds and stations" in Puget Sound and the Strait of Juan de Fuca were established by treaties negotiated in the 1850's. Isaac Stevens, then Governor and Indian Agent of the Washington Territory, negotiated five treaties with Indian tribes of Western Washington:

Treaty of Medicine Creek
Treaty of Point Elliott
Treaty with the Quinault
Treaty of Point No Point
Treaty of Neah Bay

The first three treaties in the above list include the provision: "The right of taking fish at usual and accustomed grounds and stations is further secured to said Indians in common with all citizens of the Territory." The Point No Point and Neah Bay treaties have identical language, except that they provide for fishing in common with "citizens of the United States."

Federal agencies have a trust responsibility to exercise when making decisions which may affect treaty fishing rights

There are 14 Puget Sound Treaty Tribes that are recognized as sovereign tribal entities governments with fishing rights at all "usual and accustomed grounds and stations" in Puget Sound and the Strait of Juan de Fuca (as defined in United States v. Washington (384 F. Supp. 312, (DCWA 1974)) and United States v. Washington, 459#F. Supp. 1020 (DCWA 1978)) (see table 2.5). Under these decisions, the treaty tribes are assured the opportunity to catch up to 50 percent of the harvestable portions of salmon and steelhead runs passing through or originating from usual and accustomed fishing grounds. In addition, fish are harvested for ceremonial and subsistence purposes within these areas.

Presently, regulation of fishery resources, which are subject to treaty rights, including resource conservation actions, is accomplished by agreement jointly by the State and treaty tribes. Puget Sound is subject to treaty fishing, including areas involving each of the selected open-water dredged material disposal sites discussed in this EIS. The PSDDA agencies recognize treaty fishing rights and formulated the PSDDA proposed management plan to avoid significant adverse effects on the ability of the Indian tribes to take fish or on the fishery resource.

TABLE 2.9

TRIBES POSSESSING FISHING RIGHTS
IN THE PSDDA PHASE II AREA (NORTH AND SOUTH PUGET SOUND)

The following tribes possess adjudicated fishing rights in or around the alternative disposal sites studied by PSDDA in north and south Puget Sound:

Nisqually Tribe
Squaxin Island Tribe
Jamestown Tribe
Port Gamble Klallam
Lower Elwha Klallam
Swinomish Tribe
Suqumish Tribe
Tulalip Tribes
Puyallup Tribe
Lummi Tribe
Nooksack Tribe

TABLE 2.9 (con.)

The following tribes are not formally recognized by the Federal Government at this time for the purpose of receiving services from the U.S. Bureau of Indian Affairs, but may possess fishing rights to be recognized in the future:

Samish Tribe (area unknown)
Skykomish Tribe (area unknown)
Snohmish Tribe (area unknown)
Snoqualmie Tribe (area unknown)
Stillicum Tribe (area unknown)

To ensure incorporation of tribal input, active coordination and consultation has occurred throughout the PSDDA study with Indian tribes (see exhibit F). Participation in work group meetings, direct contacts with individual tribes, special meetings with tribal representatives, and exchange of correspondence identified tribal concerns that were addressed.

The PSDDA agencies have taken a variety of steps to avert any potential for open-water disposal of dredged material to affect treaty fishing. Also further steps have been specified which would be taken on a project by project basis. These steps are summarized below, and are discussed in more detail in other sections of the FEIS and in chapters 6, 7 and exhibit D of the Phase II MPR.

(2) Indian Treaty Fishing Rights. Several steps were taken during the PSDDA site identification process to avoid the potential for significant adverse impacts on the treaty fishing rights.

As part of the site selection process, an attempt was made to identify the high intensity fishing areas and areas of significant habitat. ZSF's were defined, to the extent possible, by avoiding these areas and areas where human use activities presented potential conflicts. Also, the ZSF's were sought at first in low energy (nondispersive) environments to facilitate disposal site monitoring and to avoid offsite impacts. The ZSF siting studies identified where the least direct impact would exist to resources via direct exposure and offsite sediment transport. When it was evident that some dredging areas in north Puget Sound had high resource concerns associated with all nondispersive localities available for dredged material disposal, PSDDA sought dispersive ZSF's that had lower resource values. Within ZSF's possible disposal site locations have been chosen which avoid both fishing activities and high quality habitat areas (e.g., via food web studies).

Having identified the areas which best avoid direct impacts to marine resources, the quality of dredged material allowable at these sites further determines the level of impacts which may occur. As discussed in the Phase I final EIS and program documents, the selected site management condition (II) can be managed at nondispersive, unconfined, open-water disposal sites without unacceptable adverse effects. However, for the dispersive sites, PSDDA agencies selected a more restrictive guideline for the disposal of the dredged material which allows no adverse effects to biological resources due to chemical concentrations in the material. Tribal comments received on the DEIS have indicated concerns for chemically caused acute toxic and chronic sublethal effects to resources at and near PSDDA sites. The PSDDA agencies responded to these concerns in exhibit C. In summary, the PSDDA biological texts provide the best available and very sensitive toxicity information on these effects, while the site management conditions (disposal guidelines and environmental monitoring) provide environmental protection and assurances that Indian harvests will be unaffected.

The site selection process and managment plans formulated by PSDDA ensure that no unacceptable adverse effects may occur to Puget Sound resources nor to tribal fishing rights. Potential vessel traffic conflicts could not be entirely eliminated through only the siting process. Because disposal site areas will be used for tribal fishing, further project-specific actions were deemed necessary.

The PSDDA agencies will further use the Federal 404 permit process to assure that appropriate project-specific actions are taken to resolve any potential conflicts that dredging vessel traffic may have with tribal fishing operations. Permitting authorities will only allow disposal to occur when there is no treaty fishing activity occurring at the disposal site unless otherwise agreed to by the tribes. This will be accomplished via the Federal Section 404 permit process. During processing of individual Section 404 applications, any potential conflict between treaty fishing and vessel traffic will be addressed prior to issuance of the permit. Conditioning of permits such that disposal will be consistent with tribal fishing operations may be appropriate as may be denial of permit applications where necessary. Both the Corps and DNR (the latter issues a disposal use site permit and manages the sites) will conduct compliance inspections at the disposal site to assure that the conditions of the permits are met and that site management conditions protect Indian treaty fishing rights.

In following this permitting process, disposal-related vessel traffic and fishing gear conflicts with tribal fishing operations should not occur. Violations of permit conditions, including permit conditions based on protecting treaty rights, are enforceable under Federal law.

The PSDDA agencies have also responded to stated tribal concerns that there could be damages to tribal fishing gear from debris disposal at PSDDA sites. Chapter 6 (sections 6.1 and 6.2.7) of the final Phase II MPR require suitable debris handling practices to be specified in dredging and disposal operations completed prior to permit approval.

In response to Indian concerns, potential effects of dredged material disposal on salmon and bottomfish migration patterns, near-site crab resources, and shrimp were reviewed and updated in the FEIS. As a result of the review, crab chemical body-burden analysis was added to the Bellingham Bay monitoring plan. The conclusions in the FEIS are otherwise the same as in the

DEIS: that the designation of PSDDA sites and site management conditions would not have adverse affects on Indian treaty fishing activities. The FEIS also confirms the DEIS conclusion that should the no-action alternative be selected over the action alternatives, a significantly greater number of proposals to fill nearshore areas for confined disposal sites would occur. This would likely lead to considerably greater potential impacts to fish resources through loss of rearing habitat, and could have a greater impact on fish harvesting as well. Because specific sites for confined disposal were not able to be identified (Ecology studies may do so in several years), it is impossible to accurately evaluate the extent of nearshore impacts that would occur for either the no action nor the action alternatives. However, confined disposal is expected to result in greater environmental impacts than disposal at PSDDA unconfined, open-water disposal sites. This expectation is based on the disposal site identification process in specifying potential sites that are well buffered from resources of concern and that are of relatively low habitat value.

3. AFFECTED ENVIRONMENT

3.00 Study Area Phase II - North and South Puget Sound. The study area for Phase II includes south Puget Sound, extending south from the Narrows Bridge at Tacoma to Olympia, and north Puget Sound, lying north of the Phase I area. This includes Hood Canal and the area from the Kitsap Peninsula (Foulweather Bluff) near the entrance tc Hood Canal west thorough the Strait of Juan de Fuca to Port Angeles and north through the San Juan Islands to the Georgia Strait. Also the north sound encompasses Rosario Strait and the east side of Whidbey Island north of a point near the community of Camano (figure 1.1), to Samish, Skagit, and Bellingham Bays.

3.01 Regional Setting.

a. Physical Environment.

(1) Geology. The Phase II areas are located within the Puget Sound Lowland Physiographic Province. The lowland is a north-south trending trough which is characterized by a thick sequence of glacial sediments. Most of the lowlands lie within 500 feet of present sea level and consist of elongated hills of gentle to moderate relief. Lakes are common and many rivers and streams drain the area.

The glacial sediments which mantle most of the Puget Sound lowlands are the result of several ice advances which have occurred within the last 50,000 years. Since the last glaciation, erosion and mass wasting processes have modified the land's surface. Deposits consist of stratified and unstratified layers of clay, silt, sand, gravel, and cobbles. Ice from the most recent glacial advance, known as the Fraser Glaciation, occupied the Puget Lowlands 11,000 to 13,000 years ago. Ice is believed to have reached a thickness of approximately 1,475 feet in the Olympia area (Burns, 1985). Consequently these deposits were highly compacted by the weight of the glacial ice, and are described as "overconsolidated glacial sediments" (Hart Crowser and Assoc., Inc. 1986). Erosion along shorelines and rivers has resulted in steep bluffs and landslides. Much of this eroded material has been deposited within lakes and river valleys, and at deltas where the rivers discharge into Puget Sound. Manmade changes (cuts and fills) have occurred within the last 120 to 140 years. Based on geophysical soundings and deep test borings, it appears that the bedrock underlying the glacial sediments in the Puget Trough consists of several large tectonically active blocks which may move relative to one another. This movement is to be believed responsible for much of the area's seismic activity. Recent evidence suggests that major earthquakes to magnitude 7.8 on the Richter scale are possible within the Puget Sound basin.

(2) Water Quality. Current circulation patterns fcr water in Puget Sound are important for an understanding of water quality trends. See section 3.01a(3) for a discussion of currents. Concerns for pollutants in marine waters have surfaced in recent years and are the focus of ongoing investigations and analyses by the Puget Sound Water Quality Authority in the

Puget Sound Water Quality Management Plan (PSWQA 1988). The reader is also referred to the 1988 PSWQA "State of the Sound Report" for a comprehensive overview of water quality conditions in Puget Sound. The following summary is extracted from this report.

Historically, Puget Sound has experienced municipal (industrial, agricultural and other discharges of contaminants (e.g., pathogens and nutrients) and toxic chemical substances, although most of the point source discharges are now controlled through the National Pollution Discharge Elimination System (NPDES) permit program. Nonpoint sources, which contribute both nutrients and toxicants to the sound, are controlled though Best Management Practices applied to agriculture and forestry. Anticipated success with these programs should eventually reduce inputs of chemicals to Puget Sound sediments. Although controls on large discharges of untreated sewage and industrial effluents have succeeded in reducing high biochemical oxygen demand (BOD) and improving water quality, isolated fish kills still occur in localized areas of the sound. Nutrients are generally not a problem in the marine waters of the south and north Puget Sound basin, nor in the Straits of Juan de Fuca. Oil spills, however, have occurred in the northern sound region in recent years. Sporadic oil spills, e.g., at Anacortes and Port Angeles, have produced degraded water quality for short periods with longer-term impacts to sediments.

Significantly elevated levels of chemicals of concern have been identified in only portions of two of the Phase II study areas, Bellingham Bay and Olympic Harbor. Severe chemical contamination of Puget Sound as measured in sediments and animal tissues appears to be patchily distributed and generally confined to areas near the sources (PSWQA 1986). Of the thousands of chemicals known or suspected to exist in the environment, only a relatively few are routinely measured. They have been typically identified and ranked according to these categories: (1) affecting human health or marine life; (2) historically documented in the sound; (3) persistent in toxic form; and (4) potential for food web transfer (PSWQA, 1986). Table 3.1 summarizes the status of selected toxic contaminants of concern in the Puget Sound basin in water, sediments, and tissue. In 1986, the State Department of Ecology adopted EPA ambient water quality criteria for 22 toxicants (of the 58 PSDDA chemicals of concern) as part of the State's water quality standards review.

Concentrations of trace metals and organic contaminants from 100 to 10,000 times greater than underlying water have been observed in the thin (0.002 inches (0.05 mm) layer at the sea water surface called the sea surface microlayer (PSWQA 1986; Word et al., 1986; Hardy and Cowan, 1986). Higher levels of contaminants have been related to the presence of dissolved organic matter concentrated in this layer in a complex matrix of natural and synthetic substances floating on the surface like oil. Atmospheric inputs as well as oil and grease and metals in municipal sewage, and industrial effluent are the primary input sources to the microlayer. Floatable substances in dredged material also have been identified as a potential input sources to the sea surface microlayer (Hardy and Cowan, 1986).

TABLE 3.1

SELECTED CONTAMINANT DISTRIBUTIONS
IN THE PUGET SOUND BASIN (After PSWQA, 1986) 1/

	Water 2/	Sediment	Tissue
PAH's	Detected at very low concentrations (.01 ppb) in waters of Puget Sound central basin. Mostly associated with particulates suspended in water.	Elevated concentrations (from 10x to 420x reference) in industrialized urban areas. Eagle Harbor has highest elevation measured.	Mainly in invertebrates; some in fish livers; rarely in fish muscle tissue. Elevated levels in invertebrates from Eagle Harbor, Mukilteo ferry dock area.
PCB's	Detected at very low concentrations (.001 to .01 ppb) in waters of Puget Sound central basin. Mostly associated with particulates suspended in water.	Elevated concentrations (from 20x to 130x reference) in industrialized urban areas with exception of Bellingham Bay.	Found in nearly all organisms from nearly all areas; highest levels in fatty tissues of marine mammals with long lifespans (e.g., harbor seals from southern Puget Sound).
Copper	Detected at very low concentrations (.1 to 1 ppb) in waters of Puget Sound central basin.	Elevated concentrations (from 10x to 370x reference) in Elliott Bay, Hylebos Waterway, Everett Harbor, Bellingham Bay, Eagle Harbor, and Sinclair Inlet. Highest elevation along Ruston-Point Defiance shoreline, Commencement Bay.	Copper is a required micronutrient for many species, and is present in tissues. Copper can accumulate in tissues of bivalve mollusks, crustacea, fish livers, and birds in industrialized urban areas. Copper is a natural component of the blood of crabs and snails and some other invertebrates. Significant accumulation of copper in fish muscle tissue from several areas of Commencement Bay.
Lead	Detected at very low concentrations (1 to 10 ppb) in waters of Puget Sound Central basin.	Elevated concentrations (from 10x to 110x reference) in Elliott Bay and Sinclair Inlet. Highest elevation along Ruston-Point Defiance shoreline.	Lead can accumulate in tissues of bivalve mollusks, crustacea, fish livers, and birds in industrialized urban areas. Lead does not generally accumulate at high levels in fish tissue.
Zinc	Detected at very low concentrations (1 to 10 ppb) in waters of Puget Sound central basin.	Elevated concentrations (from 10x to 43x reference) in Elliott Bay, Duwamish River, Ruston-Point Defiance (43x reference), Everett Harbor, Sinclair Inlet.	Zinc is a required micronutrient for many species, and is present in tissues. Zinc can accumulate in tissues of bivalve mollusks, crustacea, fish livers, and birds in urban areas. Zinc does not generally accumulate at high levels in fish muscle tissue.
Mercury	Detected at very low concentrations (less than .001 ppb) in waters of Puget Sound central basin.	Elevated concentrations (from 10x to 170x reference) in Elliott Bay, Ruston-Point Defiance (170x reference), Bellingham Bay, and Sinclair Inlet.	Historically high concentrations in mussels in Bellingham Bay. Mercury can accumulate in tissues of bivalve mollusks, crustacea, fish livers, and birds in industrialized urban areas. Mercury has not been found to accumulate at high levels in fish muscle tissue from Puget Sound, but does in fatty tissues of long-lived marine mammals (probably as methyl mercury).
Arsenic	Detected very low concentrations (1 to 10 ppb) in waters of Puget Sound central basin.	Elevated concentrations (from 10x to 620x reference) in Hylebos Waterway and Ruston-Point Defiance (620x reference) shoreline.	Arsenic levels in invertebrates, fish, and birds from areas containing contaminated sediments are similar to those in reference areas. A naturally high level of arsenic in seawater in the Northwest Pacific and Puget Sound is a major source of arsenic in organisms.

1/These contaminants are selected because they have been the most studied. Many other compounds are known to be present in harmful amounts.
2/From Romberg, et al., 1984.

Site specific discussions on water quality conditions are addressed for each alternative disposal site in the following sections of the EIS.

(3) Currents and Sediment Transport. Puget Sound is an estuary which derives much of its annual freshwater input from the Fraser River in Canada; to a lesser extent (but with greater local significance) freshwater inputs come from numerous rivers which empty directly into the sound.

Oceanic waters from the Strait of Juan de Fuca are tidally pumped into central Puget Sound via strong mixing currents in Admiralty Inlet and the Whidbey Basin. Because of a shallow sill at the Tacoma Narrows, water from central sound inflowing to south sound occurs near the surface, but waters flowing north towards central sound are usually from deeper water in south sound. Water of less nutrient content from deeper south sound sources always flows northward in Colvos Passage (west of Vashon Island) and mixes with waters to the north. Admixture of central basin waters occurs in the Admiralty Inlet area. These processes force extensive mixing of the waters in Puget Sound. Although tidal pumping action is the principal driving force of the dynamic oceanographic processes occurring in Puget Sound, the basin does receive a significant volume of freshwater each year from river discharge, amounting to approximately 20 percent of its total volume. Strong tidal currents and turbulence mix the freshwater and seawater. Inflowing riverwater escapes to the ocean and, as a result of mixing, also carries seawater with it, amounting to about 9 to 10 times the freshwater volume. There is a balancing inflow of more saline water from the Strait of Juan de Fuca. Because the mixed water is of lower salinity and lower density, a net outflow of diluted seawater occurs near the surface and a net inflow of nearly full salinity at depth. The topography of Puget Sound produces complex current patterns. However, in general the swiftest currents flow near the channel centers, and weaker currents occur near the shore, and at the heads of most bays.

The rivers that flow into Puget Sound discharge about 3.5 million cubic yards of sediment annually (Downing 1983). A large portion of this material is fine enough to remain suspended, and is carried out of the sound. The rest is deposited at the river deltas and in quiet areas such as bays and inlets.

Heavier particles settling out of the water column form the bottom sediments. Lighter sediments comprised of smaller particles may be suspended in the water column just above the bottom and form what is called the benthic nepheloid layer (PSWQA 1986). The nepheloid layer moves around with the bottom currents thereby transporting and redistributing sediments throughout the deep basin of Puget Sound.

(4) Marine and Estuarine Sediments. Sediment quality throughout the north and south basins of Puget Sound and in the major harbors of the Phase I study areas was well documented (e.g., Northern Tier Pipeline FEISS 1983; Weyerhaeuser Export Facility at Dupont FEIS, 1982; Striplin et al., 1987); Chapman et al., 1985; PSWQA 1986; PSDDA FEIS 1988). These studies concluded that most of the contamination is associated with areas of intensive human activity, whereas

the deep basins and embayments receiving little human use remain relatively free of contamination. These "cleaner" areas, however, show significant elevations of chemicals relative to levels measured in core samples from approximately 1840 (PSWQA 1986). Table 3.1 summarizes the status of selected contaminants of concern in the Puget Sound basin sediments.

Site specific discussions of sediment quality conditions are given for each alternative disposal site.

(5) Air Quality. Air quality throughout the Sound is variable both geographically and seasonally. Area-specific discussions are included in sections dealing with each prospective disposal site.

b. Biological Environment.

(1) Benthic Communities. In the Strait of Juan de Fuca/Strait of Georgia, including Bellingham Bay, the community composition and diversity depends largely on habitat type. Exposed sand and gravel habitats along the Strait contain relatively sparse, simple, low diversity, communities dominated by polychaetes and small crustaceans. Cobble and rock habitat contain the richest communities and the largest standing crop biomass. These communities are dominated by macroalgae, herbivorous gastropods, mussels, barnacles, large and small crustaceans. Few seasonal changes occur within these communities. For a detailed description of the flora and fauna of the Strait of Juan de Fuca and the Strait of Georgia, see Kozloff (1983).

Economically important invertebrate species are principally located within 2 nautical miles of the shorelines. Intertidal hardshell clams are primarily distributed from Dungeness Spit eastward to Point Wilson near Port Townsend. Dungeness Bay also is a Pacific oyster culturing area, and provides habitrat for Dungeness crab. The Puget Sound Environmental Atlas (Day et al., 1987) and Northern Tier FEIS (1983) depict subtidal clam distribution areas extending southeast of the Ediz Hook eastward to Port Townsend, particularly within Dungeness Bay, and the northeast side of Protection Island. Commercial oyster harvesting is restricted to Dungeness Bay. Major geoduck beds, including commercially exploited beds occur off of Green Point eastward to Dungeness Spit, east of Dungeness Bay, and west and north of Protection Island.

(2) Plankton Communities. Long-term studies on phytoplankton diversity and abundances are lacking for Puget Sound (NOAA Technical Memorandum NOS OMA 19, 1985). Phytoplankton can affect water quality when present in intense blooms, although conditions under which blooms occur are not well understood. Blooms may be related to anthropogenic nutrient inputs as well as hydrological factors such as vertical mixing depth relative to enphotic depth. Bloom dynamics are described below for Elliott Bay, and this is used to typify the general successional sequence of specie throughout Puget Sound and the Strait of Juan de Fuca. Various embayments will differ in some of the details.

Temporal variations in phytoplankton abundances have been described in Puget Sound, with multiple blooms commencing in May and extending through September. A succession of species ensues with an initial spring diatom blooms followed by spring/summer dinoflagellate blooms followed by a fall diatom blooms. The spring and early summer blooms include species such as Skeletonema costatum, Nitzschia spp., Chaetoceros constrictus, C. debilis, C. compressus, C. socialis, Thalassiosira aestivales and T. nordenskioldii. Mid-summer peaks are usually dominated by S. costatum, whereas late summer dinoflagellate blooms are dominated by Peridinium spp., Gymnodinium spp., and Ceratium fusus. Fall diatom blooms revert to various Chaetoceros and Thalassiosira spp. Also present during the summer are very small (1 to 2 micron) flagellates which may contribute significantly to primary production. This pattern is usually followed in all the south, central, and north Puget Sound embayments, although species composition and dominance sequencies vary somewhat.

According to Thut, et al. (1978), highest phytoplankton concentrations in Nisqually Reach are expected in surface waters, and high biomass in spring blooms is followed by smaller biomass in blooms in the fall.

Paralytic Shellfish Poisoning (PSP), a serious potential health threat in Puget Sound, is associated with "red tide" phytoplankton blooms (NOAA Technical Memorandum NOS OMA 19, 1985). PSP is caused locally by a toxin which is produced by a dinoflagellate, Gonyaulax catenella. The neurotoxin bioaccumulates in shellfish and other organisms and can cause paralysis leading to death in humans eating tainted shellfish (Saunders, et al., 1982; and Strickland, 1983). PSP is a relatively recent concern in the main basin of Puget Sound (since 1976), and has been identified by the Puget Sound Estuary Program (PSEP) as warranting further study. Data are available to assess temporal trends and occurrences throughout Puget Sound. PSP is regulated in Washington State by the Department of Social and Health Services (DSHS) through shellfish harvesting regulations and shellfish bed closures which are publicized as necessary throughout the Puget Sound area. In recent years PSP has been spread through the transport of vegetative colonies and overwintering cysts. Because there is a potential for redistribution of cysts associated with sediments into previously uncontaminated (i.e., with cysts) areas it is acknowledged as a potential concern. In the fall of 1988, south sound experienced its first widespread closure for PSP although low levels of the PSP toxin have been found in most of the arms of south sound since 1981.

A large number of zooplankton species are found in Elliott Bay. The copepods Corycaeus spp., Pseudocalanus spp., and Microcalanus spp. are most numerous, while greatest biomass comes from larger copepods (Calanus spp.), euphausids (Euphausa pacifica), and amphipods. Relatively high densities of euphausids were observed in trawl catches between Devils Head and Anderson Island during July 1987 (Donnelly, et al., 1988). Nearshore zooplankton investigations near the Weyerhaueser/Dupont Site in south Puget Sound showed that calanoid copepods were the most numerous zooplankton, with seasonal secondary dominance by crab larvae (zoea), cnidaria (jellyfish), and caridean (brown) zoea. Fish eggs and larvae were dominated by gadoids (soft-fined fishes) and pleuronectids (flatfishes). English sole larvae were the most abundant flatfish larvae observed. The relative abundances of calanoid copepods decreased from March to April before increasing in May and sustained high densities through July. Peak catches of crab zoea occurred during April. Cnidaria abundances were relatively low during March and April, but increased steadily through July. Both fish eggs and fish larvae were most abundant in April, subsequently decreasing steadily through July.

The neuston community consists of minute organisms associated with the seasurface (150 micrometer) microlayer, and is divided into bacteria (bacterioneuston), animals (zooneuston), and plants (phytoneuston).

Seasurface microlayer populations of bacterioneustron have been shown to be more diverse and numerous than the rest of the water column.

Zooneuston include bacteria; protozoa; small metazoans (less than 1 mm), large metazoans (greater than 1 mm); fish eggs, larvae, and fry. Juvenile fish are known to actively feed on neuston within the surface microlayer. It is likely that zooneuston resources existing in the upper surface layers of the water column are critical to the life history stages of many important Puget Sound marine organisms. Many species of commercial and ecological importance have life history stages that could be affected by microlayer contamination.

Phytoneuston genera in the surface environment are functionally distinct from the phytoplankton community in terms of species composition and standing crop. Phytoneuston communities have higher abundances, lower diversities, and higher variations in species composition and abundance, greater absolute biomass, and more variable productivity. Phytoneuston communities, particularly those observed in nearshore environments, are frequently dominated by diatoms, dinoflagellates, blue-green algae and euglenoids (Word et al., 1986).

(3) Anadromous and Marine Fishes. Economically important fish resources are widely distributed throughout the Strait of Juan de Fuca and Strait of Georgia. Groundfish resource and harvesting areas are located north of Ediz Hook, south of the Port Angeles Zone of Siting Feasibility (ZSF), northeast of the Port Angeles, and along the eastern half of the Ediz Hook. Sizeable groundfish harvesting areas exist west of Protection Island, northwest, north, and northeast of the Port Townsend ZSF.

Northwest Indians first harvested salmon thousands of years ago, and salmon still remain the most important component of the tribal and commercial and sport fisheries in Puget Sound. Estimated average annual (1974 to 1978) total commercial salmon catch for all five species migrating through the Strait of Juan de Fuca (including Fraser River Stocks) is 117,000 tons (PSWQA 1986). The 1984 salmon harvest accounted for approximately 67 percent of the value of Puget Sound's commercial fisheries. Sport catches of salmon are estimated at 800 tons in the Strait of Juan de Fuca and approximately 1,600 tons in the main basin (PSWQA, 1986). For more recent fish harvest information by species, see sections 3.01c(4) and (5).

The salmon fishery is subject to stringent management measures which limit catches for all species and result in frequent closures in order to ensure adequate reproductive stocks. Natural runs of spring chinook are all but extinct (PSWQA 1986). Coho is the most abundant salmon species in the main basin and in south Puget Sound, and is maintained almost exclusively by hatchery propagation. Populations of chinook, coho, pink, and chum salmon, as well as steelhead trout, are also artificially supplemented by hatcheries and rearing pens throughout the sound. While hatcheries create more fish, they also diminish desirable wild gene frequencies, which could ultimately influence the fitness and health of soundwide salmon populations.

Spawning and rearing habitats have been adversely affected by such disturbances as logging operations, dam and lock construction, shoreline development, and urban runoff (PSWQA 1986; Grette and Salo 1986).

(4) Marine Mammals. Several species of Puget Sound's resident marine mammals are likely to use the habitats in and near the proposed disposal areas for feeding or resting purposes. These include the harbor porpoise (Phocoena phocoena), Dall's porpoise (Phocenoides dallii), the killer whale (Orcinus orca), northern sea lion (Eumetopias jubata), and harbor seals (Phoca vitulina). Both porpoises usually stay north of Admiraly Inlet (Puget Sound Environmental Atlas, 1987). Seasonal migrants to Puget Sound include the California sea lion (Zalophus californianus) and the gray whale (Eschrichtius robustus). California sea lions usually appear in Puget Sound in the autumn after breeding, and leave the sound in late spring. However, in recent years, several individuals have stayed throughout the summer at Port Gardner and Shilshole Bay. Minke whales (Balaenoptera acutorostrata) are fairly common near the San Juan Islands, but are only rarely seen in Puget Sound south of Port Townsend. They feed on herring and other small schooling fishes. The northern elephant seal (Mirounga angustirostris) is an occasional visitor to Puget Sound and feeds on benthic invertebrates and fishes. The diet of harbor porpoises consists of small fish and invertebrates such as herring and squid. Dall's porpoise feeds primarily on squid and small schooling fishes. A pod of killer whales continues to live in the vicinity of the San Juan Islands. Harbor seals have major nursery and haul out areas at Smith Island, Protection Island, and at Low Point (west of Port Angeles), and numerous haul out sites within Admiralty Inlet, San Juan Islands, and Skagit, Padilla, Samish and Bellingham Bays. Northern sea lions have haul out areas in the San Juan Islands and along the Strait of Juan de Fuca (primarily Dungeness Spit). California sea lions have been observed on Sucia Island in the northern San Juan Islands. A fair number of Minke whale sightings are recorded from all the waters surrounding and within the San Juan archipelago. Few sightings have occurred elsewhere in the Phase II PSDDA study area. In Puget Sound, killer whales eat fish almost exclusively: particularaly salmon, rockfish, and cod. They usually do not attack other marine mammals in the area. Because killer whales are top carnivores in the marine ecosystem the entire Puget Sound habitat is critical, particularly where there are large runs of salmon. However, in recent years, pods of killer whales have been seen less frequently in south Puget Sound. Harbor seals feed on salmon,

herring, octopus, and rockfish and are commonly found in Puget Sound bays. A major nursery and haul out area is at Gertrude Island (near Melveil Island). Northern sea lions haul out at Fox Island. In Puget Sound, the endangered gray whales forage in bays for a variety of benthic invertebrates, mysids, fish larvae, and small schooling fishes. River otters (*Lutra canadensis*) are primarily terrestrial species that may be found in quiet shoreline areas containing freshwater streams, throughout the sound.

(5) Waterbirds. Bird distributions in Puget Sound are not yet well documented (Day et al., 1987). In general, birds using the potential disposal site areas are birds that feed in deepwater. Dabbling ducks such as mallards, pintails, wigeons, etc., and other shallow-water feeders such as coots, will typically not be in deepwater. Birds living in Puget Sound typically adapted for deepwater feeding include loons; grebes; cormorants; "bay ducks" such as canvasbacks, scaups, goldeneyes, and buffleheads; oldsquaws; scoters; and red-breasted mergansers. Other birds utilizing deepwater habitats for feeding include bald eagles, ospreys, jaegers, various gulls, terns, and alcids such as rhinocerous auklets, common murres, marbled murrelets, pigeon guillemots, and ancient murrelets. Deepwater feeding birds generally follow concentrations of fish such as herring. In very stormy weather, deepwater feeding birds will seek protected bays. Alcids generally stay offshore a considerable distance during all types of weather. Peregrine falcons regularly migrate through Puget Sound (and a few overwinter), but they most often utilize shallow water or upland habitats for hunting, not the deepwater areas of the PSDDA disposal sites. The majority of the birds listed above are migrants and/or winter residents. Only cormorants, Barrow's goldeneyes, bald eagles, peregrine falcons, ospreys, some gulls, and all alcids except ancient murrelets, nest on or near Puget Sound. There are no major seabird colonies in south Puget Sound, although scattered small nests of several species occur.

Generally, the north sound is far more productive (i.e., there are many more breeding colonies and larger populations) for waterbirds than south sound. The major colonies occur at Protection Island, Smith and Minor Islands, Williamson and Bird Rocks, Colville Island, Puffin Island, Sister Islands, and Viti Rocks. The most widespread breeding birds at these colonies are (usually) glaucous-winged gulls. Pelagic cormorants are the next most numerous widespread breeding bird. Rhinocerous auklets may actually have the largest breeding population, but they are localized at Protection and Smith Islands. Protection Island is clearly the most important breeding sea bird colony in the Puget Sound region, supporting at least seven species of breeding seabirds numbering over 20,000 individuals.

(6) Endangered and Threatened Species. Endangered cetaceans that occasionally enter Puget Sound must enter through either the Strait of Juan de Fuca or the Strait of Georgia. Thus, they may pass by or through one of the proposed PSDDA Phase II disposal sites. Peregrine falcons are most numerous during migration and winter near Skagit, Padilla, Samish, and Lummi Bays. Bald eagles are relatively common throughout the Phase II area through the year.

Three species of endangered cetaceans may be seen in Puget Sound. These are the gray whale (Eschrichtius robustus), fin whale (Balaenoptera acutorostrata), and humpback whale (Megaptera novaeangliae). Fin whales have been only sighted twice in Puget Sound. The blue whale (B. musculus) has never been verified in Puget Sound waters. It is suspected that a whale identified as a fin whale in 1930 near Shelton may have been a young blue whale (National Marine Mammal Laboratory, 1980). Sightings of gray whales in the inland waters of Washington are rare, but have increased in recent years. Humpback whales used to be one of the most frequently observed whales in the Sound; but commercial whaling has dramatically reduced their numbers. Sightings of this species in the inside waters over the past few years have been rare, but reportedly are on the increase.

The peregrine falcon is an endangered species that may nest and winter in Puget Sound. The species regularly migrates through or overwinters in highly specific areas near Puget Sound, mostly in north sound. There are no known active eyries of this species near any of the proposed Phase II disposal areas. The Nisqually National Wildlife Refuge may have one or two wintering falcons.

Bald eagles are listed as a threatened species in Washington. There are many bald eagle nests throughout the Puget Sound area.

Biological Assessments (BA's) prepared for the PSDDA phase II study are attached in exhibit A. More detailed descriptions of the area's threatened and endangered species, and their habitat, are provided in the BA's.

c. Human Environment.

(1) Social and Economic Factors. Social and economic factors are described under each area considered below.

(2) Navigation Development. Vessels plying the Phase II waters vary from bulk cargo and container ships to barges, tug boats and assorted other craft. The Strait of Juan de Fuca, a major shipping route in Phase II, enables commerce to flow from and to the ports of Vancouver, B.C. and Bellingham, as well as from and to the Phase I ports of Seattle, Everett, and Tacoma. Navigation development has occurred in the areas that will be serviced by the five designated Phase II disposal sites since before 1910. Deep and shallow draft channels have been constructed which require periodic dredging to maintain adequate vessel clearances. Significant navigation improvement projects could be constructed within the 15-year planning horizon of PSDDA. In the past, navigation developments such as filling of tidal wetlands and channelization of rivers have resulted in losses of biological productivity. However, current policy is to compensate or mitigate such losses.

(3) Dredging and Disposal Activity. This section describes past and future navigation dredging activity in the Phase II area, and compares the future volume assessments under PSDDA disposal guidelines (for the action

alternatives) and under PSIC (for the no-action alternative). Table 2.7a lists the assumptions used in arriving at the volume assessments of material that is expected to be suitable for disposal at the Phase II disposal sites for the action and no-action alternatives.

Dredging activity has occurred throughout Puget Sound for a number of decades. For the period 1970 to 1985, an estimated 7.9 million cubic yards (c.y.) were dredged from waters and nearshore areas in the Puget Sound Phase II study. Of this total volume, Corps Federal projects accounted for about 27 percent of the material dredged, while the port authorities in the Phase II area accounted for about 40 percent. The remaining 33 percent was undertaken by a diverse group of dredgers, including other Federal, State, local governments, and private developers.

Historically, dredged material has been placed at several types of disposal areas. Designated multiuser, unconfined, open-water disposal sites have been maintained by DNR at six north Puget Sound sites with a total disposal volume of 2,552,000 c.y. from 1970 to 1985. The two south Puget Sound DNR-designated open-water sites received 376,000 c.y. over this period. About 325,000 c.y. were distributed to single-user, open-water locations throughout the Phase II area.

About 59 percent of the total 7.9 million c.y. dredged between 1970 and 1985 from Phase II north and south Puget Sound areas was placed at upland or nearshore sites. However, in recent years, the availability of such sites has diminished resulting in greater reliance on unconfined open-water sites for disposal of dredged material.

A 9 percent decrease in dredging activity in Phase II areas is forecast over the period 1985 to 2000, as compared to the prior 15 years. A total of approximately 7,187,000 c.y. of sediment are expected to be dredged from north and south Puget Sound Phase II areas (see table 3.2). This forecast includes 1,470,000 c.y. of material dredged from the Lummi Bay Marina construction project which is planned to be used in marina construction. The latter volume does not include berth and channel maintenance for the marina which could be discharged at a PSDDA site. Of the remaining total (5,717,000 c.y.), 83 percent (4,739,500 c.y.) is expected to be found suitable under the PSDDA disposal guidelines (see table 2.7). The remaining 977,500 c.y. would thus need to be placed at confined aquatic or terrestrial sites (upland confined areas, nearshore, or confined deepwater).

Between 1970 and 1985, a total of 16,850,000 c.y. was dredged in the Phase I area, of which 6,758,000 c.y. went to unconfined, open-water sites. Phase II total volumes are 47 percent of the Phase I total volume for this period. Fifty-two percent of the Phase I total volumes were placed in upland or nearshore disposal sites.

TABLE 3.2

FORECAST TOTAL DREDGING VOLUMES (Cubic Yards)
FOR PHASE II AREA (1985 to 2000) -

Activity	South Sound	North Sound: (Total = 5,850,000) Bellingham Vicinity	Rosario Strait Vicinity	Port Angeles Vicinity	Port Townsend Vicinity
Corps 1/	500,000	1,970,000 2/	400,000		
Ports 3/	225,000	505,000	473,000	104,000	377,000
Other 4/	612,000	602,000	928,000	181,000	310,000
TOTAL	1,337,000	3,077,000	1,801,000	285,000	687,000

1/Corps forecast includes: south sound - Olympia/Budd Inlet (West Bay Turning Basin and Channel Improvement, 500,000 c.y.); North sound - Bellingham vicinity (Whatcom Creek Maintenance, 100,000 c.y.; Squalicum Waterway maintenance, 200,000 c.y.; I and J St. Waterway maintenance, 60,000 c.y. - all in Bellingham Bay; Fidalgo Bay Capsante Waterway maintenance, 60,000 c.y.; Lummi Bay Marina construction, 1,470,000 c.y.; and Lummi Bay maintenance, 80,000 c.y.); Rosario Strait vicinity (Swinomish Channel maintenance, 400,000 c.y.).

2/Volume includes 1,470,000 c.y. of material to be dredged from the Lummi Bay Construction Project and currently proposed only to be used in marina construction.

3/Forecasts by ports: south sound - Port of Olympia/Budd Inlet (West Bay Terminal, 200,000 c.y.; East Bay moorage, 5,000 c.y.; berths 3 and 4, 15,000 c.y.; berth 2, 5,000 c.y.); north sound - Port of Bellingham (Blaine, 350,000 c.y.; I and J Waterway, 330,000 c.y.; Squalicum Creek, 30,000 c.y.; Whatcom Waterway, 5,000 c.y.); Port of Anacortes (Dakota Creek, 60,000 c.y.; Capsante Boat Haven, 40,000 c.y.; Pier 1, 20,000 c.y.; Pier II, 20,000 c.y.); Port of Skagit (Swinomish Channel development, 107,000 c.y.; Swinomish Channel Seaplane development, 4,000 c.y.; south perimeter basin maintenance, 12,000 c.y.); Port of Port Angeles (Tumwater Creek, 50,500 c.y.; Ediz Hook launch ramp, 3,000 c.y.; Port Angeles Boat Haven, 500 c.y., Dungeness Bay launch ramp, 30,000 c.y.; Port Angeles Marine Terminal, 15,000 c.y.; Sequim Bay marinas, 5,000 c.y.); Port of Port Townsend (Port Townsend boat basin, 373,000 c.y.; Point Hudson, 3,000 c.y.; Quilcene Boat Basin, 1,000 c.y.)

4/Includes estimates for Federal dredging other than by Corps, municipal, State of Washington Department of Transportation, and private dredging. This volume assumed equal to permitted dredging volumes over period 1970 to 1985.

Phase II projected dredging volumes for 1985 to 2000 are only about 31 percent of the 22.7 million c.y. forecast for the Phase I area over this same period. When the Phase II volume is adjusted for material not proposed for placement in an unconfined, open-water site, this ratio drops to 25 percent of Phase I forecast. Thus, Phase II dredged and disposal is small relative to Phase I.

(4) Native American Treaty Fishing. Fish harvesting by the Indian tribes includes shellfish and finfish; most effort is given to salmon, the most valuable finfish and the most complicated stock to manage. The five species of salmon vary as to abundance and seasonality in the different PSDDA Phase II areas. Harvest management periods for salmon species are displayed in the succeeding sections corresponding to areas near each disposal site.

Fisheries open and close in each tribal fishery area depending on run sizes, timing of runs and other management constraints. These tribal fishery openings and closure periods vary from year to year and are often based on previous information taken directly from Indian gill net records. Tribal fishery managers are required to notify the Washington Department of Fisheries of fishing openings and closures at least 24 hours in advance of these occurrences.

Exhibit E contains a synopsis of Indian fish harvest data for the years 1985-87 in the Phase II area. Specific fishery efforts of the 11 tribes in the areas of potential disposal sites are described in sections 3.02c(4) (Nisqually area), 3.03c(4) (Bellingham Bay area), section 3.05c(4) (Rosario Strait), section 3.06c(4) (Port Angeles) and 3.07c(4) (Port Townsend). A summary of tribal fishing practices is discussed in section 2.04d.

(5) Non-Indian Commercial and Recreational Fishing. Fish and shellfish harvesting in north and south Puget Sound are summarized for the years 1985-87 in appendix E (Ward, WDF, 1988, personnel communication) for both Indians and total catches.

(6) Esthetic Setting. The esthetic setting for both north and south sound provides shoreline and mountain views along with vegetated slopes, agricultural fields, rivers, and urban views. Site specific esthetic settings are given under each alternatives' discussion.

(7) Cultural Resources. No cultural resources have been identified within the selected Phase II disposal sites. Neither literature searches of marine history nor consultations with local marine history museums and historical organizations disclosed the existence of sunken historic properties within the site areas. Sidescan sonar studies conducted at Bellingham Bay and Anderson/Ketron Island disposal sites also did not detect conclusive evidence for the presence of sunken vessels. It was concluded that no National Register eligible sunken historic properties will be affected by operations at the Phase II disposal sites.

3.02 South Sound-Nisqually Area.

a. Physical Environment.

(1) Geology. See 3.01a(1) for discussion of regional geological settings, and 3.02a(3) below for discussion of sedimentation features of the Nisqually delta. Figures 2.1, 2.2, and 2.3 show the ZSFs, including the preferred and alternate disposal sites in the Nisqually area. The Nisqually reach is located at the southern end of the Puget Sound. Access to the reach is through the Tacoma Narrows to the north, where there is a relatively shallow sill (at a depth of 150 feet) controlling seawater circulation between the south basin and the rest of the Puget Sound. The majority of the south basin is characterized by shallow waters of less than 120 feet deep (Burns 1985). The ZSFs are in relatively deeper water of 442 feet (selected site) and 338 feet (alternative site) depths. A midchannel sill at 100 feet has developed at the Nisqually Delta separating bottom waters to the east and west.

(2) Water Quality. Water quality in the Nisqually Reach area of south Puget Sound is classified as extraordinary (class AA) according to 1984 Washington State Department of Ecology standards (WAC 173-201). Budd Inlet, Eld Inlet, Totten Inlet, and Hammersley Inlet are classified as "excellent" (class A) based on proximity to industrial and urban pollution sources.

Water quality in the south sound reflects the influence of land more than the north sound since it is farther from open oceanic influences. Thus, water in south sound is slower to be replaced. The less active tidal currents also contribute to the designation of the Nisqually Reach as a nondispersive disposal site, in the Phase II Dredge Disposal Plan.

In the Nisqually Reach, the mean yearly surface salinity is 26.4 parts per thousand (ppt), and at 10 m depth, 28.7 ppt. (EPA 1988). Circulation patterns are influenced by inflows from the several rivers in the area. The two largest, the Deschutes and the Nisqually, have somewhat different flow characteristics. The Deschutes' highest flow rates occur during the winter (about 880 c.f.s. average in February) and during heavy rainstorms. The Nisqually, with higher altitude origins, has a later spring peak in flow (e.g., 1,050 c.f.s. average in May and June) fed largely by snow melt (PSWQA, 1986). Because of riverine freshwater inflow, a very thin surface layer can have low salinities at high runoff periods.

For the most part, established State water quality standards are met in the south sound waters, though some areas near point source discharges have permit-established dilution zones in which chemical concentrations capable of producing chronic impacts on aquatic biota are tolerated, but in which levels causing acute impacts to aquatic organisms are not.

Point source discharges are clustered in the lower part of the south sound. Ten are listed near Shelton and nine discharge into Budd Inlet (PSWQA 1986). The NPDES permits issued to discharges outline allowable limits for prescribed chemicals; for example, sulfur compounds are designated from a Steilacoom pulp and paper facility. In May 1980, Nisqually open-water concentrations of dissolved cadmium measured 0.05 parts per billion (ppb), dissolved nickel was 0.40 ppb, and dissolved copper was 0.44 ppb (Paulson and Feeley, 1985).

Among the point sources contributing contaminants into the south sound are Sewage Waste Treatment Plants (SWTPs), which, in addition to nutrients, discharge potentially toxic organic compounds and metals into the receiving waters. Olympia, where the municipal SWTP discharges 5,950 million gallons of effluent a year into Budd Inlet, also has a Combined Sewer Overlfow (CSO) system which may discharge storm floods plus SWTP effluents when the system becomes overloaded. This increases the number of fecal coliform bacteria, estimated at 48 billion per year from the SWTP entering Budd Inlet and adds to the likelihood of prohibitions on shellfish harvesting in the south sound (PSWQA, 1986). Several areas such as Henderson and Eld Inlets have known bacterial and viral contamination. In the Nisqually Reach, the geometric mean of fecal coliform counts/100 ml for surface waters was 1.47 (EPA, 1988).

Another water quality problem is that of Paralytic Shellfish Poisoning (PSP), which is not due to discharged contaminants but results from toxic algal blooms (Gonyaulax catenella) which are ingested by suspension feeding (filtering) shellfish. In October 1988, levels of PSP toxin potentially dangerous to humans, i.e., above the 80 micrograms of toxin per 100 grams of shellfish meat allowable, were found in mussels from south sound near the proposed disposal site, and all recreational and commercial shellfish (mussel and oyster) harvesting was prohibited for a short period. Previously, only nominal amounts of PSP toxin had been recovered in shellfish from south of the Tacoma Narrows Bridge.

Dissolved oxygen (DO) levels at the surface are highest in the spring (up to 14.4 mg oxygen/l of water) and lowest in the fall (6.4 mg/l), according to data from Carr Inlet, not far from the Nisqually Reach disposal site (Collias, et al., 1974). Bottom dissolved oxygen reaches as low as 5.0 mg/l (August), but this is rare; generally, advective mixing is so strong in the area that levels below 5 mg/l dissolved oxygen (the minimum set by resource agencies) will seldom if ever occur. The yearly mean value for surface DO is 9.5 mg/l, and at 30 m depth it is 8.1 mg/l (EPA, 1988). Strong mixing also causes a relatively small temperature range both by season and by depth. Aside from a shallow near-surface warming during summer (to about 15 degrees C), water temperatures generally range from about 7 degrees to 13 degrees C in nearby Carr Inlet, while the yearly surface mean temperature in Nisqually Reach is 12.6 degrees C.

(3) Currents and Sediment Transport. The Nisqually and Nooksack deltas are probably the most studied examples of sediment processes at river mouths in Puget Sound. In comparison with other large deltas in the region, only minor aspects of these river mouths have been modified by man (Downing, 1983). The freshwater discharge and sediment load of the Nisqually River pass through a network of distributary channels on route to the sound. At the outer edge, the slope of the delta steepens and dips offshore. The horizontal sedimentary beds that make up the delta platform consist of mud deposits rich

in organic material that accumulate in the inner delta, sand deposits in tidal and distributary channels, and fine-grained intertidal sediments. The delta front consists of steeper deposits which have built seaward. The front beds usually consist of mud and fine sands. As the delta front advances out into deeper water with time, more and more sediment is required to produce new surface area on the delta platform. Therefore the rate of seaward advance of the shoreline has declined through recent geologic time while the delta has grown in volume.

The sediment dispersion pattern from the river is determined by the height of the tide and the intensity of wave and current activity at the channel mouth. At low tide, the suspended load and bedload are transported across the intertidal delta in shallow channels that are extensions of the main tributaries. At high tide these channels are submerged and the plume of suspended sediment is moved about by the tidal and nearshore currents; at this time, most of the transport of sand and coarser material on the bed ceases. Longshore currents also transport sedimentary material to the Nisqually delta. Compared with the river sediment load, the longshore contributions of sediment are of minor importance, but they can be vital to the beach stability on more exposed deltas. Longshore transport provides the coarse material to form berms and beach ridges that protect the marshes and wetlands from waves. Because of its moderate wave fetch, the Nisqually Delta is an outstanding example of delta formation by tidal and fluvial currents. Since the last glaciation, the Nisqually has filled its inlet with sediment and advanced into the main basin about 50 meters (160 feet) per century. This constriction of the channel connecting the south and central basins of Puget Sound by deltaic sediments gradually increased tidal current speeds there until an equilibrium between sediment deposition and dispersal by current was eventually reached.

Two current meter records, 19 and 115 meters off the bottom (which is at 134 meters), exist in the Anderson Island/Ketron Island ZSF(2). At the northern end of the site at a depth of 119 meters, mean speed equaled 14.55 cm/s. In the southern portion of the ZSF, mean speed at 34 meters varied between 9.07 and 11.33 cm/sec. Surface flow is in a northern direction, while below 35 meters currents flow in a southern direction. Net current speed at the 119 meter depth was 5.69 cm/sec to the south-southeast. Four current meter arrays recorded data from in and around the Anderson Island/Devils Head ZSF(3). The data from the meter within the southeast boundary of the ZSF recorded mean speeds of 14.20 to 17.51 cm/sec, at a depth of 34 meters (with the bottom at 60 meters). Net flow varied from 3.84 to 9.13 cm/sec, and net direction was to the northwest. Net flows above this depth were to the southeast The other current meters recorded mean speeds ranging from 7.07 cm/sec, in Drayton Passage, at a depth of 5 meters, to 20.81 cm/sec to the northwest of the ZSF, at a depth of 71 meters.

(4) Marine and Estuarine Sediments. The primary source of suspended sediments in the Anderson/Ketron Island ZSF is the Nisqually River which ranks fourth as a sediment source among major rivers. Annual sediment discharge is approximately 0.11 million metric tons (Downing, 1983). See also section 3.02a(3)(b) above for discussion of sedimentation.

and paper facility. In May 1980, Nisqually open-water concentrations of dissolved cadmium measured 0.05 parts per billion (ppb), dissolved nickel was 0.40 ppb, and dissolved copper was 0.44 ppb (Paulson and Feeley, 1985).

Among the point sources contributing contaminants into the south sound are Sewage Waste Treatment Plants (SWTPs), which, in addition to nutrients, discharge potentially toxic organic compounds and metals into the receiving waters. Olympia, where the municipal SWTP discharges 5,950 million gallons of effluent a year into Budd Inlet, also has a Combined Sewer Overlfow (CSO) system which may discharge storm floods plus SWTP effluents when the system becomes overloaded. This increases the number of fecal coliform bacteria, estimated at 48 billion per year from the SWTP entering Budd Inlet and adds to the likelihood of prohibitions on shellfish harvesting in the south sound (PSWQA, 1986). Several areas such as Henderson and Eld Inlets have known bacterial and viral contamination. In the Nisqually Reach, the geometric mean of fecal coliform counts/100 ml for surface waters was 1.47 (EPA, 1988).

Another water quality problem is that of Paralytic Shellfish Poisoning (PSP), which is not due to discharged contaminants but results from toxic algal blooms (Gonyaulax catenella) which are ingested by suspension feeding (filtering) shellfish. In October 1988, levels of PSP toxin potentially dangerous to humans, i.e., above the 80 micrograms of toxin per 100 grams of shellfish meat allowable, were found in mussels from south sound near the proposed disposal site, and all recreational and commercial shellfish (mussel and oyster) harvesting was prohibited for a short period. Previously, only nominal amounts of PSP toxin had been recovered in shellfish from south of the Tacoma Narrows Bridge.

Dissolved oxygen (DO) levels at the surface are highest in the spring (up to 14.4 mg oxygen/l of water) and lowest in the fall (6.4 mg/l), according to data from Carr Inlet, not far from the Nisqually Reach disposal site (Collias, et al., 1974). Bottom dissolved oxygen reaches as low as 5.0 mg/l (August), but this is rare; generally, advective mixing is so strong in the area that levels below 5 mg/l dissolved oxygen (the minimum set by resource agencies) will seldom if ever occur. The yearly mean value for surface DO is 9.5 mg/l, and at 30 m depth it is 8.1 mg/l (EPA, 1988). Strong mixing also causes a relatively small temperature range both by season and by depth. Aside from a shallow near-surface warming during summer (to about 15 degrees C), water temperatures generally range from about 7 degrees to 13 degrees C in nearby Carr Inlet, while the yearly surface mean temperature in Nisqually Reach is 12.6 degrees C.

(3) Currents and Sediment Transport. The Nisqually and Nooksack deltas are probably the most studied examples of sediment processes at river mouths in Puget Sound. In comparison with other large deltas in the region, only minor aspects of these river mouths have been modified by man (Downing, 1983). The freshwater discharge and sediment load of the Nisqually River pass through a network of distributary channels on route to the sound. At the outer edge, the slope of the delta steepens and dips offshore. The horizontal sedimentary beds that make up the delta platform consist of mud deposits rich

in organic material that accumulate in the inner delta, sand deposits in tidal and distributary channels, and fine-grained intertidal sediments. The delta front consists of steeper deposits which have built seaward. The front beds usually consist of mud and fine sands. As the delta front advances out into deeper water with time, more and more sediment is required to produce new surface area on the delta platform. Therefore the rate of seaward advance of the shoreline has declined through recent geologic time while the delta has grown in volume.

The sediment dispersion pattern from the river is determined by the height of the tide and the intensity of wave and current activity at the channel mouth. At low tide, the suspended load and bedload are transported across the intertidal delta in shallow channels that are extensions of the main tributaries. At high tide these channels are submerged and the plume of suspended sediment is moved about by the tidal and nearshore currents; at this time, most of the transport of sand and coarser material on the bed ceases. Longshore currents also transport sedimentary material to the Nisqually delta. Compared with the river sediment load, the longshore contributions of sediment are of minor importance, but they can be vital to the beach stability on more exposed deltas. Longshore transport provides the coarse material to form berms and beach ridges that protect the marshes and wetlands from waves. Because of its moderate wave fetch, the Nisqually Delta is an outstanding example of delta formation by tidal and fluvial currents. Since the last glaciation, the Nisqually has filled its inlet with sediment and advanced into the main basin about 50 meters (160 feet) per century. This constriction of the channel connecting the south and central basins of Puget Sound by deltaic sediments gradually increased tidal current speeds there until an equilibrium between sediment deposition and dispersal by current was eventually reached.

Two current meter records, 19 and 115 meters off the bottom (which is at 134 meters), exist in the <u>Anderson Island/Ketron Island ZSF(2)</u>. At the northern end of the site at a depth of 119 meters, mean speed equaled 14.55 cm/s. In the southern portion of the ZSF, mean speed at 34 meters varied between 9.07 and 11.33 cm/sec. Surface flow is in a northern direction, while below 35 meters currents flow in a southern direction. Net current speed at the 119 meter depth was 5.69 cm/sec to the south-southeast. Four current meter arrays recorded data from in and around the <u>Anderson Island/Devils Head ZSF(3)</u>. The data from the meter within the southeast boundary of the ZSF recorded mean speeds of 14.20 to 17.51 cm/sec, at a depth of 34 meters (with the bottom at 60 meters). Net flow varied from 3.84 to 9.13 cm/sec, and net direction was to the northwest. Net flows above this depth were to the southeast The other current meters recorded mean speeds ranging from 7.07 cm/sec, in Drayton Passage, at a depth of 5 meters, to 20.81 cm/sec to the northwest of the ZSF, at a depth of 71 meters.

(4) <u>Marine and Estuarine Sediments</u>. The primary source of suspended sediments in the Anderson/Ketron Island ZSF is the Nisqually River which ranks fourth as a sediment source among major rivers. Annual sediment discharge is approximately 0.11 million metric tons (Downing, 1983). See also section 3.02a(3)(b) above for discussion of sedimentation.

Sand is abundant in the main distributary, that is, the channel at the mouth of McAllister Creek. The high percentage of sand in these deposits indicates that the current tranported sediments in these areas are primarily bedload. The tidal flats to the east and west of the main distributary are covered with finer material that contains up to 90 percent silt. Silt deposition occurs during river floods and high tides when there is little wave activity.

The two ZSFs studied are both areas representing tongues of fine grained sediments extending from the delta through the south basin. The median grain size at the extreme northern end of the Anderson Island/Ketron Island ZSF is predominantly very fine sand to coarse silt with percentages of clay ranging from 4 to 8 percent. The sediment along the margins of Anderson and Ketron Islands consist of fine sand with 6 to 8 percent clay. Sediments in the central portion of the ZSF are predominantly coarse silt with the percentage of clay ranging from 10 to 12 percent. The greatest amount of organic material was found at the base of the slopes between Anderson and Ketron Islands.

Within the Anderson Island/Devil's Head ZSF, the median grain size varies from very fine sand southwest corner of the ZSF to fine silt near the center of the ZSF. The percentage of clay varies from 5 to 20 percent. Elevated amounts of organic material were found in the northeast corner of the ZSF in Drayton Passage.

Tests for percent volatile solids (%VS), 5-day biological oxygen demand (BOD_5), and percent water have been conducted at the proposed disposal site. The %Vs values ranged from 1 percent to 4 percent, with highest values in the central portion; two correlated with greatest amounts of organic matter in the sediment. Highest BOD_5 values, i.e., over 1,000 mg/kg, were also found in the central part of the proposed site (forward the western side). Trends in percent water are similar to those for BOD_5 and %VS. Sediments with greater than 40 percent water thus occur in the deeper parts of the proposed disposal area (Evans-Hamilton, Inc., 1988). Analysis for chemical substances in sediments from a sampling station about 0.5 mile north of the proposed disposal site have been conducted (Crecelius, et al., 1975). Low molecular weight polycyclic aromatic hydrocarbons, at 22 ppb, were far below the screening level (610 ppb). High molecular height polycyclic aromatic hydrocarbons were measured at 24 ppb at the same station, and were also below the screening level value of 1,800 ppb. For heavy metals at this station, the following sediment concentrations (ppm, dry weight) are (screening level concentrations for each metal are shown in parentheses): ar.enic, 8 (70); cadmium, 0.090 (0.96); copper, 21 (80); mercury, 0.058 (0.21); lead, 15 (70); and zinc, 55 (160). (Screening levels are used by PSDDA and the Puget Sound Estuarine Program to indicate concentrations of chemicals of concern, below which neither toxicity nor benthic community effects are expected based on the Puget Sound Data Base. (Screening levels are given in EPTA and the Phase I MFR.) The total organic carbon (TOC) for this same station was measured at 5 ppt in the same survey.

Additional sampling was conducted by NOAA in October 1984 in Nisqually Reach. The ranges of metal concentrations (ppm, dry weight) in the sediments of three stations were as follows: cadmium, 0.6-0.76; copper, 10-16; lead, 22.9-25.9; mercury, 0.442 (detected at one station); nickel, 24.8-36.7; zinc 96-123. (Unpublished data, 1988, Pacific Marine Environmental Laboratory, NOAA.) Nickel and mercury exceeded screening level concentrations. Additional analyses were run for PAHs and PCBs but values were either not detected or below screening level.

(5) Air Quality. The Olympic Air Pollution Control Authority (OAPCA) has jurisdiction over Nisqually Delta regional air quality. However, both ZSFs lie in Pierce County, which is part of the Puget Sound Air Pollution Control Authority (PSAPCA). Both authorities administer and enforce air pollution control standards and regulations and are responsible for implementing the requirements of the State and Federal Clean Air Acts. The nearest measurement station is located at Lacey, Washington, which is under the jurisdiction of the Olympic Air Pollution Control Authority. Air quality near the proposed site can be assumed to be better because of its distance from the Olympia urban area. In general, (based on measurements at the Lacey station) the area is in compliance with Federal standards except for infrequent violations of daily Washington State standard for total suspended particulates (150 micrograms per cubic meter). The highest concentrations of total suspended particulates occur in the winter months when atmospheric inversion layers are more prevalent. For 1986, for total suspended particulates the Lacey station exceeded 150 micrograms per cubic meter for 2 days; 1 day exceeded 200 micrograms per cubic meter. In 1987, the State standard was exceeded once. In 1987, the State criterion (150 micrograms per cubic meter) for fine suspended particulates (particles less than 10 microns) was exceeded for 1 day. In 1986, the standard was exceeded for 3 days and for 1985, for 5 days.

b. Biological Environment - Nisqually Reach and Anderson Island-Ketron Island ZSF.

(1) Benthic Communities.

(a) Nisqually Reach. The following intertidal/shallow subtidal discussions are taken from the EIS for the proposed Weyerhaeuser Export Facility at DuPont (Corps, 1982). They generally apply to benthic habitats found in the south Puget Sound study area.

Generally, two intertidal substrate types occur, cobble/gravel/sand and mudflats, the latter particularly at the Nisqually Delta. With respect to the gravel/cobble beaches, the number of species and population densities in the lower intertidal zone are greater than those found in higher intertidal areas (above +3 feet MLLW). The dominant epifaunal species, limpets (*Collisella* sp.), barnacles (*Balanus* spp., *Chthamalus* spp.), mussels, (*Mytilus edulis*), and periwinkles (*Littorina* spp.), are most abundant in the middle intertidal zone. Marine annelid worms (i.e., polychaetes and oligochaetes) are most abundant in the middle and upper intertidal zone. Mollusks are generally rare except in the lower intertidal zone where macoma clams (*Macoma* spp.) are most common. Harpacticoid copepods are also important epibenthic organisms which may serve as a major food source for outmigrating juvenile salmonids as well as for resident benthic feeding fishes.

Wisseman, et al. (1978), studied the shellfish resources of the Nisqually Reach area, and indicates that densities of clam species in the Nisqually Delta area were not sufficient to support a commercial clam fishery despite a long history of recreational clamming in the area. Noncommercial shellfish harvested recreationally in the Nisqually Reach include heart cockles (Clinocardium nuttallii), bent nose clams (Macoma nasuta), mussels (Mytilus edulis), moon snail (Polinices lewisii), and sea cucumbers (Parastichopus californicus). Ghost shrimp (Callianassa sp.) are also collected for use as bait by recreational fisherman throughout south sound. Recreational clamming species commonly collected within the intertidal areas along the DuPont Shoreline east of the Nisqually Delta are the butter clam (Saxidomus giganteus) and littleneck clams (Protothaca staminea). A privately owned oyster harvesting area is located immediately west of the Nisqually Delta (Puget Sound Environmental Atlas, 1987). Other commercial clam and oyster bed harvesting areas are located in south Puget Sound in Oakland Bay, Totten Inlet, Eld Inlet, Hendersen Inlet, and around Squaxin Island. Major recreational and commercial geoduck (Panope generosa) beds are located throughout south sound, notably at the mouths of Eld and Budd Inlets, from the head of Henderson Inlet down to the Nisqually Delta, along the eastern side of Hartstene Island; along Devils Head and northwestern Anderson Island, and around McNeil Island.

Intertidal Flora. Wisseman et al. (1978) generally describes the benthic macroalgae in the Nisqually Reach, which may be considered typical of macroalgae communities within south Puget Sound. Red algae such as Porphyra miniata and Iridaea cordata dominate the algal community. Dominant brown algae include Costaria costata, Laminaria saccharina. Dominant green algae include Ulva lactuca and Monostroma gigartina stellata. Green algae dominated the biomass and were higher in the intertidal areas down to 0.0 feet Mean Lower Low Water (MLLW)). The Nisqually mudflats generally contain only the ephemeral species of macroalgae which are capable of rapid growth on unstable substrates. Benthic production by microscopic algae is high in comparison to macroalgae. According to the Puget Sound Atlas, kelp (Laminaria spp.) is also found in Oro Bay, Anderson Island and north Anderson Island (Day et al., 1987).

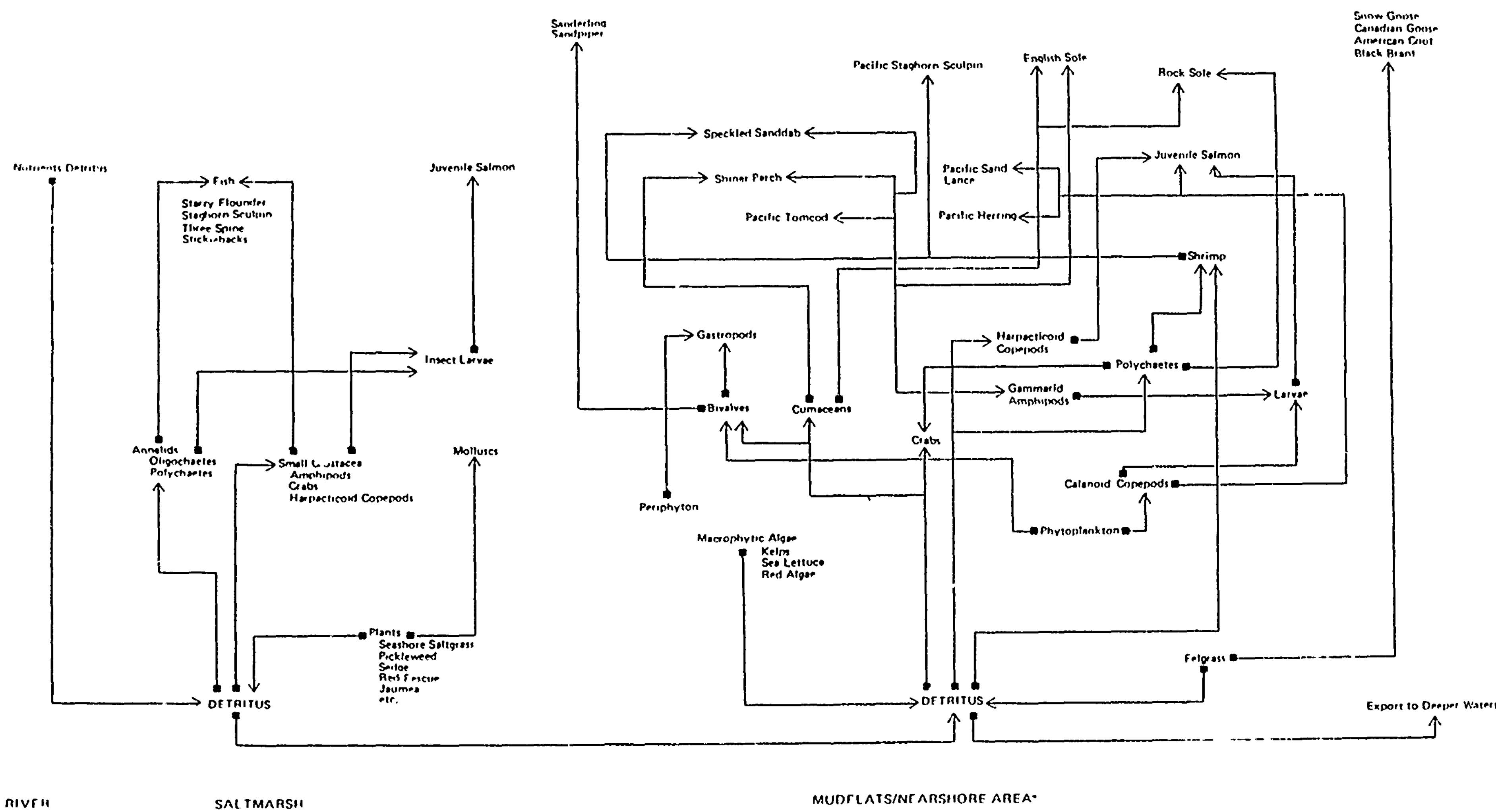
Subtidal Flora/Fauna. The subtidal benthic community structure and habitats have been described by Dames and Moore (1978) for the Nisqually Reach. Subtidal studies for depths of +6 feet to -49 feet (MLLW) indicate that the most influential factors governing the structure of the communities in the study area are substrate type and depth. Lie (1974) described three basic types of subtidal benthic habitat types in Puget Sound: (1) shallow-water mud bottoms, (2) coarse sediments, and (3) deepwater mud bottoms. He also observed that species diversity increased from fine to coarser sediments, and that standing crop increased with increasing depth and muddiness of the sediments.

Dominant flora observed near wharfs during spring and summer in relatively shallow depths (to -16 feet MLLW) were large red (Rhodymenia pertusae and Iridaea cordata) and brown algae (Laminaria saccharina, Nereocystis luetkeana). Green algae such as sea lettuce (Ulva lactuca) were abundant during August. Vegetative cover of the shallow subtidal areas by macroscopic algae ranged from 32 to 100 percent (at -16 feet MLLW) and from 0.2 to 34 percent (at -32 feet MLLW). A thick algal film consisting of diatoms occurred seasonally throughout the area (Dames and Moore, 1978). Eelgrass exhibits a wide but patchy distribution throughout south Puget Sound, notably within the subtidal and lower intertidal shorelines of the Nisqually Reach and Drayton Passage (West of Anderson Island) (Wisseman, et al., 1978; Day et al., 1987).

Floral coverage of the bottom was sparser in the vicinity of Nisqually Delta, except during summer (maximum coverage of 20 percent principally by Ulva), and this appeared to be attributable to substrate instability. The low midtidal region from about Mean Sea Level to MLLW is an area of high productivity and diversity. Large numbers of barnacles and mussels are attached to rock surfaces, but may be displaced by algae. Near MLLW, plant and animal cover on the cobble/boulder may exceed 70 percent. Beneath rocks, purple shore crabs (Hemigrapsus spp.) are abundant. Also found on or beneath rocks are encrusting sponges and sea squirts (ascidians) and the green sea anemone (Anthopleura spp.). Clay substrates are colonized by boring clams. Sand and mixed) fine substrates appear to be relatively barren except for scattered Macoma, heart cockles (Clinocardium nuttallii), butter clams (Saxidomus giganteus), and little neck clams.

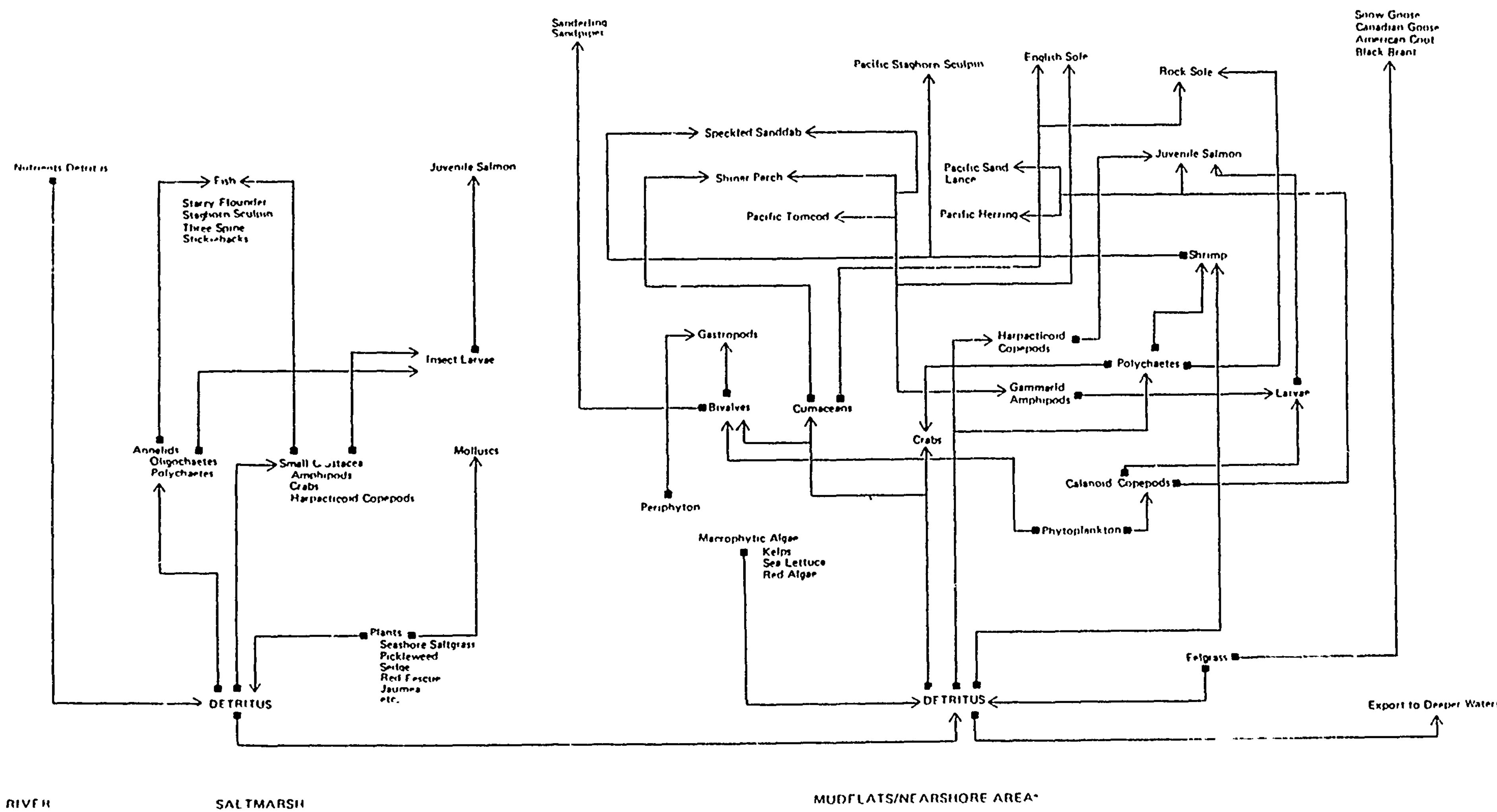
Dominating the subtidal epifaunal community near Dupont Wharf are scavenging/predaceous gastropods, crustaceans, and seastars (Wisseman et al., 1978). Infauna in this area were dominated by polychaetes and amphipods. Commerical shrimping occurs in south sound, principally in Hood Canal and Carr Inlet. A small recreational fishery for Dungeness crab exists near the Nisqually Delta. Cancer productus, a smaller relative of the Dungeness crab, is also found throughout south sound. Wisseman, et al. (1978), noted that infauna at Dupont were generally sparse and less diverse than in other areas of south sound. The most abundant epifaunal species noted during spring was a small cumacean (Lamprops sp.); during summer and fall scavenging/predatory gastropods were dominant. The sea pen (Ptilosareus guerneyi), primarily a sandy bottom suspension feeder, was the largest epifaunal organism found. The general sparseness of benthic species near the Delta is probably a consequence of sediment dynamics. Epifaunal crustaceans such as harpacticoid copepods, ostracods, amphipods, and cumaceans are present and are important food items for outmigrating juvenile salmonids and for other resident benthic fishes.

The marine and saltmarsh foodweb in the Nisqually Delta is depicted in figure 3.1. This illustrates that food pathways to higher trophic levels occur primarily through detrital feeders. Simenstad, et al. (1979), found detritus is the primary food source in six out of seven of the food pathways studied in northern Puget Sound. Dames and Moore (1978) concluded that much of the attached plant production including microalgae in the vicinity of the Nisqually Delta is transported to deep waters in the form of detritus, thereby supporting development of a rich faunal assemblage there.



*Source Simenstad et al (1979)

FIGURE 3.1
FOOD WEB IN THE
NISQUALLY DELTA AREA



*Source: Simenstad et al (1979)

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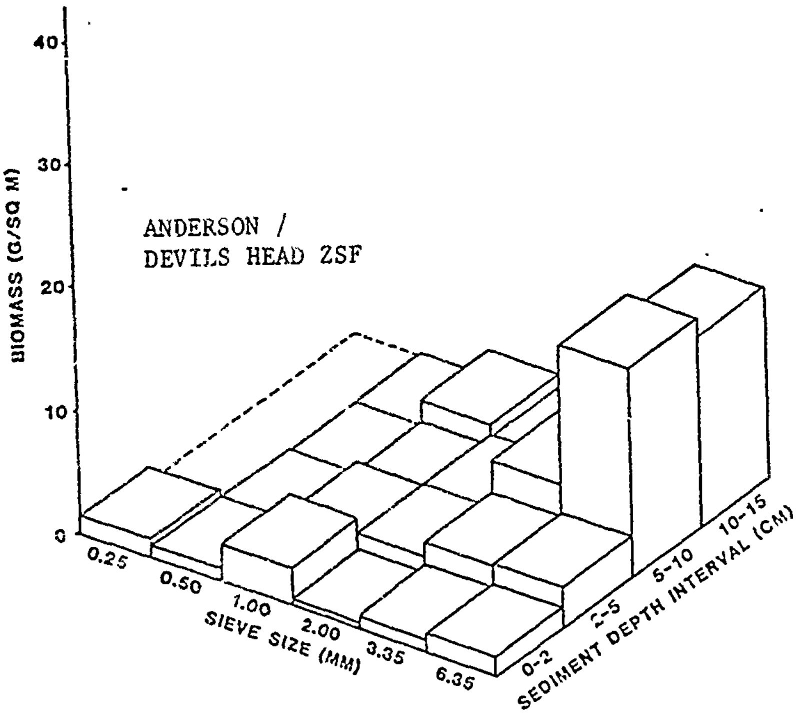


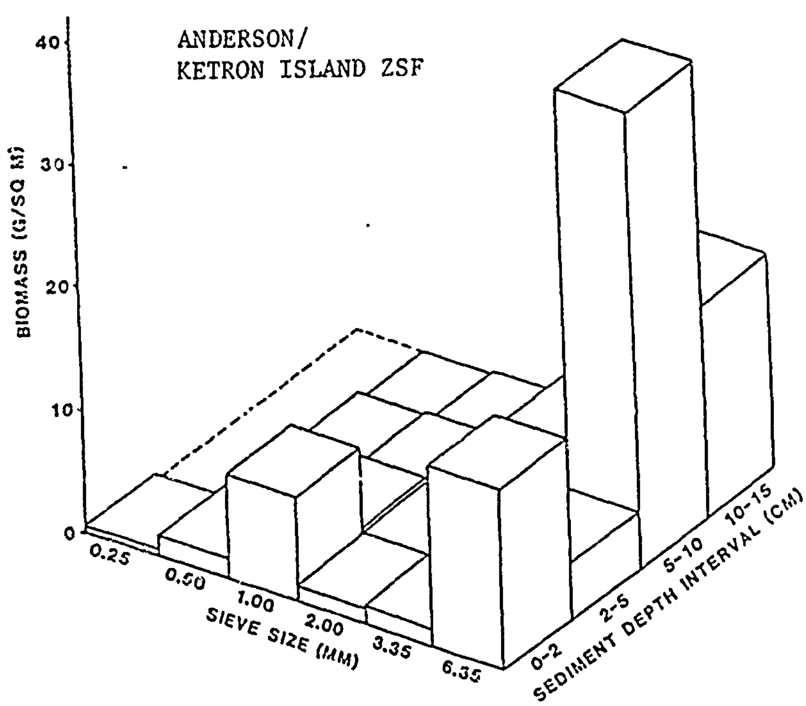
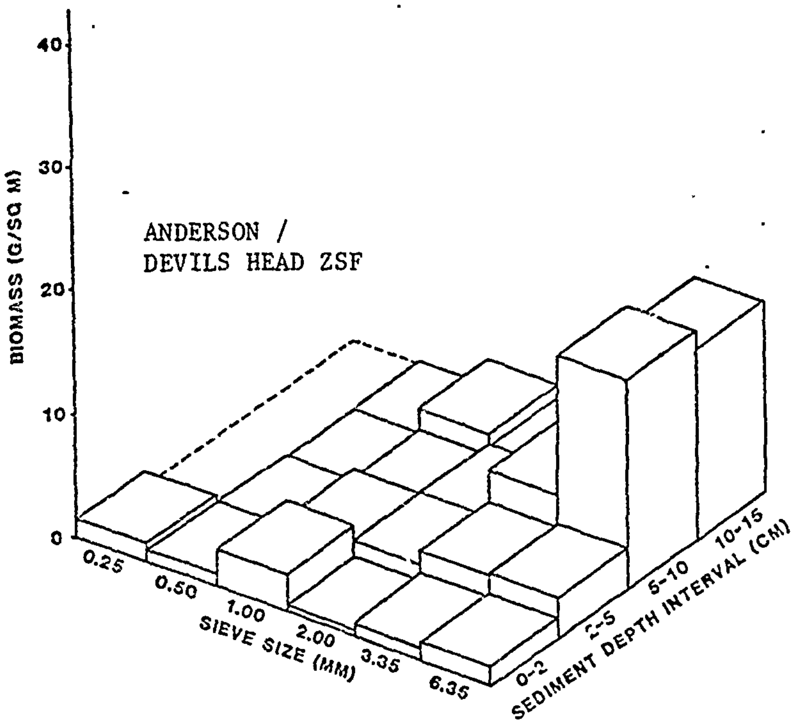


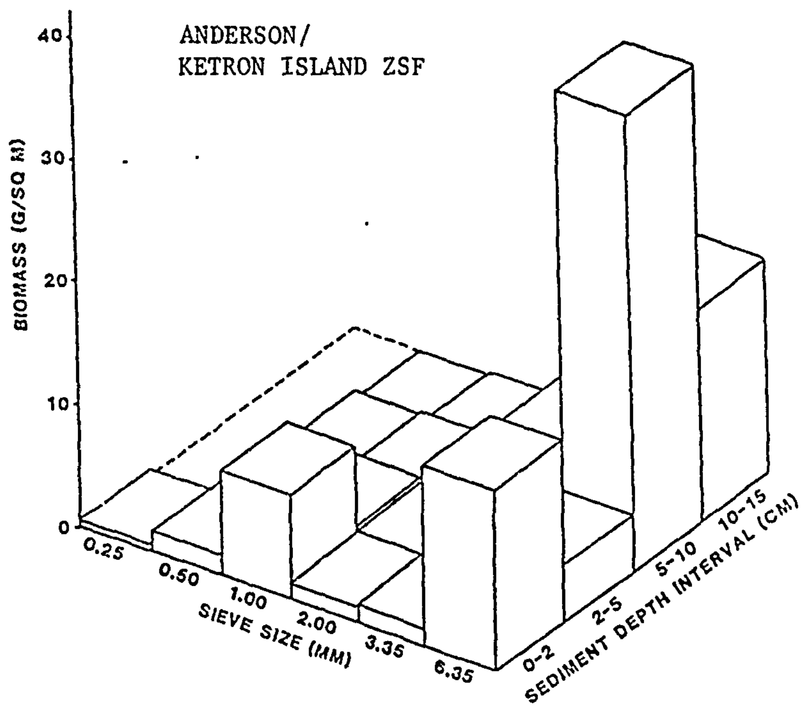
Figure 3 2 Three dimensional plot of benthic biomass across size categories and sediment depth intervals for the (A) Devils Head Alternative ZSF and, (B) Ketron Island Preferred ZSF study areas. (after Clarke and Kendall, 1987)

3. Crab and Shrimp Communities. Dungeness crab (*Cancer magister*) studies were conducted in Nisqually Delta region of south sound during four seasons: winter (February, 1987), spring (May, 1987), summer (July, 1987), and fall (October, 1987) by University of Washington Fisheries Research Institute (Dinnel, et al., 1988). Concurrently, investigations were made of abundances and distributions of commercial (Pandalid) shrimp, sea cucumber (*Parastichopus californicus*), and bottomfish. Sampling was performed at selected stations at each location using beam trawls for capturing Dungeness crab, shrimp and sea cucumbers, and otter trawls for capture of bottomfish and shrimp.

No Dungeness crab were caught in either the selected site or the alternative site in the Nisqually region during any of the four sampling seasons (figure 3.3). A small recreational crab fishery exists near the Nisqually Delta, although Dungeness crab were only caught in small numbers on the front and on either side of the Nisqually Delta area which is outside of the ZSFs (figure 3.3). The average estimated density for all seasons and stations combined was 3 crabs/ha, with the highest density being exhibited during February at 5 crabs/ha, and lowest during October at 1 crab/ha. The depth distribution varied by sex and season, with males usually being caught in shallow water (less than 20 meters), whereas females were collected at all depths in February, in shallow water during May (period of molting and mating activity), and intermediate depths during July. No female crabs were recovered during October, but it is probable that gravid (egg bearing) female crabs were buried to avoid predation in shallow areas during this season. All Dungeness crabs were large, mature individuals, with females slightly outnumbering males. A few gravid female crabs were collected outside the ZSFs during February. Two species of rock crabs (*C. productus*, and *C. gracilis*) were collected, and were much more plentiful than Dungeness crab in the Nisqually area. Rock crab densities (i.e., beam trawl) averaged 156 crab/ha, with *C. gracilis* generally outnumbering *C. productus* by roughly 10-fold in the catches (figure 3.4). A limited recreational fishery for *C. productus* exists, as this species is collected by sport crabbers and divers. A test commercial market exists in California markets for large claws of *C. productus*. Seasonal site specific population dynamics including size frequency, depth distribution, sex composition, female reproductive condition, and egg age are depicted in figure 3.5 for *C. magister*; in figure 3.6 for *C. productus*, and figure 3.7 for *C. gracilis*.

Pandalid shrimp were generally sparse in the Nisqually region, with the possible exception of the coonstripe shrimp (*Pandalus danae*). However, most coonstripe shrimp were caught in shallow areas outside the ZSFs (figure 3.8). Shrimp caught in the deeper areas included only small numbers of pink shrimp (*Pandalus borealis*) and sidestripe shrimp (*Pandalopsis dispar*). Most of the present commercial shrimp fishing efforts are confined to Carr and Case Inlets, and not in the Nisqually region. The relative seasonal shrimp reproductive conditions are depicted in figure 3.9 for Nisqually and Bellingham Bay for three species of shrimp common to other areas.





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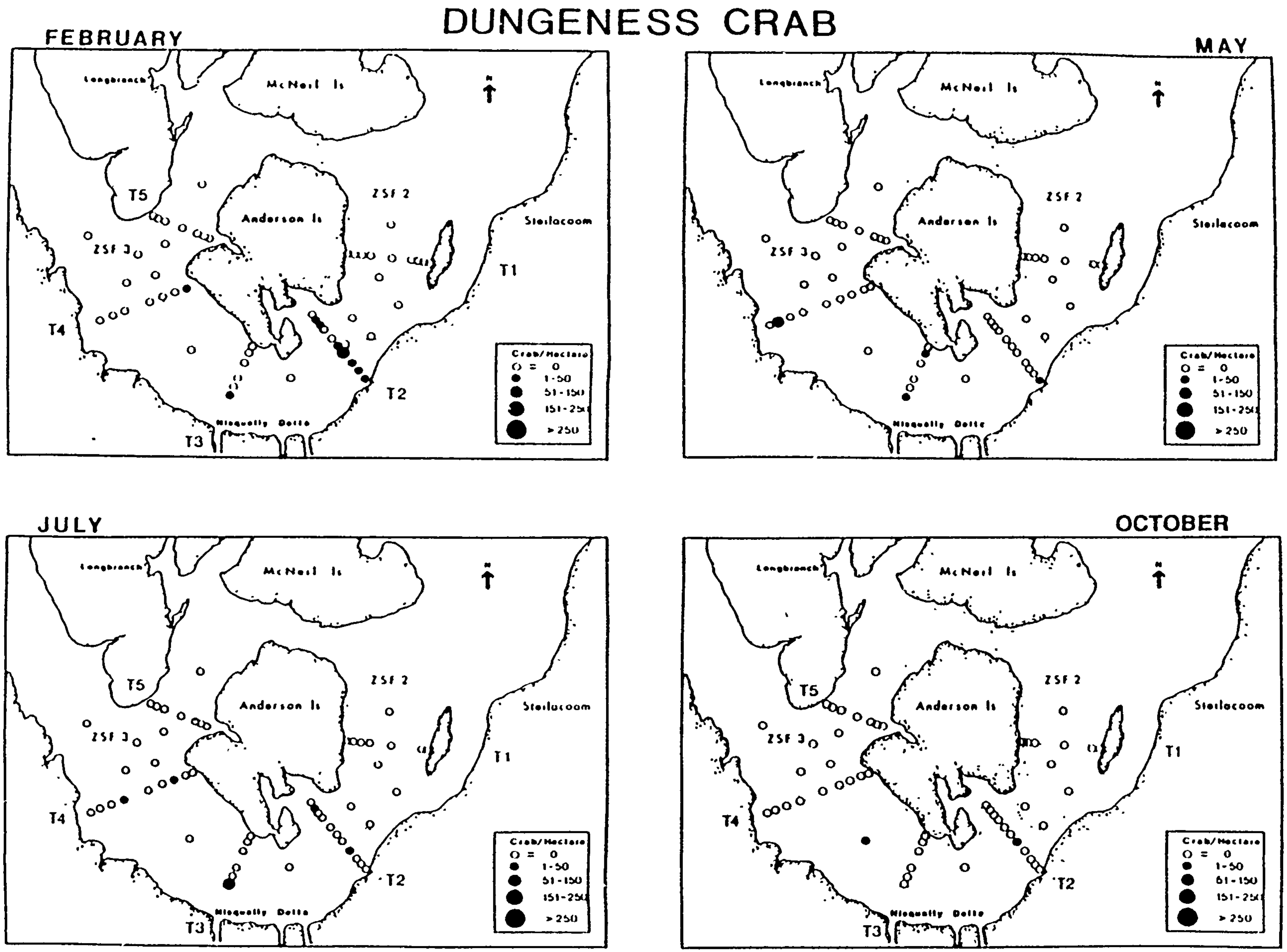


Figure 3.3 Maps of the Nisqually region showing the densities of Dungeness crab as estimated from beam trawl catches in February, May, July and October 1987 (after Dinnel et al, [illegible])

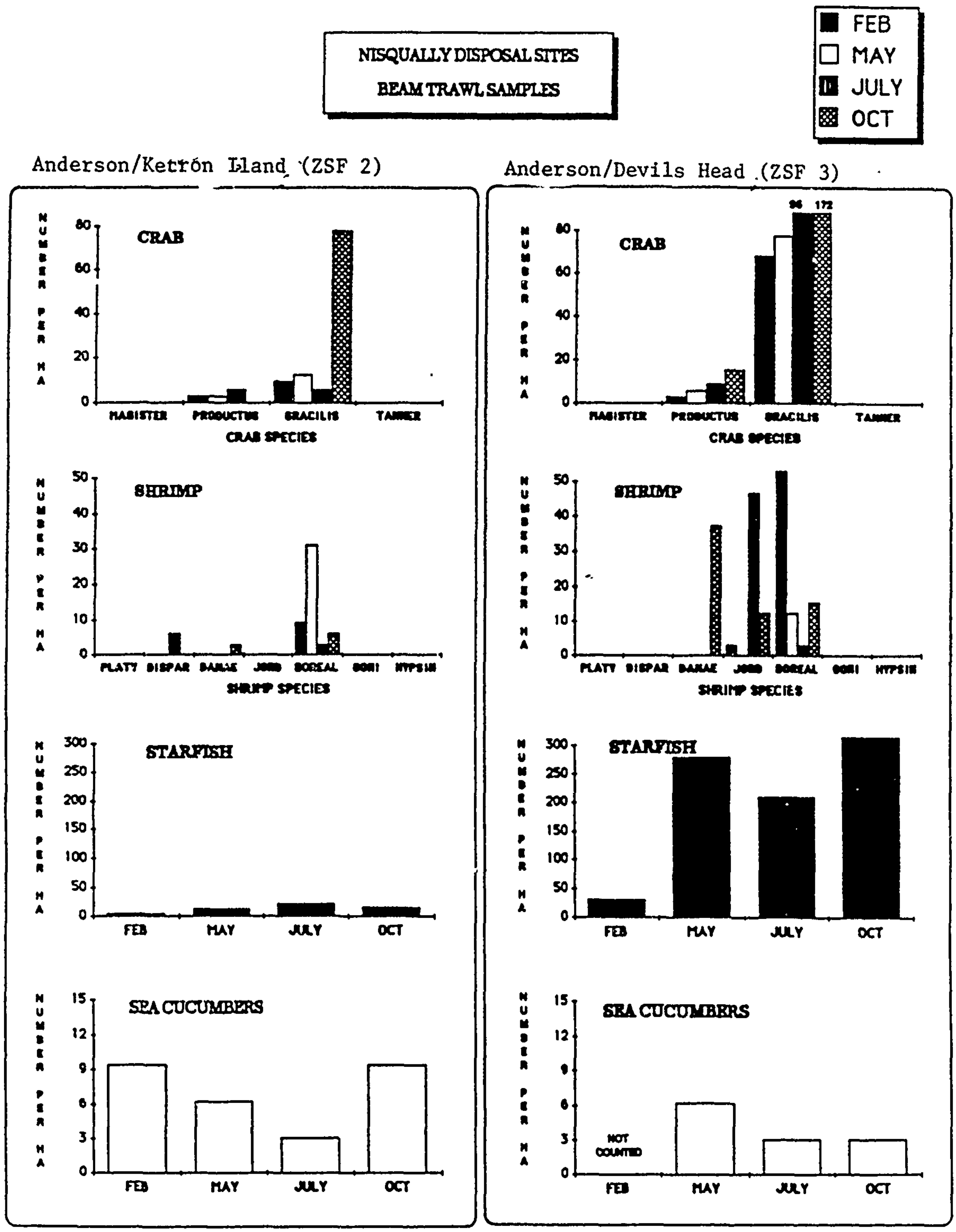


Figure 3.4 Comparison of average beam trawl catches (estimated #/ha) by species and by season between Nisqually ZSF 2 and ZSF 3. (after Dinnel et al., 1988)

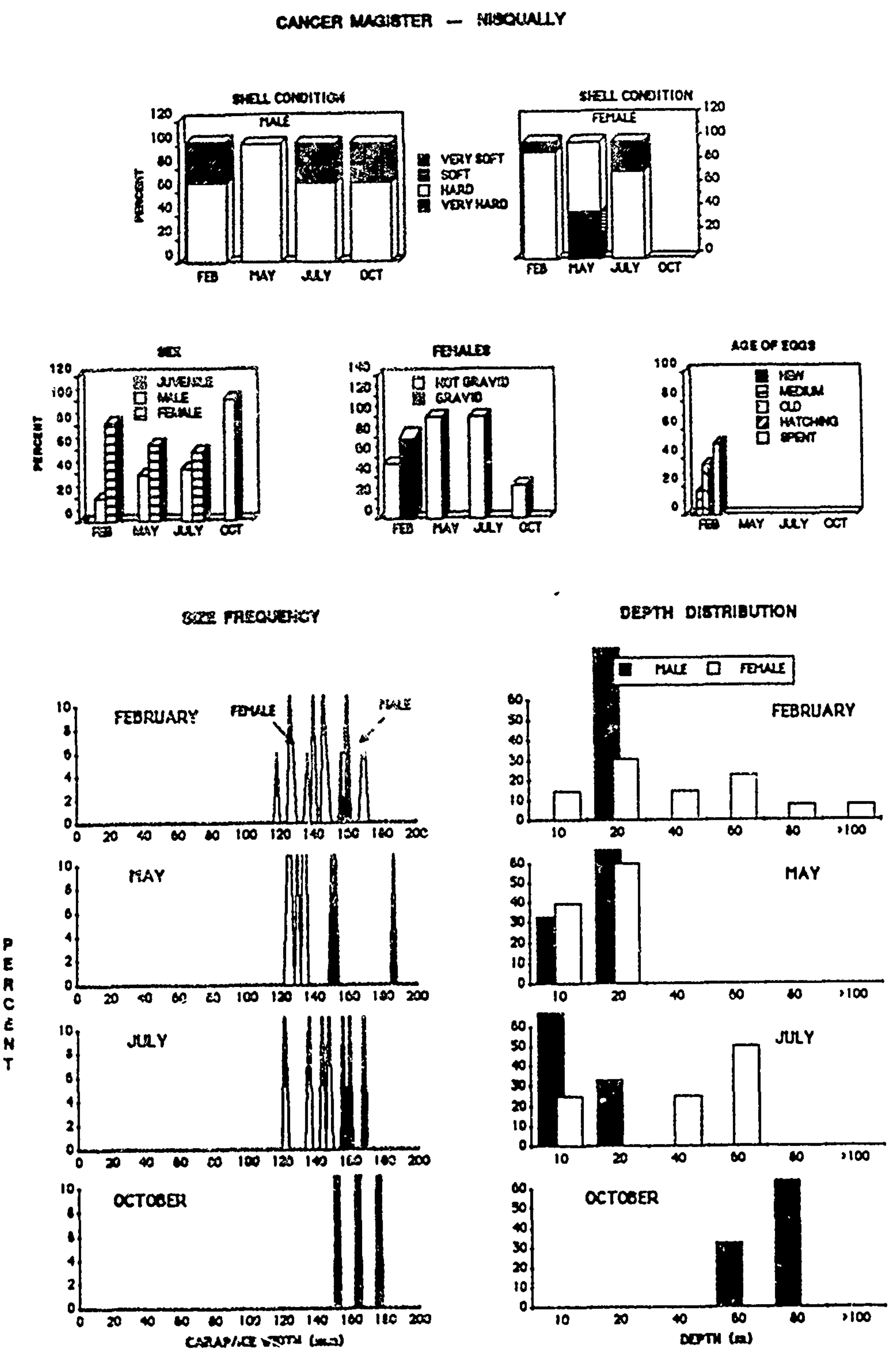
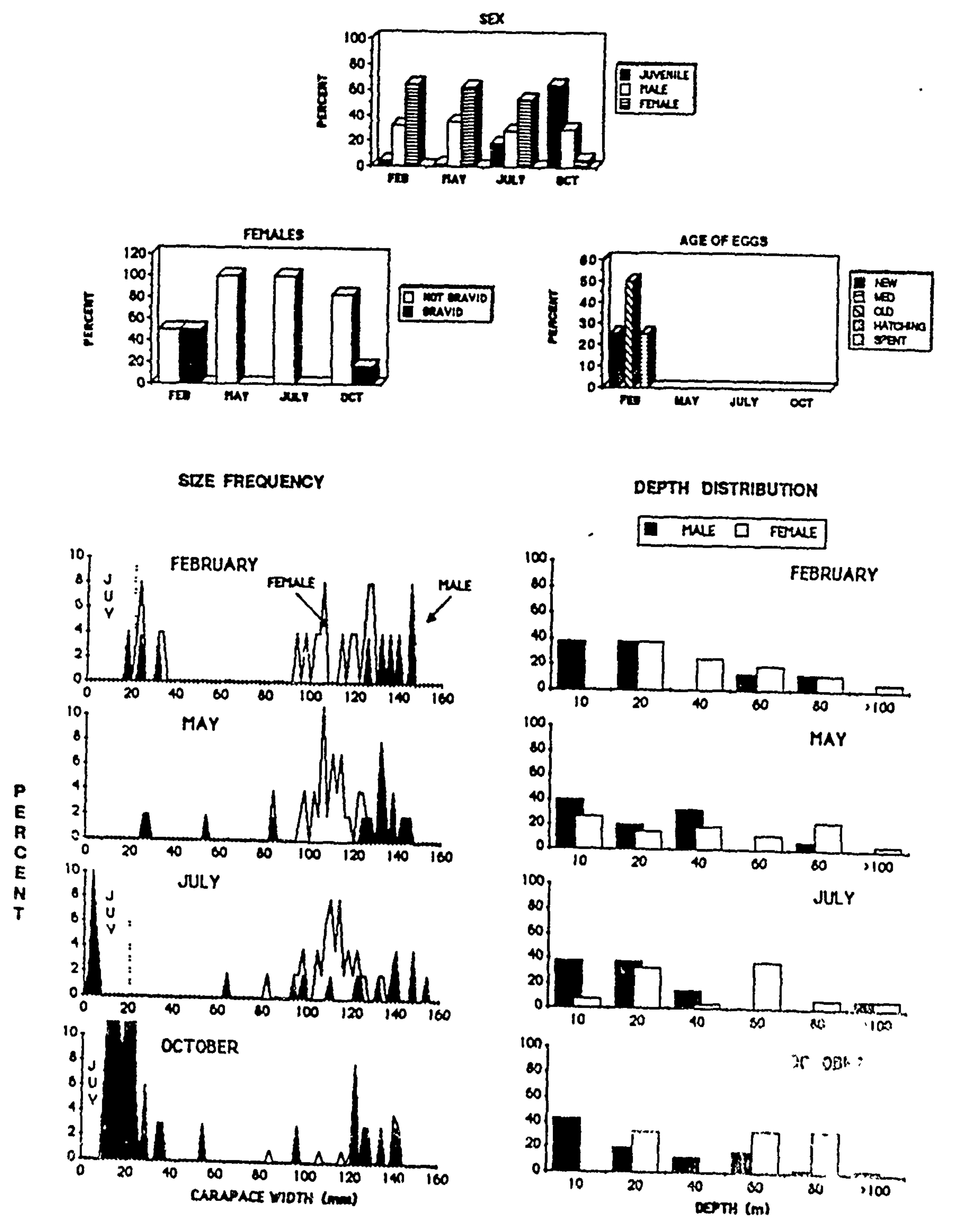


Figure 3.5 Summary of Dungeness crab depth distribution, size frequency, shell condition, sex composition, female reproductive condition and egg age in the Nisqually region during four seasons of 1987 (after Dinnel et al., 1988)

CANCER PRODUCTUS — NISQUALLY



[illegible] depth distribution, size frequency, sex composition, female reproductive condition and egg age in the Nisqually region during four seasons of 1987. (after Pinnel et al., 1988)

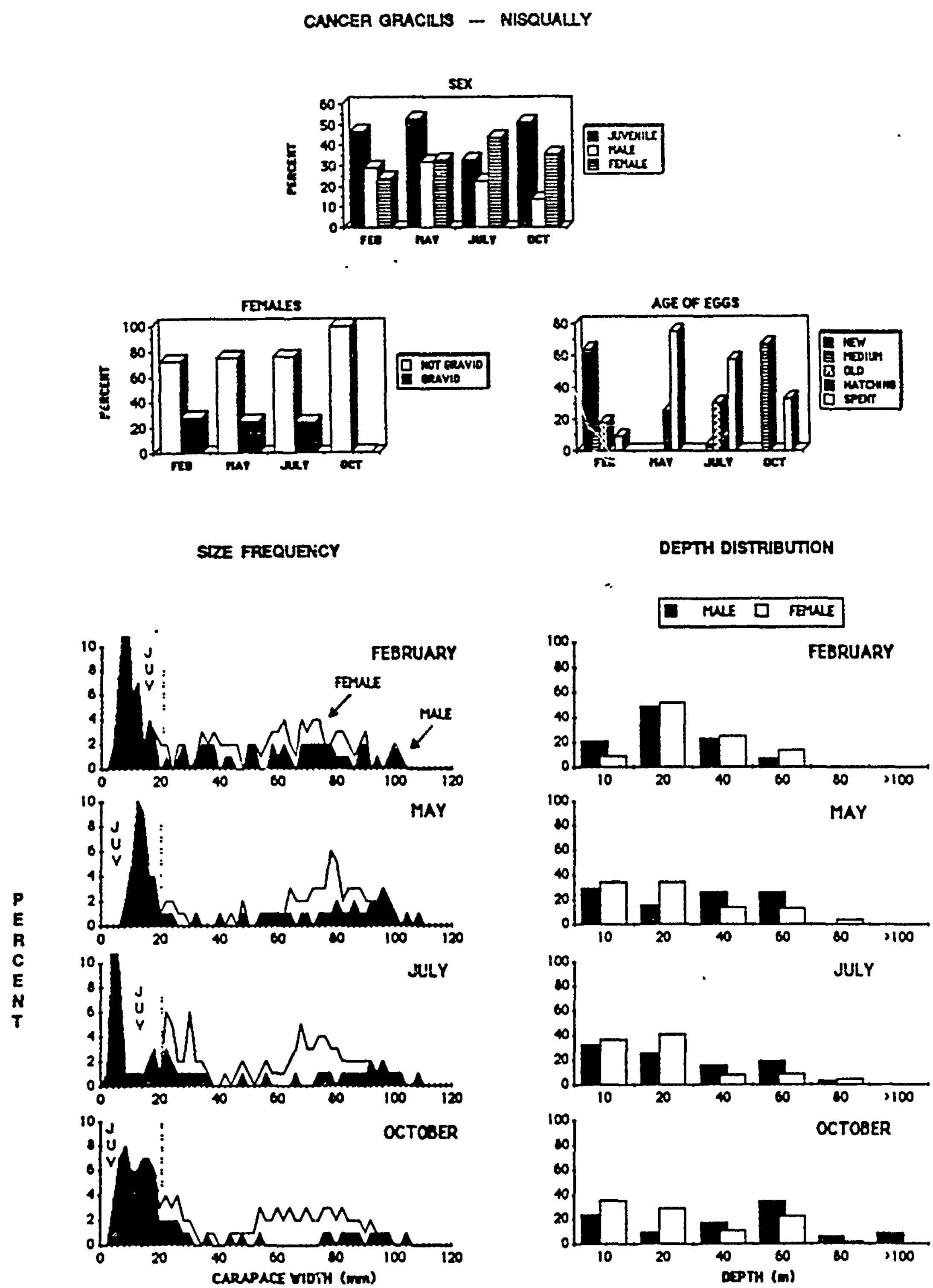


Figure 3.7. Summary of *Cancer gracilis* depth distribution, size frequency, sex composition, female reproductive condition and egg age in the Nisqually region during four seasons of 1987 (after Dinnel et al. 1988)

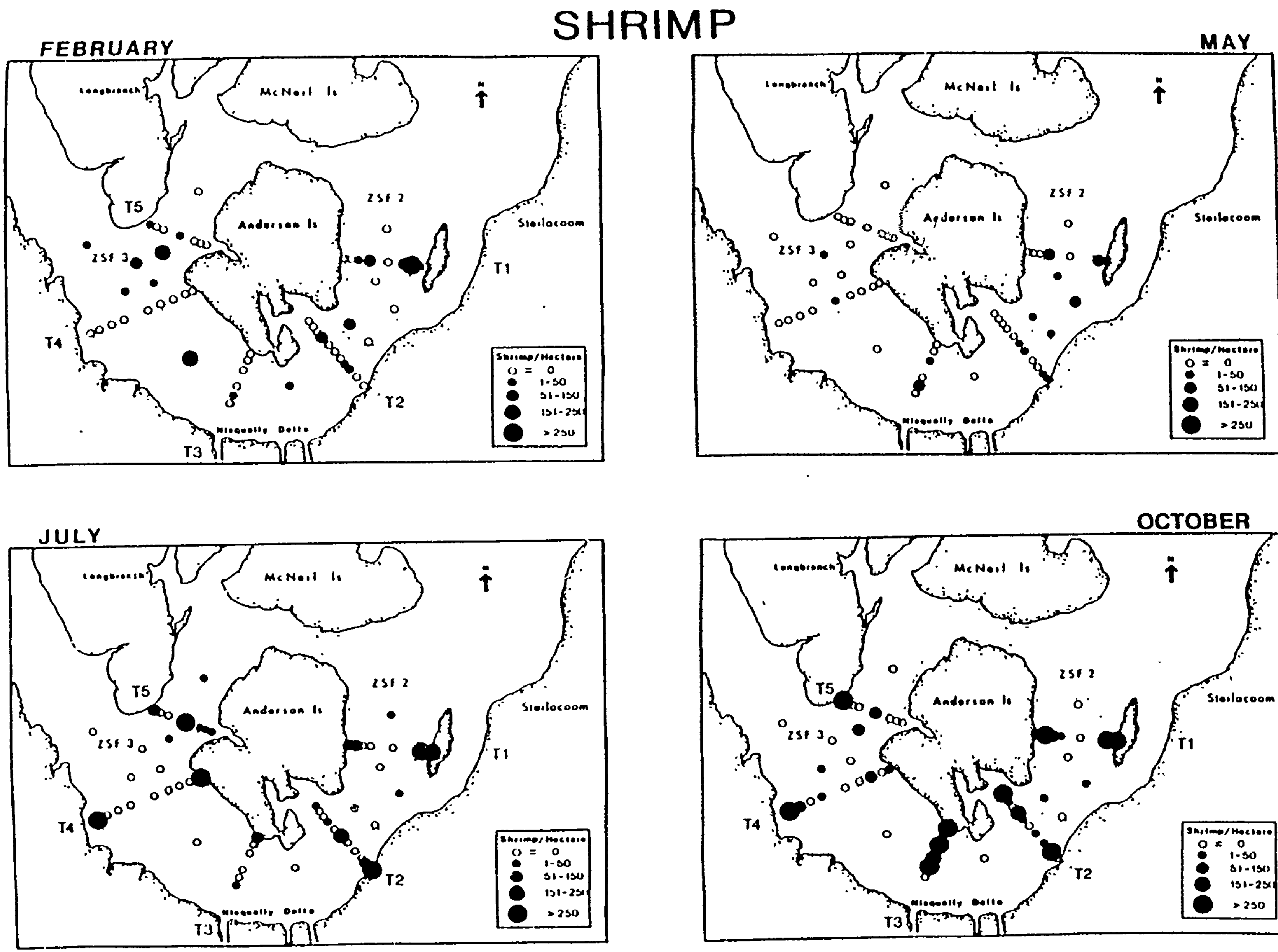


Figure 3.8. Maps of the Nisqually region showing the densities of commercial pandalid shrimp as estimated from beam trawl catches in February, May, July and October 1987 (after Dinnel et al, 1988)

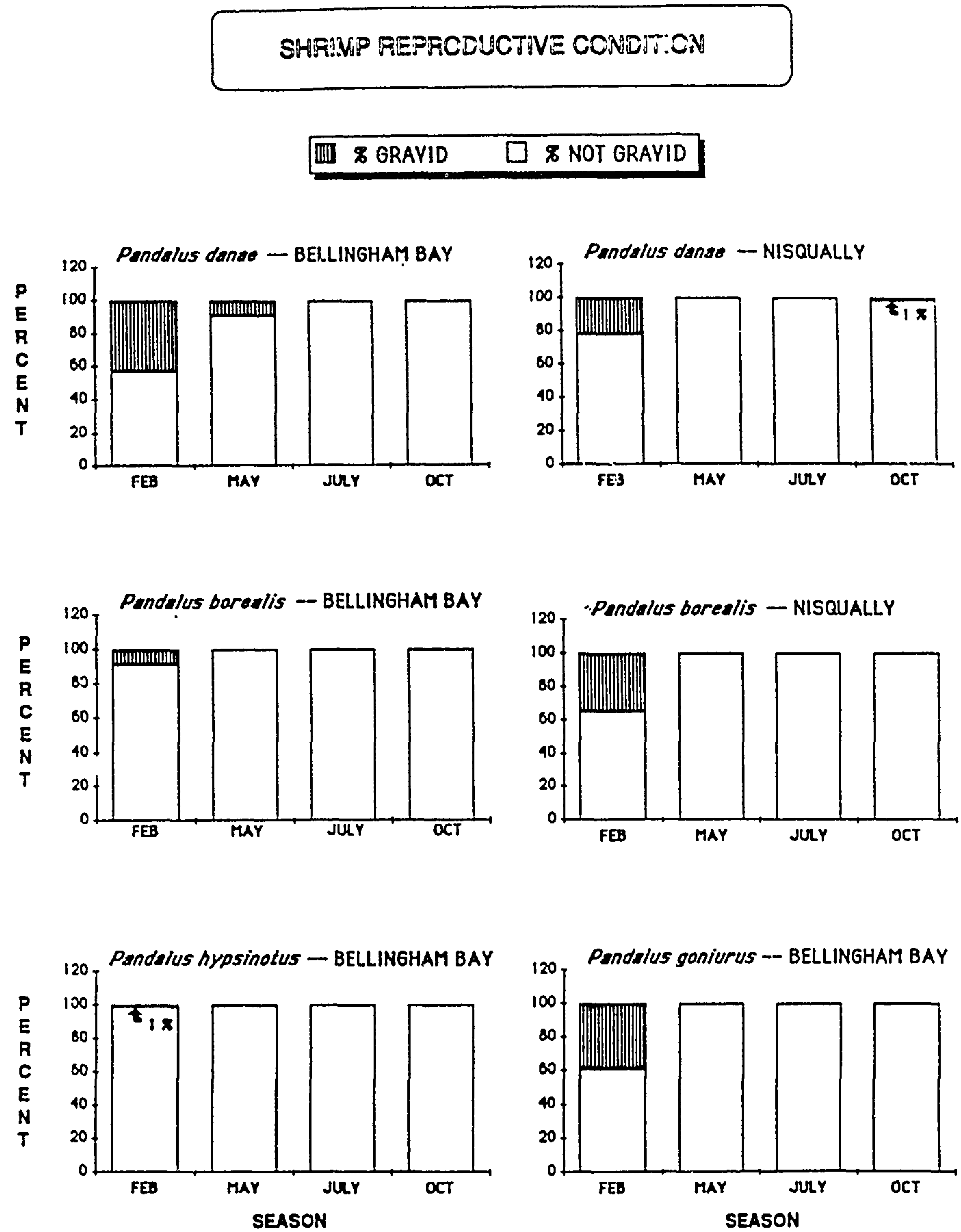


Figure 3.9. Selected shrimp reproductive conditions by area, by season, and by species. (After Dinnel et al., 1988)

The edible sea cucumber (Parastichopus californicus) was plentiful in the Nisqually Area, but only occurred in small numbers in the ZSFs. The highest densities of sea cucumbers were generally found at depths less than 40 meters, except near the south boundary of ZSF 2, where large numbers were caught as deep as 110 meters (the proposed site was located over 1 nautical mile north of the resource concentration area).

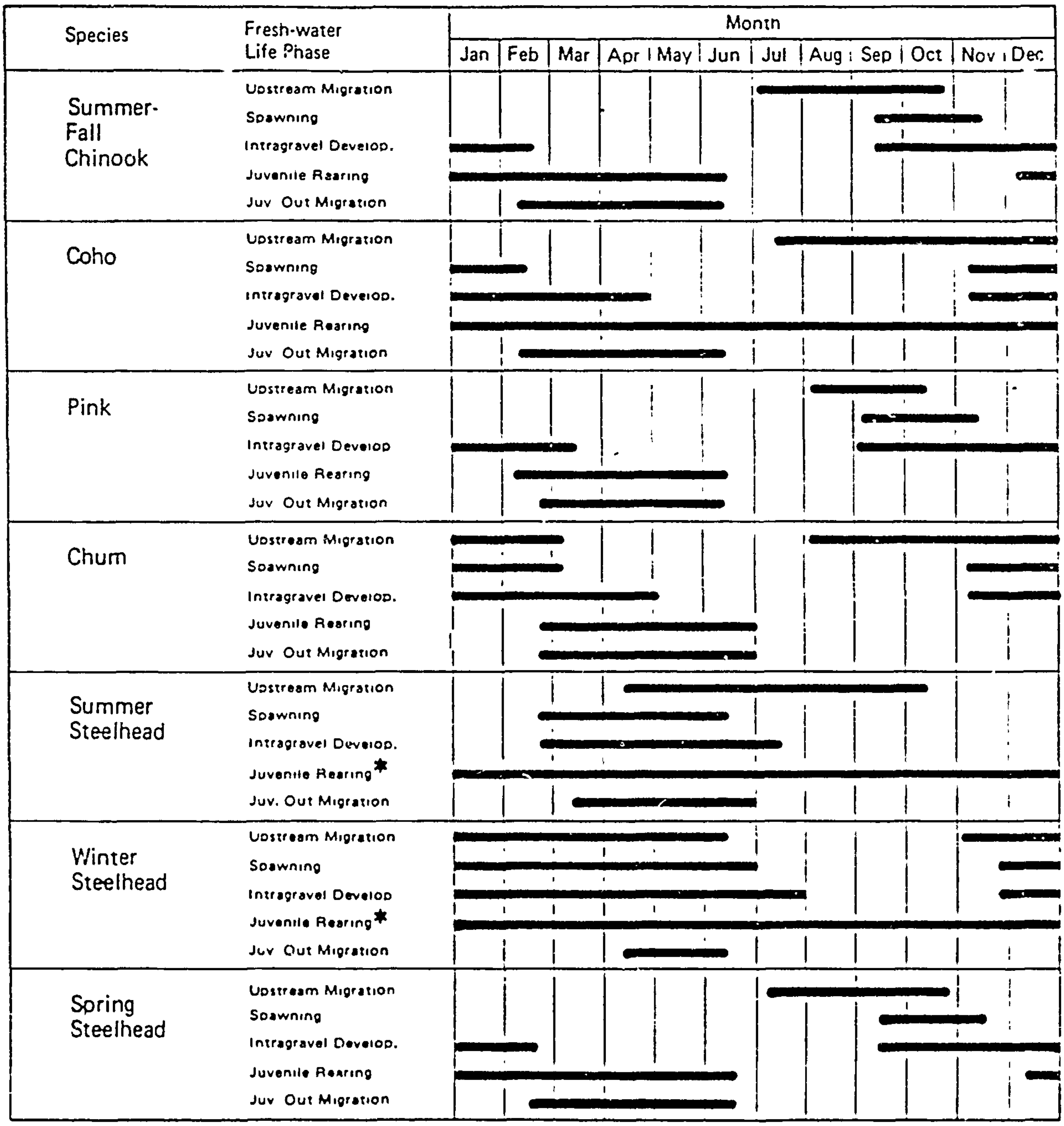
(2) Plankton Communities. Phytoplankton and zooplankton communities are ubiquitous throughout Puget Sound but exhibit tremendous spatial and temporal variations in species composition and abundances. The reader is referred to section 3.01b(2) for a general discussion on bloom periods and species succession.

(3) Anadromous and Marine Fishes. The Nisqually region of south Puget Sound supports five species of salmon (chinook, coho, chum, pink, and rarely sockeye), and three species of trout (searun cutthroat trout, steelhead trout, and Dolly Varden trout). All species spend most of their adult life in marine waters and return to freshwater streams to spawn. Each salmonid species in the reach has a characteristirc life cycle. Various species migrate through Nisqually Reach during the year. Adult salmon spawn generally between late fall and early spring. Juvenile salmon migrate downstream usually peaking between March and July, while steelhead juveniles may enter marine waters at all times of the year. Significant mortality occurs during the first 80 days of the marine life phase of salmonids. Adult upstream migration varies greatly between species.

Migration routes for juvenile salmon in the Nisqually Reach vary seasonally and annually. Shoreline configurations and water depths seem to play a major role in the early distribution patterns of outmigrating juvenile salmonids. In general, salmonids tend to follow shorelines, remaining in shallow water during their early marine residence. Historic Washington Department of Fisheries (WDF) data (Morrill, 1974) indicates juveniles are abundant west and north of the delta. Peak outmigration periods for all juvenile salmonid species are depicted in figure 3.10. In general, the outmigration period extends from mid-February to mid-June. Figure 3.10 illustrates the timing of salmon freshwater life phases in the Nisqually Basin.

Commercial and sport fishing areas occur throughout Nisqually Reach. Commercial fishing is regulated by Treaty of Medicine Creek between the U.S. Government and the Nisqually, Puyallup, and Squaxin Island Tribes. The State licenses nontreaty commercial boats, and the tribes license commercial Indian fishermen. For information on usual and accustomed fishing areas, harvest timing and level see section 3.01c(4).

Juvenile salmonids generally feed on epibenthic prey in nearshore environments during the early stages of their outmigration period and shift to neritic organisms during the later stages of their residency. Harpacticoid copepods are the most likely organisms to be exploited for food by juvenile salmon species inhabiting the Nisqually Reach.



* Normally extends over a two-year period.

Source Pacific Northwest River Basins Commission. Comprehensive Study of Water and Related Land Resources. Puget Sound and Adjacent Waters. Appendix XI, Fish and Wildlife March 1970

FIGURE 3.10
TIMING OF SALMON AND STEELHEAD FRESHWATER LIFE PHASES IN NISQUALLY BASIN

(c) Marine Fish Resources. There are many marine fish resources in the Nisqually Reach including both bottom and pelagic species. Common commercially and recreationally important species include Pacific herring (*Clupea harengus pallasi*), surf smelt (*Hypomesus pretiosus*), striped seaperch (*Embiotoca lateralis*), pile perch (*Rhacochilus vacca*), rock sole (*Lepidopsetta bilineata*), and English sole (*Parophrys vetulus*). Demersal (bottom) fish occurrence in nearshore areas was studies in 1978 by Weyerhaeuser Company scientists (Corps of Engineers, 1982). English sole and rock sole dominated the 41 species caught by trynet, while Pacific staghorn sculpin (*Leptocottus armatus*) and starry flounder (*Platichthys stellatus*) dominated the catch in beacn seines.

(d) Bottomfish Resources in the Disposal Sites. Bottomfish studies undertaken for the Corps of Engineers by the University of Washington over four seasons in 1987 (Dinnel, et al., 1987) indicated that season made little difference in the number of species caught in either the Anderson/Ketron Islands or the Anderson/Devils Head ZSF. Numbers of species ranged from 36 in July to 43 in February. However, the average number of fish caught per trawl in October (229) was approximately double that caught in the three other seasons. In all seasons, ZSF 3 catches showed greater numbers of species and greater average number of fish caught per trawl than did ZSF 2. Regarding biomass, ZSF 3 was much higher than ZSF 2 in winter and summer, and much lower in spring and autumn. Species diversity was similar between the two ZSFs. The dominant species, English sole, was very abundant in ZSF 3 in spring and autumn (over 80, catch-per-unit-effort). This accounts for the higher biomass noted in ZSF 3. For ZSF 3, in addition to English sole (the most abundant species), three other species were also commonly encountered, the Pacific tomcod, shiner perch, and blackbelly eelpout. In ZSF 2, the predominant species (by number) were English sole, Pacific tomcod, and slender sole. Overall, based on these results, ZSF 2 is located in an area that is relatively scarce in bottomfish resources.

(e) Foodweb Relationships: BRAT Assessment of Bottomfish Feeding Habitat Values in Disposal Sites. An important aspect of benthic habitat quality is the potential amount of trophic support that a given benthic habitat can provide to demersal bottom-feeding fishes. A procedure called BRAT (Benthic Resources Assessment Technique) was employed by personnel of the Environmental Laboratory, U.S. Army Engineer Waterways Experiment Station during July 1987 at each of the alternative sites to assess bottomfish feeding habitat values (see Clarke and Kendall 1988; Phase II DSSTA). The procedure is described in section 2.03g.

The analysis focuses on a parallel examination of benthic infaunal resources and bottomfish feeding behavior within each habitat. Prey size and prey vertical distribution in the sediments are two important attributes of benthic communities important to opportunistic benthic infaunal predators. Benthic Resources in the Phase I disposal sites were quantified in terms of vulnerability (benthic size distribution: 0.25 mm, 0.5 mm, 1.0 mm, 2.0 mm, 3.35 mm, greater than 6.35 mm) and availability (depth of benthic food item below the sediment-water interface: 0 to 2 cm, 0 to 5 cm, 0 to 10 cm, 0 to 15 cm). Diets were quantified for demersal bottom-feeding fishes collected in each of the study areas. This analysis determined benthic prey size distribution. A professional judgment about the probable maximum foraging depth for each fish feeding group was applied. All fish diet samples were analyzed by cluster analysis and feeding strategy groups were identified based on observed similarities in foraging behavior (i.e., similarities in benthic prey size distributions and probable foraging depths). The BRAT focuses on benthic infaunal predators only, because only benthic fish are stronly reliant on these benthic infaunal resources.

Feeding strategy groups identified through this exercise are summarized in table 3.3. The size classes of demersal fish species observed at each study area assigned to each feeding group are shown in table 3.4. Seven benthic feeding strategy groups identified as exploiters of benthic infaunal resources. English sole is the most important exploiter. Figure 3.11 depicts the spatial array of benthic feeding habitat values estimated for four of the identified predator feeding groups. Table 3.5 illustrates the disposal site specific distribution and amount of potential benthic food available to each of four observed feeding strategy groups. Prey size and depth exploitation patterns observed among feeding strategy groups reflect the heterogeneity of prey vulnerability (prey size) and availability (depth of prey in sediment) in the study area at the moment of sampling. Most benthic feeding fish are opportunistic feeders, and their feeding behavior changes over time as a result of spatial and temporal changes in the benthic food resources coupled with morphological changes (e.g., mouth size) attribute to their growth. Prey composition observed in the diets and prey size exploitation patterns closely resembled benthic community composition, predominately crustaceans, polychaetes and bivalve molluscs, and their corresponding size distributions. The strongest resemblance is seen in the upper 5 cm of the sediments.

Potential feeding habitat was generally higher at the Ketron Island preferred site relative to the Devils Head alternative site in July 1987. Potential foraging habitat values ranged from lows of 14 to 8 g/m2 (wet weight) for Group IIA predators to highs of 73 to 52 g/m2 for Group IIIA predators at the preferred and alternative sites (table 3.5). Differences in resource values for Group IIIA between sites were not significant ($p > 0.05$) and signified the patchiness in benthic communities within and between study areas. Summer benthic resource values were generally higher for Group IIC, IID, IIIA, and IIIB predators (capable of exploiting benthic prey down to depths of 10 cm) than for Groups IIA and IIB (which were foraging at shallower depths of only 0-5 cm). Benthic resource values observed in the Nisqually region were comparable to these observed in the Bellingham Bay study area as well as PSDDA Phase I study areas in central Puget Sound (PSDDA Phase I FEIS, 1988).

(4) Marine Mammals. The only common marine mammal in south Puget Sound is the harbor seal. Haul out areas are located in all of the major, named inlets of south sound, as well as in the Nisqually Reach and at McNeil and Gertrude Islands. Most of the seals in south Puget Sound are on Gertrude Island, which is also the site of a major nursery (perhaps as many as 300 seals utilize this site). It is clear the harbor seal is found in all the waters of south Puget Sound, including the selected PSDDA disposal site area.

TABLE 3.3

DESCRIPTION OF PREY SIZE FEEDING STRATEGY GROUPS
(AFTER CLARKE AND KENDALL, 1987)

Group I	Fishes feeding on prey less than or equal to 1.0 mm or smaller with a modal prey size around 0.25 mm. No representatives of this group were found in this data set.
Group II	Fishes that exploit a range of prey sizes and that are not clearly small prey or large prey expoliters. Group II contains five subgroups in this data set.
Group IIA	Fishes that exploit prey between 0.5 and 3.35 mm. A prey size mode of 2.0 mm is indicated.
Group IIB	Fishes that exploit prey between 1.0 and 3.35 mm. A prey size mode of 2.0 mm is indicated.
Group IIC	Fishes that exploit prey between 1.0 and 6.35 mm. Prey size distribution is bimodal, having separate peaks of 1.0 and 3.35 mm.
Group IID	Fishes that exploit prey between 1.0 and 3.35 mm, with a size mode of 3.35 mm.
Group IIE	Fishes that exploit prey between 1.0 and 6.35 mm, with a prey size mode of 3.35 mm.
Group III	Fishes that do not exploit small sized prey. Exploitation is predominantly among prey that are greater than 3.35 mm. Two subgroups occur in this data set.
Group IIIA	Fishes that exploit prey in the intermediate size range (1.0-3.35 mm), as well as the larger sizes with a prey size mode of 6.35 mm.
Group IIIB	Fishes that predominantly exploit prey in the 3.35 and 6.35 mm size range, with a distinct 6.35 mm prey size mode.

TABLE 3.4

DEMERSAL FISH SPECIES, SIZE CLASSES, AND NUMBER OF INDIVIDUALS ASSIGNED TO EACH PREDATOR FEEDING STRATEGY GROUP AND STUDY AREA

PREDATOR FEEDING STRATEGY GROUP	SPECIES (SIZE CLASS)	TOTAL NO. INDIVIDUALS	PERCENT (%)	STUDY AREA
IIA	ES(3),SP(3,4)	171	31	I,BB(N),BB(S)
IIB	ES(3),SF(4,5),BS(1)	63	11	DH,BB(N),BB(S)
IIC	ES(4)	69	12	AK
IID	ES(2,3,4,5),RS(3),BS(2)	151	27	AK,DH,BB(N),BB(S)
IIE	ES(4,6),DS(3),RS(4)	51	9	AK,DH,BB(N),BB(S)
IIIB	ES(4,5),BS(3)	21	4	AK,BB(S)

*LEGEND: Predator Feeding Strategy Groups (see Table 3.3)

Species:
ES = English Sole
SP = Snake Prickle Back
SF = Starry Flounder
BS = Butter Sole
RS = Rex Sole
DS = Dover Sole

Size Class (Standard Length)
1 = 05 - 9.9 cm
2 = 10 - 14.9 cm
3 = 15 - 19.9 cm
4 = 20 - 24.9 cm
5 = 25 - 29.9 cm
6 = 30 - 34.9 cm

Study Area:
AK = Anderson Island/Ketron Island ZSF
DH - Devils Head/Anderson Island ZSF
BB(N) = Bellingham Bay North ZSF
BB(S) = Bellingham Bay South ZSF

TABLE 3.5

COMPARATIVE BOTTOMFISH FEEDING HABITAT
VALUES AT ALTERNATIVE PHASE II NONDISPERSIVE DISPOSAL SITES 1/

	Predator Feeding Groups 2/			
Site	IIA	IIB	IID	IIIA
Bellingham Bay				
Selected Site	29	42	67	65
Alternative Site 1	5	13	23	46
Alternative Site 2	22	32	51	51
South Sound				
Selected Site (Ketron Island)	14	24	31	73
Alternative Site (Devils Head)	8	15	23	52

1/Benthic habitat values expressed in g/m2 (wet).
2/Predator IIA: Available zone (foraging depth: 0-5 cm)
Vulnerable sizes: 1-2 mm
IIB: Available zone: 0-5 cm
Vulnerable sizes: 1-3.35 mm
IID: Available zone: 0-10 cm
Vulnerable sizes: 1-3.35 mm
IIIA: Available zone: 0-10 cm
Vulnerable sizes: 2-6.35 mm

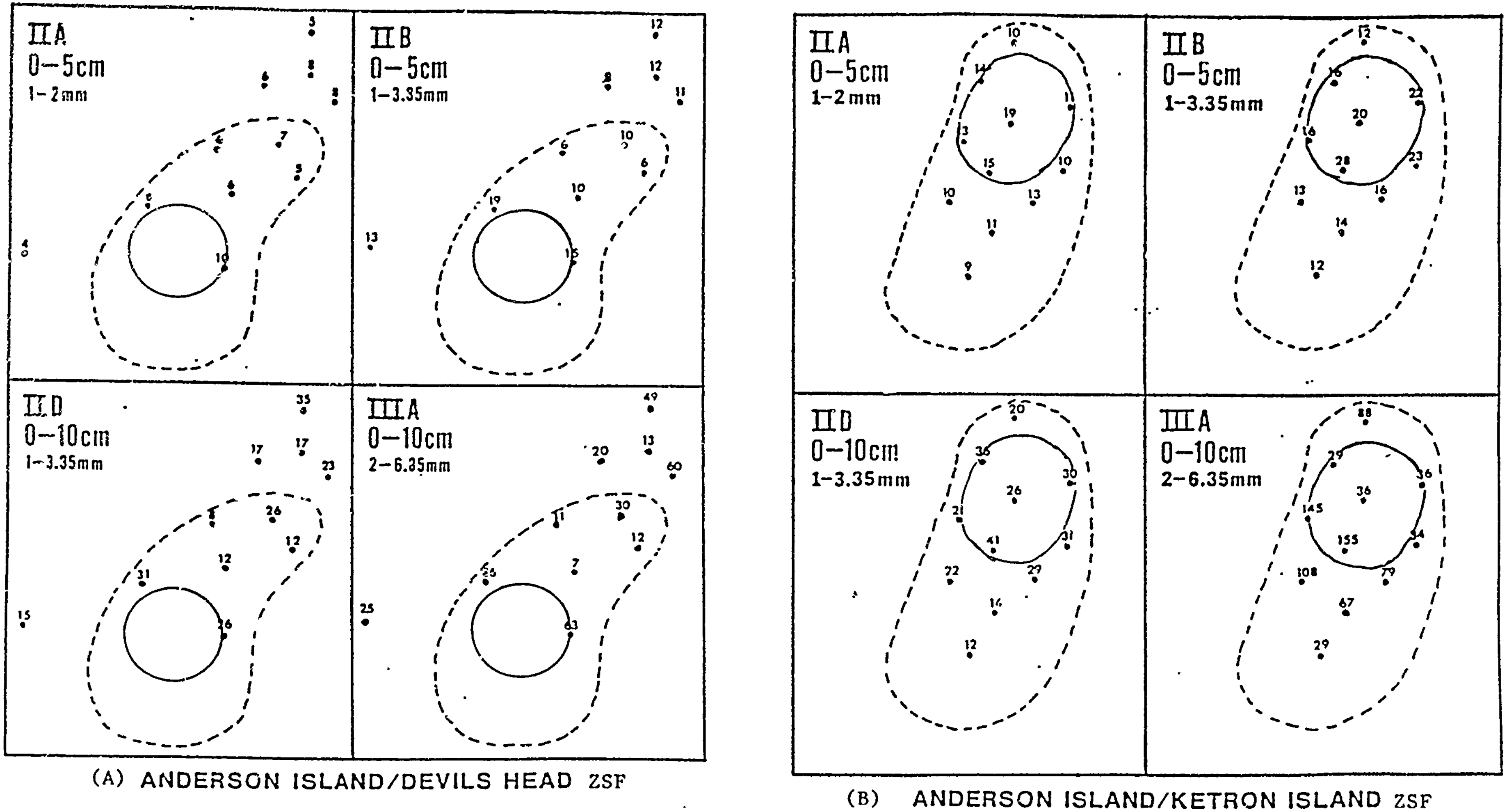


Figure 3.11 Spatial arrays of benthic feeding habitat values estimated for four of the identified predator feeding groups Values are expressed in grams/square meter (wet weight). Disposal site depicted inside ZSF for (A) Devils Head ZSF and (B) Ketron Island ZSF. (after Clarke and Kendall, 1987)

Legend: Predator Feeding Groups: IIA, IIB, IID, IIIA
Available Zone (foraging depth): 0-5cm, 0-10cm
Vulnerable Sizes: 1-2mm, 1-3.35mm, 2-6.35mm

Both California and northern sea lions have been observed at haul out sites on Fox Island. Neither species breeds in southern Puget Sound. Their status elsewhere in southern Puget Sound is uncertain. The only other nonendangered marine mammal seen in south Puget Sound is the Dall's porpoise, which is seen rarely in open waters of south sound, particularly near Anderson Island. The harbor porpoise (Phocoena phocoena) used to be considered common prior to 1950 (Scheffer and Slipp, 1948), but recently only one harbor porpoise has been seen in south sound (Calombokidis, et al., 1984). Calombokidis theorized that high levels of PCB and DDT compounds in harbor porpoise were likely responsible for the decline in numbers of this species in south Puget Sound. Calombokidis (op. cit.) also reports that harbor seals from Gertrude Island show a much higher level of contamination than harbor seals from other parts of the sound. Further discussion of pollutants in south sound and potential impacts to marine mammals are found in sections 4.03b(4) and 4.04b(4).

(5) Waterbirds. The Nisqually National Wildlife Refuge (Federal) and the Nisqually Habitat Management Area (State) are sites of important migratory waterfowl and shorebird concentrations during migration and winter seasons. This is the last and largest unindustrialized river delta in south Puget Sound. The refuge and surrounding Puget Sound waters are home to thousands of ducks, geese, gulls, alcids, and shorebirds, as well as loons, grebes, swans, rails, and many other species of birds. The remainder of south sound is less as productive, but contains numerous protected bays that shelter small numbers of waterbirds throughout the winter months. Numbers of breeding birds are quite small; pigeon guillemots are the only widespread nester, albeit in small numbers. Glaucous-winged gulls have breeding colonies in Olympia and Shelton.

Many of the protected bays in south sound provide excellent habitat for migrating and wintering waterbirds, though seldom are the numbers of birds large. Most of the birds listed above prey on finfish; a few prey on shellfish, particularly mussels, and consequently may frequent shallower water than the other species.

Observations of resident and migratory waterbirds in the Nisqually region are applicable to both the Ketron Island selected site and the Devils Head alternative site. The importance of the delta as a part of the Pacific Flyway was recognized by its designation as a national wildlife refuge. Although some birds winter in the delta, others use the area for only a short time during migration. Nevertheless, residents, wintering, and migrating birds are vitally dependent upon the area and its rich food sources.

During migration, birds expend large amounts of energy and require food, rest, and protection from predators. Because migration is a time of increased vulnerability for birds, the quality of habitat they find along the Pacific Flyway strongly influences overall species populations (Anon, 1975).

Nisqually region provides habitat for relatively large populations of both resident and migratory bird species. The region provides resting and feeding habitat for many species of migratory shorebirds and waterfowl, and functions as a stopover point during migration and as an overwintering area.

(6) Endangered and Threatened Species. Only three endangered cetaceans occur in southern Puget Sound: gray whale (*Eschrichtius robustus*), humpback whale (*Megaptera novaeangliae*), and fin whale (*Balaenoptera physalus*). The fin whale has only been observed twice in Puget Sound. One sighting in 1930 at Shelton may actually have been a young blue whale (*Balaenoptera musculus*). The humpback whale was common as recently as early 1900's but suffered a population crash primarily due to commercial harvesting, and was not seen in south Puget Sound after the 1940's (Everitt, et al., 1979). However, the species has been making a comeback, with recent sightings near Seattle (1976 and 1978), and in southern Puget Sound (June 1988).

The gray whale has been seen with the greatest regularity in Puget Sound of any endangered cetacean. Nevertheless, sightings in southern Puget Sound have been infrequent.

c. Human Environment.

(1) Social and Economic Factors. The dredging areas that would use the south sound unconfined open-water disposal site include the city of Olympia, Thurston County, the southern portions of Mason and Pierce Counties and small communities such as DuPont, Steilacoom and Shelton. Thurston County ranks eighth in county population in the State with a population of 145,000 in 1987. Population has increased by 21,236 from 1980 to 1987. Population forecasts by the Washington State Office of Financial Management show the population of Thurston County increasing to 190,261 by the year 2000. Mason County ranked 21st in the State, with 36,000 people in 1987. The population increased from 31,200 in 1980, and is projected to reach 46,500 by the year 2000. The major city in the three-county area is Olympia, with a population of 29,600 in 1987 (ranked 16th in the State). Population is projected to reach 34,400 by 2000.

(2) Navigation Development. The Port of Olympia has diversified and expanded its trade considerably since 1976, when it primarily handled logs. Its success in attracting export customers is shown in the increase from 1 customer in 1983 to 26 in 1987. Exports in 1986 totaled 536,256 short tons; imports totalled 11,479 short tons. Recent growth is also illustrated by export of 502,000 short tons of logs in 1985, and a forecasted 900,000 short tons by 1995).

At present, two Federal Navigation projects are located at Olympia Harbor, the East Bay Marina (1983) and the Olympia channel (West Bay). The latter project was authorized in 1927 and modified by several subsequent Congressional Acts, of which the latest was in 1945. Since 1939, 83 percent of the authorized dimensions of the project have been completed. The project is authorized to include a 500-foot-wide, 30-foot-deep channel from deepwater Budd Inlet to the port terminal.

To accommodate recent growth and anticipated expansion a West Bay waterway improvement involving the entrance channel and turning basin has been proposed and could be carried out by 1992. Navigation improvement is being considered at: (1) the west entrance channel; and (2) the turning basin.

Information on the dredging required to fulfill the proposed navigation improvements is provided in table 3.7.

(3) Dredging and Disposal Activity. For the south sound area, two DNR sites were used for unconfined, open-water disposal. From 1970 to 1985 these were at Dana Passage and Steilacoom, where 141,000 c.y. and 235,000 c.y. of material were disposed, respectively, from various local dredge sites. This area accounted for only 12 percent of the disposal which occurred in Phase II area unconfined, open-water sites over the 1970-1985 period.

For the period 1985 to 2000, the five project areas in the south sound are expected to yield a total of 1,337,000 c.y. Of this, the volumes shown in table 3.6 could be found suitable for disposal at the Anderson Island-Ketron Island site. See Management Plan Report for detailed discussion of disposal suitability analysis.

TABLE 3.6
PROJECTED VOLUMES OF DREDGED MATERIAL
THAT COULD BE FOUND SUITABLE FOR THE
ANDERSON ISLAND-KETRON ISLAND DISPOSAL SITE
1985-2000 2/

Dredging Area	Volume (c.y.)
Olympia/Budd Inlet 1/	518,500
Tacoma Narrows	86,000
Shelton/Oakland Bay 1/	33,500
Pickering Pass	104,000
Steilacoom	43,000
TOTAL	785,000

1/These areas will each yield an additional equal volume of dredged material which is considered not likely to pass PSDDA disposal guidelines for designated nondispersive disposal sites. This material will need to be disposed at various confined sites. Breakdowns of total volumes by activity and dredging location are shown in figure 2.7 and table 3.2.

2/See table 2.7c for the volume currently expected to be discharged at this site over the period 1985-2000 (217,500 c.y.).

(4) Native American Treaty Fishing. The Nisqually, Puyallup and Squaxin Island Indians have usual and accustomed tribal fishing places in the general vicinity of the Nisqually proposed nondispersive site, although no fishing is believed to occur at the site itself. Coho and chinook are taken by gill nets to the west of Ketron Island.

The total average annual Indian harvest for the 1985-87 period was 30,129 pounds. Only 520 pounds of this was for nonsalmon species. Of salmon, the leader was coho and the 3-year (1985-87) average yearly catch was 25,034 pounds (Washington Department of Fisheries, August 1988).

In the Nisqually Reach area, the main Indian fishing method is gill nets; information obtained from these catches in previous years help set the timing of a current year's fishing effort. The three tribes in this area release large numbers of hatchery-raised salmon and steelhead each year. Normal salmon harvest management periods in the reporting area follow (WDF and Northwest Indian Fisheries Comm., 1988). Other factors can cause modifications of those dates.

Spring chinook - April 15 to June 29
Fall chinook - July 1 to September 24
Pink salmon - August 10 to September 25 (odd years)
Coho - September 25 to November 6
Chum (early/normal/late) - September 17 to January 15

(5) Non-Indian Commercial and Recreational Fishing. The Nisqually Reach in the area of the proposed disposal site supports a non-Indian commercial and a recreational fishery in addition to Indian fishing. Of the total finfish harvest, 94.8 percent of the 1985 to 1987 annual average of 602,072 pounds was nonsalmon. This figure does not differentiate the Indian catch (see section 3.02c(4)), and was led by herring, which showed a 460,702-pound total catch in 1987. The total average annual shellfish harvest including the Indian catch for the 1985 to 1987 period was 1,501,461 pounds. This harvest was led by geoduck clams, represented by a 230,536-pound total catch in 1987.

In this area all the salmon commercial harvests were accomplished through Indian fishing (see section 3.02c(4)).

The 1986 sport catch of chinook, coho, and chum salmon for the inner Puget Sound area, which includes the Nisqually Reach, was reported as 17,265 fish (Washington Department of Fisheries, 1987).

(6) Esthetic Setting. The esthetic setting that could be impacted by disposal operations is the Nisqually delta region, including the Nisqually National Wildlife Refuge with associated wetlands, marine mammals, seabirds, shipping activities, and recreational boating. It also includes shoreline areas, offshore islands, and the Olympic Mountains. A good description of the shoreline areas is provided in the Weyerhaeuser/Dupont EIS (1982). The esthetic qualities of the bay and associated amenities are enjoyed by boaters, some of which utilize local marinas for moorage. Public shoreline access to the area is from the Long Branch Peninsula, the Olympia area, and the Nisqually National Wildlife Refuge. Principal viewing areas for the preferred and alternate sites are Steilacoom and the Nisqually National Wildlife Refuge.

3.03 North Sound - Bellingham Bay. Figure 2.4 shows the locations of the selected and alternate disposal sites. The two sites are located approximately 5 miles southwest of Bellingham in water approximately 95 feet deep.

a. Physical Environment.

(1) Geology. The impact of glaciation in the Bellingham Bay area was similar to that occuring at the other sites in the Puget Sound. Ice during the Pleistocene is believed to have reached a thickness of approximately 5,250 feet in Bellingham Bay (Burns, 1985). The Nooksack delta region of Bellingham Bay has undergone the most dramatic growth of any coastal sedimentary feature in the Puget Sound region in recent times. Its growth demonstrates the imbalance existing between marine processes, waves, and nearshore currents, responsible for removing sediment from the delta and inputing river sediment to the delta. As a consequence of these processes, wetlands have advanced seaward over 1.5 kilometers of the tidal platform, thereby producing 3 square kilometers of new bottomland. The intertidal delta area has decreased as these new subaerial wetlands have arisen (Downing, 1983).

(2) Water Quality. Water quality in the area is categorized as Class A in the 1984 Washington State Department of Ecology standards. Inner Bellingham Bay has been described as Class B in the past. The marine area is principally part of the Strait of Georgia system. Waters are generally typical of deep oceans, with low temperatures and high salinity, and are rich in inorganic plant nutrients. The northern waters around Point Roberts and Boundary Bay are influenced by the Fraser River discharge. Farther south, the waters of Bellingham Bay are influenced mainly by the Nooksack River, whose average annual flow is 3,909 c.f.s. (EPA 1983). During high discharge periods of the Nooksack, i.e., during January through March, salinities in a thin surface layer drop to 6 to 11 ppt, contrasted with 26 to 30 ppt in the drier late Autumn. Below 5m depth, salinities are usually over 25 ppt throughout the year (Corps, 1979). Similarly, temperatures in Bellingham Bay reflect the Nooksack River's freshwater contributions. Low temperatures (7.6 degrees to 8.0 degrees C) occur at the surface between December and February and increase to 20 degrees C in July. Deeper temperatures show a range of 7.6 degrees C (March) to 15 degrees C (July).

Twelve minor and two major point sources for pollutant discharges (NPDES) are located in the Bellingham areas. One of these, the Georgia-Pacific Corporation discharges 20,500 million gallons a year into Bellingham Bay (PSWQA 1986). This municipal/industrial volume is exceeded only by Seattle METRO Sewage Treatment Plant in Puget Sound. The discharge has typical pulp and paper constituents. Sulfite waste liquor from Georgia-Pacific is the dominant waste entering the Bay, though greatly reduced since construction of a secondary effluent treatment plant in 1979. It causes oxygen depletion, and levels of dissolved oxygen (DO) near the effluent concentration area (Whatcom Creek waterway) can dip to zero in near-surface waters in the summer; but, elsewhere in the Bay, DO is normally greater than 5.0 milligrams per liter (mg/l), ranging up to 9.6 mg/l in May. In May 1980, dissolved cadmium measured 0.09 parts per billion (ppb), dissolved nickel 0.54 ppb, and dissolved copper was 0.44 ppb, in this area (A. J. Paulson, personal communication, 1988).

The Bellingham Municipal sewage treatment plant's primary treatment effluent discharge at Post Point totals 5,850 million gallons per year. Bacterial loading of Bellingham Bay from this source is estimated at 160 trillion particles per year (PSWQA, 1986). Added to this are the bacteria and particulates from Bellingham's combined storm and wastewater sewer system overflows (CSO's). An EPA study station reported 2.4 fecal coliform counts/100 ml for surface waters in the southern part of the Bay (EPA, 1988). Restrictions on shellfish harvesting are in place for northern and western parts of the Bay.

Suspended solids can also be a significant factor in local water quality near the point north of Bellingham Bay where another major point source discharger, Mobil Oil Corporation, releases 91 million pounds per year of refinery-associated materials, one of the highest in the Puget Sound. Since this effluent enters the Strait of Georgia, currents will disperse it rapidly. Bellingham Bay exhibits some turbidity from the Nooksack River's sediment load, the Georgia Pacific Mill's 12,300,000 pounds/year of suspended solids, and from algal blooms.

(3) Currents and Sediment Transport. Currents in the Bellingham Bay area are extremely low. The closest current station for which NOAA publishes data (at location 0.5 mile southeast of Eliza Island) lists currents as "weak and variable." The PSDDA Depositional Analysis (Evans-Hamilton Inc., 1987) states that the entire study area has all the attributes of a very low energy, depositional environment.

(4) Marine and Estuarine Sediments. The primary source of suspended sediments in Bellingham Bay is the Nooksack River. Annual sediment discharge is approximately 526,000 metric tons, accounting for about 16 percent of the total sediment discharge into Puget Sound (Downing, 1983). In general, the sediments that settle to the bottom in Bellingham Bay consist of very fine grained material.

The intertidal platform of the Nooksack delta is covered with a layer of medium sand that contains about 12 percent silt and clay. Numerous shallow distributary channels 1.2 to 1.5 meters deep have cut across the delta platform sand. The bedload from the river moves seaward at low tide, but during high tide, tidal currents and waves disperse sands from the channel over the delta platform. Beaches near the delta are nourished by material deposited on the delta platform and subsequently redistributed.

Very little of the river silts and clays are permanently deposited on the intertidal delta. Wave and tidal currents keep most of the material in suspension and carry it to the deeper waters of the bay seaward of the delta. Deposits of deltaic silts and clays 1.5 to 6.1 meters thick have accumulated in the northern half of Bellingham Bay since the last glacial epoch (Downing, 1983).

The median grain size is medium sand grading to very fine sand off the eastern shore and the south end of Portage Island. Gradually this pattern changes to medium silt in the center of the south ZSF. Two areas containing sediment consisting of fine silt are found in the far north and to the east of the south ZSF. The amount of clay increases from the east and west sides of the Bay towards the center of the area, and is constant at 16 to 18 percent within the south ZSF. Two lobes of 18 to 20 percent clay were found northeast and northwest of the ZSF. The sediments in the Bellingham Bay south ZSF contain a large amount of enriched organic material.

Tests for percent volatile solids (%VS), 5-day biological oxygen demand (BOD5), and percent water have been conducted at the proposed disposal site. The %VS is in excess of 8 percent, BOD5 concentrations range from 2,000 to 2,500 mg/kg of sediment and percent water ranges around 70 percent; all are attributes of a low energy depositional environment.

Analyses for chemical substances in sediments from sampling station about 1 mile northeast of the selected disposal site (Crecelius, et al., 1975) removed sedimentary LPAHs at 95 ppb and HPAHs at 790 ppb. PCBs were measured at this station at less than 20 ppb (screening level for total PCBs is 130 ppb). The following sediment values were recorded for heavy metals in ppm: arsenic at 11, cadmium at 0.33, copper at 62, mercury at 0.12 (this station was about 0.5 mile due north of the proposed site), lead at 23 (same station), and zinc at 114 ppm. TOC was measured at 27 ppt.

Additional sampling of Bellingham Bay sediments was conducted by Battelle's Pacific Northwest Laboratory for EPA in 1983 and 1984 (EPA, 1986). Stations in the outer harbor frequently had undetectable levels of relevant sediment chemicals, but one station (number 23), located about 2 miles northeast of the preferred disposal site, yielded the following concentrations (ppm dry weight): arsenic at 10.8, cadmium at 0.33, copper at 62, lead at 10, mercury at 0.5, nickel at 102, and zinc at 114. Of these, mercury and nickel exceeded the PSDDA screening level values (see Phase I MPR, exhibit A). Analyses for organic chemicals in the sediments at Bellingham Bay station No. 23 yielded all values below PSDDA screening levels.

(5) Air Quality. The Northwest Air Pollution Control Authority (NWAPCA) has jurisdiction over Bellingham Bay air quality. NWAPCA administers and enforces air pollution control staudards and regulations and implements the requirements of the State of Washington laws and the Federal Clean Air Acts. Air quality in the area is considered good, and the area generally attains standards for primary pollutants, carbon monoxide, suspended particulates, and sulphur dioxide. Occasional violations of sulphur dioxide levels are recorded at the Bellingham station (NWAPCA, 1988). The 1986 annual geometric mean for total suspended particulates, 65 micrograms per cubic meter in 1986, is close to the Federal ambient air standard of 75 micrograms per cubic meter. In 1985, the Bellingham area exceeded the State standard for total suspended particulates for 3 days and the Federal standard of 260 micrograms per cubic meter for 1 day. The State sulfur dioxide standard of than 0.10 parts per million per day was exceeded for 1 day in 1985, but no violation of these standards was recorded in 1986.

b. Biological Environment.

(1) Benthic Communities.

(a) Bellingham Bay. In Bellingham Bay, the highest intertidal areas are generally riprapped with larger rock or concrete rubble, and are occupied by plants and animals adapted to extensive exposure and limited immersion in water. Common animals include littorine snails and limpets. Barnacles occur only near the Mean Higher High Water (MHHW) line.

The high midtidal region (between MHHW and Mean Sea Level (MSL)) has a much greater assemblage of plants and animals than areas above MHHW. Substrate diversity is high, further enhancing the diversity of the biological community. Barnacles occur on cobbles and boulders throughout this zone. Limpets and mussels are also found on larger rocks and lettuce (*Ulva* spp.) occurs on rocks and boulders in the upper part of the zone. The brown rockweed (*Fucus vesiculosus*), sea lettuce, and red alga (*Endocladia* spp.) are common in the lower portions.

The low midtidal region from about MSL to Mean Lower Low Water (MLLW) is an area of high productivity and diversity. Animals and plants attached to rock surfaces include large numbers of barnacles and mussels, frequently displaced by a dense cover of algae. Near MLLW, plant and animal cover on the cobble/boulder may exceed 70 percent. Beneath the rocks, the purple shore crab (*Hemigrapsus* spp.) is abundant. Also found on or beneath rocks are encrusting sponges and sea squirts (ascidians), and the green sea anemone (*Anthopleura* spp.). The clay pavement substrate is colonized by boring clams. Sand and mixed-fine substrates appear to be relatively barren except for scattered Macoma, heart cockles (*Clinocardium nuttallii*), butter clams (*Saxidomus giganteus*), and little neck clams.

The lowest intertidal area (MLLW to Mean Low Water (MLW)) contains many of the same species found in the subtidal habitats as well as some forms typically seen at higher areas. Plant and animal production and diversity are apparently greater than at higher elevations. Plants are a conspicuous and dominant feature. Scattered patches of eelgrass (*Zostera* spp.) occur down to about -1.0 feet on sand substrate. Much more common and abundant are algae species. The most abundant brown algae are *Laminaria*, *Costaria*, *Alaria* and *Sargassum*. The bull kelp, *Nereocystis* is uncommon except for the lowest levels of the intertidal zone. Green algae are dominated by *Ulva* and red algae and are characterized by encrusting and large fleshy forms. Common larger benthic animals include sea anemones, polychaete worms, crabs and sea squirts.

Typical subtidal habitats include silt and sand, sand with coarse gravel and shell debris, and gravel/cobble/boulder beds. The first habitat type is characterized by fine to medium sand sediments. Benthic plants and animals are dominated by forms adapted to soft bottom habitats. Plants are primarily a microflora of diatoms with occasional drifting or unattached macroalgae. Epifauna are generally uncommon. Occasional residents include sea stars, sea pens, Dungeness crab, pagurid hermit crabs, nudibranchs, and burrowing anemones. Mud shrimp (Upogebia) are the most common large infaunal species, although geoducks (Panope generosa) are occasional residents. Smaller infauna include a relatively diverse and abundant community of tube dwelling polychaetes and amphipods.

Another subtidal habitat is characterized by silty-sand or small cobble/gravel material. Shell debris is dense in places and consists mainly of rock boring clam and horse clam shells. Plant forms include occasional macroalgae and scattered small patches of eelgrass. Epifauna are restricted mainly to larger rocks and wood debris. Turret shells are common on the rocks and nudibranchs are occasionally found. The coon-stripe and broken-back shrimps are common under logs and under rocky rubble. The rock crab is also seen around rocky areas. Open sandy areas are occupied by occasional sea pens. Cockles are common infauna.

A third subtidal habitat is comprised of mixed coarse material overlying sediments comprised of small gravels, sand and silt, or flat clay hard pan. Marine flora utilizing this habitat are dominated by a rich and diverse assembladge of macroalgae including bull kelp (Nereocystis), Laminaria, Costaria, Alaria Petalonia, Fucus, Sargassum, Ulva. Codium, and a number of filamentous and blade-like red algae. Epifauna includes abundant populations of broken-back shrimp, rock crab, and kelp crab (Pugettia producta). Nudibranchs occur between and on top of the algae. Two anemones, Tealia coriacea and Metridium (large white anemone) are common as are slipper shells and sea squirts. Echinoderms include several sea stars and a sea cucumber (Cucumaria). Infauna include a typical community of polychaete worms adapted to gravel/rocky bottom habitats. Common are plume worms (serpulid) and spaghetti worms.

(b) Bellingham Bay ZSFs.

1. Intertidal/Shallow Subtidal Communities - Bellingham Bay. The closest shoreline is located at Post Point, approximately 0.9 nautical mile due east of the selected disposal site. To the north and west, shoreline area over 3 nautical miles away from the site. With the exception of the city of Bellingham, the northern shoreline is not highly developed. South of the city, the shoreline is irregular, with sand and gravel beaches interspersed with rocky headlands. Vegetation on these beaches is sparse or absent. Species occurring on rocky or gravel beaches include aquatic vegetation such as sea lettuce (Ulva sp.), rockweed (Fucus distichus), and other algal species. Sandy and mud beaches contain primarily Ulva and a surface film of diatoms (Corps, 1979). The marine ecology of the intertidal and shallow subtidal area of Bellingham Bay are essentially a continuation of ecosystems existing in the Strait of Georgia. The ecology of these habitats are well described in Kozloff (1983) in his treatment of shorelife in different habitats, primarily rocky shores, sandy beaches, and docks and pilings. Species diversities and densities of intertidal invertebrates in Bellingham Bay are relatively low (Corps, 1979). This is probably due to several factors including reduced salinity in surface layers, caused by

freshwater drainage and industrial activity. The rocky beaches of Lummi Island and Eliza Island have the greatest diversity and density of infauna. Cobble beach areas at Post Point, somewhat exposed to low salinity, sustain moderately rich intertidal communities. Beach and intertidal communities north of Post Point are exposed to industrial activity as well as freshwater drainage. Diversity and density of organisms at these beaches are low. The northerly beaches and beaches of Lummi Peninsula and Portage Island receive a high freshwater influence and have low diversity and density of intertidal organisms. Gravel, sand, and muddy beaches of Chuckanut Bay are the best shellfish habitats, although a few Macoma and Mya clams can be found throughout the Bay.

Beaches within Bellingham (from the northerly city limit to Post Point) have low densities of shellfish. The extensive intertidal areas between the Squalicum Boat Harbor and I & J Street Waterway yield only occasional Macoma and Mya clams. A few oysters are found in Bellingham Bay (Webber, 1975).

2. Benthic Communities - Selected and Alternative Sites. Site specific benthic studies were conducted by the Waterways Experiment Station in Bellingham Bay during July 1987 (see Clarke and Kendall 1987 and Phase II DSSTA). These studies were conducted as part of the BRAT (Benthic Resources Assessment Technique) evaluation of demersal fish feeding habitat potential. The reader is referred to section 3.03b(3)(b)4. for a discussion of the results of the fish feeding habitat analysis.

The study area encompassing the selected and alternative sites exhibited organically enriched fine textured bottoms of predominately medium silt with clay contents generally within the range of 16 to 18 percent. In general, the trophically important upper 5 cm of the sediments constituted between 28 and 33 percent of the total infaunal biomass observed within the 0 to 15 cm sediment depth examined. Figure 3.12 depicts for each of the two ZSF's studied, a generalized three-dimensional plot of mean benthic biomass across size categories and sediment depth intervals. Graded biomass and infaunal size patterns were observed from north to south in the Bellingham Bay study area. Higher total biomass and smaller sized infauna (mode ranging from greater than 2 to greater than 3.35 mm) being found towards the northern portion of the study area, and lower biomass and larger sized infauna toward the south (mode ranging from greater than 3.35 to greater than 6.35 mm). The infaunal community was dominated largely by two taxonomic groups, principally the bivalve Axinopsida serricata, and polychaetes within the families Terribellidae Maldanidae, Onuphidae, and Chaetopteridae. Bivalves and polychaetes exhibiting a model size of 2 mm dominated the upper 5 cm of the sediments at or near the preferred site, and constituted 61 percent and 21 percent of the biomass respectively with the total 0 to 15 cm biomass averaging 51.3 grams/meter squared (wet weight). These same taxa dominated the southern alternative site with bivalves comprising 48 percent and polychaetes 31 percent of the 0 to 5 cm biomass. The average total 0 to 15 cm biomass was depressed (18.3 g/m2) and infaunal modal sizes were somewhat larger (> 3.35 mm). Crustacean biomass was relatively insignificant throughout the Bellingham Bay study area, constituting less than 3 percent of the community within the top 5 cm, and generally less than 1 percent of the deeper dwelling infauna. Benthic infauna living between 5 cm and 15 cm were generally larger (> 3.35 mm to > 6.35 mm size mode) polychaetes and bivalves (i.e., Clinocardium nuttallii and Compsomyax subdiaphana) comprising 67 to 72 percent of the biomass below 5 cm. Variations in biomass distribution among stations reflect the patchy distribution of benthos typically documented in benthic investigations (Johnson, 1972; Rhoads, McCall, and Yingst, 1978). In general, the community appears to be dominated largely by opportunistic/pioneering (Type 1) species within the near surface sediment fraction, and equilibrium (Type III) species in the deeper sediment fractions (Rhoads, McCall, and Yingst, 1978).

3. Crab and Shrimp Resources in and Near the Alternative Disposal Sites. Crab and shrimp resources in Bellingham Bay were sampled by beam trawl in the preferred and alternate sites during February, May, July, and October, 1987 by the University of Washington (Dinnel, et al., 1987). Although Dungeness crab are widely distributed in the sound, little is known concerning their distribution and habitat preference. Studies of northern Puget Sound have shown that several life stages utilize marine areas to depths of 400 feet (Dinnel et al., 1985a). Theses life stages include growing and molting young and mature adults, females with and without eggs, and possibly mating pairs. The northern Puget Sound data suggested that certain habitats attract aggregations of crab for unknown reasons. Figure 3.13 depicts the spatial distribution of Dungeness crab by season in Bellingham Bay. Figure 3.14 summarizes Dungeness crab depth distribution, size frequency, shell condition, sex composition, female reproductive condition, and egg age in Bellingham Bay during 1987. Seasonal crab studies in and around the preferred and alternative sites showed that Dungeness crab densities were generally low (less than the 100 crabs/ha criterion for "background levels" for north Puget Sound). At the preferred site the average density was 21 crabs/ha for all stations in the vicinity of the site. At the alternative site, crab densities were slightly lower averaging 18 crabs/ha. Seasonal crab densities are depicted in figure 3.13, and show that highest densites at both sites occurred during the spring sampling period. Female crabs dominated the catches during all seasons by two to four times that of males. Gravid females were caught only in February, and were concentrated along the 10- to 20-meter depth contour close to Post Point. That area is east of the preferred site at a distance of 0.62 nautical miles (Paul Dinnel, personal communication, 1988).

Rock crab (C. productus and C. gracilis) were half as abundant as Dungeness crab throughout Bellingham Bay (figures 3.15 and 3.16). Relatively few C. productus were caught within the bay, especially in February and May. Sexes were fairly evenly distributed and only a single gravid female was caught in May. Settlement of 1987 young of the year crabs were observed between July and October. Most C. productus were caught in shallow depths (10 to 15 meters) near shore (figure 3.15). The majority of rock crabs caught in Bellingham Bay were C. gracilis. The sexes were equally abundant with gravid females only being found in February. Settlement of young of the year C. gracilis began in July. The distribution of C. gracilis was limited primarily to shallow areas in February and May, but extended to all depths in July and October (figure 3.16).

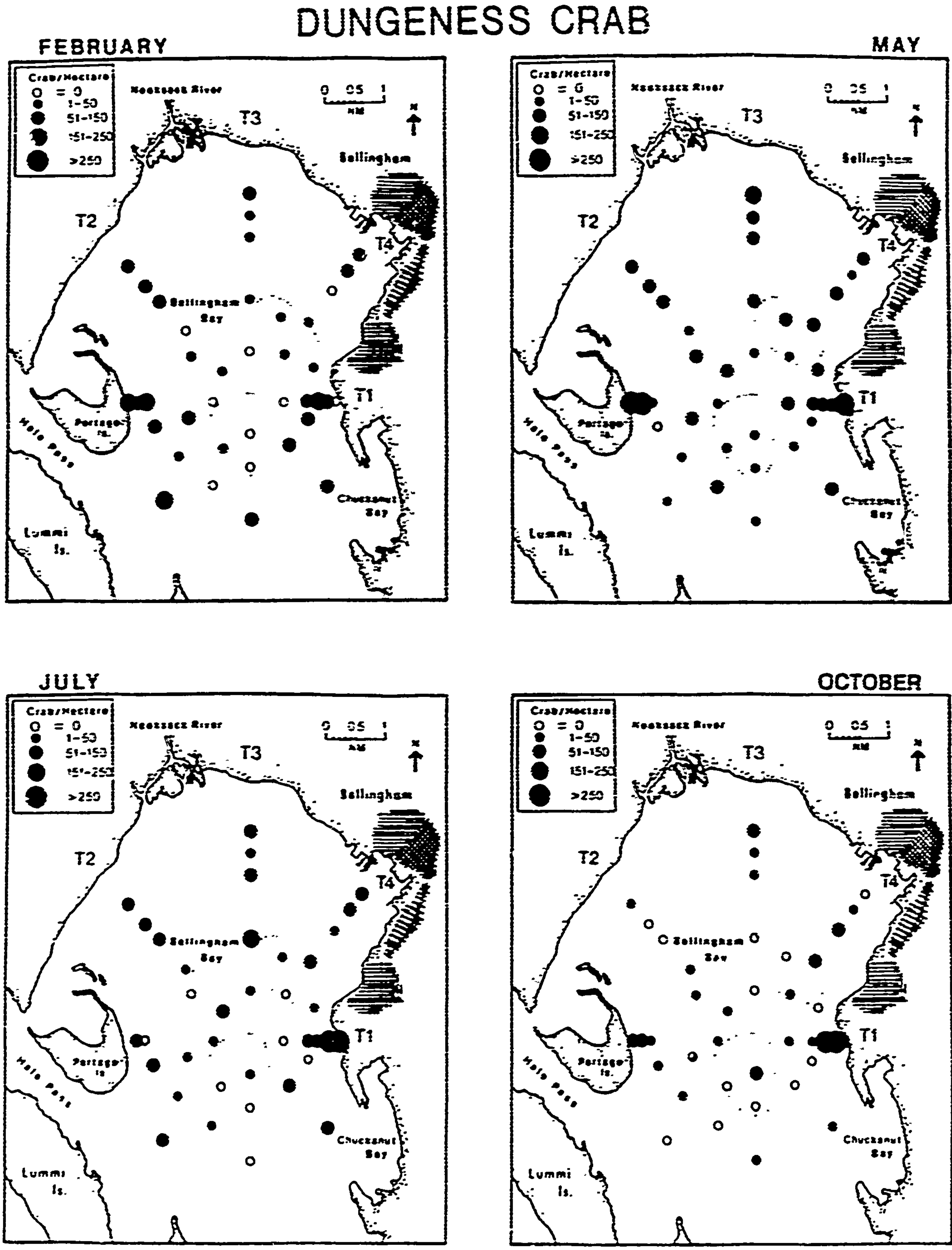


Figure 3-12 Maps of Bellingham Bay showing Dungeness crab densities as estimated from beam trawl catches in February, May, July and October 1987. (after Dinnel et al., 1988)

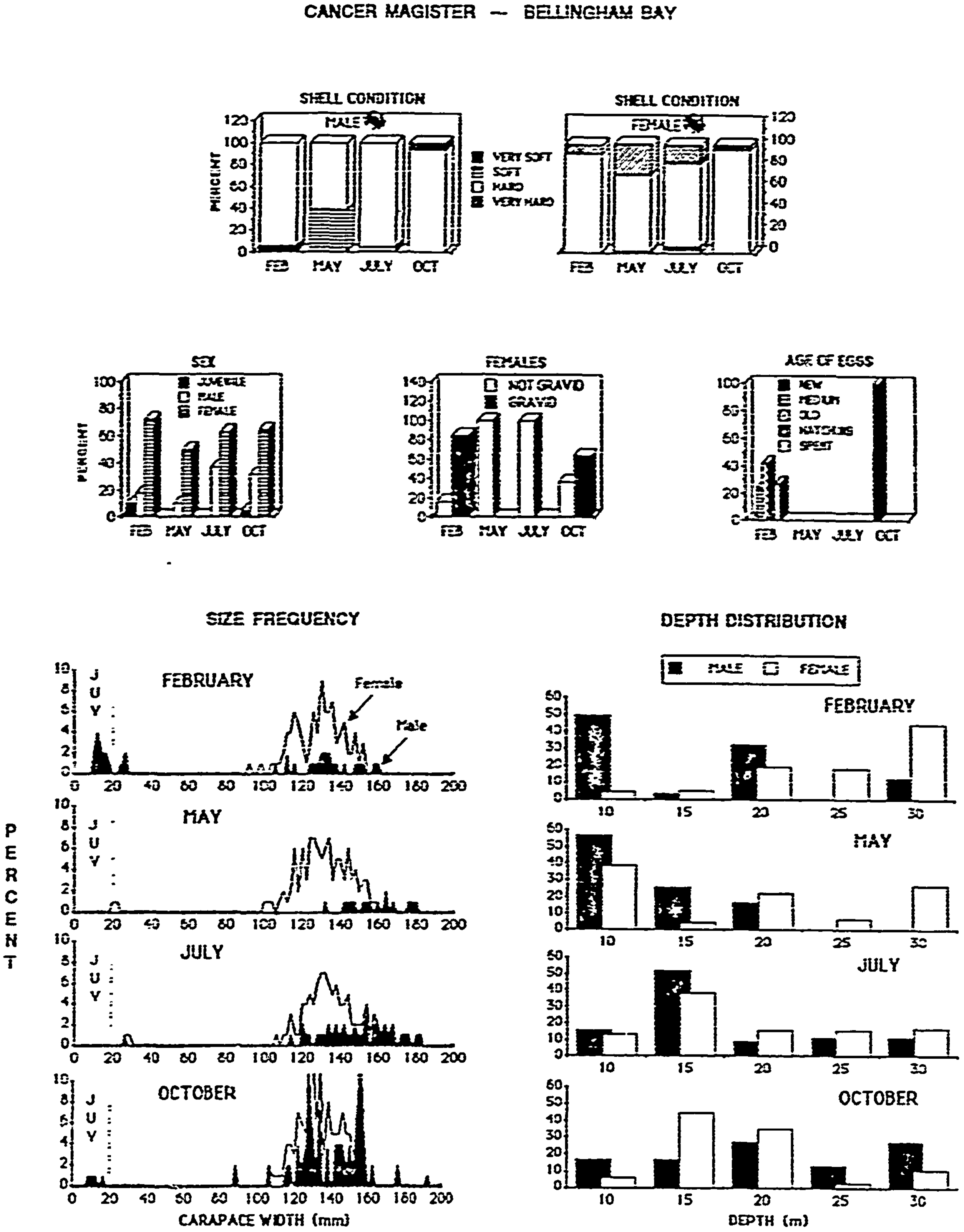


Figure 3.13Summary of Dungeness crab depth distribution, size frequency, shell conditicn sex composition, female reproductive condition and egg age in Bellingham Bay during four seasons of 1987. (after Dinnel et al., 1988)

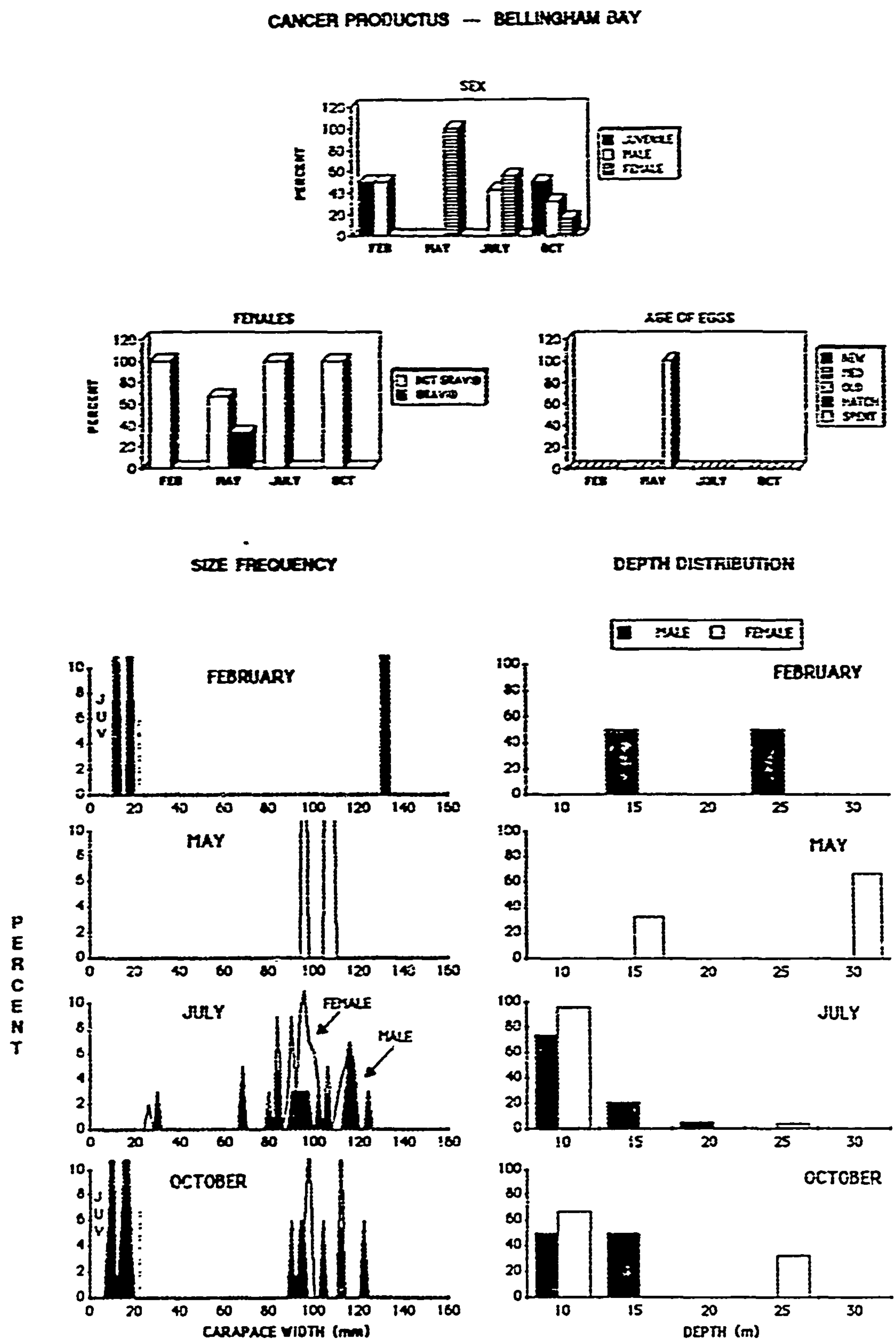


Figure 3.14 Summary of *Cancer productus* depth distribution, size frequency, sex composition, female reproductive condition and egg age in Bellingham Bay during four seasons of 1987 (after Dinnel et al., 1988)

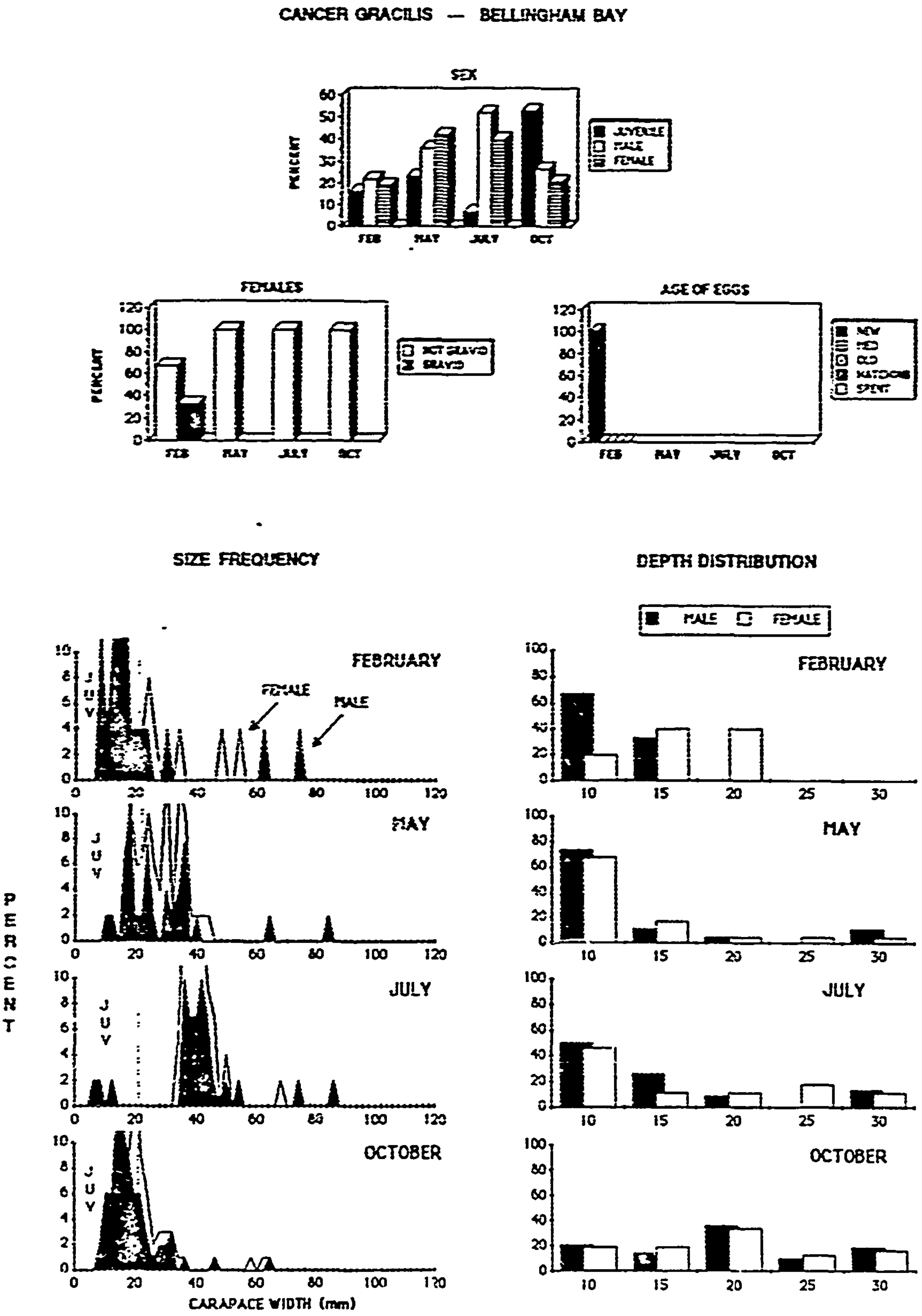


Figure 3.15 Summary of *Cancer gracilis* depth distribution, size frequency, sex composition, female reproductive condition and egg age in Bellingham Bay during four seasons in 1987. after Dinnel et al., 1988)

Tanner crab (Chionoecetes bairdi) were found in small numbers, and were mostly juveniles and confined to the deeper areas of the Bay. They were considered to be "incidental captures" since this species is not commercially exploited in inland waters.

Pandalid shrimp resources were generally abundant throughout Bellingham Bay compared with the Nisqually Delta region in south sound and many other areas in Puget Sound (figure 3.16). Seven pandalid species were recorded in Bellingham Bay during site investigations (figure 3.17). The most abundant species were humpback shrimp (Pandalus hypsinotus), coonstripe shrimp (P. danae), and pink shrimp (P. borealis). The spot prawn (P. platyceros) and pink shrimp (P. jordani) were scarce. In moderate abundance were P. goniurus and sidestripe shrimp (Pandalopsis dispar). Three species, P. danae, P. hypsinotus, and P. borealis, were abundant enough to be considered resources with future harvest potential. The overall average (all seasons, stations, species combined) density was 600 shrimp/ha for Bellingham Bay, with seasonal low averages of 413 shrimp/ha in May and a high of 942 shrimp/ha in February. Shrimp were caught at most stations with highest densities in deeper areas (i.e., 25 to 30 meters) of the Bay. Egg bearing female shrimp were generally only caught during February.

Shrimp densities averaged 690/ha at the preferred site and 650/ha at the alternative site. At the preferred site high shrimp densities of 1,554/ha and 1,064/ha were found during February and May, respectively, whereas low densities of 75/ha and 67/ha were found during July and October (table 3.8). Shrimp densities were moderately high at the alternative site during all seasons with a high during July of 1082/ha and a low of 379/ha during February.

Starfish, predominantly Luidia foliolata were generally abundant throughout Bellingham Bay, especially at the south ZSF (table 3.7) and are generally regarded as a nuisance species by ground fish trawlers.

(2) Plankton Communities. Phytoplankton and zooplankton communities are generally ubiquitous throughout Puget Sound but exhibit tremendous spatial and temporal variations in species composition and abundances. The reader is referred to section 3.01b(2) for a general discussion of bloom periods and taxonomic/species succession.

The nudibranch, Tritonia diomedia, valued as a scientific research specimen, was commonly collected in small numbers throughout Bellingham Bay at many of the deeper stations. The average estimated density was 13 Tritonia/ha, with a seasonal Bellingham Bay wide average density of 21/ha in Fwbruary and low of 6/ha in October. Densities of Tritonia averages 22/ha in the preferred site and 14/ha in the south alternative site. The higher average densities of Tritonia in the sites were largely due to high densities observed during February (table 3.7). According to Dinnel, et al. (1988) Tritonia distributions indicated that it was not abundant at any site in Bellingham Bay.

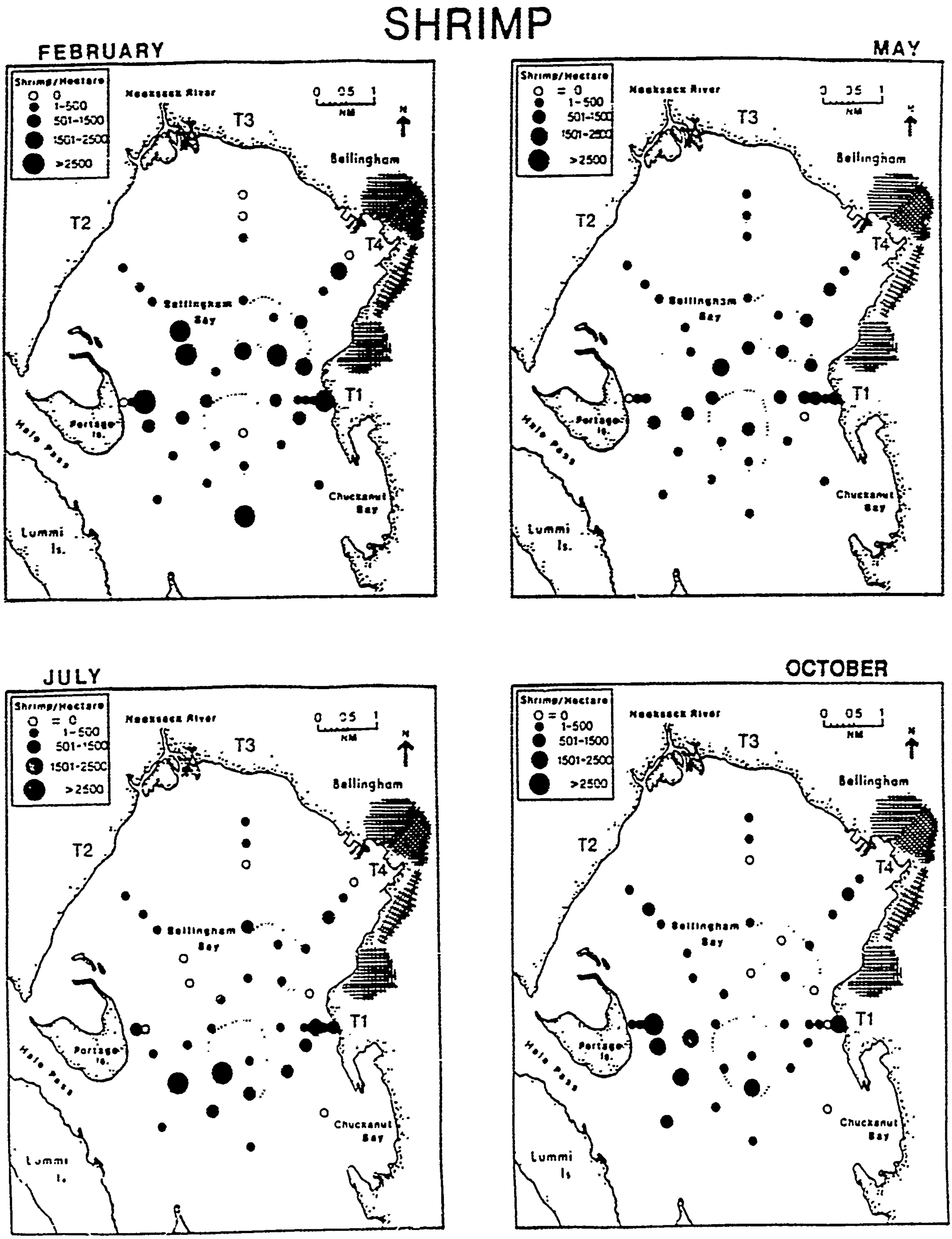


Figure 3.16 Maps of Bellingham Bay showing the densities of commercial pandalid shrimp as estimated from beam trawl catches in February, May, July and October 1987. (after Dinnel et al., 1988)

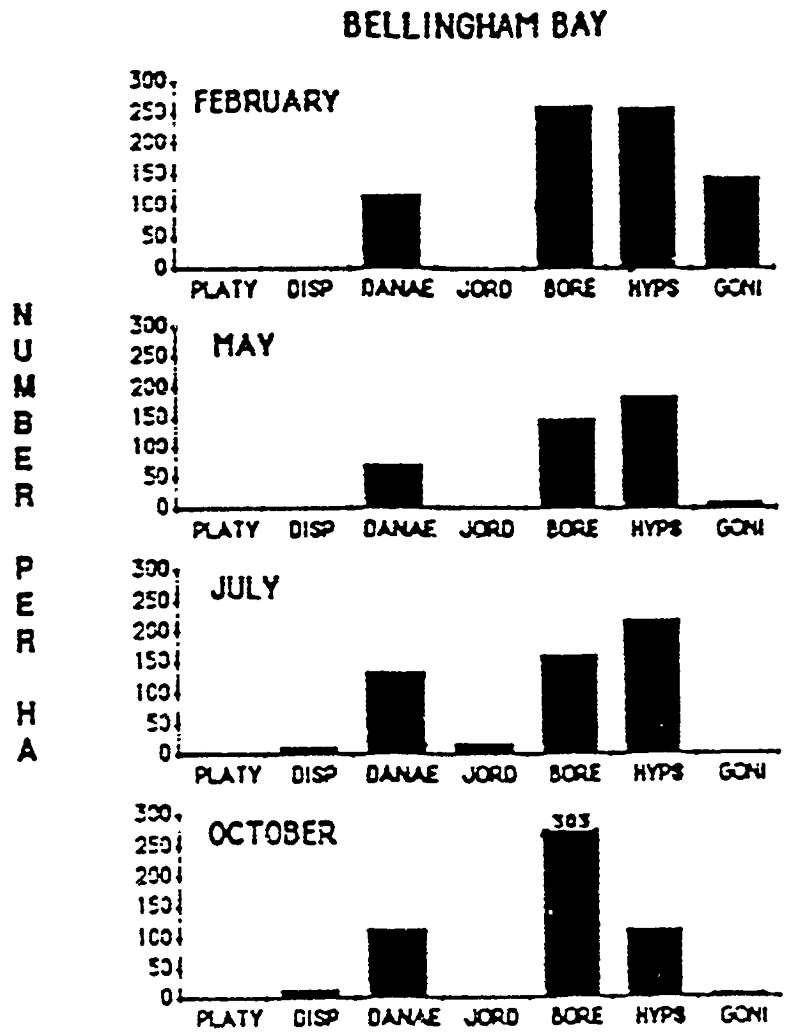
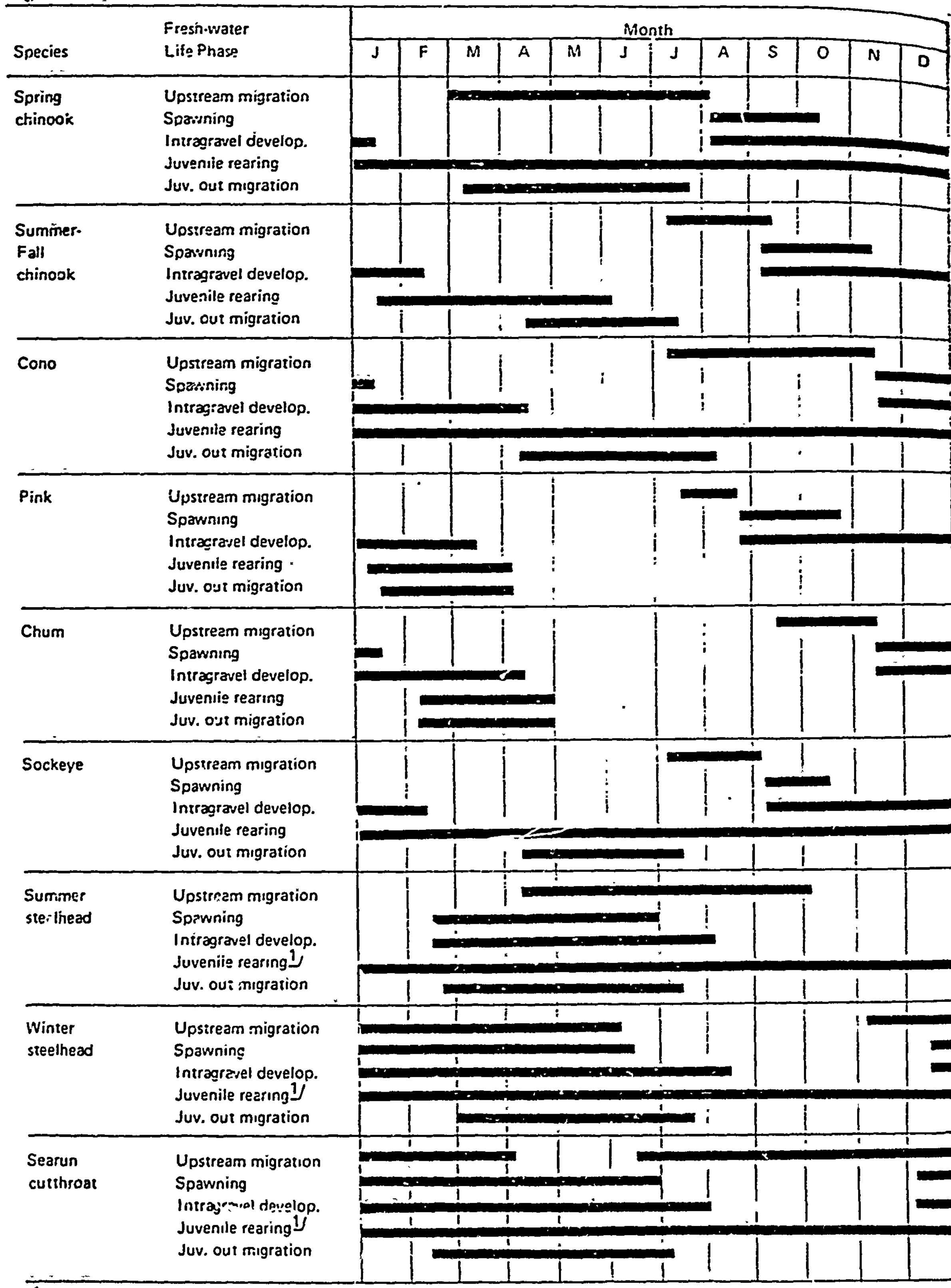


Figure 3.17 Summary of estimated average densities (#/ha) of pandalid shrimp within Bellingham Bay by season and species based on beam trawl catches. (after Dinnel et al., 1988)

Figure 3.18 Salmon and searun trout fresh-water life phases in Nooksack-Sumas Basins



1/ Normally extends over a two-year period.

TABLE 3.7

BELLINGHAM BAY MARINE INVERTEBRATE RESOURCES 1/
(AFTER DINNELL, ET AL., 1988) (AVERAGE NUMBER/HECTARE)

	Dungeness Crabs			Pandalid Shrimp			Tritonia			Starfish		
Season	P	A-1	A-2	P	A-1	A-2	P	A-1	A-2	P	A-1	A-2
February	8	12	19	1554	175	1251	41	44	26	52	225	41
April/May	37	31	79	1064	556	506	19	6	11	26	393	41
July	19	6	68	75	1423	318	23	6	15	195	300	161
October	19	19	19	67	737	45	4	0	19	131	294	154
Average	21	17	46	690	723	530	22	14	18	101	303	99

1/Legend: P = preferred site (resources estimated from stations near site)
A-1 = south alternative site
A-2 = north alternative site

(3) Anadromous and Marine Fishes. Bellingham Bay provides both marine and estuarine environments for a variety of resident and migratory fish. Most of the resident fish occurring in Bellingham Bay are not commercially important. Eighty-one species of fishes have been recorded for the benthic nearshore areas (Bellingham Harbor Navigation Project FEIS, 1979). Bellingham Bay supports commercially and recreationally significant fisheries. Salmonid species are the principal migratory fish using Bellingham Bay and the Nooksack River estuary. Chinook (*Oncorhynchus tshawytscha*), chum (*Oncorhynchus keta*), coho (*Oncorhynchus kisutch*), pink salmon (*Oncorhynchus gorbuscha*), steelhead (*Oncorhynclus mykiss*), and searun cutthroat trout (*Salmo clarki*) use the Nooksack River drainage. Juvenile pink salmon are present in Bellingham Bay only in even numbered years. Chum and coho salmon spawning occurs in small creeks entering Bellingham and Chuckanut Bays. Surf smelt (*Hypomesus pretiosus*) occur in in Bellingham Bay and longfin smelt (*Spirinchus thaleicthys*) spawning primarily in the Nooksack River, are recreationally fished. Longfin smelt runs usually begin in early November and end in early December. Pacific herring and dogfish shark are also fish stocks in the bay.

Food web relationships have been particularly well defined for salmonids. Research from studies conducted elsewhere in Puget Sound suggests that chum salmon descending the Nooksack River begin feeding in the estuary on epibenthic prey. When they reach a length of 45 to 50 mm, they shift to pelagic prey. The chum salmon juveniles fall prey to predation by larger juvenile coho, steelhead, and sculpin. Juvenile coho and chinook have a more diverse diet spectrum. Their prey would consist of riverborne insects, small crustaceans, and juvenile fish. They also are prey to larger fish, such as more mature salmon and trout (Dexter, et al., 1981; Salo, et al., 1980).

Timing of salmon and searun trout freshwater life phases in the Nooksack-Sumas Basins are depicted in figure 3.18. During July through September adult fall chinook salmon enter Bellingham Bay and move primarily along the shorelines as they approach the Nooksack River for upstream migration. Fall chinook juveniles outmigrate from the Nooksack Basin to Bellingham Bay from April to July. They tend to concentrate along the shoreline during their early estuarine residence and move offshore to feed later. The majority of the juvenile chinook are derived from the Nooksack River system. Spring chinook adult salmon migrate upstream from March to early August. Juveniles rear in freshwater for 1 year and subsequently outmigrate to Bellingham Bay from mid-March to early July. After adjusting to saltwater (completing smoltification) the juveniles disperse into the Strait of Georgia, Strait of Juan de Fuca, and the ocean.

Adult coho salmon entering the bay assume a more offshore distribution prior to moving up rivers to spawn. Adult coho salmon migrate upstream July through November. Coho juveniles (yearlings) outmigrate from the Nooksack Basin to Bellingham Bay between April and August. Following smoltification they may utilize pelagic food sources and rapidly move offshore and migrate out of the area. Adult chum salmon migrate upstream from September through November. Chum juveniles outmigrate from the Nooksack Basin to Bellingham Bay between mid-February and the end of April. Adult pink salmon are present in Bellingham Bay from July through August. Pink salmon juveniles outmigrate from the Nooksack Basin from January to April. Adult sockeye salmon are present in Bellingham Bay from July to early September. Juvenile sockeye outmigrate from the Nooksack Basin from mid-April to mid-July, after rearing for 1 year in the basin. Winter steelhead adults migrate upstream between November and early June. After 2 years of freshwater rearing, juveniles outmigrate from early March to late July to Bellingham Bay. Summer steelhead adults migrate upstream between mid-April and early October, and after 2 years of freshwater rearing, the juveniles outmigrate between late February and early July. Sea-run cutthroat adults migrate upstream between mid-June and mid-April. Following spawning and intragravel development of the eggs, juveniles rear normally for 2 years and subsequently outmigrate between mid-February to early July to Bellingham Bay.

(b) Bottomfish Resources in the Disposal Sites. Bottomfish in and around the selected and alternate disposal sites were sampled by the University of Washington School of Fisheries and Fisheries Research Institute during February, May, July, and October 1987 (Donnelly, et al., 1988). Sampling was performed with a research otter trawl.

Numerous juvenile bottomfish were caught in the otter trawl samples during February and May, suggesting that Bellingham Bay may serve as a nursery area for some fishes. July and October densities of most bottomfish species were relatively low except for longfin smelt, suggesting these two seasons may not be important for rearing in the bay. Juvenile fishes caught (e.g., longfin smelt, Pacific tomcod, shiner perch) do not appear to be important commercial/recreational species, although they are valuable prey for a number of marine predators utilizing Bellingham Bay.

Flatfish dominated the weight of catches during February but not in May, July, or October. Gravid individuals of several flatfish species were present during February indicating the potential utilization of Bellingham Bay as a spawning area during the winter, a time when many flatfish species are known to spawn in Puget Sound (Garrison and Miller, 1982). Marine fish life histories and distributions in Puget Sound are well described in several publications, most notably in Miller (1980). Commercial trawl landings for foodfish in Bellingham Bay during 1984 totaled 173,845 pounds, 58 percent of which were flatfish species, including starry flounder, sand sole, and English sole (Pattie, 1986).

Site-specific bottomfish investigations in Bellingham Bay indicated that there was little difference in abundance, species diversity, or species richness between the alternative sites because they are located at similar depths. Abundance and biomass were lowest during spring, and species diversity was lowest during summer. Butter sole abundances were highest during autumn and winter around and in the sites. Relatively higher densities of English sole were caught north of the preferred site during winter and spring. Observations by Donnelly, et al. (1988) of a few gravid female English sole during these seasons suggest this area may be used for spawning. Higher concentrations of starry flounder were found in both sites during winter relative to other areas in Bellingham Bay. Abundances during other times of the year were low. The relatively higher densities during winter suggest a spawning aggregation, due to observed condition of eggs (i.e., nearly ripe).

Longfin smelt were the dominant species in terms of seasons. This species is anadromous and completes its life cycle within 2 years. The co-occurence of juveniles and adults in high numbers in the deeper portions of the bay suggests these areas are being used as a nursery by the young and a forage area by adults.

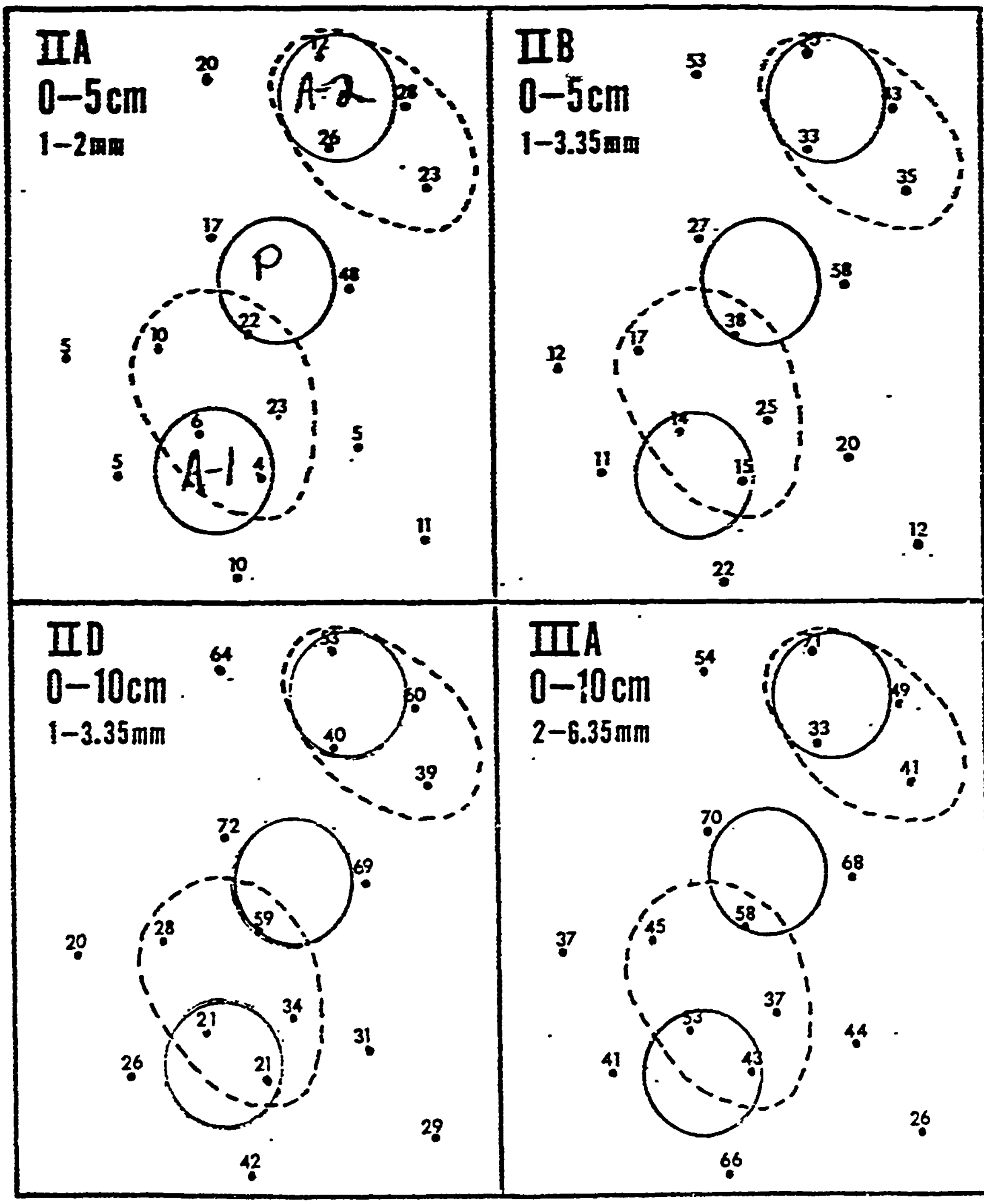
Butter sole, English sole, flathead sole, and starry flounder are caught by commercial and sport fisheries in the bay. Longfin smelt are fished in the Nooksack River. Other species, such as large skates and other flatfish species, are taken by fishermen as incidental catch.

(c) Foodweb Relationships: BRAT Assessment of Bottomfish Feeding Habitat Values in Disposal Sites. An important aspect of benthic habitat quality is the potential amount of trophic support that a given benthic habitat can provide to demersal bottomfeeding fishes. The BRAT procedure was employed by personnel of the Environmental Laboratory, WES, during July 1987 within the Bellingham Bay study area to assess bottomfish feeding habitat values (see Clarke and Kendall, 1987; Kendall and Clarke, 1988; Phase II DSSTA). See sections 2.03g and 3.02b(3) for a description of the BRAT.

Feeding strategy groups identified through this exercise are summarized in table 3.3. The size classes of species observed at each study area assigned to each group are shown in table 3.4. The BRAT focuses on benthic infaunal predators only, due to the necessary coupling of the benthic components of fish diets with benthic infaunal resources in the environment. Seven feeding strategy groups identified were actively foraging on infaunal benthos (primarily English sole). Figure 3.19 depicts the spatial array of benthic feeding habitat values estimated for four of the identified predator feeding groups. Table 3.5 illustrates the distribution and amount (g/m^2-wet biomass) of potential benthic food particles available to four of the seven observed feeding strategy groups. The differential prey size and depth exploitation patterns exhibited among the different feeding strategy groups identified within the Phase II PSDDA disposal sites, largely reflect the spatial mosaic of benthic infaunal prey availability and vulnerability throughout each study area, during a single seasonal "snapshot" of the feeding behavior of the species collected. Benthic feeding fish are largely opportunistic feeders, and their feeding behavior over time would be expected to change as a result of temporal changes in the benthic "food" resources. A direct comparison of the prey taxa composition and prey size selectivity observed in the fish diets showed a very close parallel between observed benthic taxa compositions and modal size distributions in the environment (section 3.02(b)(1)), consisting predominantly of 2 mm and 3.35 mm bivalves and polychaetes occupying the top 5 cm of sediments.

Comparative analysis of mean benthic biomass resource values at Bellingham Bay during the summer of 1987 indicated feeding habitat potentials varied among feeding strategy groups between preferred and alternative sites, and were generally lowest at the south alternative site (A-1) and highest at the preferred site, and intermediate at the north alternative site (A-2) (figure 3.20). Between-site differenced in resource value magnitude for the deeper foraging (0-10 cm) and the larger Group III predators were not significant ($p > .05$). These data reflect the patchiness of benthic communities within and between study areas. Benthic resource values were much more patchy for the smaller and shallower foraging (0-5 cm) Group II (A-B) predators, reflecting the quantitative differences in benthic size distribution patterns. In general benthic resource values observed in Bellingham Bay were comparable to those found in south Puget Sound.

(4) Marine Mammals. In Bellingham Bay, few sightings of marine mammals other than harbor seals, have been recorded (Day, et al., 1987). Everitt, et al. (1979), reports that a pod of four killer whales (known as "O" pod), was observed near Bellingham Bay consistently in the late 1970's. Harbor seals have two haul-out sites within Bellingham Bay, one on the spit at the north side of Portage Island, and one near Fish Point on the Lummi Peninsula. Other nearby haul-out sites are at the point at the south end of Chuckanut Bay, at Eliza Island, and at the north end of Lummi Island. The only other nonendangered marine mammal observed in Bellingham Bay is the harbor porpoise, on rare occasions (Puget Sound Environmental Atlas, 1987). In the San Juan Archipelago, minke whales are considered common (Everitt, et al., 1979), but apparently they do not enter Bellingham Bay (Day, et al., 1987).



BELLINGHAM BAY

Figure 3.19 Spatial arrays of benthic feeding habitat values estimated for four or the identified predator feeding groups within the ZSFs and potential disposal sites in Bellingham Bay. Values expressed in grams/square meter (wet weight). (after Clarke and Kendall, 198

Legend: Predator Feeding Groups: IIA, IIB, IID, IIIA
Available Zone (foraging depth): 0-5cm, 0-10cm
Vulnerable Sizes: 1-2mm, 1-3.35mm, 2-6.35mm

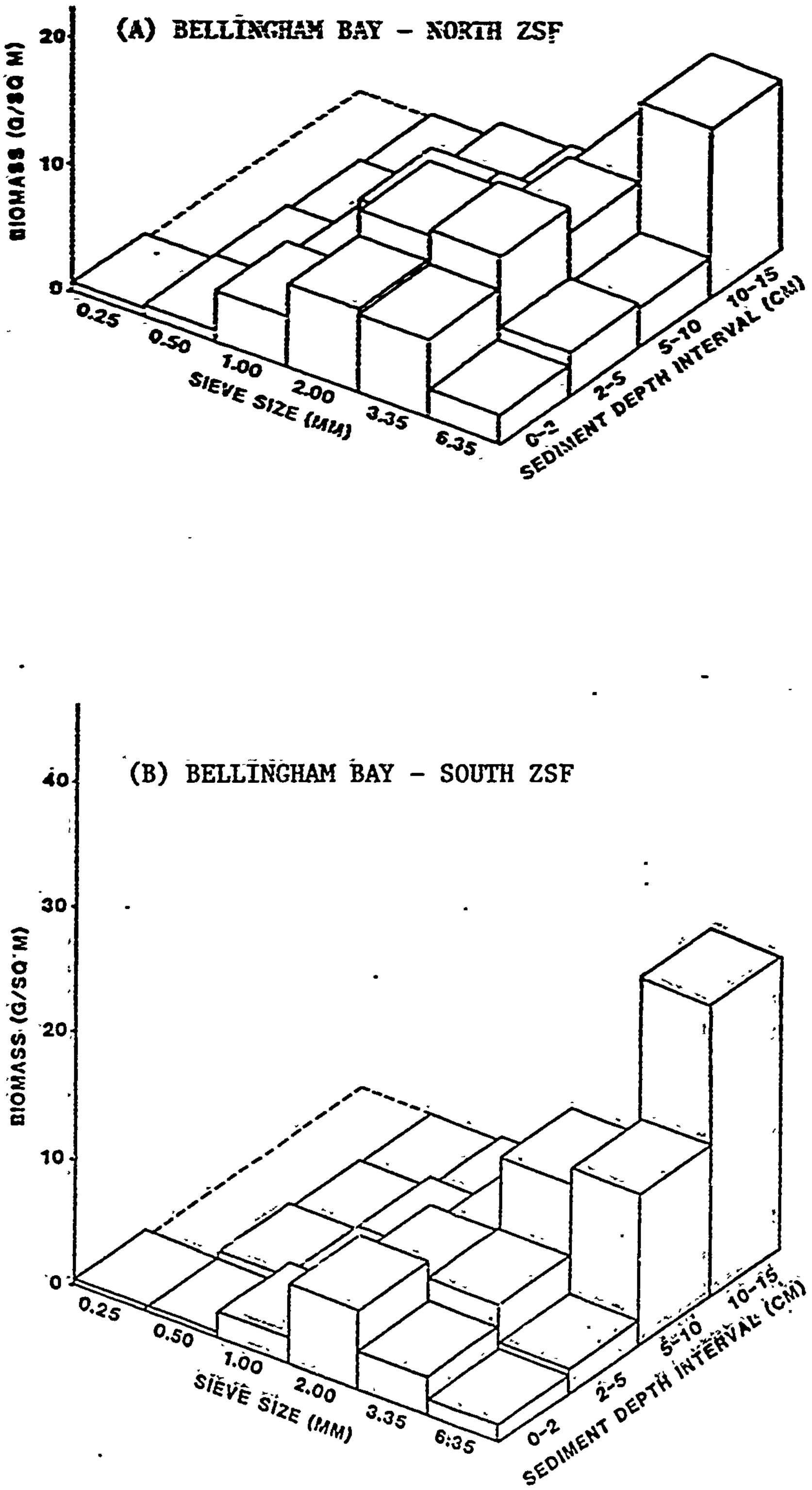


Figure 3.20 Three dimensional plot of benthic biomass across size categories and sediment depth intervals for the (A) North ZSF and, (B) South ZSF study areas. (after Clarke and Kendall, 1987)

(5) Waterbirds. The many rocks and small islands within the San Juan Archipelago provide numerous nesting opportunity for glaucous-winged gulls, cormorants, pigeon guillemots, and black oystercatchers. Tufted puffins nest at two locations: Bare Island, and Viti Rocks. The latter are just south of Lummi Island and about 6 miles from the disposal sites in Bellingham Bay. Glaucous-winged gulles and pigeon guillemots nest within th. city limits of Bellingham, as well as at Chuckanut Rock, Eliza Island, and Viti Rocks. Black oystercatchers nest at Chuckanut Rock.

During the winter, Bellingham Bay also provides habitat for many species of waterfowl, including old squaws, harlequin ducks, scoters, mallards, mergansers, scamps, and goldeneyes, as well as alcids such as common murres and rhinocerous auklets.

(6) Endangered and Threatened Species. Gray whales are considered common in north Puget Sound by Everitt, et al. (1979). Sightings in Bellingham Bay have been infrequent. Humpback whales have not been observed near Bellingham Bay for many years (Everitt, et al., 1979). No other endangered cetaceans have been observed near Bellingham Bay. Three bald eagle nests are located near Bellingham Bay. Peregrine falcons similarly can be seen every month of the year near Bellingham Bay, though seldom within the confines of the bay itself.

c. Human Environment.

(1) Social and Economic Features. The dredging areas that are expected to use the Bellingham Bay unconfined open-water disposal site include the city of Bellingham, Whatcom County, the northern portion of Skagit County and other small communities such as Point Roberts and Blaine (see table 3.6). Whatcom County had a population of 117,200 in 1987, ranking ninth in county population in the State. Population has increased by 10,500 since 1980. Population forecasts by the Washington State Office of Financial Management show the population of Whatcom County increasing to 140,400 by the year 2000. The major city in the area is Bellingham with a population of 46,400 in 1987 (ranked seventh in the state). Population for Bellingham is forecast to increase to 58,200 by 2000.

(2) Navigation Development. Bellingham Harbor has a natural deepwater approach from the south. Leading across the tideflats from this are three waterways which require Federal and port maintenance in order to provide deepwater access to marine facilities.

- Whatcom Creek Waterway, which dates back to 1910 as a Federal maintenance project, is about 1.1 miles long, and 363 feet wide from deep water, with an authorized depth of 30 feet MLLW. The innermost 750 feet segment has an authorized depth of 18 feet MLLW. Whatcom Creek Waterway has facilitated most of Bellingham's deep draft shipments in the past. Until the early 1980's a pattern of increasing shipments occurred (171,000 short tons inbound in 1980; 360,000 outbound in 1983); but in 1986, the total was only 174,200 short tons.

- I and J Street Waterway dates back to 1965. This Federal project provides for a 0.6-mile channel 100 feet wide and 18 feet deep at MLLW, from the 18 feet contour in the Bay to within 250 feet of the landward limit of the Federal pierhead line.

- Squalicum Creek Waterway was authorized in 1930, with the provision to Federally maintain a 200-foot-wide by 26-foot-deep MLLW channel, extending about 0.8 miles from deepwater to the Federal pierhead line. Both Squalicum and I and J waterways facilitate mainly seafood harvest transits with variable tonnages.

Port dredging activities also take place on all three of these waterways, in addition in the Federal maintenance. Information on dredging is given in section 3.03c(3).

In addition to the navigation maintenance in Bellingham Bay, two other waterways are expected to yield materials to be disposed at the Bellingham Bay nondispersive site.

- Fidalgo Bay's Capsante Waterway, is 2,850 feet long, 150 feet to 250 feet wide and 12 feet deep. This is in the north part of the Bay, east of Q Avenue. Additionally, a barge navigation channel is further south in the Bay and is 1 mile long, 150 feet wide, and 18 feet deep, providing passage from Guemes channel to an industrial complex.

- The Lummi Bay navigation channel is a project proposed to be completed in FY 1990, if authorized. This channel will be 7,300 feet long, 100 feet wide and 12 feet deep at MLLW. It will lead from Lummi Bay to a moorage basin and serve the moorage needs of Indian and non-Indian fishing vessels and pleasure boats.

(3) Dredging and Disposal Activity. The Bellingham area was served by two unconfined, open-water sites during the 1970 to 1985 period. These disposal sites were at Bellingham Bay and Bellingham Channel, where 766,000 and 1,147,000 c.y. were disposed respectively. This represents about 24 percent of the total material dredged in all Phase II areas during the last 15 years and about 59 percent of that disposed in unconfined open water.

For the period 1985 to 2000, three areas to be dredged in the Bellingham area are expected to yield a total of 3,077,000 c.y., which includes 1,470,000 c.y. of Lummi Bay dredged material slated for use in marina construction. Within the total, volumes of dredged material could be found suitable for disposal at the Bellingham Bay site are shown on table 3.8.

(4) Native American Treaty Fishing. The Lummi, Nooksack, and Swinomish Indians have usual and accustomed tribal fishing places in the vicinity of the Bellingham Bay proposed nondispersive disposal site. The Swinomish Tribe does not fish north of a line from Point Francis to Post Point, nor in Hale Pass. The Suquamish Tribe does not currently fish in Bellingham Bay, although it has usual and accustomed fishing sites there.

Nonsalmon Indian harvests, including shellfish and nonsalmon finfish, totaled a yearly average of 184,339 pounds over the 1985 through 1987 period. Shellfish, the dominant group, were led by little neck clams (average 46,478 pounds) and Dungeness crabs (average 118,502 pounds). Leading salmon species (within the average yearly total of 1,300, 128 pounds), in order of importance for the 1985-1987 averaged period, were: Chinook (600,533 pounds), coho (435,768 pounds) and chum (245,606 pounds).

TABLE 3.8

PROJECTED VOLUMES OF DREDGED MATERIAL
THAT COULD BE SUITABLE FOR THE
BELLINGHAM BAY DISPOSAL SITE
1985-2000 1/

Dredging Area	Volume (c.y.)
Bellingham Bay	756,000
Fidalgo Bay (including Anacortes)	384,000
Lummi Bay	41,500
TOTAL	1,181,500

Note: The Fidalgo Bay and Lummi Bay locations will each yield an additional equal volume of dredged material considered not likely to pass PSDDA guidelines for designated nondispersive disposal sites.

1/See table 2.6b for the volume currently expected to be discharged at this site over the period 1985-2000 (550,500 c.y.).

Salmon harvest management periods in reporting area 7B are as follows (WDF and Northwest Indian Fisheries Commission, 1988). Minor adjustments may occur.

Spring chinook - April 15 to July 18 (mainly near the mouth of the Nooksack River)
Fall chinook - August 2 to September 7
Pink salmon - June 30 to August 17 (odd years)
Coho - September 8 to October 26
Chum (normal) - October 27 to December 14
Steelhead are also fished in January and February.

The main Indian finfishing method in the area of the proposed Bellingham Bay disposal site is drift gill nets, although the Lummi Tribe also uses purse seines. Areas where the Swinomish Tribe concentrates its fishery for coho salmon are between Rainbow Bridge and the Burlington Northern railroad bridge in Swinomish Channel and in the southwest channel of Bellingham Bay. The Lummi Tribe's other major fishing areas are nearshore in the bay. The letter of comment from the Lummi Tribe states that significant marine resources exist at the Bellingham Bay disposal site. This conclusion is not supported by information available to the PSDDA agencies. Additional consultation has occurred with Lummi Indian Fisheries is an effort to resolve Indian concerns about the affected environment. See exhibits C (responses to Lummi Indian Business Council comment letter) and F (Indian consultation).

(5) Non-Indian Commercial and Recreation Fishing. In addition to Indian fishing Bellingham Bay supports a non-Indian commercial and a recreational fishery. Only 2.9 percent of the 1985 to 1987 annual average finfish harvest of 2,704,267 pounds was nonsalmon. This figure includes the Indian catch (see section 3.03c(4)). Catches were led by starry flounder which had 30,633 pounds total catch in 1987. The annual average shellfish harvest for the 1985 to 1987 period, including the Indian catch, amounted to 313,568 pounds. This harvest was led by Dungeness crabs, with a 200,016-pound total catch in 1987.

Total annual salmon harvests in Bellingham Bay from 1985 to 1987 averaged 2,625,843 pounds, including the Indian catch. The 1987 total harvest figures for leading species of salmon taken were: sockeye, 936,970 pounds; chinook, 768,109 pounds; and chum, 572,674 pounds.

No sport salmon harvest figures are available for Bellingham Bay (however, see Rosario discussion below, for data from the San Juan Islands).

(6) Esthetic Setting. The esthetic setting in Bellingham Bay is primarily the Bay itself, the boat traffic in the bay, the islands, and the Olympic Mountains. This setting can be viewed from the city shoreline, from bluffs overlooking the Nooksack River drainage, from the harbor industrial area, and from tall buildings in the central business district. Public access to the shoreline area includes a small city park in the southern industrial area, the city waterfront, Chuckanut Bay and Lummi Island.

3.04 North Sound - Rosario Strait (Dispersive). Figure 2.5 shows the selected and alternate disposal sites in Rosario Strait. The ZSF is located approximately 1-3/4 nautical miles south of Reef Point on Cypress Island in water approximately 230 feet deep. The channel to the northwest of the ZSF is narrow and deep, bounded on the east and west by small islands, while the channel to the east is shallow and contains several shoals. The strait is one of two major passage ways between the Strait of Georgia to the north and the Strait of Juan de Fuca to the southwest (the other is Haro Strait).

a. Physical Environment.

(1) Geology. The Skagit-Samish Basins represent the largest unit within the Puget Sound area. Within their boundaries exist numerous rivers, streams, and lakes, and a relatively large and busy reach which includs several large islands. The boundaries encompass the Skagit River, the moderate-sized Samish River system, and several smaller independent drainages including various sloughs. Nonstream freshwater areas comprise 450 lakes and reservoirs of a total 25,160 acres and 46 farm ponds of 23 acres. The impact of glaciation in the Rosario Strait area was described in section 3.01a(1). Ice at this location is believed to have reached a maximum thickness of approximately 4,250 feet.

(2) Water Quality. Water quality in the area is classified as Class A according to 1984 Washington State Department of Ecology standards. At

present time however, Rosario Strait is closed to shellfish harvesting due to PSP levels that have been found in some shellfish. The highly dynamic tidal currents in this area assure well mixed waters and relatively good water quality. Data from north of Protection Island, near the southern end of Rosario Strait, show salinites ranging between 30 and 32 ppt, throughout the year. Some reduction in salinity can be expected further north, in Rosario Strait proper, due to the influence of the Nooksack and the Skagit Rivers. The Skagit's discharge (annual average 16,670 c.f.s.) (EPA 1983) peaks in late spring, and lowers salinities near Deception Pass in particular. Temperatures in these well-mixed waters range from about 6.5 degrees C (bottom) to about 11 degrees C in a seasonally warmed thin upper layer. Dissolved oxygen concentrations range from about 9 mg/l (surface) to about 4 mg/l (bottom) (Collias, et al., 1974).

Rosario Strait is remote from point source discharges. The well-mixed waters dilute and disperse any contaminants borne westward from Bellingham Bay or through Deception Pass. In May 1980, dissolved cadmium measured 0.067 ppb, dissolved nickel was 0.25 ppb, and dissolved copper was 0.22 ppb, in this area (A. J. Paulson, personal communication). Prohibitions on butter clam harvesting due to red tide contamination frequently occur seasonally in this area.

(3) Currents and Sediment Transport. Field data from within and adjacent to the ZSF indicate that mean speeds between 36 and 69 cm per second occur in all the surrounding channels. A mean speed of 51 cm/sec was measured on the southeast edge of the ZSF. Peak speeds in the neighborhood of 100 cm/sec during nearly all tidal exchanges, and a single layer net flow southward toward the inner Strait of Juan de Fuca is evident.

(4) Marine and Estuarine Sediments. Roberts' (1979) surface sediment charts are the only source of data for the area. These charts indicate large expanses of gravel and gravelly sand in the east and northwestern corners, respectively, of the proposed disposal site. The nearest sampling station for which sediment data are available was about 3 miles northeast of this site. This 1929 sample was described as "coarse fraction cobble, shell fragments, little coarse sand" (Shelford, et al., 1935). These data are consistent with a highly dynamic marine environment, which disperses finer materials and moves coarser materials.

Analysis of HPAHs in sediments from a sampling station in the eastern part of the proposed disposal site yielded a result of 72 ppb (Barrick and Prahl, 1987). Concentrations of other chemicals of concern near the site are not available.

(5) Air Quality. The Northwest Air Pollution Control Authority (NWAPCA) has jurisdiction over Rosario Straits air quality. NWAPCA administers and enforces air pollution control standards and regulations and is reponsible for implementing the requirements of the State of Washington and Federal Clean Air Acts. Air quality in the area is considered to be good. The area is considered attains applicable standards for primary pollutants

(carbon monoxide (CO), suspended particulates, and sulphur dioxide), except for occasional violations of sulfur dioxide levels recorded at the March Point Station (NWAPCA, 1988).

b. Biological Environment.

(1) Benthic Communities.

(a) Nearshore Intertidal/Shallow Subtidal Habitats. Rocky Bottom Habitats: This discussion is taken from "The Biological Sampling Program of Intertidal Habitats of Northern Puget Sound" by Smith and Webber (1978) and from the FEIS for Ship Harbor Marina (City of Anacortes, 1984). These two documents describe the intertidal/shallow subtidal communities of Fidalgo Head, Shannon Point, and Ship Harbor, and are considered representative of shorelines of the islands surrounding the two alternative sites in the Rosario Strait. See figure 3.21.

The communities described for Fidalgo Head are located on rocky substrates and common macroalgae are Laminaria and Nereocystis sp. Smith and Webber (1978) found 198 species of which 122 were invertebrates and 76 were algal species. Of the invertebrates, crustaceans accounted for 39 species, mollusks accounted for 38 species, and polychaetes comprised 34 species. Of the crustacean species, 11 were decapods, 10 were isopods, and 7 were barnacles (Cirripedia). The mollusks were heavily dominated by gastropods, with 27 species. The bivalves consisted of 4 species, and the remainder, mainly chitons comprised 7 species. Barnacle biomass constituted over 95 percent of the total invertebrate biomass from -1 foot (MLLW) to +4 feet (MLLW). The largest and most abundant was Balanus cariosus (rock barnacle). Gastropods were composed almost entirely of limpets and marine snails, reaching a maximum abundance near +1 foot (MLLW).

Decapods were the next largest group described by Smith and Webber (1978) in terms of biomass, and were composed principally of two genus of crabs. Pugettia gracilis (decorator crab) was abundant within the algae rich lower beach up to +2.5 feet (MLLW). The hermit crab, Pagurus sp. was found in variable densities over the entire beach from -1 foot to +7 feet (MLLW), and was most abundant near +3 feet (MLLW).

Isopods exhibited a narrow range of abundance with maximum densities at about +2 feet (MLLW). The most widely distributed was Idotea wosnesenskii. Amphipods were found throughout all elevations of low and mid-beach with maximum density at about +1 foot (MLLW).

Bivalves were dominated by Mytilus edulis and three species of polychaetes were considered common (Nereis sp. and Syllis sp.) with maximum densities near +1 foot (MLLW).

Macroalgae were found in maximum quantities within the lowest elevation sampled (-2 feet (MLLW)). Three species of green algae were predominant, Ulva lactuca, Monostroma sp., and Enteromorpha linza. Brown algae were dominated by rockweed (Fucus distichus), Hedophylum sessile, and Alaria sp. Red algae were dominated by Gigartina sp. and Rhodomela larix.

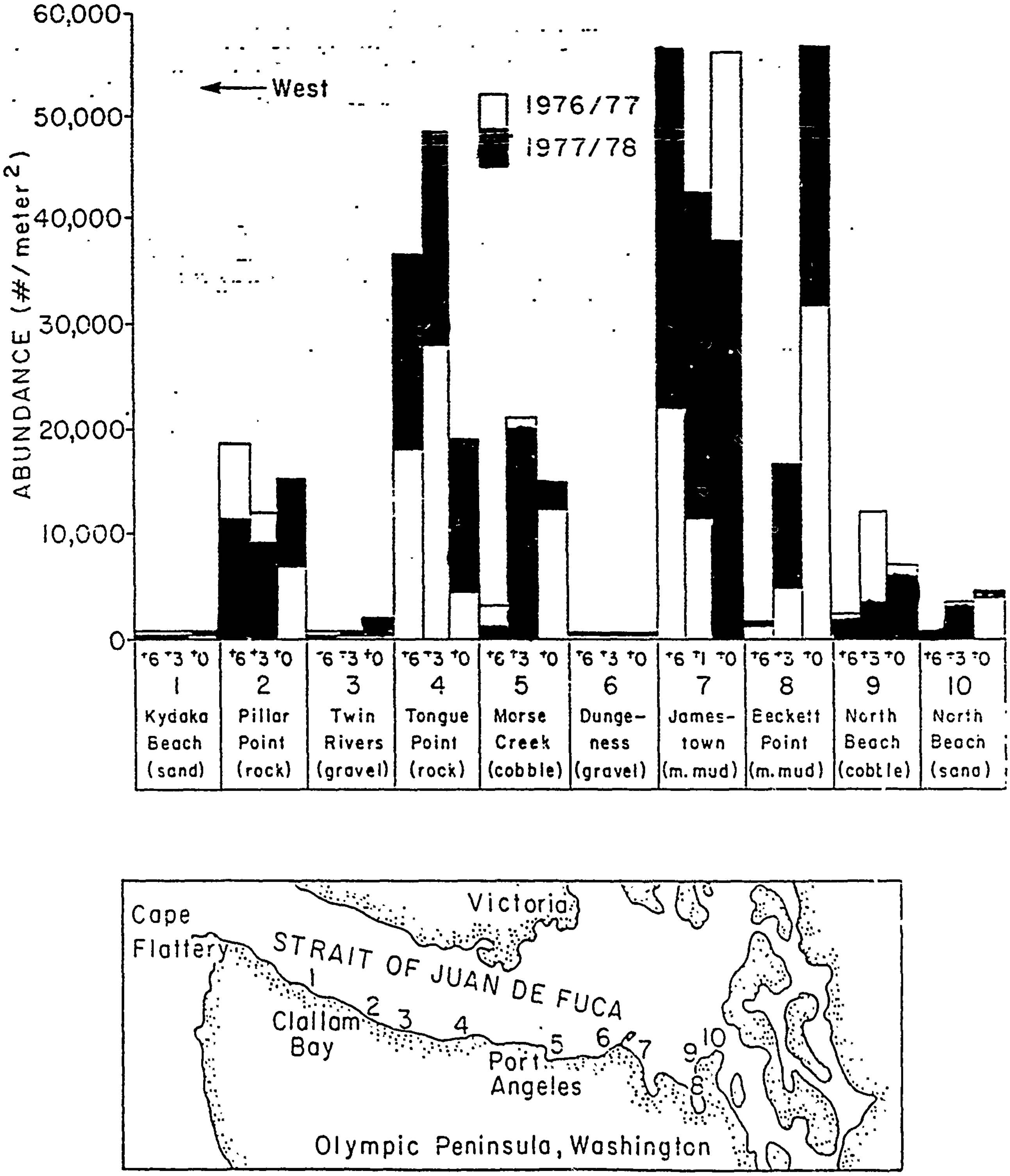


Figure 3.21 Average abundance of intertidal organisms collected at three tidal elevations (+6, +3, +0 feet) at 10 sites (after Nyblade, 1979).

Sand/Mud Bottom Habitats: Intertidal habitats at Ship Harbor are characterized by a high diversity of invertebrates typical of similar beaches in the area. Distinct zonations or subhabitats observed are discussed below.

Very few organisms were found in the supralittoral fringe. Mites and amphipods were most common in this zone. The upper midlittoral zone extends from +4 feet to +7 feet (MLLW) and dominant inhabitants were the barnacle (Balanus glandula), the snail, Littorina sitkeana, and the isopod Gnorimosphaeroma oregonenes. Littorina scutullae (snail) and Transenella tantilla (small clam) were restricted to the lower midlittoral zone (+4 feet to 0.0 feet (MLLW). The infralittoral fringe (0.0 feet to -3.5 feet (MLLW) was dominated by the clams, Macoma baltica, M. inquinata, and Transenella tantilla. ... small snail Lacuna variegata resided in eelgrass beds located in the upper portion of this zone.

Infauna described for the lower intertidal and shallow subtidal zones were the Dungeness crab (Cancer productus), Thais lamellosa (snail), large anemone (Metridium senile), small anemone (Epiactis prolifera), six rayed starfish (Leptasterias hexactis), and small crabs such as Pugettia gracilis, which were attached to the eelgrass blades.

Pebble/Gravel Habitats: Pebble/gravel habitats such as found on Guemes Island (Guemes Channel) are dominated by crustaceans and polychaetes. Isopods were dominated by Exosphaeroma media between elevations 2.5 feet and 4.0 feet (MLLW). Fifteen species of polychaetes were found including Armandia brevis and Nereis sp. Barnacles were the next most abundant taxa found in terms of biomass, Balanus glandula, and B. crenatus. Gastropods were the dominant mollusks, but only one Lacuna sp. was found on a regular basis. Bivalves were represented by Mytilus edulis in the middle intertidal and Macoma sp. in the lower intertidal zone. Amphipods, while abundant numerically, showed low biomass, with highest numbers found in detritus and moist sediment just above the water's edge. Decapods were generally rare due to lack of protective cover.

Macroalgae were generally rare with only three species being represented in the intertidal zone, Entermorpha linza, Ulva sp., and Gigartina sp., and were principally found attached to pebbles in the low to midlittoral zones.

(b) Invertebrate Resources-Preferred Site and Alternate Sites (Rosario Strait). Natural resource investigations were conducted during April and October 1987 by the University of Washington Fisheries Research Institute on and around the Rosario Strait Zone of Siting Feasibility (ZSF) (Dinnel, et al., 1988). These investigations were necessarily conducted with a rock dredge due to the swift currents and extremelly coarse sediments ranging from gravel/cobble to rock bottom. These studies indicated that the resources were relatively impoverished. Dungeness and rock crabs were completely absent during both seasons. Only small numbers of pandalid shrimp, mostly P. danae were collected at each station (figure 3.22). Pink scallops, sea urchins (Strongylocentrotus pallidus), and mussels (Modiolus sp.) were fairly common in samples collected at the southern end of Rosario Straits, well removed from the ZSF (figure 3.22).

(2) Plankton Communities. Phytoplankton and zooplankton communities are generally ubiquitous throughout Puget Sound but exhibit tremendous spatial and temporal variations in species composition and abundances. The reader is referred to section 3.01b(2) for a general discussion of bloom periods and taxonomic/species succession.

(3) Anadromous and Marine Fishes.

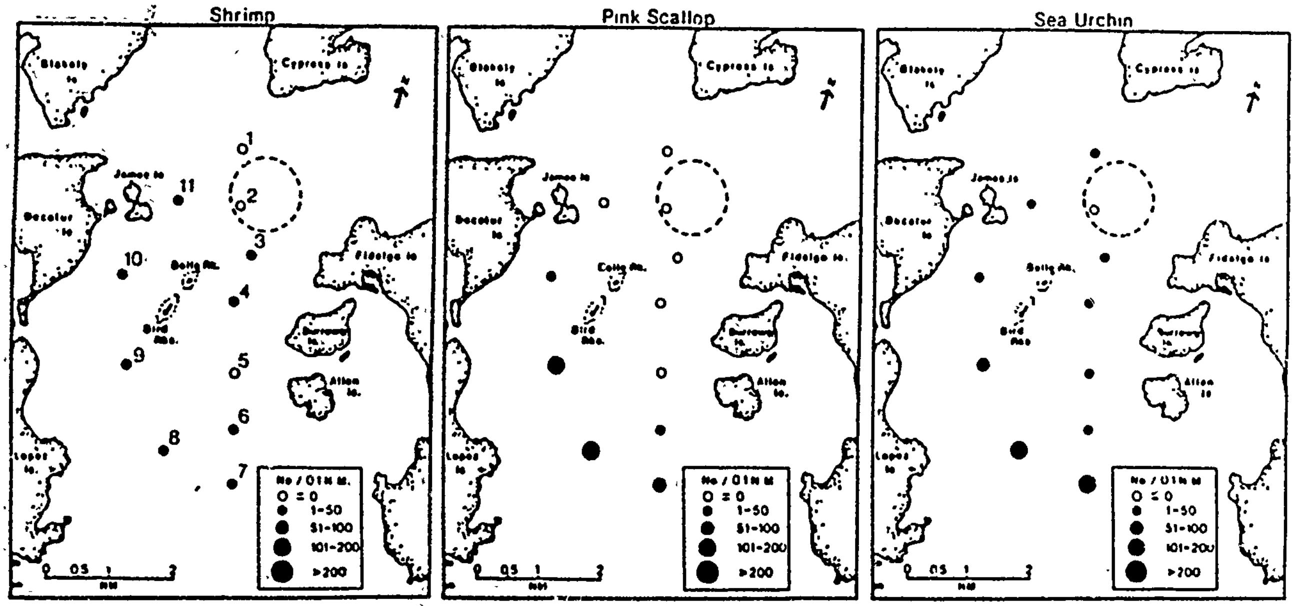
(a) Anadromous Fish Resources. The Rosario Strait ZSF is located near the Skagit-Samish River basins, which support important runs of salmon and trout. Figure 3.23 depicts the timing of salmon and searun trout freshwater life phases in the Skagit-Samish Basins. All five Pacific salmon species utilize the various drainages in this region. These include spring and fall races of chinook, coho, pink, chum, and sockeye salmon. Also, each of the anadromous gamefish occurs here, including summer and winter steelhead trout, cutthroat trout, and searun Dolly Varden char. Inventory and distribution of all species life histories are delineated in detail in the comprehensive study of water and related land resources report (Pacific Northwest River Basins Commission, 1970). In general, all salmon species except spring chinook exhibit adult upstream migrations in the period between late summer and late fall, and juvenile outmigrations between late winter and late spring. Spring chinook adults exhibit upstream migrations from mid-April to late July.

Juveniles outmigrate during late spring. For steelhead trout, summer steelhead adults inmigrate from mid-April to mid-October, while the winter adults inmigrate between November and June. Juveniles of both races outmigrate in late spring. Adult upstream migration of searun cutthrout and searun Dolly Varden char occur between June and January. Juvenile outmigration occurs between mid-March and early July.

(b) Marine Fish/Bottomfish Resources. The selected and alternative sites are located away from important marine fish resources, including surf smelt spawning beaches, Pacific herring spawning and holding areas, and groundfish resource and fishing areas in the Rosario Strait (Pay, et al., 1987). Neritic schooling fishes utilize the general area where the alternative sites are located. These include juvenile Pacific herring, Pacific sand lance, northern anchovy, surf smelt, and longfin smelt. Some of these species are present for only part of their life history in the region. As in the case of Pacific herring, which occupy neritic waters for their first year, then migrate toward the ocean (Simenstad, et al., 1979).

Bottomfish investigations were limited during disposal site selection studies, due to the rocky natural of the bottom, thereby preventing the use of beam and otter trawls, and necessitating the use of a rock dredge. The rock dredge is not an efficient sampler for fishes. Dominant species collected are not necessarily representative of bottom fish in the area. The dominant species collected in April was the ringtail snailfish, with incidental catches of Dover sole, Pacific sandlance, northern sculpin, marbled snailfish, slipskin snailfish, and the smooth alligatorfish. The October collections consisted entirely of Pacific sandlance.

ROSARIO STRAIT - APRIL 1987



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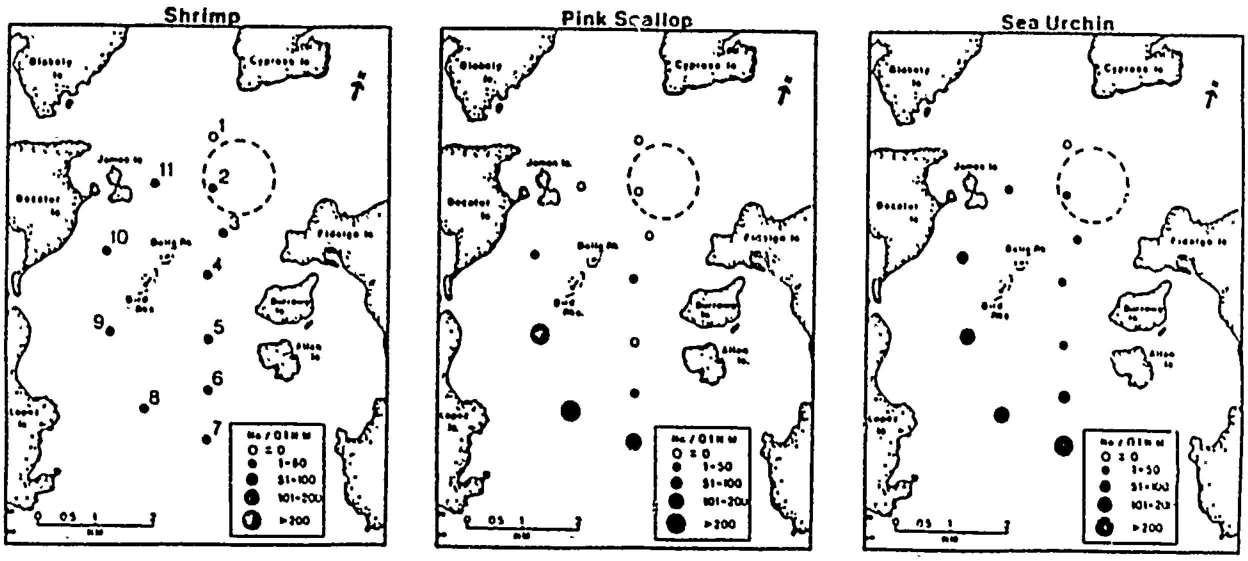
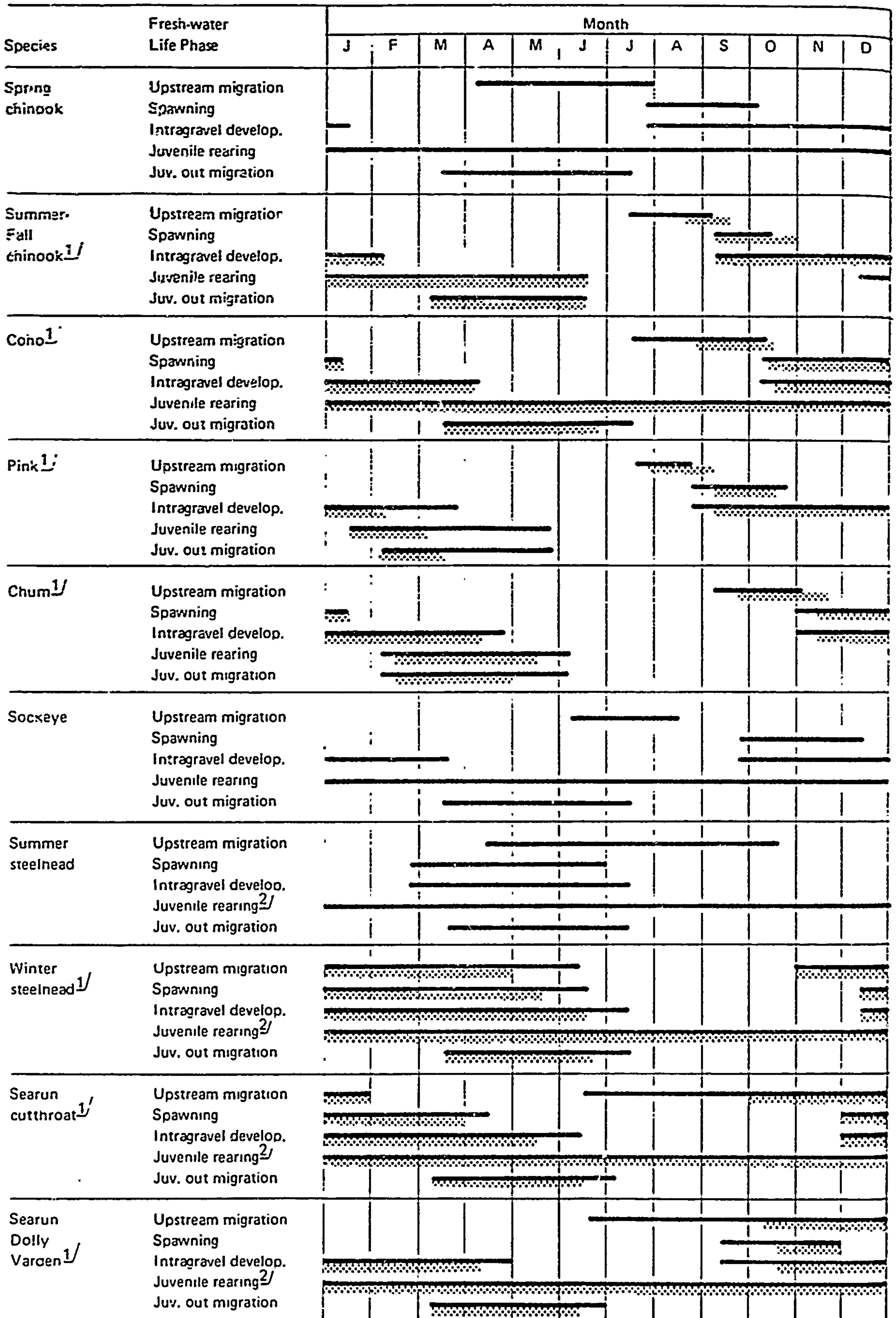


Figure 3.22 Maps of Rosario Strait showing the number of commercial pandalid shrimp, pink scallops and sea urchins caught per 0.1 nautical mile (N.M.) by the rock dredge in April and October 1987. (after Dinnel et al., 1988)

Figure 3.23 Timing of salmon and searun trout fresh-water life phases in Skagit-Samish Basins



1/ Symbol ░░░ indicates Samish River segment for this species, symbol ▬▬ indicates Skagit River segment.

2/ Normally extends over a two-year period.

(4) Marine Mammals. Of all the Phase II disposal sites, the Rosario strait sites host the largest variety and number of marine mammals. In addition, four pods of killer whales may be seen in the vicinity of the San Juan Islands (Everitt, et al., 1979). Harbor seals have major nursery and haul-out areas at Williamson Rocks, Bird Rocks, Peapod Rocks, Pointer Island, and Allan Island (Everitt, et al., 1979). Northern sea lions have haul-out areas on Sucia Island and Long Island (off southwest corner of Lopez Island), according to the Puget Sound Environmental Atlas (Day et al., 1987). California sea lions have been observed on Sucia Island in the northern San Juan Islands (Puget Sound Environmental Atlas, 1987). A fair number of minke whale sightings are recorded from all the waters surrounding and within the San Juan archipelago, though sightings from Rosario Strait are infrequent. Harbor porpoise, Dall's porpoise and river otter are all regularly observed in Rosario Strait. According to Everitt, et al. (1979), Rosario Strait appears to be an important area for harbor porpoise throughout the year. This species favors protected waters, while the Dall's porpoise seems to prefer offshore waters.

(5) Waterbirds. Generally, the north sound is far more productive (i.e., there are many more breeding colonies and larger populations) for waterbirds than south sound. The major colonies occur at Protection Island, Smith and Minor Islands, Williamson and Bird Rocks, Colville Island, Puffin Island, Sister Islands, and Viti Rocks. The most widespread breeding birds at these colonies are (usually) glaucous-winged gulls. Pelagic cormorants are the next most numerous, widespread breeding bird (Varoujean, undated; Day et al., 1987). During a study in 1978 and 1979, 1,700 nesting pairs of seabirds were counted in the Roaario Strait Area (Wahl, et al., 1981). Glaucous-winged gulls comprised about 75 percent of this number.

(6) Endangered and Threatened Species. Although gray whales have been sighted virtually throughout Puget Sound, sightings in the San Juans and Rosario Strait are conspicuously absent (Everitt, et al., 1979). No other endangered cetaceans have been observed near Rosario Strait in recent years. Peregrine falcons and bald eagles are both present throughout the year in the vicinity of Rosario Strait. The abundance of seabird colonies in spring and summer, as well as wintering waterfowl, provide a consistent and reliable source of prey through most of the year. Five bald eagle nests are located within a few miles of both disposal sites.

c. Human Environment.

(1) Social and Economic Features. The dredging areas that will use the Rosario Strait unconfined, open-water disposal site include the city of Anacortes, San Juan County and part of Island County and Skagit County and other small communities such as Friday Harbor, Orcas and Shaw (see section (2)). San Juan County had a population of 9,200 in 1987, and ranked 33rd in the state. Population has increased by 1,362 since 1980 due to increases in second homes and tourism supporting the local economy. Population forecasts by the Washington State Office of Financial Management show the population of San Juan County remaining relatively stable increasing to only 9,990 by the year 2000. Anacortes is the largest community in the area with a 1987 population of 10,160 (38th in the State).

(2) Navigation Development. Swinomish Channel, a natural waterway connecting Skagit Bay and Padilla Bay requires dredging, with the material destined for disposal at Rosario Strait. Part of this dredging will be accomplished through an existing Federal project, and part through a Port of Skagit project and through other agencies. Swinomish Channel is dredged to maintain a navigable length of 11 miles, with a of width of 100 feet and depth of 12 feet. Some parts of the channel remain naturally deep enough for navigation so will not be dredged. The waterway has a comparatively shallow draft at MLLW. Usage includes approxmately 10,000 to 12,000 small, primarily recreational, boats per year (J. Blanchard, Port of Skagit, personal communication, September 1988).

(3) Dredging and Disposal Activity. Dredged material from the Rosario Strait service area was disposed at the Padilla Bay and Skagit Bay DNR unconfined, open-water sites during the 1970 to 1985 period. Volumes of 133,000 c.y. and 173,000 c.y. were disposed at these sites respectively. The total of these volumes represents about 9 percent of the dredged material discharged at Phase II area unconfined open-water sites (see table 3.9) over this same period.

For the period 1985 to 2000, four areas are to be dredged in the Rosario Strait area. Table 3.9 shows volumes of material that could be found suitable for disposal at the Rosario Strait site.

TABLE 3.9

PROJECTED VOLUMES OF DREDGED MATERIAL
THAT COULD BE SUITABLE FOR THE
ROSARIO STRAIT DISPOSAL SITE
1985-2000 1/

Dredging Area	Volume (c.y.)
Swinomish Channel (including Skagit Bay)	1,179,000
Blaine	350,000
San Juan Islands	165,000
Whidbey Island	107,000
TOTAL	1,801,000

All this material is expected to meet PSDDA guidelines for disposal at the proposed Phase II Rosario Strait dispersive site.

1/See table 2.7c for the volume currently expected to be discharged at this site over the period 1985-2000 (1,315,000 c.y.).

Salmon catches make up over 99 percent of the total Indian harvest in this area, and averaged 8,442,336 pounds per year over the 1985-1987 period. The leading species was sockeye, with an annual average yield of 4,661,512 pounds. Chum salmon averaged 215,833 pounds, and coho averaged 231,714 pounds. Pink salmon average catch for the period was 5,231,305 pounds.

Salmon harvest management periods in Reporting Area 7 are as follows, as stated (1988) by the Washington Department of Fisheries and the Northwest Indian Fisheries Commission. Minor modifications may occur.

Spring chinook - April 15 to June 15
Fall chinook - June 16 to September 6
Pink (odd years) - August 22 to September 13
Coho - September 1 to October 12 (short run allocation to Swinomish Tribe)
Chum (normal/late) - October 1 to December 17
Sockeye (two runs) - June 5 to October 1

Indian fishing methods used in areas near the selected Rosario Strait disposal site include gill nets and purse seines. The Swinomish Tribe, for example, operates purse seines near the San Juan Islands in the vicinity of promontories. The Suquamish fish extensively from July 15 to August 30, more sporadically thereafter until November 15; Indian gill netters for sockeye concentrate in the western part of Rosario Strait. Coho are fished in offshore waters and chum in more nearshore waters.

(4) Native American Treaty Fishing - Rosario Strait. A total of eight Indian tribes have usual and accustomed fishing places in the vicinity of the Rosario Strait dispersive disposal site. Of these, the Lummi and Swinomish Tribes are the most active due to proximity. Other tribes having fishing rights in the area are the Jamestown, Lower Elwha, and Port Gamble Klallam Tribes, the Nooksack Tribe, the Suquamish Tribe and the Tulalip Tribe.

Catch statistics for Native American fishing are available from the WDF's San Juan Islands reporting area, and this encompasses Rosario Strait. For the 1985-1987 period, the average yearly shellfish and nonsalmon finfish catch total was only 2,149 pounds. Dogfish is the largest single item in this group.

(5) Non-Indian Commercial and Recreational Fishing. The Rosario Strait area supports a non-Indian commercial and a recreational fishery, in addition to Indian fishing. Of the total finfish harvest reported for the surrounding San Juan Islands area, only 2.9 percent of the 1985 to 1987 annual average of 16,964,751 pounds was nonsalmon. This figure, which includes the Indian catch (see section 3.04c(4)), was led by rock sole and dogfish, with total 1987 catches of 977,977 and 165,466 pounds respectively. The rock sole harvest reflects a boom year and skews the 3-year nonsalmon average catch figure upwards.

The annual shellfish harvest including the Indian catch, from the same San Juan Islands reporting area for the 1985 to 1987 period averaged 565,226 pounds. The 1987 harvest was led by sea urchins and sea cucumbers at a combined catch of 1,204,176 pounds. This "boom" harvest figure significantly increases the overall shellfish 3-year average.

Annual salmon harvests for the San Juan Islands reporting area from 1985 to 1987 averaged 16,472,773 pounds, including the 1987 Indian harvest figures for sockeye and pink at 6,897,455 and 4,927,905 pounds, respectively. (Pink salmon catch is the "odd year" run figure.)

The 1986 sport catch of chinook, coho, and sockeye salmon for the San Juan Islands area was reported as 27,550 fish (Washington Department of Fisheries, 1986).

(6) Esthetic Setting. The esthetic setting is Rosario Strait and Guemes Channel, including seabirds, marine mammals, and a wide variety of ship/boat traffic (recreational and some commercial including fishing), Anacortes, Whidbey, Lopez and other small Islands. The principal views of this setting are from islands contiguous to the site. Public accesses are from the city of Anacortes, and Blakeley, Decatur and Lopez Islands.

3.05 North Sound: Port Angeles (Dispersive).

a. Physical Environment.

(1) Geology. Figure 2.7 shows the selected and alternative disposal sites in the Port Angeles area. The ZSF is located approximately 4 miles north of Port Angeles in water approximately 435 feet deep. The bathymetry of the area shows a gradual sloping bottom from midchannel to the southern shoreline. Just to the west of the ZSF is a sill stretching from a point west of Port Angeles to Vancouver Island. This feature helps restrict flow of sediments in the Puget Sound. The impact of glaciation in the Port Angeles area was similar to that occuring at the other sites in the Puget Sound. Refer to section 3.01a(1) for further details on glaciation. Ice during the Pleistocene period is believed to have reached a thickness of 3,950 to 4,250 feet in Strait of Juan de Fuca (Burns, 1985). The region has been glaciated several times in the past and, as a result, much of the bedrock is buried by thick glacial and interglacial deposits, mantled by a variable thickness of recent marine sediments (Northern Tier Pipeline EIS, 1980).

(2) Water Quality. Water quality in the area is Class A according to 1984 Washington State Department of Ecology standards. The Port Angeles area is strongly influenced by the powerful flushing which takes place in the Strait of Juan de Fuca. Compared to the strong tidal currents, the 1,506 c.f.s. average annual river discharge from the Elwha River to the west is relatively insignificant. Similarly, other rivers along the south side of the strait in this area seldom cause salinities to fall below 30 ppt at the surface. Temperatures exhibit a relatively small range, from about 6.5 degrees C (bottom) to as much as 11 degrees or 12 degrees C at the surface, in the autumn. Dissolved oxygen concentrations range from about 8 mg/l (surface) to about 4.5 mg (bottom) (Collias, et al., 1974).

Three major point source discharges are located in the Port Angeles harbor area, and a large Japanese-financed lumbering operation is slated there for the future. ITT Rayonier releases a total 16,200 million gallons per year of pulp wastes from two local outfalls, including 15 million pounds of suspended solids per year. Strong currents disperse these and eroding shoreline materials.

Port Angeles has a Combined Sewer Overflow system which produces elevated bacteria levels during certain weather events. However, the dispersive capabilities of the marine waters (especially outside the city's harbor) should normally preclude contamination of shellfish. Measurements of the surface microlayer were taken in 1985 from within Port Angeles Harbor. Results indicated total metals present at 471 mg/l, with lead (314 mg/l) and zinc (141 mg/l), and total aromatics at 591 mg/l (Hardy et al., 1987). In May 1980, at an open-water station in the Strait of Juan de Fuca about 20 nautical miles west of Port Angeles, dissolved cadmium measured 0.089 ppb, dissolved nickel was 0.66 ppb, and dissolved copper was 0.28 ppb (Paulson and Feely, 1985).

(3) <u>Currents and Sediment Transport</u>. Although no tidal current data have been collected within the ZSF, numerous current meter stations surrounding it and Crean's (1983) numerical model results indicate mean speeds for the ZSF are between 30 and 50 cm/sec. There is a two-layered flow, seaward near the surface and landward in the lower depths. The division between these two layers is not well defined, but is probably located at a depth of between 30 to 50 meters. The spring ebb and neap flood tidal currents are estimated to have peak speeds of about 125 cm/sec. The spring flood has an estimated peak speed of about 100 cm/sec. and the neap ebb has a peak speed of about 65 cm/sec. The ebb tides flow westerly and the flood tides flow easterly.

(4) <u>Marine and Estuarine Sediments</u>. Few data are available on the sediments in and around the selected Port Angeles disposal site. Roberts' (1979) indicates that sediments are mostly sands to the south of the site. Granulometric data from a 1966 sampling station 113 meters deep, about 2 miles to the southwest of the site, were listed as: 70 percent sand, 18 percent silt, and 12 percent clay (IOUBC, 1966). The location in the Strait of Juan de Fuca is consistent with high energy marine currents and coarser materials.

The nearest location to the selected Port Angeles disposal site for which sediment chemistry analyses are available is a station directly south of the tip of Ediz Hook. It is not clear that the sediment contents in this more protected area those at the site; however, arsenic was listed at 10 ppm, mercury at 0.051 ppm, and TOC at 47 ppt (Crecelius, et al., 1975). Concentrations of other chemical substancea in or near the site are not available.

(5) <u>Air Quality</u>. The Olympic Air Pollution Control Authority (OAPCA) has jurisdiction over Port Angeles air quality. OAPCA administers and enforces air pollution control standards and regulations and is reponsible for

implementing the requirements of the State of Washington and Federal Clean Air Acts. Two measurement stations are located in the Port Angeles area. Pollution from the Port Angeles area tends to disperse from the area moving along the shoreline. In general, the area is in attainment for Federal and State standards with occasional violations of the daily State standard for total suspended particulates and sulfur dioxide.

In 1987, the State standard for total suspended particulates was exceeded on 1 day. In 1986, the standard was exceeded for 2 days and in 1985, 1 day. State standards for sulfur dioxide were exceeded three times in 1986 and once in 1985.

b. Biological Environment.

(1) Benthic Communities.

(a) Nearshore Intertidal/Shallow Subtidal Habitats. The following description is based on a 2-year study by Nyblade (1979) and from a summary assessment by Kopenski and Long (1981), the former pertaining to intertidal and shallow subtidal benthos along the Strait of Juan de Fuca (from 3.23), the latter a general synopsis of the nearshore environment in northern Puget Sound and the Strait of Juan de Fuca.

Exposed intertidal sand and gravel habitats containe relatively sparse, simple, low-diversity communities dominated by worms and small crustacea. Protected soft-sediment habitats exhibited dense, very diverse infaunal communities dominated by a vast array of polychaete species, small and large bivalves, and small and large crustaceans. Cobble and rock areas contained the richest communities with the largest standing crop biomass. Cobble and rock communities were dominated by macro-algae, herbivorous gastropods, barnacles, mussels, large and small crustaceans. Subtidal rock areas were equally rich. Communities there contained a large variety of algae, gastropods, small crustaceans, and the dominant algal grazers, sea urchins. Subtidal soft sediment areas were also species rich, but standing crop was much lower. Communities in these areas contained literally hundreds of species of polychaetes including a wide variety of small bivalves and crustaceans.

Over 1,000 different plant and animal species were collected during the study. The biota observed along the strait were generally more diverse and dense, especially on rock, than those found in the San Juan Islands, and roughly equivalent to those found in the Anacortes-Bellingham area. Very few organisms found on rock were found in mixed-mud or other unconsolidated beaches. Cobble beaches exhibited a mixture of species indigenous to both rock and unconsolidated habitat types. Species richness values ranged from a high of 177 (Tongue Point +0 feet (MLLW)) to a low of 1 (Dungeness Spit +6 feet (MLLW)) See figure 3.23. Numbers of species were usually highest at locations with rocky habitat, followed by cobble, mixed mud, sand, and gravel habitats. Densities ranged from a high of 56,874/m^2 Jamestown +6 feet (MLLW)) to a low of 44/m^2 (Twin Rivers +6 feet (MLLW)). Densities were highest at lower tidal elevations and usually lowest on sand and gravel beaches. Figure 3.23 shows the spatial abundances observed along the Strait of Juan de Fuca at three tidal elevations. Biomass ranged from a high of 11,375 g/m^2 (Pillar Point +0 feet (MLLW) to a low of less than 2 g/m^2 (Dungeness +6 feet (MLLW). High biomass areas were generally associated with rocky habitats where large organisms generally dominated the weight of biota present. Strong vertical zonations were observed at all but the most exposed gravel and sand habitats.

Benthic community density, species richness and biomass were generally higher in spring and summer than in fall and winter. Microscale variations in habitat type, wave exposure, shoreline slope, water quality, and other environmental factors also contributed to seasonal variations observed in the kinda and abundances of biota.

Subtidal benthic organisms were generally more abundant in by mixed-mud habitats than in other areas. Gravel habitats generally exhibited the lowest abundances. Numbers of species were roughly equivalent in all areas, generally showing a small increase from west to east along the strait. Biomass also generally increased in an eastward direction along the Strait, except where a highly productive, rocky habitat was exhibited. Little seasonal or annual variability in communities was found during the 2-year study. Mean species richness, diversity, and community similarity gave little evidence of seasonal or annual changes.

(b) Invertebrate Resources - Selected and Alternate Sites. Natural resource investigations were conducted during April and October 1987 by the University of Washington Fisheries Research Institute in and around the Port Angeles ZSF. These investigations were restricted to studies conducted with a beam trawl and an otter trawl. No benthic infaunal investigations were cond·-ted on site and observations discussed here will be restricted to major epifaunal species found during these limited studies, augmented with data from other investigations in the general area. Figure 3.24 depicts commercially important distributions of pandalid shrimp, pink scallops, and sea urchins during the two seasons investigated in the Port Angeles study area. An important finding of these investigation was that no crabs were caught in the Port Angeles ZSF. A few pandalid shrimp were caught in the April trawls. The average density was 53 shrimp/hectare (ha); the majority (about 90 percent) were Pandalus borealis. However, catches in October increased by more than two orders of magnitude due entirely to settlement of young-of-the-year P. borealis (8 to 9 millimeters carapace length). Average density approximated 6,775 shrimp/ha. Unlike Port Townsend, no P. danae were caught in the Port Angeles ZSF. Other species caught were P. dispar and P goniurus, both in low numbers.

Distribution of shrimp during April was generally uniformly low at all stations. October shrimp distributions however, were not evenly distributed throughout the ZSF, with about 94 percent of the catch coming from three stations. At these three stations, shrimp densities ranged from 26,462/ha to 68,927/ha.

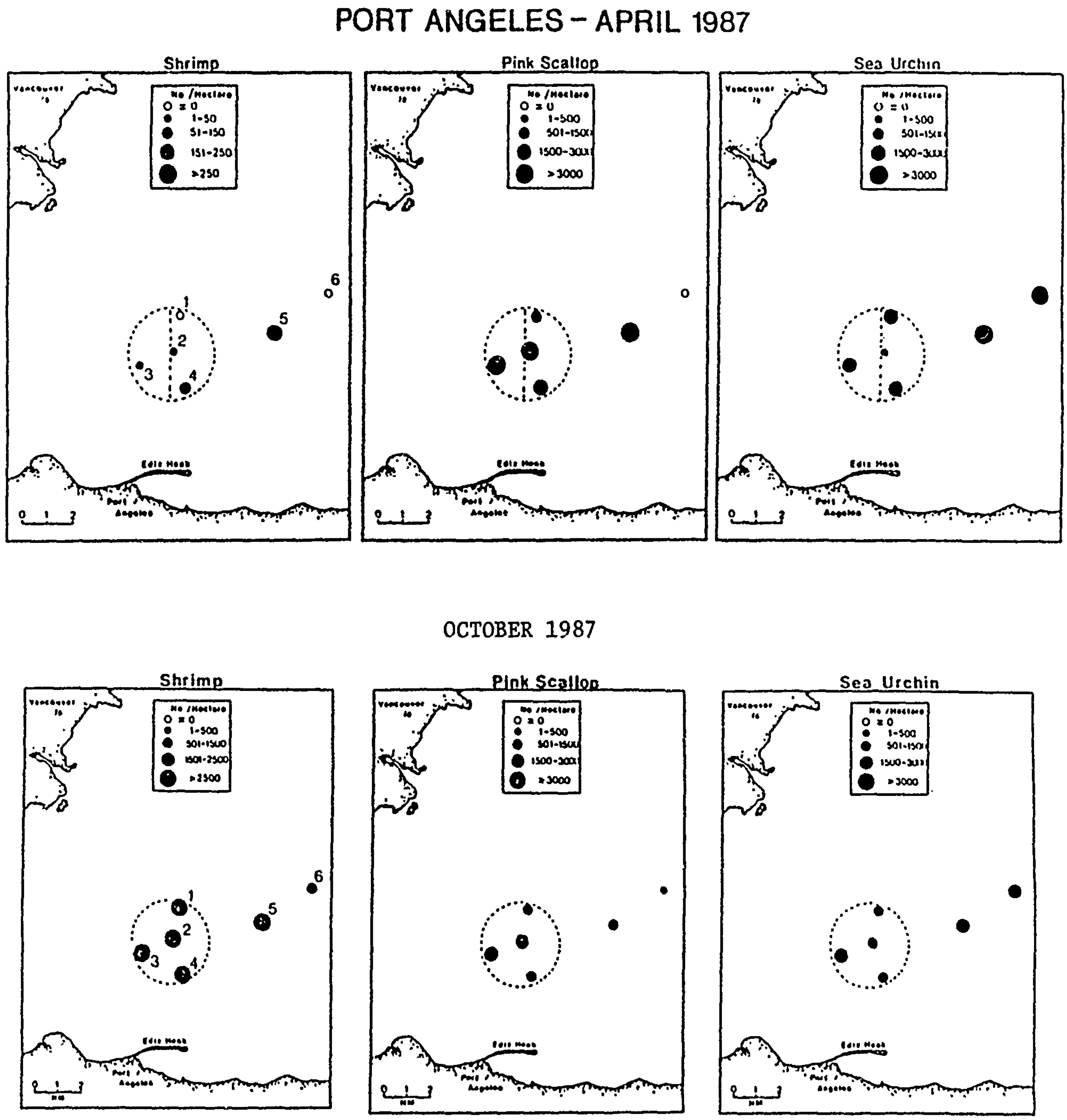


Figure 3.24 Maps of Port Angeles region of the Strait of Juan de Fuca showing densities of commercial pandalid shrimp, pink scallops and sea urchins, as estimated from beam trawl catches in April and October 1987. (after Dinnel et al., 1988)

Pandalid shrimp resources were abundant during the October sampling period. averaging almost 7,000 shrimp/ha (i.e., beam trawl collected), and comprised almost exclusively of young-of-the-year Pandalus borealis patchily distributed throughout the study area. Densities ranged from a low of 3,000 shrimp/ha in the preferred site to 55,000 shrimp/ha at the alternative site during this season. Corresponding shrimp densities were low in April with 56 shrimp/ha at the preferred site and 37 shrimp/ha at the alternative site. Relatively large densities of pink scallop were found throughout the Port Angeles study area during both seasonal sampling periods: 2,150 scallops/ha at the preferred site and 3,300 scallops/ha at the alternative site. Relatively high densities of sea urchins, principally Strongylocentrotus pallidus, were also found throughout the study area during both seasons: 2,250 sea urchins/ha at the preferred site and 550 sea urchins/ha at the alternative site. Data are lacking on abundances of pink scallops and sea urchins during winter and summer.

Pink scallops were abundant during both April and October, with densities averaging 2,781/ha and 1,323/ha, respectively. Scallop densities were highest in the southern half of the ZSF and one station northeast of the ZSF.

Sea urchins (Strongylocentrotus pallidus) were generally abundant in the study area, during both seasons. Densities averaged 1,486/ha and 2,260/ha during April and October, respectively. However, unlike Port Townsend, the high sea urchin densities were not coincident with high scallop density areas. Distribution of sea urchins was generally uniform between stations.

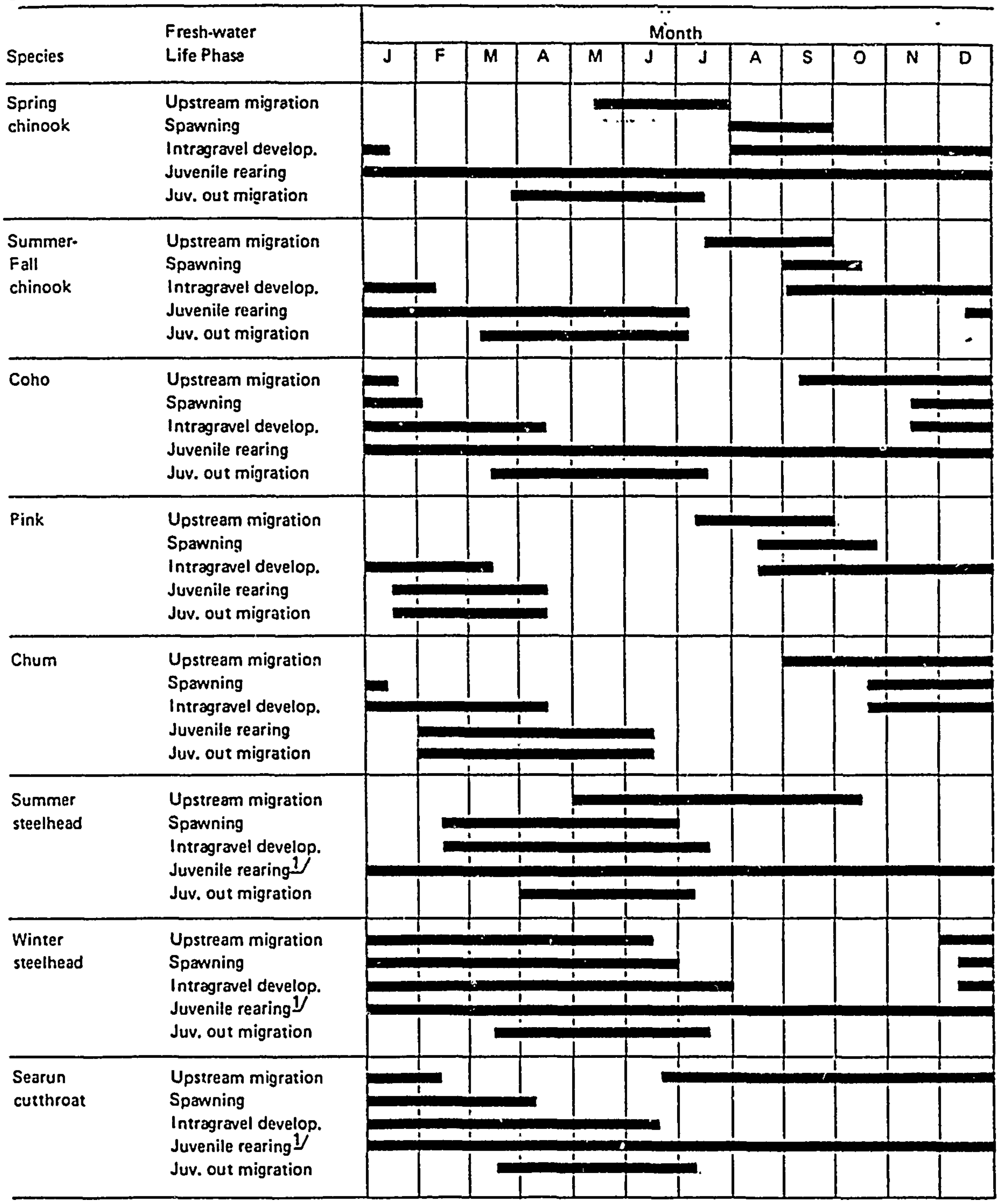
The only other invertebrate resources collected in the area were limited to moderate numbers of several starfish species and a few sea cucumbers.

(2) Plankton Communities. Phytoplankton and zooplankton communities are generally ubiquitous throughout Puget Sound but exhibit tremendous spatial and temporal variations in species composition and abundances. The reader is referred to section 3.01b(b) for a general discussion of bloom periods and species succession.

(3) Anadromous and Marine Fishes.

(a) Anadromous Fish Resources. The closest salmonid producing river basins to the Port Angeles ZSF are the Elwha and Dungeness basins. Figure 3.25 depicts the timing of salmon and searun trout freshwater life phases in Elwha-Duugeness Basins. These basins support important runs of salmon and trout. Four Pacific salmon species utilize the various drainages in this region: spring and fall races of chinook, coho, pink, and chum salmon. Also, each of the anadromous gamefish occurs here, including summer and winter steelhead trout, cutthroat trout, and searun Dolly Varden. Inventory and distribution of all species life histories are delineated in detail in a comprehensive study of water and related land resources (Pacific Northwest River Basins Commission, 1970). Upstream migration timing overlaps considerably as indicated in figure 3.25. In general, all salmon species except spring chinook begin their adult upstream migrations during the period

Figure 3.25 Timing of salmon and searun trout fresh-water life phases in Elwha-Dungeness Basins



1/ Normally extends over a two-year period.

between mid-summer and mid-winter. The adults arrive in the general vicinity of Port Angeles several days prior to entering their home river/creeks. Juvenile peak outmigrations occur throughout the spring. Pink salmon are the exception, with peak juvenile outmigrations occuring during late winter. Spring chinook adults migrate upstream from mid-May to late July. For steelhead trout, summer steelhead adults inmigrate from early-May to mid-October, while the winter adults inmigrate between December and June.

Summer steelhead juveniles outmigrate between May and October; Winter steelhead outmigrate between December and June. Adult upstream migration of searun cutthrout occurs between June and February. Juvenile outmigration occurs between mid-March and early July.

Mayer et al. (1985) found juvenile chinook salmon in nearshore intertidal areas in late May, with peak densities occuring in mid-June. Gradual movement of juvenile chinook to offshore neritic areas commenced in late June and peaked in mid-July. In Clallam Bay, outmigrating juvenile chum salmon were primarily found nearshore and rarely in neritic habitats; they arrived during early May, and peak densities were observed during mid- to late May. Outmigrating pink salmon juveniles were first observed in nearshore areas of Clallam Bay in mid-May with peak densities occuring during early June; movements into offshore neritic areas commenced during early June and peaked in late June and early July.

(b) Marine Fish/Bottomfish Resources. Numbers of fish species, total abundance, and weight of nearshore fish is often highest in protected, mixed sand/mud habitats along the Strait of Juan de Fuca (Kopenski and Long, 1981). Fish inhabiting exposed sand and gravel beaches in the strait are usually low (e.g., Morse Creek, Dungeness Spit, West Beach). Numbers and weight of fish caught in trawls are more variable than for beach seines due to greater influence of schooling fish. Catches are usually greater in the spring and summer and lowest in winter. Most trawl-caught fish are uniformly distributed along the shoreline of the Strait of Juan de Fuca and are occasionally augmented by large schools of smelt and herring or the infrequent capture of a single large fish, such as a dogfish. The Pacific herring is usually the most abundant species. Data collected in the San Juan Islands and northern Puget Sound confirmed that catches are usually highest in spring or summer. Based on historic sampling data, sites sampled in the San Juan Islands contain the fewest species, whereas those in the eastern strait have the most. Overall, fish abundance is highest along the strait, and total weight is highest in the Cherry Point/Lummi Bay area. Fish larvae and juveniles extensively utilize nearshore habitats as nursery areas for local species. The most prominent feeding habit is one that depends entirely upon epibenthic zooplankton. The number of tidepool species increases slightly from the east end of the strait to the west, possibly in response to increasing kinds of habitat types available. Most tidepool fishes prey upon small crustaceans; many of them feed exclusively on these animals.

The selected and alternative sites are removed from important marine fish resources, including surf smelt spawning beaches, Pacific herring spawning and holding areas, and groundfish resource and fishing areas in the Rosario Strait (Day et al., 1987). Neritic schooling fishes utilize the general area where the alternative sites are located. These include juvenile Pacific herring, Pacific sand lance, northern anchovy, surf smelt, and longfin smelt. Some of these species are present for only part of their life history in the region. As in the case of Pacific herring, which occupy neritic waters for their first year, then migrate toward the ocean (Simenstad, et al., 1979).

Bottomfish investigations were limited during disposal site selection studies to April and October collections with a research otter trawl and incidental catches in beam trawl samples, which is a much less efficient sampling device for fishes. Twelve demersal fish species were caught in both the April and October samples within the study area. Abundances of bottomfish were uniformally low at all stations sampled during April, with Dover sole, rex sole, and Pacific cod representing commercially important species collected. October catches also showed a general paucity for all species collected except Walleye pollock, which was abundant at all but one station outside and southeast of the ZSF. Other species of commercial interest were the Dover sole and arrowtooth flounder. Important recreational fisheries exist near Port Angeles, including an area known as the "Rock Pile" located northeast of the ZSF. There is a limited commercial fishery located in the Strait of Juan de Fuca for True cod, with incidental catches of English sole and rockfish.

(4) Marine Mammals. Near Port Angeles, Dall's porpoise has been sighted frequently; harbor porpoise has been observed on occasion; and harbor seals have a haul-out area near the easternmost pier in Port Angeles (Everitt, et al., 1978). River otters have also been observed on Ediz hook. The area between Port Angeles and Dungeness Spit appears to be a center of Dall's porpoise abundance (Day, et al., 1987; Everitt, et al., 1978). The proposed Port Angeles disposal areas are located where Dall's porpoises have regularly been sighted, particularly spring through fall, when they are common in the eastern Strait of Juan de Fuca (Everitt, et al., 1978). There are apparently no records for winter (Everitt, et al., 1978). Harbor seals are regularly sighted in the Port Angeles area, but birthing and nursing apparently does not occur in this area. A pup observed in Freshwater Bay (about 10 miles west of Port Angeles is the only such observation for the Strait of Juan de Fuca outside of Dungeness (Everitt, et al., 1978). On the other hand, Calambokidis (1987) suggests that a major increase in harbor seal numbers has occurred since Everitt's study, though he concedes that numbers are still low relative to other areas of Puget Sound, and reproduction is still very low. Harbor porpoise is only occasionally seen near Port Angeles; in Everitt, et al. (1978), only one sighting is recorded of two animals in May, 1976.

(5) Waterbirds. At Port Angeles, three species are prominent nesters: glaucous-winged gull, pelagic cormorant, and pigeon guillemot. All three nest in the port area of the city (Puget Sound Environmental Atlas, 1987). The pelagic cormorant has about 40 pairs in the colony at Port Angeles (Wahl, et al., 1981); on the other hand, Wahl, et al. (1981), do not list either glaucous-winged gull or pigeon guillemot as nesting in the Port Angeles area, and Varoujean (undated) lists no nesting for Port Angeles. For the

purpose of this EIS, it is assumed that these two species nest in small numbers at Port Angeles. The water immediately surrounding Ediz Hook are a wintering area for numerous species of waterbirds, including loons, grebes, waterfowl, shorebirds, and alcids. Little information was found regarding waterbird use of the proposed disposal site.

(6) Endangered and Threatened Species. Everitt, et al. (1978), indicates only two sightings of gray whales near Port Angeles, while Calambokidis (1987) shows the sightings of gray whales in his study were concentrated between Neah Bay and Sekiu River, with no sightings between Sekiu River and Pillar Point (the eastern end of his study area, about 35 miles west of Port Angeles in recent years.

The nearest bald eagle nest to Port Angeles is about 5 miles to the east, and few sightings of bald eagles from the Port Angeles area are on record. Almost no data were found regarding peregrine falcons near Port Angeles; undoubtedly a few occur in the area during migration.

c. Human Environment.

(1) Social and Economic Features. The dredging areas that will use the Port Angeles unconfined, open-water disposal site include the city of Port Angeles and Clallam County. Callam County had a population of 53,400 in 1987, ranking it 15th in the State. Population has increased by only 1,800 since 1980 due to a decline in the wood products industry. Population forecasts by the Washington State Office of Financial Management show the population of Callam County increasing to 61,500 by the year 2000. Port Angeles is the largest city in the region with a current population of 17,300 (27th in the State).

(2) Navigation Development. Port Angeles' waterborne commerce is prinicpally due to the area's traffic in wood products. Total volume (outbound plus inbound cargos) in 1985 was 5,191,400 short tons (Port of Port Angeles, personal communication, September 1988). This is projected to rise as high as 9,604,350 short tons by the year 2000. The only Federal project is rock revetment and rock blanketing protection of Ediz Hook. The Port's navigational responsibilities extend to Dungeness and Sequim Bays; as in similar dredging activities at Port Angeles, these are directed mainly at maintenance of short channels for small vessels.

(3) Dredging and Disposal Activity. The Port Angeles service area supplied material disposed at a DNR multiuser, unconfined open-water site during the 1970 to 1985 period. The material constituted 168,000 c.y., which represents only about 5 percent of dredged material disposed at all Phase II area unconfined, open-water sites over the period 1970-1985.

For the period 1985 to 2000, an anticipated 285,000 c.y. is expected to be dredged in the Port Angeles area from various sources. Material is expected to pass the PSDDA dispersive disposal guideline, and therefore could be suitable for disposal at the Port Angeles unconfined, open-water disposal site. However, table 2.7c indicates that only 143,000 c.y. are likely to be discharged at this site as much of the material is expected to be useable for benefical purposes.

(4) Native American Treaty Fishing. A total of seven Indian tribes have usual and accustomed fishing places in the Strait of Juan de Fuca. Because these tribes can pursue their activities near both the Port Angeles and Port Townsend dispersive disposal sites, discussion for both these sites are combined here. The tribes using the Strait of Juan de Fuca are the Jamestown, Lower Elwha and Port Gamble Klallam Tribes, the Lummi, the Suquamish, the Swinomish, and the Tulalip Tribes. The closest to the fishing grounds are the three Klallam tribes. The Fraser Panel, a joint U.S.-Canadian regulatory body, governs some aspects of the salmon fishery in the Strait of Juan de Fuca.

Catch statistics for North American Treaty Fishing are available from the Port Angeles and Discovery Bay reporting areas. For the 1985-1987 period the average yearly shellfish and nonsalmon finfishing Indian catch total was 4,650 pounds from Port Angeles and 55,409 pounds from Discovery Bay. At Port Angeles, 98.6 percent of the Indian nonsalmon catch was finfish, led by Pacific cod and halibut. At Discovery Bay, nonsalmon finfish, led by Pacific cod, made up 65.5 percent of the total. Littleneck clams were the biggest single group in the shellfish portion of the nonsalmon Indian harvest recorded for Discovery Bay.

North American Treaty fishing for salmon in the Strait of Juan de Fuca area is centered in the Port Angeles reporting area, with Discovery Bay near the Port Townsend disposal site listing only 343 pounds a year average for the 1985-1987 period. Port Angeles salmon caught by Native Americans totaled a yearly average 21,669 pounds for 1985-1987. Sockeye was the leader with an average 9,878 pounds. The 1987 catch for salmon was almost three times the 3-year average figure. Purse seining is used near Protection Island. Gill nets are used in deeper waters. Salmon harvest management periods in Reporting Area 6 are as follows (WDF and Northwest Indian Fisheries Commission, 1988). Minor adjustments may occur.

Spring chinook - April 15 to June 15
Fall chinook - July 1 to August 29
Pink (odd years) - August 14 to September 11
Coho - August 21 to October 13
Chum (normal/late) October 3 to December 17
Sockeye (two runs) - June 3 to October 1

(5) Non-Indian Commercial and Recreational Fishing. The Port Angeles area supports a non-Indian commercial and a recreational fishery in addition to Indian fishing. Of the total finfish harvest, 75 percent of the 1985 to 1987 annual average of 441,563 pounds was nonsalmon. This figure, which includes the Indian catch (see section 3.04c(4)), was led by Pacific cod and dogfish, with 1987 catches of 211,013 and 120,078 pounds respectively. The total shellfish harvest for the 1985 to 1987 period, including the Indian

catch, was an annual average of 1,091,810 pounds. This harvest was led by sea urchins, with a 1,234,427-pound total catch in 1987, and was almost a million pounds larger than the 1985 harvest.

Total salmon harvests in the Port Angeles area from 1985 to 1987 annually averaged 110,291 pounds including the Indian catch. The 1987 total harvest figures for the two leading species, sockeye and pink salmon, were 156,432 and 80,635 pounds, respectively. The pink salmon catch was the "odd year" run.

The 1986 sport catch of chinook, coho, chum, and sockeye salmon totaled 171,358 fish, from the east Juan de Fuca reporting area (Washington Department of Fisheries, 1986).

(6) Esthetic Setting. The esthetic setting for the Port Angeles ZSF is primarily the Strait of Juan de Fuca, boat traffic in the strait, and the background, the shorelines of the Olympic Pennisula, with Hurricane Ridge and Vancouver Island. The disposal site (preferred and alternate) location site can be viewed from Port Angeles Spit, tall buildings or bluff locations in Port Angeles and the Black Ball Ferry Line enrout to Victoria, B.C. Distant views of the area can be obtained from Hurricane Ridge and Vancouver Island. Public access to shoreline areas includes the Port Angeles spit and Dungeness National Wildife Refuge.

3.06 North Sound: Port Townsend (Dispersive).

a. Physical Environment.

(1) Geology. Figure 2.6 shows the selected and alternative disposal sites. The ZSF is located approximately 9-1/4 miles northwest of Port Townsend in water approximately 360 feet deep. The bathymetry of this area indicates that there are several large shoals with fairly deep passages (70 to 90 fathoms) between them. Access to the south sound is through Admiralty Inlet to the east, while access to the north sound is through Rosario Strait and Haro Strait to the north.

The impact of glaciation in the Port Townsend area was similar to that occuring at the other sites in the Puget Sound. Refer to section 3.01a(1) and 3.03a(1) for further details on the last glaciation. Ice is believed to have reached a maximum thickness of 3,950 to 4,250 feet in Strait of Juan de Fuca (Burns, 1985).

Sediments are largely maintained in the main basin due to a prominent "sill" located between Admiralty Head and Port Townsend. The central basin is generally over 600 feet deep, whereas the shallow "sill" is only 125 feet deep, thereby acting as a natural barrier to the escape of water and particles from the central basin of Puget Sound to the strait and the Pacific Ocean (PSWQA, 1986 Issue Paper: Contaminated Sediments and Dredging).

(2) Water Quality. Water quality in the area is Class A according to 1984 Washington State Department of Ecology standards. The Port Townsend area

is well flushed by tidal curents flowing through the Admiralty Inlet. Salinities are scarcely diminshed by rivers in this area, 29 to 31 ppt. Similarly, temperatures demonstrate a small range from about 8 to 12 degrees C, with only a shallow seasonal upper warming zone occurring. Dissolved oxygen concentrations range from about 8 mg/l (surface) to about 5 mg/l (bottom) (Collias, et al., 1974).

Only two point source discharges are located in the Port Townsend area. Sewage effluent and pulp-paper materials from these sources are expected to be effectively dispersed in the tidal currents. In May 1980, dissolved cadmium measured 0.042 ppb and dissolved copper was 0.16 ppb in this area (A. J. Paulson, personal communication).

(3) Currents and Sediment Transport. Field data indicate that mean speeds within the ZSF vary from 30 to 50 cm/sec. (mean of 40 cm/sec.), increasing to the north as they approach Admiralty Inlet. There is a two-layered flow in the ZSF with a demarcation between the two layers at 50 meters. The upper layer shows a net seaward flow with decreasing velocity down to 50 meters. Below this level the velocity increases again with a net landward flow. Remnants of water from Rosario Strait flowing southward are seen at the entrance of Admiralty Inlet just north of Port Townsend.

Tidally influenced currents are strongest in the northern portion of the ZSF, strongest at spring ebb with an estimated peak speed of 100 cm/sec. The neap flood current velocity is estimated to 75 cm/sec., while the the spring flood is 65 cm/sec. and the. neap ebb about 50 cm/sec. The ebb tides flow westerly and the flood tides flow easterly.

(4) Marine and Estuarine Sediments. Few data are available on the sediments in and around the proposed Port Townsend disposal site. Roberts' (1979) indicates that sediments are mostly gravel and sand just to the southeast of the site, typical of high energy localities. Granulometric data from a location 48 meters deep, about 7 miles south of the site, are 69 percent sand, 21 percent silt, and 10 percent clay (IOUBC, 1962/63).

The nearest location to the Port Townsend disposal site, for which sediment chemistry analyses are available, is a station about 6 miles south of the proposed site (about 4 miles west northwest of Protection Island). At this sampling station, arsenic was measured at 6 ppm, mercury at 0.049 ppm, and TOC at 9 ppt (Crecelius, et al., 1974). Concentrations of other chemical substances in or near the site are not available.

(5) Air Quality. The Olympic Air Pollution Control Authority (OAPCA has jurisdiction over Port Townsend air quality. OAPCA administers and enforces air pollution control standards and regulations and is reponsible for implementing the requirements of the State of Washington and Federal Clean Air Acts. One measurement station is currently located in the Port Townsend area. Pollution from the Port Townsend area tends to disperse from the area by moving out to sea over Indian Island. In general, the area attains Federal and State standards with occasional violations of the daily State standard for total suspended particulates.

In 1987, the area reported no days when the State standard for total suspended particulates was exceeded. In 1986, the standard was exceeded for 1 day, and in 1985 1 day.

b. Biological Environment.

(1) Benthic Communities.

(a) Nearshore Intertidal/Shallow Subtidal Habitats. Intertidal and shallow subtidal benthic habitats along the Strain of Juan de Fuca were described under the section dealing with the Port Angeles region. See section 3.04b(1).

(b) Invertebrate Resources-Selected and Alternate Sites (Port Townsend). Natural resource investigations were conducted during April and October 1987 by the University of Washington Fisheries Research Institute in and around the Port Townsend Zone of Siting Feasibility (ZSF). These investigations were restricted to studies conducted with a beam trawl and an otter trawl. No benthic infaunal investigations were conducted here and observations discussed are restricted to major epifaunal species found during the limited studies, augmented with data from other investigations in the general area. Figure 3.26 depicts the distribution of commercially important pandalid shrimp, pink scallops, and sea urchins withing the Port Townsend study area. A major finding of these investigations was that no crabs were caught in the Port Townsend ZSF. A few pandalid shrimp were caught in the April trawls. The average density was 236 shrimp/hectare (ha); the dominant species collected was *Pandalus danae*. However, catches in October increased to 6,802 shrimp/ha, primarily due to young (1- to 2-year old animals) *P. danae* and *P. borealis*. Distributions among stations between seasons were similar, with highest catches being recorded in the southeastern corner of the ZSF (9,382/ha) and outside the ZSF (4,682/ha). Other species caught were *Pandalopsis dispar* and *P. goniurus*, both in relatively low numbers.

Pink scallops were generally abundant during October corner and western edge of the ZSF with densities of 8,558 and 2,172/ha respectively using a beam trawl. Densities in April were lower, primarily due to the use of the ottertrawl, a much less efficient sampler for scallop. However, as in October, densities were highest in the southeastern edge of the ZSF (149/ha).

Large numbers of sea urchins (*Strongylocentrotus pallidus*) were caught at the same stations where high scallop catches were observed. Estimated densities at the high concentration stations ranged from 2,079 to 8,521/ha.

The only other invertebrate resources collected in area were limited to moderate numbers of several starfish species.

(2) Plankton Communities. Phytoplankton and zooplankton communities are generally ubiquitous throughout Puget Sound but exhibit tremendous spatial and temporal variations in species composition and abundances. The reader is referred to section 3.01b(b) for a general discussion of bloom periods and species succession.

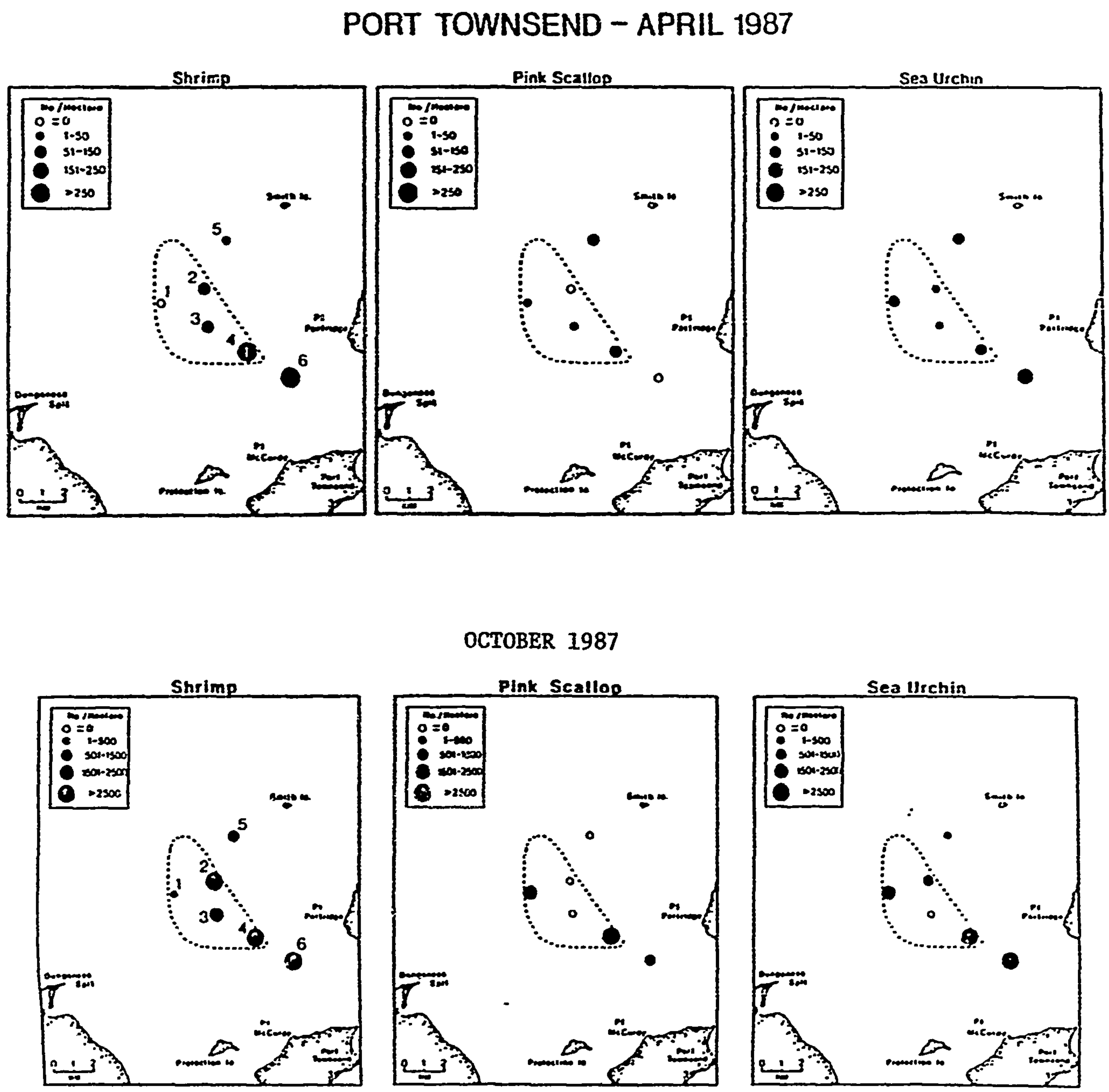


Figure 3.26. Maps of Port Townsend region of the Strait of Juan de Fuca showing the densities of commercial pandalid shrimp, pink scallops and sea urchins as estimated from otter trawl catches in April and beam trawl catches in October 1987. (after Dinnel et al., 1988)

(3) Anadromous and Marine Fishes.

(a) Anadromous Fish Resources. The closest salmonid producing river basins to the Port Townsend ZSF are the west sound basins (see section 3.04b(3)). Figure 3.27 depicts timing of salmon and freshwater life phases in west sound basins. These basins support important runs of salmon and trout. Four Pacific salmon species utilize the various drainages in this region: chinook, coho, pink, and chum salmon. Anadromous gamefish occuring here, are summer and winter steelhead trout, cutthroat trout, and searun Dolly Varden chum. Inventory and distribution of all species life histories are delineated in detail in the comprehensive study of water and related land resources report (Pacific Northwest River Basins Commission 1970). Upstream migration timing overlaps considerably as indicated in figure 3.30. Fall chinook salmon adults migrate upstream during the period between mid-July and the end of October. Coho salmon adults migrate upstream between the end of September and early December. Chum salmon adults migrate upstream from early September to mid January. Adult salmon arrive in the general vicinity of Port Townsend/west sound basins several days prior to entering freshwater. Outmigration for all species of salmon peaks during the period February-June, corresponding with high spring runoff. For steelhead trout, summer steelhead adults inmigrate from mid-April to mid-October, while the winter adults inmigrate between November and steelhead outmigrate between the end of March and mid-June. Adult upstream migration of searun cutthrout occurs between June and mid-March. Juvenile outmigration occurs between mid-March and mid-June.

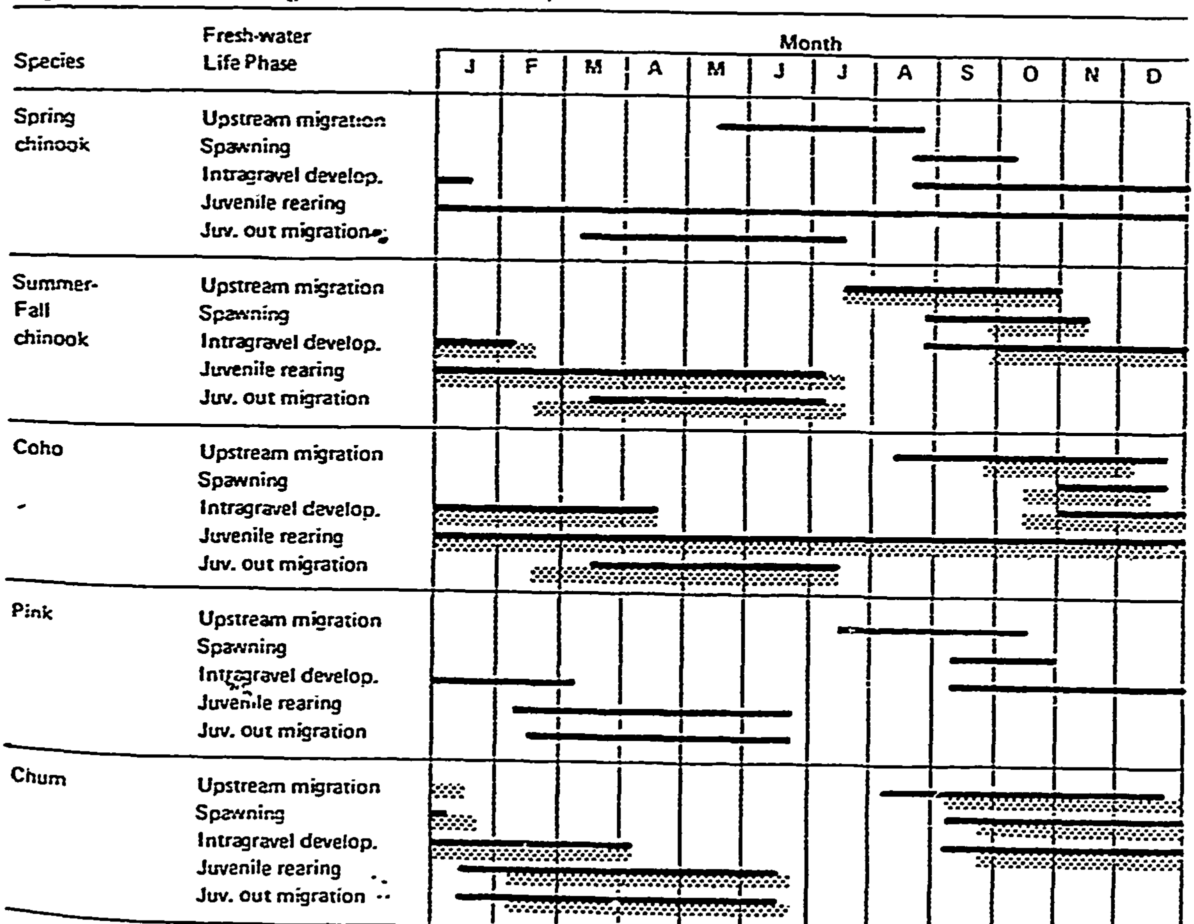
(b) Marine Fish/Bottomfish Resources. Generalized desriptions of nearshore marine fishes and bottom fish resources extending along the Strait of Juan de Fuca from Port Angeles to Port Townsend are described for Port Angeles (section 3.05b(3)).

The area has an important recreational fishery. Also, there is a commercial trawl fishery in the Strait of Juan de Fuca harvesting true cod with incidental catches of English sole and rockfish. Studies by the University of Washington Fisheries Research Institute during 1987 showed that the number of species and total abundance of bottomfish in the ZSF was low in April compared to other Puget Sound areas (Donnelly, et al., 1986; Donnelly, et al., 1984).

Overall, species richness and abundance increased in October. Several species of interest to commercial and recreational fisheries were captured during this study, including English sole, Dover sole, quillback rockfish, and walleye pollock. All exploited species except walleye pollock were low in abundance. Walleye pollock constituted a single catch in spring, but in October it was encountered in substantial numbers.

The selected and alternative sites are removed from important marine fish resources, including surf smelt spawning beaches, Pacific herring spawning and holding areas, and groundfish resource and fishing areas in the Rosario Strait (Day, et al., 1987). Neritic schooling fishes utilize the general area where the alternative sites are located. These include juvenile Pacific herring,

Figure 3.27: Timing of fresh water phases in West Sound Basins



1/ Symbol ▬ indicates Hood Canal segment; symbol ░ indicates South and West Puget Sound segments.

Pacific sand lance, northern anchovy, surf smelt, and longfin smelt. Some of these species (e.g., Pacific herring) are present for only part of their life history in the region. Herring occupy neritic waters for their first year, then migrate toward the ocean (Simenstad, et al., 1979).

Bottomfish investigations were limited during disposal site selection studies to April and October collections with a research otter trawl and incidental catches in beam trawl samplea, which is a much less efficient sampling device for fishes.

(4) Marine Mammals. The disposal sites are roughly equidistant from Dungeness Spit, Protection Island, Smith Island, and Point Partridge (Whidbey Island). Little is known about marine mammal distribution in thos area (Day et al., 1987). Harbor porpoise, Dall's porpoise, harbor seal, and minke whaie have been observed in the vicinity of the disposal sites, but not within the boundaries of the sites. However, Dall's porpoise and minke whales are regularly observed at Partridge Bank, very near the disposal areas (Everitt, et al., 1978). Harbor seals haul out at Dungeness Spit, Kulakala Point, Protection Island, Smith Island, and Minor Island. Pupping occurs on the foregoing except for Kulakala Point. Smith and Minor Islands are the most important area for harbor seals in the Puget Sound region, accounting for nearly 26 percent of the pup count for the region (Everitt, et al., 1978). Northern sea lions also haul out on Dungeness Spit, according to the Puget Sound Environmental Atlas (1987); Everitt, et al. (1978) does not include Dungeness Spit as a haul-out site for northern sea lion.

(5) Waterbirds. Smith and Protection Islands are arguably the two most important seabird breeding areas in the Puget Sound region. Both islands support seven species of breeding birds: glaucous-winged gull, double-crested cormorant, pelagic cormorant, pigeon guillemot, tufted puffin, rhinocerous auklet, and black oystercatcher (Day, et al., 1987). These are the only two sites in Washington's inland waters that support rhinocerous auklets. The colony at Protection Island (about 18,000 pairs) is far larger than at Smith Island (about 600 pairs) (Varoujean, undated). The Protection Island population of rhinocerous auklets represents about 50 percent of the total population of the contiguous United States (Wahl, et al., 1981). Roughly a third of this population takes daily foraging flights past Point Wilson into Admiralty Inlet, while another third fly northward, past the disposal sites to Smith Island, Whidbey Island, and the southern sound areas (Wahl, et al., 1981). A sizeable breeding population of about 7,000 pairs glaucous-winged gulls also occurs on Protection Island (FWS, 1985). Birds nesting in relatively small numbers at Dungeness Spit include glaucous-winged gulls, pelagic cormorants, pigeon guillemots, and black oystercatchers. During the winter, the area from Dungeness Spit south along the shore and into Sequim Bay, and also Discovery Bay, are especially important for a wide variey of seabirds and waterfowl, including loons, grebes, cormorant, waterfowl, gulls, shorebirds, and alcids.

(6) Endangered and Threatened Species. No endangered cetaceans have been reported from this area. A bald eagle nest has been active and successful on Protection Island since at least 1979 (FWS, 1985). No other nests are near the disposal sites. A dozen or more bald eagles winter in Sequim Bay and near Dungeness Spit. Peregrine falcons have been noted to winter on Protection Island (FWS, 1985). Suitable nesting habitat exists on the island, but no resting by peregrines has been known to occur (FWS, 1985). Peregrine falcon presence is also known from Dungeness Spit, but the birds are not common anywhere in the vicinity of the disposal sites.

c. Human Environment.

(1) Social and Economic Features. The dredging areas that will use the Port Townsend unconfined, open-water disposal site include Port Townsend, the northern section of Jefferson County, the western section of Kitsap County and other small communities such as Sequim and Port Gamble. Jefferson County had a population of 18,100 in 1987, ranking 27th in the State. Population has increased by 2,100 since 1980. Population forecasts by the Washington State Office of Financial Management show the population of Jefferson County increasing to 21,200 by the year 2000. Port Townsend is the largest city in the area with a 1987 population of 6,600 (48th in the State).

(2) Navigation Development. The Oak Bay Canal is a federally dredged waterway connecting Oak Bay and southern Port Townsend Bay. The Canal is 0.8 miles long, 75 feet wide and 15 feet deep.

Boat traffic in the Port Townsend area is mainly of the small boat variety. Most of the dredging, aside from the Oak Bay Canal, is done by the Port and other interests, and pertains to boat basins and their entrance channels.

(3) Dredging and Disposal Activity. The Port Townsend area supplied material disposed at one local unconfined, open-water DNR site at Admiralty Inlet) during the 1970 to 1985 period. The material disposed there was 165,000 c.y., which represents about 5 percent of that disposed in Phase II area unconfined, open-water disposal sites over the 1970-1985 period.

For the period 1985 to 2000, three areas to be dredged in the Port Townsend area are expected to yield material shown in table 3.10 that could be suitable for disposal at the Port Townsend site:

(4) Native American Treaty Fishing. See section 3.04c(4) above for this discussion, which is combined with the one for Port Angeles.

TABLE 3.10

PROJECTED VOLUMES OF DREDGED MATERIAL
THAT COULD BE SUITABLE FOR THE
PORT TOWNSEND DISPOSAL SITE
1985-2000 1/

Dredging Area	Volume (c.y.)
Port Townsend	422,000
Admiralty Inlet	121,000
Hood Canal	144,000
TOTAL	687,000

All this material is expected to pass PSDDA Disposal Guidelines and could be disposed at the Port Townsend unconfined, open-water disposal site.

1/See table 2.7c for the volume currently expected to be discharged at this site over the period 1985-2000 (159,000 c.y.).

(5) Non-Indian Commercial and Recreational Fishing. The Port Townsend area supports a non-Indian commercial and a recreational fishery, in addition to Indian fishing. Harvest statistics are listed for the WDF Discovery Bay reporting area (6B for salmon, 25A for other fishery items). Virtually all of the total finfish harvest of 200,003 pounds is nonsalmon, in the 1985 to 1987 period average annual catch figures. This figure, which includes the Indian catch (see section 3.05c(4)), was led by Pacific cod and dogfish, with total 1987 catches of 170,789 and 67,162 pounds, respectively.

The total shellfish harvest from the Discovery Bay reporting area for the 1985 to 1987 period, including the Indian catch, was an annual average of 143,243 pounds. This harvest was led in 1987 by Dungeness crabs with 97,216 pounds. Horse clams and sea cucumbers followed, with 43,300 and 41,410 pounds, respectively, in 1987.

The 1986 sport salmon catch of chinook, coho, and chum salmon totaled 79,730 fish for the Admiralty Inlet Reporting Area (Washington Department of Fisheries, 1986).

(6) Esthetic Setting. The esthetic setting is the confluence of Admiralty Inlet, Rosario Strait and the Strait of Juan de Fuca. Whidbey Island and the Olympic Mountaina form a backdrop. The principal views of this setting are from the Dungeness and Port Townsend areas on the Olympic Pennisula, and the Swantown area adjacent to Point Partridge and Fort Ebbey on Whidbey Island. Public Access is from the Port Townsend area and Whidbey Island. Protection Island, to the south, is a public nature conservancy area. The alternate and preferred sites are visible from Protection Island.

SECTION 4. ENVIRONMENTAL EFFECTS OF ALTERNATIVES

4.01 Introduction. Section 4 presents an environmental effects assessment of the final alternatives relative to anticipated impacts at identified unconfined, open-water disposal sites, and impacts that could result from selection of the no-action alternative. As presented in section 2.02, the no-action alternative for the entire Phase II area is application of the Puget Sound Interim Criteria (PSIC) as the basis for disposal of suitable material at single-user, unconfined, open-water disposal sites located in the Phase II area. Unsuitable material would be placed upland or in confined nearshore locations. The action alternatives consisted of the selected and at least one alternative disposal site for each of the five areas: Nisqually Reach, Bellingham Bay, Rosario Strait, Port Angeles, and Port Townsend. (Bellingham Bay had two alternative sites, but only the south alternative was carried forward for final analysis.) In this section an evaluation is presented of the impacts of disposal of suitable dredged material at the PSDDA sites on the physical, biological, and human resources of the Phase II area of Puget Sound.

This EIS does not address the environmental impacts associated with dredging. Such impacts are project and site specific and will be the subject of separate assessments by project sponsors, including environmental assessments or EIS's. A Section 404(b)(1) evaluation will be required, which may cite information contained in the PSDDA documents and incorporate them by reference.

When assessing the potential effects of each alternative, the evaluation includes those impacts associated with unconfined, open-water disposal and also those associated with possible confined disposal of material found not suitable for unconfined open-water disposal. Most dredged material found not to be suitable under PSDDA for unconfined, open-water disposal is generally assumed in this analysis to be placed at a confined site even though some marginal projects may in fact not be dredged if high cost confined disposal is required. While confined disposal methods include confined aquatic disposal (CAD), this technique has received only limited public acceptance. Consequently, while some CAD is likely to occur, in the near term a large proportion of the material requiring confinement will likely be handled by other confined disposal options, principally to transported upland and nearshore areas. In addition, an analysis of the impacts to both open water and land environments highlights the environmental tradeoffs that exist regardless of where dredged material is disposed.

The smaller the quantity of dredged material placed at the unconfined, open-water disposal sites, the greater the quantity of material requiring upland/nearshore disposal (and vice versa). The risks associated with chemicals of concern in dredged material will consequently shift between aquatic and land sites. The no-action alternative would allow the least amount of material to be placed at unconfined, open-water sites, and thus would concentrate most of the environmental (terrestrial species, freshwater species) and human health (exposure, drinking water) risks associated with chemicals of concern at confined sites. Conversely, selection of the PSDDA action alternatives will place more environmental (benthic species, marine fish) and human (chemicals in seafood) risks at unconfined, open-water sites. A general analysis of the environmental and human health tradeoffs between disposal of dredged material at unconfined, open-water sites and at confined sites is presented in sections 2.02 and 4.02 below.

Key assumptions are stated in the next few paragraphs. First, the assessment assumes that most dredged material found to be acceptable for unconfined, open-water disposal (under the EIS action alternatives) will be discharged at the PSDDA Phase II unconfined, open-water disposal sites. While some material may occasionally be placed in nearshore or land sites as part of approved fill projects, the relatively inexpensive and available unconfined, open-water sites are likely to be preferred by most project proponents who simply want to dispose of dredged material. When possible (e.g., Lummi Marina) the assessment takes into account material to be dredged but which is not destined for unconfined, open-water disposal.

TABLE 4.1

FINAL EIS ALTERNATIVES
EVALUATED FOR THE PHASE II AREA

EIS Alternative	Description	Addressed in EIS Section
No-Action Alternative	"No Designation of Phase II Area Public Multiuser, Unconfined, Open-Water Sites" (Use of Puget Sound Interim Criteria (PSIC))	4.02
Action Alternatives		
	Anderson/Ketron Island (Nondispersive, Selected)	4.03
	Anderson/Devils Head (Nondispersive, Alternate)	4.04
	Bellingham Bay (Nondispersive, Selected)	4.06
	Bellingham Bay (Nondispersive, Alternate)	4.07
	Rosario Strait (Dispersive, Selected)	4.09
	Rosario Strait (Dispersive, Alternate)	4.10
	Port Angeles (Dispersive, Selected)	4.12
	Port Angeles (Dispersive, Alternate)	4.13
	Port Townsend (Dispersive, Selected)	4.15
	Port Townsend (Dispersive, Alternate)	4.16

A second key assumption is that material found unsuitable for unconfined, open-water disposal will be dredged, not left in place. Though the cost of confined disposal would render some projects economically infeasible, the projects that will opt to not dredge cannot be ascertained for this programmatic analysis. Consequently, the analysis assumes that the same dredging activity will occur under both the action and no-action alternatives.

A third assumption is that adequate capacity will be available for confined disposal of dredged material that is not suitable for unconfined, open-water disposal. Since the need for confined disposal sites is apparent, it is anticipated that larger dredging projects will identify and establish disposal sites with sufficient capacity to accommodate near-term forecasts. For longer term use, the PSWQA has identified the need to create standards for confined disposal and study the feasibility of a multiuser site for dredged material. Ecology initiated in 1988 a comprehensive study to meet this need, and will adopt interim rules for confined disposal by July 1990; also, prior to that time, Ecology will recommend to PSWQA whether a multiuser confined facility should be pursued for the Puget Sound area. To the extent that adequate confined disposal site capacity is not available, some projects may be delayed or not dredged.

ENVIRONMENTAL EFFECTS OF THE
NO-ACTION ALTERNATIVE FOR THE
PHASE II AREA

4.02 No Action: No Designation of Public Multiuser Unconfined, Open-Water Disposal Sites in the Phase II Area. The no-action alternative that is assessed here for the entire Phase II area is "No Designation of Public Multiuser Unconfined, Open-Water Disposal Sites." In the absence of PSDDA, local jurisdictions are expected to deny shoreline permits to DNR for public multiuser unconfined, open-water disposal sites. However, limited unconfined, open-water disposal could continue on a project-by-project basis where the dredged material meets PSIC and local shoreline jurisdictions are willing to grant conditional use permits. This would likely occur in cases where the disposal will either have a beneficial use or the appropriate environmental impact studies will have been undertaken. All of the administrative and environmental elements of dredged material management addressed by PSDDA, i.e., evaluation procedures, site designation, consideration of need for environmental monitoring, are also expected to be conditions of a shoreline permit.

Overall, about 2.07 million c.y. is estimated to be found acceptable for unconfined, open-water disposal under chemical guidelines of PSIC, or about 36 percent of the total 5.72 million c.y. of dredged material that may be considered for open-water disposal over the period 1985-2000. The balance of 3.65 million c.y. would require confined disposal. Some of the material not passing PSIC could be transported to Phase I PSDDA sites if found suitable and the economics of the longer haul distances make this feasible. However, since in most cases the haul distances would most likely make use of Phase I sites infeasible, it was assumed that no material would leave the Phase II area. Table 2.2 presents marginal costs of transporting Phase II dredged material to Phase I disposal sites. Figures 4.1 and 4.2 and tables 4.2 and 4.3 describe volume allocations used for both the no-action and the action (selected PSDDA) alternatives.

Proper siting of upland and nearshore confined disposal facilities is the key to minimizing environmental impacts. Once suitable site locations have been found, site use can be managed to avoid unacceptable adverse effects. Acceptability of a given design for contaminant control is heavily dependent on site specific characteristics. Since no specific upland and nearshore sites have been identified under the no-action alternative, the presentation that follows is general and suggests possible impacts of accepting the no-action alternative. Detailed environmental assessment of specific upland and nearshore sites would need to be conducted on a project-specific basis in order to fully evaluate the impacts of confined disposal.

a. Impacts and Their Significance to the Physical Environment.

(1) Water Quality.

(a) Marine Water. Little direct impact is expected to marine water quality due to the limited amount of dredged material that would be disposed in open water under the no-action alternative. Material that would be disposed in open water would have small concentrations of chemicals of

TABLE 4.2

DISPOSAL 1/, 2/
OF FUTURE (1985-2000) DREDGING VOLUMES (CUBIC YARDS) AND THE
ASSOCIATED LAND/SHORE HABITAT IMPACTED

NO-ACTION ALTERNATIVE

Disposal Site	Dredged Material That Could be Considered for Open-Water Disposal	Volume Passing PSIC 2/	Volume Requiring Confined Disposal 3/	Associated Land/Shore Habitat Impacted In Acres 4/
Anderson/Ketron Island	1,337,000	0	1,337,000	82.7
Bellingham	1,607,000 5/	0	1,607,000	99.4
Rosario	1,801,000	1,801,000	0	0.0
Port Angeles	285,000	0	285,000	17.6
Port Townsend	687,000	265,000	422,000	26.1
TOTAL	5,717,000 5/	2,066,000	3,651,000	225.8

1/For the no-action alternative, Phase II area public multiuser sites for unconfined, open-water disposal of dredged material would not be designated. Disposal of material acceptable for unconfined, open-water disposal under this alternative could occur wherever local governments and State and Federal regulatory agencies would allow. This could include beneficial use projects and/or at other areas selected on a project by project basis. These values assume no transport to Phase I sites, which would not likely be economically justified for most projects.

2/PSIC: Puget Sound Interim Criteria. Estimated volume of future dredged material that could be discharged at the selected sites (once designated) such that the site management condition would not be violated. Assumptions used in deriving these estimates are described in Phase I EPTA (part II, section 10).

3/Confined disposal can include upland, nearshore, and/or confined aquatic disposal methods. This table is unadjusted for speculative projects and beneficial uses of dredged materials.

4/For purposes of this analysis, the average depth of land/shore disposal sites is assumed to be 10 feet. Also, approximately 90 percent of dredged material unsuitable for unconfined, open-water disposal would be placed on land or in nearshore sites for the no-action alternative, with the remainder going to confined aquatic disposal (CAD) sites.

5/Excludes 1,470,000 c.y. of dredged material to be removed during construction of the proposed Lummi Bay Marina project that will be used as landfill for shoreside facilities.

TABLE 4.3

DISPOSAL
OF FUTURE (1985-2000) DREDGING VOLUMES (CUBIC YARDS) UNDER PSDDA AND THE ASSOCIATED UPLAND/SHORELINE HABITAT IMPACTED

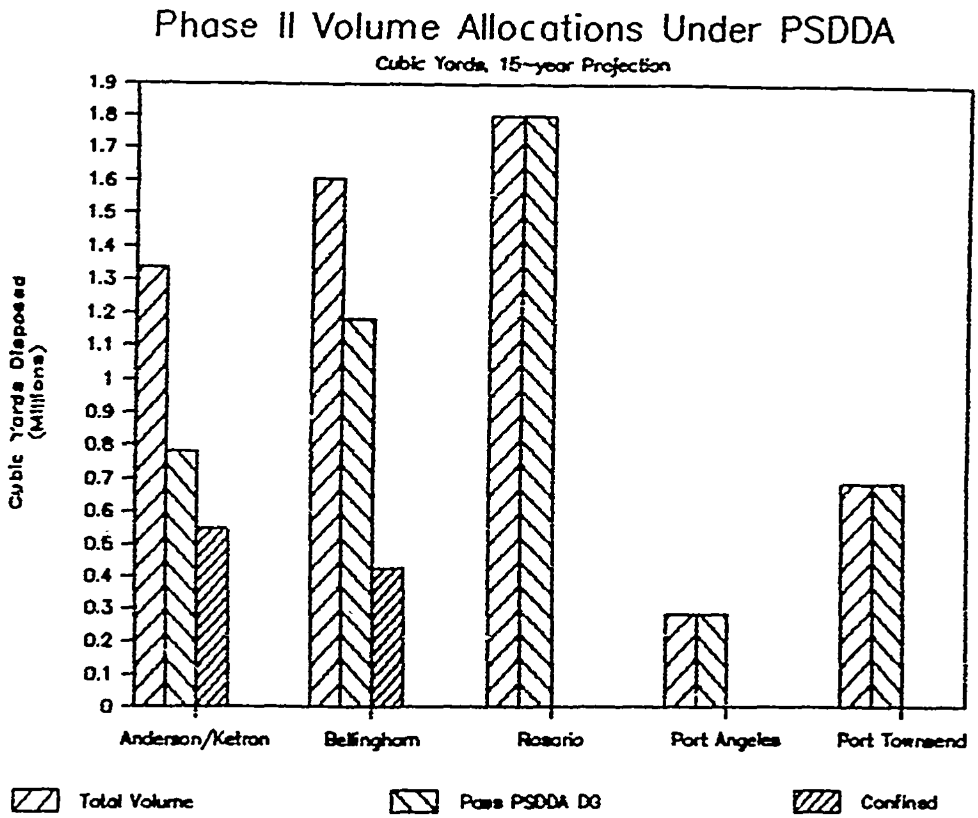
ACTION ALTERNATIVES 1/

Disposal Site	Dredged Material That Could be Considered for Open-Water Disposal	Volume Passing PSDDA Guidelines	Volume Requiring Confined Disposal	Upland/ Nearshore Habitat Impacted In Acres 3/
Anderson/Ketron Island	1,337,000	785,000	552,000	34.1
Bellingham	1,607,000 2/	1,181,500	425,500	26.3
Rosario	1,801,000	1,801,000	0	0.0
Port Angeles	285,000	285,000	0	0.0
Port Townsend	687,000	687,000	0	0.0
TOTAL	5,717,000 2/	4,739,500	977,500	60.5

1/Assumes (as does table 4.2) that 10 percent of the volume requiring confined disposal would go to a CAD site and 90 percent would go to an upland or nearshore site.

2/Excludes 1,470,000 c.y. of dredged material to be removed during construction of the proposed Lummi Bay Marina project.

3/As in table 4.2, this is unadjusted for beneficial uses of dredged material.



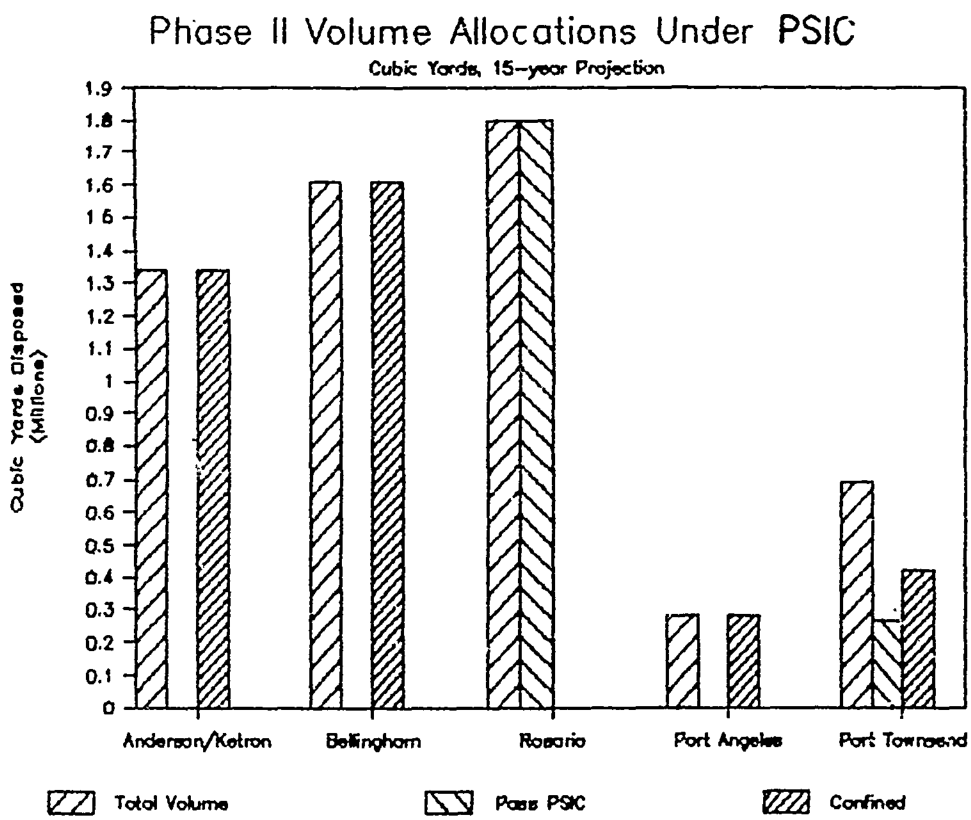


FIGURE 4.1. Volume allocations for the Phase II area for PSDDA and PSIC.

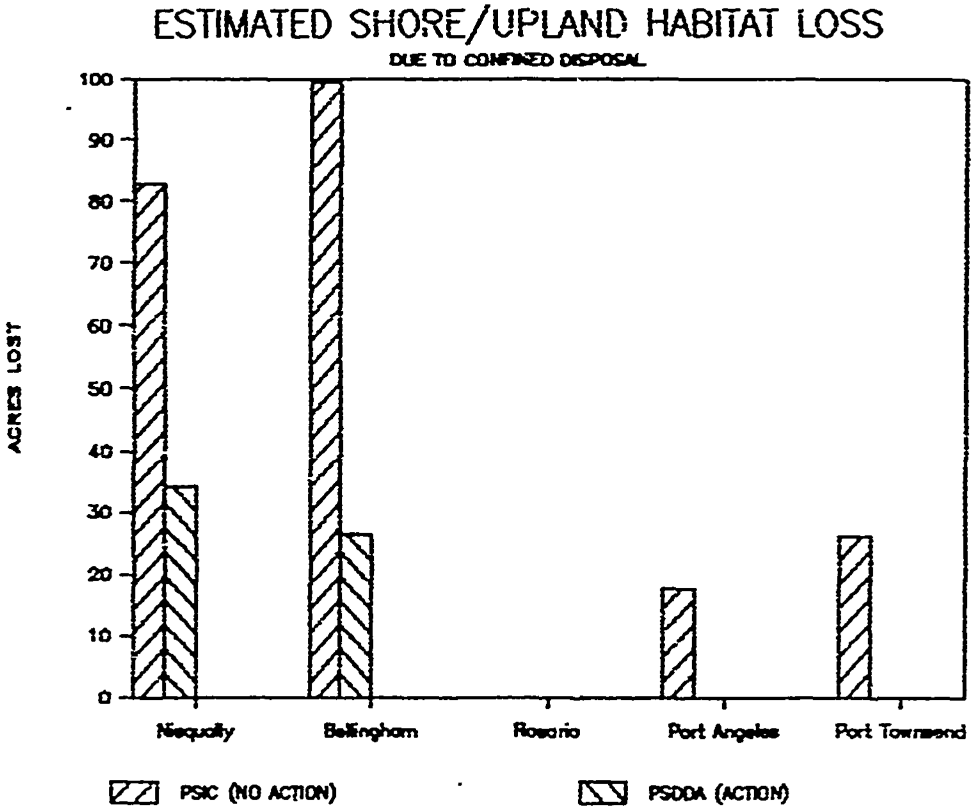


FIGURE 4.2 Estimated habitat losses associated with confined disposal under the Action and No-action alternatives. Note: these acreages are unadjusted for possible beneficial uses. It is not possible to predict the extent to which the materials could be used in construction.

concern. Short-term water quality impacts would be experienced during disposal operations of any material allowed for unconfined, open-water disposal. However, these impacts are expected to be minimal and would only occur onsite; that is, within the specified dilution zone (see MPR, chapter 7).

Other impacts to marine water quality may arise from two potential sources: (1) release of chemicals of concern in effluents produced during dewatering of dredged material preparatory to confined upland disposal or from uncontrolled runoff of an upland or nearshore confined disposal site and (2) release of chemicals of concern via leachate from confined sites which could enter ground water and eventually seep to marine waters. Impacts from these sources on marine water quality could be significant, but are likely localized around outfalls or seeps. The level of chemicals associated with effluents can be controlled through a variety of technologies, including construction of weirs and settling ponds (see Cullinane, et al., 1986).

(b) Freshwater and Ground Water. Impacts to freshwater and ground water quality can arise from two potential sources: (1) release of chemicals in effluent during dewatering preparatory to confined upland disposal or from uncontrolled runoff and (2) release of chemicals via leachate from confined sites which enter ground water. Impacts from effluent or uncontrolled runoff depend upon the type of water (e.g. hardness of the water) and the quality of the receiving waters. The degree of chemical release associated with effluents can be controlled through a variety of technologies including construction of wiers and settling ponds (see Cullinane, 1986).

Significant adverse impacts to ground water are possible from leachate at the disposal site. Because of the geochemical changes that are associated with drying of the formerly saturated materials and oxidation, chemicals in dredged material may be mobilized. This concern exists also for dredged material determined suitable for unconfined, open-water disposal should it be dried, because of oxidative changes that occur in air. Impacts associated with leachate chemical release will be greater with the no-action alternative than with any of the action alternatives. Inorganic chemicals and organic compounds, may impact ground water quality through leaching. The magnitude of the impact of leachate production on ground water quality depends on the chemical composition and physical characteristics of the dredged material, the characteristics of the containing soils, and the potential uses of underground receiving waters.

Compared to the action alternatives, the no-action alternative would place nearly four times as much material on land and nearshore environments. The risks to ground water would also be proportionately greater. Greater volumes will affect more acreage, and increase the potential for releases to the ground water. Additional acreages and additional confined sites would threaten technological controls and monitoring at the sites. While the mean concentration of chemicals released into the ground water would be higher with small volumes of more contaminated material than with larger volumes of less contaminated material, the mass release rates of contaminants would be substantially higher with larger volumes of cleaner material. Mixing of materials to achieve a true mean concentration has proven difficult. Consequently, more material placed on land, even if cleaner, would cause greater potential impacts to ground water.

Chemical release to the ground water via leachate can be controlled through a variety of technologies: leachate collection systems and construction of liners which inhibit production and movement of leachate to ground water. Leachate production can be reduced by placing dredged material below the water table (usually more of an option for nearshore/intertidal disposal), which reduces mobilization of particle-bound contaminants, preventing oxidation. Although control technologies exist for ground water protection, the costs associated with their construction are prohibitive. The need for control technologies must be determined on a sediment-specific, project-specific basis.

(2) Currents and Sediment Transport. Little or no impact on transportation of sediments would be expected under this alternative, since the currents would be unchanged. The net effect of no action on sediment disposal would be to somewhat reduce the amount of sediment disposed in the vicinity of a relatively larger number of single-user sites. Accordingly, there would be less total sediment entering the water for currents to transport.

(3) Marine and Estuarine Sediments. Little impact to marine and estuarine sediments is expected under this alternative because of the relatively small volume of material that would be placed in unconfined, open-water areas. No significant increase in sediment chemical concentrations in deepwater of the sound would be expected since material disposed in open water under this alternative would meet PSIC chemistry values.

For land and shore disposal, adverse impacts might occur at the outfall of the effluent discharge where fine particles associated with the effluent would settle. These impacts could be substantially avoided by providing controls to reduce release of suspended particles and particle-bound contaminants during dewatering and by limiting rain water intrusion and runoff.

(4) Air Quality. Under the no-action alternative, air quality could be impacted by exhaust emissions from tugboats in transport to unconfined, open-water sites, or actions associated with the upland and nearshore placement of material dredged. Overall impacts to air quality are expected to be minor, of short-term duration, and confined to the area around the disposal site.

Impacts could also arise from the volatilization of chemicals from the dredged material during dewatering and drying preparatory to upland disposal or through the transportation of contaminants as fugitive dust particles from the surface of the disposal site when winds or heavy equipment disturb it. These potential problems could require capping or plantings to control dust production. Release of combustion products in exhaust emissions from trucks and other heavy equipment are also expected to affect air quality near sites of construction and disposal. The impact of exhaust emissions on local air quality would depend upon whether site is rural or urban and upon local atmospheric conditions.

(5) Land. Disposal of dredged material under this alternative could significantly impact land development and values in the Puget Sound Region. Under the no-action alternative, over the period 1985-2000 approximately 3.7 million c.y. of dredged material would require confined upland and nearshore disposal depending primarily on whether material passing PSDDA disposal guidelines would be economically justified to go to a Phase I PSDDA site. An estimated 225.8 acres of nearshore and/or uplands would be needed to handle this material. The amount of land available for use as disposal sites in environmentally and publicly acceptable areas is limited. Thus, some dredging projects might not be undertaken.

Any development of remaining nearshore area for dredged material disposal sites would potentially result in significant adverse impacts to critical and limited nearshore lands and their ecological values. Throughout Puget Sound between 1970 and 1980, 76 percent of the material dredged by the Corps was placed in upland/nearshore fill sites, most of which were near shore areas. From 1980 to 1985, the percentage of dredged material placed in upland/nearshore areas dropped to 46 percent. The primary reasons for this decrease were the lack of acceptable sites, public opposition to usage of nearshore lands, and concerns over loss of habitat for aquatic species (principally salmonids and waterbirds). Therefore, most or all of the acreage forecast as required for confined disposal under this alternative would likely be upland.

b. Impacts and Their Significance to the Biological Environment.

(1) Benthic Communities, Flora.

(a) Marine Intertidal and Subtidal. Impacts that could occur to intertidal species under the no-action alternative are associated with the unknown proportion of the estimated 225.8 acres of upland/nearshore confined disposal that could occur in nearshore vegetated areas. This unknown proportion is expected to be small due to general unacceptability of nearshore confined disposal sites. Other impacts that could occur to subtidal macroalgae and eelgrass would primarily be due to physical disturbance due to more individual disposal sites and short-term pulses of suspended materials from return flow from upland disposal dewatering that could interfere with photosynthesis by reducing light availability. Both of the latter impacts would be minor, confined to the area around the outfall, and can be reduced through proper control of effluent discharge. As noted below in 4.02b(3)(a), a relatively larger area of bottom could be physically impacted due to more single-user sites.

(b) Terrestrial. Potentially significant adverse effects to terrestrial plants may be associated with dredged material disposal under this alternative, since most dredged material would require confined disposal in upland or nearshore environments and could amount to a total of 225.8 acres of habitat disturbed or lost. Disposal site construction would result in destruction of the existing habitat, including removal of vegetation and possibly excavation of topsoil which may be used to construct dikes, berms or stored for later use as a soil cap (Canter, et al., 1977). The impacts to plant communities under the no-action alternative are greater than those associated with the action alternatives because of the amount of habitat lost due to construction.

Following upland disposal, adverse impacts to plants recolonizing the area may occur. High salt content and the presence of chemicals of concern may hinder successful germination and growth of many plant species. In addition to slowing or preventing reestablishment of plant communities onsite, vegetation around the perimeter of the disposal area may show chronic impacts as a result of salt seepage (Harrison and Chisholm, 1974).

Once a disposal site is no longer in use, remedial actions can be undertaken to rehabilitate the land, although this is often difficult and costly to accomplish (Gosselink, 1973). Sites can be seeded with saline-resistant plants or covered with enough top soil to act as an effective barrier between establishing plants and the dredged material. Additionally, dredged material can be plowed and limed to condition soils prior to establishment of vegetation (CZRD, 1978).

The uptake and accumulation of chemicals of concern in the tissue of plants established on dredged material sometimes results in adverse effects to animals utilizing the site for forage area. In turn, these animals could transport chemicals offsite.

(2) Plankton Communities.

(a) Marine Phytoplankton. Only temporary impacts to marine plankton are expected under the no-action alternative, since only small volumes of relatively clean dredged material would be placed at unconfined, open-water sites. Impacts could result from intermittent pulses of suspended or dissolved chemicals that could modify potential for primary production by reducing light, or stimulate growth of nuisance species by temporarily raising nutrient levels in the water column. Because of the small volumes and low chemical loads expected with dredged material allowed for open-water disposal, no significant chemical impacts would be expected. The overall impacts on primary production would be insignificant, and probably not measureably different from impacts associated with the action alternatives.

(b) Zooplankton. Few impacts to zooplankton are expected under the no-action alternative, since only small volumes of clean material (meeting PSIC values) would be placed at open-water sites. Principal impacts to zooplankton could result from suspended particles physically interfering with zooplankton filter-feeding mechanisms. In addition, zooplankton in the immediate area of disposal activity could become entrained and damaged or killed by falling dredged material. The overall impacts on zooplankton are expected to be insignificant, of short duration, and typically would occur only within the mixing zone. Impacts to zooplankton under this alternative would be less than under the action alternatives.

(3) Invertebrates.

(a) Benthic Infaunal Resources. Marine invertebrate communities would be impacted by unconfined, open-water disposal activities undertaken with this alternative. Principal impacts would be temporary loss of benthic communities due to burial or smothering by falling clumps of dredged material. In the 15-year project period, only a rather small quantity of dredged material (2,066,000 c.y., with very low concentrations of chemicals of concern) is expected to go to open-water, unconfined disposal under this alternative. Disposal of this material would not result in unacceptable adverse effects to the marine resources of Puget Sound due to chemicals in the sediment. However, since individual sites would be established by each dredger, a much larger number of disposal sites are possible under the no-action alternative. Cumulative impacts from disposal at a large number of sites could be significant. If each project's disposal occurred at a separate location, considerably greater total bottom habitat could be temporarily disturbed than under the action alternatives.

Assuming that dredged materials from 30 separate projects (approximately 70,000 c.y. each) were discharged as separate locations with individual impact areas of 300-800 acres, a range of 9,000 to 24,000 acres could be physically impacted by these projects. This suggests a greater aerial physical disturbance of benthic habitats under the no-action alternative as compared to that associated with the action alternatives (2,996 total acres impacted). It is not possible to predict the value of the affected habitat, partially because it is unknown where (in high or low value areas) disposal would take place. Given the difficulty PSDDA's Disposal Site Work Group had in locating sites with low habitat values in the Phase II area, it may be estimated that some of the no-action sites would impact substantial resources. However, since disposal activity in any area would be of short duration and material disposed would be relatively free of chemicals of concern, rapid recolonization and recovery of each disposal area is expected.

(b) Intertidal. Intertidal invertebrates would be more impacted than in the action alternatives because it is anticipated that there would be more confined disposal site developments in the nearshore environment under the no-action alternative (tables 4.3(a) and 4.3(b)). Physical impacts to sedentary species from nearshore dredged material disposal would result in loss of intertidal communities due to burial during disposal.

Impacts to intertidal benthic species located outside the diked area and near the dewatering return flows are also possible. Effects observed at a nearshore site outfall are not expected to be lethal, but instead could result in lessening of animals reproductive capacity or increasing body burdens of chemicals. The level of impact would depend on leachate concentrations of chemicals of concern.

(c) Mobile Crabs and Shrimp Resources. Few impacts would be expected to mobile invertebrate resources under this alternative. Impacts to shrimp and crab resources would be due to burial. This impact is anticipated to be minor, and would not adversely impact Puget Sound crab and shrimp resources. No impacts are expected due to dredged material chemicals.

(4) Anadromous and Other Fish.

(a) Anadromous Fish. No adverse effects are expected under the no-action alternative to anadromous fish due to unconfined, open-water disposal. However, significant impacts to anadromous fish could occur under the no-action alternative should nearshore habitat areas be used as confined disposal sites. Development of nearshore for confined disposal of dredged material would likely permanently remove the area as valuable habitat for juvenile salmonids. Outmigrating juvenile salmon use shallow water nearshore areas as feeding habitat, as well as for cover from predators. Construction of dikes designed to contain dredged material will reduce the extent of shallow water bottom surface available as feeding habitat. The density of nearshore preferred prey items and the diversity of species would also be reduced through disposal site construction. Any reductions in undeveloped nearshore habitat would influence survival of juvenile salmonids.

Juvenile salmonids are opportunistic carnivores, feeding primarily upon epibenthic invertebrates. Impacts to outmigrating juvenile salmon can also occur through the accumulation of chemicals obtained feeding upon benthic species found near effluent outfalls associated with nearshore disposal operations (Malins et al., 1986). Effluent outfall areas are often inhabited by dense aggregations of pioneering benthic invertebrate communities. Such benthic communities act as a feeding attractants and, should chemicals of concern be present, could expose juvenile salmonids to the chemicals.

Changes in water quality associated with effluent discharge might also alter or delay patterns of migrating behavior through avoidance. Impacts due to these effluent discharge may, however, be minimized through a variety of control technologies designed to reduce losses of associated particles and contaminants from the disposal site (e.g., Cullinane, 1986).

(b) Bottom Fish Resources. Little impact to bottom fish resources is expected under this alternative since feeding habitats would only be temporarily physically affected by open-water disposal. Disposal of material could temporarily reduce benthic resources through burial; however, the impacted area would soon recolonize and again be available as foraging habitat for bottom fish.

For nearshore disposal, adverse effects to bottomfish resources are comparable to those experienced by anadromous fish resources. Loss of habitat and possible effects near outfalls would occur are associated with this disposal option.

(c) Freshwater Fishes. Possible significant adverse impacts to freshwater fish species could occur with the disposal of dredged material under the no-action alternative. Almost all dredged material would require confined disposal in upland and nearshore environments. Disposal of dredged material in upland environments can result in exposure of freshwater fish to resuspended dredged material and to dissolved chemicals that would not necessarily be released if left in a marine environment. Impacts to freshwater fish would be a direct result of the introduction of effluent or leachate discharge into freshwater habitats. Two sources of impacts are associated with effluent discharge: (1) impacts due to increases in turbidity and siltation, and (2) impacts due to increases in chemical concentrations.

Fish species in general, and freshwater game fish in particular, have low tolerances for increases in turbidity (Canter, et al., 1977). Fish mortality due to asphyxiation often results from the fine particles settling on the gill filaments (Sherk and O'Connor, 1975). Eventual reductions in fish population size and possibly species elimination in a locality have been observed as a result of increasing turbidity in streams with formerly low levels of suspended solids (Hollis et al., 1964).

Another significant adverse impact due to turbidity and siltation on fish populations is the reduction in spawning ground habitat (Hollis et al., 1964). Ripe fish will abandon previously used spawning grounds if siltation is high, apparently avoiding suffocation of their fertilized eggs through reduced oxygen exchange.

Freshwater fish are generally more sensitive to chemicals than marine species, and thus, are more susceptible to effluent runoff from confined disposal sites. In addition, toxic metals are more readily available for uptake by organisms in soft freshwater than in hard saline waters.

The impacts associated with both turbidity and chemical release can be reduced with the use of weirs and holding ponds which act to limit particulate loads prior to discharge.

(5) Waterbirds. See section 3.01b(5) for a general discussion of waterbirds in Puget Sound. Potential direct impacts of open-water disposal on waterbirds include the following localized and temporary impacts: avoidance, during disposal, loss of access to prey source, and some effects on intertidal organisms from drift of suspended dredged material. Turbidity limits visibility and therefore makes feeding more difficult. Waterbirds will avoid the turbidity plume and feed elsewhere. Benthic resources at the probable deepwater disposal sites are generally not utilized as food by waterbirds as few birds dive greater than 100 feet (although cormorants and loons may). Furthermore, stomach samples of deep-diving birds indicate that bottomfish generally comprise only a small proportion of the total diet. Thus, these birds primarily utilize free swimming fish such as herring and smelt. Should the disposal areas be utilized by waterbirds and not fully recolonize, the total area of impact would still be small relative to the potential feeding

area in Puget Sound. The potential loss of intertidal organisms from the shoreward drift of suspended material is considered to be minimal and will not affect waterbirds.

Direct (disturbance) impacts on waterbirds from disposal activities would not be anticipated because presumably these disposal areas would not be located in areas of high bird use. Even if birds were disturbed by the vessels, they would likely not move far. On rare occasions such disturbance might take them away from a sizeable temporary food source, such as a "herring ball" (large school of herring or other species of small fish). These birds would then experience a temporary loss of easily captured prey. Also, the disposal craft are (typically) a barge and a tug, common vessels in Puget Sound, to which birds are quite accustomed. Gulls will often flock to barges, particularly if the material in the barge contains exposed animals such as small fish or crustaceans that were caught in the dredge.

(6) Endangered and Threatened Species. Bald eagles may experience adverse impacts from disposal activities under this alternative should eagle feeding, perching or rearing habitat (forested areas) be used to create upland disposal sites. Although it is established that bald eagle reproduction has been seriously affected by biologically magnified concentrations of chlorinated pesticides, it is unknown whether chemicals associated with dredged material placed at an upland site might be biomagnified in the food chain to affect bald eagles (most Puget Sound sediments tested to date have had low concentrations of chlorinated pesticides). Eagles feed on a wide variety of prey items including fish, birds, mammals, and invertebrates. Toxins from any particular group of prey (such as those species found at an upland disposal site) would not significantly impact this species providing animals from the disposal site do not account for a disproportionate share of the diet of the bald eagles. Of the alternatives considered in the EIS, the no-action alternative represents the greatest risk of potential impacts to bald eagles. The significance of these potential impact would depend on the location of the upland or nearshore disposal site(s) and the chemicals' biomagnification potential.

Similar impacts may be anticipated for peregrine falcons; impacts would probably be less severe and less likely. Peregrines are more locally distributed than bald eagles, and upland disposal sites would be less likely to be near peregrine use areas. Peregrines feed almost exclusively on small birds, especially small waterfowl and shorebirds. Their feeding strategy is to dive into large flocks, either surprising the prey, or out-flying a slower member of the flock and overtaking it. The sites used for upland disposal are unlikely to attract such flocks of waterfowl or shorebirds, either before or after disposal. During site selection, it is presumed that a proposed site that had such use would be recognized as an important concentration area, and would not be used for disposal. Following disposal, such an area is not likely to attract large numbers of shorebirds, unless the area is maintained with a constant water body to attract waterfowl. Peregrine nest locations are closely monitored by the Washington Department of Wildlife (WDW). If a disposal area were proposed that could affect a nest site, the WDW would object to assure that the nest would remain unharmed. The greatest threat to peregrine falcons from upland disposal is the possible loss of trees that could be used for roosting, hunting and feeding, or resting. Most of these locations are known, and would likely be protected from potential dredged material disposal.

(7) Marine Mammals. See section 3.01b(4) for a general discussion of marine mammal distribution in Puget Sound. No significant impacts to marine mammals are expected from the no-action alternative. All past disposal areas became unavailable on April 30, 1989. In the absence of the PSDDA disposal sites, dredgers would be required to locate individual disposal sites and satisfy the Puget Sound Interim Criteria (PSIC, see section 4.02a(1)). Interim single-user disposal sites would require the approval of all concerned Federal and State resource agencies prior to use. Criteria for site selection using mammal and bird concentrations are lacking for most of the Phase II area, except as shown and referenced in the PSDDA Phase II documents. A potential for impacts to marine mammals exists at the numerous single-user sites due to the lack of identification of critical marine mammal use areas, and subsequent placement of a disposal site in or near such an area. Also, for each single-user disposal site selection, a coordinated environmental assessment or impact statement would be required.

Some direct, but relatively minor, impacts could occur from any dredged material disposal operation under the no-action alternative. These include short term and localized effects of turbidity on food organisms, and also prey location by marine mammals, the effects of noise, and the danger of boat collisions with marine mammals. All of these potential effects are considered minor because disposal activities occur infrequently, are short term (an hour or less), and because marine mammals are mobile and can easily avoid the area.

For a general discussion of endangered cetaceans in Puget Sound, see section 3.01b(6). As described in the biological assessments in exhibit A, no impacts to these mammals are anticipated due to the strong likelihood they will not be present at the same time that disposal operations are occurring. National Marine Fisheries Service concurred with these findings in July of 1988.

(8) Terrestrial Fauna.

(a) Terrestrial Wildlife. This EIS does not deal, except in a generic way, with the consequences of upland disposal. Ecology is pursuing two SEPA EISs in support of its effort to establish confined disposal regulations and designation of public multiuser confined disposal sites. Significant adverse impacts to terrestrial wildlife may be associated with this alternative, moreso than with any PSDDA alternative due to the generally more restrictive criteria for open water disposal under the PSIC. This would result in a larger quantity of material going to upland disposal. Development of upland and nearshore confined disposal sites could involve the destruction of wildlife habitat. The types of wildlife and number of species impacted by site construction would depend on the specific type of habitat being destroyed. Disposal site construction on an open field would generally impact smaller-sized animals and relatively less diverse communities than would be expected if forested land were utilized as sites for confined disposal. The significance of the impact to terrestrial species will depend upon the availability of nearby habitat (and its carrying capacity) to assimilate displaced wildlife.

Following its use as an upland disposal site, the land could become usable once again as habitat for wildlife, providing the land were reclaimed. Toxic effects could appear in animals utilizing the site should plants recolonizing the site accumulate chemicals from the dredged material. Terrestrial effects are outside the scope of the PSDDA study and will need to be addressed in detail in environmental documents and permits required for use of upland disposal sites.

(9) Terrestrial Birds. Terrestrial birds could be adversely impacted under this alternative because of a probable reduction in suitable habitat due to construction of confined upland and nearshore disposal sites. Following reclamation of the area after the life of the disposal site, toxic impacts to terrestrial species could potentially occur due to ingestion of plants and animals that have accumulated chemicals of concern from the dredged material.

c. Impacts and Their Significance to the Human Environment.

(1) Social and Economic Features. Some adverse impacts could be anticipated to waterborne commerce movements in the Phase II study area and related port terminal and industrial development. Impacts would be due to delays in dredging cycles and foregone benefits of some dredging projects because of the costs associated with dredging and dredged material disposal under this alternative. The significance of these impacts may include loss of jobs and property tax base devaluation. The Dredging and Disposal Activity paragraph (paragraph 4.02c(3) below) presents a comparative analysis of the costs associated with this alternative. Impacts to land and beach use could also be expected if nearshore and upland sites are developed on preferred recreational sites.

(2) Transportation.

(a) Navigation. Delays in dredging (due to costs associated with dredged material disposal in upland/nearshore sites), would have an adverse impact on navigation activity due to channel shoaling. Shoaling could eventually reach the point that commercial and recreational traffic would be impaired, causing severe regional socioeconomic hardships to the private and public sectors. The high cost of confined disposal relative to unconfined disposal (three to ten times more expensive), would result in some projects not being constructed. Because data were not available for specific projects, the analysis contained in the EIS does not address this. The analyses presume that all forecast dredged material will be removed and placed in a disposal site, confined or unconfined.

Foregone benefits for new projects and economic impacts for maintenance projects due to cessation of dredging are dependent on project-specific factors. With the sparse information available it is not possible to quantify these potential adverse effects of no action.

(b) Land. Impacts to land transportation would be greater under this alternative than the action alternatives since all dredged material not delivered to a nearshore disposal site by pipeline would be trucked to a disposal site. Truck traffic congestion could impact normal traffic flow.

(3) Dredging and Disposal Activity. The impact of the no-action alternative on dredging and disposal activity would depend on the availability of upland and nearshore confined disposal sites, and the costs associated with disposing the majority of most dredged material at confined sites. These factors would greatly influence the feasibility of a specific dredging project. For some dredging areas, added cost per cubic yard would be prohibitive.

Public multiuser, large capacity, confined disposal sites are not presently available in the Puget Sound area. Availability and feasibility of nearshore areas such as tidelands, fill at piers, and upland sites are dependent on public acceptability and Federal and State regulatory agencies' willingness to allow such sites. Acquisition and preparation of suitable sites would likely be cost prohibitive should the volumes required by confined disposal reach 3.6 million c.y. as suggested by this alternative.

(4) Native American Fishing. Should significant portions of nearshore areas be used as disposal sites, Native American "usual and accustomed grounds and stations" for fishing could potentially be impacted. Stations for setting stationary gill nets would be reduced with the construction of shoreline disposal sites. Contrary to short-term impacts to salmonid fisheries that are possible with unconfined, open water disposal of dredged material, losses of shoreline associated with confined nearshore disposal facilities under this alternative could be long lasting (for the life of site use and rehabilitation) or could result in a permanent removal of the tidelands from production.

The potential for traffic conflicts between dredged material disposal activities and Indian fishing would be less under this alternative than in the action alternatives since few barges would be in transit to open-water disposal sites. There could be traffic conflicts during nearshore disposal when barges are used to transport material to the sites. Provision of PSDDA regarding 404 permit specifications to prevent conflicts with Indian treaty fishing activities would be lacking under the no-action alternative (see section 4.03c(4)).

Impacts to biological resources of concern to Native Americans are discussed in Section 4.02.b., Impacts and Their Significance to the Biological Environment.

(5) Non-Indian Commercial and Recreational Fishing. The limited unconfined, open-water disposal activity that would result with the no-action alternative will produce no significant adverse effects to non-Indian fishing activities. Nearshore confined disposal sites, on the other hand, could result in displacement of shoreline sports fisheries. The potential for this displacement to occur, and the severity of the effects, would depend on specific site locations.

(6) Human Health.

(a) Via Seafood Consumption. No impact on human health is anticipated from the consumption of seafood impacted by disposal activities under this alternative. Little unconfined, open-water disposal of dredged material would take place and the material allowed for open-water disposal would be relatively free of chemicals of concern. Some impacts might occur due to chemicals associated with effluent discharge from confined disposal sites; however, such impacts would be localized to the immediate site of the discharge.

(b) Via Drinking Water. When dredged material containing chemicals of concern is placed in a confined nearshore or upland disposal facility, the potential exists to generate leachates that could have an adverse effect on ground water and surface drinking water. This can occur even with material that is suitable for unconfined, open-water disposal due to oxidation changes upon drying. Under the no-action alternative, most dredged material would be placed in a confined site. Because of this, the potential for major impacts on drinking water supplies exists if protective design features such as leachate collection systems, effluent control, or runoff control should not be used. The potential of contamination of aquifers used for drinking water is greater under this alternative than under the action alternatives.

(c) Via Inhalation of Dust. Dredged material placed on nearshore and upland disposal sites provides a potential source of fugitive particulates (dust) which, should they contain chemicals of concern, could have an impact on the health of workers at the disposal sites. Inhalation of dust can also be a problem at closed disposal sites that are being prepared for subsequent uses. Impacts to human health from inhalation of such dust may be minimized by dust suppression techniques and application of suitable ground cover.

(d) Via Direct Exposure. Little direct exposure to contaminated dredged material is expected. The only segment of the population that might be expected to come into contact with dredged material are workers directly involved in dredging operations or at upland and nearshore disposal facilities.

(7) Noise. Few noise impacts are expected at open-water disposal sites because of the low level of open-water disposal activity expected under the no-action alternative. The most significant noise impacts would occur with activities associated with upland and nearshore disposal operations.

Truck traffic would be greatest under this alternative and an increase in noise level could thus occur near disposal sites. The significance of noise impacts will depend on whether the sites are located in rural, urban, or industrial areas.

(8) Esthetics. Disposal operations at open-water sites are not expected to significantly affect the esthetic quality or experience in Puget Sound. Open-water disposal would not occur to a significant degree since a very little volume of dredged material would be disposed under this alternative at open-water sites. When open-water disposal does occur, operations will represent a minor part of day-to-day marine activities.

Esthetic qualities on land, however, could be significantly impacted by disposal operations under this alternative. Viewers may be distracted by development of confined upland or nearshore disposal sites and by the operations activity that would occur during disposal. The degree of impact on esthetic quality will depend on disposal site placement. Sites developed in industrialized areas are likely to have less impact than sites developed in open or forested land or along shorelines.

(9) Cultural Resources Impacts. As part of the studies to determine suitable sites, a literature search occurred to establish whether any historically significant shipwrecks are located within the Phase II area in the vicinity of the selected action-alternative sites. Since the no-action alternative involves a potentially large number of single-user sites which are not covered by this literature search, the potential for impacts to submerged historic properties eligible for the National Register of Historic Places is unknown.

d. Cumulative Impacts. A variety of cumulative effects to the environment could occur under the no-action alternative. These are, generally, (1) effects that are due to unconfined, open-water disposal and (2) effects that are due to confined disposal of material defined as unacceptable for unconfined, open-water disposal.

Permitting authorities would only allow open-water disposals to occur if their adverse impacts would not be individually significant. However, this would be determined on a case-by-case basis, and less overall control or consideration would be given to whether cumulative physical effects were becoming significant than under the PSDDA soundwide program. Because the only material that could be disposed in water would have very low (background) chemical concentrations, full recovery from any physical benthic habitat disturbance would occur rapidly. It is therefore likely that cumulative effects due to unconfined, open-water disposal would not become significant under the no-action alternative.

In contrast, cumulative effects due to confined disposal of 3.65 million c.y. of dredged material would be more significant than under the action alternatives. The most significant contribution to cumulative effects resulting from open-water disposal would derive from construction and operation of nearshore disposal sites. The construction of such sites could affect valuable shoreline habitats that serve a variety of critical functions to different life history stages of many important Puget Sound species. Such sites can also affect wetland habitats that serve many cricical functions, and alro have suffered significant levels of cumulative effects.

An estimated 225.8 acres of upland/nearshore habitats are likely to be required in the PSDDA Phase II area for confined disposal under this alternative (table 4.2). To the extent that the habitats described above are included with this acreage in future permit requests, a variety of impacts could occur. Nearshore disposal could contribute to cumulative impacts on spawning and juvenile rearing habitat for marine and anadromous fish, spawning and cover habitat for commercially important invertebrate species such as Dungeness crab and shrimp, habitat for shellfish such as clams and oysters, and feeding for shorebirds. Disposal at upland sites could potentially affect ground water quality via leachate with chemicals of concern, surface water quality if runoff carries chemicals from the sites, and freshwater aquatic resources if surface water quality is degraded to the point that long- or short-term toxic effects occur. In addition, losses of upland habitats themselves can be significant, if high value habitats cannot be entirely avoided when selecting the sites.

Until studies can be undertaken to identify multiuser confined disposal sites, it will not be possible to determine the degree to which upland, nearshore, or wetland habitats may actually be affected. However, the no-action alternative has the potential to affect the greatest amount of these habitats because it would require the greatest volume of material to receive confined disposal.

e. Relationship to Existing Plans, Policies, and Controls.

(1) Clean Water Act, Sections 404/401. Because of the very low chemical levels expected in material allowed for unconfined, open-water disposal under the no-action alternative, identification of suitable open-water disposal sites would also be consistent with 404(b)(1) guidelines. Consistency of all upland/nearshore disposal sites to 404(b)(1) guidelines would need to be evaluated on a project-by-project basis. The same is true for State water quality certification pursuant to Section 401.

(2) Coastal Zone Management. The Coastal Zone Management Act (CZMA) (Public Law 91-583: 86 Stat. 1280) was passed by the United States Congress in 1972. In June 1976, the State of Washington Coastal Zone Management Program (CZMP) was approved to receive funding allowing the CZMA to be implemented via the State Shoreline Managment Act (SMA) of 1971. As passed by the State legislature, the SMA provides "for the management of Washington's shorelines by planning and fostering all reasonable and appropriate uses." The SMA is implemented through detailed planning efforts that culminated in the Shoreline Master Programs (SMP) for the large municipalities and counties of the State. Consistency of the no-action alternative with the SMA and the current State CZMP, and satisfying consistency with State and Federal CZM requirements, would depend on where unconfined, open-water disposal sites were

located. Dredging projects which could affect other lands under jurisdiction of CZMP would have to be evaluated on a project-by-project basis.

(3) Shoreline Master Program. Shoreline permits for use of open-water disposal sites for dredged material disposal under the no-action alternative would be obtained from the appropriate local shoreline jurisdiction, on a case-by-case basis.

(4) Department of Natural Resources (DNR) Policy on Open-Water Disposal of Dredged Material into Puget Sound. Under the no-action plan, no multiuser sites would be available. Although no designation of a general use site would be made by DNR, any proposal for an open-water disposal action would require review and approval by DNR.

(5) Executive Order 11990, Protection of Wetlands. The intent of Executive Order 11990 is to protect wetlands because of the significant cumulative losses that have occurred, and due to their high value to biological productivity and their other critical functions. Wetlands could be directly affected by the no-action alternative. Dredging projects which could affect wetlands would be evaluated on a project-by-project basis at the time the project is reviewed for Section 404 permits. The no-action alternative would increase the potential for projects affecting coastal wetlands relative to the action alternatives. Because of national policies regarding no net reduction in existing wetland area, there would likely be mitigation required.

(6) Executive Order 11988, Flood Plain Management. The intent of E. O. 11988 is to provide guidance and regulation for projects located in, or affecting, the flood plain. E.O. 11988 requires, to the extent possible, avoidance of long- and short-term adverse impacts associated with occupancy and modification of flood plains. Disposal of dredged material in upland and nearshore sites could impact a flood plain; however, disposal siting would need to be evaluated on a site-by-site basis to ensure compliance with E.O. 11988.

(7) Puget Sound Water Quality Management Plan. The Puget Sound Water Quality Comprehensive Plan was adopted December 17, 1986 and the plan was upated and adopted on October 19, 1988. The contaminated sediment and dredging program of the plan contains a sediment program goal "to reduce and ultimately eliminate adverse effects on biological resources and humans from sediment contamination throughout the Sound by reducing or eliminating discharges of toxic contaminants and by capping, treating, or removing contaminated sediments." The plan also adopts the following policies which shall be followed by all State and local agencies in actions affecting sediment quality, including rulemaking, setting priorities for funding and actions, and developing permit programs:

> "All government actions will lead toward eliminating the presence of sediments in the Puget Sound basin that cause adverse effects to biological resources or pose a serious health risk to humans."

"Programs for management of dredging and disposal of sediments should result in a net reduction in the exposure of organisms to adverse effects. (The intent of this policy is that dredging and disposal contribute to the cleanup of the Sound by allowing unconfined, open-water sites to have only low levels of contamination and to dispose of more contaminated sediments in a manner that prevents continued exposure of organisms to adverse effects. For proposals where dredging will expose contaminated sediments, project-specific mitigation measures may be required."

"Sediment cleanup programs (which may include capping inplace) shall be undertaken when reasonable to reduce, with the intent of eliminating, the exposure of aquatic organisms to sediments having adverse effects. (Element S-7 directs Ecology to develop a decision process which will resolve the question of when cleanup actions are 'reasonable')"

The no-action alternative fully complies with the above goal and policies. Dredged material discharged in the Sound would not contain chemicals of concern at levels that would result in observable adverse effects to biological resources.

(8) American Indian Religious Freedom Act. The American Indian Religious Freedom Act of 1978 (AIRFA) requires Federal agencies to ensure that none of their actions interfere with the rights of individual Native Americans (including American Indians, Eskimos, Aleuts, and Native Hawaiians) to believe, express, and exercise their traditional religions. These rights include access to religious sites, use and possession of sacred objects, and the freedom to worship through traditional ceremonials and rites. AIRFA requires consultation between Federal agencies and Native Americans to ensure that federally-supported projects or projects on Federal land do not infringe on the religious practices of Native Americans.

Coordination between PSDDA agencies and potentially affected tribes has occurred throughout the study, and is an ongoing process.

(9) Canadian Acts Regulating Open-Water Disposal. The applicable laws and regulations are described under the discussion of the action alternative for Port Angeles (section 4.12e(9)). Allowable levels of chemicals of concern in the Canadian regulations and laws for open-water disposal are generally higher than either PSIC and applicable PSDDA disposal guidelines. The no-action alternative would comply with these laws, which (while not strictly applicable) are important to consider in light of Canadian-United States treaties on anadromous fish and commitments under the London Dumping Convention.

f. Probable, Irreversible, and Irretrievable Commitments of Resources. Use of the numerous, single-user unconfined open-water disposal sites would result only in an intermittent and temporary degradation of the quality of the sites' air, noise, and water resources. Additionally, intermittent use of the water surface area of the sites during disposal operations represents a commitment that may not always be in agreement with unforeseen future plans for the area. However, none of these impacts are irretrievable commitments of resources.

While fauna at the unconfined open-water sites could be buried, habitat and production values of the sites would not be irretrievably lost. Full recolonization is expected.

Plants and animals buried by upland and intertidal disposal of material that is unacceptable for unconfined, open-water disposal under no action are irretrievably lost. Ecological functions of lands filled may also be lost. While these sites are technically not irreversibly committed, in that removal of dredged material is possible with proper equipment, the lands have been committed to uses that would be very costly to reverse, and other uses of the sites may be precluded. Past experiences indicate that any lands filled for the purpose of industrial and business development are irreversibly and irretrievably committed.

Dredged material discharged to the open-water sites represents an irreversible commitment of resources to the extent that the material was potentially useful for beneficial uses or landfill. Again, though it is not technically impossible to remove the material, retrieval would be very costly and beyond the capabilities of usually available equipment.

Commitments of nonrenewable energy resources associated with the dredging program would be irreversible. In addition, the labor and capital necessary to conduct dredging operations would be irreversibly committed. This includes the dredging equipment, administrative personnel, and both skilled and nonskilled labor. However, energy and other commitments for individual dredging projects are decided by separate economic and social factors. Commitments of human resources would be essentially identical for both.

g. The Relationship Between Short-Term Use of Man's Environment and the Maintenance and Enhancement of Long-Term Productivity. The natural characteristics of north and south Puget Sound have been substantially altered in the past century due to settlement and expansion of Euro-American populations, principally in the present day urban bays. Prior human occupation had not notably impacted the sound's environment. Development and maintenance of navigation channels have contributed to an unknown extent to the impacts on the biological resources of the sound. These actions have generally been beneficial to the socioeconomic system, although at the expense of localized biological production. Use of the region's resources has been enhanced, resulting in development and maintenance of stable urban communities. Both beneficial and adverse effects to the environment have resulted from these developments.

Development and maintenance of navigation waterways and associated disposal of dredged material at unconfined open-water sites are largely short-term uses of the environment. From the human environment perspective, navigation maintains and enhances the socioeconomic conditions of the area by providing low cost tranportation, job security, and economic stability to industries linked to shipping. Many indirect benefits to local and regional economies result from these activities.

From the biological environment perspective, long-term productivity of the Sound would not necessarily be enhanced by the use of multiple unconfined open-water single user sites. Short-term losses associated with short-term uses include removal of aquatic habitats and displacement of species that utilize those habitats. Similar losses are experienced on land and shore for the other disposal options. Given the relatively small portion of the Phase II marine area that would be impacted by disposal at single user unconfined open-water sites, measurable or significant reductions in regional productivity is not anticipated. And though the lost productivity is not recoverable, the sites can return to production after their use is ended.

Increased environmental sensitivity and knowledge, coupled with more stringent environmental controls being enacted and enforced by agencies with jurisdiction, should result, in the long term, in reduced introduction of contaminants from human sources to the sound. As improved pollution source control reduces the release of contaminants into the nearshore areas of Puget Sound, overall improvement in sediment quality will follow. This should be reflected in a gradual increase in dredged material that would pass PSIC.

h. Mitigation and Amelioration of Adverse Effects. The no-action alternative does not result in selection of specific public multiuser disposal sites. Under the no-action alternative many undefined individual dispoal sites would be created. Individual mitigation would be required to deal with associated impacts. Site location and site management would be the primary mitigation (avoidance) measures associated with the no action. With proper siting and management of confined sites, potential biological resource and human use conflict problems could be mitigated.

Under the no-action alternative, the PSIC disposal site guideline would avoid discharge of sediments containing unacceptable levels of chemicals of concern and resulting in unacceptable adverse effects. This would fully comply with the applicable provisions of the State Water Quality Standards and the Clean Water Act.

SECTIONS 4.03 THROUGH 4.05

ENVIRONMENTAL EFFECTS OF THE ALTERNATIVES
CONSIDERED FOR NISQUALLY AREA (SOUTH SOUND)

4.03 Anderson Island/Ketron Island - Selected Alternative.

a. Impacts and Their Significance to the Physical Environment.

(1) Water Quality.

(a) Marine Water. Unconfined, open-water disposal activities at the selected Anderson Island/Ketron Island site will not significantly affect water quality conditions in the Nisqually reach area, which is a designated Class A water body, except for temporary and minor impacts in the immediate vicinity of the disposal site during disposal operations. The levels of dissolved chemicals in marine waters at the site (see section 3.01a(2)) are likely to undergo only minor and transitory increases at the time of disposal of dredged material. Most of the metals and organic compounds in the dredged material will remain adsorbed to sediment particles and will not become dissolved. Currents will also tend to blend the slight increases in dissolved materials into the normally low background solute levels, and to transport them according to net flows (northerly near the surface, southerly near the bottom).

Total suspended solids (TSS), which are related to optical turbidity in the water, will increase temporarily following a dump event. Calculations for a "typical" dump event at a 400-foot site with 30 cm/sec average current speeds show a suspended solids concentration due to the disposal event of 0.25 mg/l 1 hour after the dumping of a 1,500 cubic yard barge load of slurried clay/silt and fine sand (equal tc or less than 0.2 mm grain size). These concentrations would occur in the plume of sediments borne downcurrent. After 6 hours, the TSS concentration would drop to 0.007 mg/l, about 1/100 of background TSS levels found throughout most of Puget Sound (Phase II DSSTA). Slower currents than in this example occur at the Anderson Island/Ketron Island site, and will lower these projected concentrations due to quicker settling out of suspended particles. See section 4.03a(2) for further discussion of currents and sediment transport at this site.

The potential for dredged material to reduce water quality in the sea surface microlayer is considered to be minor. The sea surface microlayer is a critical habitat for developmental stages of many fish and invertebrates. It may also concentrate anthropogenic toxicants; there is evidence of reduced populations of fish and heightened chromosonal aberration rates in English sole embryos in urban bays in central Puget Sound and in Port Angeles harbor (Hardy, et al., 1987). While disposed dredged material is a suggested source of chemicals for the sea surface mircrolayer, chemical input rates to the microlayer are not reliably known. However, the contribution is not considered to be significant relative to other sources (Word and Ebbesmeyer, 1984; Word, et al., 1986). Contributions to the sea surface microlayer originate from a variety of sources, including air (particulate fallout, precipitation, gases, and animals) land sources (shoreline erosion, river runoff, discharge of sewage and industrial effluents, and spills from vessels and land based facilities), and nearshore sediments (upwelling, bubble scavenging of organic solutes, and biochemical transformations). Observations of shoreline contamination in Puget Sound implicate sewage discharges and street runoff as principal impacts to the sea surface microlayer (Word and Ebbesmeyer, 1984). A review of the literature on sea surface microlayer composition, sources, and impacts on phytoplankton and phytoneuston is presented in a PSDDA report (Word, et al., 1986). PSDDA evaluation procedures also call for consideration of need for water column testing on a case-by-case basis to ensure that dredged material disposal does not result in the release of unacceptable concentrations of chemicals into the water column, including the sea surface microlayer. Evaluation procedures use sensitive biological indicators when chemical levels are above the screening level to detect presence of chemicals which are potentially a problem, and these indicators serve to predict potential effects in the sea surface microlayer.

In addition, suspended dredged material may become incorporated in the mobile nepheloid layer which comprises a highly flocculent sediment layer that is found near the sediment/water interface. A quantitative estimate of the amount of disposed material that might become associated with the nepheloid layer is not possible; however, the level of contribution is not expected to be significant. Indirect evidence of dredged material contribution to the nepheloid layer was suggested in research conducted during the Corps Field Verification Program (FVP) in Long Island Sound. Benthic species near the experimental disposal site exhibited increased levels of certain chemicals during disposal activities. Following disposal, however, tissue levels of these chemicals rapidly dropped to background in organisms collected near the site (FVP study, 1987). The PSDDA monitoring program for the open-water sites includes collection of tissue residue data for benthic species collected off the disposal site to evaluate potential impacts due to movement of chemicals in the nepheloid layer.

In conclusion, only transient and temporary changes in dissolved constituents, suspended solids levels, and increased levels of sediment bound chemicals are expected during disposal activities. Significant adverse impacts to water quality are not expected.

(b) Freshwater and Groundwater. Impacts due to disposal in unconfined, open water should be negligible. Impacts due to other methods of disposal may occur from two potential sources: (1) release of chemicals in effluent during dewatering or from uncontrolled runoff and (2) release of chemicals via leachate from confined sites which could enter groundwater. Impacts from effluent or uncontrolled runoff will depend on the water hardness and the water quality of the receiving waters. The degree of chemical release associated with effluents can be controlled through a variety of technologies, including construction of weirs and settling ponds (e.g., Cullinane, et al., 1986).

Significant adverse impacts on groundwater may result from the production of leachate containing chemicals of concern at a confined disposal site. Because of the geochemical changes that are associated with drying and oxidation, a large fraction of sediment chemicals can be mobilized. The magnitude of the impact of leachate production on groundwater quality will depend on the chemical composition and physical characteristics of the dredged material, the characteristics of the interfacing soils, and the planned use of the underground receiving waters. For a further discussion of this, refer to section 4.02a(1)(b).

(2) Currents and Sediment Transport. Currents at the Anderson Island/Ketron Island site will not be altered by disposal of dredged material. However, currents can transport the suspended sediments within the water column. When dredged material is released from a barge it descends through the water column as a dense jet. One to 5 percent of the material is stripped from the descending jet (i.e., becomes suspended) before the jet hits the bottom, according to field measurements (Gorden, 1974; Sustar and Wakeman, 1977; Bokuniewicz, et al., 1978; Tavolaro, 1982, 1984). Based on a PSDDA numerical model study (Trawle and Johnson, 1986a), a large percentage of the remainder is unconsolidated material which forms a "pancake" less than 1-inch high inside a 600-foot radius of the center of the dump.

At the Anderson Island/Ketron Island disposal site, the current data (cited in section 3.02a(3)) yielded calculated 1 percent peak current speeds somewhat in excess of the 25 cm/sec 1 percent peak speed designated as the threshold for nondispersive sites from depths 15 and 100 meters above the bottom at two stations. These predicted current speeds do not reflect current speeds and erosional characteristics at the bottom. To assess potential sediment transport at this site, PSDDA agencies relied upon depositional analysis results on site-specific percentages of fine grained material and other parameters suggesting depositional character. These data indicate a depositional environment for the Anderson Island/Ketron Island site. Since dredged material is anticipated to behave similarly to existing onsite sediments, that material after disposal on the bottom should remain confined at the Anderson Island/Ketron Island site. A site boundary configuration was chosen for the site which follows naturally confining bottom features.

About 1 to 5 percent or the material remaining suspended more than 1 hour after a dump event will be transported by currents. For the Anderson Island/Ketron Island site, an indication of the movement of the "wedge" of suspended sediment may be predicted from numerical model projections (Trawle and Johnson, 1986a) (see section 2.03f(2)(b). The sediments were composed of 25 percent fine sand and 75 percent clay/silt. Two scenarios were considered for aggregated sediments at a current speed of 24.5 cm/sec, all material was at the bottom within 20 minutes of the dump, i.e., no suspended sediment was transported from the site. For unaggregated sediments at a current speed of 30 cm/sec, 5 percent of the sediments remained suspended after 1 hour, and the suspended sediment plume traveled 3,600 feet in 1 hour and 21,600 feet (3.56 n.m.) in 6 hours. (These distances would be less near the bottom at the Anderson Island/Ketron Island site, where currents are much slower than the speeds used in the model.)

(3) Marine and Estuarine Sediments. As stated above, the Anderson Island/Ketron Island site has nondispersive characteristics which indicate that dredged material will remain onsite. Bottom elevations onsite will therefore increase due to accretion. Computations from a numerical model

developed by WES (Trawle and Johnson, 1986a)) were applied to conditions similar to this site, which has a depth of 442 feet. The model was run at a 400-foot depth, with a current speed of 24.5 cm/sec and for a normal 1,500-cubic-yard disposal of typical (25 percent sand, 75 percent silt/clay), slurried dredged material. The results indicate that 0.017 foot of sediments could be added per dump. The mass estimate was 0.459 g/cm^2 of sediment accumulated in each disposal event. This is 128 percent of the estimated natural sediment accumulation rate at a nearby Nisqually Reach station (0.360 g/cm^2/yr (Carpenter et al., 1985)).

Site capacity is estimated to be about 9 million cubic yards. This estimate is based on an elliptically-shaped cone that is truncated, and rises 34 feet above the existing bottom of the Anderson Island/Ketron Island disposal site. It was assumed that bulking effects which take place during dredging and disposal operations were offset by the long-term consolidation of the disposal mound. Thus, dredged volumes are assumed to represent 100 percent of site capacity. Assuming that an annual average of the volume that could be discharged at this site over its first 15 years of use (14,500 c.y. to 52,300 c.y.) is experienced beyond that period, the site life could extend over 150 years.

Existing sediment characteristics at the Anderson Island/Ketron Island site are fine sand mixed with silt. Material expected to be disposed at this nondispersive site could range from sandy sediments (from a high current area such as Tacoma Narrows) to silty clays (from dredging locations such as Shelton and Olympia Harbor). Dredging areas near urban or industrial areas are expected to constitute about 50 percent of the projected dredge volumes to be disposed. All materials to be placed at this site must pass PSDDA guidelines for nondispersive site disposal. Materials to be disposed would likely increase concentrations of chemicals of concern over naturally occurring levels. Environmental monitoring would be accomplished to verify that no unacceptable adverse effects are occurring.

(4) Air Quality. No significant loading of concern chemicals to the existing air environment is anticipated as a result of forecasted disposal activities. An average of about 8-10 barge loads of material per year are forecast for this site.[1/] During those days of actual use, average level of activity would be no more than two barge loads per day and peak use no more than five barge loads per day. Tugboat activities connected with barge towing and disposal would be expected to release some hydrocarbon exhausts. Haul trucks will release similar products at upland/nearshore confined sites. Small concentrations of hydrogen sulfide gas may also be released from the dredged material during open-water disposal activities. However, no significant impacts are anticipated to the air quality environment in the Nisqually reach and adjacent lands as a result of disposal activities.

1/Forecast of disposal activity is based on volume projections used in DNR user-fee analysis (see lower portion of table 2.7c). Volumes shown have been discounted for large speculative projects and for projects where clean dredged material will be used for land development.

(5) Land. Habitat losses associated with dredged material that must be placed in all disposal sites (benthic/land/shore/confined) could include losses of benthic habitat, wetlands, of fish feeding and rearing habitat, vegetation, and natural shoreline areas (for more discussion on impacts associated with land/shore confined disposal, see section 4.02 above). Approximately 318 acres of deep-water benthic habitat would eventually be covered by dredged material while upland/nearshore habitat losses for confined disposal would approximate 34.1 acres (see table 4.3 and figure 4-2). It is not possible to further distinguish confined-disposal-related losses since development of either nearshore or upland scenarios would depend on site availability and acceptability. The significance of these losses will depend on the existing habitat and other values, previous uses of the land prior to its use as a dredged material disposal site, and mitigation measures designed by the users/operators. The open-water site for unconfined disposal is expected to be recolonized following cessation of disposal activity. Upland confined sites that are developed are usually permanently lost from biological production unless extensive effort is put into reclamation after closure. Development of nearshore areas could result in significant adverse losses of salmonid feeding habitat.

b. Impacts and Their Significance to the Biological Environment.

(1) Benthic Communities.

(a) Infaunal Resources. Both physical and chemical impacts can be anticipated as a result of dredged material disposal. Each is discussed in turn with respect to probable impacts to the benthic infaunal resources known to exist within the boundaries of the disposal site and immediately adjacent to it.

The anticipated physical impacts to sedentary benthic infaunal resources resulting from dredged material in the selected site would include the immediate, but temporary, loss of benthos due to burial and smothering by clumps of cohesive material within the single-dump bottom high impact area (which has a 250-foot diameter according to DIFID model). Direct physical effects from dredged material hitting the bottom at initial impact will be greatest in the center of the impact zone, diminishing to negligible impacts toward the edges of this zone. Estimated coverage from a single 1,500 cubic yard bottom dump barge would be around 0.8 cm at the center of the impact zone. Because of the generally low frequency of dumping (10 to 35 barge loads/year at 1,500 c.y./barge) and anticipated low annual accumulation in the disposal site (5 to 18 cm/year assuming 25 percent consolidation), it is likely that some of buried infauna, especially towards the periphery of the impact zone, will be able to survive initial burial by vertically migrating out of deposited material. Some benthic infaunal species have demonstrated the ability to migrate vertically and survive burial induced by relatively thick layers (i.e., up to 50 cm) of sediments with particle size distributions similar or different from their preferred sediment habitat (Maurer et al., 1978). However, it is likely that small crustaceans (predominantly ostracods, cumaceans, and amphipods) living within the upper 0-5cm of the sediments may be temporarily or permanently displaced away from the dump zone due to physical impacts.

During periods of dredging inactivity, partial recovery of benthos in the impacted areas is expected due to recruitment and migration from surrounding unimpacted areas. Probable early recolonizers of the disposal site may consist predominantly of polychaete opportunists such as Capitella capitata, Boccardia polybranchia, and Spiophanes fimbriata (EPA, 1985). Small crustaceans (ostracods, cumaceans, and gammarid amphipods) impacted by the disposal activities may be permanently displaced on site due to a greater sensitivity to physical and chemical stresses. Recolonization may result in the partial restoration and/or possible enhancement of benthic habitat values to foraging bottom fishes (Rhoads et al., 1978; Becker 1984; Lunz 1986; Clarke and Kendall 1988; Kendall and Clarke, 1988). Tatem (1984) reported an increase in benthic species abundance at an experimental disposal site in Elliott Bay following disposal operations. Additionally, a postdisposal survey of the Foul Area disposal site off the coast of New England using the Benthic Resources Assessment Technique (BRAT) demonstrated that potential bottomfish habitat food values (i.e., benthic resource values) increased on site relative to offsite for many of the target flatfish foraging strategies examined, particularly fish foraging for smaller prey (primarily Group IIA and IIB predators) living near the sediment-water interface (Lunz, 1986).

Existing benthic communities found on site are adapted to fine-textured, medium silt/coarse silt bottoms. Potential changes in bottom sediment grain size distribution resulting from dredged material disposal would likely have detrimental impacts on many of the resident infaunal species (i.e., due to lower reproductive potential, impaired recruitment success, and survival of young) as well as negatively influence the ability of buried adults to vertically migrate and survive burial (Maurer, et al., 1978).

Some sublethal impacts to onsite benthos are possible from chronic exposure to dredged material. However, these impacts are not expected to extend beyond the disposal site. The PSDDA monitoring program includes an analysis of benthic community structure around the disposal site to ensure that biological impacts caused by disposal, are not occurring outside the disposal site. The severity and extent of biological effects from such material are not expected to be significant because the majority of the taxa found at the selected site including polychaetes and bivalves are generally not acutely sensitive to chemicals of concern. Small infaunal crustaceans located outside the dump zone, but found within the site boundaries, may be subjected to direct physical impacts as well as sublethal chronic stress from material passing the disposal guideline. Potential increases in mortalities in species of the more sensitive taxa such as crustaceans may also occur. Other less sensitive taxa located within the disposal site boundaries may also experience some sublethal chronic effects should only material just passing the PSDDA guidelines be discharged at the site. Under these unlikely circumstances, more sensitive benthic species may be displaced over time due to chronic effects, and replaced by less sensitive opportunistic species. Although benthic habitat values will be changed, many of the recolonizing benthic species are readily exploited as a food source by bottom feeding fishes, thereby resulting in a potential habitat value enhancement to demersal fishes (Rhoads et al., 1978; Becker, 1984; Lunz 1986; Rhoads and Germano, 1986). Therefore, on balance, these are not considered to be unacceptable adverse effects.

Cumulative effects of exposure to the dredged material just passing the PSDDA guidelines could result in a reduction in abundance and biomass of equilibrium (Stage III) species, with a corresponding increase in abundances and biomass of more pollution and physical disturbance tolerant pioneering (Stage I) species. This pattern will also be maintained by the periodic physical disturbance of the site during disposal operations. Tissue concentrations of contaminants may also increase in onsite benthos exposed to the dredged material.

Impacts that could occur off site would not be significant and could consist of some food web impacts, and possible sea surface microlayer impacts. The former involves mobile benthos (crab, shrimp, etc.) and benthic-feeding fishes feeding on disposal site benthos and migrating off site with an accumulated chemical body burden and, perhaps, chronic effects, and contributing chemicals via predation or decomposition to the Nisqually Reach food web. The degree of food web transfer is unknown, but should not be significant due to the site management requirements, and because few mobile invertebrate species (crabs and shrimp) are present at the selected site. Nearshore, intertidal and subtidal invertebrate fauna would not be significantly impacted from the disposal operations due primarily to their distance from the disposal site, although the Devils Head alternative site is located closer to shorelines than the Anderson Island/Ketron Island site. Existing sea surface microlayer chemicals may occasionally contact the nearshore benthos as a result of currents, tidal actions, and wind moving chemicals onshore. The probability that chemicals from the dredged material would significantly contribute to the existing contaminant load, with significantly increased impacts, is low (Word and Ebbesmeyer, 1984; Word et al., 1986; Hardy and Cowan, 1986).

(b) <u>Epifaunal Resources</u>. As no Dungeness crab (<u>Cancer magister</u>), nor rock crabs (<u>C. productus</u> or <u>C. gracilis</u>) were caught at the Anderson Island/Ketron Island site in any sampling season, it appears they are either not normally present there, or are present only in small numbers regardless of season. Relative to off-site crab populations, dredged material would not be expected to physically impact these populations. This is because the the dredged material would be almost totally confined to the disposal site. Moreover, any suspended material that settles out in adjacent areas would form a very thin layer and deep-water populations adjacent to the site are relatively sparse. Finally, no dredging disposal would be performed during the spring molting/mating period for the species that are present.

Some impacts to crabs contacting the dredged material may occur, but are not expected to cause mortality nor be significant. This could occur if crabs migrate to the disposal site and consume food organisms, or if they by chance encounter the site during migrations to deep water habitat. Chronic exposure to the disposed sediments via either contact with the gills or feeding on small invertebrates in the disposal area could occur. Disposal impacts could extend beyond the disposal site should the smaller crabs move offsite and be preyed upon by higher food web organisms, such as large bottomfish. However, no food web biomagnification of contaminants is expected, and environmental monitoring of sessile benthic populations near the site will detect the potential for such effects should they be present.

As crabs have not been found inhabiting the site, it is concluded that use of the Anderson Island/Ketron Island site would not significantly impact Nisqually crab populations.

Also, it should be noted that the material on the bottom would be confined to the site; that small volumes of material will be placed every year (14,500 to 52,300 cubic yards per year on the average), resulting in a maximum increase in thickness of the disposal mound center of about 5 to 18 cm per year.

Only minor impacts on shrimp populations in and near the disposal site are expected. Physical effects onsite would be due to shrimp being buried by a solid clump of material at the disposal site center or to shrimp being coated by a thin layer of material away from the site center, where maximum material thickness for each disposal would be less than 1 cm. Because few shrimp occur on-site and because disposal operations will be infrequent, physical impacts on local shrimp populations are expected to be minor. Shrimp residing at the disposal site or those migrating onto the site to feed could contact the dredged material (even if only material just passing the PSDDA guidelines is present) with no significant mortality. Large numbers of shrimp are not expected to migrate to the disposal site. In general, physical and chemical effects are not expected to significantly impair the growth or reproduction of the sparse Nisqually shrimp populations due to low, sporadic frequency of disposal, relatively small quantities of material predicted for placement each year, and only placement of suitable material.

Physical impacts on edible sea cucumbers at the site would be due to either burial by clumps of material at the disposal center, or to covering by a thin layer (less than 1 cm per barge load at center of the disposal site tapering to about 1 mm or less at the site boundaries). Biochemical impacts could occur due to contact with the disposed sediments, either externally or internally (the latter due to their feeding behavior of ingesting relatively large quantities of sediment). Long-term sediment exposure could potentially result in reproductive and growth impairment of individuals, but is not expected to significantly impact sea cucumber populations in the region. As above, this is due primarily to small quantities of material and the presence of small numbers of cucumbers in the disposal area (with the closest concentration area located over 1 nautical mile away and upslope of the site).

(2) <u>Plankton Communities</u>.

(a) Marine Phytoplankton. Impacts to phytoplankton could arise during disposal operations from intermittent pulses of suspended material that either promote and inhibit primary production. Turbid mixtures of organic and inorganic materials may interfere with phytosynthesis by shielding light or stimulate growth by raising plant nutrient levels. Additionally, organic materials may make toxicants and existing nutrients available to phytoplankton by creating chemical complexes (iigands). Impacts can also occur from suspended materials adhering to the surfaces of cells, interfering with transport across the cell wall. Also photoplankton in the path of the descending dredged material mass could be entrained or flocculated, thus removing them from the euphotic zone. The release of growth inhibitory or stimulating substances from dredged material may also occur. Chemicals of concern released during disposal would be minimal, but could thus result in inhibition of photosynthesis by interfering with metabolic pathways.

As disposal operations would not occur during the major portion of the spring bloom period due to dredging closure for protection of outmigrating salmon and steelhead trout smolts, the high phytoplankton productivity at that time of the year would not be significantly impacted. Disposal would occur, however, during the fall bloom period, so that impacts to the phytoplankton community may be more pronounced than during other times of the year. The overall impacts on primary production would be localized, minimal, and not significant to overall primary productivity in the area of the sites.

(b) Zooplankton. Impacts to zooplankton could result from suspended particles physically interfering with active feeding. In addition, suspended particle loads would mask or dilute food particules in the water for filter feeders and, in some instances, reduce the amount of available food. Zooplankton in the immediate disposal area could become entrained by the disposed material, with resultant mortalities. However, most zooplankton are distributed in the water column over wide areas, and any impacts at the disposal site would not be expected to significantly affect zooplankton community structures nor overall secondary productivity of the areas near the sites.

Any impacts to the zooplankton community would be localized and short term. Chemicals released from the disposal operation may have measurable, short term, and localized impacts. Localized impacts could include mortality, inhibition of growth, and reproduction. However, the temporal nature of the disposal and the small percentage of zooplankton impacted relative to the existing sound-wide community, would render this impact insignificant.

(3) Anadromous and Marine Fishes.

(a) Anadromous Fish. Impacts of disposal operations on important juvenile salmon and steelhead trout populations would not be significant, primarily because no disposal operations would occur between March 15 and June 15, the "closed dredging window" designated by the Washington State Department of Fisheries (WDF) to protect juvenile salmon and steelhead during outmigration. The majority of the juvenile salmon population will have migrated out of the Nisqually Reach area by June 15.

Disposal could occasionally occur during the presence of late outmigrants (especially chinook salmon), or with species such as searun cutthroat trout that may tend to remain in the Nisqually Reach area for extended periods of time. These late or persistent juveniles will not be impacted by the disposal operations unless they were present immediately below a disposal barge during the short period of discharge. In this unlikely event, some fish could be subject to suspended solids impacts. Maximum impacts could include interference with oxygen exchange due to suspended solids clogging gill surfaces, and slightly lowered oxygen availability due to biological oxygen demand of the suspended dredged material in the disposal plume. No impacts are expected to juveniles from chemicals in the plume because PSDDA disposal guidelines preclude disposal of sediments that could cause acute lethal impacts as result of chemical exposure. Physical impacts, should they occur, would be minor since juveniles typically avoid disposal plumes, and the site location is removed from primary juvenile salmonid migratory pathways.

Neither adult salmon nor trout migrating through the Nisqually Reach area would be significantly impacted by disposal operations as the majority of the fish would avoid the very short-term (5 to 10 minute) disposal-associated turbidity plumes. (Observations during the March 1989 disposal at the Commencement Bay site revealed no surface turbidity during or subsequent to disposal operations.) Those fish that come in contact with the plume may be temporarily impacted from short-term clogging of their gills by suspended material and from slight depressions in dissolved oxygen due to the biochemical oxygen demand of the dredged material. However, these conditions are less severe than the fish usually encounter when they migrate up the Nisqually River during winter storm events, spring runoff, and during summer and fall when glacial silt is being discharged by the river. In general, disposal operations involving material suitable for disposal under the PSDDA guidelines should not significantly impact physiological mechanisms/behavior patterns of adult salmon in the Nisqually Reach area.

Contributions of chemicals to the sea surface microlayer from the dredged materials may occur, but is expected to be generally minor (Word et al., 1986; Hardy and Cowan, 1986). Actual chemicals and their concentrations would be difficult to identify/measure in view of the likelihood of additional source contributions from Anderson Island, McNeil Island, Steilacoom and direct atmoshpheric input to the Nisqually Reach area. Adult salmon may occasionally swim at the surface for short periods and therefore contact the microlayer during periods when they exhibit their milling behavior. However, physiological effects from exposure to dredged material chemicals (i.e., absorption via gills) are not expected to occur since the salmon would not be expected to swim for extended periods of time at the surface within the affected area of an individual dump or within the microlayer plume of that dump. Swimming at the surface for extended periods is not typical behavior for migrating adult salmon.

(b) Marine Fish/Bottom Fish Resources. In general, marine fish/bottom fish resources would not be significantly impacted by disposal activities at the Anderson Island/Ketron Island site north of the Nisqually delta. Overall results of seasonal sampling within and adjacent to the preferred site indicates that the site is not located in a particularly important bottomfish resource area (see Section 3.02b(3) and Donnelly, et al., 1988). Nevertheless, some direct and secondary impacts to neritic marine fish and bottomfishes could occur as a result of dredged material disposal. Clumps of cohesive material impacting the bottom may bury flatfish, such as English sole and slender sole, located within the single-dump 250-foot-diameter bottom high energy impact area. Any fish outside this bottom direct physical impact zone will not be wounded or killed, but could suffer some respiratory distress due to gill clogging and/or low dissolved oxygen levels due to biochemical oxygen demand, induced by elevated levels of suspended solids within the dredged material plume. It is highly likely that fish will avoid stressful levels of suspended dredged material by temporarily moving out of the area. In conclusion, because only relatively low numbers of bottom fish resources appear to be present in and around the site, direct physical impacts to bottomfish resources are not expected to be significant.

Bottom fish resources may also be affected through secondary impacts resulting from disposal of dredged material in the preferred disposal site. Benthic communities within the impact zone are expected to be temporarily lost as a result of burial and smothering, further lowering the value of the area as food habitat for bottom fish. However, as this area does not appear to be a prime feeding habitat area for bottomfish in general (Clarke and Kendall, 1987; Kendall and Clarke, 1988), the impact of this habitat loss to fish resources is not expected to be significant.

Benthic resources, however, are expected to recover during periods of disposal inactivity. Fish food habitat values, which are considered to be relatively low onsite, may increase as a result of increased production of pioneering (stage I) opportunistic species on the disposal mound (Rhoads et al., 1978; Becker, 1984; Lunz, 1986; Rhoads and Germano, 1986; Clarke and Kendall, 1987). Bottom fish foraging on these opportunistic benthic species may bioaccumulate chemicals through dietary intake of prey. Direct exposure to chemicals could also occur through the fishes' skin and gill membranes as a result of their intimate association with the bottom sediments, particularly when buried in the sediments. Because the disposal site area represents a relatively small portion of the foraging habitat for demersal bottom feeding fishes in the Nisqually Reach, and documented potential benthic fish food habitat resources on site are relatively low, only low levels of chemical bioaccumulation in fish predators are expected to occur. The relationship between local existing sediment quality and bottom fish chemical body burdens in the Nisqually Reach area is unknown, although existing sediment quality is generally good with low levels of chemicals of concern (see Section 3.02 a(3)).

Disposal operations could directly impact pelagic fishes, especially Pacific herring (<u>Clupea harengus pallasi</u>) if these fishes could not detect or avoid the disposal plume. Impacts would involve interference with respiration and gaseous exchange across the gill membrane due to high concentrations of suspended material, and exposure to certain contaminants with resultant sublethal effects. However, these impacts are not expected to be significant as (1) dredged disposal events are relatively infrequent, (2) it is probable that herring and other pelagic fishes would avoid the plume, and (3) the probability that disposal would occur coincidentally with the presence of herring schools or large concentrations of other pelagic species is low.

(4) Marine Mammals. The harbor seal is the only marine mammal of sufficient abundance in southern Puget Sound to warrant impact assessment. The other species are rarely sighted or are usually found away from the proposed disposal area. Unfortunately, harbor seals in southern Puget Sound have suffered from low reproductive success due to environmental pollutants since at least 1971 (Everitt, et al., 1979). Calambokidis, et al. (1984) recently confirmed that harbor seals at Gertrude Island still show very high levels of PCB and DDT compounds in their blubber. Since this population is already suffering from pollutants there is a heightened concern with disposal of contaminated dredged materials. PSDDA agencies are dealing with this issue through monitoring of on and near site resources to determine if unacceptable biomagnification will occur due to dredged material disposal. Based on available information, no cause for concern exists. Furthermore, the Anderson Island/Ketron Island disposal site is located in an area of low currents and is considered a nondispersive site. Even if some material with chemicals of concern were discharged at this site, the material would not be expected to move beyond the limits of the site. Thus, a significant increase in the chemical concentrations in harbor seal's prey base (rockfish, herring, salmon, and octopus) is not anticipated as a result of dredged material disposal.

Harbor seals in the vicinity of the disposal site during a disposal operation would likely avoid the area during the short-term disposal activity. This is not expected to be a serious impact since harbor seals are quite mobile and can easily locate sources of prey.

(5) Waterbirds. Waterbirds utilize the area of the Anderson Island/Ketron Island disposal site for feeding, and perhaps resting in calm weather. However, this area is not an area of concentrated bird usage. Direct impacts of open-water disposal on waterbirds include temporary turbidity, temporary loss of prey source, and potential impacts to intertidal organisms from drift of suspended dredged material, as well as direct disturbance by disposal activities. Waterbirds are mobile and can avoid the turbidity plume and disposal vessels; also, the site has relatively low biological productivity to begin with, such that the loss would be minimal. Nisqually Refuge, 3 miles away, is the closest area of bird concentrations. The disposal site is in a low current area, and predominate surface currents tend to northward, away from the refuge.

The selected site is not presently nor historically an area of waterbird concentration. The potential loss of intertidal organisms from drift of suspended material is considered to be minimal and will not affect waterbirds.

(6) Endangered and Threatened Species. Biological assessments (BA's) addressing endangered cetaceans and the Pacific leatherback sea turtle

(*Dermochelys coriacea*) were sent to NMFS. A BA addressing impacts to bald eagles and peregrine falcons was sent to the U.S. Fish and Wildlife Service (FWS). Both BA's concluded that no listed species would be impacted by any of the Phase II PSDDA disposal sites. Both NMFS and FWS concurred with these conclusions (see exhibit A).

(7) Terrestrial Species. Impacts will be restricted to confined disposal activities. For a discussion of these impacts see section 4.02b(8) and (9).

c. Impacts and Their Significance to the Human Environment.

(1) Social and Economic Features. Potential conflicts with waterborne commerce movements in the proposed Nisqually Reach area and vicinity are expected to be somewhat higher with this alternative relative to the no-action alternative. However, delays in dredging activity would be less under this alternative than those expected if the no-action alternative chosen, and therefore, on the balance, port terminal and industrial development should be enhanced. Estimates of the overall volumes of dredged material that could be discharged at the Anderson Island/Ketron Island disposal site are indicated in table 2.7c. Actual dredged material volumes placed at this site would be determined by project-specific evaluations, as required by Federal and State regulatory agencies.

Sport fishing could be temporarily impacted during infrequent disposal operations by tugs and barges (see Navigation section below). Overall, social impacts are not expected to be significant due to the adoption of the slected alternative.

(2) Transportation.

(a) Navigation. Use of the Anderson Island/Ketron Island disposal site will result in temporary, localized, and intermittent disruption of any navigation and anchorage use of the water surface area withing the disposal zone. While tug and barge traffic to and from the site will represent a potential increase in risk for vessel collision this risk is minimal due to the short-term and infrequent disposal activity. The disposal site location has been coordinated with the U.S. Coast Guard and will be marked on navigation charts. Site use will be controlled to minimize the risk for vessel collision.

Normal average annual dredged material disposal activity is expected to be about 8 to 25 days per year. Actual activity will depend on specific dredged projects, and the results of chemical and biological tests performed on material to be dredged. As navigation channels will be maintained, there will be no adverse impacts on navigation activity due to channel shoaling. Barge-tug movement during disposal operations may be greater than at present; however, there should be no significant navigation conflicts with commercial or pleasure craft.

During times of normal site use, disposal activity at the site is expected to average about one to two barges per day, with peak activity of five barges per day.

When proceeding to the disposal site, tug and barge combinations move at a slower rate loaded than unloaded. Average travel speed is typically around 5 knots. Once onsite, disposal operations within the 1,800-foot-diameter disposal zone usually will be accomplished in about 5 and 10 minutes. On occasion, weather constraints and repositioning requirements (to ensure proper location of disposal) may increase the onsite time to as much as 20 minutes. Using an average of 10 minutes, and assuming one to two barges per day, normal site occupancy could amount to about 10 to 20 minutes per day. Disposal operations scheduling will be coordinated with affected Indian tribes during the Federal 404 permit review, and conditions will become part of the permit to assure avoidance of conflicts with tribal fisheries.

Disposal operations at the selected site will represent a slight increase in navigation traffic in this area. With increased water traffic, there is an increase in risk of minor oil leaks or spills and of vessel collisions. The location of the disposal site, the infrequent site use, and the short duration of site occupancy indicate that these risks are not significant and not measurable.

(b) Land. Impacts to land transportation would be considerably less than those resulting from the no-action alternative, as about 59 percent of future dredged material is expected to be found suitable for open-water disposal at the Nisqually site area versus 0 percent that would pass PSIC (no action). Truck hauls and traffic congestion associated with upland disposal would be substantially less than under the no-action alternative where most dredged material would be placed in nearshore or upland sites.

(3) Dredging and Disposal Activity. The overall impact of this alternative on dredging activity in the south sound would be an increase in the volume of material found acceptable for unconfined, open-water disposal over that allowable under PSIC. Using PSIC, none of the future Nisqually site area material is expected to be acceptable for unconfined, open-water disposal. Under the selected alternative, 217,500 c.y. to 785,000 c.y. of material could be discharged over the next 15 years at the Anderson Island/Ketron Islan site. Actual disposal volumes will depend upon the outcome of chemical and biological tests conducted on the material and the specific projects proposed for dredging.

The costs of constructing and maintaining navigable waterways in Puget Sound waters have risen over the past several years. Increased costs are due to a variety of factors, but two of the more important in Puget Sound are the rise in costs for dredging and disposal of dredged material and costs for environmental evaluation of the material. During Phase I, PSDDA conducted an economic assessment of the impacts of PSDDA on future dredging and disposal costs (Phase I FEIS, Section 5.02a(9)). It concluded that total costs for the

Phase I area testing, dredging, disposal, compliance inspections, and monitoring of dredged material in the years 1985 to 2000 would be greater under PSIC (no action) than under the PSDDA dredged material evaluation procedures. The costs were somewhat site specific, but PSIC costs ranged from approximately 120 to 300 percent of PSDDA costs for nondispersive sites. Table 2.2 also provides an analysis of increased transportation costs under the no-action alternative, should a dredger choose to haul material failing PSIC but the passing nondispersive disposal guideline to a PSDDA Phase I site. In summary, the action alternatives will be less costly than had no action been chosen.

To the extent that significant cost increases occur for dredging, some projects may no longer be economically feasible even under the action alternatives. On the other hand, the action alternatives representing a cost savings over the recent past, and could result in additional dredging activity and related environmental effects. For all alternatives except the no-action alternative, changes in future dredging activity are not expected to be significant. Consequently, adverse effects associated with dredging are not expected to differ significantly among the action alternatives. Only the no-action alternative would be expected to noticeably alter the dredging patterns and trends presently observed in Puget Sound with a possible decrease in dredging related effects. Indirect effects of the alternatives include the effects of related navigation and development at both dredging sites and land/shore disposal sites. Only the no-action alternative would significantly reduce the extent of these effects.

(4) Native American Fishing. The selected site is located within the usual and accustomed fishing grounds of several Puget Sound tribes. However, disposal should not increase the potential for tribal fishing gear damage and/or reduced fishing time resulting from use of the unconfined, open-water disposal site. Tribal fishing rights would be protected from disposal vessel conflicts with specific project actions accomplished via the Federal Section 404 permit process. Tribal concerns regarding the impact of the PSDDA proposal to water quality and fisheries resources upon which the tribal activities are dependent are addressed in section 2.04d and exhibit F.

(5) Non-Indian Commercial and Recreational Fishing. Non-Indian fishing activities may be displaced during the discharge of dredged material at the selected disposal site. At times of peak dredging activity, this displacement could persist for 5 to 10 minutes, five times per day. The selected disposal site has been located to minimize potential conflicts with known commercial and sports fishing activities. It is anticipated that displacements, should they occur, are more probable for sports fishermen than for commercial activities. The disposal site location and the short duration of site use, are expected to preclude any significant adverse effects to fishing activities and catch success in these waters.

(6) Human Health.

(a) Via Seafood Consumption. No impact on human health is anticipated from the consumption of seafood that might be in or near the disposal site. Only suitable dredged material will be allowed for disposal at the site. No significant impact to human health is expected under the site management condition selected.

(b) Via Drinking Water. When marine/brackish, dredged material is placed in a confined nearshore or upland disposal facility, the potential exists to generate leachates having adverse impacts on ground water and surface water used for drinking. Under this alternative, material forecasted to be found unsuitable for unconfined, open-water disposal will have to be placed in a confined site. If the material is placed in a nearshore or upland facility, then potential for drinking water chemical impacts exists, especially if design features such as leachate collection systems, effluent control, or runoff control are not used or fail. Development of any upland or nearshore disposal sites, and the types of material allowed in these sites, would be subject to State and Federal regulations designed to protect drinking water sources. The relative potential for ground water chemical impacts under this alternative is less than the impacts that would be predicted if no action were chosen, since under the latter more material would probably go to confined disposal.

(c) Via Inhalation of Dust. Dredged material placed on nearshore and upland disposal sites provides a potential source of dust with chemicals of concern that could have an impact on workers and residents living around such a site. Dust production can especially be of concern at multiuser sites where the deposited dredged material is being reworked. This can also be the case at a disposal site that is being prepared for alternate uses. The impacts to human health from inhalation of dust can be minimized by the application of suitable ground cover. The relative potential for dust production under this alternative is less than would be predicted if no action were chosen for reasons similar to (b).

(d) Via Direct Exposure. Little direct exposure of humans to contaminated dredged material occurs. The only segment of the population that might be expected to come into direct contact with dredged material are workers on dredging crews and at upland and nearshore disposal facilities. Material that is highly contaminated could be placed in secure disposal sites where protection against exposure to chemicals would be minimized by operational procedures (i.e., wearing protective clothing and respirator, security to limit access to the site, application of coverage soil for disposal).

(7) Noise. There have been no measurements of ambient noise levels or of the actual noise at the shore which would be produced by disposal equipment operating at the preferred alternative site. Between 20 Setember 1985 and 24 June 1986, measurements at the Fourmile Rock disposal site in Elliott Bay were performed in the residential area nearby by two noise consultants. Ambient noise measured between 35 and 70 dBA and averaged from 35 to 51 dBA during the different measuring periods. Noise from tugs and

tug-barge combinations was measured at between 37 and 46 dBA. The average noise levels were in the low 40's. The exception was one barge which measured 58 dBA for a short time. (Muffling has since been added to bring the noise level down further.) In a number of cases, the noise testers reported that the tugs and barges could not be heard above ambient noise at the shore.

The Anderson Island/Ketron Island site is at least 2,500 feet from the nearest shoreline. It is assumed that noise impacts from use of the site will be well within State and Federal noise standards and, in many cases, unnoticeable. Noise impacts at the shoreline should also be within appropriate county standards (typically noise emissions from any watercraft are allowed to 80 dBA at the receiving property except between 10 p.m. and 7 a.m. when the limit at residential receiving properties is 63 dBA).

(8) Esthetics. Disposal operations are not expected to significantly affect the esthetic quality or experience in the Nisqually reach and vicinity. The disposal operations will be only a minor part of the marine activities ongoing in a busy marine transport area. Viewers from the various shoreline areas will see the occasional presence (between one and two times daily during normal dredging operations) of a tug and barge moving into the outer bay area, spending about 5 to 10 minutes for disposal, and leaving the area. The tug and barge will not be readily noticeable and should not be obtrusive to closer viewers. Viewers from close in areas may observe a localized turbidity plume in the immediate vicinity of the barge immediately following disposal. This plume will be short term and may be masked at times by Nisqually River runoff during high flow periods. Some viewers may perceive the tug and barge activity in a positive sense, in that it is an integral part of normal marine activities and does not detract from the overall view experience.

(9) Cultural Resource Impacts. As part of the disposal site identification mapping studies, a literature search and underwater reconnaissance were undertaken to establish if any historically significant shipwrecks were located within the selected disposal site. A side scan sonar reconnaissance of the Anderson Island/Ketron Island site disclosed two sonar features with the possibility of being shipwrecks. However, the literature search and analysis found no shipwrecks that have potential historic significance that sank in the vicinity of the site. Accordingly, the PSDDA agencies concluded that the undertaking would have no effect on properties potentially eligible for the National Register of Historic Places. The Washington State Historic Preservation Officer concurred with this finding by letter dated September 5, 1989 (exhibit D).

d. Cumulative Impacts. Disposal operations at the selected site may contribute to ongoing impacts to the water and air resources that are described in section 3. Marine water quality, air quality, intertidal and subtidal macrofauna, plankton, neuston, marine mammals, anadromous and marine fishes, and threatened or endangered species could experience some effect. None of these impacts, however, will be significant. The only resource expected to receive measurable cumulative impacts are the disposal site sediments and the benthos that are permanent or temporary residents in those sediments.

Disposal of suitable dredged material could potentially degrade a portion of the site's deepwater benthic habitat by increasing the levels of chemicals present in the sediment. Since material that is substantially cleaner than that allowed by the PSDDA guidelines will also be discharged at the site, the actual condition of the site is expected to be substantially better than that allowed by the site management condition. Overall, cumulative effects of the selected alternative are not expected to be significant.

e. Relationship to Existing Plans, Policies, and Controls.

(1) Clean Water Act, Sections 404/401. Procedures used in identifying the disposal site are consistent with the 404(b)(1) Guidelines for Specification of Discharge Sites for Dredged or Fill Material (40 CFR Part 230). Federal advance identification of the selected site as suitable for disposal of dredged material pursuant to part 230.80 of the Guidelines is addressed in exhibit B. The selected site and the site management condition are also consistent with Ecology guidelines for State water quality certification pursuant to Section 401 of the CWA.

(2) Coastal Zone Management. The Coastal Zone Management Act (CZMA) (Public Law 91-583: 86 Stat. 1280) was passed by the United States Congress in 1972. In June 1976, the State of Washington Coastal Zone Management Program (CZMP) was approved to receive funding allowing the CZMA to be implemented via the State Shoreline Management Act (SMA) of 1971. As passed by the State legislature, the SMA provides "for the management of Washington's shorelines by planning and fostering all reasonable and appropriate uses." The SMA is implemented through detailed planning efforts that culminated in the Shoreline Master Programs (SMP) for the large municipalities and counties of the State. The selected alternative is consistent with the SMA and the current State CZMP, satisfying consistency with State and Federal coastal zone management requirements.

(3) Shoreline Master Program. The selected disposal site is located within the jurisdiction of Pierce County, which adopted its shoreline master program in 1979. The selected alternative is consistent with the county's master program as presently written.

(4) Department of Natural Resources (DNR) Policy on Open-Water Disposal of Dredged Material into Puget Sound. Sites throughout the Puget Sound area have been designated by DNR for open-water disposal. If the dredged material cannot be beneficially utilized (e.g., creation of artificial islands, landfill), and it is approved by all of the various regulatory agencies for unconfined, open-water disposal, it can be deposited in one of the DNR sites. Fees and leases from DNR and permits from other agencies are all required before disposal of dredged material can occur. The selected Anderson Island/Ketron Island site will be an approved DNR open-water disposal site once the local shoreline permit has been granted by Pierce County.

(5) Executive Order 11990, Protection of Wetlands. The intent of Executive Order 11990 is to protect wetlands because of the significant cumulative losses that have occurred, and due to their high value to biological productivity and their many other critical functions. As the preferred and alternate sites lie in water over 440 feet deep, no wetlands would be directly affected. Dredging projects which could affect wetlands would be evaluated on a project by project basis at the time the project is reviewed for permits under Section 404 of CWA.

(6) Executive Order 11988, Flood Plain Management. The intent of Executive Order 11988 is to provide guidance and regulation for projects located in, and affecting, the flood plain. Executive Order 11988 requires, to the extent possible, avoidance of long- and short-term adverse impacts associated with occupancy and modification of flood plains.

As the selected disposal site lies in water over 440 feet deep, no direct flood plain impacts will be involved by use of this area. Dredging projects which could affect the flood plain will be evaluated on a project by project basis at the time the projects are reviewed for a permit under Section 404 of the CWA.

(7) Puget Sound Water Quality Comprehensive Plan. The Puget Sound Water Quality Comprehensive Plan was adopted 17 December 1986 and modified in October 1988. The contaminated sediment and dredging program of the plan contains a sediment program goal "to reduce and ultimately eliminate adverse effects on biological resources and humans from sediment contamination throughout the Sound by reducing or eliminating discharges of toxic contaminants and by capping, treating, or removing contaminated sediments." The plan also adopts the following policies which shall be followed by all State and local agencies in actions affecting sediment quality, including rulemaking, setting priorities for funding and actions, and developing permit programs:

> "All government actions will lead toward eliminating the presence of sediments in the Puget Sound basin that cause adverse effects to biological resources or pose a serious health risk to humans."

> "Programs for management of dredging and disposal of sediments should result in a net reduction in the exposure of organisms to adverse effects. (The intent of this policy is that dredging and disposal contribute to the cleanup of the Sound by allowing unconfined, open-water sites to have only low levels of contamination and to dispose of more contaminated sediments in a manner that prevents continued exposure of organisms to adverse effects. For proposals where dredging will expose contaminated sediments, project-specific mitigation measures may be required."

"Sediment cleanup programs (which may include capping inplace) shall be undertaken when reasonable to reduce, with the intent of eliminating, the exposure of aquatic organisms to sediments having adverse effects. (Element 5-7 directs Ecology to develop a decision process which will resolve the question of when cleanup actions are 'reasonable')"

Dredged material placed at the selected site will not result in significant adverse impacts to aquatic animals. The site is nondispersive and situated away from a high abundance of important aquatic species and from human use areas. Although the species that may be exposed to the dredged material are different from those present at the dredging site, the net effect of the dredging and disposal action could be to reduce overall exposure potential by moving the material from shallow estuarine areas to deeper marine waters.

Under the selected site management condition, the material to be discharged at the unconfined, open-water sites is not expected to pose a serious risk to human health. Though the selected condition could potentially result in some "observable adverse effect" in the form of sublethal effects to any organisms that remain onsite for an extended period of time, the discharge of substantially better (or "cleaner") material on the sites would likely result in an actual or average condition comparable to the stated long-term PSDDA plan goal. However, PSWQA accepts the selected site management condition for the Anderson Island/Ketron Island site (see exhibit C).

The dredger does not typically control the original discharge of chemicals of concern into the aquatic environment. Nevertheless, the PSDDA study has highlighted the importance of the PSWQA goal relative to "reducing or eliminating discharges of toxic contaminants" into the sound. As this goal would be achieved through improved source control, material dredged from the sound's waterways should improve in quality, as should the condition at the disposal sites. Consequently, source control must remain a high priority for protection of the Sound.

For the reasons described above, the selected alternative is considered to be consistent with both the 1987 and 1989 Puget Sound Water Quality Management Plans.

(8) American Indian Religious Freedom Act. The American Indian Religious Freedom Act of 1978 (AIRFA) requires Federal agencies to ensure that none of their actions interfere with the inherent right of individual Native Americans (including American Indians, Eskimos, Aleuts, and Native Hawaiians) to believe, express, and exercise their traditional religions. These rights include access to religious sites, use and possession of sacred objects, and the freedom to worship through traditional ceremonials and rites. The AIRFA requires consultation between Federal agencies an Native Americans to ensure that federally supported projects or projects on Federal land do not infringe on the religious practices of Native Americans. Coordination between PSDDA

agencies and potentially affected tribes has occurred throughout the study, and is an ongoing process.

f. Probable, Irreversible, and Irretrievable Commitments of Resources. Use of the selected disposal site will result in an intermittent and temporary degradation of the quality of the sites' air, noise, and water resources. Additionally, intermittent use of the water surface area of the sites during disposal operations represents a commitment that may not always be in agreement with unforeseen future plans for the area. However, neither of these commitments is irretrievable.

Under the action alternative, designation of the selected site for dredged material disposal will commit to this use, for the life of the site (judged to be in excess of 150 years based on an estimated site capacity of 9 million c.y. About 318 acres of benthic aquatic habitat and 34.1 acres (estimated) of upland/nearshore habitat will be impacted.

Commitments of nonrenewable energy resources associated with the dredging program would be irreversible. In addition, the labor and capital necessary to conduct dredging operations would be irreversibly committed. This includes the dredging equipment, administrative personnel, and both skilled and non-skilled labor. However, energy and other commitments for individual dredging projects are decided by separate economic and social factors. Commitments of human resources would likely be very similar for both the action and no-action alternatives.

g. The Relationship Between Short-Term Use of Man's Environment and the Maintenance and Enhancement of Long-Term Productivity. For a discussion of this topic see section 4.02g.

h. Mitigation and Amelioration of Adverse Effects. The selected disposal site has been located to avoid significant adverse effects (per NEPA) while meeting the in-water disposal needs of Puget Sound dredging. Site location and site management provisions are expected to mitigate any potential biological resource and human use conflict problems. Only suitable dredged material will be discharged at the Anderson Island/Ketron Island disposal site. Environmental monitoring willd allow for verification of anticipated conditions and provide a basis for site management changes should monitoring show such changes are needed.

The primary mitigation feature of the PSDDA Phase II plan is embodied in the siting process. The Anderson Island/Ketron Island site is generally located away from shorelines, resources, and other amenities to preserve and maintain these resources by avoiding adverse effects due to dredged material disposal. The site is the only disposal site for South Puget Sound. A minimum number of sites were identified by the PSDDA agencies so as to minimize the possible extent of bottom impacts throughout the Sound. Additionally, the Anderson Island/Ketron Island site is located in a relatively nondispersive area to minimize the possible spread of effects beyond the site (including the dilution zone) via sediment transport.

The previously adopted (Phase I) regional, effects-based disposal site management condition is designed to avoid discharge of sediments that could cause unacceptable adverse effects. Chemical effects on biological resources at the Anderson Island/Ketron Island site will be minimized by the nondispersive site condition. Environmental monitoring will ensure that there is no significant acute toxicity to species onsite and/or unacceptable adverse effects occurring outside the disposal site. These management conditions fully comply with the applicable provisions of the State Water Quality Standards.

Another important mitigation feature of the PSDDA plan is contained in the compliance inspection and monitoring elements. Appropriate compliance inspections by the PSDDA regulatory agencies will ensure that the site use requirements are met, such that planned avoidance of adverse effects can be realized. Appropriate disposal site environmental monitoring will provide needed verification of predicted site conditions within and outside the site as a result of dredged material disposal.

4.04 Devils Head/Anderson Island - Alternative Site.

a. Impacts and Their Significance to the Physical Environment. The Devils Head/Anderson Island site has similar chemical and physical characteristics to the Anderson Island/Ketron Island site, except for currents and sediment transport. Potential sediment transport at this altertnative site was also assessed by the depositional analysis (see section 2.03). These data do not support a depositional determination for the Devils Head site. Accordingly, dredged material placed at this location could be transported offsite. Other impacts on water quality, marine and estuarine sediments, air quality, and land were the same as those described for the preferred site.

b. Impacts and Their Significance to the Biological Environment. Except for infaunal resources, the impacts to the biological environment would be the same as for the selected site. Subtle differences were observed between sites in the distribution and taxonomic composition of infauna within the sediments (see section 3.03b(1)). Infauna are generally more concentrated in the top 5 cm of the sediments at the selected site than at the alternative site; this may be a consequence of lower predation pressure from demersal fish resources at the preferred site since bottomfish abundances were lower at the preferred site than at the alternative site). Small crustaceans such as ostracods, cumaceans, and amphipods were an important constituent of the near sediment surface dwelling infauna in the 0-5 cm depths at both sites, particularly the selected site. Most importantly, Indian consultation and resource studies indicated fishable herring and urchin resources in the vicinity of the alternative site and not the selected site.

c. Impacts and Their Significance to the Human Environment. There would be no difference in impacts to the human environment between the selected and alternative sites.

d. Cumulative Impacts. Cumulative impacts would be somewhat greater at the alternative site due to the herring concentrations and to a greater tendency for offsite transport of dredged material.

e. Relationship to Existing Plans, Policies, and Controls. These would be the same as for the selected site.

f. Probable, Irreversible, and Irritrievable Commitments of Resources. These would be the same as for the selected site.

g. The Relationship Between Short-Term Use of Man's Environment and the Maintenance and Enhancement of Long-Term Productivity. This would be the same as for the selected site.

h. Mitigation and Amelioration of Adverse Effects. This would be the same as for the selected site.

4.05 Adoption of the Selected Alternative. The Anderson Island/Ketron Island site was adopted as the selected disposal site for south Puget Sound, based primarily on the more depositional nature of this site and concern for the herring resources and generally greater demersal fish resources that are present at alternative site. The Anderson Island/Ketron Island site (figure 2.2) also lies in a depression that forms a natural containment basin. The Squaxin Island Tribe has expressed opposition to the alternative site because of the herring and sea cucumber resources there.

SECTIONS 4.06 THROUGH 4.08

ENVIRONMENTAL EFFECTS OF THE ALTERNATIVES
CONSIDERED FOR BELLINGHAM BAY (NORTH SOUND)

4.06 Bellingham Bay - Selected Site.

a. Impacts and Their Significance to Physical Environment.

(1) Water Quality.

(a) Marine Water. Unconfined, open water disposal activities at the selected Bellingham Bay site will not significantly affect water quality conditions in the Bellingham Bay area (currently designated as class A waters) except in the immediate vicinity of the disposal site and then only during disposal operations.

The level of normally-occurring dissolved chemicals in marine waters at the site are likely to undergo only minor and transitory increases at the time of disposal of dredged material. Most of the metals and organic compounds in the dredged material remain adsorbed to sediment particles and do not become dissolved. Currents, although low at this site, will blend dissolved materials into low background levels.

Total suspended solids (TSS), which are related to optical turbidity in the water, will increase temporarily, but will settle out quickly. If the dredged material (typically 25 percent fine sand, 75 percent clay/silt) is unaggregated, a WES model run for a 3 cm/sec current speed estimates that two to three percent of the material would remain in suspension beyond the site boundaries; another two to three percent would settle out (see Currents and Sediment Transport). Aggregated dredged material (more probable) would settle out completely within 10 minutes according to a DIFID model run for a 200-foot-deep site and 3 cm/sec current speed which approximates the selected Bellingham Bay site. Thus, very little suspended sediment would be added to background levels at this site.

(b) Fresh Water. There would be no impacts due to disposal in open marine water. See 4.02a(1)(b) for a discussion of impacts of confined upland disposal on freshwater.

(2) Currents and Sediment Transport. Currents at the Bellingham Bay site will not be noticeably impacted by disposal of dredged material there, but will transport the sediment which remains suspended in the water column until it settles out. (See section 2.03f(2)(b) for a discussion of separation of dredged material into the descending "jet" of sediment and the smaller volume of suspended sediments.)

As discussed in section 3.03a(3), no quantitative data on current strengths at the preferred site are available. The "weak and variable" description given by NOAA for currents at a nearby station, reinforced by results of Crean's (1983) model establish bottom current speeds well below 12.5 cm/sec in Bellingham Bay; the low energy environment is supported by results of depositional analysis (see section 2.03f(2)(a)1). Relatively little erosion of, and transport from, the mound of sediment formed after a typical dredged material dump will occur and little or no sediment transport of the suspended sediment plume will occur. Resuspension and subsequent sediment transport should be negligible or nonexistent at this site, because of the low currents and a depth of over 96 feet (which is well below the depth at which wind induced waves would cause strong mixing).

(3) Marine and Estuarine Sediments. The preferred site has been chosen primarily for its ability to retain sediments, i.e., it is nondispersive, but other factors such as biological consideration also came into play. The closest modeled depth to the 96-foot site, 200 feet, estimated sediment accrual to vary between 0.458 and 0.596 g/cm^2 per dump event, for current speeds between 3 and 24.5 cm/sec. The site's depth of 96 feet primarily means there will be a smaller deposition pattern and somewhat larger accumulations per unit area onsite. A station studied by Carpenter et al. (1985) located to the north of the preferred site averaged 0.650 g/cm^2 natural sediment deposition per year. The small portion of suspended sediment settling offsite from either aggregated and unaggregated dredged material was discussed above.

Site capacity is estimated to be about 8 million cubic yards. This estimate is based on flat bathymetry and an assumption that the shape of the disposal mound will approximate a truncated cone with a base diameter of 3,800 feet (disposal site boundary), an height of 32 feet (3.4 percent angle of repose), and a top diameter of 1,900 feet. It was also assumed that bulking effects which take place during dredging and disposal operations would be offset by the long-term consolidation of the disposal mound. Dredged material volumes are thus 100 percent of available site capacity volume. Assuming that the average annual volume that could be discharged at the Bellingham Bay site over its first 15 years of use (550,500 c.y. to 1,181,500 c.y.) is experienced beyond that period, the site life could range from 100 to 220 years.

Existing sediments at the selected site were described in section 3.02a(4). The percentage of fine-grained materials near and on the proposed site indicate a depositional environment. Materials expected to be dredged from Corps' dredge sites and disposed at this nondispersive site are mostly described as clean silty sand, with the exception of some material from the Capsante Waterway at Anacortes. An estimated one-half of the materials dredged by the ports and others from the Fidalgo Bay area are believed to be unsuitable to pass the disposal guideline for nondispersive sites, and thus could not be disposed at the Bellingham Bay site.

PSDDA baseline studies for Phase II indicate sediments at and near the selected site had concentrations of several PSDDA chemicals of concern that exceeded the PSDDA SL values, and one chemical exceeded the ML value. These were: mercury (highest concentration 0.56 ppm dry weight, about 2.67 times the SL, 7 exceedances in 21 stations), phenol (1 station exceeded ML by 4 times, SL by 40 times), 4-methylphenol (1 station exceeded SL by 2.33 times), There were no bioassay "hits" at the site, however. Cirratulid polychaetes, which are frequently associated with organic enrichment, were important members of Bellingham Bay benthic communities. Bioaccumulation of metals in tissues of the clam Compsomyax subdiaphana over sediment levels were from <2 times for cadmium and nickel to 15 times for arsenic. A possible bioaccumulation of benzoic acid was also found.

(4) Air Quality. No significant release of chemicals to the air is anticipated as a result of anticipated open-water disposal activities. An average of about 25 to 30 barge loads of material per year are forecast for this site.1/ Tugboat activities connected with barge towing and disposal would be expected to generate some hydrocarbon releases, including hydrocarbon byproducts and particulates from diesel fumes at the open-water disposal site. Haul trucks will release similar products at upland/nearshore sites. Negligible concentrations of hydrogen sulfide gas may also be released from the dredged material during open-water disposal activities. Confined disposal activities (principally on land) could result in fugitive particulates should the material dry on dewatering or in construction of the landfill areas.

These impacts and potential means to avoid them are discussed in section 4.02a(4). Air impacts would be considerably less with the action alternative than with no action due to significantly less volumes of materials that require confined disposal with the former (see figures 4.2 and 4.3). No significant impacts are anticipated to the air quality environment around the Bellingham Bay site as a result of disposal activities due to the selected alternative.

(5) Land. Habitat losses associated with dredged material that must be placed in all disposal sites (open-water, benthic open-water and nearshore confined, land confined) could include loss of benthic habitat, wetlands, loss of fish feeding and rearing habitat, loss of vegetation, and loss of natural shoreline areas. For further discussion of these impacts see section 4.03a(5) above. Approximately 260 acres of benthic habitat would be covered by the preferred site, while land and shore losses would approximate 26.3 acres. It is not possible to further distinguish upland and nearshore losses since development would depend on site availability. The significance of these losses would depend on the ecological values and previous uses of the land prior to its use as a dredged material disposal site. The open-water site used for unconfined disposal is expected to be recolonized following cessation of disposal activity (see Section 4.06b(3)(a), Benthic Infaunal Resources). Land disposal sites that are developed for human use are often permanently lost from ecological production unless extensive effort is put into reclamation at site closure. Development of nearshore areas could result in significant adverse losses of salmonid feeding habitat. Ecology is preparing an EIS which deals with these impacts, including any required mitigation.

1/Forecast of disposal activity based on volume projections used in DNR user-fee analysis (see lower portion of table 2.7c). Volumes shown have been discounted for large speculative projects and for projects where clean dredged material will be used for land development.

b. Impacts and Their Significance to the Biological Environment.

(1) Benthic Communities.

(a) Infaunal Resources. Existing benthic resource values are higher in the selected site than in the south alternative site, with two taxa (bivalves and polychaetes) comprising almost 95 percent of the biomass at the selected site and 68 percent of the biomass at the alternative site. The benthic infaunal communities at both sites were largely dominated by opportunistic species characteristic of physically and/or chemically impacted bottoms (Rhoads et al., 1978; Rhoads and Germano, 1986).

Physical impacts and chemical impacts are anticipated as a result of dredged material disposal at the selected site. Each is discussed in turn with respect to probable impacts to the sedentary benthic infaunal resoures known to exist within the boundaries of the disposal site and immediately adjacent to it.

The anticipated physical impacts to sedentary benthic infaunal resources resulting from dredged material will include the immediate, but temporary, loss of benthos due to burial and smothering by clumps of cohesive material within the relatively small single-dump bottom high energy impact area (250-foot diameter), about 0.3 percent of the overall disposal site area. Direct physical impacts from dredged material hitting the bottom would be greatest in the center of the impact zone, diminishing to negligible impacts toward the edges of this zone. Estimated depth resulting from a single disposal from a 1,500 cubic yard bottom dump barge would be around 0.8 cm in the impact zone. Physical impacts attributable to disposal would directly be limited to around 4-1/2 months/year (June 16 - October 31) due to the seasonal restrictions on disposal proposed by the Washington Department of Fisheries closure between November 1 - February 28 each year) and the annual dredging fisheries closure period (March 15 - June 15) for outmigrating salmon and steelhead smolts. Dredging/disposal forecasts (1985-2000) indicate that about 25 to 50 barge loads of dredged material (1,500 c.y./barge) would be placed at the Bellingham Bay disposal site on a average annual basis. This would result in an estimated annual accumulation of about 15 to 30 cm of material within the center of the disposal zone (assuming 25 percent consolidation). It is likely that many of the impacted infauna would be able to survive initial burial, especially towards the periphery of the impact zone, by vertically migrating out of the deposited material. Some benthic infaunal species have demonstrated the ability to migrate vertically and survive burial induced by relatively thick covers (i.e., up to 50 cm) of sediments with particle size distributions similar to or different from their native sediments (Maurer et al., 1978). It is likely that small crustaceans (cumaceans, and amphipods) living within the upper 0-5 cm of the sediments may be temporarily or permanently displaced within the dump zone due to chronic physical impacts. Infaunal crustaceans were generally impoverished throughout the study area (see section 3.03b(1)), and their loss would be insignificant to the benthic community structure and resulting benthic resource values.

During periods of dredging/disposal inactivity (1 November - 15 June), partial recovery of benthos in the impacted areas is expected due to recruitment and migration from surrounding unimpacted areas. Early recruits to the disposal site may consist predominantly of polychaete opportunists such as Tharyx monilaris, Capitella capitata, Boccardia polybranchia, and Spiophanes fimbriata. Later recruits to the disposal site would likely be the bivalves Axinopsida serricata and Macoma spp. Small crustaceans (ostracods, cumaceans, and gammarid amphipods) in the disposal zone may be permanently displaced due to physical and chemical stresses. Recolonization by opportunistic benthic species may result in the partial restoration and/or possible enhancement of benthic habitat values to foraging bottom fishes (Rhoads et al., 1978; Becker 1984; Lunz 1986; Clarke and Kendall 1988; Kendall and Clarke, 1988). Tatem (1984) reported an increase in benthic species abundance at an experimental site in Elliott Bay following disposal operations. Additionally, a postdisposal survey of the Foul Area disposal site off the coast of New England using the Benthic Resources Assessment Technique (BRAT) demonstrated that potential bottomfish habitat food values (i.e., benthic resource values) increased onsite relative to offsite for many of the target flatfish foraging strategies examined. In particular, fish foraging for smaller prey (primarily Group IIA and IIB predators) living near the sediment-water interface (Lunz, 1986) populations increased.

Existing benthic communities found onsite are adapted to fine to medium silt bottoms. Potential changes in bottom sediment grain size distribution resulting from dredged material disposal could adversely impact many resident infaunal species by lowering their reproductive potential, impairing recruitment success, and diminishing the ability of buried adults and juveniles to vertically migrate and survive burial (Maurer, et al., 1978).

PSDDA baseline studies indicate that onsite and nearby sediments contain elevated levels of chemistry relative to Puget Sound reference areas. This condition may result in some existing minimal adverse biological impacts. Dredged material passing the PSDDA guidelines may also cause biological effects on the site due to sediment chemistry, but these effects would be limited to the site, and would be minor and "acceptable" under the Clean Water Act. Some sublethal impacts to onsite benthos are possible from chronic exposure to chemicals in dredged material. However, existing benthic communities within Bellingham Bay may already show impacts due to existing poor sediment quality documented throughout Bellingham Bay (EPA, 1986). The PSDDA monitoring program includes an analysis of chemical level in surrounding sediments and benthic community structure and bioaccumulation potential in sessile populations around the disposal site to ensure that biological impacts offsite are not attributable to the disposal site. Additionally, chemical body-burden monitoring of crabs both predisposal and periodically afterwards will occur at the selected Bellingham Bay site. The severity and extent of biological effects from material passing the PSDDA guidelines are not expected to be significant because the majority of taxa found at the selected site and offsite consist of bivalves, mollusces, and polychaete annelids which are generally known to be less sensitive, pollution tolerant, and opportunistic species. Moreover, more sensitive species such as small crustaceans, are sparse represented within the existing benthic community in Bellingham Bay; this may be a consequence of their long-term exposure to degraded sediments. Benthic habitat values could be temporarily degraded as a consequence of disposal activity due to physical impacts, but should quickly recover due to recruitment and migration into the site from adjacent unimpacted areas. Many of these recolonizing benthic species are readily exploited as a food source by bottom feeding fishes (Rhoads et al., 1978; Becker, 1984; Lunz 1986). Therefore, on balance, there would be no unacceptable adverse effects.

Cumulative effects of exposure to the dredged material could result in additional stress to the existing benthic community dominated largely by pollution- and physical-disturbance tolerant pioneering (Stage I) species (EPA, 1986; Clarke and Kendall, 1988). This pattern would also be maintained by the periodic physical disturbance of the site over the four and one-half months of active disposal. Tissue concentrations of chemicals of concern may also increase in onsite benthos exposed to the dredged material, although the existing benthic community within Bellingham Bay may already be subjected to higher chemical body burdens due to poor sediment quality. Baseline and periodic postdisposal monitoring will evaluate predisposal and postdisposal chemical body burdens in select Bellingham Bay taxa, so that disposal site effects on the offsite benthic community may be evaluated.

Impacts offsite will not be significant, and consist of food web impacts and sea surface microlayer impacts. The food web effects could include mobile benthos (crab, shrimp, etc.) and benthic-feeding fishes feeding on disposal site benthos and migrating offsite with a higher body burden which could contribute chemicals to the Bellingham Bay food web. The degree of food web transfer is unknown, but should not be significant due to the site management condition and site monitoring. Crab and shrimp concentrations are generally low within and around the selected site during disposal timing periods (see section 3.03b(1)). Additionally, seasonal site use restrictions have been proposed to limit disposal during critical spawning periods for crab, shrimp, and fish. Nearshore, intertidal and subtidal invertebrate fauna would not be significantly impacted from the disposal operations due primarily to their distance from the disposal site. Dredged material chemicals contributed to the sea surface microlayer may occasionally make contact with the nearshore benthos as a result of currents, tidal actions, and wind moving chemicals onshore. In the case of the selected Bellingham Bay site, there is a low probability that chemicals from the dredged material will significantly contribute to the existing contaminant load, thereby increasing impacts to nearshore habitats (Word and Ebbesmeyer, 1984; Word et al., 1986; Hardy and Cowan, 1986).

(b) Epifaunal Resources. Physical impacts on Dungeness crab (*Cancer magister*) should only occur during the disposal period (from June 16 to October 31) of any given year. During that period, only low densities of crabs are expected in the disposal site (about 20 per hectare). The selected Bellingham Bay disposal site was located in an area that took into account higher density of crabs to the north of the site (the northern ZSF) and greater potentials for bottomfish trawling conflicts in the southern ZSF. However, according to WDF criteria, crab densities are not of high concern unless they exceed 100 crabs per hectare. Gravid females should not be physically impacted as they are present only during the winter and are concentrated in shallow areas at the 30- to 66-foot depths near Post Point. Disposal should not physically impact adult rock crab (C. productus, C. gracilis) populations to any major degree, as concentrations in the disposal site area are relatively low and females are present only during the spring (Dinnel, et al., 1988). Young-of-the-year crab would not be physically impacted as they were generally present only in shallower waters.

Any Dungeness or rock crabs present at the selected site during a disposal event will be subject to both physical and chemical impacts from disposal of dredged sediments. Direct physical impacts could result from crabs at "ground zero" being struck by clumps of dredged material, potentially resulting in burial and impairment of the crabs' ability to escape due to the weight of the material or to bodily damage. Some mortalities would be possible. Crabs not hit by clumps in the immediate disposal area will be subject to other impacts but will probably survive the disposal. Apart from clumps, the material (even at ground zero) would only be deposited in a relatively thin layer with each disposal event. It is estimated to be less than 1 cm depth in the 250-foot center area per 1,500 c.y. disposal event. Annual deposition is estimated at approximately 13 to 27 cm at the center of the mound, assuming 25 percent consolidation. This is a slow accumulation of material forming a relatively thin layer, even in the center of the site. The degree of physical impact would be inversely related to distance of the crab from the immediate disposal site.

Another physical impact would arise from increases in suspended material with each disposal in the disposal zone and contiguous near-bottom boundary layer. This material could accumulate in the gills and interfere with gas exchange across gill surfaces. Mortalities would not be expected, but some crabs, especially those located near the center of the impact area would be stressed, and would likely try to escape the immediate disposal area.

Impacts also could result from chronic exposure to chemicals in the dredged material. Crabs exposed to the dredged material would include those at the site during disposal operations and those having migrated to the site, either randomly or because of attraction to food organisms in the deposited material. There is lack of scientific literature to suggest crab attractions to deposited dredged sediment. This impact analysis assumes that the numbers of crabs found on-site during the disposal site investigations could double for a few days after each disposal event. Crabs could thus come in contact with particle-bound chemicals and those dissolved within the sediment pore water. Accumulation of these chemicals would occur to an extent dependent upon the concentration of the chemicals and their biological availability. The ultimate effects of biological concentration of contaminants in Puget Sound crabs are not easily predicted. Potential effects include: impairment of the molting process, reduced reproductive capability, decreased feeding ability, and decreased resistance to disease.

Offsite impacts could occur when crabs with substantial tissue body burdens move offsite and are preyed upon by higher food chain organisms, such as bottomfish and octopus. Should this occur bioaccumulation of chemicals in these predators would be expected. Monitoring will address biomagnification in offsite species.

Disposal would have both physical and chemical impacts on Dungeness and rock crabs in the disposal site and vicinity. However, these impacts would not be significant for the following reasons:

- The disposal site and vicinity does not contain high densities of Dungeness and rock crabs at any time during the year.

- Crab females are present primarily during the spring but disposal operations would not occur until after June 15 of a given year.

- Higher density crab concentrations are well removed from the disposal site.

- Disposal operations will be infrequent and will only involve small quantities of material, resulting in minor accretion throughout the disposal site. (Annual deposition is predicted to be only 13 to 27 cm at the center of the mound, assuming 25 percent consolidation).

- Few crabs will suffer mortalities, due to their low concentration at the site, the low probability that many would be buried by a direct hit at ground zero, and because sporadic disposal would occur throughout the summer and fall disposal period each year.

- Exposure to material passing the PSDDA guidelines may result in added chronic stress to the crabs, which would not significantly increase the pre-existing stresses from degraded sediment quality. The PSDDA monitoring program will detect bioaccumulation or biomagnification of chemicals in sessile invertebrate populations on- and near-site. Due to the unique proximity of the Bellingham Bay site to crab concentrations near Post Point to the east and to the west, added chemical body-burden testing of crabs for chemicals of concern to human health will be carried out and information gathered may also be informative regarding such chronic effects on crabs.

- Both physical and chemical impacts will be primarily confined to the site, which is a relatively small area within the much larger Bellingham Bay subtidal area that supports crab populations.

Disposal impacts on shrimp at the disposal site are expected to be similar to those predicted for Dungeness crab at the site. Disposal operations would not physically impact the more abundant shrimp populations observed at the site during the winter and spring months, as these operations would be scheduled only from mid-June to the end of October of any year. The relatively small numbers of shrimp present during the summer and fall months would however be subject to both physical and chemical effects from placement of dredged material. Direct physical impacts would occur as shrimp are buried by clumps of cohesive material at or near the center of the disposal site. Numbers of shrimp impacted are expected to be small due to the random distribution of shrimp in the disposal site and the small size of the high energy impact zone (250 feet diameter). Individuals buried by clumps would probably not survive; however, those covered by only 5 to 10 cm of material or less would probably migrate up through the material and survive without critical body damage. Thus, impacts would be greatest in or near the center of the disposal footprint diminishing to negligible impacts towards the footprint edges.

An additional, although minor, physical impact may occur due to temporary increases in suspended material in and adjacent to the disposal site. Suspended material could accumulate in gills and interfere with gas exchange across gill membranes. No mortalities would be expected due to the temporary nature of the event, but high suspended concentrations of material near the disposal site center could result in gill damage.

Chemical impacts could result from long-term exposure to chemicals present in the dredged material. These would be primarily chronic sublethal effects, and would be onsite only. Shrimp exposed to the dredged material would include: (1) individuals present during the summer/fall disposal season, (2) shrimp that had migrated into the site in response to food organisms in the deposited material, and (3) shrimp present in high numbers during the winter/spring nondisposal season. Chronic sublethal effects would result from shrimp being in direct contact with particle-bound chemicals and with those that become dissolved within sediment pore water. Tissue accumulation of these chemicals would occur dependent upon the concentration of the chemicals and their biological availability. Potential effects of accumulation could include impairment of molting, reduced reproductive capacity, decreased feeding ability, and decreased resistance to disease organisms. A larger population of shrimp could be affected during the restricted winter and spring seasons. However, even if all shrimp onsite suffered chronic sublethal effects compared to the overall large population present baywide, they represent only a small percentage of the total bay shrimp resource. The species of shrimp predominating in Bellingham Bay, Pandalus borealis, or pink shrimp, is not of commercial nor sport value in the fishery. Accordingly, impacts to the shrimp fishery would be minor.

Shrimp moving onsite could bioaccumulate chemicals and then migrate offsite. However, because the sediments on and offsite show elevated existing chemical levels, and contact with these sediments may have also resulted in bioaccumulations of chemicals, it is expected that it would be difficult to measure impacts due to each chemical source. In view of placement of only material that meets the site management specification, significant offsite impacts on shrimp are not anticipated.

In conclusion, disposal at the selected Bellingham Bay site is not expected to significantly impact bay shrimp resources. Monitoring of the site and vicinity sessile invertebrate populations as well as periodic checking of crab chemical body burdens will confirm that significant bioaccumulation of contaminants does not occur in shrimp.

Nudibranch (*Tritonia diomedia*) populations would also not be significantly impacted by disposal at the preferred site. Nudibranchs are not expected to be present in large numbers during the summer/fall disposal window. Fourteen per ha were encountered in trawls taken at the time. Impacts on these invertebrates would be similar to those described above for crab and shrimp. Any nudibranchs directly under the disposal barge could suffer mortalities due to burial by clumps; however, very few are expected to be impacted in this manner. More likely is the impact due to contact with the sediments and subsequent metabolism/storage of contaminants, possibly leading to chronic, sublethal effects. Based on the relatively small size of the disposal site, the relatively low mobility of this species, its apparent random distribution in the bay, and the degraded condition of bay sediments, significant impacts to bay populations are not anticipated.

Starfish (*Luidia foliolata*) populations at the selected site are significantly higher during the disposal season than during the winter/spring season. Thus, disposal from June through October would impact more starfish than during other seasons. Impacts would be due to burial at/near the center of the disposal site by clumps of material, to interference with respiration due to higher suspended solids concentrations, and to potential chronic sublethal impacts similar to those described for crab and shrimp in preceeding sections. As this species is considered an incidental nuisance catch by commercial fish trawls, any reduction in numbers in the bay could be beneficial.

(2) Plankton Communities. Impacts would be similar to those described in 4.02b(2).

(3) Anadromous and Marine Fishes.

(a) Anadromous Fish. Impacts of disposal operations on important juvenile salmon populations would be negligible, primarily because no disposal operations would occur between March 15 and June 15, the "closed dredging window" designated by the Washington State Department of Fisheries (WDF) to protect juvenile salmon and steelhead during outmigration. Additional protection will be provided by a seasonal timing restriction proposed by WDF, which would prohibit disposal from November 1 through the end of February each year. It is likely that disposal will be limited to only 4-1/2 months per year, from June 16-October 31. This assumes that the period between March 1 and March 14, currently open, will also be closed. The majority of the juvenile salmon population will have migrated out of Bellingham Bay by June 15.

Disposal could occasionally occur during the presence of late outmigrants (especially chinook salmon) or with those species that may tend to remain in Bellingham Bay for extended periods of time (e.g., searun cutthroat trout). These late or persistent juveniles will not be impacted by the disposal operations unless they were present immediately below a disposal barge during the short period of discharge. In this unlikely event, some fish could be subject to suspended solids impacts. Maximum impacts could include interference with oxygen exchange due to suspended solids clogging gill surfaces, and slightly lowered oxygen availability due to increased biochemical oxygen demand from the suspended dredged material in the disposal plume. No significant impacts are expected to juveniles due to exposure to chemicals in the plume as most chemicals would be unavailable, bound to the sediment particles rather than dissolved in the water column where they could be absorbed across gill surfaces. Physical impacts, if they occurred at all, will be minor since juveniles typically avoid disposal plumes, and the site location is believed to be remote from the primary juvenile migratory pathways.

Neither adult salmon nor trout migrating through Bellingham Bay would be significantly impacted by disposal operations as the majority of the fish would avoid the very short-term (5 to 10 minutes) disposal-associated turbidity plumes. (Observations during the March, 1989 disposal at the Commencement Bay site revealed no surface turbidity during or subsequent to disposal operations.) Those fish that come in contact with the plume may be temporarily impacted from short-term clogging of their gills by suspended material and from slight depressions in dissolved oxygen due to the biochemical oxygen demand of the dredged material. However, these conditions are far less severe than the fish usually encounter when they migrate up the Nooksack River during winter storms and spring freshets or even during summer glacial runoff.

Contributions of chemicals to the sea surface microlayer from the dredged materials may occur, but are expected to be minor relative to existing levels of chemicals from other sources (Word et al., 1986; Hardy, 1986). Actual chemicals and their concentrations would be difficult to identify/measure in view of many source contributions in Bellingham Bay (EPA, 1986). Adult salmon may occasionally swim at the surface for short periods and therefore contact the microlayer during their milling behavior, however, physiological effects due to dredged material chemicals would not be expected to occur. For there to be a noticeable impact on adult salmon fished in the bay, the salmon would have to swim for extended periods of time at the surface and near to the disposal area or microlayer "plume" to absorb chemicals via the gills and exhibit physiological impairments. Swimming at the surface for extended periods is not typical of migrating adult salmon. In general, disposal operations involving material judged to be suitable under PSDDA's disposal guidelines for nondispersive sites should not significantly impact physiological mechanisms/behavior patterns of adult salmon in Bellingham Bay.

(b) Marine Fish/Bottom Fish Resources. In general, marine fish/bottom fish resources would not be significantly impacted by dredged disposal activities in Bellingham Bay. Negligible bottomfish resources were found in July and October 1987 near the selected site and the north and south alternative sites during site specific studies. These results represent the period within which disposal operations would occur. Numerous juvenile bottomfish were observed throughout Bellingham Bay in February and May during the proposed closure period for the site. Based on these results and the final location of the selected site, potential conflicts with groundfish trawling areas to the south are minimal. The area occupied by the selected site is neither prime bottom fish habitat nor a very attractive site for fishing. The south alternative site is situated within the designated trawling area of groundfish trawlers in Bellingham Bay, and would be in conflict with bottom fish trawling activity during disposal operations. Nevertheless, some direct and secondary impacts to neritic fish and bottomfish could be expected to occur at the selected site as a result of disposal of dredged material. Clumps of cohesive material impacting the bottom may bury flatfish such as starry flounder and English sole located within the 250-foot diameter bottom high energy impact area from each dump. Fish outside this bottom impact zone will not be wounded or killed, but could temporarily suffer respiratory distress due to gill clogging and/or lower dissolved oxygen levels (i.e., elevated biochemical oxygen demand). It is highly likely that fish will avoid stressful levels of suspended dredged material by temporarily moving out of the area. In conclusion, because only relatively low numbers of bottom fish resources appear to be present in and around the selected site during the period proposed for disposal (June 16 to October 31), direct physical impacts to bottomfish resources are not expected to be significant.

Bottom fish resources may also be affected through secondary impacts resulting from disposal of dredged material in the selected disposal site. Benthic communities within the impact zone are expected to be lost as a result of burial and smothering, thereby lowering the food value of the area to bottom feeding fishes. However, this area already appears to be disturbed and the benthic community is currently dominated by opportunistic benthic species, which are resistant to physical and chemical stresses. Therefore, the impact of this habitat loss to bottom feeding fishes should be temporary, and partial recovery is expected during the 7-1/2 months when no disposal will take place (Clarke and Kendall, 1987; Kendall and Clarke, 1988). Consequently, the impact of this habitat loss to bottom feeding fish resources is not expected to be significant. Fish food habitat values may increase as a result of increased production of pioneering (stage I) opportunistic species on the disposal mound (Rhoads et al., 1978; Becker, 1984; Lunz, 1986; Rhoads and Germano, 1986; Clarke and Kendall, 1987). Bottom fish foraging on these opportunistic species could bioaccumulate or biomagnify chemicals. Direct accumulation of chemicals might also occur through skin and gill membranes as a result of their intimate association with the bottom sediments, particularly when buried in the sediments. However, existing sediment quality in Bellingham Bay is regarded as degraded and may already result in increased chemical body burdens of resident bottom fishes. Because the area of the disposal site only represents a relatively small portion of the foraging habitat for demersal fishes in Bellingham Bay, and documented potential benthic fish food habitat resources on site are relatively low, only low levels of chemical accumulation in fish predators are expected.

(4) Marine Mammals. See section 3.03b(4)(a) for a discussion on marine mammals. Environmental toxicants in north Puget Sound are not as serious a problem as in south Puget Sound based on tissue samples taken from harbor seals (Everitt, et al., 1979). Nevertheless, reproductive success of Puget Sound harbor seals is lower than the rates published for elsewhere in the world (Everitt, et al., 1979). Everitt suggests that this low rate may be a result of sampling error, but points out that the upper limit of their possible breeding success is still below all reported success rates. No theory has been advanced as to why their reproduction rate is low. PSDDA agencies are dealing with this issue through monitoring of on- and near-site invertebrate infaunal and crab resources to determine if unacceptable bioaccumulation will occur due to dredged material disposal. Based on available information no cause for concern exists. The killer whales that were present in the 1970's were apparently drawn by a large chinook salmon run in the Nooksack River (Everitt, et al, 1979). This group, "O" pod, has apparently not been seen near Bellingham Bay in recent years. Other impacts are as discussed in section 4.03b(4).

(5) Waterbirds. See section 4.03b(5) for general discussion of possible impacts to waterbirds. Dredged material disposed in Bellingham Bay could originate from Bellingham Bay, Lummi Bay, and Fidalgo Bay. Material brought in by barge from Fidalgo Bay would follow standard shipping routes. The sediments in Fidalgo Bay generally do not contain elevated levels of chemicals of concern. Thus, no impacts to waterbirds, other than generic impacts common to dredged material disposal described in section 4.02b(6), are anticipated at the selected Bellingham Bay disposal site.

(6) Endangered and Threatened Species. See sections 3.03b(6) and 4.02b(9) and the biological assessments in appendix A for a discussion of endangered and threatened species. No impacts are anticipated to endangered or threatened species in Bellingham Bay.

(7) Terrestrial Species. Impacts will be restricted to confined disposal activities. For a discussion of these, see section 4.02b(8) and (9).

c. Impacts and Their Significance to Human Environment.

(1) Social and Economic Features. Adverse impacts to waterborne commerce movements in the Bellingham Bay and vicinity and related port terminal and industrial developments are expected to be less than under the no-action alternative. Estimates of the overall volumes of dredged material that could be discharged at the Bellingham Bay disposal site are indicated in tables 2.7c and 4.3. In general, 73.5 percent of the Phase II dredged material that might be considered for unconfined, open-water disposal at Bellingham Bay would be compatible with the Phase II site management conditions, while none of the material would be held suitable under PSIC (no action). (Actual dredged material volumes placed in unconfined, open-water disposal sites would be determined by project-specific evaluations, as required by Federal and State regulatory agencies.) While the total cost of dredged material disposal would remain higher under PSDDA than experienced prior to 1984 and 1985, when interim criteria were established for use of the disposal sites, the costs under PSDDA would be substantially less than under the PSIC currently in effect because of the significantly greater confined disposal necessitated by PSIC (Phase I EPTA, 1988).

Temporary impacts to sport fishing could also occur due to displacement by tugs and barges at the selected alternative disposal site (see navigation section below). In addition, impacts to land and beach use could also be expected if nearshore and upland disposal sites were developed in recreational areas. Overall, however, social impacts are not expected to be significant.

(2) Transportation.

(a) Navigation. Use of the Bellingham Bay disposal site will result in temporary, localized, and intermittent disruption of navigation and anchorage use of the water surface area within the disposal zone. While tug and barge traffic to and from the sites will represent a potential increase in risk for vessel collision, this risk is minimal due to the short-term and infrequent disposal activity. The disposal site locations have been coordinated with the U.S. Coast Guard and would be marked on navigation charts. Site use would be controlled to minimize the risk for vessel collision. The selected site is in a seldom-used Explosives Anchorage Area, where use is governed by the Captain of the Port of Puget Sound, U.S. Coast Guard. Coordination has occurred with that office to assure no conflicts would occur, and permission has been received to use the area at any time when no explosives-containing vessels are at anchor.

Normal average annual dredged material disposal activity at the Bellingham site is expected to be about 20 to 40 days per year. Actual activity will depend on the specific dredging projects, and the results of chemical and biological tests performed on material to be dredged. As navigation channels would be maintained, there would be no adverse impacts on navigation activity due to channel shoaling. Barge and tug movement during disposal operations is not expected to be much different than at present and consequently there should be no significant navigation conflicts with commercial or pleasure craft.

During times of normal site use, disposal activity at the site is expected to average about one to two barges per day, with peak activity of five barges per day.

When proceeding to the disposal site, tug and barge combinations move at a slower rate loaded than unloaded. Average travel speed is typically around 5 knots. Once on site, disposal operations within the 1,800-foot-diameter disposal zone usually will be accomplished in about 5 to 10 minutes. On occasion, weather constraints and repositioning requirements (to ensure proper location of disposal) may increase the onsite time to as much as 20 minutes. Using an average of 10 minutes, and assuming one to two barges per day, normal site occupancy could amount to about 10 to 20 minutes per day. Though delays in disposal activities could result from avoiding conflicts with tribal fisheries (see below), these are unlikely, given the limited anticipated use of the site, and the requirement for disclosing site use schedules during 404 permit public interest review.

Disposal operations at the selected site will represent a slight increase in navigation traffic for the site. With increased water traffic, there is an increase in risk of minor oil leaks or spills and of vessel collisions. The location of the disposal site, the infrequent site use, and the short duration of site occupancy indicate that these risks are not significant and not measurable.

(b) Land. Impacts to land transportation would be considerably less than those resulting from the no-action alternative, as about 89 percent of future dredged material proposed for open-water disposal in this area is expected to be found suitable for open-water disposal at the Bellingham Bay site compared to 0 percent with PSIC (tables 4.2a and 4.3). Truck hauls and traffic congestion associated with upland disposal would be substantially less than under the no-action alternative, where most dredged material would be placed in nearshore or upland sites.

(3) Dredging and Disposal Activity. The overall impact of this alternative on dredging activity in Bellingham Bay would be an increase over the Puget Sound Interim Criteria (PSIC) in the material that could be found acceptable for unconfined, open-water disposal. Using PSIC, none of the future Bellingham Bay area material is expected to be acceptable for unconfined, open-water disposal. Under the selected alternative, about 550,500 to 1,181,500 c.y. of material could be discharged over the next 15 years at the Bellingham Bay disposal site. Actual disposal volumes will depend upon the outcome of chemical and biological tests conducted on the material and the specific projects proposed for dredging. For a discussion of costs of dredged material disposal as they relate to confined, unconfined, and transported scenarios, refer to table 2.2 and Phase I EPTA (1988).

(4) Native American Fishing. The selected Bellingham Bay site is located within the usual and accustomed fishing grounds of the Lummi Indian Tribe who commented on the DEIS with concerns for treaty fishing grounds, fishing gear fouling on debris, and the shallowness and resource-rich nature of the site. See exhibit C, section 2.04d, and impact analysis at 4.09b(1) and (3), below. There should be no increase in potential for interference to tribal fishing practices, harvests, nor gear damage resulting from use of the disposal site. Federal 404 permit conditions and PSDDA site management conditions (see Phase II MPR 6.1 and 6.2.7) preclude discharging of debris which could foul gear at the site.

Tribal fishing rights will be protected from disposal vessel conflicts with specific project actions accomplished via the Section 404 permit process. Possible tribal concerns regarding the impact of the PSDDA proposal to water quality and fisheries resources upon which the tribal activities depend are addressed in section 2.04d.

(5) Non-Indian Commercial and Recreational Fishing. Non-Indian fishing activities may be displaced during the discharge of dredged material at the selected disposal site. At times of peak dredging activity, this displacement could persist for 5 to 10 minutes, up to five times per day. The

management plan for the selected disposal site has been formulated to minimize potential conflicts with known commercial and sports fishing activities. It is anticipated that displacements, should they occur, are more likely to affect sports fishermen than commercial fishing vessels. The disposal site location, short duration of site use, and site use conditions are expected to preclude any significant adverse effects to fishing activities or catch success in these waters.

(6) Human Health.

(a) Via Seafood Consumption. No impacts on human health are anticipated from the consumption of seafood that might have come in contact with chemicals disposed at the disposal site. Only suitable dredged material would be allowed for disposal at the site. The PSDDA disposal guideline are protective of human health (Phase I MPR, FEIS, and EPTA).

(b) Via Drinking Water. When brackish dredged material is placed in a confined nearshore or upland disposal facility, the potential exists to leach saltwater which could have adverse impacts on potability of ground water and surface water. Under this alternative, material forecast to be found unsuitable for unconfined, open-water disposal will be placed in a confined site. If the material is placed in a nearshore or upland facility, then a potential exists for drinking water chemical impacts, especially if design features such as leachate collection systems, effluent control, or runoff control are not used or fail. Development of any upland or nearshore disposal sites, and the types of material allowed in these sites, would be subject to State and Federal regulations designed to protect drinking water sources. The potential for ground water chemical impacts is less than the impacts that could occur if no action were adopted since under the no-action alternative more material would go to confined disposal.

(c) Via Inhalation of Dust. Dredged material placed on nearshore and upland disposal sites provides a potential source of dust with chemicals of concern that could have an impact on workers and residents living around such a site. Dust production can especially be of concern at multiuser sites where the deposited dredged material is being reworked. This can also be the case at a disposal site that is being prepared for alternate uses. The impacts to human health from inhalation of dust can be minimized by the application of suitable ground cover. The relative potential for dust production under this alternative is less than would be predicted if no action were chosen, for reasons similar to (b).

(d) Via Direct Exposure. Little direct exposure of humans to contaminated dredged material occurs. The only segment of the population that might be expected to come into direct contact with dredged material are workers on dredging crews and at upland and nearshore disposal facilities. Material that is highly contaminated could be placed in secure disposal sites where protection against exposure to chemicals would be minimized by operational procedures (i.e., wearing protective clothing and respirator, security to limit access to the site, application of coverage soil for disposal).

(7) Noise. There have been no measurements of ambient noise levels nor of the actual noise at the shore which would be produced by disposal equipment operating at the selected disposal site which is more than 2,500 feet from the shoreline. See section 4.03c(7) for a discussion of dredging noise levels and standards.

(8) Esthetics. Disposal operations are not expected to significantly affect the esthetic quality or experience in the Bellingham Bay area and vicinity. The disposal operations would be only a minor part of the marine activities ongoing in a busy harbor/marine transport area. Viewers from the shoreline viewpoint areas will see the occasional presence of a tug and barge moving into the outer bay area, spending about 5 to 10 minutes for disposal, and entering and leaving the area once or twice a day. The tug and barge will not be readily noticeable and should not be obtrusive to closer viewers. Viewers from close-in areas may observe a localized turbidity plume in the immediate vicinity of the barge immediately following disposal. This plume would be short term and may be masked at times by Nooksack River runoff during high flow periods. Some viewers may perceive the tug and barge activity in a positive sense, in that it is an integral part of normal marine activities and does not detract from the overall view experience.

(9) Cultural Resources Impacts. As part of the disposal site identification mapping studies, a literature search and limited underwater reconnaissance were undertaken to establish if any historically significant shipwrecks were located within the preferred or alternative disposal sites. None were found. It appeared that no National Register eligible historic properties will be affected by operations at the Bellingham Bay preferred site. The State Historic Preservation Officer concurred with this opinion by letter of September 5, 1989 (exhibit D).

d. Cumulative Impacts. See section 4.03d for a discussion of cumulative impacts at the site.

e. Relationship to Existing Plans, Policies, and Controls.

(1) Clean Water Act, Sections 404/401. See section 4.03e(1).

(2) Coastal Zone Management. See section 4.03e(2).

(3) Shoreline Master Program. The selected disposal site is located within the jurisdiction of Whatcom County, which adopted its shoreline master program in 1979. The selected alternative is consistent with the county's master program as presently written.

(4) Department of Natural Resources (DNR) Policy on Open-Water Disposal of Dredged Material into Puget Sound. Sites throughout the Puget Sound area have been designated by DNR for open-water disposal. If the dredged material cannot be beneficially utilized (e.g., by creation of artificial islands or landfill), and it is approved by all of the various regulatory agencies for unconfined, open-water disposal, it can be deposited in one of the DNR sites. Fees and leases from DNR and permits from other agencies are all required before disposal of dredged material can occur. The selected Bellingham Bay site would be an approved DNR open-water disposal site once the local shoreline permit has been granted by Whatcom County.

(5) Executive Order 11990, Protection of Wetlands. The intent of Executive Order 11990 is to protect wetlands because of the significant cumulative losses that have occurred, and due to their high value to biological productivity and their many other critical functions. As the selected Bellingham Bay site lies in water about 96 feet deep, no wetlands would be directly affected. Dredging projects which could affect wetlands would be evaluated on a project by project basis at the time the project is reviewed for permits under Section 404 of CWA.

(6) Executive Order 11988, Flood Plain Management. The intent of Executive Order 11988 is to provide guidance and regulation for projects located in, and affecting, the flood plain. Executive Order 11988 requires, to the extent possible, avoidance of long- and short-term adverse impacts associated with occupancy and modification of flood plains.

As the selected disposal site lies in water about 96 feet deep, no flood plain impacts would be involved by use of this site. Dredging projects which could affect the flood plain would be evaluated on a project by project basis at the time the projects are reviewed for permits under Section 404 of the CWA.

(7) Puget Sound Water Quality Comprehensive Plan. The Puget Sound Water Quality Comprehensive Plan was adopted December 17, 1986 and modified in October 1988. See section 4.03e(7).

(8) American Indian Religious Freedom Act. The American Indian Religious Freedom Act of 1978 (AIRFA) requires Federal agencies to ensure that none of their actions interfere with the inherent right of individual Native Americans (including American Indians, Eskimos, Aleuts, and Native Hawaiians) to believe, express, and exercise their traditional religions. These rights include access to religious sites, use and possession of sacred objects, and the freedom to worship through traditional ceremonials and rites. AIRFA requires consultation between Federal agencies an Native Americans to ensure that federally supported projects or projects on Federal land do not infringe on the religious practices of Native Americans. Coordination between PSDDA agencies and potentially affected tribes has occurred throughout the study, and is an ongoing process. See exhibit ___ for discussion of coordination.

(9) Canadian Acts Regulating Open-Water Disposal of Dredged Material. See section 4.09e(9) for discussion of the relationship of these laws to the implementation of a disposal site near the international boundary. Bellingham Bay disposal material would not, as noted above, be transported into international waters.

f. Probable, Irreversible, and Irretrievable Commitments of Resources. Use of the selected disposal site will result in an intermittent and temporary degradation of the quality of the sites' air, noise, and water resources. Additionally, intermittent use of the water surface area of the sites during disposal operations represents a commitment that may not always be in agreement with unforeseen future plans for the area. However, neither of these commitments is irretrievable.

Designation of the selected site for dredged material disposal will commit to this use, for the life of the site (judged to be in excess of 100 years based on an estimated site capacity of 8 million c.y.). About 260 acres of benthic aquatic habitat and 26.3 acres of upland or near shore habitat (for confined disposal) will be impacted. The commitment of the benthic area is probably not irretrievable; however, commitment of confined sites may be.

Commitments of nonrenewable energy resources associated with the dredging program would be irreversible. In addition, the labor and capital necessary to conduct dredging operations would be irreversibly committed. This includes the dredging equipment, administrative personnel, and both skilled and non-skilled labor. However, energy and other commitments for individual dredging projects are decided by separate economic and social factors. Commitments of human resources would be similar both for the action and no-action alternatives.

g. The Relationship Between Short-Term Use of Man's Environment and the Maintenance and Enhancement of Long-Term Productivity. For a discussion of this topic see section 4.02g.

h. Mitigation and Amelioration of Adverse Effects. For a discussion of this topic see section 4.03h. The selected site has been located to avoid significant adverse effects (per NEPA) while meeting the in-water disposal needs of Puget Sound dredging. Site location and site management provisions are expected to mitigate any potential biological resource and human use conflict problems. Only suitable dredged material will be discharged at the Bellingham Bay disposal site. Environmental monitoring will allow verification of anticipated conditions and provide a basis for site management changes if the monitoring demonstrates changes are needed.

The primary mitigation feature of the PSDDA Phase II plan is embodied in the siting process. The Bellingham Bay site is generally located away from shorelines, resources, and other amenities to preserve and maintain these resources by avoiding adverse effects due to dredged material disposal. A minimum number of sites were identified by the PSDDA agencies to minimize the possible extent of bottom impacts throughout the Sound. Additionally, where possible, the sites were located in relatively nondispersive areas to minimize the possible spread of effects beyond the disposal site (including the dilution zone) via sediment transport.

The previously adopted (Phase I) regional, effects-based disposal site management condition is designed to avoid discharge of sediments that could cause unacceptable adverse effects. Chemical effects on biological resources at the Bellingham Bay site will be minimized by the PSDDA disposal guideline set up to govern the material that is suitable for unconfined, open-water disposal (see section 2.03g). In combination with the environmental monitoring, the site management condition ensures that there is no acute toxicity to sensitive species onsite and unacceptable effects do not occur outside the disposal site. This fully complies with the applicable provisions of the State Water Quality Standards.

Another important mitigation feature of the PSDDA plan is contained in the compliance inspection and monitoring element. Appropriate compliance inspections by the PSDDA regulatory agencies would ensure that the site use requirements are met, such that planned avoidance of adverse effects can be realized. Appropriate disposal site environmental monitoring will provide needed verification of predicted site conditions within and outside the site as a result of dredged material disposal.

4.07 Bellingham Bay - South Alternate Site. The north alternate site was dropped from consideration due to higher resource densities. The alternative carried forward for final consideration was the south site.

a. Impacts and Their Significant to Physical Environment. Impacts would be the same as the preferred alternative.

b. Impacts and Their Significance to Biological Environment. A slightly smaller concentration of crabs would result in less impacts to this resource than at the selected site. However, shrimp and starfish abundances are somewhat greater there.

c. Impacts and Their Significance to the Human Environment. These impacts would be very similar to those anticipated at the selected site. However, due to commercial trawling at the south alternative site, conflicts would be expected to be greater with this fishing activity than at the preferred site.

d. Cumulative Impacts. Cumulative impacts would be the same as the selected alternative.

e. Relationship to Existing Plans, Policies, and Controls. These would be the same as for the selected site.

f. Probable, Irreversible, and Irretrievable Commitments of Resources. These would be the same as for the selected site.

g. The Relationship Between Short-Term Use of Man's Environment and the Maintenance and Enhancement of Long-Term Productivity. This would be the same as for the selected site (see section 4.02g for discussion).

h. Mitigation and Amerlioration of Adverse Effects. This would be the same as for the selected site.

4.08 Adoption of the Bellingham Bay Selected Alternative. Due to similarity in physical parameters in Bellingham Bay, the basis for the selected site was resource considerations. The south alternative was at first viewed as the preferred alternative over the northeastern site. There were greater Dungeness crab resources within the northeastern site than the south site, which were statistically significant at the $p \leq 0.05$ level, (paired t-test). No gravid female crabs were observed in either site, and mean densities were below the 100 crabs/hectare guideline suggested by WDF. Shrimp abundances were somewhat higher in the south ZSF, and there were significantly higher starfish abundances as well. Seasonally high abundances of juvenile longfin smelt, Pacific tomcod, and shiner perch were observed within Bellingham Bay. WDF subsequently recommended that the south site be dropped from consideration due to conflicts with trawling and recommended a compromise site between the southern and northeastern sites and suggested seasonal timing restrictions that would reduce impacts to the resources of concern throughout Bellingham Bay (see exhibit D). Accordingly, the selected site is midway between the two previously considered sites (figure 2.4).

SECTIONS 4.09 THROUGH 4.11

ENVIRONMENTAL EFFECTS OF THE ALTERNATIVES
CONSIDERED FOR THE ROSARIO STRAIT SITE (NORTH SOUND)

4.09 Rosario Strait Site - Selected Site.

a. Impacts and Their Signifcance to the Physical Environment. The key to evaluating impacts of dredged material disposed at dispersive locations such as Rosario Strait lies in the relatively "clean," uncontaminated material that would be allowed to be disposed there in accordance with the PSDDA dispersive guideline (see section 2.03h). Since there is no practical way of monitoring sediments which are dispersed by currents greater than an average speed of 25 cm/sec (the threshold for selection of dispersive sites) impacts on the physical environment are difficult to assess.

(1) Water Quality. The few available measurements of water quality parameters in the Rosario Strait area were discussed in section 3.04a(2). Concentrations of chemicals of concern are expected to be very low in dredged material due to the restrictive dispersive guideline (2.03h) chemicals occurring in the water phase of dredged material to be dumped at the selected site will rapidly mix and become even less due to the rapid currents and would quickly become indistinguishable from background chemical levels. In much of the Puget Sound-Strait of Juan de Fuca region these levels are quite low, owing to large water volumes and mingling of offshore Pacific Ocean water. Other chemical compounds would remain absorbed to sediment particles. Particulates would also rapidly disperse total suspended solids (TSS).

After a dump there will be a temporary elevation in TSS levels. Numerical modeling (see section 2.03f(2)(b)1) using an average current speed of 30 cm/sec. and an average water depth of 400 feet, has calculated that 5 percent of the dumped material would still be suspended in the water column, after 1 hour (Phase II DSSTA, 1988). It would travel 3,600 feet downcurrent in the form of a wedge. Dividing the quantity of suspended sediment (the 5 percent remaining) by the wedge volume yields a TSS of 0.25 mg/l. This represents about one quarter of background concentrations estimated for the Rosario Strait area from NOAA field surveys (Baker et al., 1978). After a tidal cycle, the concentration of TSS from the dump (which would be farther down current) is estimated to drop to 0.0007 mg/l, or less than 1/100 of background concentration levels. Although conditions at the preferred site do not exactly match the assumptions (depth is only 230 feet, while currents are stronger), the inference is that minimal and temporary elevation in suspended sediments would occur.

(2) Currents and Sediment Transport. Current speeds from stations in and around the preferred Rosario Strait site were discussed in section 3.04a(3). A disposal event would not alter currents, but currents would transport sediments in two ways typical of a dispersive site. After the jet of dumped dredged material hits the bottom, it would be eroded with resuspended material transported downstream. Tidal currents (reaching peak speeds of 100 cm/sec in the area) are expected to disperse this suspended material in a net southward direction (Phase II DSTTA, 1989).

Current speed and size of sediment particles determine the distances which the material travels. Fine-grained particles travel longest and farthest. It has been estimated that the strong currents of Rosario Strait will transport material dumped at the Rosario Strait site an average of 10 miles a day (Phase II DSSTA, 1989).

(3) Marine and Estuarine Sediments. The existing sediments at the proposed Rosario Strait sites during a typical, 1,500 c.y. dump of dredged materials will be affected as follows. If the material is unconsolidated, 95 percent would first be deposited on the bottom (90 percent of this in a 600 foot radius of the dump location) at a mass per unit area of 0.596 g/cm^2 for a mean current of 24.5 cm/sec, and 0.225 g/cm^2 for a mean current of 50.7 cm/sec, according to model calculations based on a 200 foot depth (Trawle and Johnson 1986a). Mean current speeds have been calculated for these sites ranging from 36 to 69 cm/sec, based on current meter data.

During the tidal current cycle, peak current speeds would occur typically, reaching 100 cm/sec at the Rosario Strait site. Owing to these currents, the thin mound of sediments on the bottom near the dump location would likely completely erode over a single tidal cycle.

The above estimate of dispersal assumes that disposed material consists of a slurry of clay/silt and fine sand (less than 0.2 mm) with no clumps, and that the material does not stay on the bottom long enough to consolidate. Ordinary maintenance dredging usually produces such unconsolidated material. With clumped material or slower speeds, hardening of dredged material may occur and erosion may be resisted at speeds of up to 150 cm/sec. Thus, some accretion at these dump sites could occur. One project, Blaine Marina, has been identified which could place consolidated clay sediments at the Rosario Strait site. This material is expected to take longer to be dispersed, and the site will be physically monitored to assess the dispersion. Normal natural sediment accumulation rates in the Rosario Strait area have been measured at 0.076 g/cm^2/year Carpenter et al., 1985). If the initial accumulations after a dump event were not to undergo subsequent erosion by currents, thicknesses 6 to 13 times greater than natural rates could occur. However, the coarse type of sediments known to be present at the two Rosario Strait sites (see section 3.04 a(3)) appear to indicate a natural tendency of the currents to move fine-grained materials away.

Virtually nothing is known about sediment chemical levels at the preferred Rosario disposal site. Presumably, little contamination exists because little or no fine-grained material, which may adsorb contaminants, occurs given the strong, eroding currents present in the area. Swinomish Channel maintenance dredging is expected to be the main contributor of material to the Rosario Strait site. This material is "clean sand" (Corps, 1988) which should not degrade the site. In addition, all four areas from which dredged material could be taken to the Rosario Strait site are expected to pass the PSDDA disposal guidelines for dispersive sites (see table 4.3). Thus, degradation of existing sediments in Rosario Strait is not anticipated.

As the Rosario Strait site is located in a very high energy environment, which should result in all or nearly all disposal material being swept offsite by tidal currents, site capacity is virtually unlimited.

(4) Air Quality. No significant loading of concern chemicals to air is anticipated as a result of forecast disposal activities at the preferred Rosario Strait site. About 50 to 60 barge loads of material per year are

projected for this site.1/ During those days of actual use average level of activity is expected to be no more than two barge loads per day and peak use no more than five barge loads per day. Tugboat activities connected with barge towing and disposal would be expected to generate some hydrocarbon releases, including hydrocarbon byproducts and particulates from diesel fumes at the open-water disposal site. Haul trucks would release similar products at upland/nearshore sites. Small concentrations of hydrogen sulfide gas may also be released from the dredged material during open-water disposal activities. In summary, no significant impacts are anticipated to air quality around the Rosario Strait preferred site as a result of disposal activities due to the selected alternative.

(5) Land. Habitat losses associated with dredged material that must be placed in all disposal sites (open-water, nearshore, and upland) could include loss of benthic habitat, wetlands, loss of fish feeding and rearing habitat, loss of vegetation, and loss of natural shoreline areas (see sections 2.04d and 4.02a(5)). At the Rosario Strait disposal site, approximately 650 acres of benthic habitat would be covered by dredged material. Analysis of available channel, harbor, and marina sediment data suggests that all dredged material proposed for disposal at this site would be found suitable for disposal in either the action or no-action alternatives for this dredging service area. If all material goes to open water, there would be no land nor nearshore habitat losses. The open-water site used for unconfined disposal is expected to be recolonized following cessation of disposal activity (see Section 4.09b(1)(a), Benthic Infaunal Resources).

b. Impacts and Their Significance to the Biological Environment.

(1) Benthic Communities. Generally, only short-lived or transient impacts would be experienced in the biological environment at this dispersive site. The impacts on organisms would be mainly physical, since all dredged material placed at the site will have passed the PSDDA dispersive disposal guidelines.

(a) Infaunal Resources. Discussions of benthic impacts are qualified because only limited site investigations were conducted within the selected and alternative sites and surrounding areas. The bottom in the vicinity of the selected site was found to be comprised of coarse-grained sediments, rocks, and cobble, largely attributable to the strong tidal currents within Rosario Strait (see section 3.04a(3); Phase II DSSTA, 1989, and Dinnel et al., 1988). Benthic community structure characteristic of current swept bottoms is largely dominated by epifaunal species rather than infaunal species due primarily to the coarse nature of the bottom. Therefore, discussion of impacts is only for those epifaunal species documented as commercially and/or recreationally important invertebrate resources within and around the sites.

1/Forecast of disposal activity based on volume projections used in DNR user fee analysis (see table 2.7c). Volumes shown have been discounted for large speculative projects and for projects where clean dredged material will be used for land development.

(b) Epifaunal Resources. No significant impacts to economically or recreationally important invertebrates are expected from disposal at the selected Rosario Strait site. These resources are relatively impoverished in the vicinity of the selected and alternative sites. Dungeness crabs, rock crabs, pandalid shrimp, pink scallops, sea urchins, and mussels were found to be sparse near and around the sites, with their highest concentrations over 2 nautical miles south. Physical impacts to species inhabiting the selected site during disposal will be due to individuals being hit directly by a clump of consolidated fine-grained material, or to elevated suspended solids concentrations. The chance clumps of material striking individuals of these species is relatively low, due to their general scarcity. Mortalities could occur from the actual impact of clumps striking the bottom, but not likely due to burial, since dispersion of the clump is expected to occur generally within a tidal cycle (Phase II DSSTA, 1988). The majority of the disposed material will be consolidated, and would only be present onsite in a very thin layer that should rapidly be dispersed. Should clumps persist for several tidal cycles, they may become surface hardened (armored) and would likely present an unsuitable habitat for the predominantly epifaunal organisms existing at the site. The extent this would occur is not possible to estimate, but the amount of consolidated material to be disposed at this site is expected to be a small portion of the total.

There could also be elevated levels of near-bottom suspended solids for several hours after the disposal that could temporarily interfere with normal respiration across the gills of invertebrates. This is not expected to be markedly different from levels naturally occurring (particularly during rapid tidal currents in the area). The impact is not expected to be significant as any animals onsite can either move away from the area or are adapted to tolerate such increases. Invertebrates are also not expected to be significantly impacted because the frequency of disposal is expected to be 60 to 80[1/] ba ge loads (with 1,500 c.y./bargeload) over a 9-month disposal period/year, and because no net accumulation of dredged material is expected to occur on the bottom of the disposal site, due to high currents and rapid sediment transport, accordingly, little or no habitat alteration should occur.

Regarding chemical impacts, neither acute lethal nor chronic sublethal biological effects are expected.

Impacts that could occur offsite would not be significant, due to the rapid dilution of the suspended and settled dredged material. Higher suspended solids levels following disposal will be transient and short term, and would rapidly be diluted to background levels generally within 3,500 feet of the dump zone. No food web impacts nor sea surface microlayer impacts are anticipated as a result of the restrictive disposal guidelines adopted for the dispersive sites, and the generally low abundances of commercially and

1/The estimate of numbers of barge loads have been increased from that given in the DEIS to account for a possible range of volumes that could be disposed. This is done to assure that maximum possible impacts are considered, although the low end of the range is probably the more realistic. The conclusion of the impact assessment does not change despite the range consideration.

recreationally important invertebrates documented during site investigations. Nearshore, intertidal and subtidal invertebrate fauna would not be significantly impacted from the disposal operations due primarily to their distance from the disposal site.

(2) Plankton Communities. See section 4.02b(2) for discussion of these impacts, which will not be significant.

(3) Anadromous and Marine Fishes.

(a) Anadromous Fish. Impacts of disposal operations on juvenile salmon or steelhead trout populations would be negligible, primarily because no disposal operations would occur between March 15 and June 15, the "window" designated by the Washington State Department of Fisheries to protect juvenile salmon and steelhead during outmigration. The majority of the juvenile salmon populations migrate through the Rosario Straits by June 15.

Disposal could occasionally occur during presence of early or late juvenile migrants or with those species that tend to remain in embayments for extended periods of time (e.g., searun cutthroat trout and chinook salmon). These juveniles will not be impacted by the disposal operations unless they frequented the disposal area during the dump and immediately in the discharge plume. Should this occur, these fish could be briefly exposed to elevated suspended solids. Impacts could include interference with oxygen exchange due to suspended solids clogging gill surfaces, and lowered oxygen availability due to slightly increased biochemical oxygen demand in the disposal plume. There will be no impacts to juveniles from chemical exposures in the plume because of the highly restrictive disposal guideline selected for the dispersive sites. Physical impacts will be minor since juveniles typically avoid disposal plumes, and the site location is not located in known primary juvenile migratory pathways.

Adult salmon and trout migrating through Rosario Strait would also not be significantly impacted by disposal operations as the majority of the fish will avoid turbidities associated with disposal plumes. Those fish that come in contact with the plume may be temporarily impacted from short-term clogging of their gills by suspended material and from slight depressions in dissolved oxygen due to the biochemical oxygen demand from the dredged material. However, these conditions are far less severe than the fish usually encounter when they migrate upriver during freshets (i.e., floods and high water runoff periods).

No adverse biological effects to salmon undergoing migration are expected from chemicals in the sediments from disposal nor from floatable material contributed to the sea surface microlayer due to the strict disposal guidelines for the dispersive sites.

(b) Marine Fish/Bottom Fish Resources. Marine fish and bottomfish resources will also not be significantly impacted by disposal activities in the Rosario Straits. Few bottom fish resources were found on or near the selected site during bottom trawls conducted in April and October 1987 (See section 3.04b(3)(b)). However, the studies were conducted with sampling gear which is not regarded as selective for fish. Use of a rock dredge was necessitated due to rocky nature of the bottom. Based on limited results and the fact that the selected site is removed from known important groundfish resource and recreational fishing areas, it is probable that this area represents moderate to poor bottomfish and neritic fish habitat.

Direct physical impacts from disposal on these resources should be substantially reduced due to the forecast relatively low frequency of disposal, about 60 to 80 barge loads/year, coupled with the strong currents acting to quickly erode and disperse sediments. Nevertheless, some direct and secondary impacts to neritic marine fish and bottomfishes may occur as a result of disposal of dredged material at this site. Clumps of consolidated material falling to the bottom might bury flatfish such as Dover sole or English sole in the 1.1 acre area of high velocity falling material impacted in a single dump of a 1,500 c.y. barge. Fish outside this high velocity impact area will escape direct impacts, but may suffer some temporary respiratory distress due to gill clogging and/or low dissolved oxygen levels due to increased biochemical oxygen demand induced by the suspended solids within the dredged material plume. It is likely that fish will avoid stressful levels of suspended dredged material by temporarily moving out of the area.

(4) Marine Mammals. See sections 3.03b(4) and 4.02b(5) for discussions of marine mammal distribution in Rosario Strait and impacts to marine mammals from dredged material disposal, respectively. The marine mammals in Rosario Strait that have the greatest chance of impacts due to their abundance in the area are harbor seals and harbor porpoises. Fish are their principal diet, although harbor seals can take slightly larger species of fish than do harbor porpoises. Two harbor porpoises were reported to have choked to death on Pacific shad; harbor seals frequently eat salmon, and both rely heavily on herring. The herring harvest by fishermen in Rosario Strait was among the highest in Puget Sound in 1987, which suggests why seals and porpoises frequent this area. Effects of disposal of dredged material in Rosario Strait site on herring and other potential impacts to harbor seals and harbor porpoises would not be significant. (See sections 4.09b(2) to (4) and 4.10b(2) to (4) for a discussion of potential impacts.) The impacts to harbor seals and harbor porpoises will thus be minimal. Other specific concerns are described in section 4.02b(5) and would not be impacted.

(5) Waterbirds. See section 4.02b(6) for a general discussion of potential impacts to waterbirds from dredged material disposal in Puget Sound. As noted, disturbance by the operating barge and tug may disturb birds from feeding. As for harbor seals and harbor porpoises, the abundance of herring and other small fish make Rosario Strait a favored area for waterbirds. However, disturbance of feeding flocks is not considered likely, other than the slight disturbance caused by turbidity, due to the birds' lack of fear of vessels. The selected disposal site is located at least 2 miles from the nearest breeding colony, so these colonies are not expected to be affected by disposal activity.

(6) Endangered and Treatened Species. See section 4.02b(9) and biological assessment in appendix A for a discussion of impacts to endangered and threatened species. No endangered cetaceans have been observed recently in Rosario Strait, and accordingly no impacts to these species are expected. Although bald eagles are fairly common residents near Rosario Strait, disposal activities are not expected to affect them, primarily because bald eagles in this area are accustomed to large vessels, and since the regular concentrations of waterbirds upon which bald eagles feed do not normally occur near the disposal sites. Peregrine falcons are present throughout the year, but only in very small numbers. The area of the disposal site is not utilized by peregrines on a regular basis; thus, no impacts to peregrines are expected.

(7) Terrestrial Species. There will be minor impacts to terrestrial species as only a small amount of upland disposal is expected to occur from dredging in the area served by the Rosario Strait disposal site.

c. Impacts and Their Significance to the Human Environment.

(1) Social and Economic Features. Conflicts with other vessel traffic in Rosario Strait is possible because the dredged material forecast to be disposed there (see section 4.09c(3)). All the material that could be considered for disposal at this site is expected to pass the PSDDA guidelines. Actual dredged material volumes placed at the site will depend on project specific evaluations. The actual number of tug and barge trips will depend on the size of barge used and the particular project involved. However, these impacts are not expected to be significant to commerce or fishing as described below.

(2) Transportation.

(a) Navigation. Use of the selected disposal site could result in temporary, localized, and intermittent disruption of navigation occurring within the disposal zone. Additionally, tug and barge traffic to and from the sites will represent some potential risk for vessel collision. The disposal site location has been coordinated with the U.S. Coast Guard and will be marked on navigation charts. Site use will be controlled to minimize the risk for vessel collision.

There has been no dumping in the Strait in recent years although a nearby site, Bellingham Channel, was used previously. Normal future average annual dredged material disposal activity in the Rosario Strait area is expected to be about 60 to 80 days per annual 9-month disposal period. Disposal activity at the site would be expected to average about two barges per day. Actual activity will depend on the specific dredging projects, and the results of tests performed on material to be dredged. As navigation channels will be maintained, there should be no adverse impacts on navigation activity due to channel shoaling. Barge-tug movement during disposal operations is not expected to be much different than at present and consequently there should be no significant navigation conflicts with commercial or pleasure craft.

When proceeding to the disposal site, tug and barge combinations move at a slower rate loaded than unloaded. Average travel speed is typically around 5 knots. Once on site, disposal operations within the proposed 1,500-foot diameter disposal zone usually will require about 5 to 10 minutes. On occasion, weather constraints and repositioning requirements (to ensure proper location of disposal) can increase the onsite time to as much as 20 minutes. Using an average of 10 minutes, and assuming two barges per day, normal site occupancy could amount to about 20 minutes per day. Though delays in disposal activities could result from avoiding conflicts with tribal fisheries (see below), they are unlikely, given the limited anticipated use of the site, and the requirement that disposal schedules be disclosed in the Federal 404 permit public notice.

Disposal operations at the selected site will represent a slight increase in navigation traffic in the site area. With increased water traffic, there is an increase in risk of minor oil leaks or spills, and of vessel collisions. The location of the disposal site, the infrequent site use, and the short duration of site occupancy indicate that these risks are not significant and are likely not measurable.

(b) Land. Only limited impacts to land transportation are expected from this alternative as nearly all future dredged material that may be considered for the Rosario Strait site is expected to be discharged there.

(3) Dredging and Disposal Activity. No significant dredging activity currently takes place along Rosario Strait. Dredged material would be brought to the disposal site from five areas in north Puget Sound (the San Juan Islands, Swinomish Channel, Whidbey Island, Blaine, and Anacortes-Fidalgo Island). All the dredged material from these areas is expected to be suitable for disposal at the Rosario Strait dispersive site. Under the selected alternative 1,801,000 c.y. is projected to be suitable for disposal at the site over the next 15 years although only 1,315,000 c.y. are forecast for disposal there. Some of this suitable material may be used for shoreside development.

(4) Native American Fishing. The Rosario Strait site is located within the usual and accustomed fishing grounds of several Puget Sound tribes. However, no increase is expected in the potential for tribal fishing gear damage and/or reduced fishing time resulting from use of the disposal site. Tribal fishing rights will be protected from disposal vessel conflicts by special disposal site use conditions accomplished via the Section 404 permit process. Possible tribal concerns regarding the impact of the PSDDA proposal to water quality and fisheries resources, upon which tribal activities are dependent, are discussed in section 2.04d.

(5) Non-Indian Commercial and Recreational Fishing. Non-Indian fishing activities may be displaced during the discharge of dredged material at the disposal site. At times of major dredging activity, this displacement could persist for about 10 minutes, up to five times per day. The selected disposal site has been located to minimize potential conflicts with known

commercial and sports fishing activities. It is anticipated that displacements, should they occur, are more probable for sports fishermen than for commercial activities. The disposal site location and the short duration of site use, are expected to preclude any significant adverse effects to fishing activities and catch success in these waters.

(6) Human Health.

(a) Via Seafood Consumption. No impact on human health is anticipated from the consumption of seafood that might be in or near the disposal site. Only suitable dredged material will be allowed for disposal at the site.

(b) Via Drinking Water. When marine or brackish dredged material is placed in a confined nearshore or upland disposal facility, the potential exists to generate leachates having adverse impacts on ground water and surface water used for drinking. However, as noted above, only a small amount of dredged material is expected to be placed at nearshore or upland disposal sites.

(c) Via Inhalation of Dust. Only a small amount of dredged material is expected to be placed at nearshore or upland disposal sites.

(d) Via Direct Exposure. Only a small amount of dredged material is expected to be disposed at nearshore or upland sites. Little direct exposure of humans to dredged material occurs. The only segment of the population that might be expected to come into direct contact with dredged material are workers on dredging crews.

(7) Noise. There have been no measurements of ambient noise levels or of the actual noise at the shore which would be produced by disposal equipment operating at the selected site, which is over 1 nautical mile from the nearest shoreline. See, however, section 4.03c(7) for a generic discussion of dredging noise levels and standards.

(8) Esthetics. Disposal operations are not expected to significantly affect the esthetic quality of the Rosario Strait area. The disposal operations will only be a minor part of the marine activities ongoing in a busy harbor/marine transport area. Viewers from the various shoreline areas will see the occasional presence (about two times daily during normal dredging operations) of a tug and barge moving into the outer bay area. For about 5 to 10 minutes the vessels will be in the area and then leave. The tug and barge would not be readily noticeable and should not be obtrusive to closer viewers. Viewers from close in areas may observe a localized turbidity plume in the immediate vicinity of the barge immediately following disposal. This plume should be short term and may be masked at times by river runoff during high flow periods. Many viewers will perceive the tug and barge activity in a positive sense, in that it is an integral part of normal marine activities which does not detract from the overall view experience.

(9) Cultural Resources Impacts. As part of the disposal site identification mapping studies, a literature search and limited marine history study were undertaken to establish if any historically significant shipwrecks are located within the selected disposal site. No evidence of such ships was found. It was concluded that the designation of the Rosario Strait disposal site would not affect properties eligible for inclusion in the National Register of Historic Places.

d. Cumulative Impacts. Disposal operations at the selected site may contribute to several ongoing impacts to the water and air resources that are described in section 3. Marine water quality, air quality, intertidal and subtidal macrofauna, plankton, neuston, marine mammals, anadromous and marine fishes, and threatened or endangered species could all experience some effect. None of these contributions, however, are expected to be significant. Because of the dispersive nature of the Rosario Strait site, any cumulative impacts from dredged material disposal are expected to be slight. Dredged material should be eroded by strong currents above the relatively soon after disposal. The impacts in the water column, i.e., from suspended solids, should be transient, not cumulative. Physical monitoring will periodically be accomplished to assure that no unacceptable accretion of materials is occurring.

e. Relationship to Existing Plans, Policies, and Controls.

(1) Clean Water Act, Sections 404/401. See section 4.03e(1).

(2) Coastal Zone Management. See section 4.03e(2).

(3) Shoreline Master Program. The selected disposal site is located within the jurisdiction of Skagit County. The selected alternative is consistent with the county's master program as presently written.

(4) Department of Natural Resources (DNR) Policy on Open-Water Disposal of Dredged Material into Puget Sound. Sites throughout the Puget Sound area have been designated by DNR for open-water disposal. If the dredged material cannot be benefically utilized (e.g., creation of artificial islands or landfill), and it is approved by all of the regulatory agencies and DNR for unconfined, open-water disposal, it can be deposited in one of the DNR sites. Fees and leases from DNR and permits from other agencies are all required before disposal of dredged material can occur. The selected site will be an approved DNR open-water disposal site once the local shoreline permit has been granted by Skagit County.

(5) Executive Order 11990, Protection of Wetlands. The intent of Executive Order 11990 is to protect wetlands because of the significant cumulative losses that have occurred, and due to their high value to biological productivity and their many other critical functions. As the selected site lies in water over 230 feet deep, no wetlands would be directly affected. Dredging projects which could affect wetlands will be evaluated on a project-by-project basis at the time the projects are reviewed for permits under Section 404 of the CWA.

(6) Executive Order 11988, Flood Plain Management. The intent of Executive Order 11988 is to provide guidance and regulation for projects located in, and affecting, the flood plain. Executive Order 11988 requires, to the extent possible, avoidance of long- and short-term adverse impacts associated with occupancy and modification of flood plains.

As the selected site lies in water over 230 feet deep, no direct flood plain impacts would be involved by use of this site. Dredging projects which could affect the flood plain will be evaluated on a project-by-project basis at the time the projects are reviewed for permits under Section 404 of the CWA.

(7) Puget Sound Water Quality Comprehensive Plan. The Puget Sound Water Quality Comprehensive Plan was adopted 17 December 1986 and modified in 1988. The plan is discussed in section 4.03e(7).

(8) American Indian Religious Freedom Act. The American Indian Religious Freedom Act of 1978 (AIRFA) requires Federal agencies to ensure that none of their actions interfere with the inherent right of individual Native Americans (including American Indians, Eskimos, Aleuts, and Native Hawaiians) to believe, express, and exercise their traditional religions. These rights include access to religious sites, use and possession of sacred objects, and the freedom to worship through traditional ceremonials and rites. The AIRFA requires consultation between Federal agencies and Native Americans to ensure that federally supported projects or projects on Federal land do not infringe on the religious practices of Native Americans. Coordination between PSDDA agencies and potentially affected tribes has occurred throughout the study, and is an ongoing process.

(9) Canadian Acts Regulating Open-Water Disposal. The Rosario Strait dispersive site is situated in an area where drift card, drogue, and current studies have suggested that dispersed materials suspended in the water and transported via tidal currents at the bottom could reach Canadian waters, Canadian disposal practices were reviewed. A PSDDA report, Open Water Disposal of Material in Canadian Waters (Cooper Consultants, Inc., 1986), summarizes Canadian practices. The regulatory authorities consist of the following:

- Ocean Dumping Control Act
- Artic Water Pollution Prevention Act
- Navigable Waters Protection Act
- Fisheries Act
- Migratory Birds Convention Act
- Public Works Act

Disposal of dredged and other materials is primarily regulated through a system of permits specified by the Canadian Ocean Dumping Control Act (ODCA). This act was passed in 1975 to fulfill Canada's commitment to the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, known commonly as the London Dumping Convention. ODCA permits are obtained by petition to the Canadian Environmental Protection Service, and decisions are based on three "schedules" for substances:

• Schedule I includes "prohibited" substances known to present "serious threats to the marine enviroment due to toxicity, accumulation, and persistence." Only trace amounts can be disposed, and the associated risks must be minimal (see table 4.5).

• Schedule II includes "restricted" substances which may pose "significant hazards" when disposed. These substances may be disposed if present in moderate quantities (see table 4.6).

• Schedule III includes conventional parameters not listed in the other schedules, and includes a series of factors for material (and siting) that determine the need for more testing (see table 4.7).

TABLE 4.5

SCHEDULE SUBSTANCES AND CONCENTRATION LIMITS
SCHEDULE I

"Prohibited" substances known to present serious threats to the marine environment due to toxicity, accumulation, and persistence. Only trace amounts can be disposed and the associated risks must be minimal.

Substance	Limit
Mercury and mercury compounds phase	0.75 ppm solid phase/1.5 ppm liquid phase
Cadmium and cadmium compounds	0.6 ppm solid phase/3.0 ppm liquid phase (1 ppm solid phase guideline used in practice)
Persistent plastics and synthetic materials	4 percent by volume in a suitably comminuted form
Crude oil, fuel oil, diesel oil, lubricating oils, and hydraulic fluids	10 ppm n-hexane extractable substances (1,500 ppm guideline used in practice)
Organohalogenated compounds, such as PCBs	0.01 of a concentration found toxic to sensitive organisms (1 ppm PCBs guide-line used in practice)
Highly radioactive material	10 Ci/metric ton alpha-active waste with half-life exceeding 50 years 1,000 Ci/metric ton beta/gamma-active waste (excluding tritium). 10^6 Ci tritium/metric ton
Substances produced for biological and chemical warfare	(No limits/procedures specified)

TABLE 4.6

SCHEDULE SUBSTANCES AND CONCENTRATION LIMITS
SCHEDULE II

"Restricted" substances which may pose significant hazards when disposed. These substances may be dumped if not present in large quantities and if care is taken to isolate the waste.

Substance	Limit
Arsenic, lead, copper, zinc, beryllium, chromium, nickel, vanadium, and their compounds	1,000 ppm each
Cyanides and fluorides	1,000 ppm each
Pesticides and by-products (excluding Schedule I)	1,000 ppm each
Organosilicons	(No limits/procedures specified)
Containers and scrap metal	(No limits/procedures specified)
Low-level radioactive waste	(No limits/procedures specified)
Bulky materials waste that presents a hazard to fishing and navigation	(No limits/procedures specified)

TABLE 4.7

SCHEDULE SUBSTANCES AND CONCENTRATION LIMITS
SCHEDULE III

Substances not listed in Schedules I and II and general properties of the material and disposal site. Included are factors which must be considered in all disposal permits.

Properties and Pertinent Factors

Total quantity of material for disposal
Bulk composition of material
General physical/chemical/biological properties
General toxicity
Site and method of disposal
Receiving water characteristics
Effects on marine setting and marine life
Impacts on fishing and navigation
Current and tidal influences
Effects on recreation

Decisions for disposal permitting process in the Straits of Juan de Fuca (and elsewhere) are made on a case-by-case basis according to technical evaluation guidelines. In general, if chemical levels are within guidelines established for Schedules I, and II, open-water disposal is allowed. While the general Canadian site selection philosophy is to favor nondispersive over dispersive sites, dispersive sites are allowed by EPS when dispersion will rapidly render the dredged material chemically harmless.

The primary difference between Canadian criteria and the PSDDA guidelines is the allowed level of chemistry. Under the Canadian criteria the amphipod test (or other biological tests) may be required if there is a reason to believe that toxic chemicals are present in the material. Typically, exceedence of one standard (or the staff judgement of the Regional Ocean Dumping Advisory Committee consisting of members of the Environmental Protection Service and the Department of Fisheries and Oceans) is sufficient to disqualify dredged material from open-water disposal.

Table 4.8 compares chemical levels of the PSDDA guidelines with the Canadian contaminant limits.

In general, PSDDA's guidelines are more restrictive than Canada's, insofar as they are comparable. Also, in light of the dispersion that will occur at the Rosario Strait site further diluting the dredged material discharged there, it appears that no unacceptable material will be transported into international waters. Coordination has occurred with the national Canadian and provincial British Columbian governments.

(10) Cultural Resources. As part of the disposal site identification mappling studies, a literature search and limited marine history study were undertaken to determine if any historically significant shipwrecks or Indian traditional reef-net fishing sites would be affected by designation and use of the selected site. The results of these studies indicated that none of these resources are present at the selected or alternate sites.

f. Probable, Irreversible, and Irretrievable Commitments of Resources. Use of the selected disposal site will result in an intermittent and temporary degradation of the quality of the site's air, noise, and water resources. Additionally, intermittent use of the water surface area of the site during disposal operations represents a commitment that may not always be in agreement with unforeseen future plans for the area. However, neither of these commitments is irretrievable. It is expected that little or no irreversible or irretrievable commitments or losses of resources would occur. The "clean" quality of the dredged material and the action of the strong currents should produce mainly transient, short-lived impacts.

Dredged material discharged at the selected site represents an irreversible commitment of resources to the extent that the material is potentially useful for beneficial uses or landfill. Although it is not technically impossible to remove the material, retrieval would be very costly and beyond the capabilities of usually available equipment.

TABLE 4.8

COMPARISON OF SELECTED SCHEDULE I AND II SUBSTANCES AND PSDDA SCREENING AND MAXIMUM LEVELS

Mg/kg (Dry Weight Basis) (ppm)

Compound	Canadian Contaminant Criteria	1989 PSDDA Screening Level	1989 PSDDA Maximum Level
Arsenic	1,000	57	700
Cadmium	0.6 (solid phase)	0.96	9.6
Copper	1,000	81	810
Lead	1,000	66	660
Mercury	0.75 (solid phase)	0.21	2.1
Nickel	1,000	140	
Zinc	1,000	160	1,600
Pesticides (Total)	1,000	0.0069 1/	0.069
Total PCB's	1 2/	0.13	2.5

1/No total PSDDA measure; there are 6 specified: DDT, aldrin, chlordane, dieldrin, heptachlor, and lindane, at SL of 6.9 (DDT) and 10 ppb (the rest). An ML is only established for DDT.

2/1 ppm total PCB's is used by the Canadians to determine reason-to-believe toxicity for organohalogenated compounds. The cited figure is used as an operational surrogate for the Schedule I guideline which, fully stated, is: 1 percent of concentration of orgahohalogenated compounds found toxic to sensitive organisms. The Schedule II guideline is as stated under total pesticides.

Commitments of nonrenewable energy resources associated with the dredging program would be irreversible. In addition, the labor and capital necessary to conduct dredging operations would be irreversibly committed. This includes the dredging equipment, administrative personnel, and both skilled and non-skilled labor. However, energy and other commitments for individual dredging projects are decided by separate economic and social factors. Commitments of human resources would be essentially identical for the action and no-action alternatives.

g. The Relationship Between Short-Term Use of Man's Environment and the Maintenance and Enhancement of Long-Term Productivity. For a discussion of this topic see section 4.03g.

h. Mitigation and Amelioration of Adverse Effects. For a discussion of this topic see section 4.03h. The selected site has been located to avoid significant adverse effects (per NEPA) while meeting the in-water disposal needs of Puget Sound dredging in a cost effective manner. Site location and site management provisions are expected to mitigate any potential biological resource and human use conflict problems. Though dispersive sites will not be monitored for chemically caused biological effects, these impacts will be avoided by use of the very restriction PSDDA dispersive disposal guidelines and by the dispersal of sediments via energetic marine currents. Physical monitoring will verify that dredged material is not accumulating onsite.

The primary mitigation feature of the PSDDA plan is embodied in the siting process. Site locations were chosen, to the maximum extent possible, to be located away from shorelines, resources, and other amenities to preserve and maintain these resources by avoiding adverse effects due to dredged material disposal. Where complete avoidance was not possible (e.g., benthic invertebrates), the sites were located to minimize the possible adverse effects. A minimum number of sites were identified to minimize the possible extent of bottom impacts throughout the Sound. Dispersive areas where chosen so that strong currents would disperse suspended solids and deposited sediment, blending these materials into background levels.

The disposal guidelines adopted for dispersive sites will preclude discharge of sediments containing unacceptable levels of chemicals at these sites.

Another important mitigation feature of PSDDA is contained in the compliance inspection plans. Appropriate compliance inspections by the PSDDA regulatory agencies will ensure that the site use conditions are met, such that planned avoidance of adverse effects are realized.

4.10 Rosario Strait - Alternative Site.

a. Impacts and Their Significance to the Physical Environment. These would be the same as for the selected site.

b. Impacts and Their Significance to the Biological Environment. These would be the same as for the selected site.

c. Impacts and Their Significance to the Human Environment. These would be the same as for the selected site, except that the alternative site is slightly closer to the major dredging areas to be served by the Rosario Straits site and to shallower waters where there are concentrations of significant resources.

d. Cumulative Impacts. These are the same as for the selected site.

e. Relationship to Existing Plans, Policies, and Controls. This is the same as for the selected site.

f. Probable, Irreversible, and Irretrievable Commitments of Resources. These would be the same as for the selected site.

g. The Relationship Between Short-Term Use of Man's Environment and the Maintenance and Enhancement of Long-Term Productivity. This is the same as for the selected site (reference section 4.03g).

h. Mitigation and Amelioration of Adverse Effects. These would be the same as for the preferred site.

4.11 Adoption of the Selected Rosario Strait Alternative. The selected and alternate sites are shown in figure 2.5. The sites overlap, with neither site having significant environmental resources. The selected site was chosen as it is farther from land and concentrations of resources than those that lie to the northeast.

SECTIONS 4.12 THROUGH 4.15

ENVIRONMENTAL EFFECTS OF THE ALTERNATIVES
CONSIDERED FOR PORT ANGELES (NORTH SOUND)

4.12 Port Angeles - Selected Site.

a. Impacts and Their Significance to the Physical Environment.

(1) Water Quality. The few measurements of water quality parameters in the Port Angeles area were discussed in section 3.04a(2). Dissolved chemicals of concern in the water phase of dredged material to be dumped at the selected Port Angeles disposal site would not lead to significant concentrations of chemicals nor water quality problems since only low levels of chemicals are absorbed to sediment particles due to the restrictive disposal guidelines (2.03h). In addition, strong mixing by tidal currents present at the site will quickly blend dissolved chemical substances into background levels.

Total suspended sediments (TTS) would be elevated following a dump event at the Port Angeles site. The rationale used in section 4.09a(1) to estimate TSS following a dump of dredged material in Rosario Strait can be used for Port Angeles. The water depth of 435 feet at the Port Angeles site is close to the 400-foot depth assumptions used for the calculations. After 1 hour TSS concentrations would be 0.25 mg/l in the wedge flowing westerly on the ebb tide or easterly on the flood tide, at 30 cm/sec average current speed (Trawle and Johnson, 1986a). Mean current speeds in the area of the selected site are higher than the model calculated speed, thus after 1 hour the TSS levels should be even lower than predicted. After a tidal cycle, TSS levels should be undistinguishable from background levels prevalent in the Port Angeles sites area. Background TSS levels in the area of the proposed sites have been recorded by NOAA ranging from below 1 mg/l to 3 mg/l (Baker et al., 1978).

(2) Currents and Sediment Transport. The strong currents at the selected Port Angeles disposal site would transport sediments in the same manner as discussed in section 4.09a(2) for the Rosario Strait site, although current speeds are slightly less at Port Angeles. Both the initial 5 percent suspended sediment from the dump and the resuspended sediment wedge would be transported by currents with mean speeds of 30 to 50 cm/sec and peak speeds reaching 125 cm/sec. A two-layer flow exists at this location, with net flows eastward in the lower layer and westward in the upper layer. When the east-flowing resuspended material reaches a sill near Dungeness Spit, some could be carried upward and redirected westward. If the dredged material is aggregated, it may resist resuspension for an unknown time. However, bathymetric monitoring will disclose if there is substantial accretion at the site.

(3) Marine and Estuarine Sediments. Existing sediments at the Port Angeles site would be impacted in much the same manner as discussed in section 4.09a(3) for the Rosario Strait site.

For a typical dump of unconsolidated material, initial accumulation rates would range from 0.459 g/cm^2 for a mean current speed of 24.5 cm/sec, to 0.225 g/cm^2 for a mean current speed of 50.7 cm/sec, according to the DIFID model calculations based on a 400-foot depth (Trawle and Johnson, 1986a). Mean current speeds in this area have been recorded from 30 to 50 cm/sec.

After initial deposition, sediments are expected to erode unless quantities of aggregated material are present. The material expected to be disposed is not typically aggregated. Natural deposition rates are not available for the area, but the nature of the existing sediments, (70 percent sand) indicates a high energy environment in which most of the fine material would be transported rapidly offsite. The DIFID model predicts that unconsolidated materials should not persist onsite for more than a few tidal cycles. Projects forecast for this dredged disposal site have very few materials expected to be consolidated.

Very little is known of natural chemical levels in the sediments at the preferred Port Angeles disposal site. Coarse-grained material predominating there is expected to have lower absorbed chemical concentrations than fine-grained material at nondispersive sites. Material proposed for disposal at this site would come from a variety of small dredging projects. Applying the PSDDA dispersive site guidelines to available regional data suggests that all dredged material would pass the guidelines. This relatively clean material is not expected to cause significant degradation of the existing sediments.

As the Port Angeles site is located in a very high energy environment which should result in all or nearly all disposal material being swept offsite by tidal currents, site capacity is virtually unlimited.

(4) Air Quality. No significant chemical impacts to existing air quality are anticipated as a result of disposal activities at the preferred Port Angeles site. An average of six to thirteen barge loads of material per year are forecast for this site.1/ During days of actual size use, average levels of activity are expected to be no more than two barge loads per day and peak use no more than three barge loads per day. Tugboat activities connected with barge towing and disposal would be expected to generate some hydrocarbon releases, including hydrocarbon byproducts and particulates from diesel fumes at the open-water disposal site. Haul trucks would release similar products at upland/nearshore sites. Small amounts of hydrogen sulfide gas may also be released from the dredged material during open-water disposal activities.

(5) Land. Habitat losses associated with dredged material that must be placed in this unconfined, open-water disposal site includes loss of benthic habitat and loss of fish feeding and rearing habitat. At the Port Angeles preferred site, approximately 884 acres of benthic habitat could be temporarily covered by measurable quantities of dredged material. Analysis of available sediment data suggests that all dredged material that might be considered for this site would be found suitable for disposal. If all material goes to the preferred site there would be no land or nearshore disposal nor habitat losses. The unconfined, open-water disposal site is expected to be recolonized following cessation of disposal activity (see Section 4.12b(3)(a), Benthic Infaunal Resources).

1/Forecast of disposal activity include volume projections used in DNR user fee analysis (see table 2.7c). These volumes have been discounted for large speculative projects and for projects where clean dredged material will be used for land development. (Number of barge loads will also depend on whether a 1,500 c.y. or 4,000 c.y. barge is used.)

b. Impacts and Their Significance to the Biological Environment.

(1) Benthic Communities.

(a) Infaunal Resources. Discussions of benthic impacts are qualified because of limited site investigations conducted within the selected site and surrounding area. The bottom in the vicinity of the selected site is composed primarily of coarse-grained sand and cobbled sediments (see section 3.05a(4); Phase II DSSTA, 1989; and Dinnel et al., 1988). No benthic infaunal studies could be conducted within or around the site because of the inpenetrability of the sediment; in these conditions, infaunal communities are sparse or lacking. Benthic communities characteristic of bottoms swept by vigorous currents are dominated by epifaunal species. Discussion of impacts is focussed principally on epifaunal species documented as commercially and/or recreationally important invertebrate resources.

(b) Epifaunal Resources. Impacts to invertebrates found onsite as a result of disposal activities will be limited to direct physical impacts from the falling mass of dredged material during the rapid "convective descent" phase. Elevations of suspended solids concentrations are expected to be of short duration, not exceeding several hours. Dispersion of all dredged material out of the dump zone is expected to occur generally within a tidal cycle (Phase II DSSTA, 1989). The majority of the disposed material would be unconsolidated sands/clays, and should be present onsite after a disposal event in a few millimeters thick layer that will rapidly erode and disperse. Limited mortalities would thus tend to occur from the mass of descending dredged material falling with a killing velocity and striking (typically for a 1,500 c.y. barge) a 1.1 acre area of bottom. Burial would not be expected to cause impacts outside of this zone.

Elevated suspended solids (TSS) levels could occur in a plume moving rapidly away from the site, and should be undetectable from background levels of suspended solids within several hours following disposal. During the period when TSS are high, they could interfere with respiration across the gills of exposed invertebrates. However, bivalves such as scallops would close their shells during these periods. Occasional elevation of TSS levels is not expected to be markedly different from natural events in the Strait of Juan de Fuca. Additionally, impacts to invertebrate resources at the preferred Port Angeles dispersive site would be minor and not significant because the frequency of disposal is only expected to be 6 to 13 barge loads (1,500 c.y. capacity barges) over the 6-month open-disposal period each year[1/], and because of no accumulation of dredged material is expected to occur on the bottom of the disposal site, due to high currents and rapid sediment transport, thereby insuring that no permanent habitat alteration would occur. Should consolidated materials be disposed at the Port Angeles site and not be dispersed in several days, it is possible that the clumps would become armored

1/The estimate of number of barge loads has been increased from that given in the DEIS to account for a possible range of volumes that could be disposed. This is done to ensure that maximum possible impacts are considered, although the low end of the range is probably more realistic. The conclusion of the impact assessment does not change, despite this.

and thus present unsuitable habitat for the epifaunal animals present onsite. This is not expected to occur to a significant degree given the small amount of such material anticipated. No impacts to a Dungeness crab resources are anticipated because none were found in the selected site.

Shrimp are particularly vulnerable to direct impacts when as young-of-the-year they are newly settled on the bottom. Impacts to pandalid shrimp resources from disposal at the selected site are anticipated to be greater during the fall and lower during spring from the available data. Table 4.9 summarizes shrimp data collected during two cruises. Suspended and current-carried bottom sediments will not adversely impact shrimp outside of the "killing velocity" or convective descent area of falling materials. During a single dump only 1.1 acres (0.5 ha or a 250-foot-diameter-high radius impact area) will be affected by material that has sufficient density and velocity to injure or kill shrimp. This represents less than 0.04 percent of the zone of siting feasibility. The October (maximum annual) population will be avoided by site restrictions.

TABLE 4.9

SUMMARY OF IMPACTS RELATED TO ESTIMATED STANDING STOCK OF INVERTEBRATE RESOURCES AT PORT ANGELES

If thirteen 1,500 c.y. barge loads would be disposed annually, each would affect 0.5 ha area, for a toal of 6.5 ha. Thus, 6.5 times the stated population estimated densities wuld be killed annually, but the October (maximum shrimp) population would be avoided.

	Population Per ha (mean)	Population Per ha (maximum)
Shrimp (April over whole ZFS)	53	206
Shrimp (October, over whole ZSF)	6,775	68,927
Shrimp (October, selected site)	3,000	
Scallops (Selected site) 1/	2,150	
Scallops (Alternate site) 1/	3,300	
Urchins (Selected site) 1/	550	
Urchins (Alternate site) 1/	2,250	

1/These data are from both rock dredge and otter trawl collections. The latter is a less efficient collection method. Both methods should be regarded as estimates.

The data for shrimp suggest that the October estimated populations are substantial but that the population in the vicinity of the selected site are less than the average density across the ZSF. By late spring, the populations are considerably less. The area which could be impacted is very small relative to the study area for which these substantial numbers of shrimp are reported. Coordination with WDF regarding timing restrictions to protect the shrimp resource during the fall period resulted in a WDF proposed annual closure of the disposal site from September 1 through November 30 (R. Carman, WDF, personal communication, March 1989). This restriction would be in addition to the normal dredging closure of March 15 to June 15; overall, the site would be open 6 months a year. Due to the restricted area impacted, the avoidance of the locations with estimated higher concentrations of shrimp, and the seasonal restriction to avoid peak populations, the impacts on the shrimp population will be minor.

Sea urchins may be impacted from clumps striking individuals on the bottom, whereas suspended solids level increases may only cause short term respiratory problems. Only minor impacts would occur to the overall population.

Minor and nonsignificant impacts on pink scallops are expected for the same reasons as shrimp and urchins, and because of their ability to close their shells in response to increased TSS levels. Higher suspended solids levels following disposal will be transient and rapidly diluted to background levels. No chemical effects to any invertebrates onsite, nor food web impacts, nor sea surface microlayer impacts are expected from disposal of material meeting the PSDDA dispersive guidelines.

Nearshore, intertidal and subtidal invertebrate fauna will not be significantly impacted from the disposal operations due primarily to their distance from the disposal site. Offsite impacts would also not be significant due to the rapid dilution of the suspended dredged material and the strict disposal guideline.

(2) Plankton Communities. See section 4.02b(2) for pertinent discussion of potential impacts.

(3) Anadromous and Marine Fishes.

(a) Anadromous Fish. Impacts of disposal operations on important juvenile salmon populations will be negligible because no disposal operations will occur between March 15 and June 15, the "closed dredging window" designated by the Washington State Department of Fisheries to protect juvenile salmon and steelhead during outmigration.

Disposal could occasionally occur during the presence of early or late juvenile outmigrants (especially chinook salmon) or with those species that may tend to remain in rivers and/or embayments for extended periods of time (e.g., chinook and searun cutthroat trout and chinook salmon juveniles). These late or persistent juveniles will not be impacted by the disposal operations unless they frequent the disposal area where they would be subject to suspended solids which can interfer with oxygen exchange due to clogging gill surfaces, and temporary lowered oxygen availability due to biological oxygen demand in the disposal plume. There are no impacts expected to juveniles from chemical exposures in the plume because of the highly restrictive disposal guideline selected for dispersive sites. Physical impacts, should they occur, will be minor since juveniles typically avoid disposal plumes, and the site is not located in primary juvenile migratory pathways.

Also, adult salmonids migrating through the Strait of Juan de Fuca will not be significantly impacted by disposal operations since fish will usually avoid disposal-associated turbidity plumes detected visually. There is very small chance that a disposal event could occur directly "over" a fish. Those fish that come in contact with the plume could be temporarily impacted from short-term clogging of their gills by suspended material, and from slight depressions in dissolved oxygen due to the biochemical oxygen demand of the dredged material. However, these conditions are less severe than the fish usually encounter when they migrate up river during periods of floods and/or high water events. No adverse effects to adult salmonids are expected from chemicals in the dredged material. Also, no significant adverse effects are expected from floatable material contributed to the sea surface microlayer due to the strict disposal guidelines established for the dispersive sites.

(b) Bottom Fish Resources. Bottom fish resources would not be significantly impacted by disposal activities because negligible bottom fish resources were found on or near the selected site (section 3.05b(3)). It appears the site represents moderate to low quality bottomfish habitat. The low frequency of disposal (6 to 13 barge loads/year) forecast for the Port Angeles disposal site supports the conclusion of low impacts. An active groundfish trawling area and a recreational fishery area known locally as "the Rockpile' are significantly distant from the two alternative sites that no significant impacts there from disposal activity are expected.

However, some direct and secondary impacts to bottom fish are expected to occur as a result of disposal of dredged material at this site. The "killing velocity" zone, 1.1 acre of each dump, could bury flatfish such as Dover and English sole. Impacts would be minimal since only low frequencies and volumes are forecast for disposal at this site over the next 15 years. Any fish outside the impact area will escape direct impacts, but could suffer some respiratory distress due to gill clogging and/or low dissolved oxygen levels due to elevated high biochemical oygen demand. It is likely that fish will avoid stressful levels of suspended dredged material by temporarily moving out of the area.

No chemical effects are expected from material which must pass the PSDDA dispersive site guidelines. Therefore, marine bottom fish residing in or migrating through the area are not expected to be adversely impacted as a result of chemical effects in the dredged material.

(4) Marine Mammals. See section 4.02b(5)(a) for a generic discussion of marine mammal impacts resulting from dredged material disposal. For the Port Angeles disposal site, species and potential impacts are similar to those described in section 3.04b(4). However, the Dall's porpoise is the most likely mammal to be near the disposal sites, as they tend to prefer offshore waters. They are attracted to areas of turbulence and exchanging of waters, such as at entrances to inshore marine waters, sea mounts, canyons, and near current convergences. It is in such areas where Dall's porpoises encounter their favored food, squid. If squid are not available or in short supply, porpoises turn to schooling fishes (Angell and Balcomb, 1982). For reasons

explained in section 4.02b(5), Dall's porpoises are not expected to be impacted directly by disposal activities. The primary concern would be whether squid or schooling fishes would be affected by disposal of dredged material. Squid are highly mobile and can easily swim out of the turbidity plume and avoid boats. Such avoidance behavior may also make them more susceptible to capture by predators. Squid are not likely to be caught in the sediments, as they are extremely wary and can move rapidly. Eggs of squid would not be affected as they normally float free immediately following release (Barnes, 1963). It appears unlikely that either squid or Dall's porpoise will be affected by disposal of dredged material at the Port Angeles disposal site. Harbor seals are also potentially present in the area, but tend to stay closer to shore. See section 4.09 for a discussion of direct affects on harbor seals from dredged material disposal. Because of the lack of pupping areas nearby, and the fewer harbor seals near Port Angeles than in Rosario Strait, effects on harbor seals are less likely at the Port Angeles site. No other marine mammals are likely to be present or to be affected by disposal at the Port Angeles site.

(5) Waterbirds. See section 4.02b(6) for a generic discussion of possible effects on waterbirds from disposal of dredged material in Puget Sound. The publication by Wahl, et al. (1981), rates the waters around Port Angeles as low in value at all seasons for waterbirds, except in spring when this area received an "important" rating. Other data seems to support this ranking, although numerous species have been recorded, large concentrations do not regularly occur through most of the year. The offshore location of the disposal site generally precludes regular use by most seabirds, which prefer to feed in more sheltered locations although most species might feed offshore if prey were abundant and the weather calm). One exception is the rhinocerous auklet, which feeds wherever prey is abundant, particularly in the spring and summer nesting season. Seventeen percent of the Protection Island population regularly feeds in the waters between Ediz Hook and Dungeness Spit (Wahl, et al., 1981). It is likely that some of these birds also occasionally feed within the area of the disposal sites. A principle species of prey is the Pacific sandlance (Ammodytes hexaptera). Sandlance distribution is not well known in this area, although these fish are known to sometimes form large swimming schools while at other times they bury themselves in sandy sediments, possibly even in deep water such as the preferred site. Their small size while young is suitable for feeding fledgling rhinoceros auklets, and their schooling habit makes them available prey (Hart, 1973). The discussions in 4.12b(1) and (3) apply to the possible impacts to sandlance. Only about 0.26 percent of the total ZSF would be impacted by "killing velocity" dump events each year. This extremely small proportion suggests a very low chance of damaging buried sandlance and affecting rhinocerous auklets' food availability. No other impacts to waterbirds are anticipated at these sites.

(6) Endangered and Threatened Species. As explained in section 3.04b(6) and in the biological assessments in appendix A, no impacts to endangered cetaceans, nor to bald eagles and peregrine falcons are anticipated.

c. Impacts and their Significance to the Human Environment.

(1) Social and Economic Features. Potential conflicts with waterborne commerce movements in the Port Angeles site area are expected to be greater than with the no-action alternative since all of the material would fail the PSIC guidelines, but is expected to pass PSDDA dispersive disposal guidelines. However, disposal tug and barge movements per year are expected to be few. The relatively small number of tug and barge movements is not expected to conflict with sport fishing either, except during the short time required for an actual disposal into the water.

(2) Transportation.

(a) Navigation. Use of the selected disposal site could result in temporary, localized, and intermittent disruption of any navigation use of the water surface area within the disposal zone. Additionally, tug and barge traffic to and from the sites will represent some potential risk for vessel collision. The disposal site location has been coordinated with the U.S. Coast Guard and will be marked on navigation charts. Site use would be controlled to minimize the risk for vessel collision.

Normal average annual dredged material disposal activity in the Port Angeles site area is forecast to be about 6 to 13 barges per year.1/ Actual activity will depend on the specific dredged projects, and the results of tests performed on material to be dredged. As navigation channels would be maintained by dredging activity which would have a suitable disposal site available, there would be no adverse impacts on navigation activity due to channel shoaling. Barge-tug movement during disposal operations is expected to be somewhat higher than at present; however, there should be no significant navigation conflicts with commercial or pleasure craft.

The Port Angeles site would not be used during the salmon and steelhead outmigration dredging "closed dredging window," March 15 through June 15 nor from September 15 to November 30. During times of normal size use, disposal activity at the site would be expected to average about one to two barges per day. Low forecast volumes suggest 643 barges a year would be disposed at this site.

When proceeding from the disposal site, tug and barge combinations move at a slower rate loaded than unloaded. Average travel speed is typically around 5 knots. Once onsite, disposal operations within the proposed 1,500-foot diameter disposal zone usually will require about 5 to 10 minutes. On occasion, weather constraints and repositioning requirements (to ensure proper location of disposal) can increase the onsite time to as much as 20 minutes.

1/Forecast of disposal activity included volume projections used in DNR user fee analysis (see table 2.7c). Volumes have been discounted for large speculative projects and for projects where clean dredged material will be used for land development. Number of barge loads will also depend on the actual capacity of the barge which is used.

Using an average of 10 minutes, and assuming one to two barges per day, normal site occupancy could amount to about 10 to 20 minutes per day. Though delays in disposal activities could result from avoiding conflicts with tribal fisheries, these are unlikely, given the limited anticipated use of the site, and the requirement to disclose proposed site use scheduling in the Federal 404 public notice circulated for public interest review to all affected Indian tribes.

Disposal operations at the selected site will represent a slight increase in navigation traffic. With increased water traffic, there is an increase in risk of minor oil leaks or spills and of vessel collisions. The location of the disposal site, the infrequent site use, and the short duration of site occupancy indicate that these risks are not significant.

(b) Land. Only limited impacts to land transportation should occur from this alternative as nearly all of the future dredged material that may be considered for this site is expected to be discharged there.

(3) Dredging and Disposal Activity. The overall impact of this alternative on dredging activity in the Port Angeles area would be an increase in the volume of material found acceptable for unconfined, open-water disposal over that allowable under PSIC. Using PSIC, none of the future Port Angeles dredged material is expected to be acceptable for unconfined, open-water disposal. Under the selected alternative, 285,000 c.y. of material projected over the next 15 years could be found acceptable for unconfined, open-water disposal at the disposal site. However, only 143,000 c.y. is forecast for the site as about half of the material is expected to be used for land development or other beneficial uses. Actual disposal volumes will depend upon the outcome of chemical and biological tests conducted on the material and the specific projects proposed for dredging.

(4) Native American Fishing. The selected Port Angeles site is located within the usual and accustomed fishing grounds of several Puget Sound tribes. However, there should be no increase in the potential for tribal fishing gear damage and/or reduced fishing time resulting from use of site. Tribal fishing rights will be protected from disposal vessel conflicts by special disposal site use conditions accomplished via the Federal Section 404 permit process. Tribal concerns regarding the impact of the PSDDA proposal to water quality and fisheries resources upon which the tribal activities are dependent are summarized in section 2.04d and exhibit C responses.

(5) Non-Indian Commercial and Recreational Fishing. Non-Indian fishing activities may be displaced during the discharge of dredged material at the disposal site. At times of peak dredging activity, this displacement could persist for 10 minutes, two times per day. The selected disposal site has been located to minimize potential conflicts with known commercial and sports fishing activities. It is anticipated that displacements, should they occur, are more probable for sports fishermen than for commercial activities. The disposal site location and the short duration of site use, are expected to preclude any significant adverse effects to fishing activities and catch success in these waters.

(6) Human Health.

(a) Via Seafood Consumption. No impact on human health is anticipated from the consumption of seafood that might be in or near the disposal site. Only suitable dredged material will be allowed for disposal at the site.

(b) Via Drinking Water. Under this alternative, all the material is expected to be suitable (under the PSDDA dispersive guidelines) for unconfined, open-water disposal. However, about one-half of the material is forecast to be placed in nearshore or upland sites which are unconfined; a slight potential for such disposal to affect drinking water quality exists, largely from salts.

(c) Via Inhalation of Dust. Some dredged material is forecast for unconfined upland disposal; thus there is some potential for dust impact on workers and residents living near such a site.

(d) Via Direct Exposure. Little direct exposure of humans to dredged material occurs. The only segment of the population that might be expected to come into direct contact with dredged material are workers on dredging crews.

(7) Noise. There have been no measurements of ambient noise levels or of the actual noise at the shore which would be produced by disposal equipment operating at the selected site, which is over 1 nautical mile from the nearest shoreline. See section 4.03c(7) for a discussion of dredging noise levels and standards.

(8) Esthetics. Disposal operations are not expected to significantly affect the esthetic quality of the Port Angeles area. The disposal operations would be only a minor part of the marine activities ongoing in a marine transport area. Viewers from shoreline areas will see the occasional presence (between one and two times daily, at most, during normal dredging operations) of a tug and barge moving into the disposal area, spending about 5 or 10 minutes for disposal, and leaving the area. The tug and barge will not be readily noticeable and should not be obtrusive to viewers. Viewers from close-in areas may observe a localized turbidity plume in the immediate vicinity of the barge immediately following disposal. This plume will be short term and may be masked at time by strong tidal currents or high winds at this location. Most viewers will perceive the tug and barge activity in a positive sense, in that it is an integral part of normal marine activities and does not detract from the overall view experience.

(9) Cultural Resources Impacts. As part of the disposal site identification mapping studies, a literature search and limited marine history study were undertaken to establish if any historically significant shipwrecks were located within the preferred or alternative disposal sites. No evidence of such ships was located. It is concluded that no National Register eligible sunken properties will be affected by operations at the Port Angeles site.

d. Cumulative Impacts. Disposal operations at the selected site may contribute to physical impacts to the water and air resources. Marine water quality, air quality, intertidal and subtidal macrofauna, plankton, neuston, marine mammals, anadromous and marine fishes, or threatened or endangered species could experience some effect. None of these contributions, however, are likely to be significant. Because of the nature of dispersive sites, the Port Angeles site will probably experience only slight cumulative impacts, if any, from dredged material deposited on the bottom before being eroded by strong currents. The impacts in the water column, i.e., from suspended solids, will be transient not cumulative. Due to the restrictive chemical/biological guidelines, only material that may not cause chronic nor acute lethal effects would be found suitable for disposal.

e. Relationship to Existing Plans, Policies, and Controls.

(1) Clean Water Act, Sections 404/401. See section 4.03e(1).

(2) Coastal Zone Management. See section 4.03e(2).

(3) Shoreline Master Program. The selected disposal site is located within the jurisdiction of Clallam County, which adopted its shoreline master program in 1979. The selected alternative is consistent with the county's master program as presently written.

(4) Department of Natural Resources (DNR) Policy on Open-Water Disposal of Dredged Material into Puget Sound. Sites throughout the Puget Sound area have been designated by DNR for open-water disposal. If the dredged material cannot be beneficially utilized (e.g., creation of artificial islands, landfill), and it is approved by all of the various regulatory agencies for unconfined, open-water disposal, it can be deposited in one of the DNR sites. Fees and leases from DNR and permits from other agencies are all required before disposal of dredged material can occur. The selected site will be an approved DNR open-water disposal site once the local shoreline permit has been granted by Clallam County.

(5) Executive Order 11990, Protection of Wetlands. The intent of Executive Order 11990 is to protect wetlands because of the significant cumulative losses that have occurred, and due to their high value to biological productivity and their many other critical functions. As the selected site lies in water 435 feet deep, no wetlands will be directly affected. Dredging projects which could affect wetlands will be evaluated on a project-by-project basis at the time the project is reviewed for permits under Section 404 of CWA.

(6) Executive Order 11988, Flood Plain Management. The intent of Executive Order 11988 is to provide guidance and regulation for projects located in, and affecting, the flood plain. Executive Order 11988 requires, to the extent possible, avoidance of long- and short-term adverse impacts associated with occupancy and modification of flood plains.

As the selected disposal site lies in water 435 feet deep, no direct flood plain impacts would be involved by use of this site. Dredging projects which could affect the flood plain would be evaluated on a project by project basis at the time the projects are reviewed for permits under Section 404 of the CWA.

(7) Puget Sound Water Quality Comprehensive Plan. The Puget Sound Water Quality Management Plan was adopted 17 December 1986 and modified on October 10, 1989. The Plan is discussed in section 4.03e(7).

(8) American Indian Religious Freedom Act. The American Indian Religious Freedom Act of 1978 (AIRFA) requires Federal agencies to ensure that none of their actions interfere with the inherent right of individual Native Americans (including American Indians, Eskimos, Aleuts, and Native Hawaiians) to believe, express, and exercise their traditional religions. These rights include access to religious sites, use and possession of sacred objects, and the freedom to worship through traditional ceremonials and rites. The AIRFA requires consultation between Federal agencies an Native Americans to ensure that federally supported projects or projects on Federal land do not infringe on the religious practices of Native Americans. Coordination between PSDDA agencies and potentially affected tribes has occurred throughout the study, and is an ongoing process. Exhibit F discusses Indian coordination and consultation.

(9) Canadian Acts Regulating Open-Water Disposal of Dredged Material. See section 4.9e(9) for discussion of the relationship of these laws to the implementation of a disposal site near the international boundary.

f. Probable, Irreversible, and Irretrievable Commitments of Resources. Use of the selected disposal site will result in an intermittent and temporary degradation of the quality of the site's air, noise, and water resources. Additionally, intermittent use of the water surface area of the sites during disposal operations represents a commitment that may not always be in agreement with unforeseen future plans for the area. However, neither of these commitments is irretrievable. It is expected that little or no irreversible or irretreviable commitments or losses of resources would occur in dispersive sites such as the Port Angeles site. The good sediment quality and the action of the strong currents should produce transient, short-lived impacts.

Dredged material discharged at the selected site represents an irreversible commitment of resources to the extent that the material was potentially useful for beneficial uses or landfill. Although it is not technically impossible to remove the material, retrieval would be very costly and beyond the capabilities of available equipment.

Commitments of nonrenewable energy resources associated with the dredging program would be irreversible. In addition, the labor and capital necessary to conduct dredging operations would be irreversibly committed. This includes the dredging equipment, administrative personnel, and both skilled and non-skilled labor. However, energy and other commitments for individual dredging projects are decided by separate economic and social factors.

g. The Relationship Between Short-Term Use of Man's Environment and the Maintenance and Enhancement of Long-Term Productivity. For a discussion of this topic see section 4.03g.

h. Mitigation and Amelioration of Adverse Effects. For a discussion of this topic see section 4.03h. The selected site has been located to avoid significant adverse effects (per NEPA) while meeting the in-water disposal needs of Puget Sound dredging. Site location and site management provisions are expected to mitigate any potential biological resource and human use conflict problems. Only acceptable dredged material would be discharged at the disposal site. At the dispersive sites there would be only physical (bathymetric) monitoring. No chemically caused biological impacts are allowable under the more restrictive dispersive disposal guidelines. Also, the material would be quickly disposed via energetic marine currents.

The primary mitigation feature of the PSDDA plan is embodied in the siting process. Site locations were chosen to the maximum extent possible, away from shorelines, resources, and other amenities to preserve and maintain these resources by avoiding adverse effects due to dredged material disposal. Where complete avoidance was not possible (e.g., benthic invertebrates), the sites were located to minimize the possible adverse effects. Sites were identified to minimize the possible extent of bottom impacts throughout the Sound. Dispersive sites were chosen where strong currents will disperse suspended solids and deposited sediments within a few tidal cycles, blending the materials into background levels.

The potential for chemical effects on biological resources at the preferred disposal site would be minimized by the PSDDA dispersive disposal site guideline.

Another important mitigation feature of PSDDA is contained in compliance inspection plans. Appropriate compliance inspections by the PSDDA regulatory agencies will ensure that proper site use occurs so avoidance of adverse effects can be realized.

4.13 Port Angeles - Alternative Site.

a. Impacts and Their Significance to the Physical Environment. These would be the same as for the selected site.

b. Impacts and Their Significance to the Biological Environment. These would be the same as for the selected site.

c. Impacts and Their Significance to the Human Environment. These would be the same as for the selected site except that the alternative site would be slightly further from the main dredging areas to be served.

d. Cumulative Impacts. These would be the same as for the selected site.

e. Relationship to Existing Plans, Policies, and Controls. This would be the same as for the selected site.

f. Probable, Irreversible and Irretrieveable Commitments of Resources. These would be the same as for the selected site.

g. The Relationship Between Short-Term Use of Man's Environment and the Maintenance and Enhancement of Long-Term Productivity. This would be the same as for the selected site.

h. Mitigation and Amelioration of Adverse Effects. These would be the same as for the selected site.

4.14 Adoption of the Selected Port Angeles Site. The Port Angeles selected site was chosen over the alternative site because it lies 2 nautical miles closer to the dredging areas to be served. There are no significant differences between the sites in terms of resource and human use impacts.

SECTIONS 4.15-7

ENVIRONMENTAL EFFECTS OF THE ALTERNATIVES
CONSIDERED FOR THE PORT TOWNSEND SITE (NORTH SOUND)

4.15 Port Townsend Selected Site.

a. Impacts and Their Significance to the Physical Environment.

(1) Water Quality. Few measurements of dissolved chemicals in the waters in the vicinity of the selected Port Townsend disposal sites are available. Dissolved chemicals from dredged material destined for dispersive sites are not a major concern because of the very restrictive disposal guidelines that will be used for these sites. Strong currents at the Port Townsend site are expected to quickly blend dissolved substances into background levels which are naturally low since the waters are predominately of oceanic origin.

Suspended sediments will be temporarily elevated immediately following a dump event at the Port Townsend site. Model calculations used for the Port Angeles site apply to the Port Townsend site (site depth of 361 feet versus 400 feet in the model). The DIFID model calculations indicate a TSS of 0.25 mg/1 would occur in the wedge flowing downcurrent, i.e., net westward flowing on the ebb tide and net eastward flowing on the flood tide, one hour after the dump occurs. Field-recorded mean current speeds of 30 to 50 cm/sec, somewhat higher than those used in the model (30 cm/sec), could result in somewhat lower TSS levels. Background TSS levels in the area of the proposed sites have been recorded by NOAA ranging from below 1 mg/1 to about 2 mg/1 (Baker et al, 1978). After a tidal cycle, TSS levels should be undistinguishable from background levels.

(2) Currents and Sediment Transport. Both the resuspended sediments from the original deposition and the initial 5 percent suspended sediment wedge would be transported by currents with mean speeds of 30 to 50 cm/sec and peak speeds reaching 100 cm/sec. A two-layer flow exists at this location, with net westward flows above 50 meters depth and net eastward flow below this depth.

If the dredged material is aggregated, it may temporarily resist resuspension.

(3) Marine and Estuarine Sediments. Existing sediments at the Port Townsend site will be impacted in the same manner as described earlier for other dispersive sites.

For a typical dump of unconsolidated material, initial accumulation rates would range from 0.459 g/cm^2 for a mean current speed of 24.5 cm/sec, to 0.225 g/cm^2 for a mean current speed of 50.7 sm/sec, according to DIFID model calculations based on a 400-foot depth. Mean current speeds in this area have been recorded form 30 to 50 cm/sec, giving a relatively close fit to the model conditions.

Unless consolidated material is present, sediments are expected to immediately erode after initial deposition, and the resuspended material would be transported away by the strong currents. Natural deposition rates are not available for the Port Townsend area, but the nature of the existing sediments, (largely gravel and sand in nearby areas for which data are available), indicates a high energy environment in which most of the fine material would be borne downcurrent over time.

Very little is known of existing chemical levels in sediments of the preferred Port Townsend disposal site. Coarse grained materials, which predominate there, are typically less contaminated than fine grained material. "Clean silty sand" applies to all of the potential dredging sites. All are thus generally predicted to pass PSDDA guidelines for chemical or biological criteria, enabling their disposal at dispersive sites. These sediments are not expected to cause significant degradation of the existing site sediments.

As the Port Townsend site is located in a very high energy environment which should result in all or nearly all disposed material being swept offsite by tidal currents, site capacity is virutally unlimited.

(4) Air Quality. No significant impacts to existing air quality are anticipated as a result of forecasted disposal activities. About 7 to 30 barge loads of material per year are forecast for this site.1/ During the days of actual use, average level of activity should be no more than two barge loads per day and peak use no more than three barge loads per day. Tugboat activities connected with barge towing and disposal are expected to generate some hydrocarbon releases, including hydrocarbon byproducts and particulates from diesel fumes at the open-water disposal site. Haul trucks will release similar products at upland/nearshore sites. Negligible concentrations of hydrogen sulfide gas may also be released from the dredged material during open-water disposal activities. In summary, no significant impacts are anticipated to the air quality environment around the Port Townsend site as a result of disposal activities.

(5) Land. Habitat losses associated with dredged material that must be placed in the selected disposal sites could include loss of benthic habitat and loss of fish feeding and rearing habitat. At the Port Townsend selected site approximately 884 acres of benthic habitat could be temporarily impacted by measurable levels of dredged material. Analysis of available sediment data suggests that all dredged material that might be considered for this site would be found suitable for disposal. If all material goes to the selected site, there will be no land or near shore disposal or habitat losses. The open-water site used for unconfined disposal is expected to be recolonized following cessation of disposal activity (see Section 4.13b(1)(b), Benthic Infaunal Resources).

b. Impacts and Their Significance to the Biological Environment.

(1) Benthic Communities.

1/Forecasts of disposal activity include volume projections used in DNR user fee analysis (see table 2.7c). These volumes have been discounted for large speculative projects, and for projects where clean dredged material will be used for land development.

(a) Infaunal Resources. Discussions of benthic impacts must be qualified because of limited site investigations conducted within the selected site and surrounding area. The bottom in the vicinity of the selected site is comprised primarily of coarse grained sandy sediments, a reflection of the strong tidal currents within the strait (see Section 3; Phase II DSSTA, 1989; and Dinnel et al., 1988). No infaunal benthic studies were conducted within or around the site. Benthic community structure characteristic of areas swept by vigorous currents is largely dominated by epifaunal species rather than infaunal species due primarily to the coarse nature of the bottom. Therefore, discussion of impacts focuses principally on those epifaunal species documented as commercially and/or recreationally important invertebrate resources within and around the sites.

(b) Epifaunal Resources. Impacts to invertebrates occurring on site as a result of disposal activities are expected to be limited to direct physical impacts. During a disposal event, a rapid convective descent of falling dredged material will cause a "killing velocity" impact on the bottom, covering (for each 1,500 c.y. barge load) a 1.1 acre area. In this area it may be presumed that epifauna would be killed. Elevations of suspended solids concentrations are also expected, but would be relatively short in duration (several hours). Dispersion of the dredged material out of the dump zone is expected to occur within a tidal cycle (Phase II DSSTA, 1989). The majority of the disposed material, subsequent to the convective descent, will be noncohesive and should only be present onsite in a very thin (a few millimeters thick) layer, that also should be rapidly dispersed.

Limited mortalities that might occur from impact will be from clumps striking individuals on the bottom, not to burial. Elevated suspended solids levels over several hours following disposal may interfere with normal respiration across the gill of exposed invertebrates. However, bivalve taxa such as scallops may close their shells during periods of stress from elevated suspended solids. Occasional elevation of suspended solids levels is not expected to differ from natural elevations, especially with rapid currents in the area.

Siting studies during April and October 1987, Dinnel et al. (1988) found no Dungeness crab within the zone of siting feasibility (ZSF). Therefore, no impacts to Dungeness crab resources are anticipated as a result of disposal activities.

Pandalid shrimp resources collected by beam trawl were abundant during the October sampling period averaging almost 3,850 shrimp/ha (within the ZSF), and comprised almost exclusively of young-of-the-year *Pandalus borealis*, nonrandomly distributed throughout the ZSF. Densities during October 1987 ranged from a low of 300 shrimp/ha north of the preferred site to a high of 9,400 shrimp/ha southeast of this site. Shrimp densities collected by otter trawl during April were generally low within the ZSF averaging 72 shrimp/ha near the selected site, with sharply increasing densities located southeast of the site. Table 4.10 shows the invertebrate populations found in the Port Townsend ZSF and sites.

TABLE 4.10

SUMMARY OF IMPACTS RELATED TO ESTIMATED
STANDING STOCK OF INVERTEBRATE RESOURCES AT PORT TOWNSEND

Seven to 30 barge loads1/ disposed could be disposed annually, each affecting 0.5 ha (1.1 acres) area. Accordingly, yearly losses from direct physical impacts are 3.5 to 15 times the densities shown in this table. Note, however, that higher densities in October would be avoided by the site closure.

	Population Per ha (mean)	Population Per ha (maximum)
Shrimp (April, overall)	236	4,000
Shrimp (October, overall)	3,850	9,400
Scallops (October, selected site) 2/	2,172	
Scallops (October, alternate site) 2/	8,558	
Urchins (October, selected site) 2/	2,079	
Urchins (October, alternate site) 2/	8,521	

1/The estimate of number of barge loads has been increased from that given in the DEIS to account for a possible range of volumes that could be disposed. This is done to ensure that maximum possible impacts are considered, although the low end of the range is probably more realistic. The conclusion of the impact assessment does not change, despite this.

2/These data are from both rock dredge and otter trawl collections. The latter is a less efficient collection method. Both methods should be regarded as estimates.

The shrimp data suggest that the October estimated populations are substantial but that the population in the vicinity of the preferred site are less than the average density across the ZSF. By April, the populations are considerably less. The area which could be impacted is very small relative to the study area for which these substantial numbers of shrimp are reported. Coordination has occurred with WDF regarding timing restrictions to protect the shrimp resource during the fall period, and WDF specified an annual closure of the disposal site from September 1 through November 30 (R. Carman, WDF, personal communication, March 1989). This restruction would be in addition to the normal dredging closure of March 15 to June 15; overall, the site would be open 6 months a year. Due to the restricted area impacted, the avoidance of the locations and seasons with estimated higher concentrations of shrimp, and the seasonal restriction to avoid peak populations, the impacts on the shrimp population will be minor.

Relatively large densities of pink scallop were found during October at two stations located north and southeast of the selected site with densities of 2,172 and 8,558 scallops/ha at the two stations respectively. High densities of sea urchins, principally Stongylocentrotus pallidus, were also found at the two stations exhibiting high scallop densities (2,079 and 8,521 sea urchins/ha). (Apparent differences between seasons in pink scallop and sea urchin densities may be a function of lower catch efficiencies for these species by the otter trawl relative to the beam trawl, rather than real seasonal differences.)

Sea urchins may be directly impacted from clumps striking individuals on the bottom, whereas suspended solids level increases may only cause short term respiratory problems. Shrimp are expected to be more vulnerable than scallops or urchins to direct impacts. As noted above, the frequency of disposal is relatively low with only about 7 to 30 bargeloads (1,500 c.y. capacity barges) expected over a 6-month disposal period/year. No net accumulation of dredged material is expected on the bottom of the disposal site due to high currents and rapid sediment transport, thereby insuring that no permanent habitat alteration would occur. In view of these considerations and the seasonal restrictions, the impacts to invertebrates onsite would be minor.

Impacts that could occur off site will not be significant, largely due to the rapid dispersion of the suspended dredged material, and because of the restrictive PSDDA dispersive disposal guideline, thereby ensuring no chemical impacts on or offsite. Higher suspended solids levels following disposal would be relatively transient and short term and should rapidly reach background levels within the plume. No food web impacts or sea surface microlayer impacts are anticipated due to the restrictive disposal guidelines adopted for the dispersive sites, and the seasonal timing restrictions for disposal recommended to reduce impacts to commercially and recreationally important invertebrates documented during site investigations. Nearshore, intertidal and subtidal invertebrate fauna would not be significantly impacted from the disposal operations due primarily to their distance from the disposal site.

(2) Plankton Communities. Section 4.03b(2) contains discussion pertinent to these impacts, which should not be significant.

(3) Anadromous and Marine Fishes.

(a) Anadromous Fish. Impacts of disposal operations on important juvenile salmon and steelhead trout populations will be negligible because no disposal operations will occur between March 15 and June 15, the dredging "window" designated by the Washington State Department of Fisheries to protect juvenile salmon and steelhead during outmigration. Although the majority of the juvenile salmon populations will have migrated out of the major Puget Sound embayments by June 15, their arrival in and passage through the Strait of Juan de Fuca may be later than June 15.

Disposal could occasionally coincide with the presence of early or late juvenile salmonid migrants (especially chinook salmon) or with those species (e.g., searun cutthroat trout) that tend to remain in embayments for extended periods of time. The late or persistent juveniles will not be impacted by the disposal operations unless they frequent the disposal area during a dump and are immediately in the discharge plume. Should this occur these fish could be briefly subject to suspended solids impacts. Impacts could include interference with oxygen exchange due to suspended solids clogging gill surfaces, and slightly lowered oxygen availability due to biochemical oxygen demand of the suspended dredged material within the disposal plume. There will be no impacts to juveniles from chemical exposures in the plume because of the restrictive disposal guideline. Impacts, if they occur at all, will be minor since juveniles typically avoid disposal plumes, and the site location is removed from primary juvenile migratory pathways.

Adult salmonids migrating through the Strait of Juan de Fuca will not be significantly impacted by disposal operations as the majority of the fish avoid disposal-associated turbidity plumes. Those fish that come in contact with the plume may be temporarily impacted from short-term clogging of their gills, by suspended material, and from slight depressions in dissolved oxygen due to the biochemical oxygen demand of the dredged material. However, these conditions are far less severe than the fish usually encounter when they migrate up river to spawn, often during periods of floods and/or highwater.

No chemical effects are expected from material as noted above. Also, no significant adverse effects are expected from floatable material contributed to the sea surface microlayer. Thus, adult salmon migrating through the area are not expected to be adversely impacted as a result of chemical effects attributable to the dredged material.

(b) Bottom Fish Resources. Bottom fish resources will not be significantly impacted by disposal activities. Negligible bottom fish resources were found on or near the selected site during site specific studies in April and October 1987 (section 3.05b(3)). Although the studies were limited, the research beam trawl and otter trawl data indicate that the selected site is remote from important groundfish resource and fishing areas. An important recreational fishing area exists 5 nm southwest of the selected site, far enough away that no impacts are anticipated there.

With the low frequency of disposal forecasted (e.g., 7 to 30 barge loads/year), direct physical impacts on bottom fish resources due to dredged material disposal are not expected to be significant. Nevertheless, some direct and secondary impacts to neritic and bottomfishes may occur as a result of disposal of dredged material. Clumps of cohesive material impacting the bottom may bury flatfish such as Dover sole and English sole within the 250-foot-diameter, high energy bottom impact area. However, bottom impacts should be substantially reduced as disposal barges will attempt to maximize the dispersion of the dredged material.

(4) Marine Mammals. Refer to sections 4.09b(4) and 4.10b(2) to (4) for a discussion of probable impacts to prey species of marine mammals found near the Rosario Strait disposal site, in particular for harbor seals and harbor porpoise. This discussion also applies to the Port Townsend disposal site. Despite the large number of harbor seal pups produced in this vicinity, direct impacts to harbor seals are not expected because of the reasons outlined in section 4.03b(4). Dall's porpoises and Minke whales are also considered to be common at Partridge Banks, mainly June through August, though "common" translated to "15 to 20 animals" (Everitt, et al., 1978). Like Dall's porpoise, Minke whales feed on squid and small fishes, in addition to

shrimp and copepods. See section 4.09b(4) for a discussion of potential impacts to these prey resources. As for other marine mammals, it is not likely that Minke whales will be directly impacted by dredged material disposal activities due to their scarcity.

(5) Waterbirds. See section 4.03b(5) for a general discussion of impacts to waterbirds. For Port Townsend, the breeding colonies are closer to the disposal sites than are the wintering areas; furthermore, birds in the wintering areas tend to stay there. The breeding birds spread out in all directions from the colonies to search for food, and thus may on occasion feed within the disposal site boundaries.

For rhinocerous auklets, the most important prey fish are sandlance and herring (FWS, 1985). An important herring holding area exists to the west, and another to the south, of Protection Island. Sandlance distribution is less well known, though they are known to form very large schools at times, while at other times burying themselves in sand. Their size when young (22 to 75mm) is good for feeding fledgling rhinocerous auklets, and their schooling habitat makes them easy, available prey (Hart, 1973). It is possible that sandlance bury themselves in sand in deepwater. Thus, they may be impacted by disposal of dredged material. As indicated in the analysis of epifaunal organism impacts (4.13b(1)(b), approximately 1.1 acres per dump would receive high velocity material that could affect sandlance. Some clumps could fall with enough speed and force to catch some burrowing fish by surprise, and burying them. Whether or not this would be sufficient to suffocate a buried sandlance is unknown. Since significant impacts to sandlance are not anticipated, opportunities for rhinocerous auklet feeding are not expected to suffer. The potential for impacts resulting from turbidity plumes would be as described in section 4.02b(6).

Since significant impacts to most food sources for waterbirds are not anticipated, waterbirds are not expected to suffer significant impacts (also see section 4.03b(5).

(6) Endangered and Threatened Species. No endangered or threatened species are expected to be impacted at these disposal sites (see BA's in appendix A).

c. Impacts and their Significance to the Human Environment.

(1) Social and Economic Features. Adverse impacts to waterborne commerce in the Port Townsend site area are expected to be slight. Volumes of dredged material to be conveyed by tugs and barges will be greater under the selected alternative than under the no-action alternative.

The number of tug and barge trips in the disposal area will be relatively few on a yearly basis. Impacts of their movements on sport fishing are likely to be slight, occurring only during the limited time a disposal takes place. Under the no-action alternative, a greater amount of material would have to be discharged at nearshore or upland areas, causing greater impacts there (see section 4.02(b)) for a discussion of pertinent confined disposal impacts.

(2) Transportation.

(a) Navigation. Disposal activity at the preferred site will result in temporary, localized, and intermittent disruption of navigation within the disposal zone. Additionally, tug and barge traffic to and from the site could represent potential risks for vessel collision. The disposal site location has been coordinated with the U.S. Coast Guard and will be marked on navigation charts. Site use will be controlled to minimize the risk for vessel collision, which will reduce these potential impacts to a less-than-significant level.

Normal average annual dredged material disposal activity at the Port Townsend site is expected to average about 7 to 30 barge loads per year. Actual activity will depend on the specific dredged projects, and the results of chemical and biological tests performed on material to be dredged. As navigation channels surveyed by this site will be maintained, there should be no adverse impacts on navigation activity due to channel shoaling. There should be no significant navigation conflicts with commercial or pleasure craft.

The Port Townsend site will not be used during the salmon and steelhead outmigration window, March 15 through June 15. During times of normal site use, disposal activity at the site is not expected to exceed one to two barges per day.

When proceeding to the disposal site, tug and barge combinations move at a slower rate loaded than unloaded. Average travel speed is typically around 5 knots. Once onsite, disposal operations within the 1,500-foot-diameter disposal zone usually require about 5 to 10 minutes. On occasion, weather constraints and repositioning requirements (to ensure proper location of disposal) can increase the onsite time to as much as 20 minutes. Using an average of 10 minutes, and assuming one to two barges per day, normal site occupancy could amount to about 10 to 20 minutes per day. Though delays in disposal activities could result from avoiding conflicts with tribal fisheries (see section 2.04d), these are unlikely, given the limited anticipated use of the site and the site use conditions.

Disposal operations at the selected site will represent a slight increase in navigation traffic at that location. With increased water traffic, there is some increase in risk of minor oil leaks or spills and of vessel collisions. The location of the disposal site, the infrequent site use, and the short duration of site occupancy indicate that these risks are not significant.

(b) Land. No impacts to land transportation would occur from this alternative as all of the future dredged material proposed for open-water disposal at a PSDDA site. However, since the Port of Port Townsend (exhibit C) plans to use nearshore and upland sites (separate from PSDDA), the probable no action future would have traffic impacts due to this Port plan.

(3) Dredging and Disposal Activity. The overall impact of this alternative on dredging activity in the Port Townsend site area would be an increase in the volume of material found acceptable for unconfined, open-water disposal over that allowable under PSIC. Using PSIC, only some 265,000 c.y. of future material, that could be considered for this site, is expected to be acceptable. Under the selected alternative, 687,000 c.y. of material (100 percent) is expected to be found acceptable for discharge at the disposal site. However, only 159,000 c.y. is forecast for this site. Actual disposal volumes will depend upon the outcome of tests conducted on the material and the specific projects proposed for dredging. For a discussion of costs of dredging relating to different alternatives, see section EPTA (1988) and table 2.2.

(4) Native American Fishing. The selected Port Townsend site is located within the usual and accustomed fishing grounds of several Puget Sound tribes. However, no increase is expected in the potential for tribal fishing gear damage and/or reduced fishing time resulting from use of the unconfined, open-water disposal site. Tribal fishing rights would be protected from disposal vessel conflicts by special disposal site conditions accomplished via the Section 404 permit process. Possible tribal concerns regarding the impact of the PSDDA proposal to water quality and fisheries resources upon which tribal activities are dependent were addressed in section 2.04d.

(5) Non-Indian Commercial and Recreational Fishing. Non-Indian fishing activities may be displaced during the discharge of dredged material at the disposal site. At times of peak dredging activity, this displacement could persist for 10 minutes, two times per day. The referred disposal site has been located to minimize potential conflicts with known commercial and sports fishing activities. It is anticipated that displacements, should they occur, are more probable for sports fishermen than for commercial activities. The disposal site location and the short duration of site use, are expected to preclude any significant adverse effects to fishing activities and catch success in these waters.

(6) Human Health.

(a) Via Seafood Consumption. No impact on human health is anticipated from the consumption of seafood that might be in or near the disposal site. Only suitable dredged material will be allowed for disposal at the site.

(b) Via Drinking Water. No confined disposal is anticipated due to the action alternative. No opportunity exists for drinking water contamination as a part of the PSDDA site designation. Since the Port of Port Townsend expects to use nearshore or upland disposal of its future dredged material, ground water impacts will be considered.

(c) Via Inhalation of Dust. None is expected.

(d) Via Direct Exposure. Little direct exposure of humans to contaminated dredged material occurs. The only segment of the population that might be expected to come into direct contact with dredged material are workers on dredging crews and at upland and nearshore disposal facilities. However, no confined upland disposal is anticipated.

(7) Noise. There have been no measurements of ambient noise levels nor of the actual noise at the shore which would be produced by disposal equipment operating at the selected alternative site, which is about 5 nautical miles from the nearest shoreline. See section 4.03c(7) for a discussion of dredging noise levels and standards.

(8) Esthetics. Disposal operations are not expected to significantly affect the esthetic quality or experience in the surrounding area. The disposal operations would only be a minor part of the marine activities, as the site lies adjacent to busy shipping lanes. Viewers from the various shoreline areas would only note the occasional vessel presence during normal dredging operations. A tug and barge would move into the disposal area, spend about 10 minutes for disposal, and then leave. The tug and barge traffic would not be readily noticeable and should not be obtrusive to viewers. Viewers from close-in areas may observe a localized turbidity plume in the immediate vicinity of the barge immediately following disposal. This plume would be short term and may be masked at strong tidal currents at this location. Some viewers may perceive the tug and barge activity in a positive sense, in that it is an integral part of normal marine activities and does not detract from the overall view experience.

(9) Cultural Resources Impacts. As part of the disposal site identification, mapping studies, a literature search and limited marine history study were undertaken to establish if any historically significant shipwrecks were located within the preferred or alternative disposal sites. There was no reasonable probability that submerged properties eligible for inclusion in the National Register of Historic Places were present onsite. The PSDDA agencies conclude that there is no potential for impacts to properties which could be eligible for the National Register of Historic Places. The Washington State Historic Preservation Officer concurred with this by letter of September 5, 1989.

d. Cumulative Impacts. Disposal operations at the preferred site may contribute to several ongoing impacts to the water and air resources that are described in section 3.06a(5). Marine water quality, air quality, intertidal and subtidal macrofauna, plankton, neuston, marine mammals, anadromous and marine fishes, and threatened or endangered species could all experience an effect. None of these contributions, however, are likely to exceed very minor levels. Because of the nature of dispersive sites, the Port Townsend site would probably not experience cumulative impacts from dredged material deposited on the bottom which is rapidly eroded by strong currents. The impacts in the water column, i.e., from suspended solids, will be transient and not cumulative.

e. Relationship to Existing Plans, Policies, and Controls.

(1) Clean Water Act, Sections 404/401. See section 4.03e(1).

(2) Coastal Zone Management. See section 4.03e(2).

(3) Shoreline Master Program. The preferred disposal site is located within the jurisdiction of Clallam County. The preferred alternative is consistent with the county's master program as presently written.

(4) Department of Natural Resources (DNR) Policy on Open-Water Disposal of Dredged Material into Puget Sound. Sites throughout the Puget Sound area have been designated by DNR for open-water disposal. If the dredged material cannot be beneficially utilized (e.g., creation of artificial islands, landfill), and it is approved by all of the various regulatory agencies for unconfined, open-water disposal, it can be deposited in one of the DNR sites. Fees and leases from DNR and permits from other agencies are all required before disposal of dredged material can occur. The selected site would be an approved DNR open-water disposal site once the local shoreline permit has been granted by Clallam County.

(5) Executive Order 11990, Protection of Wetlands. The intent of Executive Order 11990 is to protect wetlands because of the significant cumulative losses that have occurred, and due to their high value to biological productivity and their many other critical functions. As the selected site lies in water 361 feet deep, no wetlands will be directly affected. Dredging projects which could affect wetlands will be evaluated on a project by project basis at the time the project is reviewed for permits under Section 404 of CWA.

(6) Executive Order 11988, Flood Plain Management. The intent of Executive Order 11988 is to provide guidance and regulation for projects located in, and affecting, the flood plain. Executive Order 11988 requires, to the extent possible, avoidance of long- and short-term adverse impacts associated with occupancy and modification of flood plains.

As the selected disposal site lies in water 361 feet deep, no direct flood plain impacts will be involved by use of this site. Dredging projects which could affect the flood plain will be evaluated on a project by project basis at the time the projects are reviewed for permits under Section 404 of the CWA.

(7) Puget Sound Water Quality Management Plan. The Puget Sound Water Quality Management Plan was adopted December 17, 1986 and modified October 19, 1988. The plan is discussed in section 4.03e(7).

(8) American Indian Religious Freedom Act. The American Indian Religious Freedom Act of 1978 (AIRFA) requires Federal agencies to ensure that none of their actions interfere with the inherent right of individual Native Americans (including American Indians, Eskimos, Aleuts, and Native Hawaiians) to believe, express, and exercise their traditional religions. These rights

include access to religious sites, use and possession of sacred objects, and the freedom to worship through traditional ceremonials and rites. The AIRFA requires consultation between Federal agencies an Native Americans to ensure that federally supported projects or projects on Federal land do not infringe on the religious practices of Native Americans. Coordination between PSDDA agencies and potentially affected tribes has occurred throughout the study, and is an ongoing process. See exhibit F for further discussion of this coordination.

(9) Canadian Acts Regulating Open-Water Disposal of Dredged Material. See section 4.09e(9) for discussion of the relationship of these laws to the implementation of a disposal site near the international boundary.

f. Probable, Irreversible, and Irretrievable Commitments of Resources. Use of the selected disposal site will result in an intermittent and temporary degradation of the quality of the site's air, noise, and water resources. Additionally, intermittent use of the water surface area of the sites during disposal operations represents a commitment that may not always be in agreement with unforeseen future plans for the area. However, neither of these commitments is irretrievable. It is expected that little or no irreversible or irretreviable commitments or losses of resources would occur. The good sediment quality and the action of the strong currents should produce mainly transient short-lived impacts.

Dredged material discharged to the selected site represents an irreversible commitment of resources to the extent that the material was potentially useful for beneficial uses or landfill. Although it is not technically impossible to remove the material, retrieval would be very costly and beyond the capabilities of available equipment.

Commitments of nonrenewable energy resources associated with the dredging program would be irreversible. In addition, the labor and capital necessary to conduct dredging operations would be irreversibly committed. This includes the dredging equipment, administrative personnel, and both skilled and non-skilled labor. However, energy and other commitments for individual dredging projects are decided by separate economic and social factors.

g. The Relationship Between Short-Term Use of Man's Environment and the Maintenance and Enhancement of Long-Term Productivity. For a discussion of this topic see section 4.03g.

h. Mitigation and Amelioration of Adverse Effects. For a discussion of this topic see also section 4.03h. The selected site has been located to avoid significant adverse effects (per NEPA) while meeting the in-water disposal needs of Puget Sound dredging. Site location and site management provisions are expected to mitigate any potential biological resource and human use conflict problems. Only acceptable dredged material will be discharged at the site. Though dispersive sites will not be monitored for chemically caused biological effects, these impacts will be avoided by the more restrictive dispersive disposal guidelines and by the dilution and dispersive nature of the site via energetic marine currents.

The primary mitigation feature of the PSDDA plan is embodied in the siting process. Site locations were chosen, to the maximum extent possible, away from shorelines, resources, and other amenities to preserve and maintain these resources by avoiding adverse effects due to dredged material disposal. Where complete avoidance was not possible (e.g., benthic invertebrates), the sites were located to minimize the possible adverse effects. A minimum number of sites were identified to minimize the possible extent of bottom impacts throughout the Sound. Sites such as this one are located in dispersive areas where strong currents will rapidly transport suspended solids and deposited sediment offsite, blending these materials into background levels.

The PSDDA disposal guideline for disposal sites is designed to avoid discharge of sediments containing unacceptable levels of chemicals of concern which could produce unacceptable adverse effects.

Another important mitigation feature of PSDDA is contained in compliance inspection plans. Appropriate compliance inspections by the PSDDA regulatory agencies will ensure that the site use occurs, such that planned avoidance of adverse effects can be realized. Appropriate disposal site environmental monitoring would provide needed verification of predicted site conditions within and outside the established sites resulting from the effects of dredged material disposal.

4.16 Port Townsend - Alternative Site.

a. Impacts and Their Significance to the Physical Environment. These would be the same as for the selected site.

b. Impacts and Their Significance to the Biological Environment. These would be the same as for the selected site.

c. Impacts and Their Significance to the Human Environment. These would be the same as for the selected site except that the alternative site would be slightly farther from the major dredging areas to be served by the Port Townsend site.

d. Cumulative Impacts. These would be the same as for the selected site.

e. Relationship to Existing Plans, Policies, and Controls. This would be the same as for the selected site.

f. Probable, Irreversible and Irretrievable Commitments of Resources. These would be the same as for the selected site.

g. The Relationship Between Short-Term Use of Man's Environment and the Maintenance and Enhancement of Long-Term Productivity. This would be the same as for the selected site.

h. Mitigation and Amelioration of Adverse Effects. These would be the same as for the selected site.

4.17 Adoption of the Selected Port Townsend Site. The selected site was chosen over the alternative site because shrimp and scallop resources are thought to be less at this location. Also, there would be less potential for conflicts with sport fishing activities.

SECTION 5. PUBLIC INVOLVEMENT

5.01 Study Coordination/Public Involvement. Public involvement procedures of NEPA and SEPA were followed to ensure that issues of concern to the public were properly addressed. The PSEP mailing list of over 2,500 was used to inform interested agencies, organizations, and individuals of study activities through newsletters and public meeting notices. Articles on PSDDA were also included in the PSEP "Puget Sound Notes," a bimonthly newsletter.

During May 1985, PSDDA agencies held six public EIS scoping meetings in the Puget Sound area (cities of Seattle, Everett, Tacoma, Olympia, Bellingham, and Port Townsend) for the Phase I studies. In June 1986 three public EIS scoping meetings were held (Olympia, Port Angeles, Bellingham) for the Phase II area. In addition, each of the three work groups conducted a number of working sessions, sharing technical information and giving participants, including citizens, representatives of ports, Indian tribes, environmental groups, local governments, and other Federal and State agencies, opportunities to make recommendations on work group outputs. Routine work group meetings, as well, have been open to public participation.

Several newsletters, containing updates on the status of PSDDA and information on study findings, were published. The first newsletter included comments and issues raised at the May 1985 public meetings and the PSDDA responses. The second issue released in April 1986 contained preliminary study findings for the Phase I area. A third newsletter was distributed in January 1988 to advise the public of the availability of the draft Phase I documents and of the two final Phase I public meetings scheduled and held in February 1988. A fourth newsletter was distributed in April 1988, providing preliminary findings for the Phase II area and notice of the three public workshops held in late April on these findings. A notice was issued in March 1989 advising the public of the availability of the draft Phase II documents.

A major display on dredging was included as part of an ongoing Puget Sound exhibit by the Seattle Aquarium. A PSDDA information brochure has been available to the public attending the exhibit, and to those visiting the Federal Center South offices of the U.S. Government. Three public workshops held in April 1988 on the Phase II preliminary findings were conducted in Steilacoom, Port Angeles, and Bellingham to obtain public comments on these findings. Three final public meetings on the Phase II preferred sites will be held 18, 19, and 20 April 1989 at Steilacoom, Bellingham and Port Angeles.

PSDDA has been coordinated closely with the PSEP and the PSWQA. Joint funding of common interest technical studies was accomplished with both of these programs. Also, the PSDDA study director and others of the study team were members of advisory committees established by PSEP and PSWQA. Similarly, staff involved in the latter two programs attended PSDDA work group sessions. Other coordination has included, but was not limited to, the following:

Exhibit F details consultation and coordination with Indian tribes.

Federal
U.S. Army Corps of Engineers
U.S. Environmental Protection Agency
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
U.S. Fish and Wildlife Service
U.S. Navy
U.S. Coast Guard

State of Washington
Department of Natural Resources
Department of Ecology
Department of Transportation
Department of Fisheries
Department of Game
Department of Commerce
Department of Social and Health Services
Parks and Recreation Commission
Puget Sound Water Quality Authority

Indian Tribes
Duwamish Tribal Office
Jamestown Klallam Tribes
Lower Elwha Tribal Council
Lummi Business Council
Muckleshoot Indian Tribe
Nisqually Indian Community
Nooksack Indian Tribal Council
Northwest Indian Fisheries Commission
Point No Point Treaty Council
Port Gamble Business Committee
Puyallup Tribal Council
Sauk-Suaittle Indian Tribe
Skokomish Tribal Council
Small Tribes of Western Washington
Squaxin Island Tribal Council
Stillaguamish Tribal Council
Suquamish Tribal Council
Swinomish Tribal Council
Tulalip Board of Directors
Upper Skagit Tribal Council

Local Government
San Juan County
Mason County
Thurston County
Island County
Jefferson County
Whatcom County
Kitsap County
Snohomish County
King County
Pierce County

Clallam County
Skagit County
City of Bellingham
City of Everett
City of Seattle
City of Anacortes
City of Tacoma
City of Olympia
City of Port Angeles
Association of Washington Cities
Association of Washington Counties
Puget Sound Council of Governments (PSCOG)
Municipality of Metropolitan Seattle (Metro)

Ports
Port of Edmonds
Port of Bellingham
Port of Everett
Port of Seattle
Port of Skagit County
Port of Anacortes
Port of Port Townsend
Port of Tacoma
Port of Port Angeles
Port of Bremerton
Port of Olympia
Washington Public Ports Association

Other Public Organizations
Washington Environmental Council
Puget Sound Alliance
Greenpeace
Friends of the Earth

5.02 Key Federal Coordination Requirements. Special efforts were undertaken pursuant to Federal NEPA coordination requirements with the following:

o U.S. Fish and Wildlife Service and National Marine Fisheries Service. As these two Federal agencies have special responsibilities for fish and wildlife protection, participation of agency representatives was sought and obtained for the three PSDDA technical work groups where the basic PSDDA plan elements were formulated. Both agencies have actively participated on the PSDDA work groups with their representatives sharing in the planning process. Also both agencies provided inputs and responded to the biological assessments and coordination documents prepared for threatened and endangered species which may be found in the vicinity of Phase II area disposal sites (see exhibit A to this EIS). Comments by these agencies on the March 1989 draft documents will be contained in FEIS exhibits C and D.

• Local Shoreline Jurisdictions and the State Shoreline's Office of Ecology. In order to ensure compliance with the Federal Coastal Zone Management Act special meetings were held with the Phase II area local governments having shoreline jurisdiction over the Phase II area alternative disposal sites. Also, coordination was accomplished through correspondence, telephone calls, and meetings. These jurisdictions received the Phase I draft final draft documents and will receive these draft Phase II documents for review. Similar coordination was accomplished with Ecology's shoreline office. The National Coastal Zone Management Act (Public Law 91-583: 86 Stat. 1280) was passed by the United States Congress in 1972. Under this act:

"(1) Each Federal agency conducting or supporting activities directly affecting the coastal zone shall conduct or support those activities in a manner which is, to the maximum extent practicable, consistent with approved state management programs.

"(2) Any Federal agency which shall undertake any development project in the coastal zone of a state shall insure that the project is, to the maximum extent practicable, consistent with approved state management programs.

"(3) After final approval by the secretary of a state's management program, any applicant for a required Federal license or permit to conduct an activity affecting land or water uses in the coastal zone of that state shall provide in the application to the licensing or permitting agency a certification that the proposed activity complies with the state's approved program and that such activity will be conducted in a manner consistent with the program."

In June 1976, the State Coastal Zone Management Program (CZMP) was approved to receive funding. The Washington State Shoreline Management Act (SMA) of 1971, as passed by the State Legislature, provided "for the management of Washington's shorelines by planning and fostering all reasonable and appropriate uses." The SMA and State CZMP are implemented through the Shoreline Master Programs (SMP) of large municipalities and the counties. The management plan for the PSDDA Phase II area is consistent with all applicable Puget Sound SMP's and so satisfies consistency with State and Federal coastal zone management requirements.

• Washington State Office of Archaeology and Historic Preservation. During the disposal site evaluation process, careful consideration was given to shipwrecks that might lie within or near the alternative disposal sites. None were identified during the literature review accomplished in conjunction with the site mapping used for site identification (see DSSTA). In June 1989, additional literature reviews and sidescan sonar studies of the preferred nondispersive sites were conducted. The efforts did not reveal conclusive evidence for sunken historic properties that might be National Register eligible at any of the Phase II sites.

o Phase II Area and Other Indian Tribes. Special coordination was undertaken with the Indian tribes having treaty fishing rights to avoid, to the maximum possible, conflicts with treaty fishing activities. Meetings were held with tribal representatives of the Lummi and Squaxin Island tribes. These tribes were also provided the Phase I draft and final documents and the Phase II draft documents for review and comment.

5.03 Remaining Coordination. Further coordination with interested parties will take place during and subsequent to the public review of the DEIS and other Phase II draft documents. Public meetings on the draft documents are scheduled for 18, 19, 20 April 1989.

5.04 Environmental Impact Statement Recipients. This DEIS was distributed to over 500 organizations and individuals for a 45-day public review in accordance with Federal and State of Washington environmental policy acts. The list of recipients is on file at the Seattle District, U.S. Army Corps of Engineers, and can be obtained by contacting Mr. Frank J. Urabeck, PSDDA Study Director.

5.05 Public Views and Responses. Comments on this DEIS and responses by the PSDDA agencies will be contained in exhibit C to the final EIS.

SECTION 6. LIST OF EIS CONTRIBUTORS

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David R. Kendall	Ph.D., Benthic Ecology, 1978 Emory University 5 years, environmental effects of dredging research, Corps of Engineers (WES) 3 years, environmental planning and biology, Corps of Engineers 3 years, contaminant research, Skidaway Institute of Oceanography 2 years, environmental regulation
Frank J. Urabeck	P.E., Civil Engineer B.S., Civil Engineering, 1962 University of Washington M.A., Economics, 1975 University of Maryland 10 years, navigation planning, Corps of Engineers; 16 years, water resources development, Corps of Engineers (14); and Department of Interior (2)
Stephen Martin	Ph.D., Invertebrate Ecology, 1971 University of Washington 12 years, environmental planning and biology, Corps of Engineers; 4 years, invertebrate aquaculture, Atomic Energy Commission
Ken Brunner	B.A.. Wildlife Biology, University of Washington 13 years, wildlife biologist, Corps of Engineers

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David G. Rice	Ph.D., Anthropology, Washington State University, 1972 8 years, environmental planning, study management, archeology, Native American coordination, Corps of Engineers 9 years, independent consultant, archeology, Native American consultation 10 years, University of Idaho, teaching and research, anthropology/archeology 5 years, Association for the Humanities in Idaho, public administration

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GLOSSARY OF TERMS AND ABBREVIATIONS

PUGET SOUND DREDGED DISPOSAL ANALYSIS (PSDDA)
GLOSSARY OF TERMS

Amphipods. Small shrimp-like crustaceans (for example, sand fleas). Many live on the bottom, feed on algae and detritus, and serve as food for many marine species. Amphipods are used in laboratory bioassays to test the toxicity of sediments.

Apparent Effects Threshold. The sediment concentration of a contaminant above which statistically significant biological effects would always be expected.

Area Ranking. The designation of a dredging area relative to its potential for having sediment chemicals of concern. Rankings range from "low" potential to "high" potential, and are used to determine the intensity of dredged material evaluation and testing that might be required.

Baseline Study. A study designed to document existing environmental conditions at a given site. The results of a baseline study may be used to document temporal changes at a site or document background conditions for comparison with another site.

Bathymetry. Shape of the bottom of a water body expressed as the spatial pattern of water depths. Bathymetric maps are essentially topographic maps of the bottom of Puget Sound.

Benthic Organisms. Organisms that live in or on the bottom of a body of water.

Bioaccumulation. The accumulation of chemical compounds in the tissues of an organism. For example, certain chemicals in food eaten by a fish tend to accumulate in its liver and other tissues.

Bioassay. A laboratory test used to evaluate the toxicity of a material (commonly sediments or wastewater) by measuring behavioral, physiological, or lethal responses of organisms.

Biota. The animals and plants that live in a particular area or habitat.

Bottom-Dump Barge. A barge that disposes of dredged material by opening along a center seam or through doors in the bottom of the barge.

Bottomfish. Fish that live on or near the bottom of a body of water, for example, English sole.

Bulk Chemical Analyses. Chemical analyses performed on an entire sediment sample, without separating water from the solid material in a sample.

Capping. See confined aquatic disposal.

Carcinogenic. Capable of causing cancer.

Clamshell Dredging. Scooping of the bottom sediments using a mechanical clamshell bucket of varying size. Commonly used in over a wide variety of grain sizes and calm water, the sediment is dumped onto a separate barge and towed to a disposal site when disposing in open water.

Code of Federal Regulations. The compilation of Federal regulations adopted by Federal agencies through a rule-making process.

Compositing. Mixing sediments from different samples to produce a composite sample for chemical and/or biological testing.

Confined Disposal. A disposal method that isolates the dredged material from the environment. Confined disposal may be in aquatic, nearshore, or upland environments.

Confined Aquatic Disposal (CAD). Confined disposal in a water environment. Usually accomplished by placing a layer of sediment over material that has been placed on the bottom of a water body (i.e., capping).

Contaminant. A chemical or biological substance in a form or in a quantity that can harm aquatic organisms, consumers of aquatic organisms, or users of the aquatic environment.

Contaminated Sediment.

Technical Definition: A sediment that contains measurable levels of contaminants.

Management or Common Definition: A sediment that contains sufficient concentration(s) of chemicals to produce unacceptable adverse environmental effects and thus require restriction(s) for dredging and/or disposal of dredged material (e.g., is unacceptable for unconfined, open water disposal or conventional land/shore disposal, requiring confinement).

Conventional Nearshore Disposal. Disposal at a site where dredged material is placed behind a dike in water along the shoreline, with the final elevation of the fill being above water. "Conventional" disposal additionally means that special contaminant controls or restrictions are not needed.

Conventional Pollutants. Sediment parameters and characteristics that have been routinely measured in assessing sediment quality. These include sulfides, organic carbon, etc.

Conventional Upland Disposal. Disposal at a site created on land (away from tidal waters) in which the dredged material eventually dries. Upland sites are usually diked to confine solids and to allow surface water from the disposal operation to be released. "Conventional" disposal additionally means that special contaminant controls or restrictions are not needed.

Depositional Analysis. A scientific inspection of the bottom sediments that identifies where natural sediments tend to accumulate.

Depositional Area. An underwater region where material sediments tend to accumulate.

Disposal. See confined disposal, conventional nearshore disposal, conventional upland disposal, and unconfined, open-water disposal.

Disposal Site. The bottom area that receives discharged dredged material; encompassing, and larger than, the target area and the disposal zone.

Disposal Site Work Group. The PSDDA work group that is designating locations for open-water unconfined dredged material disposal sites that are environmentally acceptable and economically feasible.

Disposal Zone. The area that is within the disposal site that designates where surface release of dredged material will occur. It encompasses the smaller target area. (See also "target area" and "disposal site".)

Dredged Material. Sediments excavated from the bottom of a waterway or water body.

Dredged Material Management Unit. The maximum volume of dredged material for which a decision on suitability for unconfined open-water disposal can be made. Management units are typically represented by a single set of chemical and biological test information obtained from a composite sample. Management units are smaller in areas of higher chemical contamination concern (see "area ranking").

Dredger. Private developer or public entity (e.g., Federal or State agency, port or local government) responsible for funding and undertaking dredging projects. This is not necessarily the dredging contractor who physically removes and disposes of dredged material (see below).

Dredging. Any physical digging into the bottom of a water body. Dredging can be done with mechanical or hydraulic machines and is performed in many parts of Puget Sound for the maintenance of navigation channels that would otherwise fill with sediment and block ship passage.

Dredging Contractor. Private or public (e.g., Corps of Engineers) contractor or operator who physically removes and disposes of dredged material for the dredger (see above).

Disposal Site Work Group. The PSDDA work group that is designating locations for open-water unconfined dredged material disposal sites that are environmentally acceptable and economically feasible.

Ecosystem. A group of completely interrelated living organisms that interact with one another and with their physical environment. Examples of ecosystems are a rain forest, pond, and estuary. An ecosystem, such as Puget Sound, can be thought of as a single complex system. Damage to any part may affect the whole. A system such as Puget Sound can also be thought of as the sum of many interconnected ecosystems such as the rivers, wetlands, and bays. Ecosystem is thus a concept applied to various scales of living communities and signifying the interrelationships that must be considered.

Effluent. Effluent is the water flowing out of a contained disposal facility. To distinguish from "runoff" (see below) due to rainfall, effluent usually refers to water discharged during the disposal operation.

Elutriate. The extract resulting from mixing water and dredged material in a laboratory test. The resulting elutriate can be used for chemical and biological testing to assess potential water column effects of dredged material disposal.

Entrainment. The addition of water to dredged material during disposal, as it descends through the water column.

Environmental Impact Statement. A document that discusses the likely significant environmental impacts of a proposed project, ways to lessen the impacts, and alternatives to the proposed project. EIS's are required by the National and State Environmental Policy Acts.

Erosion. Wearing away of rock or soil via gradual detachment of soil or rock fragments by water, wind, ice, and other mechanical and chemical forces.

Estuary. A confined coastal water body where ocean water is diluted by inflowing fresh water, and tidal mixing occurs.

Evaluation Procedures Work Group. The PSDDA work group that is developing chemical and biological testing and test evaluation procedures for dredged material assessment.

Gravid. Having eggs, such as female crabs carrying eggs.

Ground Water. Underground water body, also called an aquifer. Aquifers are created by rain which soaks into the ground and flows down until it collects at a point where the ground is not permeable.

Habitat. The specific area or environment in which a particular type of plant or animal lives. An organism's habitat provides all of the basic requirements for life. Typical Puget Sound habitats include beaches, marshes, rocky shores, bottom sediments, mudflats, and the water itself.

Hazardous Waste. Any solid, liquid, or gaseous substance which, because of its source or measurable characteristics, is classified under State or Federal law as hazardous, and is subject to special handling, shipping, storage, and disposal requirements. Washington State law identifies two categories of hazardous waste: dangerous and extremely hazardous. The latter category is more hazardous and requires greater precautions.

Hopper Dredge. A hydraulic suction dredge that is used to pick up coarser grain sediments (such as sand), particularly in less protected areas with sea swell. Dredged materials are deposited in a large holding tank or "hopper" on the same vessel, and then transported to a disposal site. The hopper dredge is rarely used in Puget Sound.

Hydraulic Dredging. Dredging accomplished by the erosive force of a water suction and slurry process, requiring a pump to move the water-suspended sediments. Pipeline and hopper dredges are hydraulic dredges.

Hydraulics Project Approval. RCW 75.20.100 Approval from the Washington Department of Fisheries and Washington Department of Wildlife for the use, diversion, obstruction or change in the natural flow or bed of any river or stream, or that will use any salt or fresh waters of the State.

Hydraulically Dredged Material. Material, usually sand or coarser grain, that is brought up by a pipeline or hopper dredge. This material usually includes slurry water.

Hydrocarbon. An organic compound composed of carbon and hydrogen. Petroleum and its derived compounds are hydrocarbons.

Infauna. Animals living in the sediment.

Intertidal Area. The area between high and low tide levels. The alternate wetting and drying of this area makes it a transition between land and water organisms and creates special environmental conditions.

Leachate. Water or other liquid that may have dissolved (leached) soluble materials, such as organic salts and mineral salts, derived from a solid material. Rainwater that percolates through a sanitary landfill and picks up contaminants is called the leachate from the landfill.

Local Sponsor. A public entity (e.g., port district) that sponsors Federal navigation projects. The sponsor seeks to acquire or hold permits and approvals for disposal of dredged material at a disposal site.

Loran C. An electronic system to facilitate navigation positioning and course plotting/tracking.

Management Plan Work Group. The PSDDA work group is developing a management plan for each of the open-water dredged material disposal sites. The plan will define the roles of local, State, and Federal agencies. Issues being addressed include: permit reviews, monitoring of permit compliance, treatment of permit violations, monitoring of environmental impacts, responding to unforeseen effects of disposal, plan updating, and data management.

Material Release Screen. A laboratory test proposed by PSDDA to assess the potential for loss of fine-grained particles carrying chemicals of concern from the disposal site during disposal operations.

Mechanical Dredging. Dredging by digging or scraping to collect dredged materials. A clamshell dredge is a mechanical dredge. (See "hydraulic dredging.")

Metals. Metals are naturally occurring elements. Certain metals, such as mercury, lead, nickel, zinc, and cadmium, can be of environmental concern when they are released to the evironment in unnatural amounts by man's activities.

Microlayer, Sea Surface Microlayer. The extremely thin top layer of water that can contain high concentrations of natural and other organic substances. Contaminants such as oil and grease, many lipophylic (fat or oil associated) toxicants, and pathogens may be present at much higher concentrations in the microlayer than they are in the water column. Also the microlayer is biologically important as a rearing area for marine organisms.

Microtox. A laboratory test using luminescent bacteria and measuring light production, used to assess toxicity of sediment extracts.

Molt. A complex series of events that results in the periodic shedding of the skeleton, or carapace by crustaceans (all arthropods for that matter). Molting is the only time that many crustaceans can grow and mate (particularly crabs).

Monitor. To systematically and repeatedly measure something in order to detect changes or trends.

Nutrients. Essential chemicals needed by plants or animals for growth. Excessive amounts of nutrients can lead to accelerated growth of algae and subsequent degradation of water quality due to oxygen depletion. Some nutrients can be toxic at high concentrations.

Overdepth Material. Dredged material removed from below the dredging depth needed for safe navigation. Through overdepth is incidentally removed due to dredging equipment precision, its excavation is usually planned as part of the dredging project to ensure proper final water depths. Common overdepth is 2 feet below the needed dredging line.

Oxygen Demanding Materials. Materials such as food waste and dead plant or animal tissue that use up dissolved oxygen in the water when they are degraded through chemical or biological processes. Chemical and biological oxygen demand (COD and BOD, respectively) are different measures of how much oxygen demand a substance has.

Parameter. A quantifiable or measurable characteristic of something. For example, height, weight, sex, and hair color are all parameters that can be determined for humans. Water quality parameters include temperature, pH, salinity, dissolved oxygen concentration, and many others.

Pathogen. A disease-causing agent, especially a virus, bacteria, or fungi. Pathogens can be present in municipal, industrial, and nonpoint source discharges to the Sound.

Permit. A written warrant or license, granted by an authority, allowing a particular activity to take place. Permits required for dredging and disposal of dredged material include the U.S. Army Corps of Engineers Section 404 permit, the Washington State Department of Fisheries Hydraulics Permit, the city or county Shoreline Development Permit, and the Washington Department of Natural Resources Site Use Disposal Permit.

Persistent. Compounds that are not readily degraded by natural physical, chemical, or biological processes.

Pesticide. A general term used to describe any substance, usually chemical, used to destroy or control organisms (pests). Pesticides include herbicides, insecticides, algicides, and fungicides. Many of these substances are manufactured and are not naturally found in the environment. Others, such as pyrethrum, are natural toxins which are extracted from plants and animals.

pH. The degree of alkalinity or acidity of a solution. Water has a pH of 7.0. A pH of less than 7.0 indicates an acidic solution, and a pH greater than 7.0 indicates a basic solution. The pH of water influences many of the types of chemical reactions that occur in it. Puget Sound waters, like most marine waters, are typically pH neutral.

Phase I. The PSDDA study is divided into two, 3-year long, overlapping phases. Phase I covers the central area of Puget Sound including Seattle, Everett, and Tacoma. Phase I began in April 1985.

Phase II. The PSDDA study is divided into two, 3-year long, overlapping phases. Phase II covers the north and south Sound (including, Olympia, Bellingham, and Port Angeles)--the areas not covered by Phase I. Hood Canal is not being considered for location of a disposal site. Phase II began in April 1986.

Pipeline Dredge. A hydraulic dredge that transports slurried dredged material by pumping it via a pipe. (See "hydraulic dredge".)

Point Source. Locations where pollution comes out of a pipe into Puget Sound.

Polychaete. A marine worm.

Polychlorinated Biphenyls. A group of manmade organic chemicals, including about 70 different but closely related compounds made up of carbon, hydrogen, and chlorine. If released to the environment, they persist for long periods of time and can concentrate in food chains. PCB's are not water soluble and are suspected to cause cancer in humans. PCB's are an example of an organic toxicant.

Polycyclic (Polynuclear) Aromatic Hydrocarbon. A class of complex organic compounds, some of which are persistent and cancer-causing. These compounds are formed from the combustion of organic material and are ubiquitous in the environment. PAH's are commonly formed by forest fires and by the combustion of fossil fuels. PAH's often reach the environment through atmospheric fallout, highway runoff, and oil discharge.

Priority Pollutants. Substances listed by EPA under the Clean Water Act as toxic and having priority for regulatory controls. The list includes toxic metals, inorganic contaminants such as cyanide and arsenic, and a broad range of both natural and artificial organic compounds. The list of priority pollutants includes substances that are not of concern in Puget Sound, and also does not include all known harmful compounds.

Puget Sound Water Quality Authority. An agency created by the Washington State legislature in 1985 and tasked with developing a comprehensive plan to protect and enhance the water quality of Puget Sound. The Authority adopted its first plan in January 1987.

Range Markers. Pairs of markers which, when aligned, provide a known bearing to a boat operator. Two pairs of range markers can be used to fix position at a point.

Regional Administrative Decisions. A term used in PSDDA to describe decisions that are a mixture of scientific knowledge and administrative judgment. These regionwide policies are collectively made by all regulatory agencies with authority over dredged material disposal to obtain Sound-wide consistency.

Regulatory Agencies. Federal and State agencies that regulate dredging and dredged material disposal in Puget Sound, along with pertinent laws/permits, include:

U.S. Army Corps of Engineers

- o River and Harbor Act of 1899 (Section 10 permits)
- o Clean Water Act (Section 404 permits)

U.S. Environmental Protection Agency

- o Clean Water Act (Section 404 permits)

Washington Department of Natural Resources

- o Shoreline Management Act (site use permits)

Washington Department of Ecology

- o Clean Water Act (Section 401 certifications)
- o Shoreline Management Act (CZMA consistency determinations)

Washington Department of Fisheries

- o Hydraulics Project Approval

Washington Department of Wildlife (Formerly Washington Department of Game)

- o Hydraulics Project Approval

Local shoreline jurisdiction e.g., City of Seattle, City of Everett, Pierce County

- o Shoreline permit to non-Federal dredger/DNR

U.S. Fish and Wildlife Service (Key reviewing agency)

National Marine Fisheries Service (Key reviewing agency)

The Resource Conservation and Recovery Act. The Federal law that regulates solid and hazardous waste.

Respiration. The metabolic processes by which an organism takes in and uses oxygen and releases carbon dioxide and other waste products.

Revised Code of Washington. The compilation of the laws of the State of Washington published by the Statute Law Committee.

Runoff. Runoff is the liquid fraction of dredged materials or the flow/seepage caused by precipitation landing on and filtering through upland or nearshore dredged material disposal sites.

Salmonid. A fish of the family Salmoniidae. Fish in this family include salmon and trout. Many Puget Sound salmonids are anadromous, spending part of their life cycles in fresh water and part in marine waters.

Sediment. Material suspended in or settling to the bottom of a liquid, such as the sand and mud that make up much of the shorelines and bottom of Puget Sound. Sediment input to Puget Sound comes from natural sources, such as erosion of soils and weathering of rock, or anthropogenic sources, such as forest or agricultural practices or construction activities. Certain contaminants tend to collect on and adhere to sediment particles. The sediments of some areas around Puget Sound contain elevated levels of contaminants.

Site Condition. The degree of adverse biological effects that might occur at a disposal site due to the presence of sediment chemicals of concern; the dividing line between "acceptable" (does not exceed the condition) and "unacceptable" (exceeds the site condition) adverse effects at the disposal site. Other phrases used to describe site condition include "biological effects condition for site management" and "site management condition."

Spot Checking. Inspections on a random basis to verify compliance with permit requirements.

State Environmental Policy Act. A State law intended to minimize environmental damage. SEPA requires that State agencies and local governments consider environmental factors when making decisions on activities, such as development proposals over a certain size. As part of this process, environmental documents such as EIS's are prepared and opportunities for public comment are provided.

Statistically Significant. A quantitative determination of the statistical degree to which two measurements of the same parameter can be shown to be different, given the variability of the measurements.

Subtidal. Refers to the marine environment below low tide.

Suspended Solids. Organic or inorganic particles that are suspended in water. The term includes sand, mud, and clay particles as well as other solids suspended in the water column.

Target Area. The specified area on the surface of Puget Sound for the disposal of dredged material. The target area is within the disposal zone and within the disposal site.

Toxic. Poisonous, carcinogenic, or otherwise directly harmful to life.

Toxic Substances and Toxicants. Chemical substances, such as pesticides, plastics, detergents, chlorine, and industrial wastes that are poisonous, carcinogenic, or otherwise harmful to life if found in sufficient concentrations.

Treatment. Chemical, biological, or mechanical procedures applied to an industrial or municipal discharge or to other sources of contamination to remove, reduce, or neutralize contaminants.

Turbidity. A measure of the amount of material suspended in the water. Increasing the turbidity of the water decreases the amount of light that penetrates the water column. Very high levels of turbidity can be harmful to aquatic life.

Unconfined, Open-Water Disposal. Discharge of dredged material into an aquatic environment, usually by discharge at the surface, without restrictions or confinement of the material once it is released.

Variable Range Radar. Radar equipped with markers which allow measurement of bearings and distances to known targets.

Vessel Traffic Service (VTS). A network of radar coverage for ports of Puget Sound operated by the Coast Guard to control ship traffic. Most commercial vessels are required to check in, comply with VTS rules, and report any change in movement.

Volatile Solids. The material in a sediment sample that evaporates at a given high temperature.

Washington Administrative Code. Contains all State regulations adopted by State agencies through a rulemaking process. For example, Chapter 173-201 WAC contains water quality standards.

Water Quality Certification. Approval given by Washington State Department of Ecology which acknowledges the compliance of a discharge with Section 401 of the Clean Water Act.

Waterways Experiment Station (WES). Corps of Engineers (Corps) research facility located in Vicksburg, Mississippi, that performs research and support projects for the various Corps districts.

Wetlands. Habitats where the influence of surface or ground water has resulted in development of plant or animal communities adapted to such aquatic or intermittently wet conditions. Wetlands include tidal flats, shallow subtidal areas, swamps, marshes, wet meadows, bogs, and similar areas.

Zoning. To designate, by ordinances, areas of land reserved and regulated for specific land uses.

ABBREVIATIONS

AET. Apparent Effects Threshold.

CFR. Code of Federal Regulations.

Corps. U.S. Army Corps of Engineers.

CWA. The Federal Clean Water Act, previously known as the Federal Water Pollution Control Act.

DEIS. Draft Environmental Impact Statement.

DMRP. Dredged Material Research Program.

DNR. Washington Department of Natural Resources.

DSS TA. Disposal Site Selection Technical Appendix.

DSWG. Disposal Site Work Group.

Ecology. Washington Department of Ecology.

EIS. Environmental Impact Statement.

EPA. Environmental Protection Agency.

EPTA. Evaluation Procedures Technical Appendix.

EPWG. Evaluation Procedures Work Group.

FVP. Field Verification Program.

HPA. Hydraulics Project Approval. RCW 75.20.100.

ML. Maximum Level.

MPTA. Management Plans Technical Appendix.

MPWG. Management Plan Work Group.

NEPA. National Environmental Policy Act.

PAH. Polycyclic (Polynuclear) Aromatic Hydrocarbon.

PCB's. Polychlorinated Biphenyls.

PMP. Proposed Management Plan.

PSDDA. Puget Sound Dredged Disposal Analysis.

PSEP. Puget Sound Estuary Program.

PSIC. Puget Sound Interim Criteria.

PSWQA. Puget Sound Water Quality Authority.

RAD's. Regional Administrative Decisions.

RCRA. The Resource Conservation and Recovery Act.

RCW. Revised Code of Washington.

SEPA. State Environmental Policy Act.

SL. Screening Level.

SMA. Shoreline Mangement Act.

WAC. Washington Administrative Code.

WES. Waterways Experiment Station.

401. Section 401 of the Clean Water Act.

404. Section 404 of the Clean Water Act.

4MR. The Fourmile Rock DNR disposal site in Elliott Bay.

EXHIBIT A

Threatened and Endangered Species
Biological Assesments and Coordination Letters

Brunner/cp/3624
24 May 88
5126k

Planning Branch (1110-2-1150b)

Mr. Lynn Childers
Acting Field Supervisor
Endangered Species Field Office
U.S. Fish and Wildlife Service
2625 Parkmont Lane S.W., Building B-2
Olympia, Washington 98502

Dear Mr. Childers:

Enclosed is a biological assessment (BA) evaluating the possible effects of Phase II of the Puget Sound Dredged Disposal Analysis (PSDDA) on the bald eagle (Haliaeetus leucocephalus). Phase I of the study dealt with central Puget Sound (Everett, Seattle, and Tacoma) and is nearing completion. A biological assessment for Phase I was transmitted to you in February 1987 and determined that Phase I would not result in impacts to bald eagles. Your response of March 25, 1987 concurred with this conclusion.

Your letter of March 29, 1988 again identified that the bald eagle is present in the Phase II Puget Sound areas and is potentially affected by PSDDA. The bald eagle is a threatened species in Washington on the Federal List of Endangered and Threatened Wildlife and Plants.

The BA concludes that implementation of Phase II of PSDDA would not result in impacts to bald eagles. If you wish to discuss the BA, please call Mr. Ken Brunner at telephone (206) 764-3624.

Sincerely,

R. P. Sellevold, P.E.
Chief, Engineering Division

cc w/encl:
ERS (Weinmann)
ERS (Wakeman)
PSDDA (Urabeck)
OP-RF (Kendall)
ERS (Rice/Brunner)

Enclosure

MFR: Self-explanatory. (BRUNNER)

WAKEMAN/EP-ER
RICE/EP-ER
WEINMANN/EP-ER
KENDALL/OP-RF
URABECK/PSDDA
HOGAN/EP
SELLEVOLD/E/s/
EP FILE

CENPS-EP-ER 21 April 1988

PUGET SOUND DREDGED DISPOSAL ANALYSIS
BIOLOGICAL ASSESSMENT ON BALD EAGLE
FOR THE PHASE II AREA (NORTH AND SOUTH PUGET SOUND)

1. Background. The Puget Sound Dredged Disposal Analysis (PSDDA) is a program for the management of unconfined, open-water disposal of dredged material in waters of Puget Sound. The program includes: (1) designation of acceptable disposal sites, (2) definition of dredged material evaluation procedures, and (3) disposal site management plans.

During the mid-1980's, there was heightened public and agency concern over the long-term environmental health of Puget Sound and the role dredged material played in perceived water and sediment quality problems. Questions were raised over project-by-project dredged material evaluation processes, and some felt that the existing public disposal sites were not at the "best" locations. This discomfort, combined with the fact that permits for some of the disposal sites have expired, created uncertainty with regard to future disposal of dredged material and highlighted the urgency of having an acceptable dredged material disposal program. A proposed program has been developed through a special Federal-State cooperative study.

The U.S. Army Corps of Engineers (Corps), U.S. Environmental Protection Agency (EPA), Washington Department of Natural Resources (DNR), and Washington Department of Ecology (Ecology) began the PSDDA study in April 1985. The study is being conducted in two overlapping phases, each approximately 3 years in length. Phase I covers central Puget Sound, including the sound's major urban centers, Tacoma, Seattle, and Everett. Phase II, initiated in April 1986, covers the north and south Sound area, including Olympia, Port Angeles, and Bellingham (see figure 1).

The goal of PSDDA is to provide environmentally safe and publicly acceptable guidelines governing unconfined, open-water disposal of dredged material, thereby improving consistency and predictability in the decisionmaking process.

The Corps is the lead Federal agency for this study and as such has responsibility for meeting the requirements of section 7 of the Endangered Species Act of 1973, as amended (Public Law 97-304). The bald eagle (Haliaeetus leucocephalus) was the only species included in the Fish and Wildlife Service (FWS) letter of 29 March 1988, which listed all species on the Federal List of Endangered and Threatened Wildlife and Plants that are found near Puget Sound and potentially affected by the study. This biological assessment (BA) evaluates the unconfined, open-water disposal sites considered by PSDDA, Phase II, for north and south Puget Sound (see paragraph 2 for desription) for possible impacts to this species.

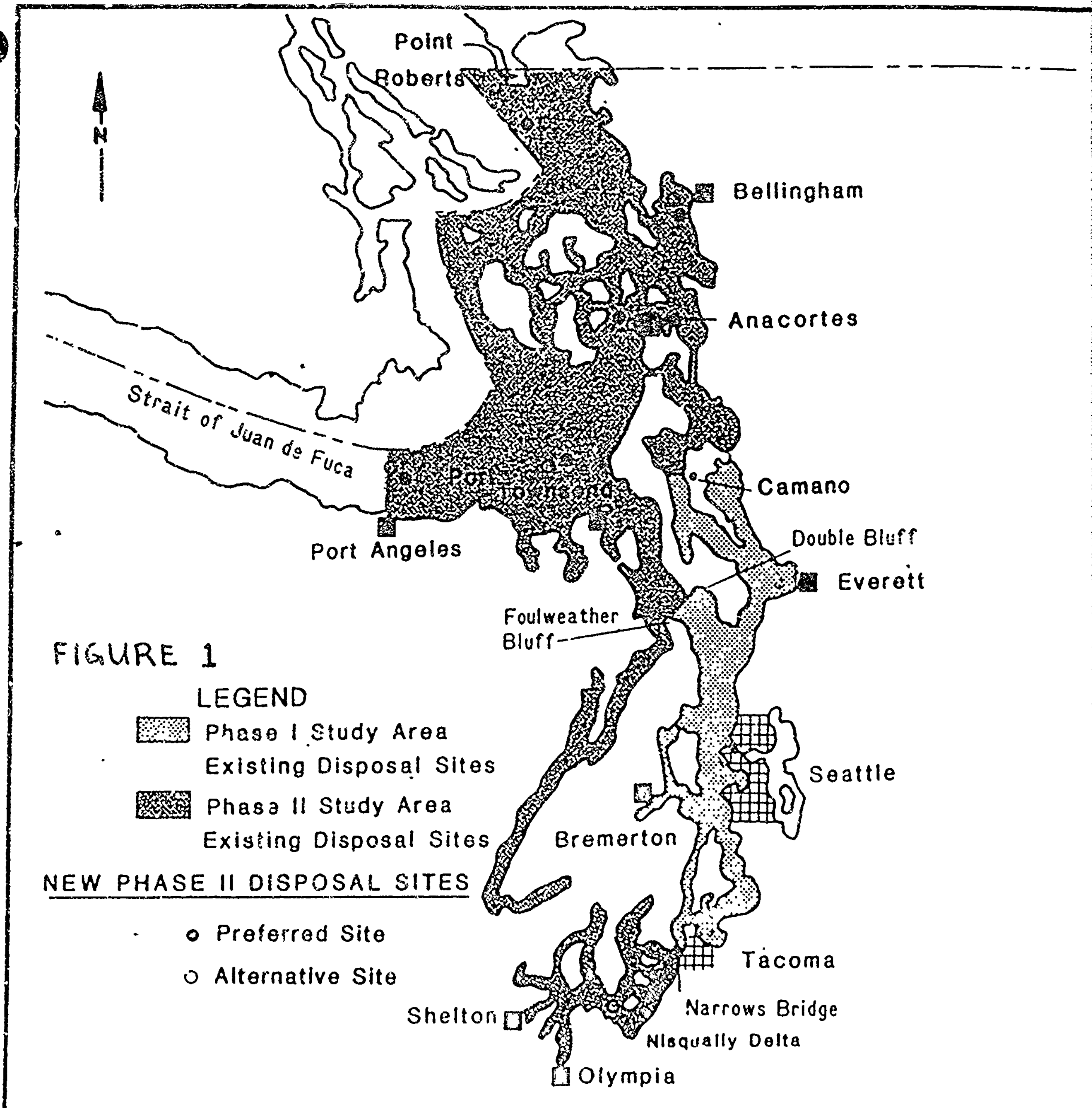
Point Roberts
Bellingham
Anacortes
Strait of Juan de Fuca
Port Townsend
Camano
Port Angeles
Double Bluff
Everett
Foulweather Bluff
LEGEND
Phase I Study Area Existing Disposal Sites
Phase II Study Area Existing Disposal Sites
NEW PHASE II DISPOSAL SITES
Preferred Site
Alternative Site
Seattle
Bremerton
Tacoma
Narrows Bridge
Shelton
Nisqually Delta
Olympia
N

FIGURE 1

2. Project Description.

a. General. Six public multi-user unconfined, open-water disposal sites have been identified which will partially meet the future dredged material disposal needs of the Phase II area. The sites, while varying in size primarily due to bathymetry, average about 318 acres in potential bottom impact area (about 4,000 feet in diameter). Each site includes a 900-foot radius, 58-acre surface disposal zone within which all dredged material must be released.

Locations for the preferred disposal sites were sought that avoided important biological resources and human use activities. Figures 2 through 8 show the Phase II disposal sites, including two alternate sites.

b. Overview of Disposal Site Selection Process. The site selection process used by PSDDA utilized existing information in combination with field studies to identify preferred and alternative disposal sites. The approach used is similar to that described in the EPA and Corps workbook entitled "General Approach to Designation Studies for Ocean Dredged Material Disposal Sites" (EPA/Corps, 1984). Steps of the site selection process were as follows:

(1) Define general siting philosophy. This step addresses disposal philosophy (i.e., whether sites should be dispersive or nondispersive), general siting locations (i.e., ocean, strait, or sound), and number of disposal sites.)

(2) Identify selection factors to delineate Zones of Siting Feasibility (ZSF's). This step uses existing information on biological resources and human use activities to identify general areas where disposal sites might be appropriately located.

(3) Conduct field studies on the ZSF's. Field and model studies are conducted to fill key data gaps and gather information on the physical and biological conditions of the ZSF's.

(4) Identify preliminary sites within the ZSF's. Information from the ZSF studies is used to identify preliminary locations for disposal sites within the ZSF's.

(5) Identify preferred sites. Information from the site-specific studies is used to identify preferred and alternative sites within the ZSF's.

Existing DNR disposal sites were considered in the disposal site selection process, but none were found to meet the site selection factors discussed below. All cooperating agencies in PSDDA agreed early on that no special a priori consideration would be given to the existing sites, because of human use conflicts and environmental concerns with past dredging and disposal protocols. An objective site selection process was used to minimize environmental and human usage conflicts as much as possible, and existing sites adequately meeting the site selection factors and constraints were given equal consideration with other potential sites.

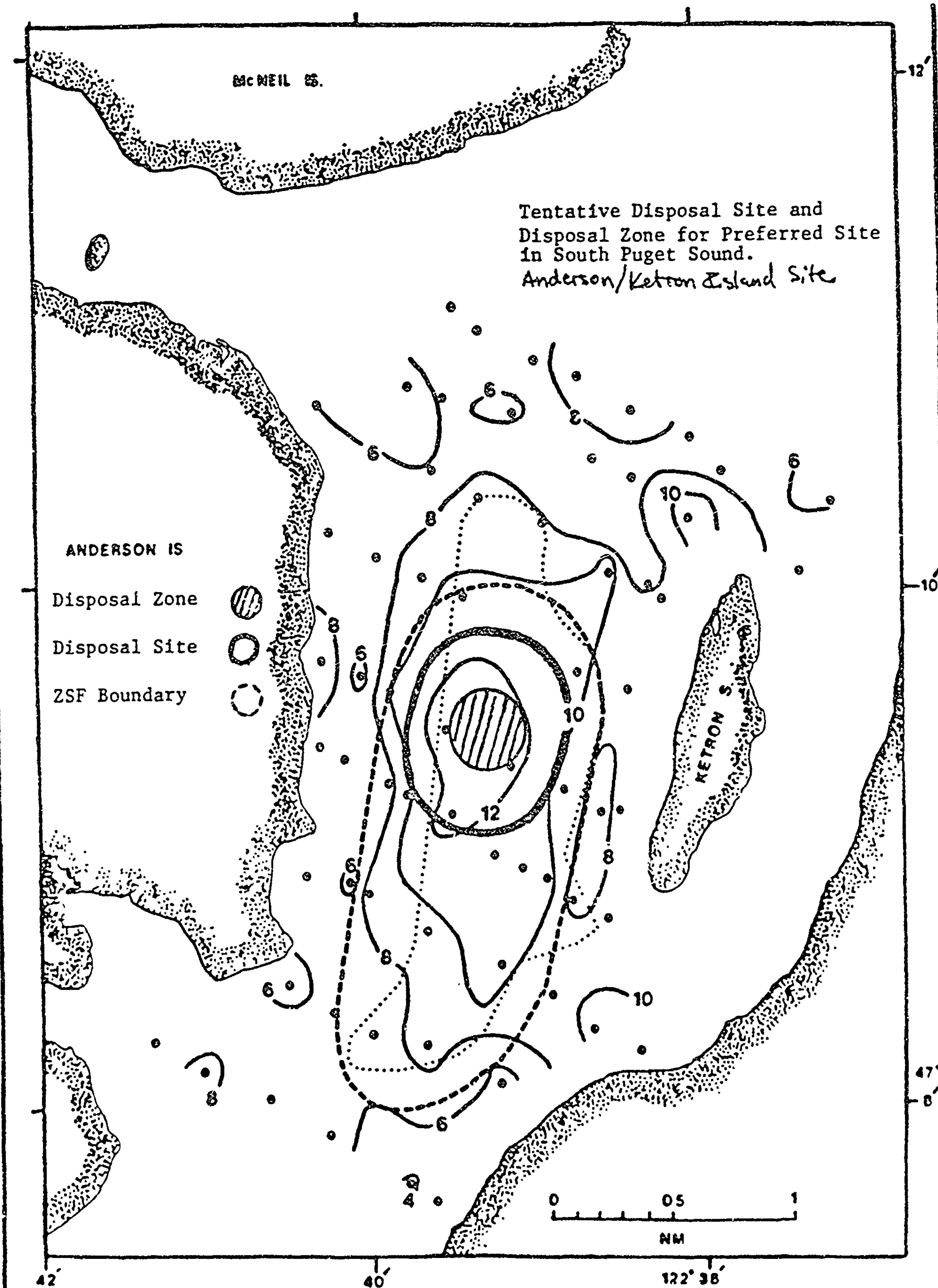

Figure 2. Contours of clay content (percent) in Anderson/Ketron ZSF. Dotted line represents preliminary ZSF boundary. Dashed line indicates revised boundary based on deposition analysis results.

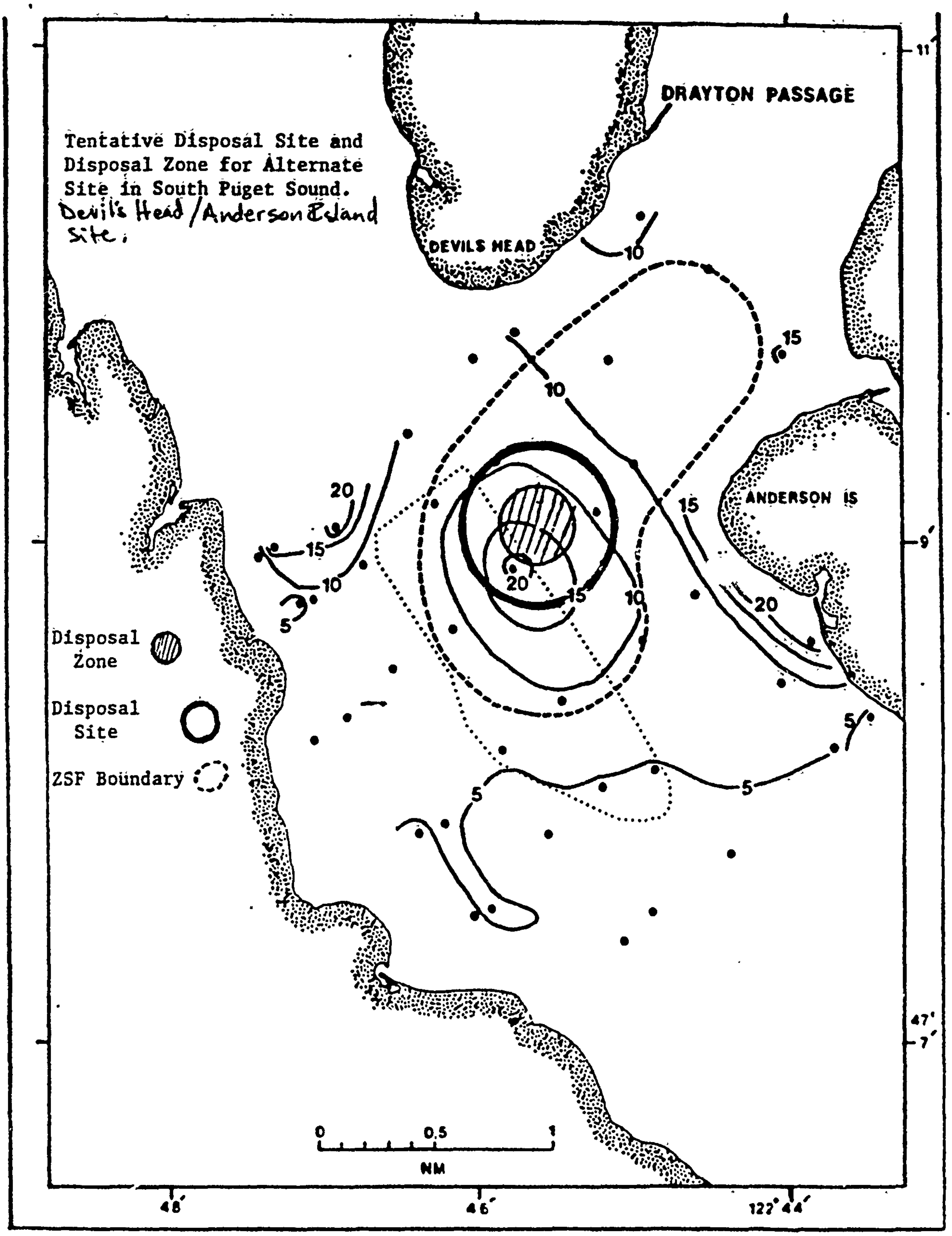

Figure 3 Contours of clay content (percent) in Devils Head ZSF. Dotted line represents preliminary ZSF boundary. Dashed line indicates revised boundary based on deposition analysis results.

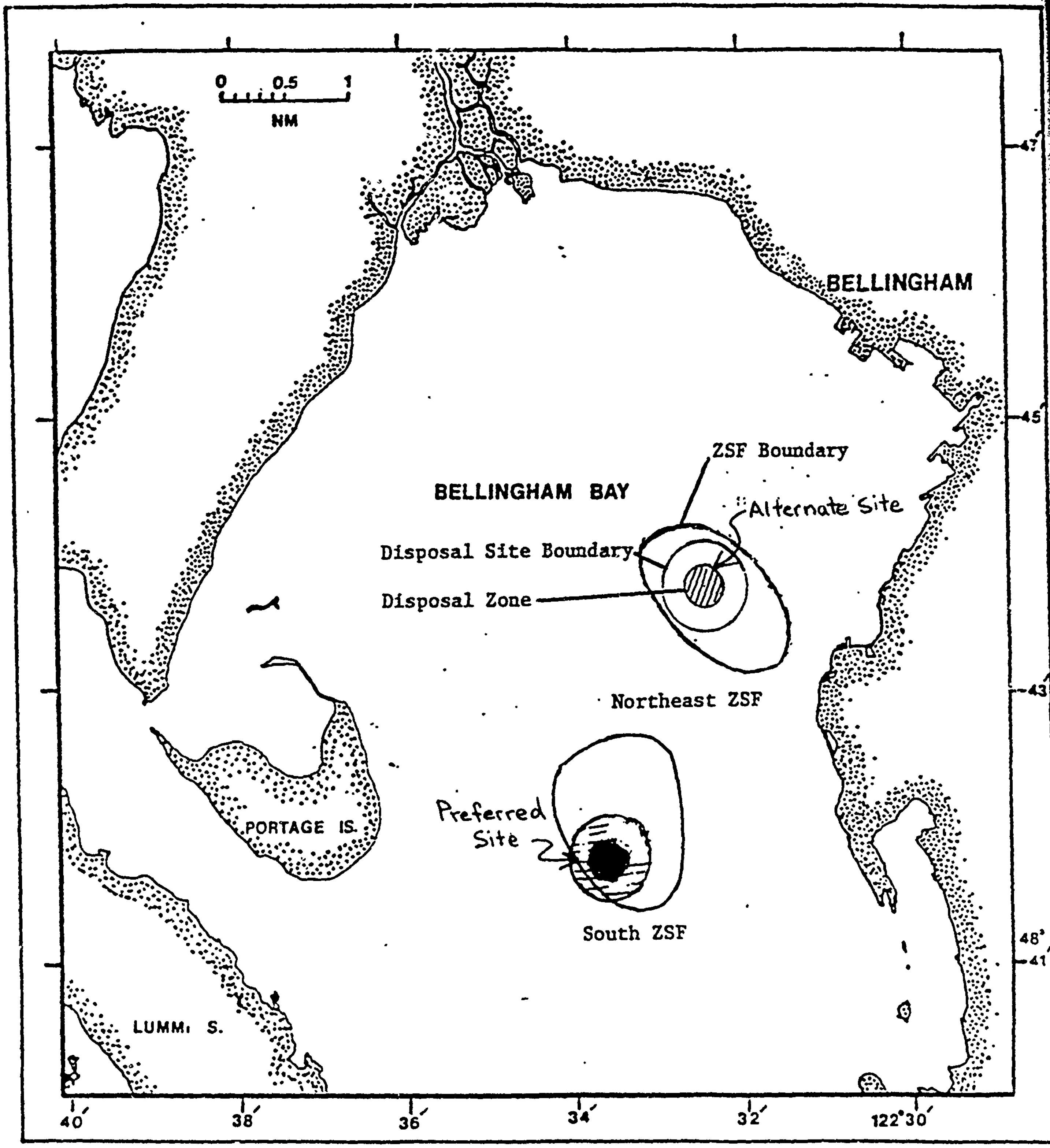

Figure 4.
Zones of Siting Feasability (ZSF) in Bellingham Bay depicting tentative Disposal Site Boundaries and disposal zones (900 ft radius).

Adjusted Disposal Site

Dump zone

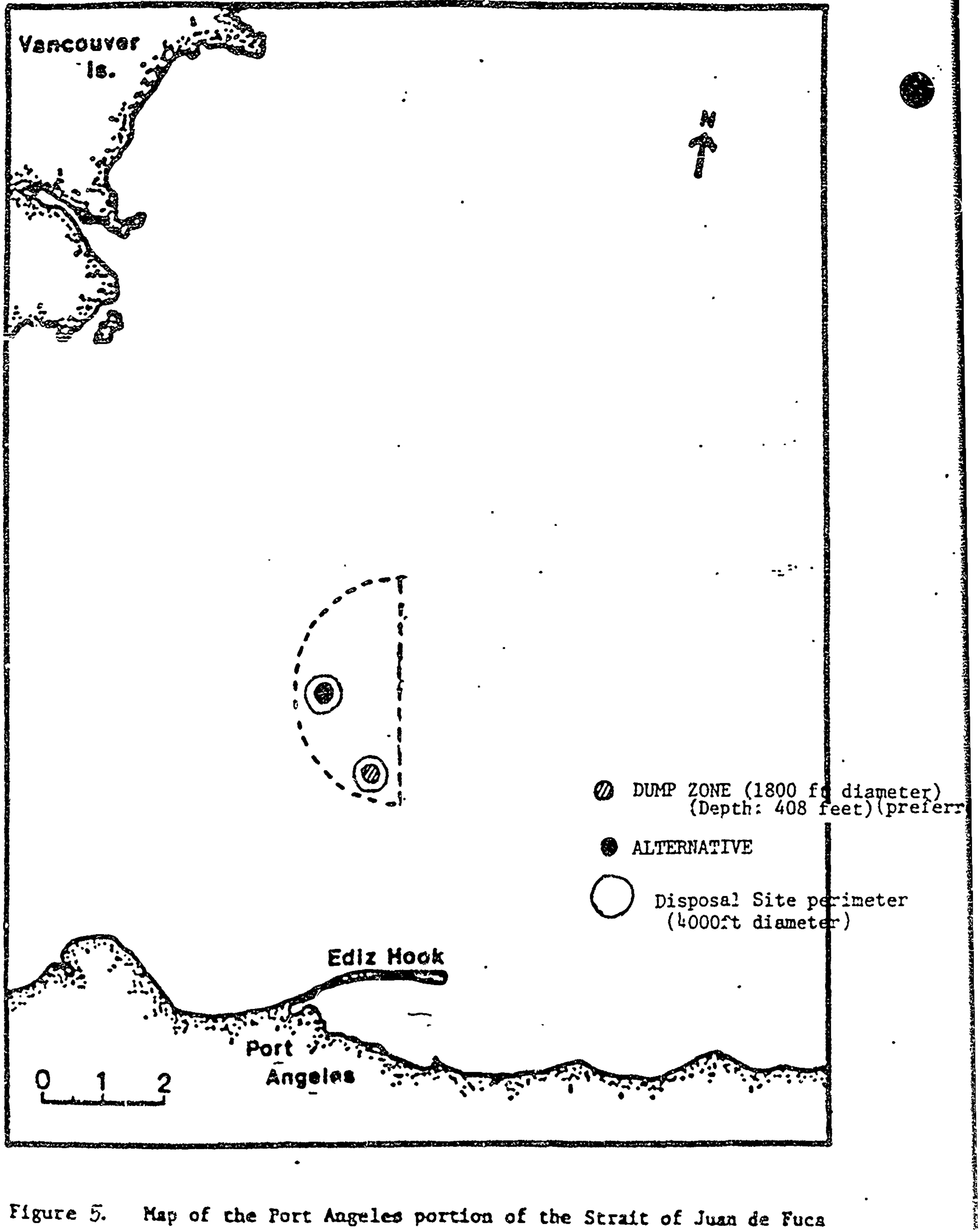

Figure 5. Map of the Port Angeles portion of the Strait of Juan de Fuca showing the preliminary location of a Zone of Siting Feasibility (ZSF) and the stations sampled by beam and otter trawls in October 1987.

Both sites in Clallam County

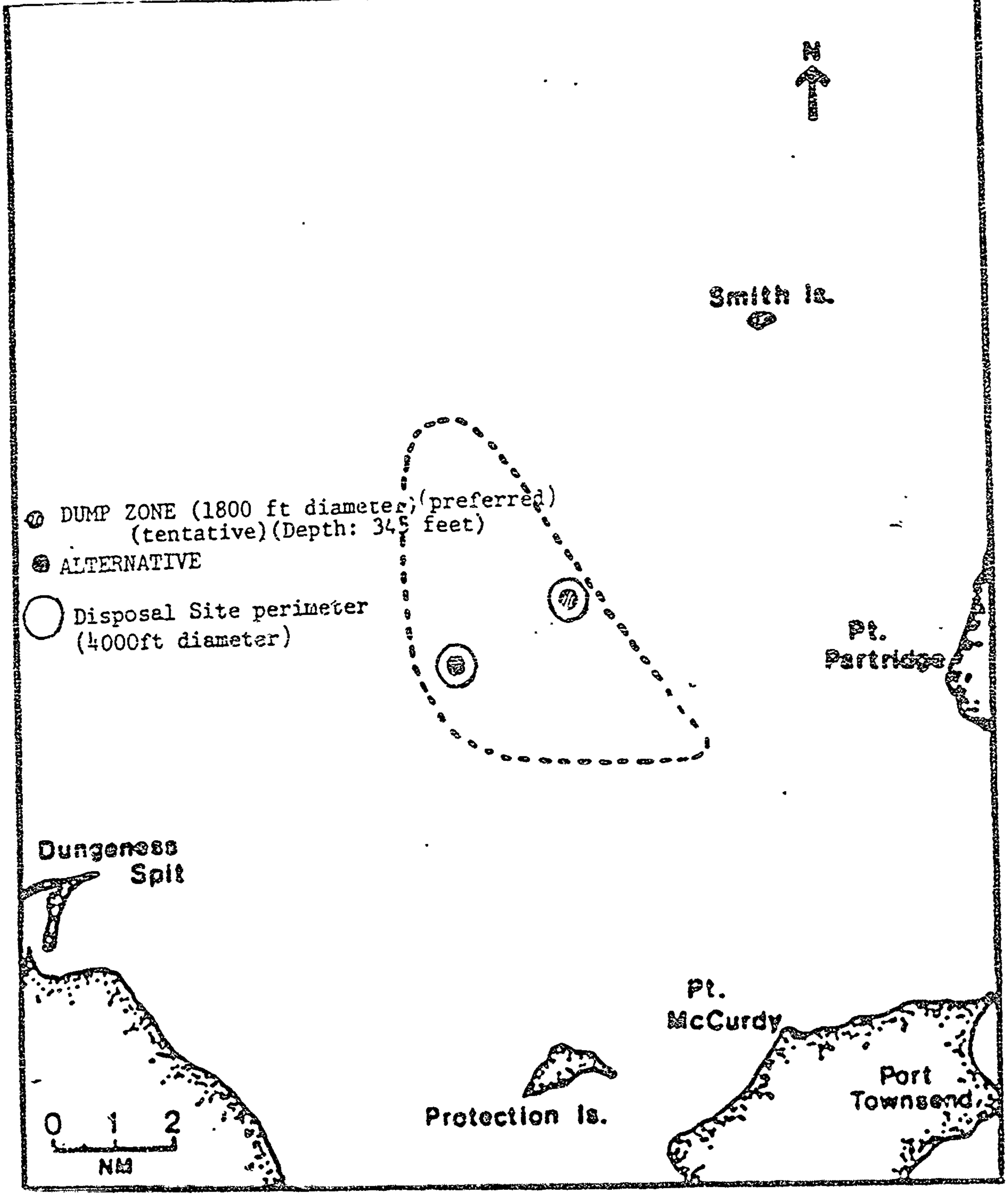

Figure 6. Map of the Port Townsend portion of the Strait of Juan de Fuca showing the preliminary location of a Zone of Siting Feasibility (ZSF) and the stations sampled by beam and otter trawls in October 1987.

Preferred site in Jefferson County
Alternative site in Clallam Count.

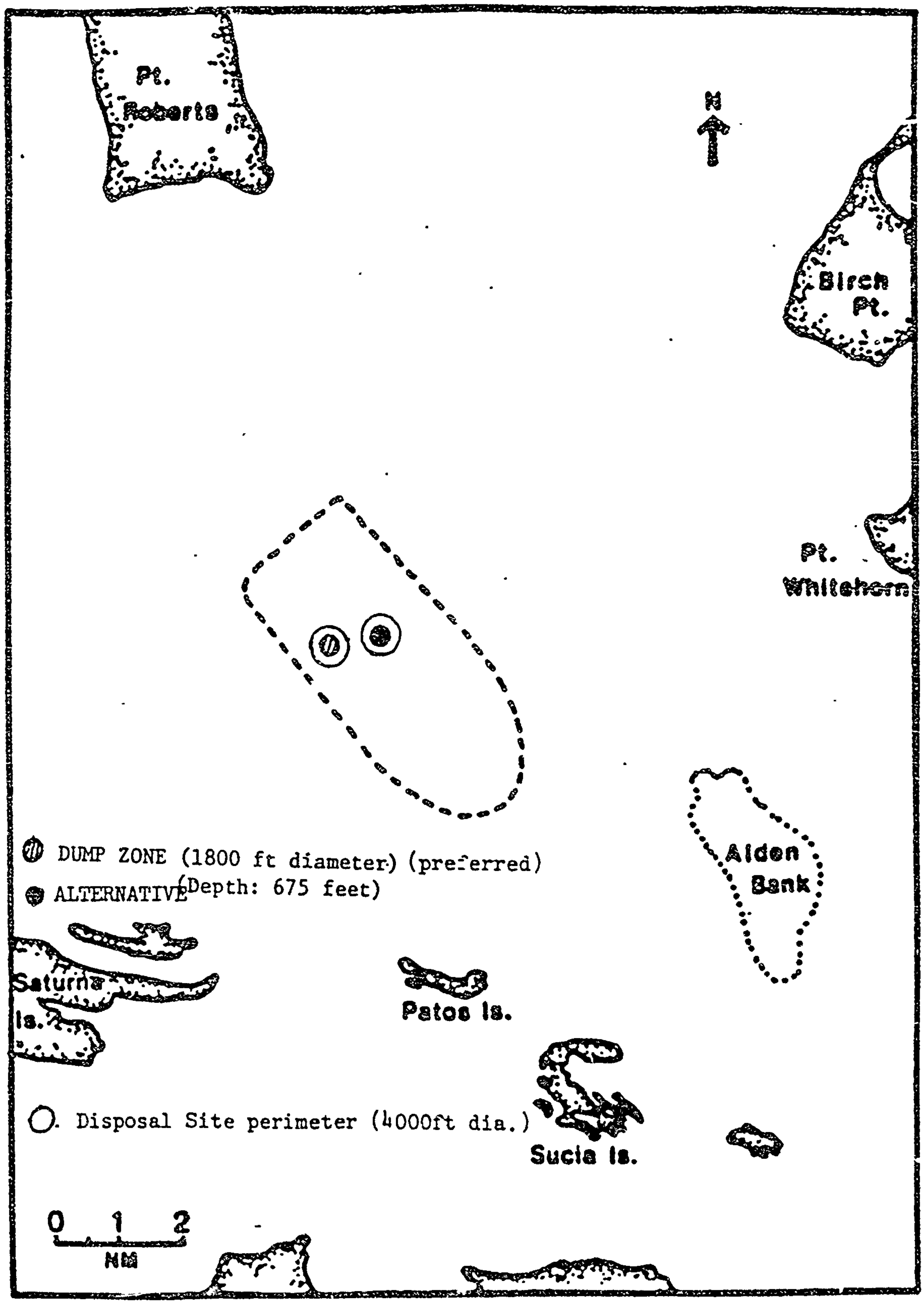

Figure 7. Map of the Point Roberts/southern Strait of Georgia area showing the preliminary location of a dispersive Zone of Siting Feasibility (ZSF) and the station locations sampled by both beam and otter trawls in October 1987.

Both sites in Whatcom County

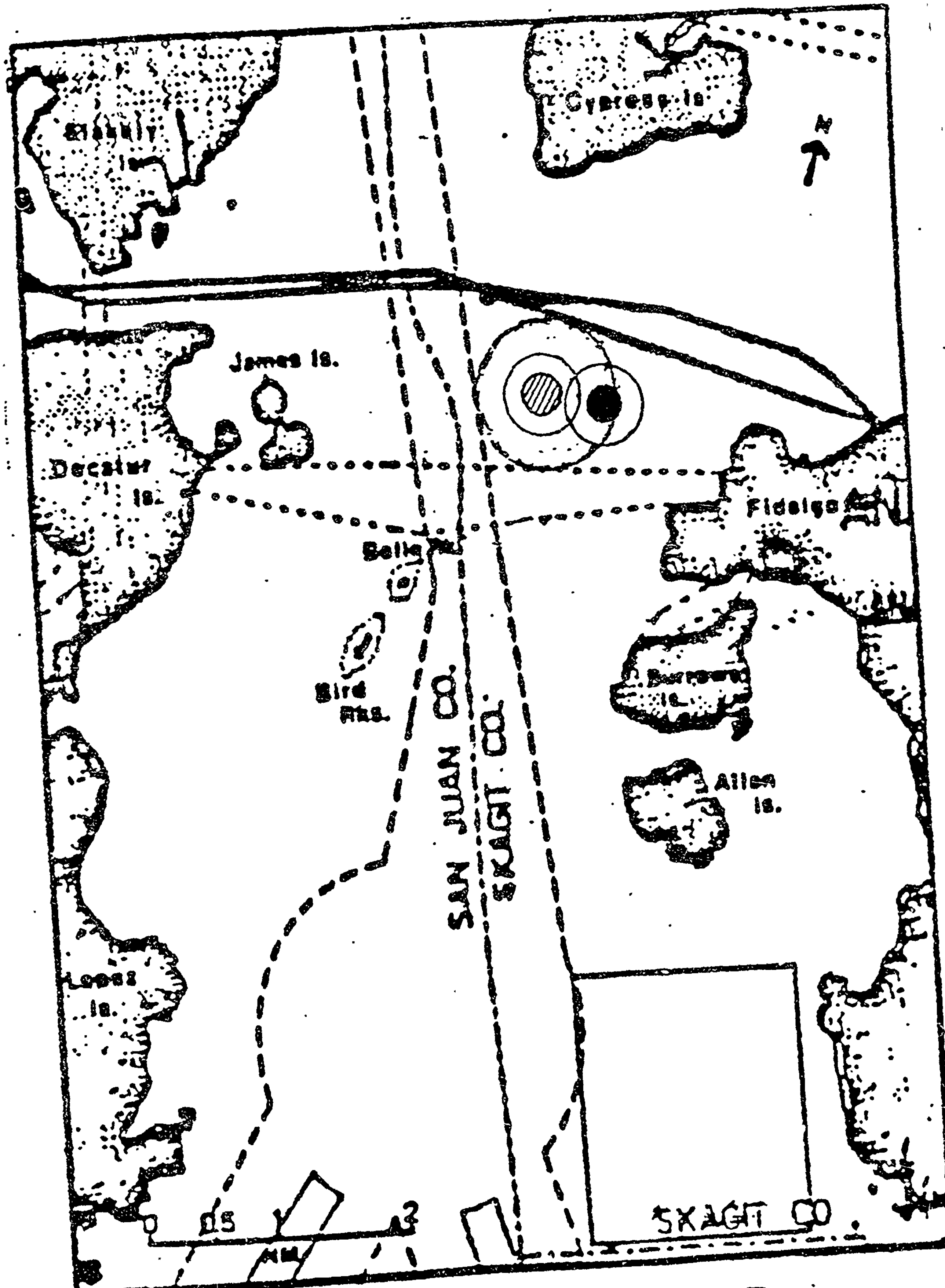

Figure 8.

DUMP ZONE (1800 ft diameter) (tentative)
(Depth: 225 feet) (preferred)

Disposal Site perimeter
(1000 ft diameter)

ALTERNATIVE

Both Sites in Skagit County

Early in the PSDDA study it was determined that unconfined, open-water disposal sites should be relatively nondispersive rather than dispersive in nature. Placing dredged material in nondispersive sites gives site managers the ability to maintain control and accountability over site conditions. This is particularly important when chemical contaminants may be present in the dredged material and it is necessary to minimize the exposure of important resources. In the Phase II area, only sites in south Puget Sound and Bellingham Bay were found that meet this objective. The other four preferred sites are located in highly dispersive environments.

c. General ZSF Selection Factors. Three general ZSF selection factors were identified early in the PSDDA study. It was determined that ZSF's should, to the maximum extent possible:

First, avoid high energy areas that would disperse dredged material significantly beyond the disposal site area.

Second, avoid significant adverse impacts on foodfish, shellfish, marine mammals, and marine birds.

And third, minimize interference with human uses to the lowest practicable level.

d. Specific ZSF Selection Factors. The three general ZSF selection factors were further defined by nineteen specific selection factors (shown in table 1). Most of these factors are identified in Federal and State regulations relating to dredged material disposal sites located in water. The specific factors were mapped and overlayed to display areas where siting might occur with a minimum of conflict.

TABLE 1

SPECIFIC FACTORS FOR IDENTIFICATION OF
ZONES OF SITING FEASIBILITY

1. Navigation activities
2. Recreational uses
3. Cultural sites
4. Aquaculture facilities
5. Utilities
6. Scientific study areas
7. Point pollution sources
8. Water intakes
9. Shoreline land use designations
10. Political boundaries
11. Location of dredging areas
12. Beneficial uses of dredged material
13. Fish/shellfish harvest areas
14. Threatened and endangered species

TABLE 1 (con.)

15. Fish/shellfish habitat
16. Wetlands, mudflats, and vegetated shallows
17. Bathymetry
18. Sediment characteristics
19. Water currents

In contrast to the Phase I disposal sites, which are all located in areas of low bottom currents, the Phase II sites include both high and low bottom current environments. Low current sites are preferable because they lend themselves to follow-up environmental monitoring, as the dredged material is expected to stay witin the site boundaries. Monitoring allows a check on predicted conditions at and near the sites and enables regulatory agencies to adjust site management conditions if warranted. However, with the exception of Bellingham Bay, no locations could be found in the north sound area that had low currents and were also free of significant fish and shellfish and resource and human use conflicts. Therefore, the PSDDA study team, with significant input from resource agencies and public interest groups, has evaluated and identified high current or "dispersive" sites in the Strait of Juan de Fuca near Port Angeles and Port Townsend, in Georgia Strait near Point Roberts, and in Rosario Strait near Anacortes. These are areas where dredged materal will be dispersed both while it is falling through the water column and after it reaches the bottom. Because monitoring is not practical at dispersive sites, the study team is considering more restrictive disposal guidelines than are required at the low current or "non-dispersive" sites. These guidelines include chemical and biological testing of dredged material prior to disposal to assure that the material is as clean as reference sites in Puget Sound (Carr and Case Inlets). Preliminary characterization of the dredged material expected to be considered for discharge at the Phase II disposal sites suggests that the material is generally quite clean and most of the material would not present environmental problems if discharged at either the dispersive or nondispersive sites.

e. <u>Summary of Phase II Site and Dredging Characteristics</u>. Two of the six Phase II preferred sites are located in areas of low tidal currents and have been designated nondispersive for management purposes. These are a site near the Nisqually delta and a site in Bellingham Bay. The other four sites are in high current areas and have been designated as dispersive sites. These are the Port Angeles, Port Townsend, Point Roberts, and Rosario Strait sites.

The anticipated dredging volume in the Phase II area for the next 15 years is 7.2 million cubic yards (c.y.), in comparison with the 7.9 c.y. dredging during the past 15 years, a slight decrease in dredging activity.

Not all material that is dredged will be allowed to go to the six preferred disposal sites, although the sites could easily accommodate the forecasted volumes. While most material is expected to be clean enough by PSDDA guidelines for disposal at these sites, some material will actually be used for other purposes such as port terminal and industrial land developments. Material not clean enough for disposal at PSDDA sites will require special considerations and placement at confined sites.

(Ecology is beginning a special study this year that addresses material that is unsuitable for unconfined, open-water disposal.)

3. Methods. Individuals knowledgeable of bald eagles in the Puget Sound area were contacted and interviewed. Available literature was reviewed and pertinent information was used in this assessment. References are listed at the end of this assessment.

4. Expected Impacts of PSDDA on Bald Eagles. This section is organized into three major subheadings: Description of the (general) Puget Sound Environment; Use of Puget Sound Habitat by Bald Eagles; and Potential Impacts to Bald Eagles from Implementation of PSDDA. The second and third subheadings are further broken down to: General; Nisqually; Bellingham; Port Angeles; Port Townsend; Point Roberts; and Rosario Strait.

a. Description of the Environment. Puget Sound is an inland arm of the Pacific Ocean that connects to the Pacific through the Strait of Juan de Fuca. Puget Sound is broadly described as a large basin consisting of a complex system of interconnecting subbasins (formed primarily by the retreat of ice sheets that covered the area until about 10,000 years ago). Puget Sound is modified and enriched by the supply of large volumes of freshwater resulting from precipitation, over 2,500 lakes and ponds (totalling 175 square miles), and over 10,000 rivers and streams ultimately flowing into Puget Sound. A critical result of freshwater streams entering marine waters is the creation of estuaries. Estuaries are characterized by the action of pumping large volumes of fresh and marine water back and forth, primarily as a result of tides. The pumping action also promotes mixing of fresh and marine waters, diluting the salinity of the marine water, but, more importantly, resulting in exchange of nutrients between the marine and freshwater systems. Estuaries are thus very productive (biologically), and rich in plant and animal life. The mouths of streams are also located in low elevation land areas with shallow gradients, which are often sites of wetlands, which greatly add to the diversity and productivity of the Puget Sound basin. Thus, the Puget Sound basin is a mixture of land masses (with their associated terrestrial and wetland habitats), rivers and lakes, estuaries, and open-water marine environments. Bald eagles utilize and depend on each of these environments for their survival. The focus of the BA will be on PSDDA's effects on the marine environment, and to a lesser extent, estuarine environment, and the resultant effects on bald eagles.

b. Use of Puget Sound Habitats by Bald Eagles.

(1) General. Bald eagles are present throughout the year in the Puget Sound basin, and nest along the coastline of the sound. The bald eagle is relatively uncommon, and nests essentially throughout the basin where large trees (usually Douglas firs, western red cedars, and western hemlocks) are

present. Bald eagles also winter throughout the basin, but are most common along streams that support salmon runs, where the eagles feed on spawned-out salmon. This may be as much as 50 miles upstream, as on the Skagit River. It is well known that bald eagles are opportunistic, feeding on whatever dead prey they can find, including fish, waterfowl, and mammals. Bald eagles also will pursue and capture live birds and fish swimming close to the surface. Bird species taken are usually waterfowl, but may also include gulls (Hayward, et al., 1977; Richter, 1984; Leschner, 1984). The author observed an adult bald eagle take a male bufflehead off the surface of Padilla Bay from amongst a large flock of waterfowl, in February, 1983.

During the winter, bald eagles roost communally usually in an area of coniferous trees. No communal roosts were identified by Washington Department of Wildlife (WDW) or FWS in the vicinity of the Phase II disposal sites (Cyra, 1988; Childers, 1988; McAllister, 1987).

(2) Nisqually. The preferred site is called Anderson Island/Ketron Island, as it is located between these two islands. Seasonal trawls conducted in February, May, July, and October 1987 showed that shrimp, crab, and other epibenthic resources were rare in this site vicinity. Fish were moderately common, but not as abundant as at the alternate site (called Devil's Head/Anderson Island). At the alternate site herring resources were quite high and and valuable to the Squaxin Island Indian Tribe. Bottomfish were also more abundant at this site than at the preferred site, though crab, shrimp, and other resources were relatively rare.

Three bald eagle nests were identified by WDW on the east shore of Anderson Island. One nest is slightly more than 1 mile from the disposal zone, while the other two nests are about 3 miles away. No nests were identified on the west side of Anderson Island or anywhere else near the Devil's Head/Anderson Island disposal site. The Nisqually Wildlife Refuge is only a few miles to the south, and McNeil Island just a few miles to the north. The waters around these areas support large concentrations of migrating and wintering waterfowl. The Nisqually River supports a salmon run which attracts some bald eagles. During seasons when waterfowl and salmon are not readily available, gulls nesting on McNeil Island, surface-swimming fish, and carrion likely provide the food source for the eagles nesting on Anderson Island.

(3) Bellingham. Both proposed disposal sites are in Bellingham Bay. The south site is the preferred site primarily because it is in an area of significantly lower numbers of Dungeness crabs than the northeast site. All other marine resources are relatively low in numbers (except pandalid shrimp) and are rather evenly distributed throughout Bellingham Bay and at the two potential disposal sites.

Three bald eagle nests were identified by FWS near these sites, all of them about 2 miles from the south (preferred) site. Two of the nests are on Portage Island, and one is on an island in Chuckanut Bay. These nesting bald eagles presumably feed on the glaucous-winged gulls that have several colonies near Lummi Island as well as in Chuckanut Bay. Again, bald eagles will feed on whatever is most readily available, and at some seasons this may be surface-swimming fish. Wintering eagles, which number about 5 to 10 birds in this area, have a slightly better selection of birds to choose from as waterfowl concentrations become quite large between Bellingham and Samish Bays. The Nooksack River supports salmon runs, which provide an additional food source to bald eagles.

(4) Port Angeles. Commercial pandalid shrimp, scallop, and sea urchin species were found at the proposed ZSF for Port Angeles. The abundance of shrimp was found to vary with the season, such that the PSDDA agencies feel that timing of disposal of dredged material, limits on discharge volume, and other restrictions would prevent impacts to the shrimp. During the fall and winter, some of the birds that stay in the Strait of Juan de Fuca may fly or swim through the area of the ZSF but the ZSF is not a specific concentration area for waterbirds. No bald eagle nests were indicated to exist near this area by either WDW or FWS. In addition, very few sightings of bald eagles exist from the Port Angeles and Ediz Hook area for any time of the year.

(5) Port Townsend. Marine resources for the Port Townsend ZSF were found to be essentially identical to those of the Port Angeles ZSF, except that bird concentrations are more likely to occur near the Port Townsend ZSF. As for Port Angeles, timing, limits on discharge volume, and other restrictions on dredged material disposal would be expected to avoid impacts to these resources.

Two bald eagle nests exist on Protection Island, nearly 5 miles from the ZSF. These eagles have ample sources of prey as a result of the breeding colonies of gulls and marine birds on Protection Island. During migration and winter, up to a dozen or more bald eagles have been observed at nearby Sequim Bay, and several more eagles winter near the Dungeness River a few miles to the west. These areas are noted for their high concentrations of waterfowl and marine birds during the spring, fall, and winter seasons.

(6) Point Roberts. No concentrations of fish or shellfish were found at this disposal site. Pacific cod and English sole were caught near the site, the latter in enough numbers to be commercially valuable.

No bald eagle nests were reported by either WDW or FWS near this proposed disposal site. Only a small number (less than five) apparently spend other seasons on the mainland to the east and Point Roberts to the north. A few eagles also winter on nearby islands, such as Sucia and Matia. Waterfowl concentrations are not great in this general vicinity, though a few miles to the southeast in Rosario Strait numbers can get quite large in the fall.

(7) Rosario Strait. This disposal site is located in an area of extremely high tidal currents. Benthic and fish resources were found to be quite low at this site. Waterfowl concentrations can become quite large in the winter, but drop off sharply in other seasons.

Five bald eagle nests were reported to be in the vicinity by WDW, all but one of them within 2 miles of the disposal site. These eagles likely find a good food source in the gull and seabird colonies of Bird and Belle Rocks. During the winter, this southern portion of Rosario Strait is quite important for waterbirds of all kinds. Bald eagles are also quite numerous during the winter in this region.

c. Impacts to Bald Eagles.

(1) General. Bald eagles are present throughout the year near all the disposal areas, except for the Port Angeles and Point Roberts sites. They feed on whatever may be present (ducks, gulls, live surface-swimming fish, dead animals washed ashore, etc.). Concentrations of birds or fish are helpful for prey-capture success. Some of the disposal sites are located within relatively large bird concentrations at one season or another.

In siting the disposal areas away from currents, benthic and epibenthic resources, shipping lanes, etc., bird concentrations areas could not always be avoided. Nevertheless, PSDDA planning has selected deepwater disposal sites that result in minimal environmental impacts and minimal human use conflicts. Concentrations of birds and fish are not expected to be directly affected by PSDDA disposal sites, but a small percentage of animals would likely suffer some effects. The only potential direct impacts of deepwater disposal on waterbirds and fish would appear to be from disturbance from relatively infrequent disposal activity and as the result of short-term, generally localized turbidity, temporary loss of prey source, and potential impacts to intertidal organisms from drift of fine-grained disposed material. Turbidity limits visibility and makes feeding difficult. Fortunately, turbidity is localized and temporary; furthermore, waterbirds will avoid the turbidity plume and feed elsewhere. In the nondispersive sites, newly disposed material may cover the bottom to several feet deep, thus burying some of the organisms that may be living in the substrate. However, at all disposal sites except Bellingham the bottom is at least 230 feet below the surface. Few birds dive this deep (cormorants and loons may), which limits the impacts to a few species, none of which are regularly preyed upon by bald eagles. Finally, even if the nondispersive disposal areas do not recolonize as expected, the total area of impact is small relative to the potential feeding area in Puget Sound. Waterbirds and fish are mobile; also, the sites selected will have relatively low biological productivity prior to disposal, such that the loss would be minimal. At dispersive sites, the bottom is not a concern since much of the material would not stay at the disposal site; instead it would be carried off by strong currents and spread over relatively large distances. It is felt that, aside from a slight increase in turbidity, the dispersing of material may actually produce a lesser overall impact than disposal at nondispersive sites. More restrictive disposal guidelines are being considered for the dispersive sites because monitoring will not be practical. A potentially greater risk from use of dispersive sites is that a larger amount of material could drift to intertidal areas. However, only relatively small volumes of dredged material are expected at most sites over the 15-year forecast period. Accordingly, the potential loss of intertidal organisms from drift of disposed material is considered to be minimal and would not be expected to affect waterbirds or fish. Finally, all materials disposed of in deep water will be pretested to ensure that only suitable material will be disposed in deep water; all other material will be disposed at special confined sites. Thus, animals are not expected to be affected by contaminants. Since the bald eagle prey base would not be affected, bald eagles would not be affected from the standpoint of food source.

Other potential effects associated with the disposal areas primarily include human disturbance and noise from disposal barges. Typically, barge operation does not disturb waterbirds; often barges even attract gulls. Bald eagles likewise are accustomed to vessels of all sizes on Puget Sound; the introduction of barges to unload dredged material is not expected to disturb them.

The following paragraphs briefly describe any variations from the above discussion that may exist with each site.

(2) Nisqually. Impacts to Nisqually area resources would be expected to be similar to those described in the preceding paragraph. The two proposed disposal sites are nondispersive sites, such that concerns with drift of material into the Nisqually Delta area are minimized. Because of this and the reasons expressed in paragraph 4.c.(1), no impacts to bald eagles would be expected at these disposal sites.

(3) Bellingham. The Bellingham disposal sites differ from the rest in that they are in water approximately 100 feet in depth. This relatively shallow depth means a greater number of diving birds could make use of the benthic resources than could at the deeper sites. Since preliminary studies indicate that, except for crabs and pandalid shrimp, benthic and epibenthic resources in Bellingham Bay are of relatively low numbers, it appears potential impacts to diving birds would be small. By extension, impacts to bald eagles through loss of potential prey seems remote. Otherwise, impacts from use of either disposal site would be expected to much as described in paragraph 4.c.(1). No impacts to bald eagles are expected.

(4) Port Angeles. Little bald eagle use near the Port Angeles disposal site has been noted. Potential impacts to bald eagles at this site are not expected.

(5) Port Townsend. The Port Townsend ZSF is located within an area of high summer and fall bird use in the Strait of Juan de Fuca. These are breeding marine birds from colonies at Smith Island and Protection Island, as well as from many other small rocks and islands in the San Juans and Haro Strait. As described in paragraph 4.c.(1), no impacts to these birds would be expected from use of this disposal site. The large numbers of bald eagles to the south of Protection Island outside the breeding season would not be near the disposal site nor come in contact with the barge traffic, except on occasion (the principal source of dredged material to be disposed of at this

site would be from Port Townsend, north and east of the "center" of eagle abundance at Sequim and Discovery Bays). Thus, no impacts to bald eagles at this site are expected.

(6) Point Roberts. Few marine resources exist at this site, and it receives little use by bald eagles. No impacts to bald eagles are expected from use of this site.

(7) Rosario Strait. This disposal site is near the highest number of bald eagles of the Phase II sites. Not only are five nests located close by, but there is a regular and predictable winter population of bald eagles in close proximity to the site. As with all other Phase II sites, the primary concerns are with disruption or impact to the bald eagle prey base, and direct disruption of bald eagles through human disturbance. The latter concern is addressed first: the proposed disposal area is adjacent to highly-traveled shipping lanes, with frequent passage of ferries and ships of all descriptions. The bald eagles that nest and winter here are clearly accustomed to such shipping activities, or they would not stay in the area. Occasional passage by barge and tug is not expected to disturb bald eagles. Since concentrations of birds are important to bald eagles for feeding, it is important to note that the nesting colonies of Bird and Belle Rocks likely provide the most dependable prey base for nesting eagles. In addition, the highest concentrations of wintering marine birds occurs in Rosario Strait south of Decatur Island. All of the dredged material to be dumped at this site would come from the north or the east of Fidalgo Island. Thus, the movements of the tugs and barges to and from the disposal site would not generally cross bald eagle flight paths. The occasional bird concentrations that might occur at or near the disposal site during disposal operations would not be significantly impacted for the reasons explained in paragraph 4.c.(1).

All other impacts to marine resources would be similar to those described in paragraph 4.c.(1). Thus, no impacts to bald eagles would be expected.

5. Conclusions. No impacts to bald eagles are expected to result from implementation of Phase II of PSDDA.

6. References.

Childers, Lynn. 1988. U.S. Fish and Wildlife Service, Olympia, Washington.

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United States Department of the Interior

FISH AND WILDLIFE SERVICE

Fish and Wildlife Enhancement
2625 Parkmont Lane SW, Bldg B
Olympia, Washington 98502
206/753-9440 FTS 434-9440

March 29, 1988 Re: 1-3-88-SP-108

R.P. Sellevold, P.E.
Chief, Engineering Division / FES ~~Blooming Bar~~ [illegible] / PSDDA
Seattle District, Corps of Engineers
P.O. Box C-3755
Seattle, Washington 98124-2255

Dear Mr. Sellevold:

As requested by your letter, dated February 29, 1988 and received by us on March 1, I have attached a list of endangered and threatened species (Attachment A) that may be present in the area of the proposed PSDDA Phase II zones of Site Feasibility in non-central Puget Sound, Washington. The list fulfills the requirement of the Fish and Wildlife Service under Section 7(c) of the Endangered Species Act of 1973, as amended. The requirements for Corps of Engineers compliance under the Act are outlined in Attachment B.

Should the biological assessment determine that a listed species is likely to be affected (adversely or beneficially) by the project, the Corps should request formal Section 7 consultation through this office. Even if the biological assessment shows a "no effect" situation, we would appreciate receiving a copy for our information.

Your interest in endangered species is appreciated. If you have any additional questions regarding your responsibilities under the Act, please contact Jim Michaels at the above phone/address.

Sincerely,

Lynn P. Childers

Lynn P. Childers
Acting Field Supervisor

Attachments

c: WDW (Nongame)
WNHP

cc: Wakeman
[illegible]

LISTED AND PROPOSED ENDANGERED AND THREATENED SPECIES AND CANDIDATE SPECIES THAT MAY OCCUR WITHIN THE AREA OF THE PROPOSED PUGET SOUND DREDGED DISPOSAL ANALYSIS (PSDDA) PHASE II ZONES OF SITE FEASIBILITY (ZSF) IN CLALLAM, JEFFERSON, PIERCE, SAN JUAN, SKAGIT, THURSTON, AND WHATCOM COUNTIES, WASHINGTON

1-3-88-SP-108

LISTED

Bald eagle (Haliaeetus leucocephalus) - Nesting activities occur from about January 1 - August 15. The following nesting territories are found in the vicinity of the proposed zones of site feasibility:

Anderson/Ketron ZSF
T19N R1E S4/17/20

Devils Head ZSF
None

Bellingham Bay NE and South ZSF
T37N R2E S7/18/24

(Also, wintering bald eagles concentrate in the vicinity of Bellingham Bay from about October 31 to March 31.)

Rosario Strait ZSF
T35N R1W S23/27
T35N R1E S22/28

(Also, wintering bald eagles concentrate around Fidalgo Island, to the southeast of this ZSF, from about October 31 to March 31.)

Port Townsend/Strait of Juan de Fuca ZSF
T31N R2W S33/34

Ediz Hook/Strait of Juan de Fuca ZSF
None

Pt. Roberts/Southern Strait of Georgia ZSF
None

Major concerns that should be addressed in your biological assessment of project impacts to bald eagles are:

1. Level of use of the project area by bald eagles.

2. Effect of the project on the eagle's primary food stocks and foraging areas in all areas influenced by the project.

3. Impacts from short- and long-term disposal operations of dredged materials (i.e., habitat degradation/contamination, increased human presence, increased water vessel traffic, elevated noise levels) which may result in disturbance to bald eagles and/or their avoidance of the project area.

PROPOSED

None

CANDIDATE

None

Attachment A

SECTION 7(a) - Consultation/Conference

Requires: 1. Federal agencies to utilize their authorities to carry out programs to conserve endangered and threatened species;

2. Consultation with FWS when a federal action may affect a listed endangered or threatened species to ensure that any action authorized, funded, or carried out by a federal agency is not likely to jeopardize the continued existence of listed species or result in the destruction or adverse modification of critical habitat. The process is initiated by the federal agency after they have determined if their action may affect (adversely or beneficially) a listed species; and

3. Conference with FWS when a federal action is likely to jeopardize the continued existence of a proposed species or result in destruction or a adverse modification of proposed critical habitat.

SECTION 7(c) - Biological Assessment for Construction Projects 1/

Requires federal agencies or their designees to prepare a Biological Assessment (BA) for construction projects only. The purpose of the BA is to identify any proposed and/or listed species which is/are likely to be affected by a construction project. The process is initiated by a federal agency in requesting a list of proposed and listed threatened and endangered species (list attached). The BA should be completed within 180 days after its initiation (or within such a time period as is mutually agreeable). If the BA is not initiated within 90 days of receipt of the species list, please verify the accuracy of the list with our Service. No irreversible commitment of resources is to be made during the BA process which would result in violation of the requirements under Section 7(a) of the Act. Planning, design, and administrative actions may be taken; however, no construction may begin.

To complete the BA, your agency or its designee should: (1) conduct an onsite inspection of the area to be affected by the proposal which may include a detailed survey of the area to determine if the species is present and whether suitable habitat exists for either expanding the existing population or potential reintroduction of the species; (2) review literature and scientific data to determine species distribution, habitat needs, and other biological requirements; (3) interview experts including those within FWS, National Marine Fisheries Service, state conservation departments, universities, and others who may have data not yet published in scientific literature; (4) review and analyze the effects of the proposal on the species in terms of individuals and populations, including consideration of cumulative effects of the proposal on the species and its habitat; (5) analyze alternative actions that may provide conservation measures; and (6) prepare a report documenting the results, including a discussion of study methods used, any problems encountered, and other relevant information. Upon completion, the report should be forwarded to our Endangered Species Project Leader, 2625 Parkmont Lane S.W., Olympia, Wa 98502.

1/ "Construction project" means any major federal action which significantly affects the quality of the human environment (requiring and EIS) designed primarily to result in the building or erection of man-made structures such as dams, buildings, roads, pipelines, channels, and the like. This includes federal actions such as permits, grants, licenses, or other forms of federal authorization or approval which may result in construction.

United States Department of the Interior

FISH AND WILDLIFE SERVICE

Fish and Wildlife Enhancement
2625 Parkmont Lane SW, Bldg B
Olympia, Washington 98502
206/753-9440 FTS 434-9440

July 27, 1988

Re: 1-3-88-I-182

COE Reference:
Regulatory Branch

R. P. Sellevold
Chief, Engineering Division
Seattle District, Corps of Engineers
P.O. Box C-3755
Seattle, Washington 98124-2255

Dear Mr. Sellevold:

This is in response to your letter dated May 31, 1988, and received by us on June 2, transmitting your biological assessment for the proposed Phase II Puget Sound Dredged Disposal Analysis within Puget Sound, Washington.

We have reviewed your assessment and concur with your finding that implementation of the proposed action is not likely to adversely affect the bald eagle. The U.S. Army Corps of Engineers has complied with the requirements of Sections 7(a)(2) and 7(c) of the Endangered Species Act of 1973, as amended, thereby concluding the consultation process.

If you have any questions regarding your responsibilities under the Act, please contact Jim Michaels of my staff at the above phone/address.

Sincerely,

John R. Kerbow

John R. Kerbow
Acting Field Supervisor

c: WDW, (Nongame)
WNHP

Brunner/rh/36[illegible]
25 May 88
5245k

MAY 31 [illegible]

Planning Branch (1110-2-1150b)

Rolland A. Schmitten, Regional Director
National Marine Fisheries Service
Northwest Region
7600 Sand Point Way Northeast
BIN C-15700, Building 1
Seattle, Washington 98115

Dear Mr. Schmitten:

Enclosed is a biological assessment (BA) evaluating the possible effects of Phase II of the Puget Sound Dredged Disposal Analysis (PSDDA) on seven species of marine mammals and one sea turtle. Phase I of the study dealt with central Puget Sound (Everett, Seattle, and Tacoma) and is nearing completion. A biological assessment for Phase I was transmitted to you in February 1987 and determined that Phase I would not result in impacts to any of these listed animals. Your response of February 19, 1987 concurred with this conclusion.

Your letter of April 1, 1988 again identified these eight species as being present in the Phase II Puget Sound areas and therefore potentially affected by PSDDA. These species are all listed as endangered in Washington on the Federal List of Endangered and Threatened Wildlife and Plants.

The BA concludes that implementation of Phase II of PSDDA would not result in impacts to any of the eight species. If you wish to discuss the BA, please call Mr. Ken Brunner at telephone (206) 764-3624.

Sincerely,

R. P. Sellevold, P.E.
Chief, Engineering Division

cc w/encl:
ERS (Weinmann)
ERS (Wakeman)
PSDDA (Urabeck)
OP-RF (Kendall)
ERS (Rice/Brunner)

Enclosure

WAKEMAN/EP-ER
RICE/EP-ER
WEINMANN/EP-ER
KENDALL/OR
URABECK/PSDDA
HOGAN/EP
SELLEVOLD/E/s/
EP FILE

CENPS-EP-ER 21 April 1988

PUGET SOUND DREDGED DISPOSAL ANALYSIS BIOLOGICAL ASSESSMENT ON MARINE ANIMALS FOR THE PHASE II AREA (NORTH AND SOUTH PUGET SOUND)

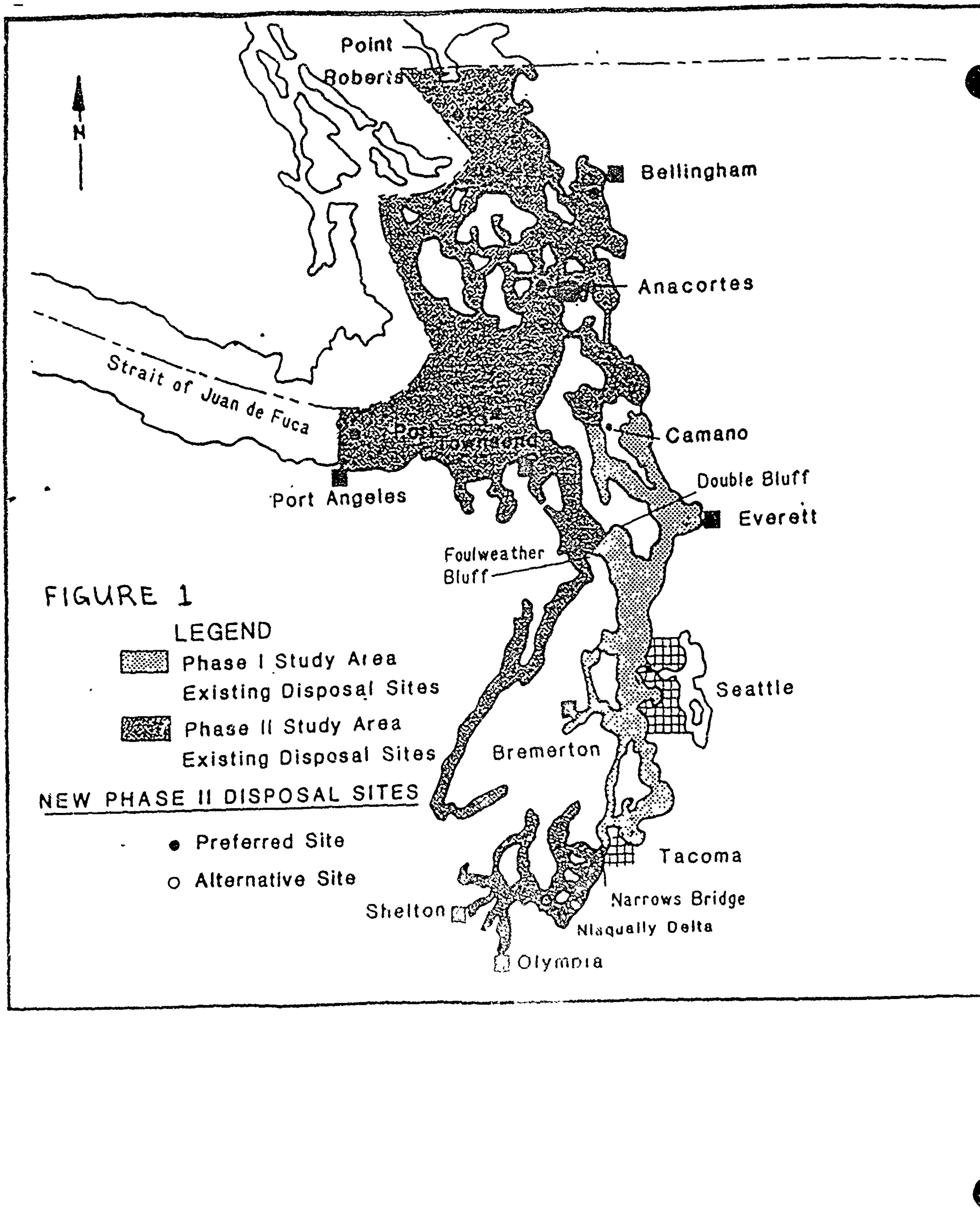
1. Background. The Puget Sound Dredged Disposal Analysis (PSDDA) is a program for the management of unconfined, open-water disposal of dredged material in waters of Puget Sound. The program includes: (1) designation of acceptable disposal sites, (2) definition of dredged material evaluation procedures, and (3) disposal site management plans.

During the mid-1980's there was heightened public and agency concern over the long-term environmental health of Puget Sound and the role dredged material played in perceived water and sediment quality problems. Questions were raised over the project-by-project dredged material evaluation processes, and some felt that the existing public disposal sites were not at the "best" locations. This situation, combined with the fact that permits for some of the disposal sites had expired, created uncertainty with regard to future disposal of dredged material and highlighted the urgency of having an acceptable dredged material disposal program. A proposed program has been developed through a special Federal-State cooperative study.

The U.S. Army Corps of Engineers (Corps), U.S. Environmental Protection Agency (EPA), Washington Department of Natural Resources (DNR), and Washington Department of Ecology (Ecology) began the PSDDA study in April 1985. The study is being conducted in two overlapping phases, each approximately 3 years in length. Phase I covers central Puget Sound, including the Sound's major urban centers, Tacoma, Seattle, and Everett. Phase II, initiated in April 1986, covers the north and south Sound area, including Olympia, Port Angeles, and Bellingham (see figure 1).

The goal of PSDDA is to provide environmentally safe and publicly acceptable guidelines governing unconfined, open-water disposal of dredged material, thereby improving consistency and predictability in the decisionmaking process.

The Corps is the lead Federal agency for this study and as such has responsibility for meeting the requirements of section 7 of the Endangered Species Act of 1973, as amended (Public Law 97-304). Seven species of endangered whales and one endangered sea turtle are found in Washington waters according to the April 1, 1988 letter from National Marine Fisheries Service. These are the sperm whale (Physeter macrocephalus), gray whale (Eschrichtius robustus) fin whale (Balaenoptera physalus), sei whale (B. borealis), blue whale (B. musculus), humpback whale (Megaptera novaeangliae), right whale (Eubalaena glacialis), and leatherback sea turtle (Dermochelys coriacea). This BA evaluates the PSDDA identified alternative unconfined, open-water disposal sites for the Phase II study area (see paragraph 2 for description) for possible impacts to these species.



N
Point Roberts
Bellingham
Anacortes
Strait of Juan de Fuca
Port Townsend
Camano
Port Angeles
Double Bluff
Everett
Foulweather Bluff
LEGEND
Phase I Study Area Existing Disposal Sites
Phase II Study Area Existing Disposal Sites
NEW PHASE II DISPOSAL SITES
Preferred Site
Alternative Site
Seattle
Bremerton
Tacoma
Narrows Bridge
Shelton
Nisqually Delta
Olympia

FIGURE 1

2. Project Description.

a. General. Six public multiuser unconfined, open-water disposal sites have been identified which will partially meet the future dredged material disposal needs of the Phase II area. The sites, while varying in size primarily due to bathymetry, average about 318 acres in potential bottom impact area (about 4,000 feet in diameter). Each site includes a 900-foot radius, 58-acre surface disposal zone within which all dredged material must be released.

Locations for the preferred disposal sites were sought that avoided important biological resources and human use activities. Figures 2 through 8 show the Phase II disposal sites, including the currently preferred and alternate sites.

b. Overview of Disposal Site Selection Process. The site selection process used by PSDDA utilized existing information in combination with field studies to identify preferred and alternative disposal sites. The approach used is similar to that described in the EPA and Corps workbook entitled "General Approach to Designation Studies for Ocean Dredged Material Disposal Sites" (EPA/Corps, 1984). Steps of the site selection process were as follows:

(1) Define general siting philosophy. This step addresses disposal philosophy (i.e., whether sites should be dispersive or nondispersive), general siting locations (i.e., ocean, strait, or sound), and number of disposal sites.)

(2) Identify selection factors to delineate Zones of Siting Feasibility (ZSF's). This step uses existing information on biological resources and human use activities to identify general areas where disposal sites might be appropriately located.

(3) Conduct field studies on the ZSF's. Field and model studies are conducted to fill key data gaps and gather information on the physical and biological conditions of the ZSF's.

(4) Identify preliminary sites within the ZSF's. Information from the ZSF studies is used to identify preliminary locations for disposal sites within the ZSF's.

(5) Identify preferred sites. Information from the site-specific studies is used to identify preferred and alternative sites within the ZSF's.

Existing DNR disposal sites were considered in the disposal site selection process, but none were found to meet the site selection factors discussed below. All cooperating agencies in PSDDA agreed early on that no special *a priori* consideration would be given to the existing sites, because of human use conflicts and environmental concerns with past dredging and disposal protocols. An objective site selection process was used to minimize environmental and human usage conflicts as much as possible, and existing sites adequately meeting the site selection factors and constraints were given equal consideration with other potential sites.

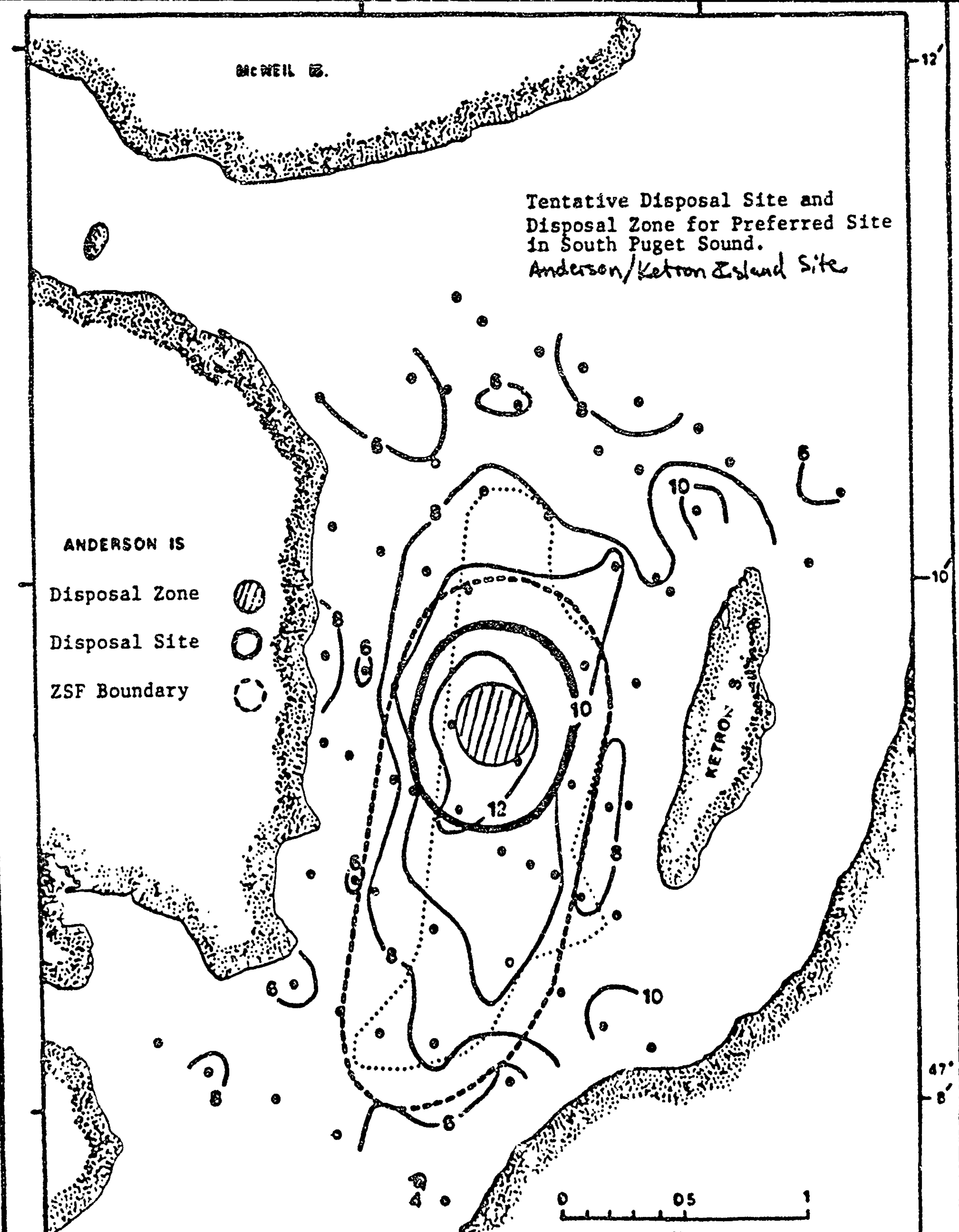


Figure 2. Contours of clay content (percent) in Anderson/Ketron ZSF. Dotted line represents preliminary ZSF boundary. Dashed line indicates revised boundary based on deposition analysis results.

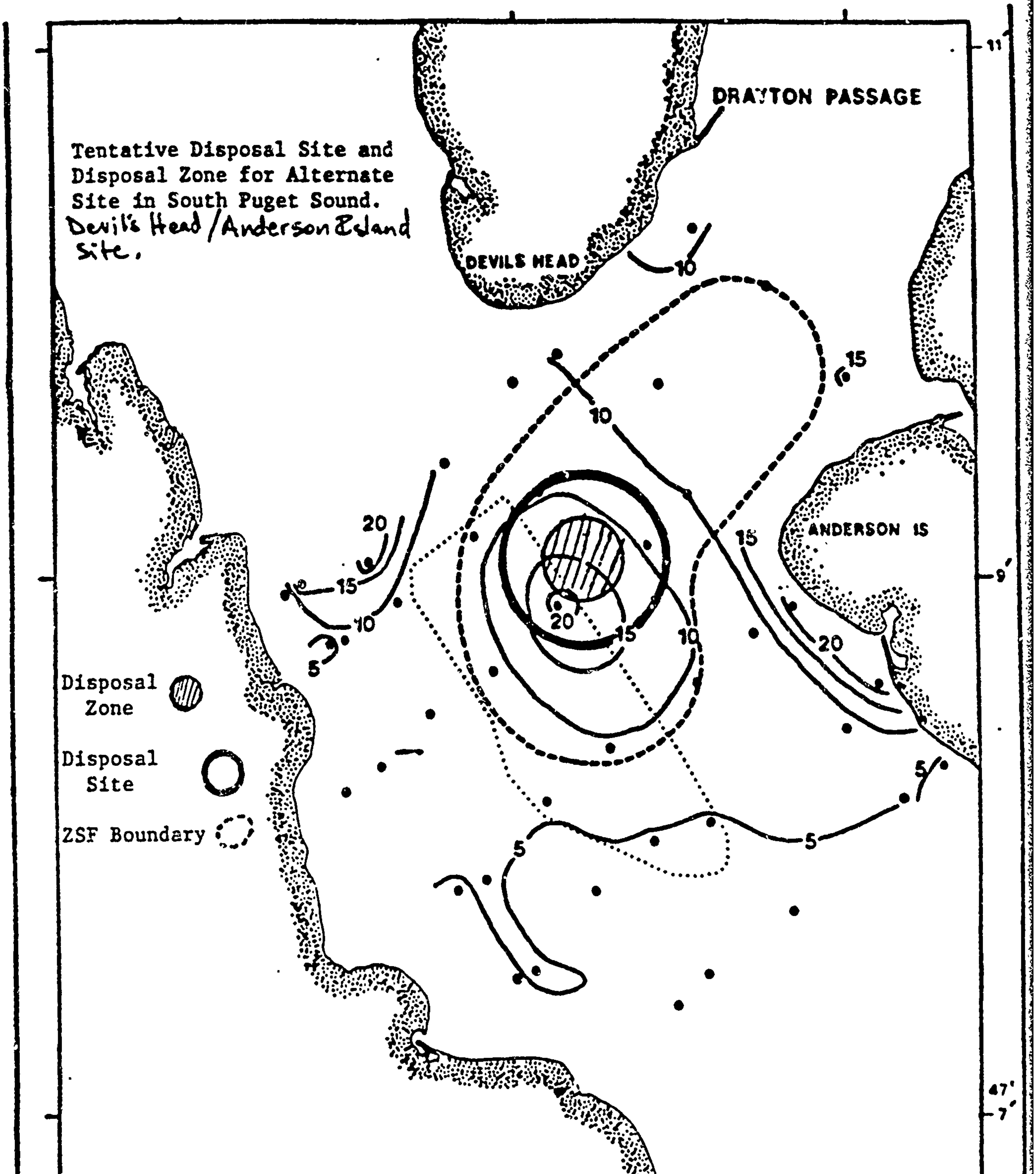


Figure 3 Contours of clay content (percent) in Devils Head ZSF. Dotted line represents preliminary ZSF boundary. Dashed line indicates revised boundary based on deposition analysis results.

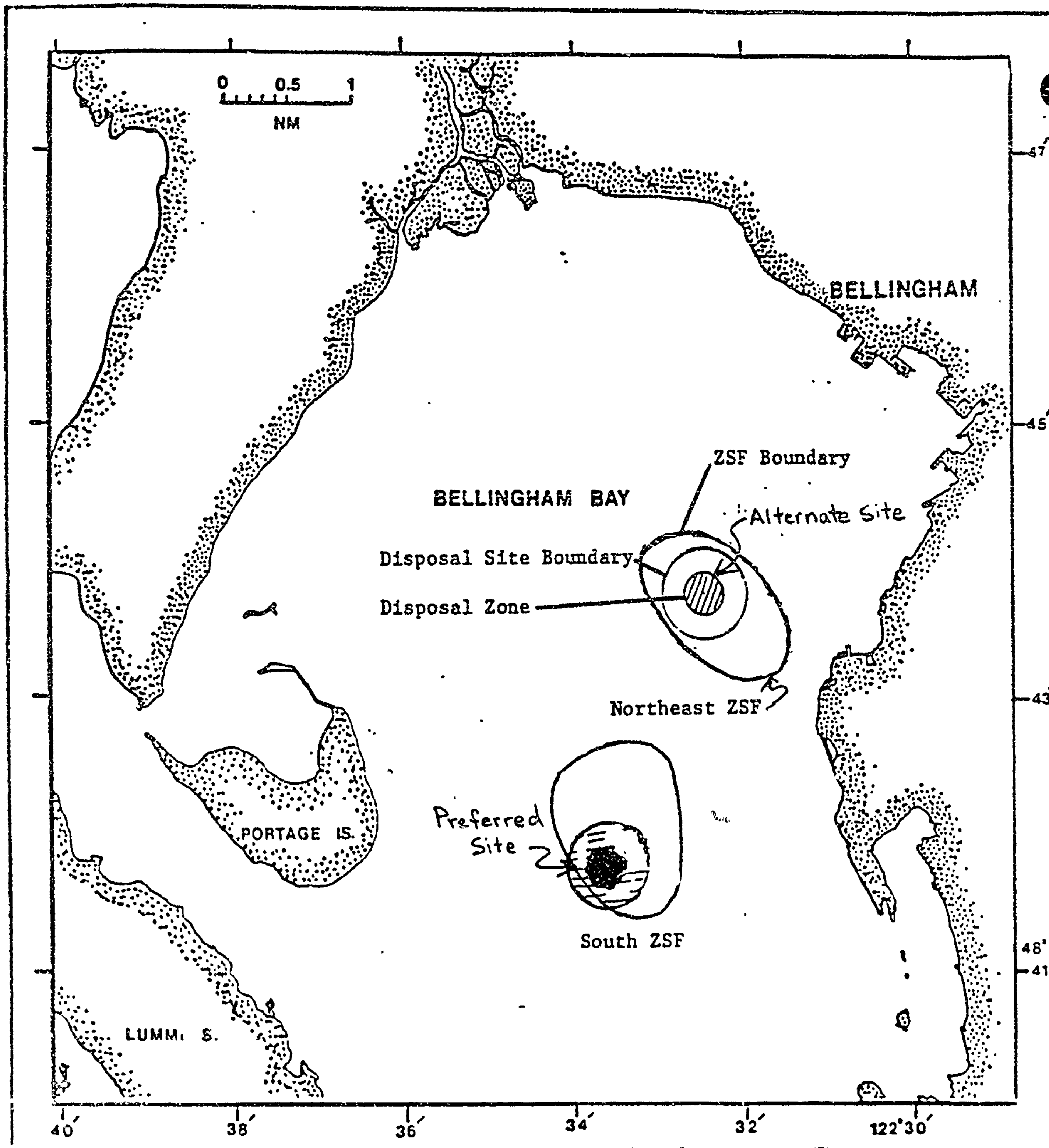


Figure 4.
Zones of Siting Feasability (ZSF) in Bellingham Bay depicting tentative Disposal Site Boundaries and disposal zones (900 ft radius).

Adjusted Disposal Site

O Dump zone

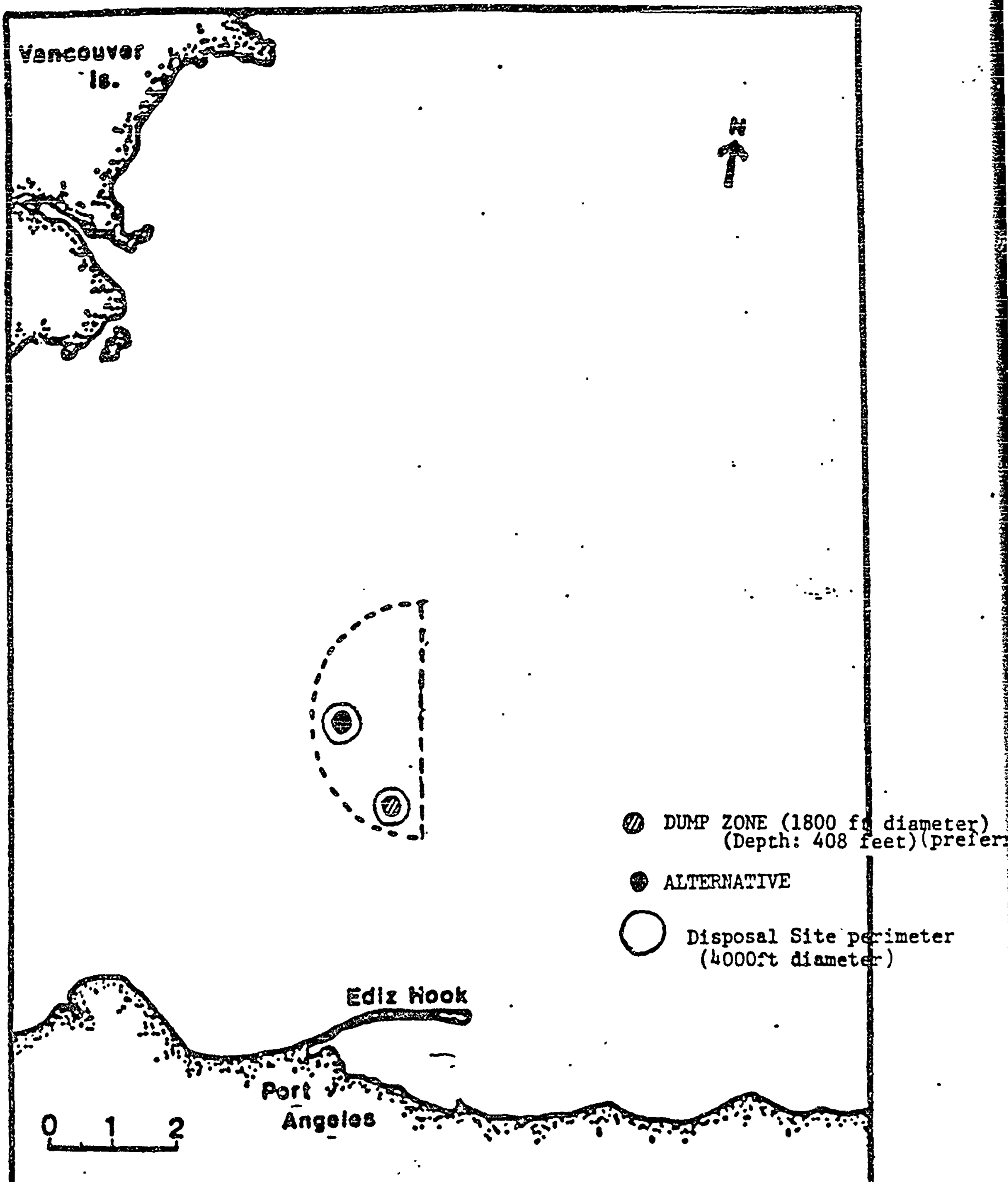


Figure 5. Map of the Port Angeles portion of the Strait of Juan de Fuca showing the preliminary location of a Zone of Siting Feasibility (ZSF) and the stations sampled by beam and otter trawls in October 1987.

Both sites in Clallam County

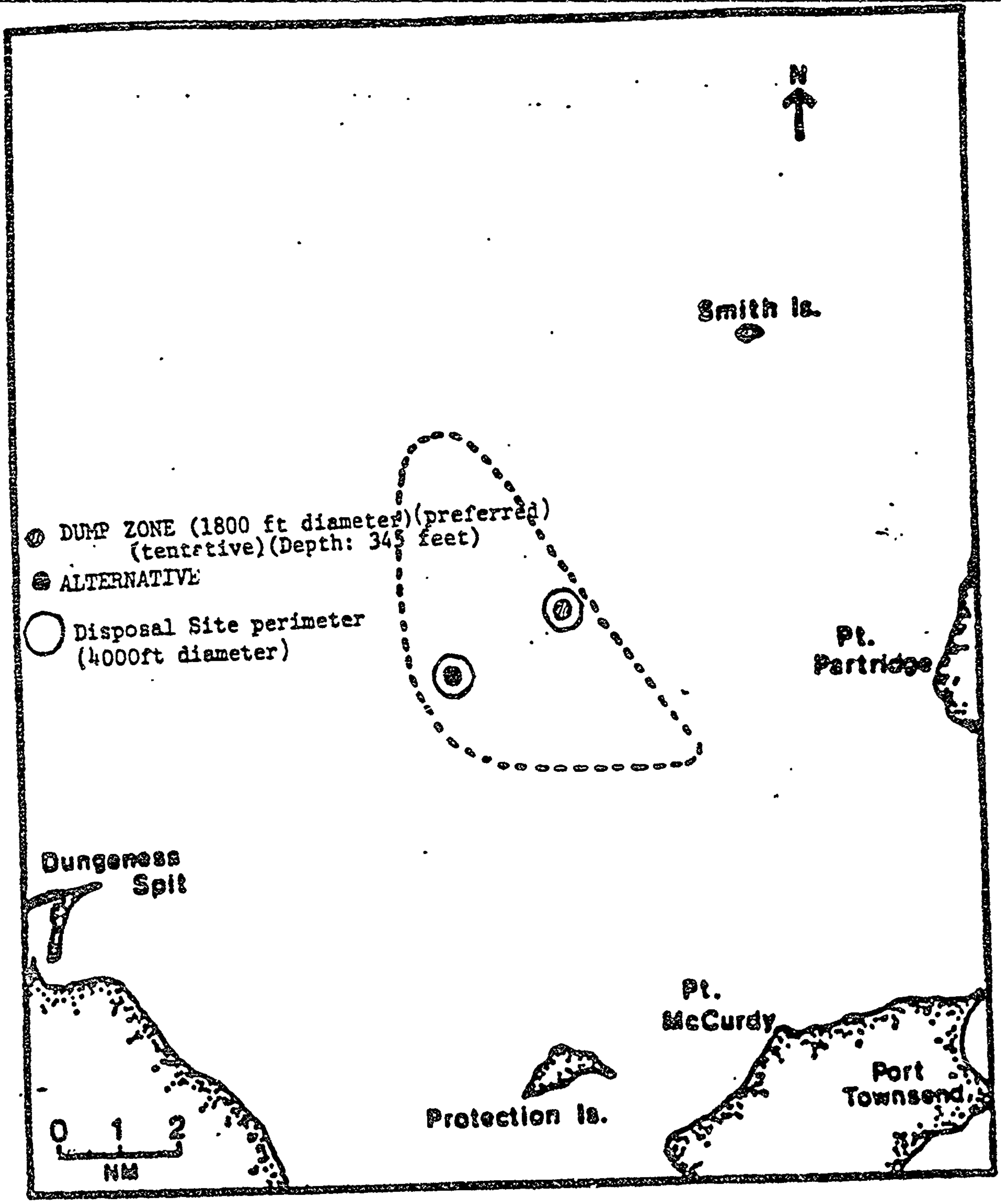


Figure 6. Map of the Port Townsend portion of the Strait of Juan de Fuca showing the preliminary location of a Zone of Siting Feasibility (ZSF) and the stations sampled by beam and otter trawls in October 1987.

Preferred site in Jefferson County
Alternative site in Clallam Co.

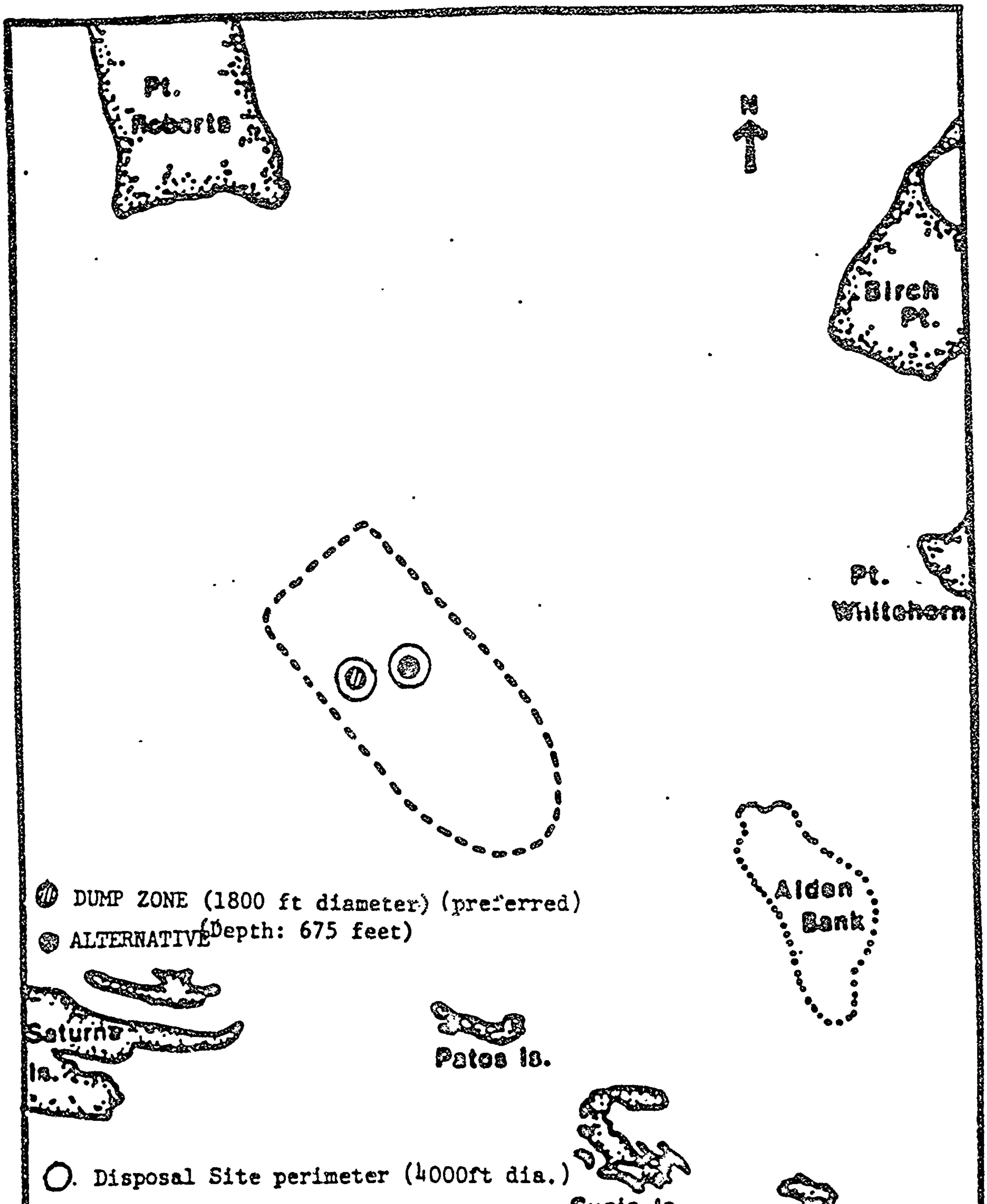


Figure 7. Map of the Point Roberts/southern Strait of Georgia area showing the preliminary location of a dispersive Zone of Siting Feasibility (ZSF) and the station locations sampled by both beam and otter trawls in October 1987.

Both sites in Whatcom County

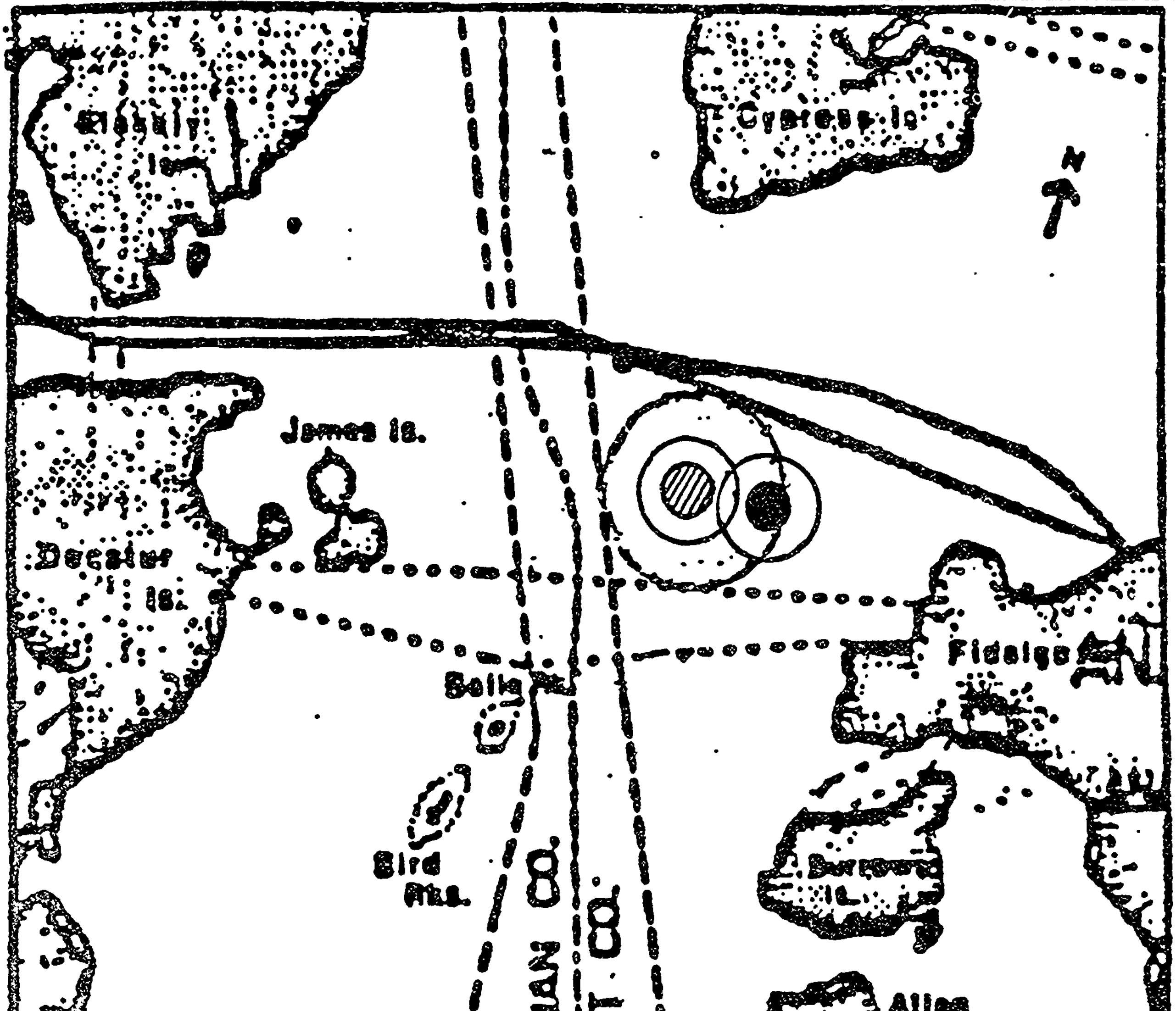


Figure 8.

DUMP ZONE (1800 ft diameter) (tentative)
(Depth: 225 feet) (preferred)

Disposal Site perimeter
(1000 ft diameter)

ALTERNATIVE

Both sites in Skagit County

Early in the PSDDA study it was determined that unconfined, open-water disposal sites should be relatively nondispersive rather than dispersive in nature. Placing dredged material in nondispersive sites gives site managers the ability to maintain better control and accountability over site conditions. This is particularly important when chemicals of concern may be present in the dredged material and it is necessary to minimize the exposure of important resources. In the Phase II area, only sites in south Puget Sound and Bellingham Bay were found that could meet this objective. The other four preferred sites are located in highly dispersive environments.

c. General ZSF Selection Factors. Three general ZSF selection factors were identified early in the PSDDA study. It was determined that ZSF's should, to the maximum extent possible:

First, avoid high energy areas that would disperse dredged material significantly beyond the disposal site area.

Second, avoid significant adverse impacts on foodfish, shellfish, marine mammals, and marine birds.

And third, minimize interference with human uses to the lowest practicable level.

d. Specific ZSF Selection Factors. The three general ZSF selection factors were further defined by nineteen specific selection factors (shown in table 1). Most of these factors are identified in Federal and State regulations relating to dredged material disposal sites located in water. The specific factors were mapped and overlayed to display areas where siting might occur with a minimum of conflict.

In contrast to the Phase I disposal sites, which are all located in areas of low bottom currents, the Phase II sites include both high and low bottom current environments. Low current sites are preferable because they lend themselves to follow-up environmental monitoring, as the dredged material is expected to stay within the site boundaries. Monitoring allows a check on predicted conditions at and near the sites and enables regulatory agencies to adjust site management conditions if warranted. However, with the exception of Bellingham Bay, no locations could be found in the north Sound area that had low currents and were also free of significant fish and shellfish and resource and human use conflicts. Therefore, the PSDDA study team, with significant input from resource agencies and public interest groups, has evaluated and identified high current or "dispersive" sites in the Strait of Juan de Fuca near Port Angeles and Port Townsend, in Georgia Strait near Point Roberts, and in Rosario Strait near Anacortes. These are areas where dredged material will be dispersed both while it is falling through the water column and after it reaches the bottom. Because monitoring is not practical at dispersive sites, the study team is considering more restrictive disposal guidelines than are required at the low current or "non-dispersive" sites. These guidelines include chemical and biological testing of dredged material prior to disposal. Preliminary characterization of the dredged material

TABLE 1

SPECIFIC FACTORS FOR IDENTIFICATION OF
ZONES OF SITING FEASIBILITY

1. Navigation activities
2. Recreational uses
3. Cultural sites
4. Aquaculture facilities
5. Utilities
6. Scientific study areas
7. Point pollution sources
8. Water intakes
9. Shoreline land use designations
10. Political boundaries
11. Location of dredging areas
12. Beneficial uses of dredged material
13. Fish/shellfish harvest areas
14. Threatened and endangered species
15. Fish/shellfish habitat
16. Wetlands, mudflats, and vegetated shallows
17. Bathymetry
18. Sediment characteristics
19. Water currents

expected to be considered for discharge at the Phase II disposal sites suggests that the material is generally quite clean and most of the material would not present environmental problems if discharged at either the dispersive or nondispersive sites.

e. Summary of Phase II Site and Dredging Characteristics. Two of the six Phase II preferred sites are located in areas of low tidal currents and have been designated nondispersive for management purposes. These are a site near the Nisqually delta and a site in Bellingham Bay. The other four sites are in high current areas and have been designated as dispersive sites. These are the Port Angeles, Port Townsend, Point Roberts, and Rosario Strait sites.

The anticipated dredging volume in the Phase II area for the next 15 years is 7.2 million cubic yards (c.y.), in comparison with the 7.9 c.y. dredging during the past 15 years, a slight decrease in dredging activity.

Not all material that is dredged will be allowed to go to the six preferred disposal sites, although the sites could easily accommodate the forecasted volumes. While most material is expected to be clean enough by PSDDA guidelines for disposal at these sites, some material will actually be used for other purposes such as port terminal and industrial land developments. Material not clean enough for disposal at PSDDA sites will require special considerations and placement at confined sites.

(Ecology is beginning a special study this year that addresses material that is unsuitable for unconfined, open-water disposal.)

3. Methods. Individuals knowledgeable of marine animals were contacted and interviewed. Available literature was reviewed and pertinent information was used in this assessment. References are listed at the end of this assessment.

4. Expected Impacts of PSDDA on Bald Eagles. The following section is divided into three major subsections: Descriptions of the Environment, Use of Puget Sound by Endangered Marine Animals, and Potential Impacts to Endangered Marine Animals. The second subheading is further broken down to: General, Nisqually, Bellingham, Port Angeles, Port Townsend, Point Roberts, and Rosario Strait. The third subheading is broken down to: General, Nisqually, Bellingham, and Port Angeles.

a. Description of the Environment. Puget Sound is an inland arm of the Pacific Ocean that connects to the Pacific through the Strait of Juan de Fuca. Puget Sound is not in the direct pathway of marine mammal migration routes, and consequently is seldom used by marine mammals. However, the Sound is rich in resources and when marine mammals do venture into this inland "sea" they find protected bays and food.

b. Use of Puget Sound by Marine Animals.

(1) General. Of the eight species of listed marine animals discussed in this BA, the right, blue, sei, and sperm whales and the leatherback sea

turtle have been observed with certainty in the inside waters of Washington. The blue whale has never been verified from the inside waters, though it is speculated that a whale identified as a fin whale in 1930 in Shelton may actually have been a young blue whale (National Marine Mammal Laboratory, 1980). This fin whale sighting is ~~the~~ one of only two sightings in Puget Sound, and the chances of it occurring again in Puget Sound are quite remote. Because of the rarity of these six species in Puget Sound, they are not discussed further in the BA. Only the gray and humpback whales regularly occur in Puget Sound and are discussed below.

Gray whales are regularly, though infrequently, sighted in Puget Sound. These individuals are considered stragglers which may or may not feed while in Puget Sound. Some of the few recent sightings of gray whales in Puget Sound have been relatively close to some of the disposal sites. In most instances, the whales were present for no more than 1 day and were not seen again in the same area. The implication is that the whales are "passing through" (and in all likelihood not feeding) and find no special attraction for any one area. However, one possible exception is a group sighted in Hood Canal in 1979 and seen again 3 days later near Port Townsend.

The humpback whale generally inhabits coastal and offshore waters but does enter protected inside waters on occasion. In the eastern north Pacific Ocean this species ranges from the Arctic to southern California in summer and occupies tropical waters in winter. The north Pacific population is estimated to be about 1,000 animals.

During the first part of the 20th Century this species was one of those most frequently sighted in the inside waters of Washington. Recent sightings of this species in Puget Sound were made off Seattle, Washington, in May 1976 (two individuals) and in September 1978 (four individuals).

Humpback whales could occur anywhere in the inside waters of Washington but the chance of more than a few stragglers occurring is slight.

(2) Nisqually. Gray whales have been regularly, though certainly not commonly, observed in many of the inlets of south Puget Sound south of the Narrows. Gray whales feed in water depths between 40 and 125 feet, primarily for euphausiid shrimp, nektonic fishes, and anchovy. The nektonic fishes and anchovy may be incidentally caught and not actively pursued by gray whales, as they are normally bottom feeders. Feeding has only been noted in northern migrant gray whales; those migrating south toward the breeding area apparently fast during migration. Those observed in Puget Sound are apparently stragglers who may stay in Washington waters for extended periods. No one seems to know whether these stragglers feed while they are in Washington waters (Everitt, et al., 1979), although it seems logical to assume that a small summer resident population off the west coast of Vancouver Island probably feeds there.

Humpback whales have apparently not been observed near Tacoma or southern Puget Sound since the 1940's (Slipp, 1948, Fide Everitt, et al., 1979). They are now one of the rarest of whales, numbering less than 1,00C individuals, and chances of seeing them again in southern Puget Sound are remote.

(3) Bellingham. Sightings of gray whales in Chuckanut Bay, at Gooseberry Point, and along the west shore of Lummi Island, indicate that they regularly visit the vincinity of Bellingham Bay. There have been no recent sightings of humpback whales near Bellingham Bay.

(4) Port Angeles. Two recent sightings of gray whales (one in 1977, the other in 1978, Everitt, et al., 1979) are an indication that gray whales visit this area. Recent research by Cascadia Research Collective (Calambokidis, et al., 1987) indicates regular use by gray whales in the vicinity of Neah Bay. This correlates with the recent knowledge that a summer population of about 50 gray whales regularly occurs along the west coast of Vancouver Island. It may be that they occur near Port Angeles more often than the few sightings suggest. There are no recent sightings of humpback whales from this vicinity. However, two recent sightings from Puget Sound near Seattle (Everitt, et al., 1979) indicate that humpbacks may occasionally still come through the Strait of Juan de Fuca.

(5) Port Townsend. There are no recent sightings of either gray whales or humpback whales from the vicinity of this disposal site. The sightings of both species from Puget Sound indicates that they may both occasionally pass through the area of the disposal site.

(6) Point Roberts. There are no recent sightings of either gray whales or humpback whales from this vicinity and it is not considered likely that they will be sighted here with any regularity in the future.

(7) Rosario Strait. There are no recent sightings of either gray whales or humpback whales from the vicinity of this disposal site. The sightings of grays whales near Bellingham Bay provide an indicator that they may occasionally pass through Rosario Strait on the way to and from Bellingham Bay.

c. Impacts to Gray Whales and Humpback Whales.

(1) General. Both gray whales and humpback whales occur so rarely in Puget Sound that the chances for impacts to these species from open-water disposal is extremely remote at any of the proposed disposal sites, with the possible exceptions of Nisqually, Bellingham, and Port Angeles. The few sightings near these three areas also indicates a remote chance that whales would occur at the same time as dredge disposal operations are occurring. However, it is possible that gray whales occur more commonly in these three areas than generally believed. These three disposal sites are discussed separately below.

(2) Nisqually. Seasonal trawls conducted in February, May, July, and October 1987 showed that shrimp, crab, and other epibenthic resources were rare in the vicinity of both the preferred and the alternate disposal sites

(Anderson Island/Ketron Island and Anderson Island/Devil's Head, respectively). The alternate site is a valuable herring spawning area to the Squaxin Island Indian Tribe. The preferred disposal site is at a depth of 442 feet and the alternate site is at a depth of 238 feet. These are much deeper than the deepest depth that gray whales would normally feed (usually considered to be about 125 feet). Thus, impacts to shrimp and other epibenthic resources at these sites, regardless of how small or large, would have little effect on gray whale feeding in the area.

It is unlikely that gray whales would be passing through the disposal zone at the actual time of disposal operations. But, if they did, the disposal material would lower visibility and likely cause discomfort to the whales as it drifted down around them. It seem unlikely that this material would cause direct physical harm to the whales, which could easily swim away from the falling dredged material. Thus, no impacts to gray whales are expected at these two potential disposal sites.

The likelihood of occurrence of humpback whales in this area is considered to be so remote that impacts are not expected.

(3) Bellingham. The two potential disposal sites in Bellingham Bay are about 100 feet in depth. The south (preferred) site has relatively lower numbers of Dungeness crabs and pandalid shrimp than the northeast (alternate) site. All other epibenthic resources at both sites are relatively low in numbers.

The depth of these sites is within the feeding range of gray whales. Although no sightings of gray whales have been made within Bellingham Bay (Everitt, et al., 1979), the sightings from nearby areas and the relative shallowness of the bay makes it seem a logical place for gray whales to visit. Once again, however, their scarcity and the infrequency of dredging disposal operations makes the occurrence of the two at the same time seem highly unlikely. And, as for Nisqually, it seems unlikely that disposal operations would harm the whales should they be in the area at the time of disposal. Thus, no impacts to gray whales are expected from use of either of the Bellingham Bay disposal sites.

Humpback whales have not been recorded in Bellingham Bay in recent years (possibly never). As such, it seems highly unlikely that they would be affected by dredged material disposal in Bellingham Bay.

(4) Port Angeles. Gray whales may regularly use the coastline between Neah Bay and Port Angeles and may even feed while in the vicinity. The disposal sites are both over 400 feet in depth, so the whales would not be expected to be in the vicinity of the sites, except for an occasional pass through. Again, this makes their occurrence at the same time as infrequent dredged material disposal extremely unlikely. Impacts to gray whales are not expected at the Port Angeles disposal sites.

Humpback whales may also pass through the vicinity of these sites on occasion. Again, their rare occurrence indicates that impacts from dredged material disposal would be highly unlikely.

5. Conclusion. No impacts to any of eight listed species of endangered marine animals are expected from dredged material disposal at Phase II PSDDA disposal sites.

6. References.

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Wahl, T., S. Speich, D.A. Manuwal, K.V Hirsh, and C. Miller, 1981. Marine Bird Populations of the Strait of Juan de Fuca, Strait of Georgia, and Adjacent Waters in 1978 and 1979. U.S. Environmental Protection Agency, Washington, D.C., 125 pages.

12y BL

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Northwest Region
7600 Sand Point Way NE
BIN C15700, Bldg. 1
Seattle, Washington 98115

cc:

JUL 6 1988

F/NWR3: 1514-04 js

Mr. R.P. Sellevold, P.E.
Chief, Engineering Division
Seattle District Corps of Engineers
P.O. Box C-3755
Seattle, WA 98124

Dear Mr. Sellevold:

This is in response to your May 31, 1988 letter regarding an Endangered Species Act (ESA) biological assessment for Phase II of the Puget Sound Dredged Disposal Analysis project. We have reviewed the biological assessment and have a few technical comments (copy enclosed). We concur with your determination that populations of endangered/threatened species under our purview are not likely to be adversely affected by the proposed actions so long as the disposal activities are limited to sediments that pose no adverse impacts to aquatic organisms.

This concludes consultation responsibilities under Section 7 of the ESA. However, consultation should be reinitiated if new information reveals impacts of the identified activities that may adversely affect listed species or aquatic organisms, the identified activity is subsequently modified, or a new species is listed or critical habitat is determined that may be affected by the identified activity. If you have any new information or questions concerning this consultation, please contact Joe Scordino at 526-6140.

Sincerely,

Thomas E. Kruse
for Rolland A. Schmitten
Regional Director

Enclosure

cc: F/NWR5 - Rob Jones
F/PR2 - Patricia Carter
F/NWC3 - Howard Braham

Copy for COE Seattle
JUN 28 1988

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Northwest and Alaska Fisheries Center
National Marine Mammal Laboratory
7600 Sand Point Way N.E., Bldg. 4
Seattle, Washington 98115

(206) 526-4045 FTS: 392-4045

June 24, 1988 F/NWC3:HK

MEMORANDUM FOR: F/NWR35 - Joe Scordino

FROM: F/NWC3 - Howard W. Braham

Howard

SUBJECT: Review of Biological Assessment on marine mammals for Puget Scund Dredged Disposal Analysis.

No objections were raised by the NMML's Permit Review Committee concerning the impact on endangered cetaceans from dredging and disposal of dredged material in selected dumping areas in Puget Sound. However, we offer the following general comments for your consideration in reply to the Corps of Engineers.

The Army Corps of Engineers' Biological Assessment appears to underestimate the frequency of occurrence of gray whales in Puget Sound; rejects the possibility of gray whales feeding in Washington's inland waters (including dredged material) and underestimates the depths at which gray whales feed. The effects of gray whales feeding on dredged materials would probably not present any problems as long as the dredged material is tested for toxins and pollutants before permission is granted for its disposal. The gray whale is unique among the large cetaceans in that it feeds primarily on benthic organisms, invertebrates, mysids, fish larvae, and small schooling fishes. Gray whales are known to feed at depths up to 221 ft (68 m) in southern Chukchi Sea (Nerini 1984). As the population of grey whales continues to increase, we can probably expect to see more gray whales in Washington's inland waters. Gray whales that summer along the west coast of Vancouver Island are known to feed on dense populations of ampelicid amphipods. Specific comments are as follows:

1. p13, 4: Caption should refer to marine mammals, not bald eagles.

2. p13, 4a: "endangered cetaceans" should be used instead of "marine mammals".

from their report

3. p13: Presumably the last line should say fin whale rather than blue whale, based on the content of the next sentence on p.14.

4. p14: Gray whales feed primarily on amphipods, not on euphauiis.

5. p14: No citation was given for NMML (1980) or Slipp (1948).

from their report

6. p14, 3rd paragraph: The Arctic is not considered to be part of the Pacific Ocean.

7. p14, bottom 2 lines: Humpback whales have been observed in southern Puget Sound for 11 days during June 1988.

from their report

8. p14 & 15: A better estimate for the North Pacific humpback whale population is 1,200 animals (Braham 1984).

NOAA, NOS Chart #18400 (formerly C & GS #6300) 28th Ed. 9/15/76 indicates that the Port Townsend ZSF is in or very near to a Restricted Dumping Ground.

Braham, H. 1984. The status of endangered whales: an overview. Mar. Fish. Rev. 46(4):2-6.

Nerini, M. 1984. A review of gray whale feeding ecology. pp. 423-450. In The gray whale. Jones, M. L., S.L. Swartz, and S. Leatherwood, Eds. Academic Press, Inc. Orlando. 600 p.

GARY NEAL
[illegible] Director

STATE OF WASHINGTON

DEPARTMENT OF WILDLIFE

600 North Capitol Way, GJ-11 • Olympia, Washington 98504-0091 • (206) [illegible]

April 4, 1988

R.P. Sellevold, P.E.
Chief, Engineering Division
Seattle District, Corps of Engineers
P.O. Box C-3755
Seattle, WA 98124-2255

RE: PSDDA Study - US Army Corps of Engineers

Dear Mr. Sellevold:

We have completed a review of our files for information on significant natural features in the study area. The result of this review is presented in the enclosed material, which summarizes the occurrence of special animals reported within TWO MILES OF THE STUDY AREA. The Washington Natural Heritage Program will mail, under separate cover, project area information concerning special plants and plant communities.

We hope this presentation will be useful to you. This response is provided for your information only and is not to be construed as an official Department of Wildlife environmental review of your project. For official Department review and comment, mail environmental impact documents to: Washington Department of Wildlife, Ted Muller, Regional Habitat Biologist, 16018 Mill Creek Boulevard, Mill Creek, WA 98012.

In order to ensure the protection of the special species occurring in the study area, we recommend that if information presented here is published or distributed that only the township and range be shown.

If your office should publish or distribute general information from the enclosed material, please provide the Nongame Wildlife Program with a draft of any document in which information from the Natural Heritage Data System is incorporated or referenced, and cite the System as follows:

> Natural Heritage Data System
> Washington Department of Natural Resources and
> Department of Wildlife - Nongame Program
> c/o Mail Stop EX-12
> Olympia, WA 98504

cc: ERS (Brunner)
Wakeman

The information provided is not to be taken as a complete inventory of the project area and does not eliminate the need or responsibility to conduct more thorough research. If you have further questions or concerns, please feel free to contact us at (206) 586-1449.

Sincerely,

THE DEPARTMENT OF WILDLIFE

Thomas A. Cyra

Thomas A. Cyra
Nongame Data Systems Biologist

TAC:pr-b

cc: Jim Watson
Ted Muller

ELEMENT OCCURRENCE SUMMARY

Introduction

The Natural Heritage Data System was established by the State of Washington and the Washington Natural Heritage Program of The Nature Conservancy. It is currently maintained by the Heritage Program under contract to the Washington Department of Natural Resources and by the Nongame Wildlife Program of the Washington Department of Game.

The database is comprised of "element occurrences." An "element" is a natural feature of particular interest because it is exemplary, unique, or endangered on a statewide or national basis. An element can be a plant community, special plan, or special animal species. An "element occurrence" is a reported or confirmed locality of a native vegetation community, or of significant habitat for a plant or animal species of concern. Information on element occurrences in the state is collected from herbarium and museum specimens, scientific literature, knowledgeable individuals, and field investigations. This information is compiled in the Natural Heritage Data System for use in land-use planning and evaluating the status of Washington's natural features.

This enclosure summarizes the special animal occurrences reported within or adjacent to the study area and catalogued in the Natural Heritage Data System. The Washington Natural Heritage Program manages similar information concerning special plants and plant communities.

Format

The Element Occurrence Summary table lists those special animals that have been reported to occur in or adjacent to the area specified in your information request.

- The first column lists the U.S. Geological Service (USGS) topographic quadrangle.
- The second column lists the township, range, and section.
- The third column, entitled "conf." (confirmation), lists a code indicating the specifically of the locations recorded for each element occurrence.

Confirmation Codes

C = The location of the element occurrence is known to within a 1/4-mile radius. In addition, the locality has been confirmed.

U = The location of the element occurrence is known to within a 1/4-mile radius, but at this time has not been confirmed.

N = The location of the element occurrence is known to within a 1-mile radius. This information usually is derived from secondary sources.

G = The element occurrence is locatable only to a general area, usually denoted by a geographic name. This information was derived from secondary sources.

- The next column contains federal and state status information.

Status Codes for Special Animals

Code	Explanation
FE	Federal Endangered - A species in danger of extinction throughout all or a significant portion of its range.
FT	Federal Threatened - A species which is likely to become endangered within the foreseeable future.

The state status given in the second column under "Element Status" is based on status evaluations conducted by the Washington Department of Game, Nongame Program.

Code	Explanation
SE	State Endangered - A species which is seriously threatened with extirpation throughout all or a significant portion of its range within Washington.
PE	Proposed Endangered - A species proposed for listing as Endangered.
ST	State Threatened - A species that could become endangered within Washington in the foreseeable future without active management or removal of threats.
PT	Proposed threatened - A species proposed for listing as Threatened.
SS	State Sensitive - A species that could become threatened if current water, land, and environmental practices continue.
PS	Proposed Sensitive - A species proposed for listing as Sensitive.
SM	State Monitor - A species of special interest because it: 1) has significant popular appeal; 2) requires limited habitat during some portion of its life cycle; 3) is an indicator of environmental quality; 4) requires further field investigation to determine population status classification; or 6) was justifiably removed from Endangered, Threatened, or Sensitive classification.
PM	Proposed Monitor - A species proposed for listing as Monitor.
PD	Proposed Delete - A species proposed for deletion from the special animal species classification.

- In the fourth column the animal species is named.

- The fifth column, entitled "Crit." (Criteria), lists codes that indicate the specific criterion/criteria used to evaluate whether a habitat location is significant to the species.

Element Occurrence Criteria for Special Animals

IO — Individual occurrence. Any record of the species constitutes a special animal occurrence.

HC — Herptile Concentration. Five or more individuals present in the same location.

CR — Colonial roosts.

B — Evidence of breeding: nest, young or eggs, adult visiting probable nest site, nest building activity (i.e., carrying nest material), breeding display, agitated behavior and distraction display (i.e., feigning injury).

RI — Regular individual occurrences at the same location. Observations of less than 10 individuals that have been made during at least three different years, not necessarily consecutive.

RSC — Regular small concentrations, during migration, breeding or winter seasons, of 10-70 individuals observed during at least three different years, not necessarily consecutive.

RLC — Regular large concentrations, during migration, breeding or winter season of over 70 individuals, that have been reported during at least three different years, not necessarily consecutive.

Comments

The enclosed information represents the reported element occurrences currently catalogued in the Natural Heritage Data System. The Data System is constantly updated as more current and historic information on element occurrences in the state are reported. Consequently, some of the element occurrences reported to occur historically within the study area may no longer be present. Likewise, areas within the study boundary for which element occurrences have not yet been reported, nevertheless, may support special animal species.

Finally, if information is needed on specific plant community or special plant occurrences within the study area, please contact the Washington Natural Heritage Program, (206) 753-2449. For additional information on specific special animal occurrences, please contact the Washington Department of Game, Nongame Wildlife Program, (206) 586-1449.

Enclosure 1

ELEMENT OCCURRENCE SUMMARY - SPECIAL ANIMALS

FOR: PSDDA Study - US Army Corps of Engineers

Quad Name	T	R	S	Conf.	Status Fed.	Status State	Element Name	Crit.	No.	Nest #
4712226/McNeil Is	19N	1E	4	C	FT	ST	Haliaeetus leucocephalus (Bald eagle)	B	126	1,2
4812246/Deception Pass	35N	1E	28	C	FT	ST	Haliaeetus leucocephalus (Bald eagle)	B	585	2
4812247/Blakely Is	35N	1W	23	C	FT	ST	Haliaeetus leucocephalus (Bald eagle)	B	057	1
" " "	35N	1W	23	C	FT	ST	Haliaeetus leucocephalus (Bald eagle)	B	057	2
4812247/Lopez Pass	35N	1W	27	C	FT	ST	Haliaeetus leucocephalus (Bald eagle)	B	842	

EXHIBIT B

Final Determination of Suitability
for Disposal of Dredged Material in Waters of
Northern and Southern Puget Sound

PUBLIC NOTICE

FINAL DETERMINATION OF SUITABILITY
FOR DISPOSAL OF DREDGED MATERIAL IN WATERS OF
NORTHERN AND SOUTHERN PUGET SOUND

1. On April 15, 1988, the U.S. Environmental Protection Agency (EPA), Region 10, Seattle, Washington, and the Seattle District, U.S. Army Corps of Engineers (Corps), issued a Public Notice to initiate the Advanced Identification of sites in northern and southern Puget Sound suitable for disposal of dredged material under Subpart I of the Section 404(b)(1) Guidelines of the Clean Water Act, as described at 40 CFR 230.80. A multiagency study of alternative potential disposal sites was undertaken by the Corps; EPA, Region 10; and the State of Washington Departments of Ecology and Natural Resources. This effort is known as the Puget Sound Dredged Disposal Analysis (PSDDA). The PSDDA study, which began in April 1985, has been conducted in two 3 1/2-year-long overlapping phases. Phase I dealt with the central region of Puget Sound (Everett, Seattle, and Tacoma), and was completed in December 1988 with the signing of the Record of Decision by the Corps District Engineer and EPA Regional Administrator. Phase II covers the balance of Puget Sound (see figure 1).

2. In March 1989, the Corps issued a Draft Management Plan Report (DMPR) and Draft Environmental Impact Statement (DEIS) for the Phase II study area, pursuant to the National Environmental Policy Act (NEPA), identifying the preferred alternative unconfined open-water disposal sites. A Proposed Determination of Suitability was issued in conjunction with the DEIS and public comments on these documents solicited. A Final Environmental Impact Statement (FEIS) and Management Plan Report (MPR), incorporating responses to public comments, are being published concurrently with this Public Notice. These documents, including technical appendix, provide the basis for this final determination of suitability.

3. The identified sites are considered suitable for the disposal of dredged material found acceptable for unconfined open-water disposal per the Section 404(b)(1) Guidelines (see 4 below). These sites are located in northern and southern Puget Sound as shown in figure 2. They include nondispersive sites in Bellingham Bay in northern Puget Sound and between Anderson and Ketron Islands in southern Puget Sound, and dispersive sites near Port Angeles, near Port Townsend, and in Rosario Straits, in northern Puget Sound.

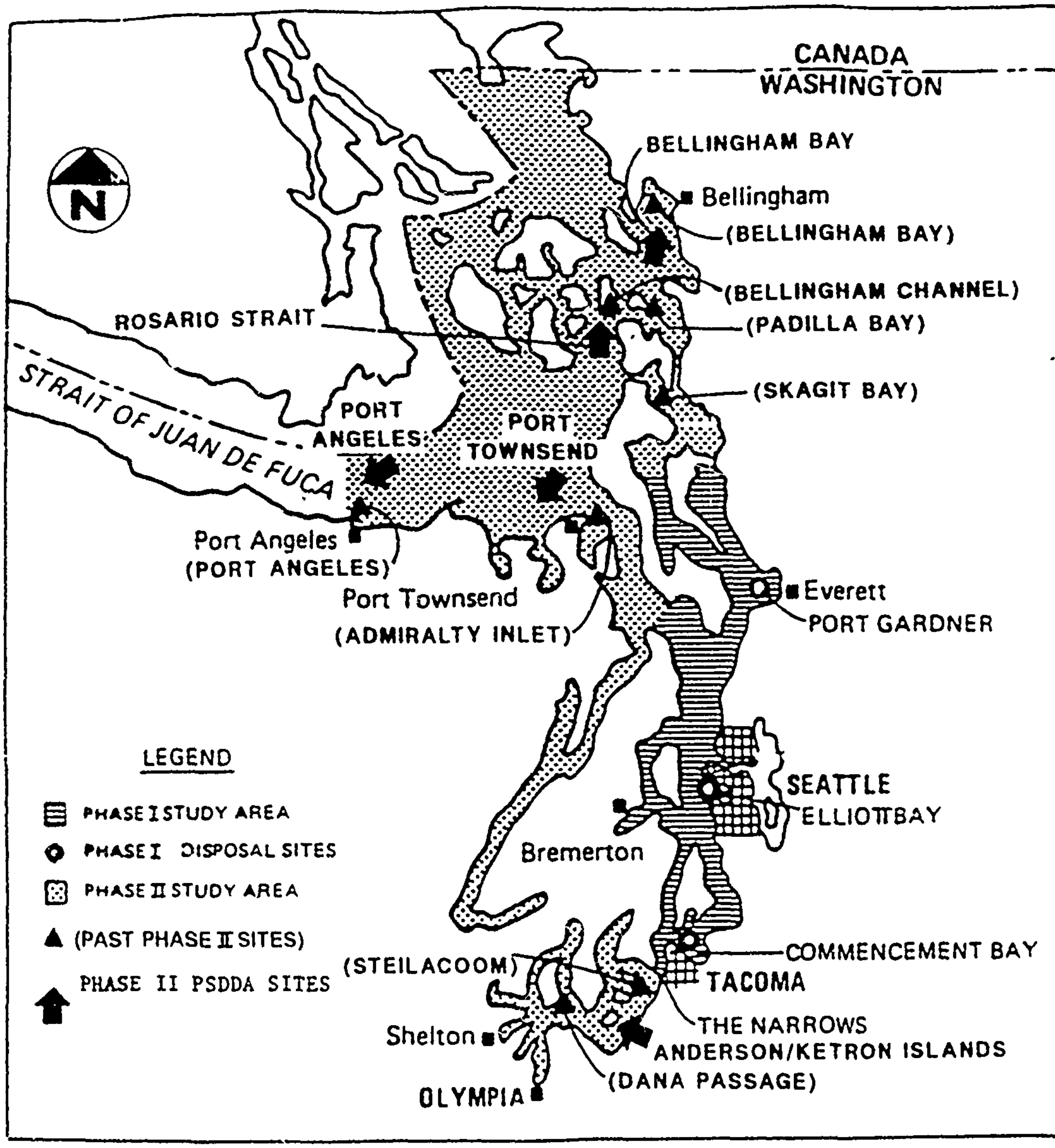

Figure 1 Puget Sound Dredged Disposal Analysis. Location of past and PSDDA Phase II selected disposal sites.

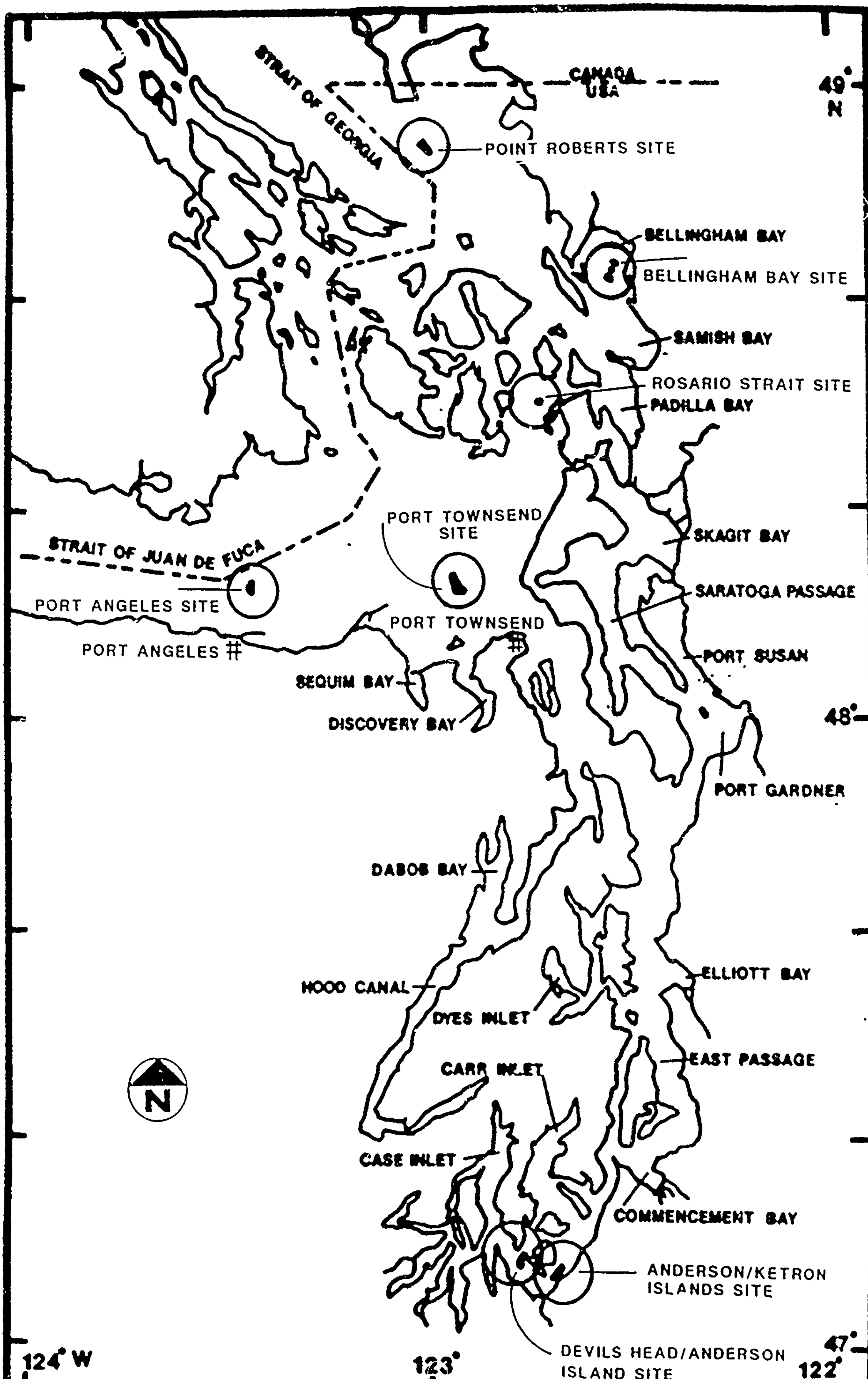

Figure 2 PSDDA Phase II Zones of Siting Feasibility (ZSF's) and Disposal sites.

Nondispersive Sites.

Bellingham Bay. The center of the disposal zone of the site, located in northern Puget Sound, is at latitude 48° 42.83' longitude 122° 33.03' (figure 3). The site covers an area of approximately 260 acres and has a depth of about 96 feet at the center of the disposal zone. Site diameter is 3,800 feet.

Anderson/Ketron Island. The center of the disposal zone of this site, located in southern Puget Sound, is at latitude 47° 09.43' longitude 122° 39.40' (figure 4). The site covers an area of approximately 318 acres and has a depth of 442 feet at the center of the disposal zone. Site dimensions are 4,400 by 3,600 feet.

Dispersive Sites.

Rosario Strait. The center of the disposal zone of this site, located in northern Puget Sound, is at latitude 48° 30.88' longitude 122° 43.48' (figure 5). The site covers an area of approximately 650 acres and has a depth of 230 feet at the center of the disposal zone. Site diameter is 6,000 feet.

Port Townsend. The center of the disposal zone of the site, located in northern Puget Sound, is at latitude 48° 13.62' longitude 122° 58.95' (figure 6). The site covers an area of approximately 884 acres and has a depth of 361 feet at the center of the disposal zone. Site diameter is 7,000 feet.

Port Angeles. The center of the disposal zone of the site, located in northern Puget Sound, is at latitude 48° 11.68' longitude 122° 24.86' (figure 7). The site covers an area of approximately 884 acres and has a depth of about 435 feet at the center of the disposal zone. Site diameter is 7,000 feet.

4. Use of sites identified by EPA and the Corps as potentially suitable for discharge of dredged material will be conditioned to restrict the kind of discharge to be permitted when it is determined that the dredged material has characteristics which are likely to affect compliance with the 404(b)(1) Guidelines. Dredged material sampling and testing procedures that will be used to determine acceptability for disposal at these sites and site management conditions are described in detail in the Phase II MPR.

5. The purpose of this public notice is to notify concerned citizens, Indian tribes, the business community, agencies, and the local governments of EPA's and the Corps' final determination of suitability for the dredged material disposal sites identified in paragraph 3 as sites deemed generally acceptable for the discharge of dredged material subject to the restrictions discussed in paragraph 4. This action will aid the Corps and EPA in making decisions on Section 404 permit applications involving future disposal of dredged material in northern and southern Puget Sound and complements an earlier determination of suitability made by EPA and the Corps for dredged material disposal sites in central Puget Sound.

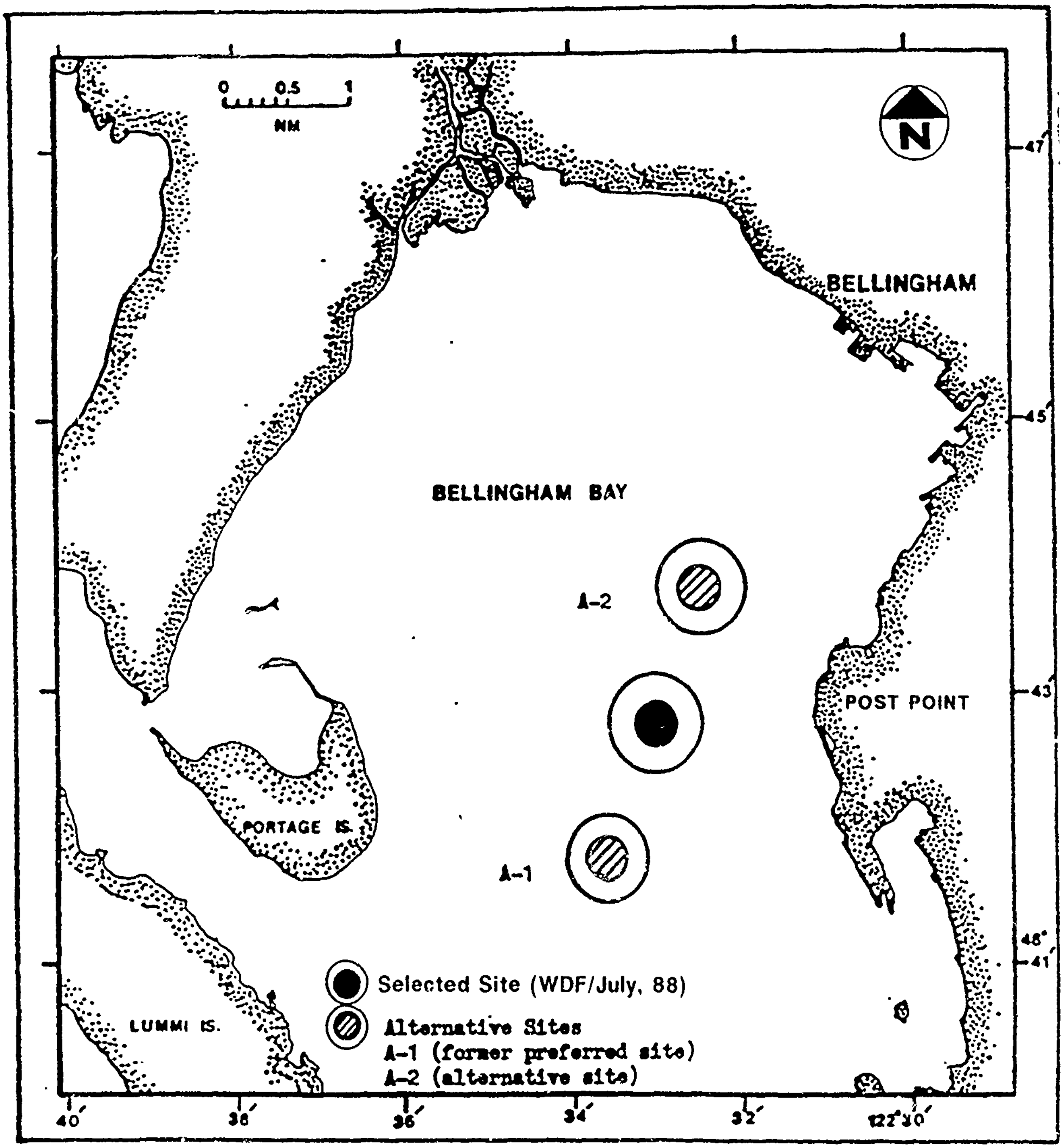

Figure 3 The Bellingham Bay disposal site perimeter (solid line) and disposal zone (hatched circles for alternative sites and solid circle for selected site).

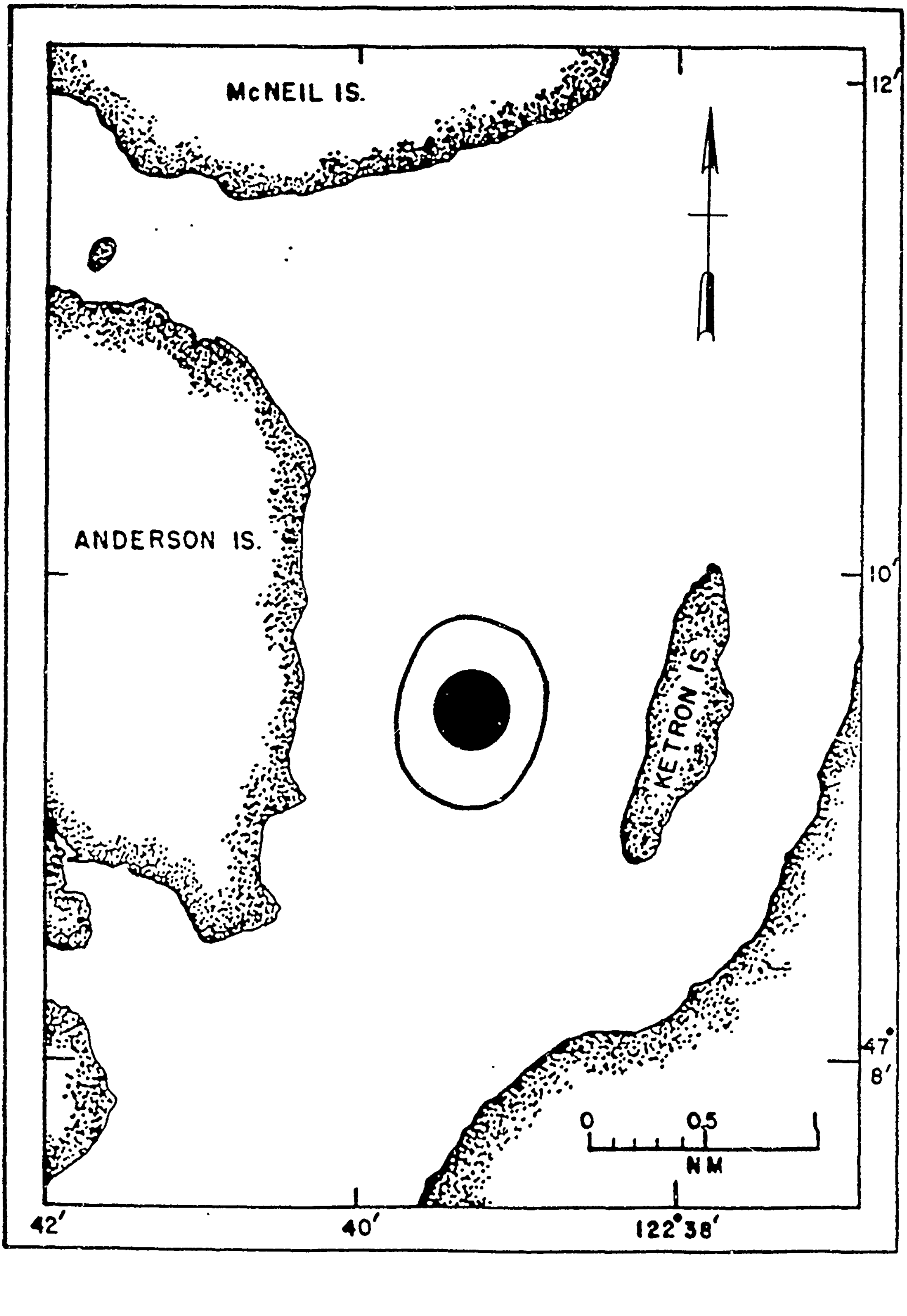

Figure 4 The selected Anderson/Ketron Island disposal site perimeter (solid line) and disposal zone (solid circle).

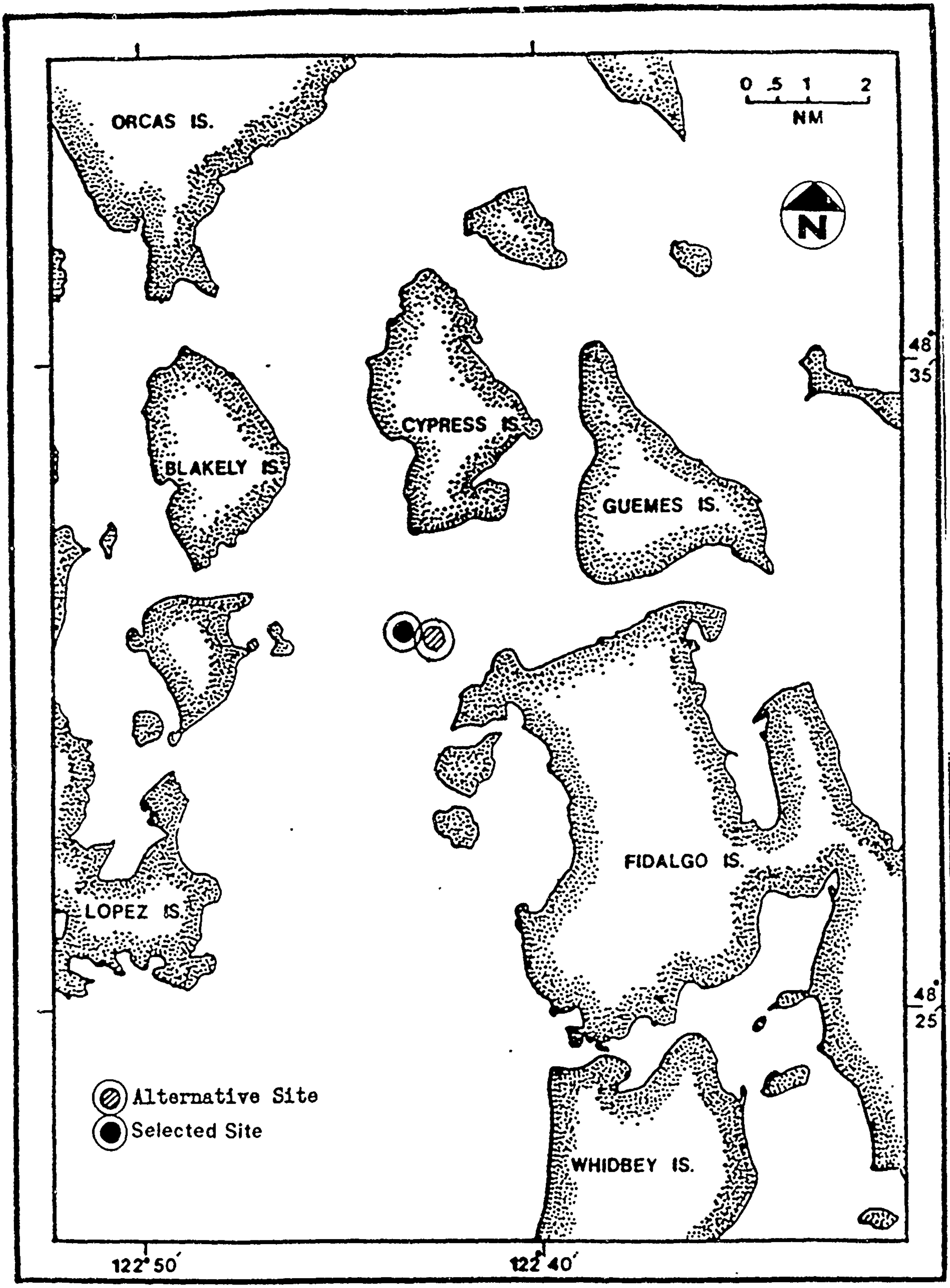

Figure 5 Rosario Strait disposal site perimeter (solid line) and disposal zone (solid circle for selected and hatched circle for alternate site).

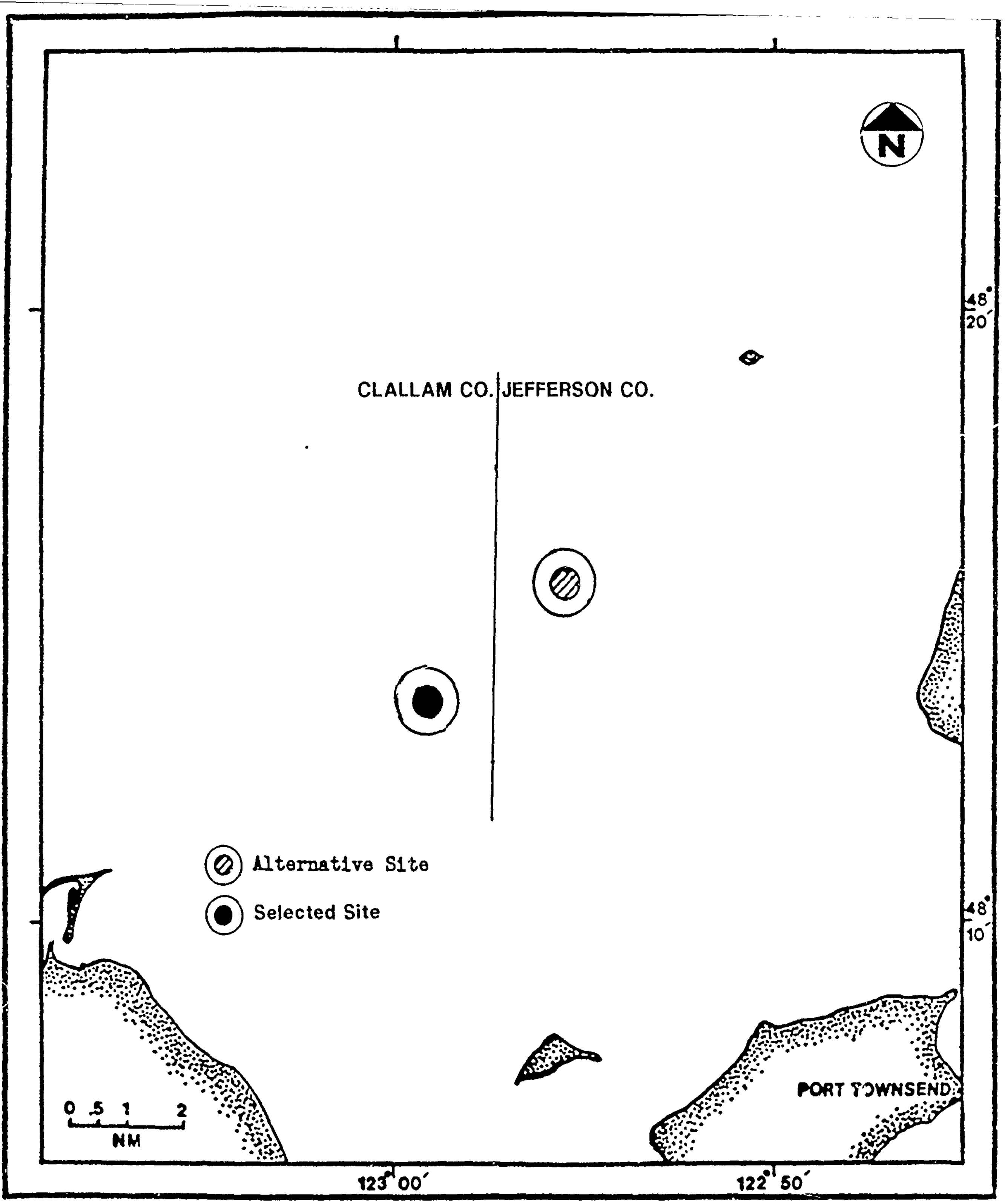

Figure 6 Port Townsend disposal site perimeter (solid line), and disposal zone (solid circle for selected and hatched circle for alternate site).

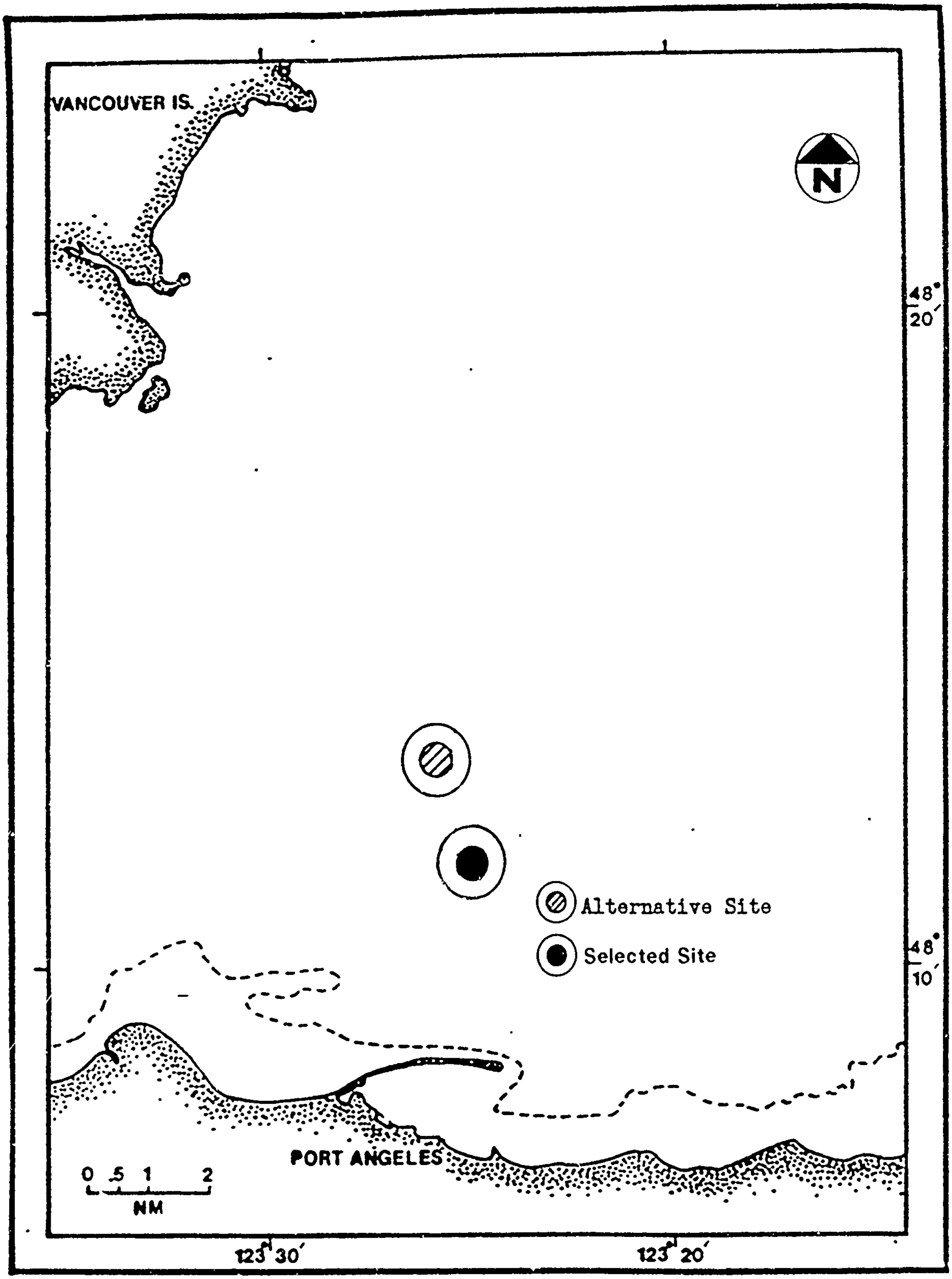

Figure 7 Port Angeles disposal site perimeter (solid line) and disposal zone (solid circle for selected, hatched for alternate).

Dredged material may be discharged in areas identified as generally suitable for such activities provided the material fully complies with the Clean Water Act Section 404(b)(1) Guidelines and the discharge is approved through the Corps of Engineers' permit process. The identification of areas that are generally deemed suitable for disposal should not be regarded as a guarantee that permits to discharge dredged material in such areas will be issued. Instead, the identification process should assist a potential applicant in determining whether the requirements of the Section 404(b)(1) Guidelines will be met.

6. This advanced site identification 230.80 process, which began on April 15, 1988, will be completed at the time of issuance of the Record of Decision for PSDDA Phase II. Major 230.80 milestones are as follows:

° Initial joint EPA/Corps public notice	April 15, 1988
° Public comment period on initial public notice	April 15 through May 16, 1988
° Proposed determination of site suitability	March 1989
° Public comment period	March 31 through May 15, 1989
° Public meetings	April 18, 1989 (Steilacoom) April 19, 1989 (Bellingham) April 20, 1989 (Port Angeles)
° Final determination of suitability	(Published with FEIS) August 1989
° Record of Decision	(Issued 30 days following release of final EIS)

7. Agencies and organizations consulted in this advanced identification effort include the following:

U.S. Environmental Protection Agency
U.S. Army Corps of Engineers
U.S. Fish and Wildlife Service
U.S. Department of Commerce-National Marine Fisheries Service
U.S. Coast Guard
Washington Department of Natural Resources
Washington Department of Ecology
Washington Department of Fisheries
Washington Department of Wildlife
Washington Department of Social and Health Services
Washington Parks and Recreation Commission
Washington Department of Transportation
Puget Sound Water Quality Authority
University of Washington Fisheries Department

University of Washington Institute for Marine Studies
Island County
Jefferson County
King County
Kitsap County
Mason County
Pierce County
San Juan County
Skagit County
Snohomish County
Thurston County
Whatcom County
City of Anacortes
City of Bellingham
City of Everett
City of Olympia
City of Port Angeles
City of Port Townsend
City of Seattle
City of Tacoma
Puget Sound Council of Governments
Municipality of Metropolitan Seattle (Metro)
Association of Washington Cities
Association of Washington Counties
Washington Public Ports Association
Port of Bellingham
Port of Everett
Port of Seattle
Port of Port Townsend
Port of Tacoma
Port of Anacortes
Port of Edmonds
Port of Olympia
Port of Port Angeles
Port of Skagit County
Northwest Indian Fisheries Commission
Duwamish Tribal Office
Jamestown Klallam Tribes
Lower Elwha Tribal Council
Lummi Business Council
Muckelshoot Indian Tribe
Nisqually Indian Community
Nooksack Indian Tribal Council
Point No Point Treaty Council
Port Gamble Business Council
Puyallup Tribal Council
Sauk-Suaittle Indian Tribe
Skokomish Tribal Council
Small Tribes of Western Washington
Squaxin Island Tribal Council
Stillaguamish Tribal Council
Suquamish Tribe

Swinomish Tribal Council
Tulalip Tribe Board of Directors
Upper Skagit Tribal Council
Puget Sound Alliance
League of Women Voters
Greenpeace
Washington Environmental Council
Friends of the Earth
Washington Association of General Contractors

PHILIP L. HALL
Colonel, Corps of Engineers
District Engineer
Seattle District

ROBIE G. RUSSELL
Regional Administrator
U.S. Environmental Protection Agency
Region 10, Seattle

EXHIBIT C

Public Comments on Draft Environmental Impact Statement (DEIS) and Supporting Documents and PSDDA Agency Responses

EXHIBIT C

PUBLIC COMMENTS ON DRAFT
ENVIRONMENTAL IMPACT STATEMENT
(DEIS) AND SUPPORTING DOCUMENTS
AND PSDDA AGENCY RESPONSES

Comments on the Draft Environmental Impact Statement - Proposed Unconfined, Open-Water Disposal Sites for Dredged Material, Phase II (North and South Puget Sound) received during the April 18, 19, and 20, 1989, public meetings; and in written form prior and subsequent to the public meetings are contained in this exhibit.

Responses to comments generally appear directly alongside each comment. While the official 45-day public review period was from March 31 to May 15, 1989, comments were received and accepted until June 15, 1989.

Comment letters and meeting testimony follow. The dates given are the date of receipt, which differ from the date on the letters. In instances when these dates are very different, this is detailed.

Federal Agencies and U.S. Congressmen

Agency	Page
U.S. Department of Agriculture, Soil Conservation Service - May 5, 1989	C-4
U.S. Environmental Protection Agency - June 15, 1989	C-5
U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control - May 12, and June 2, 1989 in response to Corps'letter of of May 25, 1989	C-6
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R 5/8/89

United States Department of Agriculture
Soil Conservation Service

W. 920 Riverside, Rm. 360
Spokane, Washington 99201-1080

May 1, 1989

Mr Frank Urabeck, PSDDA Study Director
Department of the Army
Seattle District, Corps of Engineers
P.O. Box C-3755
Seattle, Washington 98123

Dear Mr. Urabeck:

We have reviewed your joint NEPA and SEPA DEIS and MPR for Phase II of the interagency Federal/State Puget Sound Dredged Disposal Analysis Study. It would appear the concerns of the Soil Conservation Service have been addressed, and we have no comments to offer at this time. 1

Thank you for the opportunity to review your documents.

Sincerely,

Lynn Brown

LYNN A. BROWN
State Conservationist

cc: F. Easter, AC, SCS, Spokane SO

RESPONSE TO U.S. DEPARTMENT OF AGRICULTURE,
SOIL CONSERVATION SERVICE

Response 1. Comment acknowledged.

REPLY TO ATTN OF: WD-138

June 13, 1989

Colonel Philip L. Hall
District Engineer
Seattle District, Corps of Engineers
P.O. Box C-3755
Seattle, Washington 98124-2255

Dear Colonel Hall:

We have completed our review of the draft Environmental Impact Statement (EIS), Management Plan Report (MPR), and Disposal Site Selection Technical Appendix for the Puget Sound Dredged Disposal Analysis (PSDDA) Phase II Unconfined Open-Water Disposal for Dredged Material. This review was conducted in accordance with the National Environmental Policy Act (NEPA) and our responsibilities under Section 309 of the Clean Air Act.

We are a cooperating agency for the PSDDA effort and have been extensively involved in its development and coordination. With the Corps of Engineers, the Environmental Protection Agency (EPA) will utilize the Advanced Identification provision of the Clean Water Act, described at 40 CFR 230.80, to identify potentially acceptable disposal sites in northern and southern Puget Sound. The PSDDA study has focused on identifying and designating environmentally acceptable sites for unconfined, aquatic disposal of dredged material, developing procedures and interpretations for testing dredged material, and implementing site management requirements. The effort has been a far-reaching, cooperative venture involving the federal government and state of Washington in defining a comprehensive, understandable framework for dredged material management. A full range of alternatives has been evaluated and a number of complex, highly-charged issues addressed.

These documents represent a four-agency consensus program based on existing state of the art knowledge. As was noted in the Phase I documents, dredged material management is rapidly evolving. These Phase II documents acknowledge the lessons learned from implementation of PSDDA in central Puget Sound through improvements to the program. Revisions to the PSDDA program in the future will be needed and have been allowed for through an annual review process that incorporates public participation.

We have rated the draft EIS as LO - Lack of Objections, Category I - Adequate. An explanation of the EPA rating system for EISs is enclosed for your reference. This rating will be published in the Federal Register. 1

We are pleased to have been a part of the planning process and commend the commitment and work of the other participating agencies. Thank you for the opportunity to review the draft EIS.

Sincerely,

Robie G. Russell
Regional Administrator

RESPONSE TO U.S. ENVIRONMENTAL PROTECTION AGENCY

Response 1. Comment noted.

C-5

DEPARTMENT OF HEALTH & HUMAN SERVICES

Public Health Service

Centers for Disease Control
Atlanta GA 30333

May 12, 1989

Col. Philip L. Hall
District Engineer
Seattle District, Corps of Engineers
P.O. Box C-3755
Seattle, Washington 98124

Dear Col. Hall:

(1) We have reviewed the Draft Environmental Impact Statement (DEIS) for the "Unconfined Open-Water Disposal for Dredged Material, Phase II, (North and South Puget Sound." We are responding on behalf of the U.S. Public Health Service. We concur with the need for an unconfined dredged material disposal site in the deep waters of Puget Sound. We feel that the DEIS provides a adequate assessment of the potential environmental impacts resulting from this project.

(2) Clearly, a major public health concern with dredging operations in Puget Sound is the large amount of contaminated sediments which have accumulated due to municipal and industrial disp practices in the past. This problem is well documented in the DEIS and it is stated that only "acceptable" materials will be dredged for ocean disposal. We do request that additional, more detailed information (in addition to Table 2.6) be included in the Final Environmental Impact Statement (FEIS) regarding the proposed methods for reliably determining the acceptability of sediment materials for disposal.

(3) We were pleased to find sections in this DEIS devoted specifically to human health. These sections provided an explicit assessment of potential hazards to human health from seafood contamination, drinking water, inhalation of dust, direct exposure, and noise. Assuming only "acceptable" sediments are disposed at sea, we concur with the finding that potential impacts to human health are minimal. While some increase in ambient noise is anticipated during dredging and transportation operations, these impacts appear minimal due to infrequent noisy operations as well as muffling devices which have been proposed to quiet noisy equipment.

Thank you for sending this document for our review. Please insure that we are included on your mailing list for the FEIS for this project as well as future documents with potential public health impacts which are developed under the National Environmental Policy Act (NEPA).

Sincerely yours,

David E. Clapp, Ph.D., P.E., CIH
Environmental Health Scientist
Center for Environmental Health
and Injury Control

RESPONSE TO DEPARTMENT OF HEALTH AND HUMAN SERVICES

Response 1. Comment noted.

Response 2. In dealing with this request, the PSDDA agencies sent the Department a response letter (attached as the next letter) and the PSDDA Phase I Final EIS and Evaluation Procedures Technical Appendix. Dr. Clapp acknowledged that his comments had received adequate consideration in a further letter (which is attached).

Response 3. Comment noted.

DEPARTMENT OF HEALTH & HUMAN SERVICES

Centers for Disease Control
Atlanta GA 30333
June 2, 1989

Mr. Frank Urabeck
Seattle District, Corps of Engineers
P.O. Box C-3755
Seattle, Washington 98124

Dear Mr. Urabeck:

Thank you for your recent (undated) letter regarding our Agency's comments on the Puget Sound Dredged Disposal Analysis (PSDDA) Phase II project. We feel that our comments have received adequate consideration, as described in your letter, and we have no further comments to offer at this time.

Thank you for sending the PSDDA documents for our review. Please insure that we are included on your mailing list for any further documents for these projects as well as future documents for projects with potential public health impacts which fall under the provisions of the National Environmental Policy Act (NEPA).

Sincerely yours,

David E. Clapp

David E. Clapp, Ph.D., P.E., CIH
Environmental Health Scientist
Center for Environmental Health
and Injury Control

25 May 1989

Planning Branch

Dr. David E. Clapp
Environmental Health Scientist
Center for Environmental Health and Injury Control
Centers for Disease Control
Public Health Service
Department of Health and Human Services
Atlanta, Georgia 30333

Dear Dr. Clapp:

I have received your letter of May 12, 1989, regarding the draft Environmental Impact Statement (EIS) and Draft Management Plan Report (DMPR) for the Puget Sound Dredged Disposal Analysis (PSDDA) Phase II. Thank you for your comments.

In your letter, you request that further information be added to the final EIS on proposed methods for reliably determining the acceptability of sediment materials for disposal. The draft EIS incorporates a number of Phase I documents by reference. Of these, the final Phase I EIS discusses the choice of the nondispersive disposal guideline, and the Evaluation Procedures Technical Appendix describes the rationale behind selection of particular procedures. I have included both of the referenced Phase I documents, which were previously reviewed by your staff. Within the Phase II documents, the DMPR chapter 5 and appendix A list all the procedures and proposed changes/clarifications to them. The principal change is the adoption of a new, more restrictive guideline for dispersive sites which does not involve new tests, but instead a tighter interpretation of existing tests, and is a Regional Administrative Decision. Because of the number of descriptions and references to them in these documents circulated for public review, I do not believe it necessary to add further information to the FEIS.

If you should like to discuss this, please contact me at telephone (206) 764-3708.

cc:

Sincerely,

Frank Urabeck
PSDDA Study Director

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
Washington, D.C. 20230

Office of the Chief Scientist

June 5, 1989

Mr. Frank J. Urabeck
Seattle District, Corps of Engineers
P.O. Box C-3755
Seattle, Washington 98124

Dear Mr. Urabeck:

This is in reference to your Draft Environmental Impact Statement on the Management Plan Report-Unconfined Open-Water Disposal of Dredged Material, Phase II (North and South Puget Sound), Washington.

We hope our comments will assist you. Thank you for giving us an opportunity to review the document.

Sincerely,

David Cottingham

David Cottingham
Director
Ecology and Environmental
Conservation Office

Enclosure

75 Years Stimulating America's Progress ★ 1913-1988

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
1002 NE [illegible]
PORTLAND OREGON [illegible]

F/NWR5:43

JUN 1 3 1989

Received
July 11, 1989

Mr. Frank J. Urabeck
Seattle District, Corps of Engineers
P.O. Box C-3755
Seattle, Washington 98124

Dear Mr. Urabeck:

We have completed our review of the Puget Sound Dredged Disposal Analysis (PSDDA) Phase II Draft Environmental Impact Statement (DEIS), Management Plan Report (MPR), and Disposal Site Selection Technical Appendix (DSSTA). The following comments are based on the National Marine Fisheries Service's (NMFS) responsibility for the management, protection and enhancement of marine, estuarine, and anadromous fishery resources and their supporting habitats.

This program, as described in the subject documents, proposes the open-water disposal of approximately 6.2 million cubic yards (DEIS page S-7) of dredged spoils (including contaminated sediments) at five locations in Puget Sound comprising 2,996 acres. Each of these locations is geographically isolated, possesses greater biological value, and differs substantially in habitat character relative to disposal sites evaluated during Phase I of PSDDA. General Response

The following comments are presented in two sections: I. General Comments; and II. Specific Comments.

I. General Comments

A. The decision to limit the comparative analysis of program alternatives to disposal site location (DEIS pages S-19), and not evaluate alternate disposal guidelines, appears to be inconsistent with regulations that require the assessment of alternatives that avoid or minimize adverse environmental impacts (40 C.F.R. 1500.2(e)). This decision and the absence of necessary information precludes any meaningful involvement by agencies and the public in decision making under the National Environmental Policy Act (NEPA). 1

Disposal guidelines have been unilaterally adopted for this proposal despite significant differences in site characteristics (resource values at phase II sites are greater than in phase I areas DEIS page 1-5), disposal

RESPONSE TO NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION, NATIONAL MARINE FISHERIES SERVICE

General Response. The statement that "contaminated sediments" would be disposed in open-water sites is incorrect. The PSDDA evaluation procedures were formulated to avoid unconfined, open-water disposal of contaminated sediments in open water.

Response 1.

Comparative analysis of program alternatives.

The alternatives presentation in the DEIS fully complies with 40 CFR 1500.2 (e): "identify and assess the reasonable alternatives to proposed actions that will avoid or minimize adverse effects of these actions on the quality of the human environment." The DEIS has been rated as "lack of objections--adequate" by EPA letter dated June 13, 1989 (attached to this exhibit).

PSDDA was established as a regional approach to dredged material management in response to suggestions made by various environmental organizations, the Puget Sound ports, other Federal and State agencies, and elected officials. Agencies and individuals participating in PSDDA recognized that a regional approach promotes predictable and consistent decisions that benefit environmental resources, the dredging community, and society at large. Limited manpower and funding resources precluded the entire geographic region from being addressed at once. Consequently, the study was split into two overlapping phases. The public was clearly informed at the beginning of PSDDA that this would be the approach, and that decisions reached in Phase I would govern certain aspects of Phase II, e.g., dredged material evaluation procedures.

Section 1.04d of the FEIS describes both NEPA and State Environmental Policy Act (SEPA) requirements and their relation to the PSDDA planning process. The Phase II DEIS/FEIS incorporate the Phase I FEIS and other PSDDA documents by reference, including the full analysis of alternative site management conditions given therein. Taken together, the PSDDA Phase I and II FEIS address the total range of alternatives necessary to evaluate the potential environmental consequences to the significant resources of Puget Sound. While divided into Phase I and II geographic areas with slightly different times for completion of program planning, PSDDA was (as stated in the Phase II FEIS section 2.01, page 2-4), a general or soundwide program. This was also made clear in the EIS scoping notices issued at the beginning of both the Phase I and II studies and during the many public meetings and workshops held throughout the Puget Sound area. NEPA and SEPA scoping and public meetings occurred throughout the entire Puget Sound area during Phase I, and continued during Phase II, and included mailings of newsletters and environmental documents to both areas. Participation as part of the Disposal Site Selection Work Group, Management Plan Work Group, and Evaluations Procedures Work Group was encouraged of all interested agencies, Indian tribes, environmental organizations and private citizens. As indicated in Section 5 of the DEIS, a broad and varied participation was achieved. NOAA/NMFS representatives attended some of these meetings and the first PSDDA Annual Review Meeting held in February, 1989. With the exception of technical input on chemical and biological test protocols, NOAA/NMFS did not indicate opposition to the PSDDA disposal guidelines in work group sessions.

The key features of the Phase II management plan that govern environmental impacts not previously addressed in the Phase I FEIS are the location of the sites and specific site management plans. The Phase I FEIS focused on alternative site locations (resources existing at or near the alternative site locations) for the Central Puget Sound area, and provided extensive considerations regarding alternative site management conditions for nondispersive disposal sites (the acceptable level of biological effects on resources due to sediment chemicals of concern). Dredged material evaluation procedures (including sampling, testing and disposal guidelines, were presented. These procedures were designed to ensure that the selected site management condition would not be exceeded. Some of these procedures are updated in the Phase II documents to reflect initial experience in the Phase I area and new information gained from other studies and scientific research.

As the nondispersive guideline had been selected during Phase I of the program, there was no reason to address this guideline during Phase II. Consideration was given to using the same guideline for the dispersive sites. However, due to monitoring constraints at these dispersive locations, the PSDDA agencies opted for a more restrictive guideline. The guideline is documented in the Phase II MPR (Chapter 5, section 5.8 and Exhibit A) and the FEIS (section 2.03h). In both Phase I and Phase II documents, and for both nondispersive and dispersive sites, a reasonable and most likely no-action alternative was selected. That alternative included the disposal guideline in existence at the time the Phase II DEIS was prepared, the Puget Sound Interim Criteria, or PSIC. The PSIC would be more restrictive (as noted in the FEIS) for some chemicals, but the list of chemicals is not as comprehensive as PSDDA's. Also, only the amphipod (a relatively insensitive biological test) is used, with raw mortality the measure of failure (PSDDA is relative mortality compared to Puget Sound reference areas). The PSIC were arbitrarily established without the benefit of the careful scientific process provided by PSDDA. The PSIC incompletely cover chemical and biological effects concerns as well as are excessively restrictive. The PSIC were always intended to be, as the name implies, interim guidelines pending completion of the PSDDA. Resources agencies (including NOAA/NMFS) have long encouraged the addition of chemical and biological testing beyond PSIC. This has been accomplished through the PSDDA study.

As noted above, the disposal guidelines for Phase II were not "unilaterally adopted." The disposal site identification process took into account the resources at these sites and significant adjustments were made in the site management plans to minimize potential adverse effects (see FEIS section 4 for details).

guideline deficiencies (the absence of sublethal and chronic effects bioassays), and concerns expressed by Federal and State resource agencies and Indian Tribes. NMFS opposed the adoption of these guidelines and recommended a less environmentally damaging alternative in comments addressing the Phase I DEIS dated March 24, 1988. Similar comments were presented by the United States Fish and Wildlife Service, and the Tulalip and Suquamish Indian Tribes. The Puget Sound Water Quality Authority also indicated that such guidelines were inconsistent with the Authority's long term goal.

B. The DEIS does not provide necessary information relevant to reasonably foreseeable adverse impacts, including impacts that have catastrophic consequences, even if their probability of occurrence is low. (2) Foreseeable impacts to aquatic organisms include sublethal and chronic effects and behavioral responses resulting from sediment and water column contamination. (3) The DEIS should state that necessary information is incomplete, provide a summary of existing credible scientific evidence that is relevant to evaluating such impacts, and an evaluation of such impacts based upon theoretical approaches or research methods generally accepted in the scientific community (40 C.F.R. 1502.22(b)). This requirement is necessary to facilitate a reasonable choice among alternatives.

C. The DEIS does not provide adequate information regarding potential food web contaminant transfer offsite, and sensory impairment or behavioral modification of anadromous salmonids (particularly coho and chinook salmon that residualize in Puget Sound) encountering dredged material contaminants in the water column. Such information is essential to allow a reasoned choice among alternatives. (4)

D. The adopted disposal guidelines are incomplete as evidenced by the statement "there is still no regulatory test for assessing chronic sublethal effects" (MPR page 5-19). The adoption of interim disposal guidelines, and the intent to develop, interpret, and implement sublethal and chronic effects bioassays for future use, precludes public involvement in decisions that affect the quality of the environment (40 C.F.R. 1500.2(d)). (5)

The interim use of acute toxicity and bioaccumulation tests, as planned to assess chronic and sublethal effects, is inappropriate and would not lead to adequate environmental protection. The MPR (page 5-19) states that "When a chronic sublethal test is ready for use, the PSDDA agencies will consider how such a test will be interpreted relative to disposal guidelines used to make decisions on the acceptability of dredged material for discharge at the PSDDA sites". However, the statement that the development of a "regulatory test will depend upon the availability of funds and upon decisions made by the PSDDA agencies" (MPR page 5-

The Phase I FEIS concluded that the disposal guidelines adopted for the Phase I nondispersive sites were fully consistent with Section 404(b)(1) of the Clean Water Act and all other Federal and State laws, as well as the Puget Sound Water Quality Management Plan. The Clean Water Act requires that the discharge of dredged material not result in an "unacceptable adverse effect" to the aquatic environment. In the implementing regulations ("Section 404(b)(1) Guidelines"), this requirement is clarified as the "least environmentally damaging practicable alternative" (emphasis added). Impacts to Puget Sound were deemed by the PSDDA agencies to be minor and "acceptable" in the context of the CWA. In addition, monitoring is required to verify that an unacceptable site condition is not created through the use of the disposal guidelines. For a discussion of chronic and sublethal effects bioassays and their relationship to the PSDDA disposal guidelines, see response 3, below.

NOAA/NMFS' opposition to the adopted Phase I disposal guidelines was acknowledged in the Phase I FEIS and fully considered by the PSDDA agencies in the decisionmaking process. The Federal Record of Decision, signed by the Corps and EPA in December 1988 also recognized the concerns by NOAA/NMFS, but noted that a more restrictive guideline was inappropriate. The Puget Sound Water Quality Authority (PSWQA) has accepted the Phase II management plan, including the disposal guidelines, as appropriate for the Phase II sites (see PSWQA comments, this exhibit). The DEIS/FEIS discusses the relationship of PSDDA to the PSWQA Water Quality Management Plan (see FEIS summary, page 5-5; 4.03e(7); 4.06e(7); 4.09e(7); 4.12e(7); and 4.15e(7).

See response 3, below, for discussion of chronic and sublethal effects bioassays.

Response 2. The PSDDA agencies disagree. The current Council on Environmental Quality regulation (40 CFR 1502.22) states that:

> "When an agency is evaluating reasonably foreseeable significant adverse effects on the human environment and there is incomplete or unavailable information the agency shall always make clear that such information is lacking.
>
> (b) If the information relevant to reasonably foreseeable significant adverse impacts cannot be obtained because of the overall costs of obtaining it are exorbitant or the means to obtain it are not known, the agency shall include within the environmental impact statement: (1) A statement that such information is incomplete or unavailable; (2) a statement of the relevance of the incomplete or unavailable information to evaluating reasonably foreseeable significant adverse impacts on the human environment; (3) a summary of existing credible scientific evidence which is relevant to evaluating the reasonable foreseeable significant adverse impacts on the human environment; and (4) the agency's evaluation of such impacts based upon theoretical approaches or research methods generally accepted in the scientific community . . . ."

The requirement for the summary cited in 40 CFR 1502.22(b) (1987) does not apply unless information is unavailable concerning a reasonably foreseeable significant environmental consequence. Although it is acknowledged that there is a degree of professional judgment required to predict impacts of the dredged material on disposal area benthos, the FEIS and other PSDDA documents present adequate information to support the conclusion that reasonably foreseeable impacts will not be significant. The environmental analysis used in the FEIS conservatively assesses the potential impacts on the basis that all material disposed is just passed the PSDDA disposal guidelines. In reality, most material discharged at the sites will be substantially cleaner than this.

The analysis indicates that some measurable physical impacts to fauna will occur due to disposal activities, but no significant, long-term chemically caused impacts are anticipated. No "catastrophic consequences" are foreseen, even those that might have a low probability of occurrence.

Response 3. As stated above, the requirement for a summary of information specified in 40 CFR 1502.22(b) does not apply. The PSDDA agencies have summarized and referenced pertinent information on chronic sublethal effects in the final Phase II documents. In Phase I and the draft Phase II MPR, the PSDDA agencies acknowledged the current lack of a chronic sublethal test, despite several major research efforts funded by the agencies, including a study conducted by NMFS scientists. Further research by EPA and Ecology is in progress, and may conclude with a chronic sublethal test useful for regulatory decision making. NMFS scientists are aware of current PSDDA and Puget Sound Estuarine Program research actions, and participated in briefings and expert workshops on the subject. In the absence of a chronic sublethal test, the PSDDA agencies are relying on the existing suite of sensitive PSDDA bioassays that include several sublethal indicators (amphipod, oyster sediment larval assay, and microtox) that were recommended by NMFS scientists (see EPTA pp II-74 to II-78 and exhibit E-22). These bioassays will provide the weight of evidence necessary to evaluate dredged material prior to discharge at PSDDA sites. As noted above, chronic sublethal effects due to chemicals in disposed dredged material are acceptable adverse effects at the nondispersive sites but not outside them.

The lack of a chronic sublethal test at this time does not place aquatic populations at significant risk. Recently acquired additional information on this issue has been added to the final Phase II documents (section 5.10).

Several existing program features address water column and near-site impacts. First, a sensitive species is used in the larval tests with a combined lethal/sublethal endpoint to assess potential benthic and water column impacts from suspended sediments and dissolved toxicants. By agitating the sediment in water prior to conducting the test, a "worst case" exposure environment is created, overestimating the predicted suspension that would occur during disposal, and very likely exposing as lethal and sublethal endpoints effects which could occur in the field as chronic sublethal responses in a comparably sensitive or less sensitive species.

20), denotes uncertainty regarding funding, development, timeliness, and the final result of this crucial program component.

The acceptability of dredged material for open-water disposal is a pre-eminent and controversial issue. Although many of the biological consequences associated with dredged material disposal have been identified, the DEIS acknowledges that chronic effects experienced by aquatic organisms exposed to contaminated sediments have not been established. Such uncertainty has fostered public efforts to severely restrict or prohibit dredged material disposal in Puget Sound, even leading to the closure of key open-water sites. The development of disposal guidelines that establish the acceptability of dredged material for open-water disposal, is an integral component of the PSDDA program. The interim disposal guidelines previously rejected by Federal resource agencies, Indian tribes, and citizen groups, are recognized to be incomplete, and ill-suited to evaluate sublethal and chronic effects to aquatic organisms. We question the adoption of these guidelines for PSDDA Phase II prior to the development of chronic and sublethal effects bioassays.

E. Contrary to conclusions presented in the DEIS, the dredged material disposal guidelines seems inconsistent with the objectives or requirements of existing environmental laws and policies. (6)

A fundamental objective of the Clean Water Act and NEPA is to restore the chemical and biological integrity of aquatic areas. The Puget Sound Water Quality Comprehensive Plan shares this objective given it's intent to eliminate the presence of sediments that cause adverse effects to biological resources. The Puget Sound Water Quality Authority also maintains this view, as evidenced by its goal to support activities that do not allow adverse effects to biological resources resulting from sediment contamination.

The adopted disposal guidelines allow chronic sublethal effects to occur due to the presence of chemicals in dredged material (DEIS page S-13). Permitting the degradation of aquatic areas comprising hundreds of acres, the maintenance of aquatic habitats in a degraded condition with the disposal of contaminated dredged spoils, and the dispersion and dilution of contaminants in aquatic areas to minimize adverse effects seem inconsistent with the intent of these laws and policies.

Environmental impacts associated with the implementation of the adopted disposal guidelines include: (7)

1. Acute toxicity is expected for some onsite species (DEIS page S-17);

Response 4. The PSDDA agencies disagree. The DEIS and FEIS provide adequate information on these issues. As noted in FEIS section 2.03f(2)(b)3 (page 2-38 of the DEIS), a very small percentage of dredged material is expected to be suspended during a disposal event. Thus, this material will not provide a significant exposure pathway for chemicals of concern to juvenile nor adult salmonids. A large number of water column monitoring tests has shown low levels of chemical residuals even when sediments released in the water column during testing contained elevated levels of chemicals of concern. Food web transfer offsite is addressed by environmental monitoring of sessile benthic communities surrounding the site for increased body burdens and for community composition. At the Bellingham Bay site only, crab populations' body burdens will also be monitored.

Response 5. As discussed in responses 4 and 5 above, the lack of a regulatory chronic sublethal test does not preclude adequate protection of the marine environment. What is portrayed in this comment as uncertainty or risk is really the need for a suitable measurement tool. The PSDDA evaluation procedures presently address chronic sublethal concerns as described in EPTA (p. II-74ff) and the phase II MPR (Section 5-10) via sediment quality values which include benthic community index measures and biological tests with sensitive acute lethal and combined lethal sublethal endpoints. These procedures are anticipated to be improved through time via the annual review process, and this is clearly stated in the MPR and EPTA. As indicated in response 3, above, substantial amount of in-progress research is occurring to develop a usable chronic sublethal test. An acceptable test does not exist at the present time. NOAA/NMFS' comment fails to acknowledge the considerable gain in knowledge concerning dredged material evaluation and the substantial improvement in the management of dredging disposal activities which has been accomplished through PSDDA to date. It is neither logical nor reasonable to delay disposal activities until an acceptable chronic sublethal test is developed.

It now appears that funding availability will not preclude test development (see MPR, Section 5-10).

Response 6. The PSDDA agencies fully support ongoing Clean Water Act programs to control and eliminate sources of chemicals discharged to Puget Sound. As technology improves and these source control programs achieve their objectives, sediments in navigation channels will improve in quality. The Clean Water Act addresses the discharge of pollutants into the aquatic environment in a technology based manner, but Section 404 of the law specifies an effects-based approach to regulating the discharge of dredged and fill material into waters of the United States. The CWA requires that the discharge of dredged material not result in an "unacceptable adverse effect" to the aquatic environment. In the implementing regulations ("Section 404(b)(1) Guidelines"), this requirement is clarified as the "least environmentally damaging practicable alternative."

The nondispersive guidelines are fully consistent with this clause of the CWA and all other Federal and State laws, well as the PSWQA management plan. It

2. materials to be disposed would likely increase concentrations of chemicals of concern over naturally occurring levels at disposal sites (DEIS page 4-32);

3. less sensitive taxa located within the disposal site boundaries may also experience some sublethal chronic effects (DEIS page 4-32);

4. cumulative effects of exposure to dredged material could result in a reduction in abundance and biomass of equilibrium species (DEIS page 4-32);

5. fishes could experience chronic effects from contaminated sediments via either contact with the gills or feeding on small invertebrates in the disposal area. Such effects could extend beyond the disposal site (DEIS page 4-35);

6. chemical bioaccumulation in fish predators is expected to occur. Direct exposure to chemicals could also occur through the fishes skin and gill membranes as a result of their intimate association with the bottom sediments (DEIS page 4-39);

7

7. mobile benthos (crab, shrimp etc.) and demersal fishes feeding on disposal site benthos and migrating offsite with a higher body burden could contribute chemicals to the food web (DEIS page 4-56);

8. the environmental effects resulting from the bioaccumulation of contaminants in Puget Sound crabs are unknown. Potential effects include: impairment of the molting process, reduced reproductive capability, decreased feeding ability, and decreased resistance to disease (DEIS page 4-58);

9. chronic sublethal effects would result from shrimp being in direct contact with particle bound chemicals and with those that become dissolved within sediment pore water" (DEIS page 4-59);

10. adult salmonids in the vicinity of a disposal area or microlayer "plume" could absorb chemicals via the gills and may as a result exhibit physiological impairments (DEIS page 4-61). Resident populations of coho and chinook salmon, and migrating adult anadromous salmonids, exhibit milling behavior at the surface throughout Puget Sound and, therefore, could experience such exposure for extended periods;

11. in both laboratory experiments and field evaluations, clams and burrowing worms have been found to accumulate significant concentrations of organic compounds that had been associated with dredged material (Phase I MPR page 5-4); and

can also be argued that less restrictive guidelines would be consistent with the 404(b)(1) guidelines (see Phase I FEIS). The guidelines clearly do <u>not</u> require that <u>no</u> adverse impacts be permitted, as suggested by NOAA/NMFS. There has been no application of this extreme interpretation anywhere in the nation. The PSWQA recognized the need for allowing some adverse effects in disposal site areas in order to meet the socio-economic needs of the region and also acknowledged that potential adverse environmental effects of disposal of dredged material in other environments is a key consideration. With the active involvement of NOAA/NMFS and other Federal and State agencies, the tribes and the public, improved pollution source control should be achievable within the foreseeable future. This would lessen the potential for problem sediments that require upland disposal and result in generally cleaner sediments disposed in unconfined, open-water sites.

<u>Response 7.</u> Response 3 deals with the consideration of chronic sublethal impacts, associated risks to aquatic populations, and programmatic protection and checking measures. The list shown in the comment contains PSDDA DEIS and Phase I MPR text, presented out of context. The listed impacts are based on worst-case conditions as noted in the response to comment number 2, above. Many of these impacts may not occur as most dredged material is expected to be much cleaner than that allowed by the PSDDA guidelines. Also, as described in Section 4 of the FEIS, a management plan for each disposal site has been formulated to restrict disposal actions to further avoid possible adverse effects.

<u>Response 8</u>. The PSDDA agencies disagree. The no-action alternative is adequately evaluated for purposes of the programmatic EIS. Each proposed dredging project will be evaluated on its own merits.

<u>Response 9</u>. The DEIS did indeed deal generally with the alternate (confined) fates of dredged material. That is the only way that they may be considered given present information on development of multiuser confined, upland sites for dredged material disposal in the Puget Sound region. The comment does not recognize that the purpose of PSDDA is to designate environmentally and publicly acceptable unconfined open-water sites. Decisions on acceptability of material for this, and no other purpose, is the present action. For this reason, a no-action alternative was chosen and is fully described in the DEIS Section 2.02) which fulfills the stated intents of NEPA and SEPA. The no-action alternative leads to the probable future lack of public, multiuser, open-water, unconfined sites in the Phase II area.

This comment states that there is always a possible alternative to open-water disposal in upland confined disposal. It is true that this is a possible alternative, but not always a plausible nor feasible option. There is a considerable amount of work yet to be done in achieving a practicable regional, multiuser upland confined site. Existence of an unconfined open-water site under PSDDA does not <u>per se</u> determine acceptability of disposal of any specific dredged material at PSDDA sites under existing laws and regulations.

... chemicals known ... Puget Sound sediments, selected chemicals thought to be associated with adverse biological effects, have the potential to remain toxic in the aquatic environment for extended periods, and have the potential for entering the food web (Phase I MPR page 5-10).

Requirements of existing environmental laws and policies seem unfulfilled by the adopted disposal guidelines. The Section 404(b)(1) Guidelines, and State laws establish the need to consider chronic and sublethal effects to aquatic organisms resulting from chemicals that could be present in sediments proposed for open-water disposal (MPR page 5-18). Dependence on interim disposal guidelines, pending development of an appropriate sublethal bioassay (MPR page 5-18), puts important aquatic resources in Puget Sound at risk without assurance of the necessary protection.

F. The DEIS does not provide an adequate evaluation of the no action alternative (40 C.F.R. 1502.14(a)); therefore, a clear basis for choice among dredged material disposal options is not available. 8

Although the DEIS acknowledges that "chemical release to the ground water via leachate can be controlled through a variety of technologies" (page 4-10), the comparative effectiveness, cost, and environmental consequences of each technique relative to open-water disposal is not provided. Upland confinement technologies are well developed and offer a moderate to high degree of protection for public health and the environment by isolating contaminated dredged spoils in a secure environment that is readily monitored (Commencement Bay Nearshore/Tideflats Feasibility Study, Executive Summary, March 1988). 9

The characterization of candidate dredged spoils expected to be considered for discharge at Phase II sites as "generally quite clean" (DEIS page 1-4), precludes any meaningful comparative evaluation of disposal alternatives and their associated environmental impacts. Information regarding the acceptability of contaminated dredged material for disposal at landfills, and the availability, capacity and cost of landfill disposal is not presented.

The Section 404 Guidelines always prohibit discharges when there is a practicable less environmentally damaging alternative. Upland confinement techniques, instead of open-water disposal, represent a less damaging alternative for aquatic resources given the state-of-the-art and the nature of candidate disposal material. Under these circumstances, the "acceptability" of open-water disposal cannot be ascertained until an objective evaluation that establishes the practicability of upland confinement alternatives for the PSDDA Phase II region is completed. Information necessary to facilitate such an evaluation

The regulations state that, except as provided under Section 404(b)(2) of the Clean Water Act, no discharge of dredged or fill material shall be permitted if there is a practicable alternative to the proposed discharge which would have less adverse impact on the aquatic ecosystem, so long as the alternative does not have other significant adverse environmental consequences. Practicability takes into account economic (cost, availability) and environmental (protectiveness of the quality of the human environment and human health) factors and logistics.

Accordingly, under PSDDA, the determination of compliance with the guidelines are made on a project-by-project basis as a regulatory action which is subject to full public and agency review. Availability and environmental protectiveness of upland and other confined disposal options will be taken into account at the time of each of these decisions. Unconfined, open-water disposal of dredged material may not be the allowed alternative for all projects where disposal has been proposed.

The DEIS states (page 4-5): "Proper siting of upland and nearshore confined disposal facilities is the key to minimizing environmental impacts. Once suitable site locations have been found, sites can be designed to acceptably contain chemicals of concern. 'Acceptability' of a given design for contaminated material is heavily dependent on site specific characteristics." Few multiuser upland sites with scant capacity for dredged material presently exist in the region, and Ecology is still very early in the process which will create guidelines, siting feasibility studies and means to designate suitable sites. The FEIS presents the best available information on quantities of material that might not be found suitable for unconfined open-water disposal, but does not indicate where that material might go, nor whether it would be feasible to dredge the material. Disposal options involving upland, nearshore, and deepwater environments are briefly considered (along with potential associated environmental damages), as is the "no dredging" option. This treatment of alternatives is adequate to an informed decision on the designation of unconfined, open-water sites for dredged material disposal.

There is a substantial body of scientific evidence suggesting that saturated soils, with even low levels of chemicals, may release these chemicals once the material has been drained, dried, or acidified by aerobic microbiological processes or solid-waste-derived chemicals which may co-occur in upland landfills. The FEIS discusses the potential tradeoffs between environmental and public health impacts of such dried soils and saturated soils disposed in an aquatic environment.

The comment suggests a tie between the Ecology effort and PSDDA which does not exist. In order to give a sense of the current and future availability of confined, upland and in-water disposal facilities, the following paragraphs describe the Ecology studies relating to PSWQA Plan Elements S-4 (confined disposal criteria) and S-6 (confined disposal facility siting feasibility study). The Ecology studies, which complement PSDDA, have demonstrated that technologically protective sites for upland disposal are possible, but generally regionally unavailable.

includes the quantity of contaminated candidate disposal material and the degree of environmental protection provided by the upland confinement of candidate material.

References to adverse impacts to nearshore aquatic habitats resulting from dredged material disposal under the no-action alternative are inappropriate since most or all of the acreages forecast for confined disposal under this alternative would likely be upland (DEIS page 4-12).

G. Contingency plans presented in the MPR (page 7-9) are vague and potentially unresponsive to adverse environmental impacts. Such plans should be concise, prioritized, and not require reinterpretation during the duration (10 years or more) of the program. Specific performance standards have not been established and are also necessary. If environmental impacts exceed established performance standards, disposal operations should be suspended until appropriate measures are implemented to ensure that the desired environmental condition is preserved. (10)

II. Specific Comments

A. Environmental Analysis (DEIS, page S-12, paragraph 5.) (11)

Sediment chemistry information specific to each proposed disposal site was not provided in the subject documents. Expectations that sediment contamination at the Bellingham Bay site will "remain the same or perhaps improve" are unfounded.

B. Purpose and Need for Action (DEIS, page 1-1, paragraph 3.)

"The PSDDA program does not address the dredging and disposal aspects of specific projects or disposal options for a given project. At the time of public and agency review of permit applications for each project, documents must be prepared by the applicant that present the alternatives considered for that project and include an evaluation of anticipated environmental effects of dredging and disposal". We concur with this determination and recommend subsequent Phase II documents state that Department of the Army Regional Permits should not be issued for dredged material disposal applications since this may preclude resource agency and public review of individual disposal proposals. (12)

C. Issues and Concerns (DEIS, page 1-4, paragraph 4.) (13)

The comments "In the Phase I area, there has been a clear trend toward increased open-water disposal of dredged materials." and "In the Phase II area, open-water disposal is also expected to be the preferred option for most dredgers." do not reflect the concerns of resource agencies. Our primary objective when considering the open-water disposal of

The S-4 and S-6 studies of dredged material management in nearshore and upland environments arose from concerns stated by the Washington Ports and others regarding availability of sites for dredged material that could not be disposed at open-water disposal sites. This planning effort was mandated with the adoption of the PSWQA Puget Sound Water Quality Management Plan. Ecology is presently working to create standards for confined disposal and a decisionmaking framework. Confined disposal standards for sediments will be adopted as interim standards by July 1, 1990. The decisionmaking framework in Ecology's S-4 documents bear a resemblance to PSDDA's tiered testing process, and the PSDDA report titled <u>Guidelines for Selecting Control and Treatment Options for Contaminated Dredged Material</u>. The Ecology reports are currently being circulated by Ecology for review by affected agencies, including NOAA/NMFS, the Indian tribes, and the public. The schedule for completion of the rulemaking phase is July, 1990. A concurrent effort is being made by Ecology for multiuser site(s) in upland, nearshore, or aquatic environments. Ecology will make a recommendation to PSWQA by July 1990 on whether to proceed with a multiuser, confined disposal site feasibility study. However, prior to the establishment of such a multiuser site, a SEPA (or NEPA/SEPA) siting EIS would need to be completed, and, at this writing, it is not clear what agency or entity would do so.

The Ecology S-4 and S-6 efforts should take a minimum of 2 years to complete. Until then, the existing framework of State and local jurisdictions, guided by the decisions of local solid waste and public health departments will continue to determine the availability and cost of upland disposal. Options now consist of landspreading (if allowed), construction debris landfills, and lined landfills regulated under the Resource Conservation and Recovery Act. A review of available upland sites in King and Pierce Counties suggests that there is very limited space available for dredged material disposal.

<u>Response 10</u>. The comment perceives a deficiency in textual description of monitoring triggers and associated actions, and indicates monitoring plans are "potentially unresponsive to adverse environmental impacts." The associated contingency actions are specified at those locations and summarized in Phase II MPR Section 7.4.3. They include potential site closure and remediation in extreme instances. This statement appears to derive partially from the reviewers having overlooked the detailed information contained in other sections of PSDDA documents. Concise, prioritized monitoring schemes and performance standards are located in the Phase I Management Plans Technical Appendix Exhibit I, as well as in the Phase II MPR, Exhibit D.

The comment states management plans should not require reinterpretation of guidelines during the duration of the program (life of the site?), suggesting that a rigid set of rules should be the basis for decision-making. This would be difficult, as, for example, the performance guidelines set up for detecting benthic community changes require a statistical difference be shown relative to benthic communities in surrounding communities. Should a statistical difference be found, it is necessary then to do further analyses and interpret the results in an ecological context which takes into account the inherent variability of marine systems. The PSDDA agencies strongly support the need for professional judgment in this process, and would use state-of-the-art analyses in interpreting information.

Response 11. Site-specific sediment chemistry was not available at the time the DEIS was written. However, subsequent site-specific information was obtained by the baseline studies. A very conservative approach was employed in performing the environmental impact analysis. PSDDA effects-based tests (chemical and biological) compare prospective dredged materials to unimpacted Puget Sound reference areas, not to conditions at the disposal sites. The environmental impact assessment was conducted relative to presumed "ideal" conditions, not to the disposal site, even through it may have elevated levels of chemicals. This was used in combination with the highly conservative (worst-case) assumption that all disposed material would have just passed. To the extent that new information suggests there are existing chemical impacts at the site and that disposed material will be cleaner than allowed by guidelines, the actual impacts will be less than predicted.

The statement regarding sediment contamination in Bellingham Bay sediments was based on chemical data cited on page 3-46 (Section 3.03.a.5) of the DEIS, derived from samples generally taken from the inner harbor, and on bioassay information from the EPA Eight Bay Study that demonstrated that sediments nearer Post Point showed toxicity. PSDDA baseline data indicates that sediments in and near the disposal site have concentrations of several PSDDA chemicals of concern that exceed the PSDDA SL values. One chemical exceeded the ML value. These were: mercury (highest concentration 0.56 ppm dry weight, about 2.67 times the SL, 7 exceedances in 21 stations), phenol (1 station exceeded ML by 4 times, SL by 40 times), 4-methylphenol (1 station exceeded SL by 2.33 times). There were no bioassay "hits" at the site, however. Macrobenthic communities were predominated by cirratulid polychaetes which are frequently associated with organic enrichment. Bioaccumulation of metals in tissues of the clam Compsomyax subdiaphana over sediment levels were from <2 times for cadmium and nickel to 15 for arsenic. Substantial unexplained tissue concentrations of benzoic acid occurred over levels in the sediment, although benzoic acid in sediment was under the SL. It is not clear whether this compound is bioaccumulating or is a natural metabolite of the clams. Benzoic acid is not on the list of human health concern chemicals for which target values have been established. These data support the discussion in the DEIS/FEIS that the sediments in the vicinity of the site are chemically impacted.

The sediments in and near the Anderson/Ketron Island site showed only one compound, zinc, that exceeded the SL, by factor of 1.69. No stations failed the PSDDA disposal guidelines based on bioassays. The only elevated tissue concentration was benzoic acid. These data support the contention in the DEIS that the sediments in this location are not impacted.

Response 12. The issuance of Department of Army Regional Permits is not a part of the PSDDA program. A regional permit for maintenance dredging projects involving unconfined, open-water disposal at designated PSDDA sites was proposed. However, in response to public comment, the Seattle District Corps of Engineers concluded that such a permit should not be issued at this time.

Response 13. It is recognized that NOAA/NMFS and other resource agencies wish to avoid adverse impacts to the aquatic environment and the exposure of the public to contaminated seafood. The PSDDA agencies state similar goals and have sought resource agency involvement in the planning process to assure that trends towards increased open-water disposal may coexist with protection of resources in the aquatic environment and human health.

NOAA/NMFS has been encouraged to participate in PSDDA and to influence study considerations and directions throughout the process. It is hoped that NOAA/NMFS staff will participate in Ecology's confined disposal planning activities under PSWQA plan elements S-4 and S-6. As discussed in response to comment 9, capacity and availability of upland sites is limited and there can be significant adverse environmental impacts associated with use of these sites. Preliminary findings by Ecology reinforce conclusions of the PSDDA study, i.e., unconfined, open-water disposal sites, when properly located and managed, are environmentally acceptable and may even be environmentally preferable to upland or nearshore confined sites in some cases.

Most participants in the PSDDA process acknowledge that "simple solutions" do not exist and that Puget Sound marinas and deep-draft harbors and ports must be periodically dredged to meet the socio-economic regional needs, including those of recreational and commercial (Indian and non-Indian) fisheries. However, the paramount concern of PSDDA agencies has been to protect the marine environment. A careful reading of all the PSDDA documents, including the many technical special studies reports, shows this to be true.

The PSDDA agencies are also "resource agencies" in the sense that all are concerned with the protection of Puget Sound resources. These resources have gained substantial improvement in environmental protection through the PSDDA dredged material management plans. The Washington State Department of Fisheries (WDF), the key State agency responsible for the protection and management of Puget Sound fisheries resources provided outstanding technical assistance and guidance throughout the PSDDA planning process, and helped ensure that fisheries resources were protected. Adjustments in site location and site management conditions reflect their recommendations.

As stated earlier, the designation of PSDDA sites does not automatically assure that dredged material will be suitable for disposal there. In order to receive a CWA Section 404 permit for disposal at a PSDDA site, a determination must be made that disposal at the site is the "least environmentally damaging practicable alternative." The sampling, testing, and disposal requirements brought about through PSDDA are comprehensive and protective of the environment, and much greater than prior to PSDDA. Also, the PSDDA annual review process allows for adjustments based on new information and understanding resulting from the rapidly changing state of the art of sediment evaluation methodologies.

Response 14. The text has been changed to reflect beneficial uses with dredged material in other settings. Beneficial uses of this sort are not a new concept and have been used in a number of settings.

dredged material in Puget Sound is avoiding adverse impacts to the aquatic environment, including the contamination of seafoods consumed by the public. In this regard, upland disposal remains the preferred alternative for clean as well as contaminated sediments. The intent of PSDDA should be to provide open-water disposal opportunities only if less environmentally damaging alternatives are not available.

D. Dredged Material Research Program Reports (DEIS, page 1-11, paragraph 1.) 14

The beneficial use of dredged spoils (fish and wildlife habitat development) has not been demonstrated at Jetty Island. Pilot studies are not yet underway. This reference should be deleted from the DEIS.

E. Alternatives (DEIS, page 2-4, letter e.)

The statement "When site use is discontinued, eventual recovery to ambient conditions should occur", is invalid. Chemicals associated with dredged materials have the potential to remain toxic in the aquatic environment for long periods. 15

F. Disposal Guidelines for Nondispersive and Dispersive Sites and Their Effects on Volumes Disposed DEIS, page 2-61, Paragraph 1. 16

The statement "At nondispersive sites, unacceptable adverse impacts can be identified and controlled via monitoring, thereby providing accountability and public acceptability" indicates that "unacceptable" is the standard by which dredged spoils disposal will be measured. The relationship between the term unacceptable and potential adverse impacts to aquatic organisms including acute and sublethal effects, species, life history stage, number of individuals, and location should be defined. Furthermore, the ability of monitoring techniques to identify and quantify such impacts must be established.

G. New Information Gained During Phase II (MPR, page 5-4, paragraph 1.) 17

The use of the "apparent effects threshold" (AET) to derive screening level (SL), and maximum level (ML) values for decision making is an empirical approach that is dependent on the "sensitivity" and validity of the tests used to estimate sediment toxicity. The sensitivity of the tests, however, has not been systematically compared experimentally. Furthermore, none of the tests incorporates chronic and/or sublethal effects for the determination of SL and ML values.

Response 15. While it is true that some chemicals are persistent, chemical toxicity in sediment is not necessarily permanent. Extensive literature exists that indicates recovery of disposal impacted communities to pre-disposal conditions or to similar ecological index conditions after cessation of disposal. This eventual recovery of biological communities to pre-disposal states can occur through a variety of mechanisms, but reduced bioavailability of chemicals from dilution of chemical levels by cleaner dredged material, natural degradation of organic chemicals, and natural sedimentation are major factors.

Response 16. The relationship between unacceptable effects and the biological parameters is the basis for the determination that the PSDDA disposal guidelines are consistent with the CWA Section 404. (See also responses 1, 3, and 6.) The ability to quantify effects via ecological monitoring including chemical and biological tests and bioaccumulation testing is well established. Further information on this subject is presented in the Corps' Environmental Effects of Dredging Program documents and in the scientific literature. The PSDDA documents (e.g., EPTA appendices) include summaries of some pertinent documents.

Response 17. The tests used to determine biological effects are the best available at this time. See the Phase II MPR, Section 5.2.a for a discussion of reliability verification of the sensitivity and efficiency of the PSDDA SL's and ML's. The relative sensitivity of the biological tests have also been systematically by the study conducted for EPA (1988) titled Comparison of Bioassays for Assessing Sediment Toxicity in Puget Sound. The benthic infaunal index does incorporate a measure of sublethal effects in the AET. Benthic infaunal testing integrates population growth, reproduction and fitness through a measurement of community structure and taxonomic abundance. The larval sediment test, larval water column test, and the Microtox that directly assess sublethal effects. EPA and Ecology have further research underway that may lead to a new bioassay which will directly measure chronic sublethal effects. See the Phase II MPR, Section 5.10, and response 3, above.

Response 18. The intent of the statement was to assure that the raw data is provided in the data worksheets to the PSDDA agencies, not merely reported as "unsuitable for reduction," which had occurred. The PSDDA procedures depend on a comparison of test sediment response to the response associated with a "clean" Puget Sound reference area. Reference sediments are not expected to be significantly dose responsive, i.e., they should not usually exhibit a response interpreted as potential toxicity. During the use of the Microtox test in evaluating dredged material, when a significant dose response is shown to occur in the test sediment extract dilution series, the highest test sediment extract response is statistically compared with the comparable extract of the reference sediment. This change in test interpretation was suggested by a NOAA/NMFS scientist at an Evaluation Procedures Work Group (EPWG) meeting.

Response 19. The suggested corrections have been made. The interpretation of this test is based on statistically significant difference between mean test

H. Saline Extract Microtox Test (MPR, page 5-7, paragraph 3.)

The statement that the reference and test sediment mean values of the Microtox assay will be reported if statistically different, is unnecessary. If no dose-responsiveness occurs, no values at the highest concentration can be reported as valid.

I. Saline Extract Microtox Test (MPR, page 5-7, paragraph 4.)

The phrase "of the test sediment" should be added to the first sentence so that it reads "If there is a significant dose-responsiveness relationship of the test sediment...". Also alpha should be less than or equal to 0.05 not 0.5. There is no biological rationale for a 20% decline in light output of the Microtox necessary to act as a trigger for regulatory action. Why isn't a statistically significant decline sufficient to act as a trigger?

J. Organic Extract Microtox (MPR, page 5-7, paragraph 1.)

The reason for excluding the organic Microtox bioassay is unclear. It is also unclear why there should be concordance between the results of the organic and saline Microtox bioassay, as suggested in the document. These tests measure different types of toxicants in the sediments and, therefore, are not likely to be concordant.

K. Clarification of Suitable Bioassay Reference Station (Selections MPR, page 5-15, paragraph 1.)

The purpose for the incorporation of the reference sediment into the bioassay protocol is to test the effects of physical characteristics of the sediments on the bioassays response. If the results of the reference sediment bioassay exceed a certain allowable limit, interpretation of the results cannot be properly evaluated by the bioassay in question. Allowing the project proponent to search for a better result runs contrary to the bioassay design. If the bioassay cannot handle the variable physical sediment characteristics, it should be excluded from the decision making process, page 5-16, paragraph 4. Allowing 25% mortality in lieu of a poor result from the bioassay of a reference sediment is contrary to the intent of the bioassays.

L. Test Development During Phase II and in Related Programs (MPR, page 5-19, paragraph 1.)

With regard to the use of Neanthes sp. in a 10-day lethal and a chronic growth bioassay for regulatory decisions, there is currently very little information relating mortality and growth of this organism to toxicants in sediments that would indicate that Neanthes is in fact a sensitive and responsive organism. We have initial evidence that certain sediment bioassays (both lethal and sublethal) utilizing marine

(18) sediment and mean sediment reference response, and a greater-than-20% diminution of light by the test sediment compared to the reference sediment. As stated in section 8d of exhibit A, "Statistical significance is used to determine if observed differences are 'potentially real' when natural variability of the parameters being measured is considered. Statistics consider the accuracy and acceptability of the bioassays in indicating whether the observed differences warrant further professional evaluation. However, statistical significance does not imply ecological significance, and professional judgment is essential in interpreting bioassay results."

(19) The 20% diminution of light represents a regional administrative decision for the use of saline Microtox test in the context of evaluating dredged material for suitability for unconfined, open-water disposal. This regional administrative decision for regulatory purposes, as well as others stated in the Phase I and Phase II documents, were the result of peer-reviewed workshops and meetings during Phase I and II, in which NOAA/NMFS took part. EPWG, drawing upon the best available technical expertise for dredged material evaluation procedures, recommended this guideline to the PSDDA agencies, who adopted it. What follows is a brief history of the development for all tests.

(20) The 404(b)(1) Guidelines require that dredged material disposal not result in "unacceptable adverse effects" to the aquatic environment. In assessing whether dredged material could result in unacceptable effects, "appropriately sensitive species" are used in biological testing, which includes several different life stages and means of exposure of the tested organisms that represent real exposure routes anticipated at disposal sites.

(21) During development of the evaluation procedures, PSDDA reviewed a number of possible species and biological tests to determine their suitability for use in addressing the regulatory assessments. Though a number of common and indigenous benthic species (e.g., adult shrimp and crabs) could be collected and used for laboratory testing of sediments, many of these were not considered to be "appropriately sensitive." The biological tests selected for the PSDDA evaluation procedures were those recommended by the NOAA/NMFS scientists as the most sensitive and best available at this time: amphipod, bivalve larvae and Microtox. The adopted suite of tests addresses a variety of life stages (adult amphipods, and developing bivalve larvae), exposure routes (water extracts, suspended sediment and contact by direct burial), and endpoints (survival, normal development, and metabolic function). To address concerns that infaunal taxa may not be adequately represented by the selected biological tests, a fourth species was added by the PSDDA agencies to the evaluation procedures requirements (a juvenile infaunal species).

(22) In conducting biological tests, the PSDDA agencies recognized that factors other than sediment chemical contamination also affect the response of the test species, including inconsistency in testing methods, the laboratory testing environment and physical sediment factors such as grain size and organic carbon content. These factors need to be considered when determining whether dredged sediment disposal would result in significant degradation. Concerning testing methods, PSDDA adopted and enhanced the standard laboratory

protocols developed by the Puget Sound Estuary Program. PSDDA evaluation procedures required that a control sample be run concurrent with the test sediment (the sediment to be dredged). To ensure that laboratory conditions (and/or unhealthy animals) are not interfering with the test, a performance standard for the control samples was established (e.g., allowing no more than 10 percent mortality in the amphipod test).

To address grain size, organic carbon and other naturally occurring effects on the test species, the evaluation procedures also required that a reference sediment be run concurrent with the test sediment. Since the reference sample provides a control for these other sediment factors, the effects of any chemicals in the test sediment bioassay is evaluated relative to the reference sediment bioassay results. To ensure that contaminated sediments are not utilized as reference sediments, the PSDDA procedures specified a performance standard for the reference sediment bioassay results (e.g., for the amphipod test, no more than 20 percent mortality in the reference sediment bioassay above the control sediment mortality). This performance standard recognized that grain size and other factors introduce substantial variability in biological test results. Variability has been documented in laboratory studies, where mortality of amphipods even in clean, extremely fine-grained sediments can exceed 80 percent. The variability is also evident in the range of responses seen in clean sediments from Puget Sound reference areas, typically indicating 15 to 25 percent mortality.

The PSDDA evaluation procedures identified a biological test result which indicates the potential for "unacceptable adverse effects" to occur at the disposal site. In deciding how to define "unacceptable effects" (i.e., how to interpret the biological tests), the environmental effects of dredged material disposal were assessed in other environments and the cost tradeoffs of several alternatives were considered (these were detailed in the PSDDA Phase I documents). The selected alternative allows "minor effects" onsite (primarily chronic sublethal effects, but also some mortality in sensitive species), but allows no adverse effects due to dredged material disposal offsite.

In defining "minor effects onsite," the PSDDA evaluation procedures specified that a statistically significant difference between the test (dredged material) bioassay result and the reference sediment bioassay result for only one of the four test species, by itself, did not indicate a potential for unacceptable adverse effects. However, if any two of the four species showed a statistically significant test result relative to reference, then the material is considered unsuitable for unconfined, open-water disposal. (See figure 5.1 in the Phase II MPR.)

Although there is often substantial agreement among the different bioassay species when determining whether a sediment shows adverse effects, the PSDDA evaluation procedures also recognize that each species potentially has unique sensitivity to some chemicals, and may provide some unique information which could assist in protection of the aquatic environment. Consequently, the PSDDA disposal guidelines also provided a single bioassay species can indicate that the material is unsuitable for unconfined, open-water disposal (see referenced figure). These single-species interpretation guidelines are used only when the other three species show no statistical difference relative to reference. In specifying this biological guideline, the PSDDA agencies considered the national precedent for water quality criteria, where the "LC_{50}" value is used (50 percent of the test population shows an effect). However, given the reference area performance standard of 20 percent allowable effect, PSDDA decided to select a more conservative single-species response guideline of 30 percent (50 percent minus 20 percent) for the nondispersive sites. This lower value also addresses the recognized uncertainty in biological test predictions, and provides an intentionally conservative posture regarding environmental protection. For dispersive sites, given the difficulty in monitoring, it was decided that the single-species guideline should be further reduced (to 10 or 15 percent, depending on the species being tested).

Regarding statistical significance, the PSDDA evaluation procedures recognized that the variability of the reference sediment bioassay result could introduce substantial differences in test (dredged material) result conclusions. For example, it was possible for reference area sediments to show no mortality, resulting in a conclusion that minor response in the test sediment result could be found to be statistically different from the reference sediment. To address this issue, the PSDDA evaluation procedures noted that a test sediment that performs as well as a reference sediment (i.e., meets the reference area performance standards) should not be considered to have a significant effect, regardless of statistical differences. The disposal guidelines therefore specify a "lower limit" or minimum response to the conclusion that a significant response is occurring in the test chamber. For example, an amphipod bioassay reference results may show no mortality, and the dredged material results may be statistically significant relative to the reference. If the amphipod mortality in the dredged material does not exceed 20 percent, the PSDDA disposal guidelines conclude that this material is not showing a significant result because the dredged material is performing as well as acceptable reference material that is found elsewhere in the Sound.

Where species-specific information was available, control and reference performance standards are specific to individual test species (e.g., amphipod reference performance and oyster larvae control performance). Where information was lacking, performance standards were extrapolated from the other test species for purposes of program consistency (e.g., the 20 percent minimum response or "lower limit" for the Microtox). These standards may be improved as experience and data for these tests are obtained during PSDDA implementation, resulting in modifications to the evaluation procedures during the PSDDA annual review meetings.

<u>Response 20</u>. Organic-extract Microtox does measure a different suite of potential toxicants than saline-extract Microtox. The text has been clarified to state that the organic-extract Microtox is not included in the program at this time because its relationship to saline-extract Microtox and other PSDDA bioassays is not well enough understood to justify its inclusion as a regulatory test at this time. The organic extract Microtox test would be very

difficult to interpret in a regulatory context since Puget Sound reference areas show a very large range of response with this test, as noted in studies conducted for PSDDA by NMFS scientists.

The reasons for including saline-extract Microtox were given in the Phase I documents (EPTA, II-5.2.2, page II-62). Saline-extract Microtox is consistent with the EPA (1986) Recommended Protocols for Measuring Selected Environmental Variables in Puget Sound, and provides data used to calculate some sediment quality values in the Puget Sound Database. It has been found to be a valuable assay for estimating biological responses in the PSDDA program to date, and, despite its obvious differences from other PSDDA bioassays, it resembles them in that the exposure of the test organism to contaminants occurs in a saline medium.

The salient comparison being made in the PSDDA program is test sediment extract performance versus the performance of the reference area extract. Reference areas are expected to have low levels of contaminants, and thus minimal biological response parameters. Organic-extract Microtox is acknowledged to be a more sensitive test for detecting potential toxicity in reference areas, but this is does not appear to the PSDDA agencies to be highly desirable for the purposes of regulatory decisionmaking. Microtox is currently used only as a corroborative test in nondispersive sites; i.e., can only fail dredged material if another bioassay species confirms the results of microtox tests showing significant toxic response.

Response 21. The PSDDA agencies agree that the purpose of using reference sediment response or "blocking" of physical (grainsize) parameters is to distinguish biological effects related to chemicals in the test sediments. The discussion cited is not to be taken as a "loosening" of criteria by allowing a project proponent to search for a known high mortality reference area in order to achieve higher allowable mortality in project sediments being tested. Section 5.6 of the final MPR has been expanded to show the considerations that the PSDDA agencies made regarding the reference performance standard for the amphipod test, and concluded that the 20% performance standard will be retained. The PSDDA agencies will determine on a case-by-case basis whether exceedance of the performance standard will disqualify the use of the data in a regulatory decision, or whether the test must be rerun. An example of information which could be used in that determination is given.

Response 22. The PSDDA agencies have sponsored test development for both the 10-day acute toxicity test using this organism and the 20-day chronic sublethal test. NOAA/NMFS staff had opportunity to participate in an EPWG meeting which included discussion on the tests' development and were provided written summaries of the proceedings and a review copy of the draft report on the 10-day test. The draft results from the 20-day chronic sublethal test development will be available in October. Available information suggests that the Neanthes acute test shows dose responsiveness to a range of contaminated sediments from Puget Sound, which is at least comparable to the amphipod Rhepoxynius test. There is a great deal of information on this polychaete's organisms indigenous to Puget Sound, appear to be responsive to sediment contaminants, and tend to be more sensitive than _Neanthes_ sp. We concur that the _Neanthes_ sp. bioassay should be better tested before adoption in a regulatory program. Additionally, other chronic bioassays should be developed, to form a suite of tests, so that sediment toxicity can be more accurately evaluated.

(23) It is apparent that the PSDDA agencies have invested considerable effort to deal in a comprehensive manner with the environmental, jurisdictional, and societal complexities associated with the disposal of dredged materials in Puget Sound. However, significant deficiencies in the DEIS should be fully addressed prior to any implementation of PSDDA Phase II.

Sincerely,

Einar Wold
Division Chief

response to dissolved chemicals, and a somewhat less involving its response to chemicals in a sediment matrix. It was, however, the large amount of total information that prompted the PSDDA agencies to use this organism. In time, and with better experience on candidate indigenous species, the _Neanthes_ acute test (and the chronic sublethal test, once adopted), could be replaced with an indigenous species. PSDDA representatives met with NOAA/NMFS staff to discuss ongoing research that might yield candidates.

Response 23. Except for the text changes noted in responses to comments made in this letter (and otherwise in this appendix), the PSDDA agencies do not concur with NOAA/NMFS conclusion that deficiencies must be corrected prior to implementation. Specific issues have been individually addressed above.

United States Department of the Interior

FISH AND WILDLIFE SERVICE
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May 19, 1989

Colonel Philip L. Hall
U. S. Army Corps of Engineers
Seattle District
Post Office Box C-3755
Seattle, Washington 98124

RE: Draft Environmental Impact Statement - Unconfined Open Water Disposal for Dredge Material Phase II North and South Puget Sound

Dear Colonel Hall:

The subject document has been reviewed by both the U.S. Fish and Wildlife Service (Service) and the Bureau of Indian Affairs (Bureau). The following comments and recommendations are provided for your use and consideration.

Fish and Wildlife Service

The Service has participated in both Phase I and II of the Puget Sound Dredged Disposal Analysis Study (Study). The Service supports planned efforts to strengthen Phase I monitoring at the Port Gardner, Elliott Bay, and Commencement Bay disposal sites. Unresolved Study concerns include nonselection of an environmentally preferred Saratoga Passage site, and overall site management condition (site Condition I), dredged material testing for "red flag" contaminants, and potentially disparate chemical and biological testing guidelines between Phase I and II sites. ①

The draft Phase II document analyzes a narrow range of alternate Study actions, which primarily entail selection of candidate disposal sites in North and South Puget Sound. The Service has worked with Study representatives to guide the selection of candidate disposal sites away from key fish and wildlife concentration areas such as Dungeness Spit, Protection and Smith Islands, and the Nisqually Delta. ②

The Service supports a primary Study objective, which is to minimize the extent of dredge material impacts throughout the Puget Sound. Nevertheless, the draft projects that several candidate sites should receive potentially minimal use, such as Port Angeles (7 barges/year), Port Townsend (7 barges/year), and Anderson/Ketron Island (10 barges/year). ③ Valuable fishery resources such as pandalid shrimp, sea urchins, and scallops would be ④

RESPONSE TO UNITED STATES DEPARTMENT OF THE INTERIOR, FISH AND WILDLIFE SERVICE AND BUREAU OF INDIAN AFFAIRS.

Response 1. The PSDDA agencies acknowledge the results of the participation by the FWS in the PSDDA study, primarily in the site screening and site selection process. The "unresolved concerns" cited regard (a) levels of monitoring in Phase I areas, (b) the selection of the Phase I Port Gardner site over the Saratoga Passage site, (c) evaluation procedures for dredged material testing, and (d) the selection during Phase I of Site Condition II and associated biological effects conditions. These concerns were expressed during the Phase I studies, and were answered in Exhibit C of the Final EIS and the Federal Record of Decision. The PSDDA agencies concluded that the course being taken was appropriate, compliant with all pertinent laws and regulations, and would not have a significant impact on the human environment. The concerns were responded to in the Phase I FEIS as noted below.

Concern (a): Response No. 13, page C-17
Concern (b): Response No. 4, p. C-14.
Concern (c): Response No. 9-12, pp. C-15 and C-16.
Concern (d): Responses No. 7 and 8, pp. C-15 and C-16 (which also reference Responses 3, 7, 8 and 9 to comments in NMFS letter, on pp. C-6 through C-8).

Comments by the Service on the two projects thus far proposed for disposal at the Port Gardner site have not reflected the stated concern for the alternative Saratoga Passage site. Informal discussions with FWS staff on July 20, 1989 resulted in the PSDDA agencies' conclusion that these concerns were being adequately addressed.

Response 2. The EIS does cover more than candidate disposal sites, although much of the text in the Phase II EIS primarily deals with site screening and selection. The inputs of FWS were valuable contributions to this process. The no action alternative included three subalternatives. Also, elements were presented which would avoid fish, wildlife and human use conflicts. These included timing of disposal site use to avoid damage to seasonally-present resources and fishing activities; debris exclusion to assure no adverse effect to commercial Indian and non-Indian fishing; and a dispersive site disposal guideline which is more restrictive than the disposal guideline used in the nondispersive areas because of the inability to fully monitor dispersive sites due to their very dynamic currents.

As stated in Response No. 1 to NOAA/NMFS (this exhibit), the alternatives presentation in the DEIS and FEIS fully comply with 40 CFR 1500.2 (e): "identify and assess the reasonable alternatives to proposed actions that will avoid or minimize adverse effects of these actions on the quality of the human environment." The DEIS was rated as "lack of objections--adequate" by EPA in its letter dated June 13, 1989 (attached to this exhibit).

Response 3. This comment is amplified by the subsequent comment (number 25) into a request to consolidate disposal sites in order to minimize environmental impacts. While the PSDDA agencies acknowledge that less impacts could occur with fewer sites, there could also be significant adverse economic impacts should the relatively low cost option of unconfined, open-water disposal not be available to the communities that would be served by the Port Townsend and Port Angeles sites. The array of sites presented in the Phase II documents reflects a reduction from eight DNR disposal sites in use prior to PSDDA to five PSDDA identified sites. The need for each individual site was carefully assessed taking into account Puget Sound dredging requirements, service areas, and economic haul distances from active areas of dredging (see, FEIS section 2.03d and Tables 2.1, 2.7a and 2.7c in the FEIS). It also was concluded on the basis of information presented in Table 2.2 of the FEIS that the majority of dredged material would not be economically feasible to haul to the nearest Phase I site. However, the need for disposal sites was balanced by consideration of probable environmental impacts and measures to mitigate unavoidable effects.

Response 4. The cited resources at the Port Angeles and Port Townsend sites were carefully considered by the Disposal Site Work Group (DSWG) in selecting these sites. The Washington Department of Fisheries (WDF), an active participant of DSWG, proposed specific measures, including timing restrictions, to further lessen impacts to these resources. Also, the more restrictive guideline for the dispersive sites will only assure low levels of chemical impacts. In light of these measures, significant impacts to valuable fishery resources are not anticipated.

Site depth (96 feet) and mounding which could reach 15-18 feet annually are cited as reasons why FWS feels the Bellingham Bay site cannot be recommended. The referenced text contained a typographic error. Annual deposition is expected to be on the order of 15-30 cm. (The erroneous text has been corrected.) Calculations detailed in FEIS section 4.06a(3) indicate that potential site life could be 100 to 220 years. Program features described in the MPR (see chapter 6) assure that debris which could foul fishing nets is excluded from this site. Also, timing and specific site use restrictions will be imposed to ensure Indian fishing will not be adversely affected by disposal activities. Regarding benthic resources, the site was recommended to the PSDDA agencies by WDF as the best location in Bellingham Bay where bottom fishing and shellfish harvesting activities are likely to minimally impacted. In addition, extraordinary site closure periods suggested by WDF will also be imposed to further reduce the potential for adverse impacts to the fishery. Studies conducted during Phase II indicate that site resources have low population density relative to Bellingham Bay. FWS concern over impacts to starfish is curious, because starfish may compete with demersal fish and crabs for benthic food sources, and because the most numerous species Luidia foliolata appears to be undergoing a "bloom" condition which fouls local fishermen's nets in the Bay (DEIS, p. 3-55).

The environmental monitoring of sessile marine species on and offsite will be used to verify that unacceptable adverse impacts do not occur. Because of potentially impacted at Port Angeles and Port Townsend sites. Site logistic (i.e., water depths of 96 feet and dredged material mounding of 15 to 18 feet) problems and potentially impacted resources including Dungeness crab, pandalid shrimp, starfish, and marine fish are such that the candidate Bellingham Bay site cannot be recommended.

5 Furthermore, Phase II dredge material volumes are considerably smaller than those for Phase I. It also appears that greater proportions of contaminated sediments would be eligible for unconfined disposal under proposed Study test guidelines than the existing more stringent Puget Sound Interim Criteria (Interim Criteria). In addition, scant or conjectural information on existing sediment contamination conditions is disclosed in the draft for all the candidate sites. This compounds the difficulty of providing meaningful assessment of potential impacts to the sites, as well as promoting comparative verification of future site conditions.

6 Finally, in the absence of expedient ratification of Phase II of the Study, dredging shall likely be deferred or material shall be transported to Phase I disposal sites. However, the draft assumes the latter probable scenario shall not occur or that transport is not economically justified.

7 In view of these aforementioned concerns, the Service requests the final statement include expanded discussion of potentially consolidating and selecting fewer sites or utilizing characterized North or Central Puget Sound disposal sites. The final Study document should more fully disclose and evaluate specific material testing and transport costs, as well as Study agency administrative, site management and monitoring cost savings that may be accrued. In view of the fishery resources at risk due to potentially increased volumes of contaminated dredge material, an overall reduction in disposal sites, in combination with contamination of the Interim Criteria, is the Study Alternative preferred by the Service. It would be consistent with provisions of Section 404 and the Puget Sound Water Quality Comprehensive Plan. This recommended alternative should be evaluated in the final statement.

Bureau of Indian Affairs

8 The Bureau of Indian Affairs (Bureau) understands that the Corps of Engineers (COE) has a national policy framework regarding the evaluation of the disposal of dredge material, and realizes considerable effort went into the development of environmental concerns under this proposed management plan. However, the COE must be fully informed and cognizant of the unique situation regarding Stevens Treaty Tribes and their associated rights to harvest the fish and shellfish resources found in their usual and accustomed fishing grounds and stations throughout Puget Sound. The affected Tribes have considerable concerns regarding this proposed action. The Bureau strongly supports the Tribes efforts to receive proper consultation and participation throughout the review process and its' final outcome.

concern for highly mobile species such as Dungeness crab at the Bellingham Bay site a pre-disposal and periodic chemical body-burden analysis of crab in the vicinity of that site has been added to the site monitoring specifications (see the FEIS and final MPR).

In light of the foregoing, the PSDDA agencies conclude that the Bellingham Bay site has been properly selected and can be managed to avoid unacceptable adverse impacts.

Response 5. The reason that a higher percentage of dredged material is expected to be found suitable for unconfined, open-water disposal in the Phase II area than Phase I is because the dredged material in these generally non-urban areas is cleaner, not because of less restrictive guidelines.

In both Phase I and Phase II documents, and for both nondispersive and dispersive sites, a reasonable no-action alternative was evaluated. That alternative included the disposal guideline in existence at the time the Phase II DEIS was prepared, the PSIC. It is true that forecast dredging volumes are substantially less for Phase II than for Phase I, and that the Puget Sound Interim Criteria (PSIC) are generally more restrictive than the PSDDA disposal guidelines for both dispersive and nondispersive sites. Some chemical levels in PSIC are higher than in PSDDA and the single biological test is not as sensitive as some PSDDA tests. See EPTA, 1988, p. II-17:

- PSIC would be less restrictive than the PSDDA SL for lead, zinc, PCB's, and both high and low molecular weight PAH's;
- above the PSDDA SL all PSDDA bioassays apply (including the amphipod, the only species used by PSIC)
- most PSDDA bioassays are more sensitive than the amphipod; and
- under the PSIC less mortality is allowed in the amphipod test than under PSDDA testing since raw survivorship, not difference from reference sediment was the basis for a determination of suitability for open-water disposal.

It is important to note that the PSIC were arbitrarily established without the benefit of the careful, scientific process set forth by PSDDA, and expire in 1989. The PSIC provide incomplete coverage of chemicals and biological effects concerns, and were intended to be interim guidelines pending completion of the PSDDA planning process. Subsequently, the PSDDA evaluation procedures were established, and are more scientifically defensible. In light of the environmental analysis of impacts that could occur with inclusion of the nondispersive and dispersive guidelines in the Phase II area, the FEIS concludes that the PSIC are not the selected because of excessive restrictiveness, which does not substantially add to the protection of the marine environment. Also, the economic and upland/near-shore habitat impacts associated with this alternative would be substantial (see FEIS section 4.02).

The assumptions and process used in the environmental impact assessment were described in response 11 to NOAA/NMFS (this exhibit). The assessment does not depend upon site-specific chemistry. PSDDA effects-based evaluation procedures utilize unimpacted Puget Sound reference areas as comparators for dredged material biological and chemical measurements, not conditions at the disposal site. That is to say, no assumption is made of pre-existing impacts at the disposal site. Then, for the sake of predicting impacts due to disposal, it was assumed further that all material placed onsite was at or near the disposal guideline values. To the extent that site-specific information indicates existing contamination onsite and that the average conditions of the disposed material is cleaner than the guideline value, the environment impact analysis will have overpredicted actual impacts.

When the DEIS was being written, site-specific sediment chemistry reports were generally unavailable. However, the PSDDA baseline studies for Bellingham Bay and Anderson/Ketron Island were recently completed, and the resulting data are discussed in the FEIS and in this exhibit (see response 11 to the NOAA/NMFS letter).

Response 6. On the basis of DEIS/FEIS table 2.2 and discussions with numerous port authorities, in the absence of available Phase II site it is most likely that only the most urgently required dredging would occur in the Phase II area. Disposal options under the no-action alternative do include more costly single-user unconfined, open-water disposal sites, upland disposal, or transport to the Phase I areas. The impacts of this scenario are assessed in section 4.02.

Response 7. The range of alternatives addressed in the DEIS are sufficient for a reasoned choice under NEPA/SEPA. FWS' proposal is a variation on the alternatives already presented, i.e., combination of parts of the no-action alternative wich the selected alternative. Information provided in the DEIS (see table 2.2) clearly demonstrates that hauling dredged material 60 nautical miles (nm) from Port Angeles to Port Gardner (the nearest Phase I site) would be uneconomical and unreasonable. PSDDA was established to provide disposal sites which meet dredging requirements within reasonable cost (that is, within reasonable haul distances of dredging activity). This distance is generally taken to be 10 nm. With the selected Phase II sites, haul distances will range up to 37 nm although most areas of frequent dredging activity will be within 10 to 15 nm of a site.

The Phase I and II documents have already presented the information suggested by FWS. Material testing costs are evaluated in the Phase I MPR on pages 2-6 to 2-9, EPTA pp II-160 and following pages, in particular II-170 and II-171; and in EPTA Exhibit D. As presented at the PSDDA First Annual Review Meeting in February, 1989, these costs have been tracking well with projections. Site management and monitoring costs for the Phase II area are shown in Phase II MPR. Exhibits C and D and are reflected in the text of Phase II MPR Chapters 7 and 9. State-related site management and monitoring costs will be paid by user fees. Federal costs for physical monitoring are separate. In summary, DNR will manage the sites in a financially responsible manner to achieve

The importance of the United States fiduciary responsibilities to protect these Indian treaty rights is paramount, as was documented in the recent court proceedings regarding the construction of the Elliott Bay Marina (Muckleshoot Tribe v. Hall, 689 F. Supp. 1504, W. D. Wash. 1988).

The Indians' reservation of a right to take fish at all usual and accustomed grounds and stations is a property interest of explicit geographic scope binding "against the United States and its grantees as well as against the State and its grantees." (U.S. v. Winans 198. U.S. at 387 - 82). Judge Boldt also found:

> ". . . Every fishing location where members of a tribe customarily fish from time to time at and before treaty times, however distant from the then usual habitat of the tribe, and whether or not other tribes then also fished in the same waters, is a usual and accustomed ground or station at which the treaty tribe reserved, and its members presently have the right to take fish." United States v. Washington 384 F Supp. at 332 (emphasis added).

Both direct and indirect interference with the Indian right to take fish at usual and accustomed places have been prohibited by the Courts (U.S. v. Winans and Muckleshoot Tribe v. Hall) and should be documented in the final statement and Record of Decision. Further, these Indian rights are not adequately addressed under Section 2, 2.04, Alternatives, Native American Indian Fishing nor anywhere else within the draft document.

Preferred alternative disposal sites in Bellingham Bay and the Anderson/Ketron Island zone of siting feasibility number 2 are within the usual and accustomed fishing areas for several tribes. Specific resources of a high economic value to the tribes include Dungeness crab, clams, and salmonids, all of which, at some time during their life history, occupy the areas proposed to be dredged or used as disposal sites.

Regardless of the size of the area being impacted by dredging operations, these activities can have a significant impact on the treaty Indian tribes living in the area. The COE must realize that the tribes are confined to certain usual and accustomed grounds and stations as defined in U.S. v. Washington. Therefore the identification and consideration of only high intensity fishing areas and areas of significant habitat is not suitable (Item 2, page 3 - 76). Any reduction of treaty fishing resources or opportunity must be properly mitigated or compensated.

It is the obligation of Federal agencies to do more than consider impacts to these Tribes' fishery. The intent of the Stevens Treaties to insure that Indian rights are protected or the tribes compensated for losses that will be incurred must be taken into account. These issues are only partially addressed in a general manner throughout the document by citing "that

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publicly-desired goals which include availability of sites within a reasonable haul distance of major dredging service areas. Administrative costs are being addressed by Puget Sound ports with a report anticipated at the next PSDDA annual review meeting.

Response 8. The two Federal agencies acknowledge their Federal responsibilities. The State of Washington and the federally recognized Indian tribes signatory to the August 4, 1989 Centennial Accord recognized a mutual obligation to respect the sovereignty of both State and tribal governments. Accordingly, all PSDDA agencies have sought to assure that Indian usual and accustomed fishing rights in the Phase II (and Phase I) areas are properly protected.

Response 8--Concern 1. Consultation, participation in review and site selection process.

The goal of PSDDA is to provide publicly acceptable guidelines for environmentally safe unconfined, open-water disposal of dredged material. The PSDDA dredged material management plans identify acceptable disposal sites for dredged material and provide a consistent framework for dredged material evaluation and site management. However, disposal of any particular project's sediment at a PSDDA site will depend on individual Section 404 permit actions. All affected tribes are given notices of pending permit actions and an opportunity to express concerns as part of the public interest review. Tribal concerns are given special attention because of the Federal trust responsibility.

An Indian Coordination Exhibit (exhibit F) has also been added to the FEIS that indicates the kinds of participation and consultation which occurred during the PSDDA studies. In summary, the PSDDA agencies have encouraged participation by the tribes in the various work groups dealing with evaluation procedures, site selection, and management of the sites. Tribal representatives have participated in these meetings and taken active part in the discussions. Beyond normal EIS scoping and public meetings, Indian tribes have been visited by PSDDA representatives who explained the activities and the protective program measures relating to avoidance of potential Indian treaty fishing conflicts.

Documentation of decisions, and tribal involvement in the permit decisionmaking process. As discussed in chapter 5.5.10 and exhibit A.10 of the MPR and sections I-2.4 and I-2.5 of EPTA, the PSDDA Management Plans are intended to provide both consistency and flexibility in the application of dredged material evaluation procedures. All decisions require documentation of the reasons for the decisions including responses to comments provided to the public notice for each project. This documentation is available upon request to affected Tribes and other interested parties. The concerns expressed by tribal representatives for a specific project are addressed during the decisionmaking process. As provided in Corps regulations, the District Engineer may develop operating procedures whereby Indian tribes designate a tribal representative to receive and respond to public notices with the official tribal position (33 CFR 320.4(j)(6)). Seattle District has established points-of-contact with all western Washington tribes to assure that public notices are received in a manner that provides for timely review.

Conditions on site use to avoid navigation and access conflicts. The PSDDA agencies acknowledge important Indian fishing activities in the vicinity of the Phase II PSDDA sites. Accordingly, disposal activities will be managed to avoid potential conflicts with tribal fisheries, and to maintain access to Indian usual and accustomed fishing grounds. The FEIS notes that avoidance of conflicts is being addressed on a project-by-project basis. Potential adjustments to avoid conflicts could include disposal site closure or limiting disposal to those daylight hours during which tribal fishing would normally not occur. In addition, Corps Section 10/404 permits, which are given issued individually once a determination has been made that they meet applicable provisions of the Acts and other requirements, will specify that the dredger must comply with site use conditions specified in DNR site use permits and the Corps may also impose permit conditions to address Indian concerns. Comments on proposed dredging activities are being invited from agencies, tribes, and the concerned public for each Corps' public notice published for proposed dredging and disposal operations. For Corps' Federal navigation projects, the Corps will coordinate with the tribes and will consider similar restrictions provided they comply with environmental laws. U.S. Coast Guard Navigation Rule 18 states that power driven vessels underway must avoid fishing vessels.

Site use and mitigation for impacts. Under the Corps permit process, the Corps and EPA, with input from FWS, NMFS, State agencies, local governments, tribal governments and environmental interest groups, evaluate the impacts of individual dredging projects under the 404(b)(1) guidelines. The dredger must also obtain a Section 401 State Water Quality Certificate from Ecology. As part of the process the dredger may propose uses for the clean material other than unconfined, open-water disposal. Mitigation for project impacts may be required and could result in proposals to create favorable intertidal or shallow subtidal habitat in project specific locations. These types of activities will be planned on a project specific basis with input from the above-cited agencies and groups, per comments received in response to the Corps public notice for each proposed project.

PSDDA disposal site use conditions described in the PSDDA documents and incorporated in 404 permits should effectively avoid conflicts with tribal fishing activities. This does not necessarily preclude relaxation of these conditions if agreements between the tribes and a permittee on a particular project are effected.

Response 8--Concern 2. Protection of Indian Treaty Fishing Rights. Indian fisheries impacts were given special consideration throughout the PSDDA study. The Phase I Management Plan Report (MPR) chapter 2.8; the Phase I FEIS section 2.05d(2); and the Phase II FEIS sections 2.04d and 4.0Xc(4) (where X represents the individual sites: X=2 (no action), X=3 (Anderson/Ketron Islands), X=6 (Bellingham Bay), X=9 (Rosario Straits), X=12 (Port Angeles), and X=16 (Port Townsend)) deal with Indian treaty rights and avoidance of conflicts. Native American fisheries impacts are discussed at these locations in light of comments on the DEIS and further Indian coordination which has occurred in the FEIS.

The expanded text clarifies that Indian treaty fishing rights are being *actively* protected by the PSDDA agencies and the Corps permit process, and indicates that this protection is greater now than it has been in the past because of the much greater degree of specification of procedures for disposal activities and record keeping (positioning, compliance inspection, debris and daily logs). Specific provisions for debris handling/exclusion from the dredged material and navigation positioning plans to assure that materials are disposed accurately onsite have been made in the revised text to address concerns raised by the tribes for offsite dumping and gear fouling.

The protection that is provided through the 404 permit process is greater than simply a determination that no "significant" adverse impacts (in the sense that NEPA uses this term) would occur. Potential Indian treaty fishing impacts are addressed by the PSDDA management plan (see concern 3 of response 8, below). Site location and site management provisions of the PSDDA management plans also mitigate any potential biological resource impacts and human use conflicts according to Council on Environmental Quality regulations at 40 CFR 1508.20).

Response 8--Concern 3. Usual and accustomed fishing grounds will be diminished by the designation and use of PSDDA dredged disposal sites; high economic value resources occur (crabs, clams and salmonids) upon which the tribes depend occur in selected PSDDA sites; to avoid high intensity fishing areas is inadequate to protect Indian treaty rights.

The PSDDA agencies recognize that treaties carry with them a right of access to usual and accustomed fishing grounds, and have provided a mechanism via the Corps' 404 permit process and subsequent compliance inspections to assure that interferences do not occur. The PSDDA agencies attempted to avoid impacts to habitat by determining significant resources and avoiding them during site selection. The operating definition of significance included an estimation of harvestability (see discussions in FEIS Section 2.03f(3)(a)1-5, for example).

The process of site selection is described in detail in Section 2.03 of the FEIS. The literature and map-overlay process first attempted to identify areas of low (below harvestable) habitat values that appeared to be nondispersive. Then, further studies were performed to assure that the sites were nondispersive. At this point, the Disposal Site Work Group (DSWG, which included several tribal fisheries biologists) determined that the Anderson/Ketron Island and Devils Head sites were candidates, but that there were no deepwater nondispersive sites with corresponding low habitat value in North Puget Sound. As a result, the depth criterion of 120 feet (which had been used only as a working rule to assist in avoiding shallower, high-resource areas) was relaxed to allow a site to be considered in Bellingham Bay at the suggestion of the Washington Department of Fisheries. Biological surveys were conducted. An area was located within the Bay with very low densities, with crabs present only below harvestable levels (see FEIS, figures 3-12 and 3-13). Trawls and the Benthic Resources Assessment Technique (BRAT) (described in the FEIS in Section 2.03g) were used to assure that habitat values were moderately low both for infaunal invertebrates and demersal fish.

In subsequent considerations (after the biological studies were available), DSWG selected the Anderson/Ketron Island site over the alternative site to avoid herring resources, because crab resources were absent, and because of input from the Squaxin Island tribe. The Bellingham Bay site was selected *because it has low habitat value and low crab densities. However, in* recognition of proximity of the Bellingham Bay site to concentrations of Dungeness crab near Post Point, pre-disposal and periodic body-burden monitoring has been added to the PSDDA monitoring program to be accomplished by DNR for that site in order to confirm the determination that significant bioaccumulation of chemicals of concern to human health does not occur in Dungeness crab. Finally, the season for disposal at the Bellingham Bay site has been severely restricted to avoid known concentration periods for crab and other commercially-exploited species. In summary, all protective measures that may reasonably be incorporated into the disposal site management plans have been adopted to minimize the potential for damage to Indian-harvested fish and shellfish.

The Phase II dispersive sites also were chosen for low habitat and resource values. As with the Bellingham site, site use conditions include extraordinary additional site closures during periods when shellfish may be present in harvestable concentrations. These discussions also included tribal representatives. The FEIS concludes that in light of these avoidance measures there will not be significant adverse effects on the biota at these sites, nor to harvestable levels of economically important fishery resources.

Because only minor, nonsignificant adverse effects are expected to occur at the disposal sites, there should be no measurable effects to economically important species utilized by Indian treaty fishing practices.

Response 8--Concern 4. The Federal fiduciary trust responsibility is not served by PSDDA; in particular, page 2-77 of DEIS suggests that Federal fiduciary trust responsibility may be delegated to the State DNR.

The agencies fulfilled their trust responsibility through the protections provided by specifications made via the 404 permit process. This has been described above. The referenced text has been changed.

The text now states:

> "Permitting authorities will only allow disposal to occur when there is no treaty fishing activity occurring at the disposal site unless otherwise agreed to by the tribes. This will be accomplished via the Federal Section 404 permit process. During processing of individual Section 404 applications, any potential conflict between treaty fishing and vessel traffic will be addressed prior to issuance of the permit. Conditioning

specific actions accomplished via the Section 404 permit process will protect these rights". Deferring protection measures and analysis to a specific permit process in the approval of a disposal area is contrary to the NEPA process.

This is a commitment to a course of action that cannot be segmented out for delayed review (Town of Huntington v. Marsh 859 F. 2D 1134, 2D Cir. 1988) The COE has no specific authority to delegate Federal fiduciary trust responsibilities to Washington State Department of Natural Resources, as is proposed on page 2-77.

Instead, specific mechanisms should be identified, through proper consultation with the affected tribes, which will adequately mitigate tribal concerns. (8)

In the draft document section of Relationships to Existing Plans, Policies and Controls (Sections 2 & 4), the COE needs to consider the potential impacts to the salmon and steelhead resources as related to United States obligations under the Pacific Salmon Treaty. A considerable amount of money and time is being invested in the protection and restoration of these resources, as well as development of management plans for effective sharing of the harvest between the countries. It would be unfortunate if this proposed action would jeopardize our nations' responsibilities in this process.

Specifically, the following issues and concerns raised by the tribes must be more adequately addressed.

1) The COE should consider possible disruption of migratory routes of fish entering and leaving the river drainages because of the importance of terminal river harvest to several tribes. (9)

2) Disposal of contaminated sediments containing Class II materials, such as mercury and copper, may potentially impact tribal treaty resources. The potential impacts of contaminents, silt, and bombardment on sensitive marine organisms, habitat, or migrational pathways has not been adequately studied or analyzed. (10)

3) Inadequate cost/benefit analysis of Distance Criteria for locating Dredge Disposal sites, in particular locating sites 50 NM from source. (11)

4) Gear fouling created by illegal disposal of debris into Disposal Sites. Several Treaty fishermen have reported uncompensated gear losses after fishing near shallow disposal sites. (12)

5) Insufficient assessment of the potential impacts to Dungeness crabs in Bellingham Bay. (13)

of permits such that disposal will be consistent with tribal fishing operations may be appropriate as may be denial of permit applications where necessary. Both the Corps and DNR (the latter issues a disposal use site permit and manages the sites) will conduct compliance inspections at the disposal site to assure that the conditions of the permits are met and that site management conditions protect Indian treaty fishing rights."

Response 8--Concern 5. Specific mechanisms should be identified, through proper consultation with the affected tribes, to adequately mitigate tribal concerns, including fouling of fishing gear.

Specific protective/avoidance mechanisms have been previously described above. These include: the site selection process which sought to avoid high resource areas; timing restrictions to avoid seasonal concentrations of life stages of economically-harvestable species; chemical and biological guidelines to minimize onsite impacts; and 404 permit conditions including debris exclusion provisions and assurance of access to all usual and accustomed fishing grounds that address Indian concerns for fishing conflicts.

Response 8--Concern 6. Impacts to the salmon and steelhead resources as related to United States obligations under the Pacific Salmon Treaty should be considered.

These impacts have been considered at 4.xb(3) in the DEIS/FEIS, which concludes that there will be no significant adverse impacts to salmonids as a result of disposal of dredged material at the PSDDA sites because of timing restrictions to avoid sensitive life stages' presence, and because water column effects would be transitory and avoided by fish. (See, for example 4.12b(3) and the following response.)

Response 9. Information contained in the DEIS/FEIS is adequate to describe the anticipated effects to salmonids. Dredged material is expected to remain in the water column for a relatively short time period, so that even if salmon passed directly into the turbidity plume, the period of contact with the suspended material would not be long enough to allow enough absorption/ingestion of chemicals of concern to significantly change behavior in the way suggested. As for effects of turbidity, salmonids are subjected to much higher suspended solids levels during natural storm events or in glacial rivers (e.g., Nooksack, Skagit, Puyallup, Nisqually) during prolonged periods of warm weather.

Response 10. Tribal resources are not expected to experience any losses due to disposal at the selected sites. The disposal guidelines for dispersive sites allow only very low chemical levels and virtually no biological effects. The nondispersive guideline allows minor adverse effects (Phase I FEIS, p. 2-33, and Phase II FEIS sections 4Xb(4)), but only within the disposal site. However, whether these minor adverse effects will actually occur is very doubtful. Much of the disposed material will have considerably lower potential for adverse effects than that allowed under the guideline. During disposal periods, periodic physical disturbance of the site is expected to inhibit development of an abundant or diverse benthic infaunal community that would be exposed to the dredged material and some sensitive benthic species may be eliminated. At such times the depressed infaunal community will not be attractive to demersal fish. During the remainder of the year, the benthic community would reestablish and be available for fish grazing. However, the loss would be minor, since all sites were located in areas which did not have significant populations of demersal finfish and shellfish.

Response 11. See response 8, concern 3, above. The cited minimum depth criterion was a "screening" rule which was only relaxed once there was a clear decision on the basis of the best available oceanographic and ecological information available that there are no nondispersive sites in the North Sound area that are in such deep water. Subsequent biological analyses supported this conclusion in that there would be no significant adverse effects to biological resources at the selected Bellingham Bay site. Accordingly, economic haul distances were considered and the economic analysis presented is considered adequate.

Response 12. This was answered in response 8, concern 5, above.

Response 13. This issue was initially raised by the Lummi Tribe in a letter dated June 7, 1988. Response was made by letter of July 19, 1988, indicating that further consultation with and re-examination of data collected by University of Washington researchers had been made.

After reviewing the discussion in the DEIS on impacts to Dungeness crabs, the PSDDA agencies conclude that a thorough discussion of both direct and indirect impacts of disposal activities on Dungeness crab and shrimp resources was included in the DEIS, in particular on pages 4-54 through 4-60. This section of the DEIS (titled "Impacts and Their Significance to the Biological Environment") discusses factors such as physical burial, suspended material in the water column, potential for crab attraction to the disposal area, chemical toxicity and potential for bioaccumulation/biomagnification in both crab and shrimp.

FWS commented that (1) further study, evaluation, and mitigation of potential impacts to Dungeness crabs should be conducted, and (2) the Lummi Tribe has suggested an additional investigation using sampling methodologies that will detect buried crab." Based on recent research by University of Washington scientists in particular studies at Ship Harbor (near Anacortes, Washington) and in Port Gardner, Dungeness crab generally do not bury in sediments that are characterized as predominantly silts and clays, such as occur at the preferred Bellingham site. The aggregations of gravid female Dungeness crab found in the Bellingham Bay trawl studies were identified east of the site, near Post Point, upslope and on sandier substrate. Relative to further evaluation and mitigation of potential impacts, additional baseline/monitoring studies are planned for the Bellingham Bay Phase II site, which are specific to monitoring and maintaining the health of crab and shrimp populations. Specifically, Dungeness crab will be sampled both before and after the use of the site to assess bioaccumulation against the background population in

6) Reduction of tribal treaty fishing area due to the proposed establishment of disposal sites within their usual and accustomed fishing areas. (14)

7) Deficient minimum depth criteria for locating dredge disposal sites. (15)

To make this document adequate to the Indian governments and the Bureau, further studies may be needed and detailed analysis completed pertaining to Treaty Indian resources in Puget Sound. In addition, the following specific recommendations are made in an effort to improve the quality of this NEPA document:

1) Since NEPA requires that "All reasonable alternatives must be considered", we strongly support the Tribe's recommendation to extend the proposed siting criteria to greater than 50 NM from the source. The distance criteria should be developed according to ecological, as well as economical purposes. (16)

2) Further study, evaluation, and mitigation of potential impacts to Dungeness Crabs should be conducted. The Lummi Tribe has suggested an additional investigation using sampling methodologies that will detect buried crabs. (17)

3) The minimum depth criteria should not be relaxed to 100 feet, but should meet the 120' to 600' depth criteria. (18)

4) A compensation fund should be established as mitigation for treaty fishermen impacted by gear fouling due to illegal debris disposal resulting from the establishment of these proposed disposal sites. (19)

5) Administrative provisions or other mitigation should be proposed to provide prompt effective relief to Treaty fishermen being impacted by disposal impacts. For example, mechanisms should be proposed as mitigation, which will enable affected Tribes the opportunity to close down dredge disposal operations, if they are having an impact on the tribes resource or ability to harvest its' guaranteed share of the resource. (20)

6) Any irretrievable or irreversible losses of resources should be identified and compensations proposed. (21)

Summary Comments

The draft document analyzes a narrow range of potential Study actions, which implemented as proposed, would relax existing Puget Sound Interim Criteria in North and South Puget Sound. This action would lead to increased unconfined open water disposal of contaminated dredge material. Biological (22) (23) (24)

Bellingham Bay and the PSDDA target tissue concentration values (see page A-34 of Phase II MPR).

Response 14. This was answered in response 8, concern 3.

Response 15. This concern was also addressed in response 8, concern 3, above.

Response 16. The option for sites far away from the sources was considered. The sequence that DSWG used was as follows: general disposal areas were identified; then, using map overlays which emphasized ecological and hydrographic information, DSWG identified areas that had low resource values and were anticipated to be nondispersive; DSWG then checked the nondispersive nature of the sites; when no deepwater nondispersive sites with low resource values were found for North Sound, DSWG (at the suggestion of the Department of Fisheries and with tribal representatives informed and present at DSWG meetings) considered shallower waters in Bellingham Bay, again using ecological and hydrographic screening criteria and avoidance of known human use conflicts; DSWG then had biological field studies performed. During preparation of the DEIS based on site management conditions and evaluation procedures, it was determined that no significant adverse impacts to the quality of the human environment would occur through the use of the Bellingham Bay site. This conclusion supported the use of a Bellingham Bay site, and allowed a decision of "practicability" or economic distance to be made. The incremental cost analysis presented in the DEIS and FEIS is based on discussions with dredging firms. It is adequate to characterize economic impacts that could occur from long-distance hauling. Accordingly, there is no reason to initiate new siting nor economic studies. See also responses 3 and 6.

Response 17. See response 13.

Response 18. See response 8, concern 3. All disposal sites, except for Bellingham Bay meet the 120' to 600' PSDDA site selection guideline.

Response 19. The PSDDA agencies believe that Corps Section 10/404 conditions will avert interference with tribal fishing activities, and that compliance inspections and debris-exclusion provisions will protect tribal fishing gear.

Response 20. For reasons given in responses 8 and following, The PSDDA agencies believe that potential damages to tribal access to usual and accustomed fishing grounds, tribal fishing gear, and tribal fish and shellfish harvests have been averted and adequately addressed by numerous currently existing program features.

Response 21. The potential for irretrievable and irreversible commitments of resources is addressed in FEIS sections 4.X g. In summary, it is concluded that there will be no irreversible nor irretrievable loss of resources as a result of disposal at PSDDA sites.

Response 22. See response 2.

resources impacted near Port Angeles, Port Townsend, and in Bellingham Bay would not be insignificant. Alternative courses of actions, such as continuing implementation of the Interim Criteria, and consolidating and/or designating few sites or using Phase I sites, should be more rigorously evaluated in the final statement. Questions regarding these fish and wildlife protection recommendations should be directed to Mr. John Cooper, of my staff at the letterhead phone/address. (24) (25)

The draft document poorly addresses Native American concerns and needs substantial revision, after thorough consultation with the affected Tribes and the Bureau to insure adequate protection of Treaty rights. The Corps should assure that these rights are protected to the satisfaction of the Tribes and the Bureau. Evidence of this consultation and agreement with the proposed Study action should be included in the final document. Please contact Mr. Dan Thayer, Environmental Coordinator, Puget Sound Agency, at (206) 258-2651 to obtain addresses, phone numbers, and specific information concerning the Tribes that may be affected by this Study action. (26) (27)

Sincerely,

David C. Frederick
Field Supervisor

c: BIA, Portland
EPA, Seattle
NMFS, Portland
WDE, Olympia
WDNR, Olympia
WDW, Olympia
WDF, Olympia

JWC:alj

Response 23. See response 5.

Response 24. See response 4. NEPA requires evaluation of significant impacts to significant resources. For reasons stated in the DEIS/FEIS sections 4.12b(1)(b) and 4.15b(1)(b), the PSDDA agencies concluded that PSDDA site designation would not be significant.

Response 25. See response 2.

Response 26. Text revisions and further consultation have occurred, as detailed in responses 8 and following. Also, see exhibit F for documentation of coordination with affected tribes during the Phase II following public review of draft documents.

Response 27. In discussions between PSDDA agency representatives and Mr. Dan Thayer of the BIA, Puget Sound Agency, he noted that each tribe speaks for itself, and that BIA merely passes tribal comments to the PSDDA agencies. Accordingly, the consultation and revisions that have occurred are intended to show attempts to reconcile the concerns of the tribes with the PSDDA study findings. Evidence of the consultation is included in Exhibit F.

AL SWIFT
2d District, Washington

COMMITTEE ON
ENERGY AND COMMERCE

Subcommittee on Telecommunications, and Finance

Subcommittee on Energy and Power

Subcommittee on Transportation and Hazardous Materials

COMMITTEE ON
HOUSE ADMINISTRATION

Chairman,
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June 8, 1989

Mr Frank Urabek
US Army Corps of Engineers
Seattle District Engineering Dept.
P.O. Box C3755
Seattle, WA 98124-2255

Dear Mr. Urabek:

I received a copy of the letter that was sent to you from Dick Visser of Inner Sound Crab Association. I was very pleased to see the positive reinforcement provided by the Association in regards to the Strait of Georgia disposal site for dredged material. 1

I have repeatedly told Colonel Hall that I am impressed with the job that the Corps does in the Seattle District Office. It is good to see that the public agrees with me.

Keep up the good work!

Sincerely,

Al Swift
Member of Congress

AS/dn

RESPONSE TO AL SWIFT.

Response 1. Comment acknowledged.

LUMMI INDIAN BUSINESS COUNCIL
2616 KWINA RD. • BELLINGHAM, WASHINGTON 98226-9298 • (206) 734-8180

DEPARTMENT ______________ EXT ______

May 15, 1989

Frank Crabeck
Seattle District, Corps of Engineers
P.O. Box C-3755
Seattle, Washington 98124

Dear Mr. Crabeck:

The following are comments by the Lummi Indian Business Council regarding the Draft Environmental Impact Statement - Unconfined Open-Water Disposal for Dredged Material, Phase II and the Draft Management Plan Report - Unconfined Open-Water Disposal of Dredged Material, Phase II.

The Lummi Tribe objects to the siting of a nondispersive dredge disposal site in Bellingham Bay for the following reasons: ①

The site chosen is shallow compared with the original PSDDA guidelines requiring depths deeper than 120 feet. The Bellingham site is located in an area used extensively by the Lummi and non tribal fishing fleet. In the past, logs and debris dumped in other nearby disposal sites have damaged fishing gear and are therefore avoided by many fishermen. This new site located farther out in the Bay will reduce again the areas free of obstructions for the fishing fleet. ②

Compliance to avoid illegal debris disposal has been poor in the past and future disposal of debris that will damage gear is likely. The DEIS does not detail adequately how the Department of Natural Resources will prevent this or how fishermen would be compensated for fishing gear damaged by debris. A further reduction of the Tribes prime fishing area in Bellingham Bay is not acceptable. ③

Indian treaty rights have NOT been properly protected by siting the disposal site in an area used extensively by Tribal gillnet salmon fisheries. The Orrick Decision (U.S. vs Washington, phase II) not only protects treaty fishing rights, it also protects the treaty right to the quality of water and habitat upon which Usual and Accustomed fisheries depend. ④

The proposed sediment standards for nondispersive disposal areas allow an unacceptable level of toxicity in dredged material. The assumption that "Dredged material passing the PSDDA guidelines is expected to be no more toxic than existing sediments (DEIS pg 4-58)" is false. Upon this assumption is based all DEIS estimates of significant biological impact in Bellingham Bay. ⑤

RESPONSE TO LUMMI INDIAN BUSINESS COUNCIL.

Response 1. Comment noted.

Response 2. The PSDDA agencies recognize that salmon fishing does occur at and on the vicinity of this site. Accordingly, special efforts were made in the site management plan to avoid conflicts between dredging barge traffic and Indian treaty fishing. The special site management conditions are discussed in response to comment number 8 of USFWS/BIA.

The site selection process and the reason for relaxing the 120 foot depth guideline is described below in response 4. In summary, the search for nondispersive sites that were at least 120 feet deep and had few resource conflicts was unsuccessful in North Puget Sound. It was suggested by WDF that a site with nondispersive characteristics and non-significant resource conflicts could be found in Bellingham Bay. Field studies provided information that helped locate such a site. Also, site management conditions were specified that restrict site use to times when seasonal resources are low and when no tribal fishing is taking place at the site. Accordingly, the use of this site, under conditions of the site management plan, should not impact the usual and accustomed tribal fishing activity in this area.

A sidescan sonar reconnaissance for submerged historic properties was performed at the selected Bellingham Bay site, and no obstacles were found onsite that would be expected to snag fishing gear. The Management Plan Report (MPR) for Phase II sites has been modified to assure that no debris will be disposed at the Bellingham Bay PSDDA site which would cause interference with fishing gear. Debris management plans are now required for projects (see Chapter 6 of the Final Phase II MPR, section 6.2.7). These more rigid requirements for debris handling, along with compliance inspections by the Corps and DNR, should preclude disposal of debris that is likely to snag fishing gear.

Response 3. As discussed above, specific debris management plans for each dredging project will be approved by the Corps and DNR. The means of identifying and removing floatable or nonfloatable debris will be assessed by those agencies and appropriate requirements will be incorporated into permit conditions. Predredging inspections and removal of debris encountered during dredging by physical screening of dredged material may be required.

The tribe may seek compensation for damages through the civil courts. However, the PSDDA agencies believe that the debris removal requirements which are imposed through the Federal Section 404 permits will be sufficient to avert damages.

Response 4. A further reduction of tribal prime fishing area will not result from use of the Bellingham Bay disposal site. The PSDDA agencies have been very sensitive to protecting Indian treaty rights. See response to comments 2 and 3 above.

The process of site selection is described in detail in Section 2.03 of the FEIS. Significant resources were avoided during site selection, and included an estimation of harvestability (see discussions in FEIS Section 2.03f(3)(a)1-5, for example). The literature reviews and map-overlay processes attempted to identify areas of low (below harvestable) habitat values that appeared to be nondispersive. Then, further studies were done to assure that the sites were indeed nondispersive. At this point, the Disposal Site Work Group (DSWG, which had participation from the Lummi tribe) determined that there were no deepwater nondispersive sites with corresponding low habitat value in North Puget Sound. As a result, the depth criterion of 120 feet (which had been used only as a working rule to assist in avoiding shallower, high-resource areas) was relaxed to allow a site to be considered in Bellingham Bay at the suggestion of the Washington Department of Fisheries. Biological survey trawls were conducted, and confirmed that there are areas located within the Bay which have relatively low densities of some fish resources. The zones of siting feasibility considered had crab densities below harvestable levels (see FEIS, figures 3-12 and 3-13). Benthic Resources Assessment Technique (BRAT) (described in the FEIS in Section 2.03g) was also used and confirmed that habitat values were moderately low both for infaunal invertebrates and demersal fish. Shrimp were relatively abundant at the south zone of siting feasibility but the populations were primarily *Pandalus borealis* (pink shrimp) that is not of commercial nor sport value in Bellingham Bay. Other information on potential fishing conflicts was gathered by meetings with the Lummis and with commercial fishermen. The Bellingham Bay site was selected because it has low habitat value for demersal fish and low crab densities. However, in recognition of proximity of the Bellingham Bay site to concentrations of Dungeness crab near Post Point, body-burden monitoring has been added to the PSDDA monitoring program for that site to assure that significant bioaccumulation of chemicals of concern to human health is not occurring in Dungeness crab. The season for disposal at the Bellingham Bay site was also severely restricted to avoid concentration and rearing periods for crab and other commercially-exploited species.

Because only minor, nonsignificant adverse effects would occur at the disposal sites, there will be no measurable effect to economically-important species utilized by the Lummi Tribe.

In summary, all reasonable protective measures have been incorporated into the disposal site management plan to avert potential damages to Indian-harvested fish and shellfish. The FEIS concludes that in light of these measures there will be no significant adverse effects on the biota at these sites, nor to harvestable levels of economically-important fishery resources.

Response 5. The PSDDA disposal guidelines should not lead to unacceptable levels of toxicity. The statement regarding sediment sites contamination in Bellingham Bay sediments was based on chemical information cited on page 3-46 (Section 3.03.a.5) of the DEIS, which was generally obtained in the inner harbor, and on bioassay information from the EPA Eight Bay Study which recorded that sediments nearer Post Point having shown toxic responses to test animals. Subsequent to the release of the Phase II DEIS, the PSDDA baseline study for Bellingham Bay was accomplished. These data are now available.

The NEW guidelines proposed for Phase II nondispersive sites in the current draft are less restrictive than the guidelines to which the Lummi Fisheries Department has previously objected. The old guidelines did not allow ANY 1 of 3 bioassay tests to exceed 30% mortality over reference at a statistical significance of 95%. The NEW guidelines allow NO MORE THAN 1 of three to exceed this guideline (pg 5-17). For example, now it is permissible to kill all of one bioassay organism (e.g. bivalve larvae) AND up to 60% (Technical Appendix pg II-113) of the second bioassay organism (e.g. amphipod) and still not have a significant adverse biological impact according to PSDDA guidelines. 6

Contrary to the statement in the DEIS (pg. ES8), we do not feel the the Phase II plan "fully complies with the Clean Water Act and its objectives to restore and maintain the environmental quality of the Nation's water " or that it ". is also in consonance with all applicable State and Federal laws. .(pg ES-8)". 7

The Clean Water Act Section 404(b)(1) Compliance requires the avoidance of "unacceptable adverse effects" to the aquatic environment (pg 1-5)

Clean Water Act Section 404(c) contains authorization "to prohibit or restrict the use of a disposal site whenever it determines that the discharge of such materials will have "unacceptable adverse impacts" on municipal water supplies, shellfish beds and fisheries, wildlife or recreational areas (pg 1-1)".

The Water Resources Act of 1971, RCW 90.54.020 (3) reads, in part, "The quality of the natural environment shall be protected and, where possible, enhanced as follows:

> (b)...Notwithstanding that standards of quality established for the waters of the state would not be violated, wastes and other materials and substances shall not be allowed to enter such water which will reduce the existing quality thereof, except in those situations where it is clear that overriding considerations of the public interest will be served." pg 1-8)".

Sediments to be dredged for disposal in the proposed Bellingham Bay nondispersive disposal site will come from "Bellingham Harbor from the cement plant to the old disposal site, and from the I and J Waterway to Post Point". This is a high ranking area (Table A.1 pg A-8). "Characteristics of high ranking areas include many known contaminant sources, high concentrations of chemicals, and/or significant acute toxicity in sediment bioassays (pg A-6)". Some of the inner harbor sediments where dredging is planned are extremely toxic. The 1988 State of the Sound Report listed Bellingham's sediments as containing high levels of mercury and moderate levels of copper and zinc.

Wherever contaminated sediments are located, there is the risk of transfering toxins from sediments to food fisheries. "The food web effects could include mobile benthos (crab, shrimp, etc.) and benthic-feeding fishes feeding on disposal site benthos and migrating offsite with a higher body burden which could contribute chemicals to the Bellingham Bay food web (DEIS pg 4-56)". "Dredged material chemicals contributed to the sea surface microlayer may occasionally make contact with the nearshore benthos as a result of currents, tidal

Sediment concentrations of several PSDDA chemicals of concern exceeded the PSDDA SL values, and one chemical exceeded the ML value. These were: mercury (highest concentration 0.56 ppm dry weight, about 2.67 times the SL, 7 exceedances in 21 stations), phenol (1 station exceeded ML by 4 times, SL by 40 times), 4-methylphenol (1 station exceeded SL by 2.33 times). There were no bioassay "hits" at the site, however. Macrobenthic abundance was high, and cirratulid polychaetes, which are frequently associated with organic enrichment, were important members of the benthic communities. Bioaccumulation of metals in tissues of the clam <u>Compsomyax</u> <u>sudiaphana</u> over sediment levels were from <2 times for cadmium and nickel to 15 times for arsenic. Tissue concentrations of benzoic acid occurred higher than sediment "background" although the level of this compound in sediment was well below the SL. Benzoic acid is not on the PSDDA list of target human health chemicals. This could be a natural metabolite. These data generally support the discussion in the DEIS that the sediments at and in the vicinity of the site contain elevated levels of chemicals of concern.

While the DEIS/FEIS based the environmental assessments of sediment chemical impacts on dredged material which would just pass the guidelines, most of the material actually disposed onsite will have much lower potential for toxicity than allowed by the guidelines. The sentence you cite has been edited to say, "Baseline studies indicate that some onsite sediments contain elevated levels of chemistry relative to Puget Sound reference areas. This condition may result in some minimum adverse effects. Dredged material passing the PSDDA guidelines may also cause biological effects on the site due to sediment chemistry, but these effects would be limited to the site, and would be minor and 'acceptable' under the Clean Water Act." This statement is consistent with the analysis and conclusions of the FEIS.

<u>Response 6</u>. The disposal guidelines have <u>not</u> been made less restrictive. The guidelines cited in the draft Phase II MPR was not intended to be different from the Phase I specification, but the language in the table was not clear. Table 5.4 has been revised to more clearly show the similarities and differences testing and disposal guidelines for the nondispersive and dispersive sites. The nondispersive bioassay guidelines have been adjusted through Phase II. These adjustments are described in detail in chapter 5 of the final MPR. A new figure, Figure 5.1, is also provided on page 5-17 of the final MPR to clarify the bioassay decision guidelines. The statement in the comment regarding amounts of allowable mortality is not correct. Exhibit A of the MPR provides several examples of use of the guidelines for nondispersive sites such as the Bellingham Bay site.

<u>Response 7</u>. The PSDDA agencies are in agreement that the Phase II plan is in full compliance with the Clean Water Act.

The PSDDA Phase II Management Plan is consistent with Federal policies contained in the Federal Water Quality Standards Regulation (40 CFR Part 131). These policies deal with anti-degradation of water quality and apply to the area beyond the disposal sites. Some short-term lowering of water quality is expected during disposal of dredged material at these sites but little or actions and wind moving chemicals onshore (DEIS pg 4-57)

The 1988 state of the sound states, PCBs and mercury levels occasionally exceed accepted standards in ground fish at some urban sites such as Bellingham Bay. Federal guidelines for contamination in fish and shellfish are very rarely exceeded in Puget Sound. The removal and relocation of these toxic sediments to relatively clean areas requires very careful consideration. While the occurrence of degraded sediments in Bellingham Bay may make it difficult to distinguish fisheries degredation due to dredge disposal site activities, this is not a rationale for further degradation (DEIS pg 4-56,58) ⑦

We take exceptionto the following statement in the DEIS "The preferred disposal sites were located, to the maximum extent practicable, in areas with few important biological resources and human use activities (pg ES-9) ⑧

All locations studied for the proposed nondispersive disposal site in Bellingham Bay were found to have significant biological resources. The preferred site is one mile north of an established trawl fishery within an area that is an extensive Dungeness crab fishery, two miles from major commercial shellfish beds, part of the migratory pathway for salmon and herring, and in an area of shrimp abundance.

Bellingham Bay supports a significant Dungenese crab fishery for Tribal and nontreaty fisherman. U of W trawl studies showed relatively high numbers of Dungenese crab, shrimp, and ground fish in Bellingham Bay compared with other sites examined in Puget Sound. Locating another disposal site further out into the Bay has the effect of increasing the area of contamination in an area rich in natural resources.

There are concerns for crab because of the habit of egg bearing females to bury in sediments during the incubation period. Hatching success or larval survival may be lowered by toxic sediments allowed under these guidelines. Bioassy experiments should investigate this possibility.

Significant numbers of mobile species are not expected to be attracted to the active disposal sites... the sites are not expected to provide sufficient prey to attract additional mobile species beyond the few that were observed during site identification studies (pg 7-..)

The limited trawl sampling conducted does not indicate densities that could be considered representative for these species. The abundance of species listed in the PSDDA Disposal Site Selection Appendix Draft are all undervalued.

Preferred site data for fish are underestimated "due in part to the lack of stations (pg II-14,)

Data for crab are underestimated due to the burying behavior of Dungeness crab and the consequent lack of crab caught in a beam trawl.

Data for shrimp are underestimated as values were derived from incidental catches from a trawl not set up for shrimp.

no water quality impacts are anticipated beyond the site boundaries. The PSDDA dredged material evaluation procedures allow only relatively clean sediments to be discharged at the sites. Monitoring, included as part of the plan, will be conducted to verify predictions. Site management adjustments will be made if monitoring indicates this is needed.

Section 404 of the Clean Water Act (CWA) establishes an effects-based approach to regulate the discharge of dredged and fill material into waters of the United States. The CWA requires that the discharge of dredged material not result in an "unacceptable adverse effect" to the aquatic environment. In the implementing regulations ("Section 404(b)(1) guidelines"), this requirement is clarified as the "least environmentally damaging practicable alternative." The nondispersive guidelines are fully consistent with this clause of the CWA and all other Federal and State laws, as well as the Puget Sound Water Quality Authority's management plan. The PSDDA Phase I and II documents have provided a complete impact analysis of effects to water quality, fisheries, benthic communities, and human uses, as well as assembling scientifically-designed evaluation procedures and environmental monitoring plans that go considerably beyond similar programs elsewhere in the country. All of these elements work to provide reliable protection of marine resources.

The guidelines state that, except as provided under Section 404(b)(2) of the Clean Water Act, no discharge of dredged or fill material shall be permitted if there is a practicable alternative to the proposed discharge which would have less adverse impact on the aquatic ecosystem, so long as the alternative does not have other significant adverse environmental consequences. Practicability takes into account both economic (cost, availability) and environmental (protectiveness of the quality of the human environment and human health) factors.

Accordingly, under PSDDA, the determination of compliance with the guidelines are made on a project by project basis as a regulatory action which is subject to full public and agency review. Availability and environmental protectiveness of upland and other confined disposal options will be taken into account at the time of each of these decisions. Unconfined, open-water disposal of dredged material may not be the allowed alternative for all projects where disposal has been proposed.

With the active involvement of Federal and State agencies, the tribes and the public, improved pollution source control should be achievable in the foreseeable future, which will also improve the quality of dredged material which could be disposed at PSDDA sites.

The PSDDA initial ranking scheme that is cited in the comment provides guidance to regulators for requirements for sampling. In a high ranked area, there is good reason to expect that chemicals are present at or above the PSDDA SL values. The high ranking indicates that more sampling must occur since contaminated areas are expected to have highly localized concentrations of these chemicals. The ranking system provides additional protection against disposing chemicals that are present but were not characterized. Bellingham

Harbor is a high ranked area, for precisely the reasons cited: known high concentrations of metals and other compounds occur there. Bellingham Harbor sediments which are found unsuitable for unconfined, open-water disposal under the PSDDA guidelines, would not be disposed at the Bellingham Bay PSDDA site. The guidelines include chemical, biological and, where appropriate, bioaccumulation testing. The PSDDA guidelines incorporate potential for food web transfer of toxic chemicals (see EPTA II.8.4 and Exhibit A of the Phase II MPR, tables A.8 and A.9). Additionally, the PSDDA agencies recognized that the proximity of the Bellingham Bay site to crab concentration areas near Post Point merits special crab body burden studies in addition to the standard environmental monitoring which is planned to assure that chemical levels do not rise in offsite populations of benthic organisms. Again, these measures are very protective of resources, and will not allow degradation.

Response 8. Chapter 2 of the DEIS/FEIS discusses the site selection process, and this is summarized in response 4, above. Chapter 3 of DEIS/FEIS identified the proximity of concentrations of resources and quantified those in the vicinity of the site, and chapter 4 discusses the potential adverse impacts to these resources and to fishing, and concluded that these would not be significant. The PSDDA agencies agree that the selected site location should not increase "the area of contamination in an area rich in natural resources." The management plans that have been described in the documents and summarized above provide protection against contamination and degradation.

Bellingham Bay does have higher crab populations than some other areas in Puget Sound, but numbers of Dungeness crab at the disposal site were always found to be below the 100 crabs/hectare threshold that is believed to be the average northern Puget Sound background concentration of Dungeness crab (see DEIS, page 2-48). (This background concentration does not include the lower crab numbers known to occur in the Strait of Juan de Fuca.) However, numbers of crabs at a distance from and upslope of the site exceeded 100/hectare.

The issue of buried crabs and study limitations were raised by the Lummi Tribe in a letter dated June 7, 1988. Response was made by letter of July 19, 1988, indicating that further consultation with and re-examination of data collected by University of Washington researchers had been made. After reviewing the discussion in the DEIS on impacts to Dungeness crabs, and shrimp, the PSDDA agencies conclude that it contains a thoroughgoing discussion of both direct and indirect impacts of disposal activities on these resources, in particular on pages 4-54 through 4-60. Factors such as physical burial, suspended material in the water column, potential for crab attraction to the disposal area, chemical toxicity and potential for bioaccumulation/biomagnification in both crab and shrimp are considered.

The research tools and techniques used for the collection of benthic organisms and fish are not perfect, as the quotation suggests, and the numbers given are estimates of populations based on inferences from the results. However, the techniques used by the University of Washington researchers were adequate to provide population estimates that are comparable to other Puget Sound sites and to determine areas within Bellingham Bay in which resources are fewer.

"The severity and extent of biological effects from material passing the PSDDA guidelines are not expected to be significant because the majority of the taxa found at the selected site and offsite consist of bivalves molluscs, and polychaete annelids which are generally known to be less sensitive species (DEIS pg 4-56)" (9)

Bivalve larvae are used as a bioassay organism precisely because of high sensitivity and constitute the Lowest Apparent Effects Threshold level for chemical contaminants in Puget Sound (WAC 173-204-200)

The proposed dumping window of 16 June to 31 October occurs during the period of highest commercial and recreational human use activity (10)

Before relocating any material, we would like to know specifically how the clean and contaminated material is to be separated during dredging, how contaminated material is to be transported, and where it will be stored (11)

The search for disposal areas for clean material should be continued using the original minimum depth recommendation of 120 feet. Past disposal sites in Bellingham Bay were too shallow requiring a new locations to be found soon after they had filled in. A deeper site would also generally have fewer marine resources and impacts to fisheries (12)

It is unfortunate that we are being asked to choose another disposal site for contaminated material in a new, relatively clean area before there is a plan or action to clean up Bellingham's inner harbor and the old dredge disposal sites. Recently a Work Group has been formed to provide a cleanup plan for Bellingham Bay. We hope this "Bellingham Bay Action Program" will identify technologies that will allow the cleanup of this material. At present we are unaware of any method that will reduce contamination without introducing additional risks to the environment (13)

Because our ability to cleanup a contaminated disposal site is, at present unknown, it is most important that any action taken to transfer, sort or dispose of contaminated material be taken with care to minimize additional impacts to the resource. We suggest that the Corps wait for the Action Programs plan so that these strategies could be incorporated into the PSDDA process prior to selecting a disposal site for the transfer of contaminated sediments within the Bellingham Bay inner harbor

The Lummi Tribe suggested additional investigations using sampling methodologies that would detect buried crab. Based on recent research by University of Washington scientists (in particular studies at Ship Harbor near Anacortes, Washington and in Port Gardner), Dungeness crab generally do not bury in sediments that are characterized as predominantly silts and clays, which occur at the Bellingham site. The aggregations of gravid female Dungeness crab that were identified occur to the east of the site, near Post Point, upslope and on sandier substrates. Also, monitoring of Dungeness crab before and during use of the Bellingham Bay site will assess bioaccumulation potential in the populations, which will address the concern that they are being impacted by chemicals to which they could be exposed by such behavior.

Response 9. That different sensitivities may occur in different life stages (e.g., larvae versus adults) of the same species is well-known. Bioassays using the larval stages of both the bivalve and echinoderm have repeatedly demonstrated greater sensitivities than, for example, bioassays such as the adult amphipod bioassay (Rhepoxynius abronius and Eohaustorius estuarius). This was documented in the EPA (1989) report, Comparison of Bioassays for Assessing Sediment Toxicity in Puget Sound. Appropriately sensitive species and life stages are used by PSDDA to judge sediment toxicity. Different species of adult bivalves may exhibit a range of sensitivities to toxic chemicals when exposed to them in experimental aquaria. On the other hand, the composition of a benthic community exposed to such chemicals reflects all exposed life stages, both sensitive and insensitive. In experiments designed to monitor benthic communities near dredged material disposal sites, crustaceans are generally displaced early; communities become dominated by less sensitive species of polychaetes and bivalves. For example, the opportunistic bivalve species Axinopsida serricata is less sensitive than the oyster to toxic chemicals, and is widely distributed in Bellingham Bay sediments. Similarly, the PSDDA Phase II baseline studies indicated predominance at the site of the cirratulid family of polychaete worms, which are known to be tolerant to organically-enriched sediments such as occur onsite.

Response 10. The 4½-month dumping window (most limited of any PSDDA disposal site) does occur during the highest commercial and recreational use period. As stated in response 8 to the FWS/BIA comment letter, protective mechanisms have been provided through the Federal Section 404 permit process and compliance inspections to assure that there will be no conflicts with Indian treaty fishing activities. The highly restrictive window was chosen to avoid known resource concentrations in the benthos. The Bellingham Bay site is also located in an active navigation area and within an explosives container ship anchorage zone managed by the U.S. Coast Guard. These other activities may tend to conflict with fishing and shellfishing activities. However, the PSDDA site management plan is designed to make disposal compatible with all these other activities.

Response 11. During the Section 404 permit process, there are several required submittals from the permit applicant. (Federal navigation projects have similar requirements, and in what follows the term "permit applicant" applies to them as well.)

Prior to the permit application public review, a sampling and analysis plan is required of the permit applicant, which is described in Exhibit A of the Management Plan Report and which provides chemical and biological information to characterizes the material at the dredging site. The sampling and analysis plan defines "dredged material management units" or area and depth sectors of the proposed dredging project. The PSDDA agencies review and approve the plan and interpret the test results for each management unit in terms of that unit's suitability or unsuitability for unconfined, open-water disposal

When the management units have been evaluated, the permit applicant submits proposed dredging and disposal operations plans describing how the material will be removed and disposed (see chapter 6 of the MPR). Sediments unsuitable for open-water unconfined disposal are defined and the means of disposing these are specified. Ecology is presently drafting standards for the dredging, handling, storage and disposal of sediments that require confined disposal, that is, which may not go to a PSDDA site. This is a separate action from PSDDA, but one which will provide a comparable level of protection during disposal of these contaminated sediments. It is more fully described in response 9 to NOAA/NMFS' comment letter in this exhibit.

The suitability of dredged material for disposal at a PSDDA site under the PSDDA guidelines and the operating plans will be described in the Public Notice circulated to the public and the tribes for comment. At the end of the public interest review period, the permit conditions will be specified, and approved operations plans will govern the permit applicant's activities during dredging, transport, and disposal. Approval of a navigation positioning method for the tug/barge at the PSDDA disposal site must occur before the operation may begin.

Response 12. The site selection process and the reason for relaxation of the 120 foot criterion was described in response 4, above. The estimated annual accretion rate of dredged material is 15-30 cm. Site capacity for the Bellingham Bay site is estimated to be about 8 million cubic yards. This estimate is based on known flat bathymetry and an assumption that the shape of the disposal mound will approximate a truncated cone with a base diameter of 3,800 feet (disposal site boundary), a height of 32 feet (3.4 degree angle of repose), and a top diameter of 1,900 feet. It was assumed that bulking effects which take place during dredging and disposal operations will be offset by the long-term consolidation of the disposal mound. Thus, there would be a one-to-one ratio of disposal dredged material volume to site capacity volume. Assuming an annual average of the volume that could be discharged at the Bellingham Bay site over its first 15 years of use (550,500 c.y. to 1,181,500 c.y.) continues, the site life could range from 100 to 220 years.

As previously stated, there were no nondispersive sites with acceptably low resource levels identified in north Puget Sound. Site management conditions

Again the Lummi Tribe is opposed to the location of the confined dredge disposal site for Bellingham as identified in the DEIS. Our Fisheries staff will be gl. ' to assist you in investigating other locations that may be more suitable for the disposal of dredged sediments. We are also interested in improving sediment criteria standards that will determine the degree of contamination acceptable for open water disposal. (14)

Signed,

Gerald I. James
General Manager, LIBC

Merle Jefferson, Director
Lummi Indian Fisheries

cc D. Ross, Tribal Attorney
Matt Aamont, Whatcom County Public Works
Vicky Matheson, Bellingham City Planning

such as timing restrictions will help avoid impacts to marine resources at and near the site.

Response 13. The PSDDA agencies have discussed the plans for designating a disposal site with representatives of the Bellingham Bay Action Group. PSDDA is totally compatible with the planning and cleanup activities that will occur in Bellingham Harbor as well as the PSWQA Puget Sound Management Plan. In fact, the cleanup activities could include remedial dredging of sediments containing low levels of chemicals for ultimate disposal at the PSDDA site. There is no compelling reason to stop dredging and disposal activities until the Action Group has developed its strategies.

Response 14. The PSDDA agencies believe that sediment standards that are protective of marine resources have been formulated. Lummi representatives have attended the DSWG meetings and been provided memoranda of the ongoing site selection process, which is now completed with the publication of the FEIS. Furthermore, the PSDDA agencies have discussed the comments made on the document with the tribe, and acknowledged the tribes opposition to the site.

Point No Point Treaty Council
Port Gamble Klallam • Lower Elwha Klallam • Jamestown Klallam • Skokomish

May 15, 1989

Mr. Frank Urabeck
PSSDA Study Director
Department of the Army
Seattle District, Corps of Engineers
P.O. Box C-3755
Seattle, WA 98124

RE: PUGET SOUND DREDGED DISPOSAL ANALYSIS PHASE II; NORTH AND SOUTH PUGET SOUND

Dear Mr. Urabeck:

We would like to offer the following comments on the SEPA/NEPA review of the draft documents referenced above.

The Treaty Council is the fisheries management agency for the three Klallam and the Skokomish Tribes, whose usual and accustomed fishing areas includes marine waters of the Strait west to the Hoko River, Admiralty Inlet and the San Juan Islands, and Hood Canal. All three proposed dispersive open water disposal sites are located within our treaty fishing area. These sites will be likely to receive dredged material from nearby marinas and harbors assigned high and moderate area rankings for potential presence of chemicals of concern (Exhibit A, PSSDA Dredged Material Evaluation Procedures).

Our primary concerns include toxic and chronic sublethal effects on marine biota, potential impacts on salmon and halibut migrations, interference with seasonal treaty fisheries, and tributyltin testing requirements.

1 Although PSSDA represents an improvement over the status quo for dredge disposal operations, we are not fully assured that the PSSDA process will prevent harmful impacts to fish and shellfish resources. Dilution of disposed dredged material containing elevated levels of metals, organic compounds, and other toxic substances in relatively clean Puget Sound waters conflicts with ongoing efforts to clean up the Sound. We believe that only clean sediment is suitable for disposal at the dispersive sites, and biological testing guidelines for dipersive sites should be adjusted to achieve no toxic effects or mortality over reference areas.

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Response 1. The disposal guidelines that will be applied to the dispersive disposal sites are highly protective of the marine environmenta and do not rely on dilution to achieve that protection. Any bioassay failure relative to reference sediments in material proposed for these sites is sufficient for a determination of unsuitability for confined, open-water disposal. As detailed in responses 1 and 6 to the NMFS letter, the PSDDA disposal guidelines are consistent with Section 404 of the Clean Water Act and the Puget Sound Water Quality Authority's Water Quality Management Plan for Puget Sound. The potential for toxic and chronic sublethal effects is addressed in the FEIS, the final MPR and in responses 3 and 5 to the NOAA/NMFS comment letter, this exhibit.

Response 2. The dredging window has been restricted at the Port Angeles and Port Townsend sites in response to recommendations by WDF (these sites will only be open 6 months versus 9 months elsewhere). As indicated in response 9 to the FWS/BIA comment letter, no damage is anticipated to salmon migration patterns. This also would apply to halibut. Conflicts with Indian treaty fishing will be avoided at the PSDDA sites, as described in response 8 to the FWS/BIA comment letter.

Response 3. As indicated in response 9 to the FWS/BIA comment letter, material released during disposal is not expected to remain in suspension at sufficient levels to create adverse effects to migrating fish. Observations of disposal at Commencement Bay in March 1989 revealed no detectable surface turbidity immediately following a dump.

Response 4. Responses 3 and 5 to the NOAA/NMFS comment letter and added text in the Phase II MPR chapter 5 address this concern. Chronic sublethal effects are considered during the evaluation of dredged material under the Section 404(b)(1) guidelines. While a specific acceptable chronic sublethal test does not yet exist, the PSDDA agencies are continuing their efforts toward development of such a test. Sublethal effects are partially addressed by some of the acute toxicity bioassays currently in use by the PSDDA agencies (see Phase II MPR Section 5-10). The more restrictive disposal guideline that will be used at the dispersive sites along with the high energy nature of the sites hould combine to preclude chronic sublethal effects at these locations. Accordingly, the PSDDA agencies do not feel that further restrictions are necessary.

Response 5. Tributyltin (TBT) was adopted as a chemical of concern for limited areas, with an interim SL of 30 ppb. A review of the available information is provided in the Phase II MPR, section 5.2c(8). TBT testing will be required whenever there is a reason to believe that the chemical is present at a level that could cause harm. For most marinas, it is expected that biological testing will be required whether TBT is tested for or not. Biological testing is the basis for determining suitability for disposal whenever concern is above its screening level.

We are concerned that disposal operations may conflict with treaty fishing activity at the proposed dispersive sites, and request that timing be limited to periods when commercial fishing activity is minimal. At the proposed Rosario Strait site, the salmon fishery extends from July 1 to the end of November. At the Port Townsend site, sockeye salmon fishery extends from July 1 to September 1. Halibut fishing activity near the Port Angeles and Port Townsend sites is generally in spring and early summer. ②

Assuming that a portion of dreged materials remains suspended in the upper water column for periods of hours or longer, we are concerned about potential interference with salmon migrations. We request that timing of disposal operations be adjusted to avoid peak migrations of salmon in and out of the Strait and Admiralty Inlet. ③

We remain concerned about chronic sublethal effects of toxic dredged materials on the marine ecoysytem. Since chronic effects must be accounted for in the overall evaluation of sediment quality, we request that deposition of materials which test over screening levels for chemicals of concern be prohibited until the chronic effects work is completed and reviewed by the tribes and appropriate entities. ④

Finally, because of its extreme toxicity, we ask that testing for butyltins be required for all marinas and harbors where it is potentially present, and not just areas of active vessel maintenance. It is acknowledged that the exact areas and extent of TBT contamination in Puget Sound is unkown. We suggest that the "chemical of concern in limited areas" designation be conservatively interpreted by PSSDA agencies and that testing occur wherever TBT contamination is possible. ⑤

The Treaty Council requests early notification of dredged material disposal activity and sediment quality data for the proposed dispersive sites. ⑥

Thank you for this opportunity to comment on the PSSDA draft documents.

Sincerely,

Holly Coccoli

Holly Coccoli
Water Quality Specialist

cc: PNPTC Fisheries Managers
BIA Agencies
Northwest Indian Fisheries Commission

<u>Response 6</u>. As described in response 11 to the Lummi Indian Business Council comment letter, all interested parties, including affected Indian tribes, are notified of proposed dredging projects through the Section 404 public notice issued by the Corps as part of the public interest review. Dredged material test results are available upon request from the Corps.

SQUAXIN ISLAND TRIBE

May 18, 1989

Frank Urabeck, PSDDA Study Director
Seattle District, Army Corps of Engineers
P.O. Box C-3755
Seattle, Washington 98124

Dear Mr. Urabeck:

The following comments reflect the concerns of the Squaxin Island Tribe on Phase II of the Unconfined Open-Water Disposal of Dredged Material Study. As you have noted in your reports, the Tribe is a federally recognized Indian Tribe with treaty rights to natural resources in the parts of the area covered by the Phase II reports. This obligates the Tribe to undertake a critical analysis of how the proposed action may affect critical resources of concern to the Tribe, particularly fish, shellfish, and related marine resources in this case.

Initially, we would like to point out that the proponents have the responsibility to "avoid and minimize [any] adverse effects" as you have pointed out in the documents. This is a somewhat higher standard that the Army Corps' compliance standard of avoiding "unacceptable adverse impacts". The Tribe is perfectly capable of determining the acceptability of adverse impacts and would request that the Corps, under their trust responsibility to the Tribes, recognize the higher standard which is utilized by the Tribe in their review and is fully supported by federal law. 1

We would prefer to focus our comments on the South Puget Sound area as it is entirely within the Tribe's "usual and accustomed fishing area". Though anadromous fish clearly migrate throughout Puget Sound, we have a better knowledge of the specific interactions present in South Puget Sound as well as knowledge about the source materials proposed for dredging and disposal in this area.

NATURAL RESOURCES DEPARTMENT / West 81 Highway 108 / Shelton, WA 98584
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RESPONSE TO SQUAXIN ISLAND TRIBE

Response 1. The Federal government has a responsibility to protect legitimate and established Indian treaty rights, including right of access to usual and accustomed fishing grounds. The PSDDA Phase I and Phase II documents indicate mechanisms in the Federal 404 permit process to insure that interference with treaty fishing does not occur. Regarding adverse impacts to marine resources, the PSDDA agencies have concluded that, under the PSDDA disposal guidelines, any potential adverse impacts that might occur at the Anderson-Ketron Island site would be minor and "acceptable" under the CWA. No adverse impacts to Indian harvests are anticipated. The Federal trust responsibility is fully served (as discussed in response 8 to the FWS/BIA comment letter) by the adopted environmental protection mechanisms.

Response 2. The Anderson-Ketron Island site has been selected as the appropriate location for disposal of dredged material passing the PSDDA guidelines. No further consideration is being given to the Anderson Island/Devils Head site.

Response 3. The selected site was determined to be nondispersive based on the depositional analysis (see 2.03f(2)(a)1 in FEIS). Further information provided by the recently conducted Phase II baseline studies tended to confirm this determination. A variety of management actions have been described under the PSDDA monitoring program (see Phase II MPR chapter 7). These range from further analysis to establish the ecological significance of tentatively identified changes to major program responses such as site relocation or closure.

Response 4. ML values are not established based on SL values. Conversely, for most chemicals of concern, the SL value is set to one-tenth the ML. For pentachlorophenol, the ML value is equal to the highest AET.

Response 5. The PSDDA agencies acknowledge the desirability of having an acceptable regulatory chronic sublethal test and, as noted in chapter 5, section 5.10 of the MPR, sought to develop such a test by funding two major research effects. There was no commitment to delay completion of the PSDDA study until that test was achieved. Also, research is continuing by EPA and Ecology. At present, there is no chronic sublethal test in regulatory use anywhere in the nation. The PSDDA agencies are satisfied that the acute toxicity tests contain elements that at least partially address sublethal effects. Accordingly, until an acceptable chronic sublethal test is achieved, existing tests are viewed as sufficient for regulatory decision making. See responses 3 and 5 of the NOAA/NMFS letter, this exhibit.

Response 6. See response 5 above. The PSDDA evaluation procedures are in full compliance with Federal and State laws.

Response 7. The monitoring plan for the Anderson-Ketron Island site is adequate based on the low numbers of mobile species found in PSDDA field

First we wish to dispose of the subject of the continued identification of the Anderson Island/Devils Head ZSF 3 as an alternate disposal zone. Your data does not support any further consideration of this site. There are conflicts with herring and groundfish resources at the site. A sufficient buffer zone on the area cannot be achieved unless an arbitrary decision is made to decrease its size, despite other siting criteria. Sport and commercial fishing areas will be impacted. Finally, your own data indicates that it does not meet the criteria for a non-dispersive site. (DEIS, page 4-49) Any further consideration of this site in any context should be abandoned. ②

The proposed Anderson/Ketron site is perhaps a better disposal site though it too crosses the threshold for siting criteria relative to peak current movement at the site. Despite the bathymetry indicating some physical constraints to deposited sediment movement, we question what will happen as dredged material builds elevation of the bottom contours. Should the dredge material mound at the disposal site it would create greater cause to believe resuspension of sediment would occur under certain current conditions with the result being potentially contaminated sediment moving off site. It would appear that the monitoring program proposed for the site would likely detect a southerly movement of material, but there are only a few weakly worded considerations of what would happen in this instance. This is of particular concern because of the proximity of important resources located in surrounding areas and particularly to the south. ③

We are glad to see PSDDA take a harder look at the SL and the ML issues on pentachlorophenol. We strongly support lowering the SL to 69 parts per billion. We have some concerns however, that the setting of the ML at 690 ppb based on the standard procedure of ten times the SL may not provide adequate protection to resources. This is of particular concern because of problems relative to the Port of Olympia proposed dredging project. ④

The Tribe has consistently indicated the immediate need for the development of chronic and sublethal testing mechanisms within the PSDDA guidelines. We were assured that they would be developed during Phase II of the process. As indicated in your report, this has not happened, nor have the PSDDA agencies been willing to consider test interpretation relative to disposal guidelines. We regard this as a serious breach of faith in the development of this process. While fully understanding that we cannot foresee all the pitfalls associated with the development of a testing procedure, we cannot approve of continued development of Phase II sites without addressing this concern. ⑤

The current Apparent Effects Threshold approach to biological testing is exactly as it states - apparent. It simply has no device to measure chronic and sublethal effects. Interpretation of test results for protocols whose endpoints are death of test organisms is not a surrogate for chronic effects. I refer to the suggestion that analysis of deformity in the oyster larvae test and sublethal effects in the Microtox test are adequate indicators of the possible effects of sediment chemicals of concern. This is not the case as evidenced by the intensive efforts involved to develop such a test. We believe that series of chronic and sublethal tests must be developed prior to any further permitting of any proposed PSDDA sites, including Phase II sites in South Puget Sound. We believe that this position is clearly supported by State and Federal law including the Clean Water Act and additionally by SEPA and NEPA requirements to consider cumulative effects. 6

We believe that PSDDA has accepted a flaw in reasoning as an assumption in designing the monitoring program. The concern is regarding mechanisms whereby contamination can move off site. The study assumes that significant numbers of mobile species will not be attracted to the site. Thus you appear to have discounted the movement of contaminants off site by mobile species as a vector for more widespread contamination. We believe that you should incorporate a greater degree of biological monitoring of mobile species, especially in light of the fact that you have not developed a chronic and sublethal testing protocol. Mobilization of contaminants via a biological resource could represent a threat to other components of the food chain. 7

We are equally concerned as to the level of analysis that will be possible with such a limited monitoring approach. The data set you derive will contribute little to actual determination if site management problems exist. Statistically derived differences will not carry much weight should a party be arguing for drastic and costly site management changes or even closure. We feel that PSDDA owes it to the program to conduct a better monitoring program which can provide data which is consistent with the need to make management decisions based on it. 8

In conclusion let me reiterate the concerns of the Squaxin Island tribe. Chronic and sublethal testing protocols for dredge spoils should be an absolute priority <u>before</u> any additional site are permitted. The South Sound site is of marginal quality because of concerns over currents resuspending sediments and therefore should receive the attention of a more well developed and thorough monitoring program. 9

We appreciate the efforts that have gone into the PSDDA program and the contributions that the study program has made towards our understanding of Puget Sound and its dynamic processes. Thank you for this opportunity to comment.

Sincerely,

Jeff Dickisen, Biologist

surveys which also noted low resources that could attract demersal fish and shellfish. However, chronic sublethal testing of disposal site sediments may be added to future environmental monitoring, if found to be appropriate as part of the PSDDA annual review process.

Response 8. The monitoring that is planned for the Anderson-Ketron Island site is considered to be sufficient to meet site management requirements. Should problems be discovered, additional field studies may be conducted to establish a basis for appropriate management actions. Statistical and ecological measures indicated are fully adequate in the opinion of expert benthic ecologists to provide early warnings of exceedance of site management conditions. A more rigorous sampling and analysis would only add corroborative information, but if the situation warrants, there is a contingency for further sampling or further analysis of archived samples. The results of site monitoring will also be publicly discussed at PSDDA annual review meetings.

<u>Response 9</u>. See responses to comments number 3, 5, 6, and 8.

KATHERINE FLETCHER
Chair

STATE OF WASHINGTON
PUGET SOUND WATER QUALITY AUTHORITY
217 Pine Street Suite 1100 • Seattle Washington 98101 • (206) 464-7320

May 18, 1989

Frank J. Urabeck
Seattle District Corps of Engineers
P O Box C-3755
Seattle, Washington 98124

Comments on Management Plan Report and Draft EIS, PSDDA Phase II

Dear Mr. Urabeck

The Authority congratulates the four PSDDA agencies for their continued commitment to reworking and improving the dredged material disposal program for Puget Sound. This letter transmits our comments on the Phase II documents.

Dispersive Sites

(1) The Authority concurs that dispersive sites are necessary in the Phase II area. The standards for dispersive sites must be more restrictive to ensure that serious adverse effects to not occur off site The description of the dispersive site disposal guidelines provided on page 5-17 of the Draft Management Plan Report is acceptable. It allows no more than one bioassay (of three) to be statistically significant over reference, and no greater than 10% absolute mortality over reference Figure A.2 b of Exhibit A is incorrect (it indicates that up to 30% mortality over reference is acceptable) and should be corrected.

Dispersive Site Monitoring

(2) The discussion of dispersive site monitoring is inadequate. The thickness of sediment accumulation that will be detected by the proposed method must be specified. In addition, the monitoring plan should state that any sediment that does accumulate, over some specified minimal amount, will be sampled and tested in a manner similar to that for the depositional sites Simply stated, if the dredged material is not washed away, its effects should be monitored

Puget Sound Plan Language

(3) The relevant sections of the 1987 Puget Sound Water Quality Management Plan have been referenced in the Phase II documents In some cases, language changes were made in the 1989 Puget Sound Plan, which was adopted in October 1988 and supercedes the 1987 version The final Phase II documents should be updated to reflect the latest plan version. Sections of the 1989 plan are attached for your information

Superfund Material

(4) The PSDDA Phase II documents do not address material that may be dredged solely for the purposes of contamination cleanup, e g , Superfund program actions, based on an assumption that such material would not be acceptable for the PSDDA sites The Authority feels that PSDDA sites should be available for material from cleanup actions that passes the PSDDA tests We recognize that it is virtually impossible to estimate the volume of such material that may be generated However, making PSDDA sites available for this material may decrease the cost of cleanup actions and make them more feasible This would provide a net benefit to Puget Sound Since the same evaluation procedures and site guidelines would be

RESPONSE TO PUGET SOUND WATER QUALITY AUTHORITY

Response 1. The error has been corrected. Protection for resources at dispersive sites is equivalent to that at and near nondispersive sites. No unacceptable adverse effects would be allowed at either sites by disposal of material passing PSDDA guidelines. It is only because it is impossible to cost-effectively monitor far-field effects that the dispersive guideline is selected to be more rigorous.

During the finalization of the Phase II Management Plan Report, EPWG recommended the combination of the measures of mortality and abnormality in the sediment larval test. For reasons relating to "noise" in the sediment larval test and described on page 5-22 of the final Phase II MPR, it was determined to adopt a 15% single-hit rule for that test only; the rest of the PSDDA bioassays remain at 10%, as described in the draft MPR.

Response 2. The bathymetric methods used for monitoring the sites will distinguish approximately 1 percent of the depth of the sites. However, as all of the dispersive sites are extremely hydrographically dynamic, and materials that are part of the highly variable "natural" Puget Sound sediment bedload will be moving through the sites, this resolution does not indicate an action level adopted by the PSDDA agencies. Instead of a simple "depth rule," bathymetric results for each site will be reviewed by coastal hydrographic engineers from the Corps to determine if there is a significant accumulation of dredged material. Should mounding be detected, the PSDDA agencies will determine what actions should be taken, depending upon specific circumstances. Some options include: further physical monitoring, change in the means of disposal at the sites, and site closure. Chemical and biological studies would not be warranted because of the restrictive disposal guideline that would not allow contaminated material to be disposed at these sites.

Response 3 The text has been revised per the information provided in the PSWQA letter.

Response 4. As indicated in the Phase I FEIS, dredging solely for the purpose of cleanup under Superfund was not included in the scope of PSDDA because it was assumed that sediments removed in cleanup programs would not be acceptable for unconfined, open-water disposal. It was left to the ongoing Superfund programs to establish the appropriate remedial action for cleanups. The PSDDA agencies do not anticipate that sediment requiring removal under Superfund will pass disposal guidelines for disposal at PSDDA sites. It is possible that sediments from other dredging activities, e.g., navigation maintenance, in the vicinity of Superfund sites will pass PSDDA guidelines and thus be suitable for disposal at a PSDDA site. Also, there may be non-Superfund cleanup activities which generate materials suitable for unconfined, open-water disposal.

Response 5. Comment noted. The final MPR text has been expanded to indicate the PSDDA agencies intent with regard to areas which should be tested for TBT, and an interim SL has been selected.

used for navigation and cleanup dredging, the environmental risk would be the same.

Changes to Evaluation Procedures

The Authority supports the proposed changes to evaluation procedures described in the Draft Management Plan Report chapter 5. In particular, we support the addition of tributyltin as a chemical of concern and believe it is appropriate, both to collect information on TBT at dredging sites, and to document TBT going to the disposal sites. Because TBT has been used in upland applications in addition to its use in anti-fouling paints, some TBT tests are probably appropriate in urban areas. The focus should clearly be on shipyards and marinas with boatyard areas. ⑤ We support the proposed changes to chemical screening levels, which appear to be appropriate. ⑥ We also support recommendations on chemical methods to help permit applicants achieve the necessary chemical detection limits. The inability of the CLP chemical methods to routinely achieve needed detection limits, reported in the PSDDA reports, is disturbing. Every effort must be made to achieve adequate chemical detection limits. ⑦

Thank you for this opportunity to comment. If you have any questions about these comments, please call John Dohrmann (464-7318).

Sincerely,

Katherine Fletcher
Chair

Response 6. Comment noted.

Response 7. Comment noted. The modifications to the final Phase II MPR include the latest information available from the ongoing EPA Recommended Protocols revision and other sources to assure that detection limits and quality assurance steps are adequately met by laboratories doing PSDDA analyses.

PROGRAM ELEMENTS

Policies

S-1. Sediment Program Policies

The following policies shall be followed by all state and local agencies in actions affecting sediment quality, including rulemaking, setting priorities for funding and actions, and developing permit programs:

a. All government actions will lead toward eliminating the presence of sediments in the Puget Sound basin that cause adverse effects to biological resources or pose a serious health risk to humans.

b. Programs for management of dredging and disposal of sediments should result in a net reduction in the exposure of organisms to adverse effects.[23]

c. Sediment cleanup programs (which may include capping in place) shall be undertaken when reasonable to reduce, with the intent of eliminating, the exposure of aquatic organisms to sediments having adverse effects.[24]

[Status: Agencies are incorporating these policies into their programs and activities.]

Unconfined Open Water Disposal

S-2. Program for Unconfined Open Water Disposal

The Authority shall review each draft report and environmental impact statement (EIS) of the Puget Sound Dredged Disposal Analysis (PSDDA) and provide timely comments to the Corps of Engineers (lead PSDDA agency). In addition, Authority staff shall review preliminary drafts of PSDDA draft EISs and advise the Authority of any significant changes needed. Comments will then be forwarded to PSDDA. Every effort will be made to resolve PSWQA concerns with PSDDA recommendations so that the recommendations in the final reports by PSDDA can be adopted by the Authority. The Authority shall review, modify if necessary, and adopt the recommendations of each phase of PSDDA within three months of the publication of the final reports and EISs.

In commenting on the draft EIS and adopting final unconfined open water disposal recommendations, the Authority will specify how state agencies and local governments should conform their programs to the recommendations.

23 The intent of this policy is that dredging and disposal contribute to the cleanup of the Sound by allowing unconfined open water sites to have only low levels of contamination and to dispose of more contaminated sediments in a manner that prevents continued exposure of organisms to adverse effects. For proposals where dredging will expose contaminated sediments, project-specific mitigation measures may be required.

24 Element S-7 directs Ecology to develop a decision process which will resolve the question of when cleanup actions are "reasonable."

After adoption by PSWQA, the recommendations shall become part of the Puget Sound Water Quality Management Plan and shall be used by state agencies and local governments in reviewing and acting on proposals for unconfined open water disposal. If required, all state and local agencies shall promptly modify their regulations and programs as necessary (including shoreline master programs) to conform to the adopted recommendations. Revisions to regulations and programs shall be completed within one year of adoption by PSWQA. Agencies which cannot act within one year shall notify the Authority immediately to request an extension to this time limit.

Target Dates: Schedule is governed by PSDDA document production.

[Status: PSDDA Phase I report is complete. Authority adoption of recommendations for Phase I is incorporated as element S-3. In adopting Phase I recommendations, the Authority is not requiring local governments to amend shoreline master programs to conform to the PSDDA recommended language. Phase II draft is expected in late 1988.]

S-3. Unconfined Open Water Disposal Sites

The Authority adopts by reference the following portions of the Management Plan for Unconfined Open Water Disposal Phase I:

- Selection of dredged material disposal sites in Everett, Seattle, and Tacoma harbors to serve as regional sites for disposal of dredged material that meets the PSDDA evaluation procedures (page 4-5 of the PSDDA Phase I Management Report).
- Selection of site condition II for the phase I sites (page 4-5 and Chapter 5 of the PSDDA Phase I Management Report). It is the Authority's long-term goal that dredged material disposal sites have NO chemical adverse effects. The Authority concurs with the PSDDA recommendation of Site Condition II ("minor" adverse effects) for the near term because: the sites are being selected to minimize the resources affected; the sites will receive large of amounts of material that would pass a Site Condition I standard, which will moderate the potential effects of the material that falls between conditions I and II; and the proposed program of monitoring and reevaluation will allow protective adjustments to the evaluation procedures if problems develop.
- Evaluation procedures (Chapter 5 and Appendix A of the PSDDA Phase I Management Report).
- Disposal Site Management Plans (Chapter 6 of the PSDDA Phase I Management Report). The Authority supports model shoreline master program language proposed by PSDDA for adoption by local governments and suggests that local governments consider amending their programs but is not requiring local governments to do so.
- Disposal site environmental monitoring (Chapter 7 of the PSDDA Phase I Management Report).
- Data management (Chapter 8 of the PSDDA Phase I Management Report).
- Annual review and program update (page 9-6 of the PSDDA Phase I Management Report).

Changes to any of these PSDDA recommendations are considered major public actions subject to Authority review.

Target Dates: As described in PSDDA Phase I Management Report.

[Status: Permits for the three Phase I sites are pending as of October 1, 1988.]

Confined Disposal

S-4. Confined Disposal Standards for Sediments

Ecology shall develop and adopt by regulation standards for reuse or disposal of dredged material that exceeds the sediment standards developed under element P-2 and that will not be disposed of at unconfined open water disposal sites established by the PSDDA process. These standards for confined disposal will be used by Ecology, shoreline jurisdictions, and local health departments in approving or denying permits for the use or disposal of dredged material that exceeds the P-2 standards. The objective of these disposal standards is to prevent the exposure of aquatic or terrestrial organisms, including humans, to adverse effects from the contaminants in the sediments.

In developing the standards Ecology shall consult with agencies and other parties with technical expertise and shall provide a public education/public involvement program. The standards shall address treatment as well as in-water and upland confined disposal methods.

Target Dates: Adopt interim standards by September 1, 1989. Adopt final standards by July 1, 1990.

[Status: Ecology has begun developing standards.]

S-5. Revision of Rules and Programs

After the adoption by Ecology of disposal standards for sediments that exceed sediment standards (S-4), the Authority shall review the standards and consider the degree to which local governments and other state agencies should conform their programs to the Ecology standards so that the use or disposal of sediments in compliance with the disposal regulations is not unreasonably precluded. Shoreline master programs, solid waste rules, and the hydraulics permit rules may be affected. The Authority may then amend the Puget Sound Water Quality Management Plan to direct state agencies and local governments to revise their programs. If required, these revisions shall occur no later than two years after final action by the Authority. Any agency or local government that cannot meet this deadline shall request, at the earliest possible time, an extension from the Authority.

Target Dates: Begin review on April 1, 1990. Adopt plan language by October 1, 1990. Complete state/local revisions by October 1, 1992.

[Status: Will follow S-4. The schedule for state agencies and local governments to revise their programs has been extended by one year because of funding restrictions.]

S-6. Multiuser Confined Disposal Sites Study

Ecology shall undertake a study of the utility and viability of establishing a system of multiuser confined disposal sites. This study shall consider the amounts, locations, and contaminant characteristics of sediments projected to be dredged; the fraction of this material that might be disposed of at multiuser

JOSEPH R. BLUM
Director

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May 19, 1989

Mr. Frank Urabeck
U.S. Army Corps of Engineers
Seattle District
P.O. Box C-3755
Seattle, Washington 98124-2255

SUBJECT: Draft Environmental Impact Statement, Management Plan and Disposal Site Selection Technical Appendix - Unconfined Open-Water Disposal For Dredged Material, Phase II (North and South Puget Sound)

Dear Mr. Urabeck:

The Washington Department of Fisheries (WDF) has reviewed the above-referenced documents and offers the following comments.

General Comments

1 The ability of the Phase II section of the Puget Sound Dredge Disposal Analysis (PSDDA) to comply with the Clean Water Act should be discussed in greater detail. There seems to be an inherent contradiction between the anti-degradation requirement of the Clean Water Act and the concept of allowing placement of material which will cause on-site impacts in the nondispersive sites. 2 The relationship between the treatment of hazardous materials in PSDDA and their treatment on land should be discussed. Would all the materials meeting EPWG criteria be acceptable in a landfill?

3 Emphasis is needed on the probable "average" conditions at the nondispersive sites. The standards proposed for controlling the quality of material that will be placed at nondispersive sites will define the worst material which can be placed at these sites. The average quality of dredged material, however, is expected to be considerably cleaner than the guidelines allow. This is mentioned at least once in the Phase II DEIS but needs to be emphasized. In essence, the nondispersive sites may never reach Site Condition II due to the "capping" which is expected as cleaner sediments are placed on top of more contaminated sediments. Certainly, if a site is found to be handling the dredging needs in a given area and subsequent monitoring shows the site to be at Site Condition I, the standard for that site should be changed to the cleaner condition. This would comply with the anti-back sliding provision of the Clean Water Act.

General Response. In a meeting on 13 June, 1989, these comments were discussed with Earl Finn, Marv Tarr and Randy Carman of WDF. Agreements were reached between the PSDDA and WDF representatives that most of the stated WDF concerns could be addressed by FEIS text clarifications. The following responses are provided to assure that all these clarifications have been accomplished.

Response 1. The relationships of the PSDDA program to the applicable sections of the Clean Water Act are described in detail in the Phase I FEIS and in the Phase II DEIS (section 1.04).

The PSDDA Management Plan is consistent with Federal policies contained in the Federal Water Quality Standards Regulation (40 CFR Part 131). These policies deal with anti-degradation of water quality, and apply to the area beyond the disposal sites. Some short-term lowering of water quality is expected during disposal of dredged material at these sites, but little or no water quality impacts are anticipated beyond the site boundaries. The PSDDA dredged material evaluation procedures allow only relatively clean sediments to be discharged at the sites. Monitoring, included as part of the plan, will be conducted to verify predictions. Site management adjustments will be made if monitoring indicates this is needed.

The Clean Water Act (CWA) Section 404 establishes an effects-based approach to regulate the discharge of dredged and fill material into waters of the United States. The CWA requires that the discharge of dredged material not result in an "unacceptable adverse effect" to the aquatic environment. In the implementing regulations ("Section 404(b)(1) guidelines"), this requirement is clarified as as the "least environmentally damaging practicable alternative." The nondispersive guidelines are fully consistent with this clause of the CWA and all other Federal and State laws, well as the Puget Sound Water Quality Authority's management plan. The PSDDA Phase I and II documents have provided a complete impact analysis of effects to water quality, fisheries, benthic communities, and human uses, as well as assembling scientifically-designed evaluation procedures and environmental monitoring plans that go considerably beyond similar programs elsewhere in the country. All of these elements work to provide reliable protection of marine resources.

The guidelines state that, except as provided under Section 404(b)(2) of the Clean Water Act, no discharge of dredged or fill material shall be permitted if there is a practicable alternative to the proposed discharge which would have less adverse impact on the aquatic ecosystem, so long as the alternative does not have other significant adverse environmental consequences. Practicability takes into account both economic (cost, availability) and environmental (protectiveness of the quality of the human environment and human health) factors.

Under PSDDA, the determination of compliance with the guidelines is made on a project by project basis as a regulatory action which is subject to full

In addition, a commitment to improving conditions at the nondispersive is needed in both the DEIS and the management plan. The general trend in Puget Sound sediments and the expected sediment changes due to the improved regulation of point sources and of storm water outfalls should be discussed. Analysis of sediment cores for historical changes in sediment quality have shown a generally improving trend. The Puget Sound Water Quality Authority and the Department of Ecology have planned and undertaken programs to further control inputs of toxicants into the Sound. These efforts are anticipated to further improve the quality of future dredged materials. It is very important that the PSDDA Management Plan reflect these changes with progressively higher standards at the disposal sites as the average material handled improves. As the effectiveness of these control programs is felt, contaminated material is expected to become less common. There will consequently be less rationale for continuing to allow open-water unconfined disposal of material which might entail impacts on-site. While major improvements in sediment quality are yet to be realized, a proposed plan of action which recognizes this future condition should be defined and included in the final versions of these documents.

Specific Comments

DEIS, p.4-58, paragraph 3:

The authors state there will be no "significant" impact to Dungeness crabs at the Bellingham Bay disposal site for the cited reasons. WDF believes this section needs to be modified to indicate the preferred site is a comprise between concerns for crab at the northern ZSF and concerns for the bottom trawl fishery at the southern ZSF. Further, we believe impact to crab at the preferred site will be minor, but this assumption is based on a limited number of observations.

DEIS, p.4-93, paragraph 3:

It is stated, "invertebrate resources would not be significantly impacted at the preferred Port Angeles dispersive site...over the 9-month open-disposal period each year,". This section should be reworded to state, "impacts will be minor," and the open disposal period is six (6) months, not nine (9).

DEIS, p.4-94, paragraph 3:

The statement that "overall, the site would be open 5 months a year." is incorrect. With site closures from March 15 through June 15 and September 1 through November 30, the Port Angeles site would be open a total of six (6) months each year.

public and agency review. Availability and environmental protectiveness of upland and other confined disposal options are be taken into account at the time of each of thesedecisions. Unconfined, open-water disposal of dredged material may not be the allowed alternative for all projects where disposal has been proposed.

Response 2. No dredged material which is "hazardous" may be disposed at a PSDDA site. Corps' national dredging regulations (51 FR 19694, May 30, 1986; 33 CFR 320-330) state that dredged material is not a solid waste, and the designation and question appears to relate to solid waste disposal. Dredged material that would just pass the PSDDA guidelines would still exhibit several orders of magnitude lower levels of chemicals of concern than the values that are used to evaluate solid waste for disposal in landfills.

Response 3. The concept that the average material disposed at a PSDDA site will have lower levels of chemicals of concern is indeed an important one, and is referenced several times in this comment-response section and in the text. Also, it is probable that future source control of pollutants may provide for in-place capping with cleaner dredged material. Future dredged material conditions are further discussed in response 4, below.

An important goal of PSDDA is to restrict any realized chemical effects from dredged material to the nondispersive site. PSDDA agencies have not committed to any specific course of action regarding changing the site management condition at this time. The nondispersive guideline (Site Condition II in the language of the Phase I FEIS) as a limiting condition for site management could conceivably be changed in future. However, there are two possible options that could be considered if this occurs. The first is to continuously seek to reduce chemically caused onsite effects which WDF supports. The second is to allow higher levels of sediment chemicals of concern to be disposed should the realized site condition be less than the limiting condition for site management. Both options may be discussed at PSDDA Annual Review Meetings, but a change in site condition to either a more or a less restrictive condition may require a supplemental EIS.

The antibacksliding provisions of the Clean Water Act are not applicable to dredged material disposal. Dredged material is regulated under section 404 of the Act, while Section 402 of the Act contains the antibacksliding provisions and applies to point discharges.

Response 4. PSDDA agencies endorse the long-term management goals of the PSWQA which include actions to reduce biological effects from sediment contamination. As a part of the soundwide management plan, PSDDA agencies are committed to annual reviews of evaluation procedures, site use and site management, monitoring and trend analysis at the sites. As information is collected and reviewed, adjustments may occur. The PSDDA agencies believe that it is premature to develop a proposed plan of action which contemplates progressively higher standards at disposal sites as average disposed material improves. Technology is changing, and there are new chemicals being developed virtually every day. While some sediment cores show higher chemical levels in

DEIS, p.4-95, paragraph 6:

Chinook juveniles should be included with the cutthroat trout as a species which spends an extended period in bays and estuaries. (7)

DEIS, p.4-95, last paragraph:

There is no reference on the statement that adult salmon will avoid the plume. Is the statement based on a specific study or "common knowledge?" This may or may not occur depending on the circumstances (see next comment on avoidance). (8)

DEIS, p.4-96, paragraph 3:

The statement is made that, "It is likely that fish would avoid stressful levels of suspended dredged material by temporarily moving out of the area." This statement is based on several assumptions. The first being that fish are able to detect stress producing chemicals at low enough concentrations to allow them to exit the area before significant contact occurs. This is not necessarily true for all substances.

The statement also assumes that fish will encounter the plume of material in a way that would allow avoidance. The data included in the dispersal model indicated that a considerable area would be impacted by a single dump. An area with a diameter of 3500 feet would encompass acres of bottom. A fish in the center of this area at the time of a dump would not necessarily be capable of determining an effective route out of the plume. The avoidance reaction in fish is actually a series of rapid random movements which _may_ carry the fish out of the vicinity of the irritating substance. It is not, however, the kind of focused, directed movement implied in this document (see Jones, et al, 1960, _Fish and River Pollution_, for an accurate description of this fish behavior).

DEIS, p.4-109, paragraph 2:

As noted earlier for the Port Angeles site, the Port Townsend site would be open a total of six (6) months a year, not five (5), if the recommended timing restrictions are imposed. (9)

MPR, p.ES-4, paragraph 1:

The statement that, "Puget Sound examples of beneficial use of dredged material include Jetty Island..." appears to be premature. While the planned use of dredged material at Jetty Island will likely occur in the near future, the project is experimental in (10)

old^r sediments, more recent sediments also have a differing association of chemicals than do the old ones. These trends are among those that will be examined through the annual review process.

Response 5. The text has been edited to include the statement that the Bellingham Bay site is a compromise between several resources of concern. The PSDDA agencies agree with WDF that the impacts will be minor in light of the available information.

Response 6. The National Environmental Poli , Act requires analysis of impacts including a statement of significance of these impacts. The PSDDA agencies agree that these impacts will be minor, and also not significant. The cited timing error has been fixed.

Response 7. This error has been corrected.

Response 8. While it is true that a fish that is directly under the dump (an infrequent event) might be injured by falling material and thus disoriented, fish detect turbidity visually and would be expected to rapidly exit a plume. As significant disorientation of fish is unlikely, turbidity plumes are very short termed, fish tend to avoid the plumes, and the dredged materials do not contain sufficiently high levels of chemicals to provide a significant exposure.

Response 9. Comment noted, and change made.

Response 10. The text has been modified. Although the Jetty Island project has some experimental aspects, the use of clean dredged material to create intertidal and shallow subtidal habitat has been accomplished in several other parts of the country.

Response 11. This change has been made in the text.

Response 12. The WDF quoted figure (Schink, et al., 1974) used a weight-for-weight basis and referred to in-place sediments in urban bays, while the research conducted by the Corps' Waterways Experiment Station in the development of the DIFID model used a volumetric basis and referred to a slurry of material that is characteristically encountered in dredged material in barges. In the discussions between WDF and PSDDA staff, it was agreed that these clarifications reconcile the differences. A consolidated slurry (that hangs together but is not clumped) that has the volumetric composition of 21% (the national average for ordinary maintenance dredged material) was assumed for the purposes of the DIFID model as a scenario which would give rise to maximum spreading of dredged material. This was a highly conservative scenario used to set maximum intervals for the sites' boundaries. It is possible that cohesive (clumped) dredged material may be disposed at some of the dispersive sites. Dredge material that derives from native clays could be cohesive, would be denser, would have a lesser tendency to spread as it falls, and would take a longer time to erode if disposed in a dispersive site than the model indicates.

nature and will require extensive monitoring to determine the level of success.

MPR, p.6-6, paragraph 2:

Please note that State regulations concerning hydraulic project approval are included in WAC 220-110 not WAC 220-100. (11)

DSS Technical Appendix & DEIS, pp.(as noted in text)

A final issue of considerable concern to WDF relates to the methods used to estimate the area of impact and rate of dispersion at the Port Angeles and Port Townsend dispersive sites. Two main questions must be resolved in this regard to facilitate an accurate estimate of potential impacts that may occur to shellfish resources at the proposed disposal sites.

1. Will the dredged material be a thick slurry having a 21 percent total solids content (pp 2-41 and II-97), or will it be consolidated material (pp 2-38 and II-92) having a solids content of possibly 50 percent (Schink et al. 1974)? (12)

2. Is maximum dispersal of the sediment desired at the time of dumping? If so, a barge will be moving (at possibly 3 knots) and take about ten minutes to dump the load (pp 2-43 and II-29). Or will the barge make a dump while sitting still at the center of the disposal zone so that the material will fall within a small zone having a 250 foot diameter (pp 4-94 and II-25)? (13)

The numerical model used to estimate areal impacts assumed that the material contained 21 percent total solids and that the diameter of the disposal zone would be 3000 feet due to a 3 knot barge speed during dumping (p II-29). However, the sections of the report which address biological impacts from disposal at dispersive sites assume that most of the sediment will fall as an intact mass within a 1.1 acre zone (pp 4-94 and 4-109). At the same time the report expects the material to have the non-cohesive properties of a slurry which will cause it to disperse rapidly and thinly over a large area (pp 4-93 and 4-108). These assumptions are incompatible. (14)

The primary impact zones at the dispersive sites are reported to include diameters that will range from 250 to 3000 feet. On page II-25 it is stated that most of the barge load is expected to fall within a diameter of 250 feet (1.1 acre) at a dispersive site where the water depth is 400 feet. The collapsing mound of sediment will then be eroded rapidly by the current resulting in distribution of the sediment over a 1000 foot radius area (72 acres).

<u>Response 13</u>. The reason that the barge would be moving at 3 knots is because these highly exposed locations require forward movement of tug and barge to maintain navigational control against current, wind and waves. The following response explains the 250-foot diameter "falling material" zone concept.

<u>Response 14</u>. In the discussions with WDF staff, PSDDA representatives agreed to add information to the text to clarify these apparent inconsistencies. In summary, there are several phases or events that are referenced to by the different sections of the impact analysis. Some of these events relate to physical impacts of the falling material while others relate to slower movements laterally after the disposal event. Figure II.7-1, in the Phase II Site Selection Technical Appendix at Page II-107 shows these different phases.

A dredged material disposal event may be separated into three physical phases. The first is convective descent, during which the fluid jet of dredged material falls from a bottom dump barge to the bottom under the influence of gravity. It occurs rapidly, since the terminal velocity of dredged material in water may exceed 10 feet per second and, at the depths of PSDDA sites, is completed in less than 2 minutes. In the PSDDA environmental analysis, this phase is used to characterize the area of "killing velocity," since the impact is too fast to be avoided even by mobile bottom-dwelling animals at ground zero. Second, the dynamic collapse phase occurs when the jet of material impacts the bottom. This occurs more slowly, and spreads the material laterally in an hour to several hours. This kind of movement could cover and smother nonmobile benthic organisms that are unable to avoid the material. However, many invertebrates are known to be able to "dig out" of the material when it is not too deep or has not fallen directly on top of them. The third phase could take days or weeks in a nondispersive site, but would probably not have a chance to occur in a dispersive site. This is the long-term passive diffusion phase of the material, which causes it to assume a thin pancake-like shape in a nondispersive site. The model runs of DIFID (described at 2.03f(2)(b) in the DEIS/FEIS) give information on spreading of the dredged material after all phases have occurred.

The area of the convective descent, referenced in the above comment, is 250 feet in diameter (1.1 acres), or the "killing velocity" zone. The WDF representatives agreed that the dynamic collapse phase of the disposal event should not physically impact shrimp. The 1,000-foot diameter circle referenced in the Disposal Site Selection Technical Appendix text was carried out in the DEIS to the model's ability to calculate thickness of dredged material (0.02 feet) from a single event (DEIS/FEIS) figure 2.10, and becomes a 7000 feet diameter circle. However, these larger circles do not correspond to impacts to the populations onsite, for reasons given in the text at 4.12b(1) and 4.15b(1).

<u>Response 15</u>. Both the Alcatraz and Dana Passage data were considered in the PSDDA Report <u>Literature Search on Dispersive Sites for Dredged Material in Northern Puget Sound and Strait of Juan de Fuca</u>. On pages 11-13, Dana Passage is described to be somewhat erosive, with current speeds near the 25 cm/second threshold that PSDDA considered as a threshold for true dispersivity. For

15 Two studies dealing with erosion of sediment from disposal zones indicate that cohesive sediment erodes very slowly. The Alcatraz disposal site study in San Francisco Bay indicated that a deposit of compact, course sand was very resistant to erosion (p 2-43). Also, observations made by WDF of muddy sediment deposited in Dana Passage, southern Puget Sound in 1972 indicated that the material landed largely intact and eroded slowly only when the current at the bottom reached a speed o f 0.5 knot (Westley et al. 1973). At the end of the two-month period of dumping, after 21,000 cu yds of sediment had been deposited, the center of the material was 36 inches thick. At that time, 38 percent of the original material remained within an area having a radius of 200 feet. Five months later the depth of the material was reduced to 21 inches and 25 percent of the sediment remained within the area having a 200 foot radius.

16 A study conducted by WDF (Tarr 1977) adjacent to hydraulic clam harvesters using jets of water, 50-60 psi, to harvest clams indicates that cohesive sediment does not readily break down into individual particles which can easily be transported by the current. The substrate in Agate Passage and Kilisut Harbor consisted of coarse sand and gravel, while the fine material in Port Susan contained 22 percent silt and clay. Only a small amount of the silt and clay was put into suspension by the water jets since the silt plumes were only 75 to 200 yards long behind the harvesters and the maximum concentration of suspended solids above the background level was 85 mg/L in the very shallow water of Port Susan. Obviously, cohesive sediment is not easily eroded, so the rate at which sediment will be dispersed at the dispersive disposal sites may be much less than predicted by the numerical model.

To widely distribute the sediment at a dispersive site, the barges are required to move at a slow speed when they make a dump (p. 2-43), so the estimated dimensions of a dispersive disposal zone are based on the assumptions that the tow speed will be three knots and a dump will be completed in ten minutes (p. II-29). Therefore, the dimensions of the depositional patterns at all dispersive sites are expected to be 3,000 feet wide and 3,500 feet long (241 acres) (pp II- 205 and 206). However, the thickness of the material deposited in the disposal zone was calculated by the model using an estimated diameter of 3,000 feet (162 acres) (p II-206).

17 It is stated that the thickness of the material resulting from a 1,500 cu yd barge load deposited on the disposal sites at both Port Angeles and Port Townsend will vary from 0.3 cm at a current speed of 1.0 knot to 0.8 cm at a velocity of 0.5 knot (Fig II.7-3b). Accumulation rates in Rosario Strait will be about twice the above

comparison, the bottom velocity of currents in Port Townsend is 140% of Dana Passage speeds, and Port Angeles' bottom current velocity is 200% of Dana Passage. The figures stated in the comment regarding depth of dredged material that remained onsite in Dana Passage are based on diver observations, but core samples showed less of the material remaining after several months.

The PSDDA agencies agree that some consolidated dredged material may not erode as fast as the DIFID model indicates, and the text has been changed to reinforce this point. In discussions it was clarified that WDF wishes to have possible habitat damages for benthic invertebrates due to persistent clumps of consolidated material considered in the impact analysis. This change has also been made in the text.

Response 16. As stated in comment 13, barges move at the stated rate of speed to be able to maintain navigational control, not to further disperse the material. The disposal site dimensions were changed to 3500 foot radius (7000 foot diameter) circles to take into account the effects of currents. The larger area scarcely changes the results of the calculations.

Response 17. Speeds at Rosario Strait are considerably greater than those at Port Townsend. The calculations given in the comment are incorrect because they assume that all the dredged material remains in the area impacted by the convective descent phase of dredged material disposal (see comment 14, above).

Response 18. See response to comment 14.

Response 19. As a result of the meeting of the WDF with PSDDA staff and the changes to the text which have been made, it appears that the issues have been resolved to the satisfaction of WDF.

rates due to lower current speeds. However, these predicted thicknesses for the deposits are correct only if the solids content of the dredged material is 21 percent. The actual solids content may be near 50 percent, resulting in a thickness more than double the predicted values from one barge load. It is also stated that if the material is distributed over an area having a radius of 1,000 feet, the thickness of the deposit at the center of the dispersive disposal zone will be 0.3 inch (0.8 cm) and only 0.04 inch at the edge (p II-25). However, initially that material will be deposited in a 1.1 acre zone. Therefore, our calculations indicate that the 1,500 cu yd deposit will be 5.5 inches thick if uniformly distributed and the solids content is 21 percent. If the sediment has a solids content of 50 percent, the deposit would be 13.0 inches thick prior to erosion. (17)

Our analyses of muddy sediment collected in four industrial harbors and five other bays in 1973 (Schink et al. 1974) showed that the dry solids content of mud from those bays varied from 41 to 58 percent, having a mean of 50 percent. (18)

WDF believes that these issues need to be resolved before it can be determined with any degree of certainty what shellfish impacts will actually occur at the Port Angeles and Port Townsend dispersive sites. (19)

We appreciate the opportunity to provide these comments. If you have any questions regarding our response, please contact Randy Carman at (206) 753-2908.

Sincerely,

Duane E. Phinney

Duane E. Phinney, Chief
Habitat Management Division

DEP:rc

cc: DOE - Olympia
DNR - Olympia
EPA - Seattle
USFWS - Olympia
NMFS - Portland

WASHINGTON PUBLIC PORTS ASSOCIATION

May 12, 1989

Mr. Frank Urabeck
PSDDA Study Director
U.S. Army Corps of Engineers
Seattle District
P.O. Box C-3755
Seattle, WA 98124

Dear Mr. Urabeck,

This is a comment letter on the draft Phase II documents produced for the Puget Sound Dredged Disposal Analysis (PSDDA) Study. These comments are intended to supplement the comments presented by WPPA at the PSDDA public hearing in Steilacoom on April 18th.

(1) The ports feel that the three dispersive sites and the two non-dispersive Phase II sites have been properly selected, and that the PSDDA agencies have accomplished their goal of establishing environmentally sensitive, cost-effective dredged material disposal sites.

(2) After a careful review of the documents, we have a few general comments to make. To begin with, we would like the PSDDA documents to be more clear on recency guidelines for sediment testing. There needs to be a clarification of both the timeframe and order of magnitude of re-testing requirements. We would like to see these guidelines indicate that re-testing will be limited to those contaminants that were considered a problem during the original testing. This will help meet the cost-effective goals of the program by eliminating unnecessary and potentially costly tests.

(3) In addition, we would like the Department of Ecology to indicate how the tests developed under Element S-4 of the Puget Sound Management Plan will work when they are added to the evaluation procedures that the Department has agreed to under PSDDA. WPPA is concerned that the Department of Ecology's work under Plan Element S-4 may prevent PSDDA's stated goal of being cost-effective.

(4) We also wish to stress the importance of guidelines for adequately pre-characterizing the reference areas. It is very important that reference areas be carefully identified (using latitude and longitude) and that a sufficient number of reference areas be available to give

P O Box 1518 • Olympia, Washington 98507 • (206) 943-0760 • Fax 753 6176 • 1501 Capitol Way • Suite 304

RESPONSE TO WASHINGTON PUBLIC PORTS ASSOCIATION

Response 1. Comment noted.

Response 2. Recency guidelines have been reviewed for clarity, and discussed in the final Phase II MPR. In the clarifying text, primarily the timing and circumstances that affect the acceptability of data are described. The text of the Phase I MPR and EPTA are clear that, if there are no new sources of chemicals of concern, only testing of chemicals that that have been discovered to be problems in former properly quality-assured testing would be required. Additionally, programmatic mechanisms to downrank project areas support the goal of eliminating unnecessary and costly tests.

Response 3. It is not clear how S-4 will influence the cost-effectiveness of unconfined, open-water disposal of dredged material, which is the subject of PSDDA. However, the PSDDA agencies share with the ports the concern for reasonability and cost-effectiveness of all aspects of dredged material management, including confined disposal options. For relationships between S-4 and PSDDA guidelines, the recent Ecology "Confined Standards Documentation Report" contains these details, and port representatives as well as the PSDDA agencies are taking an active part in the technical review of these standards currently.

Response 4. The PSDDA agencies have taken steps to assure that reference areas are well-characterized and documented for use by permit applicants. See the final Phase II MPR section 5.6 for discussion of these steps and considerations.

Response 5. The PSDDA agencies agree with this comment. Recent experiences indicate that the inspection process will vary from site to site. At those sites with VTS coverage (Elliott Bay, Port Angeles, Port Townsend, and Rosario Strait), disposal compliance checking will be continuous. Disposal at the other sites will be checked using a variety of tools ranging from radar and visual inspection to microwave continuous monitoring. (The last method is currently being explored for feasibility by the Corps and DNR.)

Response 6. Comment noted.

Response 7. Comment noted.

Response 8. As noted in section 5.3f of the Final Phase II MPR, some preliminary testing using this organism in a 10 day acute test on both reference and toxic sediments has been done. Comparable data are also available from approximately 4 more potential reference areas in the PSDDA report on development of a 20-day chronic sublethal test (see section 5.10: this report also scored mortality of worms) and in the recent EPA bioassay intercomparison report.

the dredger a complete range of grain sizes. There needs to be a "library" of reference areas available to the dredger, along with information on the grain size and chemical characterization of the site. It should be the responsibility of the PSDDA agencies, not the dredgers, to provide this information. The reference areas should also be in water of reasonably shallow depth, if possible.

We also stress the importance of the spot checking requirements contained in chapter nine of the draft Phase II Management Plan Report (MPR). Both the Department of Natural Resources and the Corps of Engineers need to be able to independently carry out these inspections in a coordinated way. The inspections must also be frequent enough to ensure a low risk of off-site dumping. Significant off-site dumping may jeopardize the monitoring of the disposal sites. (5)

The ports have also carefully reviewed the proposed changes in evaluation procedures (chapter five of the draft Phase II Management Plan Report), and we have several comments on the proposed changes.

WPPA acknowledges the discussion on pages 5-4 and 5-5 regarding updates of the ML values based on the 1988 Highest Apparent Effects Threshold (HAET) values. While it is true that there may be modifications to the AET values as a result of the EPA Science Advisory Board's recommendations, WPPA feels that both the SL and ML values need to be examined as part of the annual review process as new data becomes available. We do support the review of the Science Advisory Board, however. (6)

We agree with the conclusions on page 5-7 of the draft MPR regarding the saline extract microtox test. We feel that the proposed change for this test is acceptable. We also agree with the conclusions on page 5-7 regarding the organic extract microtox test. (7)

The discussion on pages 5-8 and 5-9 regarding the Neanthes test is also of interest to the ports. We feel that Neanthes is a reasonable substitute for the geoduck acute test, but we need to gather information on the response variation of the organism to the various reference sediments found in Puget Sound. This will allow a better understanding of the normal Neanthes response to various clean sediments of varying grain sizes. (8)

Section 5.4 of the draft MPR discusses limits of detection for organic compounds. The ports would like to see a more explicit analysis by the PSDDA agencies of the real benefit of the lower levels of detection. (9)

WPPA also feels that more work needs to be done on the chronic sublethal test. Section 5.10 of the draft MPR discusses this test, and recent progress on it. We feel strongly that more work needs to be done with interpretation of the chronic tests, not just protocols for the tests. We need to be much more certain of the (10)

Response 9. While PSDDA is concerned for cost-effectiveness of testing, it is absolutely necessary that these organic compounds be detected and quantified below the PSDDA SL. Cost analyses cited in the Phase I MPR and EPTA incorporate costs necessary to achieve this objective. In recent experience, quality control failures have occurred when dredgers have attempted to save money by using the lower-cost Contract Laboratry Procedure Scope of Work methods which were meantdesigned for use with solid wastes. Accordingly, the PSDDA regulatory agencies have been seeking to notify and clarify acceptable methods in recent documents and meetings. In the end, this specification should lead to a savings, because it is expensive to have to repeat analyses.

Response 10. Comment noted. The revised text in section 5.10 of the Phase II MPR summarizes progress to date.

Response 11. Comment noted. The text has been modified.

meaning of the chronic test results before we take steps to require these chronic tests for sediment characterization.

We also note that the draft MPR discusses the workshop held on February 28 and March 1, 1989 to discuss chronic test protocols. It is the opinion of the ports that the statement that the experts "...resolved all of the issues agreed to be critical in establishing an interim protocol." is misleading. The issues discussed at this workshop were very narrowly defined, and many of the critical issues surrounding final test protocols were not agreed upon. We believe that the final Phase II documents should more accurately reflect the tone of this meeting. 11

Thank you for this opportunity to review and comment on the PSDDA Phase II documents. We applaud the four PSDDA agencies for their excellent analysis on this project. The ports feel that PSDDA is an example of the benefits of both intragovernmental cooperation and an open public process. We are pleased to have helped play a role in this important and necessary program.

Yours Truly,

WASHINGTON PUBLIC PORTS ASSOCIATION

Eric Johnson

Eric D. Johnson
Environmental Specialist

c: WPPA Environmental Committee

SKAGIT COUNTY
DEPARTMENT OF PLANNING AND COMMUNITY DEVELOPMENT

Room 204 County Administration Building Mount Vernon, Washington 98273 (206) 336-9410

Steven C. Wood, AICP
Director

Betsy D. Stevenson, AICP
Assistant Director

May 12, 1989

Mr. Frank Urabeck
PSSDA Study Director
Corps of Engineers
P.O. Box C-3755
Seattle, WA 98124

Dear Mr. Urabeck:

Thank you for the opportunity to comment on the Draft Environmental Impact Statement and the proposed Management Plan for the Phase II Unconfined Open Water Disposal for Dredged Material. The study group and all the various committees should be commended for their efforts in the development of the Phase I and Phase II plans.

As you know, the proposed Rosario site is located in Skagit County and will require a shoreline permit. In addition, the County requests additional information regarding the dispersal of material from the site. This may require some additional study, to include a bottom current and water movement evaluation. As a dispersive site, it is important to understand the water circulation patterns to better estimate the movement of the deposited materials. ①

In addition to the chemical sampling of the dredge spoils, the County will consider the need for some biological testing, to provide a better indicator of what is actually affecting the organisms. The extent of such testing can be discussed as part of the permit process, or prior to submittal of an application. ②

Again, thank you for the opportunity to review and comment on the documents. If you or someone from the Department of Natural Resources has any questions, or would like to discuss these comments further, please feel free to contact me.

Sincerely,

Betsy Stevenson

Betsy Stevenson, AICP
Assistant Director

RESPONSE TO SKAGIT COUNTY DEPARTMENT OF PLANNING AND COMMUNITY DEVELOPMENT

Response 1. As a result of this comment, the PSDDA agencies met with Skagit County representatives to discuss the concern for current studies. Supporting technical reports were provided to the County to assist in their completion of the environmental analysis required for a shoreline permit.

Response 2. This was also discussed, and the issue has been resolved.

R 5/8/89

Seattle
Department of Construction and Land Use

Dennis J. McLerran, Director
Charles Royer, Mayor

May 5, 1989

Frank Urabeck
PSDDA Study Director
Seattle District, Corps of Engineers
P.O. Box C-3755
Seattle, Washington 98124

Dear Mr. Urabeck:

1 Thank you for providing the opportunity to review the PSDDA Phase II Draft EIS and Management Plan. As you know, the City of Seattle previously commented on the Phase I documents and did an in-depth review of the Elliott Bay site as a part of our permit review process for the shoreline permit issued for that site.

The City continues to have an active interest in the PSDDA program and we appreciate being informed of on-going efforts and events. We do not, however, have any comment on the Phase II draft documents.

Sincerely,

Dennis J. McLerran

DENNIS J. McLERRAN
Director

DJM:MG:v

cc: Mayor Royer
Meredith Getches

\wp1\wpx\urabeck

RESPONSE TO SEATTLE DEPARTMENT OF CONSTRUCTION AND LAND USE

<u>Response 1</u>. Comment noted.

PORT OF
ANACORTES
PO BOX 297 / ANACORTES, WASHINGTON 98221-0297 U.S.A. / TELEPHONE (206) 293-3134 / FAX (206) 293-9608

April 13, 1989

Mr. Frank J. Urabeck, Study Directors
CENPS-EP-PSDDA
U.S. Army Corps of Engineers
P.O. Box C-3755
Seattle, Washington 98124-2255

Subject: Letter Of Support
Puget Sound Dredge Disposal Analysis (PSDDA)
Phase II (North and South Puget Sound)

The Port of Anacortes wishes to extend it's support of the findings of the Puget Sound Dredge Disposal Analysis (PSDDA) study for the Phase II area (North and South Puget Sound). Specifically the proposed designation of the Rosario Strait and Bellingham Bay sites as Preferred Open-water Disposal Sites. ①

Navigation of Puget Sound waterways has and will continue to play a vital role in our region's economic stability, development and growth. Users of these waterways include private citizens, private developers and public entities (Federal and State agencies, Ports , and local governments). Facilities have been constructed upon these waterways to provide economic as well as recreational benefits for the citizenry. To maintain these and future facilities in and along our waterways it is necessary to dredge and dispose of dredge materials at one of the following sited areas: on-land, near-shore, or open-water. Open-water has historically been the most cost effective.

Those facilities located in and around the Anacortes area rely heavily on the ability to use the open-water disposal sites as a economic vehicle to maintain essential services. The Port of Anacortes alone has two (2) Marine Terminal Piers located on Guemes Channel and a 1,000 Slip Marina (Cap Sante Boat Haven) located in Fidalgo Bay. The Marine Terminal has a significant impact within the community by providing jobs and accompanying economic spin-offs. The 1,000 slip marina provides moorage for both recreational boaters and Commercial Fishermen. The Port's ability to maintain current and future facilities is directly connected with our ability to properly and economically dredge and dispose of dredge material.

RESPONSE TO PORT OF ANACORTES

<u>Response 1</u>. Comment noted.

<u>Response 2</u>. Comment noted.

The PSDDA Study Group, in researching the effects on the environment and the citizenry, regarding the disposal of dredge material in open-water, has accomplished their task in a diligent and proficient manner. The Port of Anacortes supports the designation of the preferred sites: the Rosario Strait and Bellingham Bay Sites, by the PSDDA Phase II Study. ②

Sincerely,

C. Jack Smith

C. Jack Smith
Port Planner

915 Washington St NE
Post Office Box 827
Olympia Washington 98507-0827
206 586-6150

PORT OF OLYMPIA USA

April 18, 1989

Mr. Frank Urabeck, P.E.
Seattle District
U.S. Army Corps of Engineers
P. O. Box C-3755
Seattle, WA 98124-2255

Dear Mr. Urabeck,

The Port of Olympia strongly supports the overall objectives of the PSDDA study, and we are encouraged that the Phase II effort has consistantly included a Southern Puget Sound disposal site to meet this region's future needs. (1)

We believe it is essential to the economic health of our Port to have available a dredge disposal site in reasonably close proximity to the Budd Inlet area. Maintenance dredging and channel improvements are a necessary element of ocean commerce and we at the Port of Olympia rely on these improvements to provide safe vessel access to our ocean terminal.

Of the two sites analyzed in South Puget Sound, the Port would have preferred the Devil's Head ZSF as it is approximately six nautical miles closer to Olympia than the Anderson/Ketron ZSF. However, we understand the Devil's Head ZSF would have more impact on the fisheries resource, and agree the Anderson/Ketron site selection is a wise decision. We therefore wish to give our support to the selection of the Anderson/Ketron site. (2)

In summary, the Port of Olympia supports the conclusions of the Puget Sound Dredge Disposal Analysis and hopes for a successful conclusion which will include designation and approval of the Anderson/Ketron site. This will accomplish the study objectives, enhance the economic viability of ocean commerce in Southern Puget Sound, and, at the same time, protect our environment. (3)

Sincerely,

Douglas P. Edison
Executive Director

ROM/cbr

Commissioners
W.L. "Wes" Barclift
O.R. "Ray" Dinsmore
J.D. "Jim" Wright

Executive Director
Douglas P. Edison

RESPONSE TO PORT OF OLYMPIA

Response 1. Comment noted.

Response 2. Comment noted.

Response 3. Comment noted.

CITY OF BELLINGHAM
OFFICE OF THE MAYOR
TIM DOUGLAS

April 15, 1989

Frank Urabeck, Study Director
Puget Sound Dredged Disposal Analysis Study
U.S. Army Corp of Engineers
P.O. Box C-3755
Seattle, Washington 98214-2255

Dear Mr. Urabeck:

Thank you for the opportunity to comment on siting of a deep water dredge disposal site in Bellingham Bay. The City of Bellingham has some concern about the depth of the site and its location within an urban bay. The Bellingham Bay site is considerably shallower than any other of the North Sound sites. Is this depth adequate to protect the water quality of Bellingham Bay? (1)

We recognize that the Bay is one of our most valuable assets. Its recreational and commercial use is an integral part of our community and we would encourage the Corp of Engineers and the Environmental Protection Agency to take any and all measures to protect this resource.

Sincerely,

Tim Douglas
Tim Douglas
Mayor

CITY HALL / 210 LOTTIE STREET / BELLINGHAM WASHINGTON 98225 / (206) 676-6979

encl 3f

RESPONSE TO CITY OF BELLINGHAM

Response 1. The PSDDA agencies believe that the following considerations will insure protection of water quality, recreational and commercial uses of Bellingham Bay.

First, the PSDDA study, conducted over 4-1/2 years, has carefully considered all significant scientific evidence relating to the effects of disposal of dredged material, and utilized this knowledge and input from national and regional scientific experts to create a set of evaluation procedures that would avoid adverse effects.

Second, the site screening process used to select disposal sites was designed to lower potential for biological and human use conflicts. In the case of the Bellingham Bay site, this search involved site-specific studies, meetings with Indian tribes and commercial fishermen, and deliberations of oceanographers and fisheries scientists.

Third, through coordination with fisheries managers and Indian tribes, the PSDDA agencies have developed site use conditions such as timing restrictions and permitting processes that assure that potential conflicts will be averted.

Finally, during the environmental analysis of Phase II of the PSDDA program, it was the conclusion of the PSDDA agencies that the designation of an open-water site would not have unacceptable consequences to the marine animal and human uses of Bellingham Bay, and also that the nearshore and upland impacts of disposing clean dredged material (which would occur to greater degree without an open-water site) could have significant adverse economic and environmental impacts.

PORT OF PORT TOWNSEND

2539 Washington Street Port Townsend, Washington 98368 Phone (206) 385-2355 Seattle 464-7207 SCAN 576-7207

9 May 1989

Frank J. Urabeck, Study Directors
Puget Sound Dredged Disposal Analysis Study
U. S. Army Corps of Engineers
P. O. Box C-3755
Seattle, WA. 98124-2255

Dear Mr. Urabeck,

This letter is in response to your call for public comments and your public hearing conducted in Port Angeles on 20 April 1989. I attended the public meeting in Port Angeles and also briefly looked at some of the key aspects of the dredged disposal study. The following comments apply for the Port of Port Townsend.

- The Port of Port Townsend does not have a significant maintenance dredging requirement. Our current dredging requirements are developed by the Corps of Engineers and are likely to be only small quantities. If possible, we prefer on-shore disposal of all maintenance dredging materials. ①
- For new construction, we anticipate the development of an on-shore disposal for most dredged material, and near shore wetland development for some material.
- For unforseen requirements, we would like to develop near-shore disposal for the development of intertidal wetlands. We believe that this concept can improve the environmental conditions of Port Townsend Bay and provide lower cost disposal.
- If contaminated materials are located, we will develop a program at that time; however, the preferred solution would likely be on-shore disposal. ②
- We have no objections to the proposed deep water disposal site north of Port Townsend; however, we have not conducted extensive public review of this disposal site. ③

We thank you for the opportunity to comment on this very important topic and look forward to continued cooperation between the Corps of Engineers, other state and federal agencies, and the Port of Port Townsend. If you have any specific questions that you would like the Port of Port Townsend address, please contact me.

Sincerely,

William H. Toskey
General Manager

WHT:rb
cc: EPA
DOE

RESPONSE TO PORT OF PORT TOWNSEND

Response 1. As indicated on page C-3 of the final Phase II MPR, all of the material that will be dredged for the proposed port marina expansion was deducted from the volumes estimated to go to the Port Townsend unconfined, open-water disposal site. The PSDDA agencies encourage upland disposal and beneficial (construction or habitat development) uses of dredged material where possible.

Response 2. Contaminated materials are not allowed at PSDDA sites.

Response 3. Comment noted.

R51/19

ECONOMIC DEVELOPMENT ASSOCIATION OF SKAGIT COUNTY

April 27, 1989

Mr. Frank Urabeck, Study Director
Puget Sound Dredged Disposal Analysis Study
U.S. Army Corps of Engineers
P.O. Box C-3755
Seattle, WA 98124-2255

Dear Mr. Urabeck:

The Board of Directors of the Economic Development Association of Skagit County (EDASC) supports the findings of the Puget Sound Dredge Disposal Analysis (PSDDA) Study for the Phase II area (north and south Puget Sound). (1)

EDASC is a private, non-profit corporation with the purpose of promoting a growing and balanced economy for Skagit County. Our goals are to help retain existing businesses, assist in expansion of existing businesses and to recruit new businesses compatible with our livability to locate in Skagit County.

A healthy marine industry is vital to the economic health of Skagit County. In particular, clear and open navigation of Puget Sound waters remains directly tied to the economy of the entire region of Northwest Washington. From the commercial activity generated through the Main Terminal Piers at the Port of Anacortes to the recreational activity that is associated with the area's marinas, open navigation remains important to maintain these facilities in Skagit County.

To maintain these and other facilities in Skagit County in and along our waterways, it is important to dredge and dispose of the dredged matter. It is important to maintain open-wide disposal sites in the area because it is an economically feasible way to dispose of dredged materials.

We agree with the PSDDA Study that selected the Rosario Strait dispersive site for the deposit of dredged materials.

Also, we commend the PSDDA Study group and the combined efforts of the Army Corps of Engineers, the Environmental Protection Agency and the Washington State Departments of Ecology and Natural Resources for diligently completing this study that supports these findings.

Sincerely,

Jerry Kaufman
President

Don Vick
Executive Director

511 S. Third Street • P.O. Box 40
Mount Vernon WA 98273 USA
(206) 336 6114 • Fax (206) 336 9478

RESPONSE TO ECONOMIC DEVELOPMENT ASSOCIATION OF SKAGIT COUNTY

Response 1. Comment noted.

CLALLAM COUNTY
ECONOMIC DEVELOPMENT COUNCIL

102 E FRONT • PO BOX 1085 • PORT ANGELES WA 98362 • (206)457-7793

April 20, 1989

Frank Urabeck, Study Director
Puget Sound Dredged Disposal Analysis Study
U. S. Army Corps of Engineers
P. O Box C-3755
Seattle, WA 98124-2255

Dear Mr. Urabeck

The Clallam County Economic Development Council supports the PSDDA Study recommendation that would keep a site for disposal of clean dredge spoils offshore rom Port Angeles. Port Angeles harbor's continuing role as a working harbor is absolutely essential to the health of our local economy. The loss of an offshore dredge disposal site within reasonable distance could make development in this harbor economically less viable.

It is our understanding that the spoils approved for disposal at this site would be tested and certified clean before dumping in water would be permitted. With this protection, we ask that Clallam County's access to dredge disposal at reasonable cost be continued.

Sincerely,

Margaret Crawford

Margaret Crawford
Acting Director

RESPONSE TO CLALLAM COUNTY ECONOMIC DEVELOPMENT COUNCIL

Response 1. Comment noted.

April 3, 1989

Frank Urabeck, Study Director
Puget Sound Dredged Disposal Analysis Study
U S Army Corps of Engineers
P O Box C-3755
Seattle, Washington, 98124-2255

Dear Frank

I read with some interest your Public Notice of March 31, 1989 on the Proposed Determination of Suitability for Disposal of Dredged Material in Waters of Northern and Southern Puget Sound. The choice of sites appear to be very adequate for their dispersive and non dispersive qualities They also seem to be well placed in that they are not areas of uniqueness and lie at the more common depths available in the Sound ①

I had one thought however, about the disposal process I would hope that the designation of these disposal areas will not preclude the use of dredged material for other purposes. If the dredged material is of the proper type and quality, I would hope that it could be used as land fill and as beach feed material when beach feed programs are required. This would save money and the use of land materials The Port Angeles site is a case in point If material of good quality is designated for disposal at this site, the Corps should consider its use as beach feed material for the on-going maintenance of Edis Hook Beach feeding requires in part, water disposal and should not be restricted by the adoption of dredged material disposal sites ②

You and PSDDA are to be commended on the excellent job that has been done in this study.

Sincerely,

Alyn C. Duxbury

Alyn C Duxbury
School of Oceanography, WB-10
University of Washington
Seattle, Washington 98195

RESPONSE TO ALYN C. DUXBURY

Response 1. Comment noted.

Response 2. The PSDDA agencies actively encourage the beneficial uses of dredged material such as are mentioned in this comment. As noted on page C-3 of the Phase II MPR, the volumes of dredged material which could go to the PSDDA sites have been substantially discounted in light of these possible uses.

R 5/6/89

HYMAN J. FINE
PROFESSIONAL CIVIL ENGINEER
7432 NORTH SHORE ROAD • NORFOLK, VIRGINIA 23505

1 May 1989

Frank Urabeck, Study Director
U. S. Army, Corps of Engineers
P. O. Box C-3755
Seattle, Washington 98124-2255

Dear Mr. Urabeck:

Thank you for the Phase I and II Management Plan Reports and supporting appendices you were kind enough to send to me on the comprehensive study and disposal of dredged material in the waters of Puget Sound in the State of Washington. ①

If you have completed such a report on a confined disposal site, I would also appreciate receiving a copy.

Please send it to: Hyman J. Fine, Planning Division
Norfolk District, Corps of Engineers
803 Front Street
Norfolk, Virginia 23510-1096

Thank you very much for your cooperation.

Yours very truly,

Hyman J. Fine

HYMAN J. FINE, P.E.

HJF:ezf

FELLOW - AMERICAN SOCIETY OF CIVIL ENGINEERS
MEMBER - NATIONAL SOCIETY OF PROFESSIONAL ENGINEERS
AMERICAN GEOPHYSICAL UNION
UNITED STATES COMMITTEE ON LARGE DAMS

RESPONSE TO HYMAN J. FINE

Response 1. Mr. Fine's address has been transmitted to the Ecology S-4 study office.

#116
16600 25th Ave. NE
Arlington, Wa. 98223
4-7-'89

Colonel Philip L. Hall
Box C-3755
Seattle, Wa. 9812 4

Dear Colonel Hall;

I am in receipt of the copies NEPA documents and I want to thank you for sending them to me. ①

In what at times seems like a thankless attempt to reach some of these hopelessly " heads in the sand" idiots it helps to have bona fide grounds besides to me just plain common sense.

I have at this writing one more little missle enroute to the Everett Herald in my running battle with the local pacifists.

Thank you, again.

Yours truly,

V.S. Young

co;B. Boyle

RESPONSE TO V.S. YOUNG

Response 1. Comment noted.

David H. Monroe, M.S.P.H., Ph.D.
Consultant in
Environmental Toxicology
and Public Health

ECN Environmental Consultants Northwest
P.O. Box 309
Stanwood, WA 98292
(206)387-6987

May 12, 1989

Frank Urabeck
PSDDA Study Director
Seattle District Corps of Engineers
P.O. Box C-3755
Seattle, WA 98124

re: Draft Environmental Impact Statement and Management Plan Report for PSDDA Phase II

Dear Mr. Urabeck,

I have reviewed the Draft Environmental Impact Statement and Management Plan Report for Phase II of the Puget Sound Dredged Disposal Analysis (PSDDA). It is evident that a great deal of effort and good work has gone into these documents. Many of the topics and issues have been addressed thoroughly. However, some concerns of major importance are not adequately discussed. There are also some major oversights in the mitigation plans.

1 In order to fulfill the requirements of the Clean Water Act, NEPA, SEPA and other relevant pieces of legislation, the PSDDA agencies must thoroughly assess potential impacts to the environment of Puget Sound and potential risks to human health from dredged disposal operations. All unreasonable impacts must be mitigated. My major concerns focus on bioaccumulation of chemical contaminants, chronic effects on aquatic organisms, and risks to human health from the consumption of contaminated seafoods. The PSDDA agencies have neither adequately addressed these issues nor developed adequate mitigations against associated unreasonable impacts.

2 Pulp mill effluents are a major contributor to sediment contamination in the Puget Sound region. These effluents contain such chemicals as

RESPONSE TO DAVID H. MONROE

Response 1. The PSDDA agencies believe that all reasonably foreseeable impacts have been identified and suitably resolved in the final Phase II documents, including the issues regarding bioaccumulation, chronic effects, and human health risks that are raised in this letter.

Response 2. The PSDDA agencies do not agree that environmental and human health effects of these compounds have been ignored. In the following paragraphs, a summary of pertinent information on pp 5-12 to 5-14 of the final Phase II MPR is presented.

The PSDDA evaluation procedures have been revised to address compounds in areas which the State of Washington is designating (or will designate) as Clean Water Act Section 304(l) listed pulp and paper mills. (The referenced section of the Act deals with discharges of toxicants and the description of the waterbodies affected by the discharge.) There are two mills presently considered for listing in Puget Sound, the Simpson plant which discharges into Commencement Bay and the Weyerheueser plant in Everett, which discharges into the Snohomish River. The following subparagraphs deal with the individual compounds or classes of compounds.

Chlorinated Phenols.

Pentachloropherol (PCP) is already listed as a routine chemical of concern for dredged material testing under PSDDA, and has been reconsidered in light of the expanded Puget Sound Database (as discussed in paragraph 5.2 of the Phase II MPR). Although field information on PCP in Puget Sound is limited, the proposed Phase II establishment of an ML of 690 ppb, reduction of the SL (from 140 ppb to 69 ppb) and bioaccumulation testing trigger (from 1000 to 504 ppb) provide a means for addressing the environmental and human health risks of this chemical of concern. Accordingly, no further change is needed.

Tetrachlorophenol is a suspected pulp mill effluent discharge chemical which has been found to co-occur with PCP and is a potential precursor chemical to polychlorinated dibenzofurans (PCDF's) and dibenzodioxins (PCDD's). These latter two classes of compounds are of concern because they are listed as human teratogens and carcinogens. Since tetrachlorophenol has not been listed as a chemical of concern in any of the compendia of sediment chemicals for Puget Sound, and since the PSDDA evaluation procedures are directly addressing the co-occurring chemicals PCP, PCDD's and PCDF's with the proposed revisions, there appears to be no reason to add tetrachlorophenol to the list of chemicals of concern.

Polychlorinated Dibenzodioxins and Polychlorinated Dibenzofurans. PCDD's and PCDF's meet several of the PSDDA requirements for listing as chemicals of concern in dredged material. They are documented to be highly toxic, are persistent in the environment, may bioaccumulate in animal tissues, and are listed as human teratogens and carcinogens. EPTA (1988, p. II-87) outlined the reasons for not including these compounds at that time on the list of general chemicals of concern, although nonchlorinated furans were included in the list of chemicals of concern. At the time, analyses for PCDD's and PCDF's in Puget Sound did not indicate their presence in several sediments otherwise contaminated with high levels of PAH's and heavy metals. The concern for toxicity was addressed *in part by the demonstrated sensitivity of the* PSDDA sediment quality values (SL and ML): there are very few toxic stations in all of Puget Sound that are not correctly identified by the disposal guidelines *for chemicals of concern* (see EPTA, 1988, section II-7.2.3.3). This, combined with the apparent absence of these chemicals, high testing costs and uncertain analytical methods, led to the decision in Phase I not to include PCDD's and PCDF's on the list of chemicals of concern.

EPTA (1988) acknowledged that human health concerns for these chemicals are not fully addressed by the toxicity data. Recent data from kraft paper mills operating in Puget Sound indicate that PCDF's and PCDD's are measurable in *fish tissues collected near the points of discharge. It is possible that* sediments in these same locations may also contain measurable levels of these chemicals, although no sediment data were then available from near the discharge *points*. The *revisions* to the PSDDA evaluation procedures deal with potential human health concerns near the discharges by examining the bioaccumulation of the compounds into Macoma clams after their exposure to sediment.

New information from *EPA's (1989) National* Bioaccumulation Study indicates concentrations of dioxin below 10 ppt in fish tissues near pulp mills in Puget Sound. (It is not accurate that to state that this EPA study showed dioxins *are "routinely" encountered* in Puget Sound *fish* because only a few samples were taken, and those were from areas near probable dioxin sources.)

Regulatory agencies are actively working to control and eliminate the discharge of these chlorinated compounds into Puget Sound and other Washington waters. Ecology and EPA are reviewing information to determine whether these compounds are present in the sediments and, if they are, to verify concentrations and distribution near known discharges from kraft pulp and paper plants.

Due to the lack of information on sediment levels of the compounds, it was decided not to add them to the general list of chemicals of concern nor to the list of chemicals of concern for limited areas at this time. They will be treated as dexcribed in the next subparagraph. The potential for sediment *concentrations of PCDF's and PCDD's to result in tissue* concentrations of marine organisms is being intensively studied by the Corps and EPA, but results are not yet available to assist in interpretation of sediment data. The PSDDA annual review *process* will provide the appropriate avenue for dealing with the new information resulting from these ongoing studies.

Pending definitive sediment data and definition of potential bioaccumulation relationships, dredging projects proposed for areas "in the near vicinity" of a Clean Water Act 304(1)-listed kraft pulp mill discharge will be required to conduct a 30-day bioaccumulation test using the Macoma bivalve, with tissue pentachlorophenol, tetrachlorophenol, polychlorinated dibenzofurans, and polychlorinated dibenzodioxins. Pulp mill effluents are known to contain these toxic and persistent chemicals, as well as 2,3,7,8-tetrachloro-dibenzo-p-dioxin (TCDD). These compounds are known to accumulate and persist in the sediments and biota. Dioxin emissions from pulp mills in British Columbia are suspected of causing severe reductions in the breeding success of Heron colonies. Dioxins are routinely found in Puget Sound fish (EPA, 1988). Dioxin accumulation in fish has led to the closure of fisheries in Wisconsin, and the issuance of health advisories by the Minnesota Department of Health. PSDDA has failed to list many of these chemicals on the "Chemicals of Concern" list. Thus, all associated environmental and human health impacts are virtually ignored.

It appears likely that the PSDDA criteria may be inadequate to protect human health from carcinogenic chemicals that bioaccumulate in Puget Sound seafoods. At present, the mean concentration of PCB's in Puget Sound Sediments is less than 200 ppb (PSWQA, 1988, p. 140), and the mean concentration of PCB's in fish is 138 ppb (Tetra Tech, 1988, p. 67). The estimated cancer risk from the consumption of 3.4 ounces of this fish per day is 2 per 1000 people (Tetra Tech, 1988, p. 67). For comparison to these contaminant and risk levels, the PSDDA screening level for PCB's is 130 ppb and the PSDDA sediment bulk chemistry trigger value for bioaccumulation testing of PCB's is 1,790 ppb. This suggests that sediments contaminated with carcinogenic chemicals that bioaccumulate may pose a significant cancer risk to humans consuming Puget Sound seafoods, even when the requirements of PSDDA are met. The relationships between sediment concentration and bioaccumulation in seafoods are not well established at present, however, this very important question should be addressed in great detail. ③

According to PSDDA, by definition, no significant acute toxicity would be allowed at the disposal site, and any long-term, sublethal adverse effects would be confined to the disposal site where they can be monitored and managed. It is well known that organisms with the greatest potential for bioaccumulation, i.e. crab and bottom fish, migrate over large areas and will not be confined to the disposal site. Mitigation measures described in Chapter 7 of the Management Plan are inadequate to assess offsite contamination of Puget Sound seafoods. ④

analysis for PCDF's and PCDD's. The definition of "in the near vicinity of a discharge" will be determined on a case-by-case basis by consensus of the PSDDA regulatory agencies after review of information on effluents, tidal currents and distribution of other compounds which move in the particulate phase (as would PCDF's and PCDD's).

Bioaccumulation testing of sediments where PCDF's and PCDD's are found or suspected in sediments provides direct evidence of potential tissue concentrations that could result from sediment and water exposure to these compounds. Chemistry data on tissues will be reviewed to determine suitability of the sediments for unconfined, open-water disposal. Information is emerging rapidly on human health risk levels for seafood tissue concentrations of these compounds. Tissue concentrations will be assessed using the best available information, including risk analysis advisory levels available from FDA AND EPA.

The use of Macoma bivalves in bioaccumulation testing offers two important advantages relative to other test species. First, this animal feeds in direct contact with the sediment, allowing a more direct exposure to sediment chemicals than either a mobile species or a sessile, filter-feeding organism. Second, unlike fish and crabs, bivalves have low ability to metabolize chemicals of concern, which facilitates direct detection of significant chemical levels in their tissues. Although there is no definitive study that relates bivalve bioaccumulation to fish or crab bioaccumulation, these features of Macoma indicate it is an adequate surrogate for potential fish or crab bioaccumulation. We are unaware of any physiological mechanism unique to crabs that precludes the use of Macoma as a surrogate for determining PCDD and PCDF bioaccumulation potentials.

Response 3. The Evaluation Procedures Work Group (EPWG) reconsidered the PCB human health trigger derived in the Phase I EPTA in light of a whole-body-potential model described in the final Phase II MPR, pp 5-14 ff. The figures cited in the comment letter apply to a risk assessment of near-shore fisheries in the Commencement Bay area. Although there is a Phase I site in Commencement Bay, there is little potential for fish harvesting in this location. Risk analysis procedures are described in Phase I EPTA, section II-8.4. EPWG concluded upon recalculation of the data using the model that the bioaccumulation trigger was still protective of human health, but that total PCB's it should be normalized to Total Organic Carbon in the sediment to better reflect what is known of their bioavailability. Accordingly, the value was changed to 38 ppb, normalized to Total Organic Carbon in the sediment. A further check on material disposed on PSDDA sites is done: chemical testing occurs both in onsite and offsite sediments and in benthic infaunal populations (see the Phase II MPR section 7.3.2.c.). It should be noted that, in the case of Bellingham Bay, where mobile crab populations exist at harvestable levels near the selected site but were never found to be abundant onsite, the PSDDA agencies determined to chemically test crab tissue before and periodically after the opening of this site.

Federal guidelines governing dredged material disposal (40 CFR 230 Subpart B) require that no discharge will cause or contribute to significant adverse effects on human health. Under Section 404(c) of the CWA (40 CFR Part 231), the administrator of EPA can prohibit or withdraw a permit upon determination that the discharge would have unacceptable adverse effects on shellfish beds or fishery areas. Thus, bioaccumulation in seafoods and the resulting human health risks are clearly a required consideration in the assessment of chronic (sublethal) biologic impacts from the disposal of dredged sediments.

The PSDDA EIS should contain a literature review and risk assessment regarding the potential for bioaccumulation, chronic effects, and human health risks posed by pulp mill effluent chemicals (including TCDD), and other chemicals which are reasonably foreseeable to have accumulated in sediments to be dredged and disposed of at PSDDA sites. Of particular interest would be correlations between sediment TCDD concentrations, biologic tissue TCDD concentration, and human cancer risk in the Great Lakes Region and the marine environments of Puget Sound and British Columbia. A discussion of the TCDD-related reproductive failure in the Heron colonies of British Columbia, and how that relates to TCDD's in Everett Harbor is also essential to adequately assess the potential chronic (sublethal) effects of the Navy's dredged disposal plan. Other chemicals of concern for bioaccumulation include chlorinated phenols, chlorinated dibenzofurans, PCB's, and chlorinated pesticides.

5

Bioaccumulation should also be discussed in terms of species differences. The adequacy of the *Macoma* bivalve bioaccumulation test to predict bioaccumulation in species higher in the food chain, i.e. crab and predator fish, should be discussed. It is probable that bioaccumulation would increase significantly at each step in the food chain. The unique physiology of the Dungeness crab, as compared to fishes, should be discussed in terms of its potential for bioaccumulation of chlorinated compounds and aromatic hydrocarbons. Risks to other species high in the food chain, such as bald eagles, seals, and sea lions, should be addressed.

6

In the past, dibenzofuran has been mistakenly used as an indicator compound for TCDD contamination. I have reviewed numerous scientific studies and must conclude that concentrations of non-chlorinated dibenzofuran do not serve as a good indicator of potential TCDD

7

Response 4. The PSDDA agencies do not agree that mitigation measures are inadequate to avert offsite chronic sublethal effects including contamination of Puget Sound seafoods. Regarding seafood bioaccumulation, see responses 2 and 3 above.

The PSDDA disposal sites were selected to avoid high concentrations of bottomfish or shellfish, as well as known fishery areas. Dredged material placed at these sites will be reviewed for toxicity and human health concerns via chemical, bioassay and/or bioaccumulation testing, where appropriate, prior to disposal. Material found onsite will be analyzed for chemicals of concern (including PCB's and other human health chemicals) and laboratory toxicity will be measured. Tissue concentrations of chemicals of concern will be measured in benthic animals downcurrent from the disposal site. These site features and monitoring measures adequately address potential seafood contamination and human health concerns for the disposal site sediments. Physical disturbance of the site (due to disposal of sediments) prevents any routine monitoring of benthic communities on site, and monitoring results using mobile fish and shellfish would be difficult to relate to the site sediments. Though these other measures are not needed for routine monitoring, they may be appropriate for detailed assessment of any problems indicated by the other monitoring measures.

Response 5. As indicated above, bioaccumulation and human health risks are fully considered. No significant effects to human health are allowable under the PSDDA guidelines.

By requiring the Macoma bivalve bioaccumulation test in areas where there are suspected polychlorinated dibenzodioxins and dibenzofurans and the bioaccumulation potential model which is in development should address bioavailability and bioaccumulation/biomagnification of these compounds. As stated in response 3,above, this approach will generate data that are comparable to existing risk analyses for seafood.

PSDDA Phase II does not deal with the US Navy Homeporting use of the Phase I site. Further literature review was accomplished during the Phase II study, was discussed in EPWG, and is incorporated into the text changes noted. Some pertinent literature is listed below. Several of these references deal with the difficulty of predicting bioaccumulation from sediment data without observations of bioaccumulation in test species.

Baumann, P.C. and D.M. Whittle, 1988. The status of selected organics in the Laurential Great Lakes: an overview of DDT, PCBs, dioxins, furans and aromatic hydrocarbons. Aquatic Toxicology, 11(1988): 241-257.

Norstrom, R.J., R.W. Risebrough and D.J. Cartwright, 1976. Elimination of chlorinated dibenzofurans associated with polychlorinated biphenyls fed to mallards (Anas platyrhyncos). Toxicol. Appl. Pharmacol. 37:217-228.

contamination. Chlorinated dibenzofurans are found together with TCDD in pulp mill effluents. However, non-chlorinated dibenzofuran has been found in association with polycyclic aromatic hydrocarbons and other combustion products. This relationship holds true in the available data on Everett Harbor (Tetra Tech, 1988). Therefore, dibenzofuran test results should not be used as justification for ignoring the risks associated with TCDD contamination.

(7)

From the PCB data discussed above, it appears possible that the PSDDA bioaccumulation trigger levels may be on the order of 1000 times too high for the carcinogenic chemicals with bioaccumulation potential. Therefore, failure of chemical analysis results to reach screening level, or bioaccumulation trigger levels, should not be used as justification to eliminate a thorough discussion of bioaccumulation and human health risk from the chronic (sublethal) evaluation.

(8)

Sincerely,

David H. Monroe

References

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Tetra Tech, Inc. (1988). Everett Harbor Action Program: Analysis of Toxic Problem Areas. Prepared for U.S. Environmental Protection Agency Region X, Office of Puget Sound, Seattle, WA. TC-3338-26.

Tetra Tech, Inc. (1988). Health Risk Assessment of Chemical Contamination in Puget Sound Seafood. Prepared for U.S. Environmental Protection Agency Region X, Office of Puget Sound, Seattle, WA. TC-3338-28.

U.S. Environmental Protection Agency (1988). National Bioaccumulation Survey, Data Update.

Washington Dept. of Ecology (1988). Draft Sediment Quality Standards/Preamble P-2 Sediment Quality Standards.

Stallings, et al. 1983. Residues of polychlorinated dibenzo-p-dioxins and dibenzofurans in Laurentian Great Lakes fish. In Tucker, R.E., A.L. Young, and A.P. Gray, Human and Environmental Risks of Chlorinated Dioxins and Related Compounds. Plenum Publishing Corp, pp 221-240

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Staples, C.A. et al., 1983. A model for predicting the influence of suspended sediments on the bioavailability of neutral organic cheicals in the water compartment. In Cardwell, R.D., R. Purdy and R.C. Bahner (ed), Aquatic Toxicology and Hazard Assessment. ASTM STP 854, pp. 417-428.

Van den Berg, M.F. Blank, C. Heeremans, H. Wagenar, and K. Olie. 1987. Presence of polychlorinated dibenzo-p-dioxins and polychlorinated dibenzofurans in fish-eating birds and fish from the Netherlands. Arch. Environ. Contam. Toxicol. 16: 149-158.

Response 6. See response 3, above, regarding the suitability of the *Macoma* bivalve test. As stated in responses 3 and 4 above, PCP, PCDD's and PCDF's, and PCB have been updated. Chlorinated pesticides have been reviewed, but there was no indication in the Puget Sound Database nor in the literature that suggested that there is a need to change the trigger values for these chemicals at this time. If it should be needed in the future, PSDDA annual review meetings may change these values.

The cited research on Great Blue Heron reproductive failure as it relates to PCDD's and PCDF's deals with considerably greater levels than have ever been noted in Puget Sound. Based on the current information from Puget Sound regarding these compounds, there is no reason to suspect biomagnification is occurring. Also, should biomagnification occur, it logically would be less dangerous to human health in deeper waters of PSDDA sites, in areas of low fish and shellfish utilization, and with capping occurring from disposal of other, cleaner sediments, than in the shallow estuarine areas which are the typical dredging sites.

Response 7. The PSDDA agencies agree that concentrations of nonchlorinated dibenzofurans may not correlate well with the presence of chlorinated dibenzodioxins in sediment. The PSDDA evaluation procedures have been modified to address the chlorinated compounds.

Response 8. See response number 3, above, regarding the risk level associated with the PSDDA bioaccumulation testing trigger for PCB's. The trigger has been revised to better reflect the organic carbon content of the sediments being evaluated.

Testimony of Eric Johnson, Washington Public Ports Association
Puget Sound Dredged Disposal Analysis Hearing
April 18, 1989
Steilacoom, Washington

My name is Eric Johnson, and I am the environmental specialist for the Washington Public Ports Association. The port association is the liaison and coordinating agency for the public port districts of the state of Washington, and represents 65 ports in 33 of Washington's 39 counties.

I am here to testify in strong support of the open-water dredged material disposal sites that have been identified in Phase II of the Puget Sound Dredged Disposal Analysis study. The ports of Puget Sound have been working with the four PSDDA agencies since the beginning of this planning process. The tremendous effort that has gone into PSDDA has provided Puget Sound's maritime industry with environmentally safe yet cost-effective sites for the disposal of dredged material in open water.

The ports of the Puget Sound region have a continuing need for dredging, and hence for dredge disposal sites. As ships become larger, deeper drafts are needed to accommodate them. The old 30 or 35 foot navigation channels now must often be deepened to 45 feet. Many water-dependant economic development activities also require dredging.

In addition, there is a continuing need to maintain and expand the marinas, boat launch sites and other recreational boating facilities that rely on dredging for at least part of their operation. The demand for recreational boat facilities - particularly marinas and other moorage areas - is increasing rapidly in Puget Sound. This translates into a strong demand for moorage facilities. The first use of a PSDDA site in central Puget Sound was for maintenance dredging of a recreational moorage facility. The Phase II open water disposal sites will continue to serve the region's recreational boating public.

The ports have been working very cooperatively with the four PSDDA agencies to implement Phase I of the study, and we believe that the PSDDA agencies have done an excellent job of allowing input from both the regulated community and the general public. The existence of a public annual review by the four agencies, as well as meetings of the Policy Review Committee and other work groups give both the regulated dredging community and the public an opportunity to influence the process. The annual review process, in particular, gives us the opportunity to reassess and review our policies as we gain experience using the sites.

Our Association's review of the Phase II documents convinces us that the five sites that have been chosen by the study for the northern and southern areas of the sound have been selected with great care, and are environmentally protective. Furthermore, the study has developed very protective evaluation procedures to ensure that unacceptable levels of contaminants do not reach the sites. Although these procedures often mean extra dredging costs for the ports, we feel that this caution is necessary in order to maintain the excellent water quality levels that prevail at these sites.

The ports are pleased to see a management plan report that insures that these sites will be well managed, with frequent inspections of dredging operations and stringent monitoring policies.

In summary, the Washington Public Ports Association supports the establishment of the Phase II open water disposal sites, as well as the draft documents that make up Phase II of the PSDDA study.

PUBLIC MEETING TESTIMONY - APRIL 18, 1989
STEILACOOM, WASHINGTON

Eric Johnson, Environmental Specialist, Washington Public Ports Association (WPPA)

Comment 1. WPPA strongly supports the need for the preferred sites and the results of the PSDDA effort

Comment 2. The environmental protection measures will assure that unacceptable levels of contaminants will not be disposed at PSDDA sites

Comment 3. The annual review process will provide an opportunity to reassess the policies in light of the experience gained in using the sites.

Response 1. Comment noted.

Response 2. Comment noted.

Response 3. Comment noted.

NORTHWEST
MARINE TRADE
ASSOCIATION

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April 18, 1989

PUGET SOUND DREDGED DISPOSAL ANALYSIS PHASE II

PUBLIC MEETING

I, Patty Lane, a representative of the Northwest Marine Trade Association, would like to present the following comments concerning the site study for the Puget Sound Dredged Disposal Analysis Phase II. The Northwest Marine Trade Association exists to promote boating, the marine industry, and favorable relations between the industry and the public.

The issue of open-water disposal sites throughout the Puget Sound is of vital importance. This will enable us to pursue the demand for increased water access such as launch ramps and recreational boating facilities. We strongly support the efforts to determine such sites and provide environmentally sound and cost effective methods to do so.

It is a prime concern, and very crucial to maintain our water ways as the need for marinas, moorage areas, and boating increases.

The Northwest Marine Trade Association commends the four agencies; U.S. Army Corps of Engineers, U.S. Environmental Protection Agency, and the State of Washington Department of Natural Resources and Ecology in their development of the Puget Sound Dredged Disposal Analysis. We are eager to join efforts to promote an economical and environmental way to dispose of non-contaminated dredged material in your waters.

Patty Lain, Northwest Marine Trade Association.

Comment 1. The NWMTA represents about 1,000 marinas as well as recreational boaters and marine industries. It strongly supports PSDDA, which it believes assures environmental protection in an economically feasible manner. The designation of open water disposal sites under PSDDA is vital to increasing marina availability for the public.

Response 1. Comment noted.

Michael Zittel, owner of Zittel's Marina in Olympia.

Comment 1. Disposal sites are essential to small marinas, and it is vital the environmental guidelines be in place for the protection for fish and shellfish The PSDDA studies address both of these needs.

Response 1. Comment noted.

Douglas Edison, Executive Director of the Port of Olympia.

Comment 1. The Port of Olympia supports the PSDDA selection of the Anderson/Ketron Island site, despite the closer Anderson/Devils Head site, in recognition of the relatively higher fisheries values at the latter. The Port hopes that the Phase II study will successfully designate the Anderson/Ketron site, and believes it would enhance the economic viability of the ocean commer in Southern Puget Sound while protecting the environment.

Comment 2. The Port of Olympia, in keeping with its involvement with the Budd Inlet Task Force, will also attempt to use dredged material in beneficial ways such as capping near the contaminated Cascade Pole site.

PUBLIC MEETING TESTIMONY - APRIL 19, 1989
BELLINGHAM, WASHINGTON

Dirk Visser, President of the Inner Sound Crabbers' Association.

Comment 1. The Inner Sound Crabbers' Association is spokesman for crab resources and commercial crab and fisheries. The lower Strait of Georgia provides 2/3 or 2 million pounds annually of the crab catch for north Puget Sound. The Association feels that PSDDA has appropriately acted to protect biological resources of Puget Sound/Strait of Georgia inland waters. The Association concurs with dropping the Strait of Georgia site, and that Washington Department of Fisheries had been consulted and listened to in both the Strait of Georgia site and the seasonal restrictions to protect crab resources in Bellingham Bay.

Comment 2. The flexibility in the annual review process of PSDDA implementation is a good idea.

Comment 3. The Association takes a positive view of the PSDDA process.

Comment 4. Dredged material is a resource which should be used to construct wetlands or other beneficial projects.

Comment 5. What alternatives were considered for disposal of debris and contaminated sediment, and wouldn't there be a strong predilection to use the unconfined, open-water PSDDA sites instead of other available disposal methods?

Comment 6. What communication occurs between the Bellingham Bay Action Plan work group and PSDDA?

Response 1. Comment noted.

Response 2. Comment noted.

Response 3. Comment noted.

Response 4. Beneficial uses are anticipated to be utilized as an option for dredged material management, and have been considered to account for approximately 50% of the material in the Port Angeles area.

Response 5. Beneficial uses are encouraged and were included in the DEIS volume estimates; for contaminated sediments, the State of Washington is pursuing standards for design of confined disposal. For construction debris, landfills will take the debris (which is not usually contaminated) at present, although availability could become a problem if the volume of debris were large. The final MPR (Chapter 6), details debris requirements.

Response 6. The Corps is responsible for dredged disposal data management and Ecology is connected to the Corps' data system. There will be regular data interchange. EPA is tring to develop and maintain good communications between the Office of Puget Sound and in particular the Bellingham Bay Action Plan work group. The Corps and DNR also have representatives on the work group.

LUMMI INDIAN BUSINESS COUNCIL PUBLIC TESTIMONY

ACTION Corps of Engineers selection of a nondispersive dredge disposal site in Bellingham Bay

HEARING April 19, 1989, 7:30 PM
Bellingham Council Chambers
Bellingham City Hall

STATEMENT.

The Lummi Tribe objects to the siting of a nondispersive dredge disposal site in Bellingham Bay for the following reasons:

1 The site chosen is shallow compared with the origional PSDDA guidelines requiring depths deeper than 120 feet. The Bellingham site is located in an area used extensively by the Lummi and non tribal fishing fleet In the past, logs and debris dumped in other nearby disposal sites have damaged fishing gear and are therefor avoided by many fishermen This new site located farther out in the Bay will reduce again the areas free of obstructions for the fishing fleet Compliance to avoid illegal debris disposal has been poor in the past and future disposal of debris that will damage gear is likely The E I S does not detail adequately how the Department of Natural Resources will prevent this or how fishermen would be compensated for fishing gear damaged by debris A further reduction of the Tribes prime fishing area in Bellingham Bay is not acceptable.

2 The existing sediment standards for nondispersive disposal areas allow an unacceptable level of toxicity in dredged material. Condition II criteria allow mortalities of up to 60% in test species which are chosen to reflect bottom dwelling organisms found at these sites Some of the inner harbor sediments where dredging is likely are extremely toxic The 1988 State of the Sound Report listed Bellingham's sediments as containing high levels of mercury and moderate levels of copper and zinc

3 Bellingham Bay supports a significant Dungenese crab fishery for Tribal and nontreaty fisherman U of W trawl studies showed relatively high numbers of Dungenese crab, shrimp, and ground fish in Bellingham Bay compared with other sites examined in Puget Sound Locating another disposal site further out into the Bay has the effect of increasing the area of contamination in an area rich in natural resources. There are concerns for crab because of the habit of egg bearing females to bury in sediments during the incubation period. We don't know if hatching sucess or larval survival may be lowered by toxic sediments allowed under these guidelines. Bioassy experiments should investigate this possibility.

4 Wherever contaminated sediments are located, there is the risk of transfering toxins from sediments to food fisheries The 1988 State of the Sound states, "PCBs and mercury levels occasionally exceed accepted standards in ground fish at some urban sites such

Jack Smith, Port of Anacortes.

Comment 1. The port supports the Rosario Strait site. It is important to the port to have available open-water disposal sites for dredged material to maintenance of navigation, which is vital to preserving essential services at the ports in an economic manner.

Comment 2. PSDDA has been a diligent, effective and environmentally-protective process.

Response 1. Comment noted.

Response 2. Comment noted.

Verne Johnson, Jr., Representative of the Lummi Tribal Business Council.

Comment 1. The site is shallower than original PSDDA guideline of 120 feet. It should be relocated to a minimum depth of 120 feet to assure that the site does not have to be relocated and to place it in an area with fewer resources.

Comment 2. Debris that is disposed at the shallower location may interfere with tribal fishing. Compliance inspections in the past have not been adequate to avoid debris disposal at the former Bellingham Bay site. The EIS does not adequately detail how DNR will prevent debris disposal nor how fishermen would be compensated for gear loss.

Comment 3. Further reduction of the Tribe's prime fishing area in Bellingham Bay is unacceptable.

Comment 4. Unacceptable toxicity levels appear to be allowed under PSDDA guidelines for dredged material, and significant toxicity has been reported from sediments in Bellingham.

Comment 5. PSDDA studies conducted by the University of Washington indicated significant Dungeness crab, shrimp and groundfish in Bellingham Bay. These are the basis for a Dungeness crab fishery by both nontribal and tribal fishermen.

Comment 6. The site location in Bellingham Bay at a site farther from shore than the old DNR site will increase the area of contamination.

Comment 7. Toxicity effects on egg bearing females, hatching success and larval survival are unknown, and should be investigated by bioassays.

Comment 8. Food fisheries may be impacted by transfer of toxicants from sediments to fish; relocation f toxic sediments to relatively clean areas require careful consideration. At present, Federal guidelines for contamination in fish and shellfish are rarely exceeded.

Comment 9. How will clean and contaminated material be separated during dredging, and how will it be transported and stored?

Comment 10. The plan to designate a disposal site for contaminated material in a relatively uncontaminated area would happen before the Bellingham Bay Action Program would have a plan to clean up Bellingham Harbor and the former disposal as Bellingham Bay " Federal guidelines for contamination in fish and shellfish are very rarely exceeded in Puget Sound. The removal and relocation of these toxic sediments to relatively clean areas requires very careful consideration

Before relocating this material we would like to know specifically how the clean and contaminated material is to be separated during dredging how the contaminated material is to be transported, and where it will be stored

The search for disposal areas for clean material should be continued but using the original minimum depth recommendation of 120 feet. Past disposal sites in Bellingham Bay were too shallow requiring a new locations to be found soon after they had filled in. A deeper site would also generally have fewer marine resources and impacts to fisheries

It is unfortunate that we are being asked to choose another disposal site for contaminated material in a new, relatively clean area before there is a plan or action to clean up Bellingham's inner harbor and the old dredge disposal sites Recently a Work Group has been formed to provide a cleanup plan for Bellingham Bay We are hopeful this "Bellingham Bay Action Program" will also identify those responsable who need to share in the costs of cleanup and disposal of contaminated sediments in Bellingham Bay

Signed,

Larry Kinley, Chairman LIBC

Merle Jefferson, Director

Response 1. These concerns are quite similar to those expressed subsequently by the Tribe in commenting on the DEIS. Therefore, these responses reference the longer responses made previously. Also, PSDDA representatives discussed the Lummi's concerns on several occasions, the most recent was on September 1, 1989 with the Tribal Chairman, Larry Kinley. See responses 2 and 12 to the Lummi Indian Business Council letter ofcomment, earlier in this exhibit.

Response 2. See responses 2 and 3 to the Lummi Indian Business Council letter ofcomment, earlier in this exhibit.

Response 3. See responses 4, 7 and 8 to the Lummi Indian Business Council letter of comment, and response 8 to the Fish and Wildlife Service/Department of Interior letter of comment, earlier in this exhibit.

Response 4. The PSDDA guidelines for disposal do not allow toxic materials that would have an unacceptable adverse effect on marine animals at the disposal sites nor nearby. For further discussion of this, see responses 6 and 9 to NOAA/NMFS' letter of comment, earlier in this exhibit and responses 5 through 8 to the Lummi Indian Business Council letter of comment, earlier in this exhibit.

Response 5. See response 8 to the Lummi Indian Business Council letter of comment, earlier in this exhibit.

Response 6. See responses 2, 4, 5, and 7 to the Lummi Indian Business Council letter of comment, earlier in this exhibit.

Response 7. See responses 2 , 4, 5 and 7 to the Lummi Indian Business Council letter of comment, earlier in this exhibit.

Response 8. See responses 2, 4, 5 and 7 to the Lummi Indian Business Council letter of comment, earlier in this exhibit.

Response 9. See response 11 to the Lummi Indian Business Council letter of comment, earlier in this exhibit.

Response 10. See response 13 to the Lummi Indian Business Council letter of comment, earlier in this exhibit.

Don Ellis, Port of Bellingham

Comment 1. The Port of Bellingham strongly supports the Rosario and Bellingham Bay preferred disposal site locations. It is vital to have disposal sites that are close as possible to the dredging area.

Comment 2. The port was the initiator of the Point Roberts site for use primarily in disposal of the material from the expansion of Blaine. It concurs with the PSDDA decision to drop this site from consideration in light of the fisheries concerns, and despite the potential for the increased haul distance to the Rosario Strait site to increase costs for Blaine expansion by 15%.

Response 1. Comment noted.

Response 2. Comment noted.

Archie Rishnsic, a commercial fisherman.

Comment 1. He asked why the Blaine marina material could not be disposed next to the Blaine breakwater.

Response 1. State and Federal agencies have regulations governing such disposal, and have met with the port and indicated that this was not acceptable, because eelgrass in wetlands would be adversely affected.

Andrew McArthur, a Blaine-based commercial fisherman

Comment 1. He also mentioned the potential to dispose the material on beaches or near the Blaine breakwater.

Comment 2. He stated that he opposes the Point Roberts site, and asked if the PSDDA agencies had considered the sites that they had been told are not fished in the Strait of Georgia.

Comment 3. What is PSDDA doing about pollution that arises in Canada that is affecting US eelgrass beds.

Response 1. See response 1 to Archie Rishnic, above.

Response 2. The information was considered in light of WDF and other user groups' input, and decided against. In any case, the Point Roberts site was dropped from consideration.

Response 3. The State should be notified if international shoreline pollution is a problem. PSDDA isn't dealing with more than designation of open-water sites and considering effects of dredged material disposal on US and Canadian waters and resources. PSDDA has coordinated its reports with the Canadian and British Columbian governments; in general, the Canadians are less restrictive in their guidelines for contaminated sediments than is PSDDA. There is a conference on Trans-Boundary Pollution that will be held in Canada in November, 1989.

Vickie D. Matheson, of the City of Bellingham Department of Planning and Economic Development, provided written testimony in the form of a letter from Bellingham's mayor, Tim Douglas. This is answered in the correspondence section.

Comment 1. Mayor Douglas asked if the location close to Bellingham and the relatively shallow depth of the site was adequate to protect water quality of Bellingham Bay. He encouraged the Corps and EPA to take all measures available to protect the recreational and commercial uses of Bellingham Bay.

Response 1. See letter in correspondence section.

Angus McArthur, Blaine crab and salmon fisherman.

Comment 1. He opposes the Point Roberts site.

Comment 2. He is concerned for the effect of toxic materials in the disposed material. He stated that none of the dredged material should be disposed at sea, but instead on land; confined disposal at sea is not acceptable.

Comment 3. He expressed concern that the Bellingham Bay site would cause fishermen to move north, to the Strait of Georgia.

Comment 4. He said he did not believe that the University of Washington studies found few resources at the Point Roberts site, and requested a copy of the studies.

Resonse 1. The Point Roberts site has been eliminated from consideration.

Response 2. The PSDDA guidelines for disposal do not allow toxic materials that would have an unacceptable adverse effect on marine animals at the disposal sites nor nearby. PSDDA considered the tradeoffs between deep-water, nearshore, and upland disposal. Nearshore and upland disposal sites are not always the best in terms of environmental impacts. For further discussion of this, see responses 6 and 9 to NOAA/NMFS' letter of comment, earlier in this exhibit.

Response 3. There should be no impact to Indian fishing at the site. It is possible that commercial and sports fishermen might have slightly less opportunity to fish the site, but this would be a minor impact as the site use is only anticipated to be intermittent and only 20-40 days a year, for visits to the site that would take less than 20 minutes each.

Response 4. Mr. McArthur was provided a copy of the trawling studies for review and comment. No comment has been received as of the finalization of the FEIS.

Shawn Waters, fisherman and member of the Washington State Inside Draggers.

Comment 1. He is opposed to disposal in water; it should be done on land.

Comment 2. He expressed doubt about the results of the UW studies. He asked why the material could not be put on the beach at Blaine.

Comment 3. He stated that compliance monitoring would be difficult in Point Roberts when seas are running high.

Comment 4. He asked how big is "debris?" Would a 100 pound or a 500 pound rock constitute debris?

Response 1. Land disposal also has impacts, which were considered in the FIS. For further discussion of this, see responses 6 and 9 to NOAA/NMFS' letter of comment, earlier in this exhibit. In the specific instance of Blaine that ws discussed, Federal regulations strongly discourage filling in nearshore areas. PSDDA considered the tradeoffs between deep-water, nearshore, and upland disposal. Nearshore and upland disposal sites are not always the best in terms of environmental impacts.

Response 2. Mr. Waters was also provided a copy of the trawling studies for review and comment. No comment has been received as of the finalization of the FEIS.

Response 3. In any of the sites (Point Roberts is no longer an option), high seas would probably stop disposal. The management plan includes a fully-developed compliance inspection plan that will be carried out by both the Corps and DNR. It is in the interest of all parties (dredgers, agencies) that disposal be completely in accord with the conditions of the permits.

Response 4. The PSDDA agencies have adopted a "functional" definition of debris, which is listed in the MPR at section 6.2.7. In summary, debris is something that can interfere with a particular use, such as fishing gear fouling, or material that could interfere with navigation or float up on and damage a beach. Each project applying for a Federal 404 permit and all Federal dredging projects must specify how they will handle debris prior to the operation.

Douglas A. Boltthuis, Fidalgo Bay National Estuary Preserve in Padilla Bay.

Comment 1. He indicated that he is glad that the Guemes Island site closer to Padilla Bay was dropped from consideration early in the site selection process; and that the program has attempted to minimize contaminated sediments in disposal. He asked whether the chemical screening criteria will pick up all toxicity.

Comment 2. He stated concern that materials disposed at the Rosario Bay site will get into Padilla and Fidalgo Bays, with accompanying toxicity.

Response 3. What is grain size measurement used for in the PSDDA evaluation procedures?

Response 1. The highly restrictive guidelines for dispersive sites allow no toxicity to be exhibited in the dredged material, as described in the FEIS at section 2.03h

Response 2. The likelihood of minute quantities of dispersed (bottom current carried) dredged material to get into Padilla and Fidalgo Bays is rather small. Subsequent to this comment, PSDDA representatives discussed the concern with Mr. Boltthuise, and provided him with additional copies of the DEIS and a PSDDA report titled Literature Search on Dispersive Sites for Dredged Material in Northern Puget Sound and Strait of Juan de Fuca.

Response 3. Grain size is not a basis for rejection of material per se; it is used in matching reference stations to test stations in the biological testing.)

PUBLIC MEETING TESTIMONY - APRIL 20, 1989
PORT ANGELES, WASHINGTON

Eloise W. Kailin, of Protect the Peninsula's Future.

Comment 1. She stated that she did not see in the document what toxicant standards would be used for evaluating acceptability of dredged material for open-water disposal. She stated that priority pollutants and chemicals of hum health concern should be tested for, including tributyltin. She also stated that biological testing should be done in every case.

Comment 2. She stated low confidence in compliance monitoring because of past performance. She stated that she was concerned that highly contaminated material from Everett Navy Homeporting would be disposed of the Olympic Peninsula.

Response 1. Subsequent to the meeting, Ms. Kailin she was shown the lists of chemicals of concern, the proposed addition of TBT, and the tiered testing process; she stated that she was much more confident that PSDDA was doing the right thing.

Response 2. She was provided a copy of the management plan with monitoring discussion. PSDDA does not specify restrictions on materials from one part of the Sound going to another, so long as the materials meet the disposal guidelines at the receiving site. However, the high costs of transport make th movement of material from urbanized central Puget Sound to Port Angeles or Port Townsend extremely unlikely. Also, the disposal guidelines for use of the dispersive sites are more restrictive than those for the Central Puget Sound sites. In the case of Everett Homeporting material, the portion disposed in open water will go to the Port Gardner PSDDA site due to the legal agreements. After the meeting, Ms Kailin stated that she thought PSDDA had answered her concerns.

Orville Campbell, of Daishowa America.

Comment 1. Having an offshore deepwater dredged disposal site is critical to continued operation at the existing pulp and paper mill and for providing deep-draft navigation at Daishowa's planned new mill. Daishowa strongly supports th PSDDA objectives and has no objection to the testing and monitoring procedures.

Response 1. Comment noted.

R. S. Dubigk, of the Port Angeles Salmon Club.

Comment 1. He asked who did the materials testing and literature review on the conditions at the preferred site.

Comment 2. He asked what will happen when sediment of high BOD is disposed on fisheries at Green Point and Hind Bank.

Comment 3. R.S. Dubigk asked if the PSDDA agencies were aware of a PBY plane that went down 3/4 mile off Ediz Hook many years ago. He stated that the currents are so strong that only small pieces of it were found. He indicated that the site is very dispersive.

Comment 4. He asked if Hood Canal was considered in the site selection process.

Comment 5. He stated that the Port Angeles Salmon Club, on the basis of the information provided, does not object to the PSDDA disposal site.

Response 1. PTI Environmental Services, Inc., reviewed existing information on the levels of chemicals in the Port Angeles and Port Townsend areas, and estimated probable levels of prospective dredged material based thereon. Evans-Hamilton, Inc., did the oceanographic literature reviews and studies on site conditions. The University of Washington's Fisheries Research Institute did onsite trawl studies.

Response 2. Current information indicates there is no real impact on dissolved oxygen levels from disposing even highly organic material into well oxygenated and dispersive ocean waters such as occur at Port Angeles.

Response 3. The PSDDA agencies had not been aware of the airplane. The information was considered in the literature review of possible submerged cultural resources but did not on the basis of available information to have appreciable likelihood of being submerged at the selected PSDDA site nor appear to be a property eligible for the National Register of Historic Places. The PSDDA agencies agree that this site is very dispersive.

Response 4. Comment noted.

Margaret Crawford, the acting director of the Clallam County Economic Development Council

Comment 1. The Council supports the PSDDA efforts to designate a site for disposal of clean dredged material at reasonable cost. The support recognizes that such a site is needed to make marina development and the development and maintenance of navigations channels viable.

Response 1. Comment noted.

Jeff Rossbeck, of ITT Rayonier.

Comment 1. ITT Rayonier supports a deep water disposal site for clean dredged material. Currently, much of the dredged material it generates goes to a landfill, but landfill capacity is becoming increasingly scarce and costly.

Response 2. Comment noted.

John Ward, of the Olympic Outdoors Sportsmen's Club

Comment 1. He asked what was wrong with the old site.

Comment 2. He believes that the questions the Club had on only clean material going to the site have been answered.

Response 1. The site selection process disclosed that moving farther offshore is less environmentally damaging.

Response 2. Comment noted.

Comment 2. He said that the evaluation procedures, although more expensive than before, increase public acceptability of the sites and environmental protection.

Comment 3. He stated that the additional 3 months of closure to protect the shrimp onsite would cause some difficulties for the Port, but that he felt it could be worked around.

Comment 4. He stated that, with all of the environmental features, the DEIS showed that there would be no unacceptable environmental impacts due to site use. The designation of open water disposal sites is essential to navigation and economic development of the area.

Response 1. Comment noted.

Response 2. Comment noted.

Response 3. Comment noted.

Response 4. Comment noted.

Bill Conley, of the Port of Port Angeles.

Comment 1. The Port examines the open-water disposal as well as other available disposal options in light of economics for disposal.

Comment 2. It is sometimes less costly or more beneficial to go upland and use the material for uses such as construction or to dispose upland at a construction landfill.

Comment 3. If there is not a locally available PSDDA site, the cost (given in the PSDDA DEIS) for transport to another open water site of $0.10 to $0.30 per cubic yard nautical mile would be prohibitive for open-water disposal.

Response 1. Comment noted.

Response 2. Comment noted. "Adjusted" volumes for disposal at the Port Angeles and Port Townsend sites calculate that only approximately 50% of the material generated by dredging and which might pass the PSDDA dispersive site guideline would go to open-water sites because of the available alternate disposal/use/recycling options.

Response 3. Comment noted.

Ken Ridout, representing the City of Port Angeles

Comment 1. Mr. Ridout indicated on the attendance card that the City is interested in and very supportive of the PSDDA site designation.

Response 1. Comment noted.

Ken Sweeney, planner from the Port of Port Angeles.

Comment 1. The Port of Port Angeles supports the preferred PSDDA alternatives for both Port Angeles and Port Townsend. It believes that the PSDDA proposal is both carefully considered and conservative; through it a publicly acceptable system of disposal sites have been identified to serve Puget Sound needs. He praised the PSDDA site management plan, and stated that he believes the compliance inspections will work.

Response 1. Comment noted.

EXHIBIT D

OTHER PERTINENT CORRESPONDENCE

Correspondent	Date	Page
Federal Agency		
U.S. Coast Guard	Oct. 7, 1988	D-1
State Agencies--State of Washington		
Department of Natural Resources	April 9, 1988	D-2
Department of Fisheries	June 13, 1988	D-4
Department of Fisheries	July 19, 1988	D-7
Office of Archaeology and Historic Preservation (Corps' letter attached)	September 5, 1989	D-8 D-9
Indian Tribe:		
Lummi Tribe	June 7, 1988	D-11
Lummi Tribe	Aug. 29, 1988	D-14
Other:		
ITT Rayonier	Aug 12, 1988	D-15
Port of Olympia	Aug. 11, 1988	D-16
Port of Port Angeles	July 20, 1988	D-17
Port of Bellingham	Aug. 3, 1988	D-19
Port of Port Townsend	June 28, 1988	D-21
Port of Anacortes	June 20, 1988	D-22
Port Angeles Salmon Club	Aug. 10, 1988	D-24
Inner Sound Crab Association	Feb. 9, 1989	D-25

U.S. Department of Transportation
United States Coast Guard

U.S. Coast Guard
Captain of the Port
Puget Sound

1519 Alaskan Way S
Seattle, WA 98134
(206) 286-5550

16711
7 October 1988

U. S. Army Corps of Engineers
Attn: Mr. Frank Urabeck
P. O. Box C-3755
Seattle, WA 98124-2250

Dear Mr. Urabeck,

The use of the Bellingham Bay Explosive Anchorage area for a dredged material disposal site is agreeable to me, with the understanding that the disposal site will be closed when explosive laden vessels are using the anchorage.

It is recommended that your Site Operation Manual identify the need to contact the Puget Sound Vessel Traffic Service, prior to using the disposal site to ascertain if any vessels are currently in the anchorage.

If you should have any further questions regarding this matter please contact LT D. Smith of my Port Safety Branch at (206) 286-5530.

Sincerely,

J. R. FELTON
Captain, U. S. Coast Guard
Captain of the Port
Puget Sound, Washington

cc: CO, PSVTS

WASHINGTON STATE DEPARTMENT OF
Natural Resources

BRIAN BOYLE
Commissioner of Public Lands

OLYMPIA, WA 98504

April 9, 1988

Lt. Sergio Cerda, Watch Supervisor
Puget Sound Vessel Traffic Service
1519 Alaskan Way South
Seattle, WA 98134-1192

Dear Lt. Cerda:

This letter is to confirm my understanding of our discussions today regarding use of VTS to aid in positioning and monitoring of disposal at PSDDA Phase II sites. You said the Coast Guard would be willing to enter into an agreement with DNR for the Phase II sites, similar to the current agreement with DNR for the Elliott Bay disposal site. This agreement provides for Coast Guard positioning assistance to disposal site users and monitoring of disposal accuracy. This would be a great help to us in managing use of these disposal sites.

We also discussed the availability of VTS coverage at the Phase II sites. This is a summary of my notes.

Rosario Strait

VTS coverage in the vicinity of the disposal site is hampered by tall trees in the direction of the site. To check whether the site can be monitored, it will be necessary to drive a boat through and check the radar screen. DNR will arrange for this test. If VTS works, accuracy would be within 40 yards.

Port Angeles

There is good VTS coverage of this area. Accuracy would be within 60 yards. You mentioned possible conflicts with the navigation lanes. Ocean vessels leaving the Strait would have dropped their pilots at Port Angeles and may have non-English speaking masters. You recommended shifting the disposal zone to the east out of the navigation lane. You also suggested using the Navy calibration buoy as a site marker. A less preferable alternative would be to place the disposal zone in the buffer area between the incoming and outgoing traffic lanes. This area is shown on navigation charts. I will convey your concerns to the work group responsible for identification of disposal site locations.

Jefferson County

VTS coverage here is good, accuracy to 60 yards. It appears the disposal zone is just to the west of the traffic lanes (to be verified) so this would be a good location.

Point Roberts

This site is at the intersection between U.S. and Canadian vessel traffic control. Seattle could assist positioning in this area but would need to be notified in advance. Accuracy of VTS would be 60 to 80 yards. The disposal zone appears to be in the middle of the navigation lane but this appears to be an acceptable site.

Bellingham Bay and Anderson Island

No VTS coverage

As I mentioned, David Jamison will be talking to you in more detail about site operation and about making a test run at the Rosario site. Thank you very much for your cooperation.

Sincerely,

Steve Tilley

Steve Tilley, Assistant Manager
Division of Aquatic Lands
206/586-6375

c: MPWG

ps.cg

JOSEPH R. BLUM
Director

STATE OF WASHINGTON
DEPARTMENT OF FISHERIES
115 General Administration Building • Olympia, Washington 98504 • (206) 753-6600 • (SCAN) 234-6600

June 13, 1988

Mr. Dave Kendall
Corps of Engineers
Post Office Box C-3755
Seattle, Washington 98124-2255

Dear Mr. Kendall:

The Washington Department of Fisheries (WDF) has reviewed the proposed site recommendations for Phase II PSDDA Dispersive and Non-Dispersive sites and offers the following recommendations and concerns:

A. Non-Dispersive Disposal Sites.

1. <u>Nisqually Region</u>

The most important invertebrate resources occurring in this region are geoduck and Dungeness crab. Although geoducks were not included in the surveys just completed, they do support a major commercial fishery in South Sound. The western half of the Nisqually delta, encompassing ZSF-3, is extremely important to this fishery.

The entire South Puget Sound Dungeness crab population is confined to the immediate vicinity of the Nisqually delta. It is a small population in the process of establishing itself and currently supports a small but growing sport fishery. South Sound was recently closed to commercial crab fishing due to the fragile nature of this resource. February sampling has shown that mature females are found in deeper water adjacent to the southern edge of ZSF-2. Gravid female crab often move into deeper waters and remain buried in soft sediments for long periods during egg maturation. Sediments contaminated from disposal would pose a threat to the egg mass of the crab and could ultimately impact reproduction in this region. Although this causes concern for disposal at ZSF-2, the presence of gravid female crab in February appears to be limited to the area south of the disposal site.

We therefore recommend that ZSF-2 be used rather than ZSF-3 to protect the geoduck resource and avoid potential conflict with the commercial fishery for geoducks.

2. Bellingham Bay Region:

Dungeness crab and pandalid shrimp are the most important invertebrate resources inhabiting this region. Dungeness crab currently support large commercial and sport fisheries in Bellingham Bay. Pandalid shrimp are also increasing in value and importance, and support a minor commercial fishery. Surveys have shown that the density of crab at the southernmost ZSF site is slightly lower than those densities occurring at the more northerly site. This zone, however, also borders on the most dense population of pandalid shrimp found in Bellingham Bay.

The southern site is also in conflict with established trawl fishery areas.

For these reasons, WDF has concerns over selecting either the northern or southern ZSF in Bellingham as a preferred disposal site. We suggest that the Corps contact Mr. Jim Humphreys of the Bellingham Sea Grant office to more completely delineate the concerns of the trawl fishermen in this area.

B. Dispersive Disposal Sites.

1. Point Roberts ZSF:

Studies at this site show that important invertebrate resources do occur here, but not in sufficient quantity to recommend against its use for dredge disposal, based solely on this criteria. The Point Roberts site, however, is located in one of the most heavily trawled areas in Puget Sound and, therefore, is in conflict with present uses. The alternative Pt. Roberts site, relocated approximately six nautical miles to the southwest, has been discussed, but no biological sampling has occurred to our knowledge. We, therefore, cannot adequately assess the potential impacts to resources of concern at the alternative site, but understand it would not conflict with existing trawl fisheries.

Because of the similar nature of the conflicts between the Point Roberts site and the Bellingham Bay southern site, we again have concerns and recommend that the Corps contact Mr. Jim Humphreys.

2. Rosario Strait ZSF:

While important invertebrate resources are known to occur at this site, they are present at relatively low levels of abundance. The Roasario Strait site additionally does not conflict with known trawl fishing areas. We, therefore, have no objections to this dredge disposal site.

3. Port Townsend ZSF:

While no conflicts with trawling occur, surveys conducted at the Port Townsend site show that important shellfish resources can be found at these locations in high densities and that only during the month of April are densities low enough to allow disposal. We, however, have restrictions on dredging activities from March 15 to June 15 for the protection of juvenile salmon outmigrants. Therefore, unless additional surveys are conducted to show that disposal can occur during other months of the year without impacting the shellfish resources, we recommend that no disposal occur at this site.

4. Port Angeles ZSF:

We have major concerns over the use of this site for dredge disposal. Surveys revealed much higher densities of sea urchins, scallops, and pandalid shrimp than at any other location surveyed throughout the study period. These resources presently support important and rapidly expanding commercial fisheries along the Straits. Unless it can be demonstrated through additional sampling that the high resource densities observed in October are not representative of this site or that disposal can be restricted to certain times of the year to avoid adverse impacts, we recommend that no disposal occur at the Port Angeles site.

The Port Angeles site is also in conflict with a trawl fishery which occurs from December through February. This conflict, however, could be reduced by restricting the disposal area to the northern portion of the ZSF.

If you have any questions or need additional information, please contact Randy Carman, Regional Habitat Manager, at (206) 753-2908.

Sincerely,

Duane Phinney

for

Joseph R. Blum
Director

JRB:RC:dmm

JOSEPH R. BLUM
Director

STATE OF WASHINGTON

DEPARTMENT OF FISHERIES

115 General Administration Building • Olympia Washington 98504 • (206) 753-6600 • (SCAN) 234-6600

July 19, 1988

Mr. Dave Kendall
Corps of Engineers
Post Office Box C-3755
Seattle, Washington 98124-2255

Dear Mr. Kendall:

Due to concerns over selecting either of the proposed ZSF's in Bellingham Bay as a preferred disposal site, the Washington Department of Fisheries (WDF) has further reviewed cruise reports showing the distribution of Dungeness crab and pandalid shrimp in this area. Based on this review, we believe a preferred site can be located midway between the proposed north and south ZSF's with no further impact to crab and shrimp. This will, however, place the disposal site closer to more dense populations of Dungeness crab than the southern site. For this reason, we recommend a timing restriction prohibiting disposal from November 1 through February 28 each year. With this timing restriction, location of a disposal site midway between the two proposed ZSF's will alleviate our previous concerns over Dungeness crab (northern ZSF) and established trawl fishery areas (southern ZSF).

If you have any questions or need additional information, please contact Randy Carman, Regional Habitat Manager, at (206) 753-2908.

Sincerely,

for Joseph R. Blum
Director

JRB:RC:bl

CHUCK CLARKE
Director

STATE OF WASHINGTON

DEPARTMENT OF COMMUNITY DEVELOPMENT

OFFICE OF ARCHAEOLOGY AND HISTORIC PRESERVATION

111 West Twenty-First Avenue, KL-11 • Olympia, Washington 98504-5411 • (206) 753-4011 • SCAN 234-4011

September 5, 1989

Mr. Frank Urabeck
Acting Chief, Planning Branch
Seattle District, COE
P.O. Box C-3755
Seattle, WA 98124-2255

Log Reference: 1008-F-COE-S-04
Re: Puget Sound Dredge Disposal
Analysis

Dear Mr. Urabeck:

Thank you for the opportunity of providing us with portions of the advance copy of the underwater archaeological survey results for the PSDDA project, Phase II.

The materials we have reviewed conform to professional practices and we believe your identification efforts to locate submerged shipwrecks were adequate in the specific project zones.

For the final report we request that the Side Scan plots be keyed to the specific site map and the boundaries of each survey area be identified. We also suggest that in the Rosario Strait ZSF the issue of the identification of traditional cultural properties such as reef net sites be considered.

Please feel free to contact us should you have any questions. We look forward to receiving the completed documents.

Sincerely,

Jacob E. Thomas

Jacob E. Thomas
State Historic Preservation Officer

mr

cc: Ken Cooper

DEPARTMENT OF THE ARMY
SEATTLE DISTRICT, CORPS OF ENGINEERS
P.O. BOX C-3755
SEATTLE, WASHINGTON 9812(-2255

REPLY TO ATTENTION OF

Planning Branch

AUG 24 ....

Jacob E. Thomas
State Historic Preservation Officer
Office of Archeology and
Historic Preservation
111 West 21st Street, KL-11
Olympia, Washington 98504

Dear Mr. Thomas:

This letter concerns the Puget Sound Dredge Disposal Analysis (PSDDA) project, Phase II Disposal Sitings in North and South Puget Sound.

In April 1989, we forwarded a Programmatic Agreement for cultural resources to your office for signature that would cover our proposed PSDDA Phase II activities. Meanwhile, between that time and the present, our ongoing inventory studies for the various Phase II disposal sites have failed to produce evidence for historically significant shipwrecks within or adjacent to the preferred disposal sites. The documentation for our findings is now in preparation and consists of the following:

a. Literature search for the general areas of the Phase II disposal sites, resulting in a list of sunken vessels of possible historical significance; none of the listed vessels occur within the preferred disposal sites.

b. Sidescan sonar studies have now been conducted at the nondispersive disposal sites at Bellingham Bay and Anderson/Ketron Island, resulting in no sonar anomalies that clearly identify historically significant sunken shipwrecks. Two sonar anomalies at Anderson/Ketron Island appear to mark barge remains or debris.

c. Vignettes of maritime history for each of the disposal site areas. These were originally intended to provide some context to aid in the evaluation of any sunken vessels found in the disposal areas. Since no shipwrecked vessels have been found at any of the disposal sites, these studies will serve as a good baseline.

We are providing advance copies of items a. and b. above (enclosures) for your review and comment at this time, even though a complete draft report on these activities will not be available to you until September 1. The final report for this project will address any comments that you may have on either the enclosed material or the complete draft final report. Copies of the final report will be provided to your office, the PSDDA agencies, and the Advisory Council in October 1989.

Since the above study efforts have not identified any National Register eligible properties that would be affected by this undertaking, it is our present position that we no longer need the Programmatic Agreement, provided that we obtain your concurrence that Phase II activities will not affect significant cultural properties. The enclosed copies of items a. and b. above and the complete draft report for this project to be supplied to you by September 1 comprise the documentation for your review and comment. We request that you provide us your letter of comment on an expedited basis, by September 8th, so that it can be included in our Final Environmental Impact Statement for PSDDA Phase II.

Sincerely,

Frank J. Urabeck
Acting Chief, Planning Branch

Enclosures

LUMMI INDIAN BUSINESS COUNCIL
2616 KWINA RD. • BELLINGHAM, WASHINGTON 98226-9298 • (206) 734-8180

DEPARTMENT ______________________ EXT ______

June 7, 1988

Frank Urabeck
Seattle District
U.S. Army Corps of Engineers
P.O. Box C-3755
Seattle WA 98124-2255

RE: Comments on the PSDDA Phase II Preliminary Findings for the Bellingham Bay Non-dispersive sites.

Dear Mr. Urabeck:

The following comments were prepared by the Lummi Fisheries Department at the direction of the Lummi Fish and Game Commissioners. We were able to meet with them on 5/5/88 to discuss the preliminary findings of the Phase II site selection process after our meeting with you on 4/28/88. We would like to express our appreciation for your willingness to meet with us and discuss some of the potential fisheries problems associated with a site selection in our area.

Non dispersive dredge sites, we understand, are to be used for those sediments under the present class II designation. These would include those which may show some acute and sublethal effects to bioassy test organisms. These might also include some sediment types that, due to their mildly toxic nature would not qualify for a dispersive site because of the need to confine the material and to monitor possible long term effects.

As you know, Bellingham Bay unfortunately has contaminated sediments that may not meet the class I (no acute and sublethal effects) designation. It is assumed to have class II material. Without testing it is difficult to determine how much may be very toxic, class III (acute and sublethal effects).

The more highly contaminated material is likely to be located in the surface sediments from the inner harbor waterways which is also where future dredging is planned. It is of particular concern to us that this material be handled with the minimum of exposure to other marine resources. Specific resources of a high economic value to the Tribe include Dungenese crab, clams, and juvinile salmonids, all of which occupy the areas intended to be dredged and the proposed disposal sites at some time during thier life history.

The original criteria for locating dredge sites in the Phase II areas have been modified because initial investigations could not identify areas which did not fit these guidelines. Some of these are:

CRITERIA FOR LOCATING DREDGE DISPOSAL SITES:

ORIGINAL	PRESENT	PROPOSED
1. 10 NM from source	Same	50 NM from source
2. Depth 120-600'	Depth over 90'	Depth 120'+
3. Low velocity currents	Same	Same
4. 2,500' from shoreline	Same	Same
5. No significant marine resources present.	Some significant resources allowed.	No critical marine habitat present.

At present, the depth restriction has been eased to allow a site to be located in Bellingham Bay because of the need to be near the source of the material to be dredged. While there may be specific technical reasons for locating a site within 10 miles of its source, they have not been clearly identified. The rationale for the distance criteria at present appears to be related to the cost of transporting these sediments, not ecological concerns.

It would seem that extending the range would allow other sites to be concidered that would meet more of the original quidelines-albeit at a somewhat greater cost in the transportation of these sediments. For Bellingham Bay sediments, we feel extending the range for potential sites is essential due to several critical marine habitats and resources that are present here. We suggest a re-evaluation of other locations because of the nature of material likely to be located in these confined disposal sites and the relatively high resource value of fisheries located in Bellingham Bay.

An example of a significiant resouce that has come to our attention is the presence of gravid female Dungenese crab in the bottom sediments of Bellingham Bay. We feel the numbers of these found in the trawl studies were not necessarily representative of their abundance because of the trawls tendency to skip over crab which have the habit of burying themselves in the bottom sediments while incubating their eggs. Given the abundence of crab which are harvested in Bellingham Bay we feel it is reasonable to assume that the benthos may provide the critical habitat used by gravid female Dungenese crab. An additional investigation using sampling methodologies that will detect buried crab would be required to varify this hypothesis. The sampling would need to take place in a number of embayments throughout Puget Sound to adequately evaluate the relative importance of Bellingham Bay to this resource.

Another potential problem with the location of an additional disposal sites in Bellingham Bay has to do with gear fouling from debris such as logs, cable, and other harbor refuse that finds its way into these areas. Several gillnet fishermen have reported gear losses that they have incurred attempting to fish over the several existing disposal sites. They are not looking forward to having their fishing areas further reduced by the placement of another shallow site farther out into the bay. This may be more of an enforcement problem, but past experiences in dealing with this problem has not been sucessful. We would suggest DNR establish a fund to compensate fishermen who foul their gear as a result of debris that has been illegally disposed of at these sites.

To summarize, the Lummi Fish & Game Commission cannot support the disposal of toxic sediments in Bellingham Bay due to ecological and gear fouling concerns. It is recommended that another area be found for this material which will not conflict with the high resource values of the fisheries located here.

We hope these comments will provide some guidance for the future selection of a non-dispersive disposal site. Please inform us of any actions towards this selection in the future. We would be available to meet with you to discuss further these concerns or to assist you in the design of any future investigations if these are required.

Sincerely,

Merle Jefferson

Merle Jefferson, Assistant Director
Lummi Indian Fisheries

LUMMI INDIAN BUSINESS COUNCIL
2616 KWINA RD. • BELLINGHAM, WASHINGTON 98226-9298 • (206) 734-8180

DEPARTMENT: FISHERIES EXT.

August 29, 1988

Mr. Frank Urabeck, P.E., Study Director
Puget Sound Dredged Disposal Analysis
Seattle District, U. S. Army Corps of Engineers
P.O. Box C-3755
Seattle, WA 98124-2255

Dear Mr Urabeck:

With reference to your letters of July 19 and August 18, 1988 relating to disposal sites for Bellingham Bay dredge spoils, the Lummi tribe would like to re-iterate its position as stated in my June 7, 1988 letter to you. We do not see anything in the aforementioned letters that substantially changes our position.

Sincerely,

Merle Jefferson

Merle Jefferson, Assistant Director

cc: Lummi Indian Fish and Game Commission
M. J. MacKey

ITT

ITT Rayonier Inc.

Port Angeles Pulp Division
700 N. Ennis, P.O. Box 191
Port Angeles, WA 98362
Telephone (206) 457-3391

Frank Urabeck
Seattle District
U.S. Army Corps of Engineers
P.O. Box C-3755
Seattle, WA 98124-2255

August 12, 1988

Dear Sir:

It has been brought to the attention of the ITT Port Angeles Mill by the Port of Port Angeles that a deep water disposal site is being evaluated for servicing the Port Angeles Port area.

Because of the rapidly decreasing availability of possible land disposal sites and the higher costs associated with land disposal, ITT Port Angeles Pulp Division would like to emphasize our support for the efforts to find and develop a deep water disposal site for <u>clean</u> dredged material.

Presently, ITT Rayonier's Port Angeles Pulp Mill semi-annually dredges out the Mill's chip barge berths and the log pond located in the harbor. This amounts to approximately 8000 cubic yards of material. Past handling practice for this material was to dispose of the dredgings at our permitted land fill site. This, of course, can proceed only for a finite time due to the limited dumping area.

Development of an alternative disposal site would allow the mill flexibility for the dumping of clean dredged material, and save costly land fill area.

Again, ITT Rayonier would like to express it's support for the development and designation of a deep water dredge disposal site servicing the Port Angeles area.

Any questions regarding ITT Rayonier PAPD's dredging and disposal practices, please feel free to call.

Sincerely,

Brian D. Jones

Brian D. Jones
Environmental Superintendent

cc: Kenneth W. Sweeney, AICP
Port of Port Angeles
P.O. Box 1350
Port Angeles, WA 98362

BDJ/mm
61501

915 Washington St. N E
Post Office Box 827
Olympia Washington 98507-0827
206 586-6150

PORT OF OLYMPIA USA

August 11, 1988

Mr. Frank Urabeck, P.E.
Chief Navigation & Coastal Planning Section
US Army Corps of Engineers
Seattle District
P.O. Box C-3755
Seattle, WA 98124

Via Fax: 764-3796

Dear Frank:

Thank you for your continuing efforts to analyze environmentally safe and economically affordable disposal sites for Puget Sound's dredge spoils.

The Port of Olympia would ordinarily prefer the option with the shortest and therefore, least expense hauling distance from Budd Inlet. I can not fully anticipate our disposal needs, but can reasonably predict that maintaining the harbor's viability will eventually lead to a navigation project as recommended by the Corps' Reconnaissance Study for Budd Inlet, published last October. In that report, the Corps postulated the removal of 495,000 yards of material to widen the ship basin and straighten the entrance channel. As the Devil's Head site is closer, it would be the more economical site for placement of the materials.

However, I understand from Corps, Washington State Department of Natural Resources, and others, that there are good reasons to prefer the Ketron Island site in relation to the protection of our fisheries resources. If this is indeed the case, the Port would not object to the designation of the Ketron Island site or the preferred alternative. The differential in hauling costs, approximately $445,500, would be a good investment by the Port in fisheries resource management.

Please keep me informed on the progress of this important selection.

Sincerely,

Douglas P. Edison
Douglas P. Edison
Executive Director

Commissioners
WL Wes Barclift
OR Ray Dinsmore
JD Jim Wright

Executive Director
Douglas P Edison

PORT OF PORT ANGELES

338 West First
TELEX 469230

Post Office Box 1350
Port Angeles, WA 98362-0251

Area Code 206 457-8527
FAX 206-452-3959

D. G. HENDRICKS
Executive Director

COMMISSIONERS

President
ANDREW NISBET, Sequim

Vice President
TED SPOELSTRA, Forks

Secretary
ROBERT M. McCRORIE, Port Angeles

July 20, 1988

Frank Urabeck
Seattle District
U.S. Army Corps of Engineers
P.O. Box C-3755
Seattle, WA 98124-2255

RE: PSDDA, Phase II Preliminary Finding

This letter is submitted as a follow-up to the Corps public workshop meeting held in Port Angeles on April 27, 1988. The subject of that meeting was preliminary findings for the PSDDA Phase II area.

At the outset I want to emphasize the Port of Port Angeles has strongly supported the overall objectives of the PSDDA effort, which are:

- to provide publicly acceptable guidelines governing environmentally safe, unconfined open water disposal of dredged material;
- to identify acceptable public multi-user unconfined open-water disposal sites;
- to define consistent and objective evaluation procedures for dredged material to be placed at these sites.

We believe it is essential to the economic health of our Port and our community to have available a dredge disposal site in close proximity to the Port Angeles harbor. Both the Port and our local industries have projects on the drawing board which include dredging and which could depend on having available a deep water dredge disposal site. In addition both the Port and the City of Port Angeles have to do maintenance dredging periodically. The City has to dredge the mouths of three creeks emptying into the harbor for flood control purposes. The Port needs to occasionally deepen the small boat launch ramp on Ediz Hook, maintain our log booming area at the mouth of Tumwater Creek, and maintain adequate water depth at our marine terminals. All of these projects could require deep water disposal.

I am encouraged that the Phase II study has consistently included a Port Angeles disposal site to meet the community's future needs. And I am further encouraged that the various studies throughout the Phase II process have shown the Port Angeles disposal site to have no significant adverse effect on either natural resources or human use activities.

Finally, I have been pleased that no special interest groups in our community have opposed a Port Angeles disposal site. Initially, at a meeting primarily for fishermen on March 11, 1987 it appeared there could be some opposition. However, with the movement of the site to the west in the zone of siting feasibility and with a clarification that dredgers from inner Puget Sound would not be transporting dredge material to the Port Angeles site those initial concerns were allayed.

In summary, the Port of Port Angeles has supported the Puget Sound Dredge Disposal Analysis from the beginning, continues to support the study, and hopes for a successful conclusion which will include designation and approval of a Port Angeles deep water dredge disposal site. This will accomplish the study objectives as outlined, enhance the economic viability of dredging projects in the Port Angeles harbor and nearby areas, and at the same time keep the environment clean and healthy.

Sincerely,

PORT OF PORT ANGELES

D. G. Hendricks
Executive Director

DGH:ga

PORT OF BELLINGHAM
Washington State

August 3, 1988

Mr. Frank Urabeck, P.E.
Study Director
Puget Sound Dredge Disposal Analyze
Department of the Army
Seattle District Corps of Engineers
P.O. Box C-3755
Seattle, Washington 98124-2255

Subject: PSDDA Phase II Disposal Sites

Dear Mr. Urabeck:

As we fast approach the final site selection process for the PSDDA Phase II Sites, I would like to emphasize the Port of Bellingham's desire to maintain disposal options in the North Puget Sound area.

Our primary concern in maintaining disposal options in close proximity to our operation stems from the cost savings, in not having to transport dredge material great distances. The proposed Bellingham Bay non-dispersive site provides Bellingham Bay, Swinomish Channel, Fidalgo Bay, Lummi Bay and the San Juan Island areas with a site in relatively close proximity to future projects, both for new development and maintenance of existing projects. It is noted that the only other non-dispersive site currently being considered in North Puget Sound is at Port Gardner some 57 nautical miles from Bellingham Bay assuming a loaded barge can transit Swinomish Channel at high tide.

In suggesting the importance of having a site in close proximity to a project, we recognize the potential impact of these sites on the biological/fisheries community in and surrounding the disposal areas and the resultant effect this may have on those who make their livelihood from the various fisheries. It would be our hope that those who depend on Puget Sound for their livelihood, including those who regulate same, take an objective look at quality and technical expertise which has been put into the PSDDA process to date. No process is infallible and some irreversible impacts may in fact occur in the immediate vicinity of a dump zone. We must defer to the wide and varied technical expertise of the various PSDDA work groups as to how and to what extent these impacts will be.

COMMISSIONERS
I. B. ASMUNDSON KENNETH McAULAY PETER ZUANICH
ADMINISTRATIVE OFFICES
625 Cornwall Avenue P.O. Box 1737 Bellingham, Washington 98227-1737
(206) 676-2500 County 398-2600 SCAN 136-2025 TELEX 882806 FAX 206-671-6411

We do feel that perhaps the quantities of dredged material have been overstated in some instances and that the frequency of dumping may be such that the sites are not impacted to the degree as originally envisioned. We understand that clumping of dredged material and possible obstructing objects such as logs, etc., which may likely foul nets, might be concerns of fishermen. It is our opinion that the regulatory agency(s) supervising these sites can and should implement specific disposal criteria such as scheduling etc., thus leading to an effective program of specific site management for any given location.

The Port of Bellingham through our ownership and lessees represent sole ownership along the I & J, Squalicum and a portion of the Whatcom Waterways served by Bellingham Bay. In addition, we are the sole operator of the 1700 vessel Squalicum Marina in Bellingham and the 400 vessel Blaine Marina.

It is imperative that we provide our tenants along the indicated waterway and facilities with projects at reasonable cost. It is ironic that the fishing industry is situated on both sides of this fence, in fact they depend on the Bay for their livelihood and also depend on the waterways to bring their commodity to market and the mooring of their vessels in our marinas. It is therefore very important to seek a balance in providing projects at least cost and without serious adverse environmental impacts.

We feel that the PSDDA group has made excellent progress to date. We are fully supportive of the dredging study and are looking forward to an early completion of the Phase II work.

Do not hesitate in contacting our staff, if we can be of any assistance in the closing phases of the study.

Sincerely,

Donald C. Fleming
Executive Director

DCF/en

P.O. Box 1180

PORT OF PORT TOWNSEND

2539 Washington Street Port Townsend, Washington 98368 Phone. (206) 385-2355 Seattle. 464-7207 SCAN. 576-7207

June 28, 1988

Mr. Frank Urabeck
Seattle District
U.S. Army Corps. of Engineers
P.O. Box C-3755
Seattle, Washington 98124-2255

Mr. Urabeck,

We have reviewed the Phase II Preliminary Findings of the Puget Sound Dredged Disposal Analysis. We are very supportive of the program as it is developing.

As you may be aware, the Port of Port Townsend adopted its comprehensive plan in 1982 which calls for doubling the size of our present marina. As a small port with limited capital resources, it is important that a deep water deposal site be located relatively close to Jefferson County. Therefore, we are very pleased that you have located two sites within the Straights of Juan de Fuca that meet your standards and our requirements.

The Port of Port Townsend wishes to be on record supporting the preferred site and or its alternate site located in Jefferson County.

Sincerely,

George B. Yount

George B. Yount
Manger

cc. The Commission
GBY/rb

Kendall

cc: TSC
Jamison - DNR
Phillips - Ecology
Malek - EPA
Wake...

PORT OF
ANACORTES
PO BOX 297 / ANACORTES, WASHINGTON 98221-0297 U.S.A / TELEPHONE (206) 293-3134 / FAX (206) 293-9608

June 20, 1988

Frank Urabeck
Army Corps of Engineers
Seattle District
4735 East Marginal Way South
Seattle, WA 98134

Dear Mr. Urabeck:

The Port of Anacortes has, since its inception, regarded the ability to dredge its waterways as a necessary and essential function. The Ports' property is primarily located adjacent to navigable waters and the majority of its operations are directly related and dependent upon water uses.

With the Ports main centers of operations related to water activities the majority of its income is derived directly from these centers. The Port of Anacortes maintains two deep water berths which represent an integral part of the Marine Terminal operations. These berths with their associated piers provide shipping facilities for lumber, logs, petroleum coke and sulfur. The Port also operates Cap Sante Boat Haven which is a public marina and provides approximately 1000 moorage slips for both pleasure and commercial craft. Additionally, the marina offers upland support facilities for the benefit of the water dependent vessels.

On a regular basis the Port is required to dredge material from these facilities either to maintain a safe operating area or to invest in additional facilities by dredging in new areas. The benefits (the majority of the ports income) for providing and maintaining adequate water depths for water borne commerce and recreational boating dictates the continuous effort of the Port to provide these facilities at the lowest possible cost.

Dredging projects can be broken into two basic parts. The actual dredging of material being first and the physical disposal of this material being the other. The cost of dredging material can generally be determined by quality and quantity of the materials. The disposal of the material however, poses a more complex problem. Will the dredged material be permitted disposal in-water or will it be at an upland site? What will be the restrictions for each site? One extremely important aspect is the distance the disposal site is located from the projects' location.

When it has been permissible, the Port of Anacortes has for several years, disposed of its dredge material in-water at the site that is now being designated as the Rosario Strait Site. This particular location, because of its proximity to the Port, allows us in-water disposal at relatively economical costs. Without the ability to use this specific location the Port would very likely incur significantly higher disposal costs, which would have to be passed on to all of the users as well the public in general.

We at the Port of Anacortes strongly support and urge that an in-water disposal location be maintained at the Rosario Site.

Please contact me or any member of our staff if any further information is required regarding this most important issue.

Sincerely,

James G. Miller
Director of Marketing & Development

Port Angeles Salmon Club

Sponsors of the ANNUAL PORT ANGELES SALMON DERBY

Post Office Box 830

PORT ANGELES, WASHINGTON 98362

August 10 1988

Frank Urabeck
Seattle District
U.S. Army Corps of Engineers
P.O. Box C-3755
Seattle, WA 98124

RE: PSDDA Phase 11 Preliminary Finding:

The Port Angeles Salmon Club, a non profit organization, leases a portion of Ediz Hook from the City of Port Angeles for the purpose of conducting an anual Salmon Derby, this Labor Day week end will be our fifty first Derby.

In addition to the Salmon Club Derby, the premises are used thruout the summer months by countless fishermen from around the Northwest. Derbies are also sponsored by Fraternal orders, Labor organizations, American Legion, Handicapped or special People groups and others.

As lease holder it is our obligation to maintain the premises including the small boat launch ramp. At the present time their is need for some dredging to allow use during low tides.

Therefore we support the position of the Port of Port Angeles in their request for an open water disposal site for dredged material.

Sincerely,

Port Angeles Salmon Club

Paul Mygind

Paul Mygind
President

CC: TSC
Dave Kendall
Steve Tilley
John Wilcom
Keith Phillips
John Malek

R Feb 9, 1[illegible]

Inner Sound Crab Association

Dirk Visser, President
1776 Emerald Lake Way, Bellingham, 98226

Mr. Frank Urabek
U. S. Army Corps of Engineers
Seattle District Engineering Dept.
P. O. Box C 3755
Seattle, WA 98124-2255

Dear Mr. Urabek,

The executive board of the Inner Sound Crab Association was pleased to recently learn that the proposed disposal site for dredged material near Blaine in the Strait of Georgia has been dropped from further consideration.

We felt that your presentation of the proposal last spring and the discussions which developed were very instructive for all groups concerned, the public media included. In listing the public comments received as a major factor in the decision you have made an incremental, but significant, step toward building credibility and cooperation among all concerned citizens and industries. We all share the common goal and responsibility of making Puget Sound the best place it can be.

With our concurrence in your decision to abandon the deep water dispersive strategy at this location, we must include a continuing cautionary note: We remain fundamentally opposed to the idea of underwater disposal unless it is approached from the point of view of repair to toxic or marginal zones. Studies indicating damaged areas must be carried out so that relatively clean fill can be used in a revitalizing and enhancement sense. We feel dredged sediments are often overlooked as potential value for upland uses, and that they are an obvious liability for the marine ecosystem and food chain unless handled with systematic knowledge and precision. A particularly valuable specific marine use is the clean sediment "cap" which can be used to contain an existing troubled area.

Until these views become more firmly established in the dredging industry, upland construction industry, the regulatory agencies, and society as a whole, we will continue to express ideas suggesting the long-term benefits of integrative, restorative, management.

All of us are caught in the balancing act of getting the job done and making it pay. The trick, as we do it, is to make things a little better for the next time around. This is a tough one, but it's the big one.

Once again, we applaud not only the decision regarding the Strait of Georgia site, but perhaps even more importantly, the responsible orientation which we have found evident in working with your agency on this challenge.

- - for the resource, and what it means ...

Dirk Visser

Dirk Visser

DV/jc

cc: Al Swift - U. S. Congress
Booth Gardner - Governor
Pete Kremen - Rep 42nd Dist
Ann Anderson - State Senate
Dr. Fran Solomon - Dept of Ecology, Bellingham Work Group
Joe Blum - Director, Dept of Fisheries
Leo Mullen - Bellingham Herald
John Hesburg - Seattle P-I

EXHIBIT E

Total and Indian Fisheries Harvests from
Selected Puget Sound Areas, 1985-1987 Annual Averages

TOTAL HARVESTS OF FISH AND FINFISH, 1985-7 AVERAGE, POUNDS ROUND WEIGHT
Source Washington Department of Fisheries Statistics Division

SPECIES	Gulf of Georgia	Bellingham Bay	San Juan Islands	Strait of Juan de Fuca	Discovery Area	South Sound
CHINOOK	174,732	1,167,492	259,561	3,179	0	2,493
CHUM	541,981	588,379	375,749	435	0	5,015
PINK	2,184,147	9,606	6,529,060	33,827	0	290
COHO	260,427	821,382	395,909	4,083	0	25,037
SOCKEYE	5,538,227	39,801	8,821,336	68,767	0	0
STURGEON	81	80	35	40	7	9
SMELT	765	111	37	874	200	1,956
HALIBUT	51	20	1,558	4,412	76	0
GEN SOLE	21	0	0	0	0	0
BUTTER SOLE	401	872	8	0	0	0
DOVER SOLE	23,646	76	117	1,086	332	35
ENGLISH SOLE	389,545	6,196	2,230	12,011	5,231	16,751
PETRALE SOLE	222	0	0	47	1	0
REX SOLE	158	0	0	9	0	0
ROCK SOLE	44,734	2,572	326,554	3,298	15,161	542
SAND SOLE	26,326	4,672	246	912	484	223
SAND DABS	0	0	0	49	0	0
STRY FLNDR	227,031	38,478	4,258	4,074	2,093	1,509
ARRWTH FLNDR	5,302	0	0	1,767	0	0
MISC	0	0	0	0	0	0
HERRING	64,337	0	6,435	0	0	534,010
SABLEFISH	4,626	2	43	1,465	50	1
LINGCOD	136,163	743	1,349	5,141	548	24
PACIFIC COD	1,219,718	7,922	2,836	192,253	113,414	827
POLLOCK	42,504	134	177	1,454	0	0
WHITING	18,447	0	0	0	0	0
ROCKFISH	12,934	497	842	10,378	4,567	7,436
BLUE SEAPERC	191	38	0	0	30	1,376
PILE PERCH	94	415	0	211	487	7,436
SCULPIN	0	0	24	73	104	0
GEN SHARK	1,597	0	157	0	0	222
DOGFISH	1,217,976	9,180	134,505	76,159	57,198	21,645
SOUPFIN SHRK	100	142	0	0	0	0
SKATE	109,309	5,457	687	15,559	0	552
BUTTER CLAMS	92	633	25	0	2,310	0
LN CLAMS	16,878	46,447	308	0	24,744	147
HORSE CLAMS	0	301	0	0	0	0
MANILA CLAMS	78,829	20,609	6,795	0	3,157	350
GEODUC CLAMS	0	0	0	0	0	1,341,183
SOFTSHL CLAM	0	7,508	0	0	0	0
MUSSELS	0	0	6,844	0	0	0
PAC OYSTERS	0	60	27,068	0	1,893	154,586
OTHER OYSTER	0	0	3,247	0	0	0
SCALLOPS	0	0	12,312	0	56	0
OCTOPUS	13,947	137	14	695	8,168	3,907
SQUID	5,570	23	34	0	30	81
DUNG CRABS	762,953	235,879	109,837	3,265	77,843	1,069
ROCK CRABS	0	0	0	0	77	40
CN STRP SHRM	115	0	32,914	80	988	0
SD STRP SHRM	0	0	160	0	0	0
SPOT SHRMP	0	0	8,643	300	2,976	0
PINK SHRMP	0	0	9,223	7	4,957	0
SEA CUKMBR	29,961	700	101,929	9,041	43,289	13,808
SEA URCHN RD	4,546	1,973	300,379	1,084,946	4,430	0
SEA URCHN GR	811	0	47,424	2,517	1,795	0
TOTAL	13,159,495	3,018,535	17,530,872	1,542,416	391,202	2,142,668

INDIAN HARVESTS OF FINFISH AND SHELLFISH, 1985-7 ANNUAL AVERAGE, POUNDS
Source: Washington Department of Fisheries, Statistics Division

	Gulf of Georgia	Bellingham Bay	Port Angeles	Discovery Bay Area	Nisqually Area
CHINOOK	61,784	600,533	4,132	343	[illegible]
CHUM	181,868	245,606	351	0	[illegible],809
PINK	715,486	4,093	6,048	[illegible]	293
COHO	99,111	435,768	1,182	0	25,034
SOCKEYE	2,410,064	11,892	9,678	[illegible]	[illegible]
STEELHEAD	565	2,236	79	[illegible]	[illegible]
W STGN	0	0	40	[illegible]	0
GR STGN	8[illegible]	27	0	0	[illegible]
HERRING	43,404	0	0	0	0
HALIBUT	518	20	1,435	4	0
DOVER SOLE	3	0	0	0	0
ENG SOLE	1,261	278	10	187	0
REX SOLE	148	0	0	0	0
ROCK SOLE	66	0	48	435	0
SAND SOLE	0	0	333	3	0
STRY FLDR	4	90	26	[illegible]	0
ARWTH FLDR	0	0	13	[illegible]	0
LING COD	58	7	433	0	0
POLLOCK	939	33	0	[illegible]	[illegible]
PAC COD	10,334	804	1,602	15,045	0
ROCKFISH	87	3	314	86	149
BLUE PERCH	183	0	0	0	78
SEA PERCH	0	0	0	0	67
SCULPIN	0	0	49	[illegible]	0
DOGFISH	10,649	3,313	261	1,079	0
SKATE	128	55	19	65	55
BUTTER CLAM	0	633	0	8	0
COCKLE	0	0	0	3	0
HORSE CLAMS	0	301	0	[illegible]	0
LN CLAM	4,311	46,478	16	14,982	147
MANILA CLAM	357	8,608	0	21.259	27
PAC OYSTER	29	60	0	[illegible]	0
OCTOPUS	27	65	49	0	0
SQUID	0	13	2	0	0
CRAB	65,029	118,502	0	[illegible]	6
EEL EGGS	2	16	13	0	0
ROE ON KELP	5,048	5,048	0	0	0
TOTAL	3,611,534	1,484,483	26,332	55.752	[illegible]

EXHIBIT F

INDIAN COORDINATION AND CONSULTATION
FOR THE PHASE II PSDDA STUDY

Indian Coordination and Consultation

Purpose: Some of the letters of comment received on the DEIS and listed in Exhibit C which indicated that there was insufficient evidence of coordination and consultation with affected tribes. This exhibit is presented and text has been modified in the FEIS to include and answer concerns expressed by Indian tribes. Specific responses to tribal concerns are included in Exhibit C.

During the PSDDA study, considerable efforts were made to assure tribal participation and understanding of the nature of the PSDDA study, and that tribal concerns were heard and addressed. The following broadly describes these elements.

Scoping and Mailings of Newsletters. Affected tribes and their representative organizations (such as Point No Point Treaty Council and the Northwest Indian Fisheries Commission) which fish in the Phase I and II areas received scoping notices, the PSDDA newsletter, copies of draft and final documents for Phase I and draft documents for Phase II, and notices of public meetings. These include:

Tulalip Tribes	Nisqually Tribe
Muckleshoot Tribe	Squaxin Island Tribe
Puyallup Tribe	Jamestown Tribe
Suquamish Tribe	Port Gamble Tribe
Yakima Tribe	Lower Elwha Klallam
Lummi Tribe	Port Gamble Klallam
Swinomish Tribe	Stillicum Tribe
Duwamish Tribe	Nooksack Tribe
Samish Tribe	Skykomish Tribe
Snohomish Tribe	Snoqualmie Tribe

Work Groups and Other Forums. The PSDDA study is organized into special-interest work groups dealing with aspects of the large and complex study. The Disposal Site Selection Work Group (DSWG), which considered all aspects of site selection studies and discussed results of site-specific studies, was attended by representatives of the Lummi, Muckleshoot, Squaxin Island and Tulalip tribes, who received mailings of meeting minutes and the Phase I and II Disposal Site Selection Technical Appendices. The Evaluation Procedures Work Group (EPWG), which developed procedures and guidelines for assessing the quality of dredged material and delineating which materials are acceptable for unconfined, open-water disposal. EPWG was attended by representatives of the Northwest Indian Fisheries Commission, Squaxin Island, Muckleshoot, and Tulalip Tribes, who received mailings of meeting minutes and the Evaluation Procedures Technical Appendix. The Management Plan Work Group (MPWG) had the responsibility for development of management plans for use of each unconfined, open-water site. MPWG invited members of the tribes to participate, but there was no participation that occurred. The Phase I Management Plan Technical Appendix and the Phase II, draft and final Management Plan Reports (which contain the site management plans for the Phase II area) were distributed to the tribes. The first annual PSDDA Annual Review Meeting on February 15, 1989, was also attended by a tribal representative. The Puget Sound Water Quality Authority meetings at which PSDDA dredged material management plans were discussed were also attended by tribal representatives.

Meetings and Correspondence. This provides a brief record of important contacts on specific PSDDA-related issues that have occurred. (While some of these meetings included Phase I tribes, the focus is on Phase II area tribes.)

Puyallup Tribe:

- September 7, 1989 meeting with Tom Deming, Tribal Biologist; Bill Sullivan, Environmental Director; and Russ Hanley, Tribal Biologist. Discussions included Phase II actions, Indian concerns, and points-of-contact for staff and 404 permit public notice mailings.

- Meeting on September 24, 1986 with all Phase I area tribes, attended by Tom Deming, Tribal Biologist for Puyallup Tribe; Paul Hickey, Tribal Biologist, Muckleshoot Tribe; Dee Ann Kirkpatrick, Tribal Biologist, Suquamish Tribe; and Daryl Williams, Tulalip Tribe. Discussions included a number of Phase I and some Phase II issues and comments on the impact analysis in Phase I EIS.

- Letter of September 17, 1986, relating to meeting of September 24, 1986

Lummi Tribe:

- September 1, 1989 meeting with Larry Kinley, Tribal Chairman, to discuss concerns raised in comment letters on DEIS.

- August 4, 1989 telephone call to Merle Jefferson, Director, Lummi Indian Fisheries. Mr. Jefferson indicated that the Tribal Council had decided that the request to interview tribal crab fisheremen (see below) was denied.

- Letter dated July 12, 1989 to Merle Jefferson, Director, Lummi Indian Fisheries. Letter contained questions for interviews with tribal fishermen on Bellingham Bay crab harvests and request tribal approval for conducting interviews.

- June 5, 1989 telephone call to Merle Jefferson, Director, Lummi Indian Fisheries, and Mike McKay, Tribal Biologist. Discussions included tribal concerns and PSDDA representatives asked whether, in the absence of any Indian harvest data for crab that was specific to the Bellingham Bay site, interviews with Lummi tribal shellfishermen might be made.

- Letter dated July 19, 1989 to Merle Jefferson, Assistant Director, Lummi Indian Fisheries. Letter responded to concerns raised about the selection of a site in Bellingham Bay, and questions the Tribe raised about the adequacy of resource studies performed.

- Meeting with Tribe, January 31, 1989. Discussions included tribal concerns and the relationship of the PSDDA site to the Lummi Marina proposal.

- Correspondence dated July 19, 1988, with Mike McKay, Tribal Biologist. Letter transmitted Washington Department of Fisheries letter concerning Bellingham Bay site.

Nisqually Tribe:

- August 29, 1989, telephone call to George Walter, Environmental Coordinator, Nisqually Tribe. Call was made to request a meeting to discuss tribal concerns about PSDDA; Mr. Walter indicated that the Bureau of Indian Affairs should provide review of PSDDA reports, and the Tribe had no official position on PSDDA.

Squaxin Island Tribe:

- July 14, 1987 meeting and mailings. Discussions included EIS alternatives, chronic sublethal testing, joint management of fisheries by tribes and Washington Department of Fisheries.

- Call on March 26, 1987, regarding Squaxin Island Tribe's concerns.

Bureau of Indian Affairs:

- Telephone call to Dan Thayer, August 21, 1989. Call to get input on the accuracy of the memorandum of the call of July 26, 1989. Mr. Thayer suggested some additional language.

- Telephone call to Dan Thayer, July 26, 1989. Call to discuss the issues raised in the Fish and Wildlife Service/Bureau of Indian Affairs comment letter (see Exhibit C). Mr. Thayer provided the names of contact persons at the Puyallup and Nisqually Tribes, and PSDDA representatives agreed to consult with the tribes. Mr. Thayer indicated that BIA wishes clarification of consultation in the FEIS, and that comments made in the BIA letter represent comments received from the tribes.