Yaquina Bay
Interim Ocean Dredged Material Disposal Site Evaluation Study

US Army Corps
of Engineers
Portland District

FINAL

April 1985

SYLLABUS

The report was prepared for compliance with the Marine Protection, Research, and Sanctuaries Act of 1972, as amended, and subsequent rules put forth in 40 CFR, Parts 220-229. Parts 228.5 and 228.6 lists general and specific requirements for designating ocean disposal sites to receive materials approved for ocean disposal under Part 227 of the rules. This report addresses these requirements for designating a disposal site to receive dredged materials from either Department of Army permit activities or federally authorized actions.

A joint task force of Environmental Protection Agency and Corps of Engineers personnel, was established to prepare a procedures manual for evaluating disposal sites. The manual was to be based on the above rules and experience to date by field offices of both agencies. A draft workbook was prepared in October 1983 and is entitled, "Technical Guidance for the Designation of Ocean Dredged Material Disposal Sites." Prior to preparation of the final version, it was desired by the task force to try the procedures in the field. The Yaquina Bay interim ocean disposal site was selected as a pilot study for this purpose. Portland District, Corps of Engineers, used the draft workbook along with experience gained from designating a site at Coos Bay, Oregon, to prepare the following ocean dredged material disposal site evaluation study.

The evaluation studies documented in this report will be appended to the final version of the workbook. The report will also be submitted to Environmental Protection Agency, with a request that they utilize it in their formal rulemaking process for final designation of the Yaquina Bay interim ocean disposal site.

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PURPOSE AND NEED

1. Purpose. The purpose of this evaluation study is to determine if the existing interim ocean dredged material disposal site (ODMDS) at Yaquina Bay, Oregon, designated by Environmental Protection Agency in 40 CFR 228.12 fully meets all criteria and factors set forth in Parts 228.5 and 228.6 of Title 40 CFR. These regulations were promulgated in accordance with criteria set out in Sections 102 and 103 of the Marine Protection, Research, and Sanctuaries Act (MPRSA) of 1972. The report will make full use of existing information to discuss various criteria and will collect new field data only when necessary to address a critical resource of limited distribution. This approval encompasses a secondary purpose of this report, to attempt to designate an ocean disposal site utilizing procedures developed by a joint task force of Environmental Protection Agency (EPA) and Corps personnel, while addressing the requirements of 40 CFR 220-229. The task force prepared a draft workbook entitled, "General Approach to Designation Studies For Ocean Dredged Material Disposal Sites, May 1984." This report is the pilot attempt at using these evaluation procedures. If accepted, the procedures will greatly reduce the costs associated with designating interim and new ocean dredged material disposal sites. Use of site would be for disposal of material dredged for operation and maintenance of the federally authorized navigation project at Yaquina Bay, Oregon, and for disposal of dredged material from other dredging projects authorized in accordance with Section 103 of the MPRSA.

2. Need. The interim ODMDS is a necessary part of the maintenance of the authorized project. No other environmentally or economically feasible estuary or upland disposal sites are now approved for use or are likely to be in the future. The Yaquina Bay project was authorized for the following purposes:

a. Decrease waiting times for vessels crossing the bar;

b. Allow deep-draft shipping access to Yaquina Bay;

c. Provide mooring facilities for small boats which take advantage of project facilities;

d. Permit barge and small boat traffic upstream to river mile 14;

e. Provide a harbor of refuge.

Consequently, maintenance of the navigation channel to authorized depths is critical to keeping the harbor open and sustaining these vital components of the state and local economy.

3. The frequency of maintenance dredging depends upon the volume of sediments transported into the estuary and the frequency and severity of storm conditions. An average annual volume of dredged material for the last 10 years has been 600,000 cubic yards from the entrance bar and channel and about 40,000 cubic yards from the turning basin. The need for the ocean disposal site will continue for the foreseeable future, as it is an integral part of maintaining the channels to authorized depths. Use of this interim disposal site has been essential to the Corps' ability to carry out its statutory responsibilities for maintaining navigable waterways, as no in-bay disposal sites are available in the lower 3 miles of the project. To continue these responsibilities, it is essential that environmentally acceptable ocean disposal sites be identified, evaluated, and permanently designated for continued use.

INTRODUCTION

4. General. Yaquina River enters the Pacific Ocean near the city of Newport, Oregon, approximately 115 miles south of the Columbia River (see figure 1). Yaquina Bay is the fourth largest estuary in Oregon. The estuary is fed mainly by Yaquina River, which drains 253 square miles and is 58.8 miles from its mouth to headwaters.

5. The Portland District, Corps of Engineers has been responsible for maintenance of navigable waterways of the North Pacific Coast since 1871. The need for improved navigation controls in Yaquina Bay estuary began with the founding of a port city at Yaquina. Because of the navigation need, two rubblemound jetties were constructed in 1896, and Congress authorized dredging

Figure 1. General Location of Yaquina Bay

in the bay in 1919. The presently authorized project includes jetties, groins, and river channel outside the scope of the present study. Portions of the authorized project considered in this report are:

a. An entrance channel 40 feet deep and 400 feet wide, and approximately 3,000 feet long.

b. A channel 30 feet deep and 300 feet wide from the inner end of the entrance channel to McLean Point, including a turning basin 30 feet deep, 900 to 1,200 feet wide, and 1,400 feet long.

6. The frequency of maintenance dredging depends upon the volume of sediments transported into the estuary and the frequency and severity of storm conditions. Future predictions are for a yearly dredging of about 600,000 cubic yards from the entrance bar and channel and about 40,000 cubic yards from the turning basin.

7. These dredged materials are disposed of in the EPA interim approved ODMDS. The site was designated interim in 40 CFR 228.12. It was entitled, Yaquina Bay and Harbor Entrance and given the following coordinates: 44°36'31"N, 124°06'04"W; 44°36'31"N, 124°05'16"W; 44°36'17"N, 124°05'16"W; 44°36'17"N, 124°06'04"W. Figure 1 shows the approximate location of this site, 1.3 statute miles southwest of river mile 0, starting in about 50 feet of water. The site is the subject of this evaluation study to determine its feasibility for final EPA ocean disposal site designation.

8. Background. Prior to the interim ODMDS receiving this designation in 1977, it had been used by Portland District. The designations in 1977 were an attempt by EPA to document and establish coordinates for historically used Corps of Engineers disposal sites. Interim designations were to lead to final designations or termination of their use, within 3 years of the interim designation. Since the 3-year period ended in 1980, extensions have been approved for continuing interim use of the sites, pending completion of required studies for final designation. This study will report on these requirements and request final site designation for the interim site, from EPA.

9. The interim site, or areas in the same vicinity, have been used by Portland District since 1916 when the U.S. hopper dredge COL PS MICHIE conducted trial disposal operations at Yaquina Bay to determine the feasibility of keeping the bar open year around. These trials led to project authorization in 1919. Since that time, the majority of the dredged material has been disposed of at the general location of the interim site. From old Annual Reports to the Chief of Engineers it is estimated that approximately 200,000 cubic yards a year were dredged from the project from 1919 to 1968 when the project was deepened to its present depth. Since that time, approximately 460,000 cubic yards a year have been disposed of in the vicinity of the interim site. Appendix B, table B-2 presents the last 10 years of dredging records.

10. Procedures for Evaluation. Since publishing the 11 January 1977 Federal Register requiring evaluation studies, several have been completed. All were expensive and required extensive field work. The concern that evaluations were taking too long and costing too much prompted EPA and the Corps to form a joint task force to examine the problem. This task force consisted of policy and field level personnel from both agencies. The task force met in September 1983 and prepared a draft procedures manual. This draft manual was published in October 1983 and recommended utilizing existing information to the extent possible. The workbook was developed to provide a general technical framework and guidance for the identification, evaluation, and designation of ocean dredged material disposal sites.

11. The site designation process was structured into three major phases in the workbook (figure 2). Phase I included delineation of the general area being considered for site designation and identification and collection of necessary information on resources, uses and environmental processes for the area. Phase II involved identification of candidate sites within the area based on information collected and processed in Phase I. The final Phase III was the evaluation of candidate sites and the selection of a site or sites for designation.

12. In Phase I, the geographic area of consideration must first be defined. Reasonable distance of haul is the determining factor and will be affected by such considerations as available dredging equipment, energy use constraints,

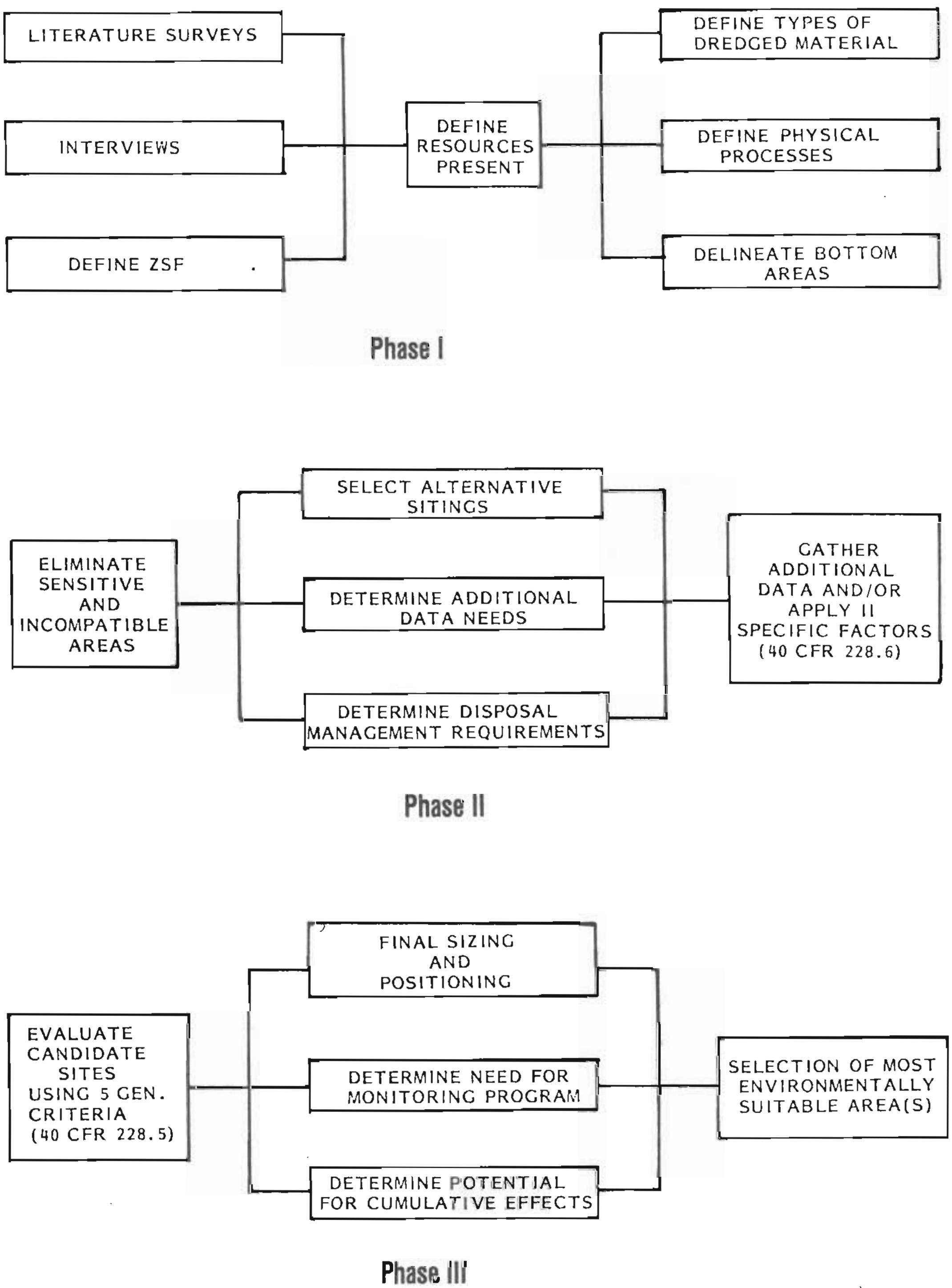


Figure 2. Overall process for ocean dredged material disposal site evaluation, as detailed in joint EPA/Corps Task Force Report. "Technical Guidance for the Designation of Ocean Dredged Material Disposal Sites," Oct 83.

costs, and safety considerations. Then, within this delineated area of interest, a preliminary screening process, based on available data, is applied to identify and map reach boundaries for sensitive resources as well as zones of incompatibility. Such areas may include clustered areas of special fisheries and shellfisheries value, navigation lanes, beaches and marine sanctuaries.

13. Upon completion of the preliminary screening, additional screening should be conducted, based on the general type of expected dredged material and a general knowledge of physical processes. This screening should delineate bottom areas that may be incompatible with anticipated sediments to be disposed, such as silt on sand. In addition, the secondary screening should insure establishment of appropriate disposal buffers around each such identified sensitive or incompatible use area.

14. Except in rare cases, the preliminary and secondary screening will have eliminated sensitive and incompatible areas from further consideration. The remaining areas may be considered as candidate areas for location of an ocean dredged material disposal site or sites. At this point, the selection of alternative sites for further evaluation becomes a matter of informed judgment.

15. During Phase II, fundamental issues are resolved and a determination made of additional data requirements. Candidate sites are identified for further evaluation considering their environmental and other aspects such as disposal management requirements. Phase II is considered completed when adequate data and information are available to address the 11 specific factors (40 CFR 228.6, see table 1) for each site under consideration. If additional data are required, steps should be initiated immediately to obtain the necessary information.

16. Phase III consists of evaluation of candidate sites and the selection of site(s) for designation. The environmental suitability of each alternative site for designation as an ODMDS will be determined. Necessary evaluations are to be based on 40 CFR 228.6, "Specific Criteria for Site Selection" of the EPA Ocean Dumping Regulations and Criteria.

TABLE 1

ELEVEN SPECIFIC FACTORS FOR OCEAN DISPOSAL SITE SELECTION (40 CFR 228.6)

1. Geographical position, depth of water, bottom topography, and distance from coast.

2. Location in relation to breeding, spawning, nursery, feeding, or passage areas of living resources in adult or juvenile phases.

3. Location in relation to beaches or other amenity areas.

4. Types and quantities of wastes proposed to be disposed of and proposed methods of release, including methods of packaging the waste, if any.

5. Feasibility of surveillance and monitoring.

6. Dispersal, horizontal transport, and vertical mixing characteristics of the area, including prevailing current velocity, if any.

7. Existence and effects of present or previous discharges and dumping in the area (including cumulative effects).

8. Interference with shipping, fishing, recreation, mineral extraction, desalination, shellfish culture, areas of special scientific importance and other legitimate uses of the ocean.

9. Existing water quality and ecology of the site, as determined by available data or by trend assessment or baseline surveys.

10. Potential for the development or recruitment of nuisance species within the disposal site.

11. Existence at or in close proximity to the site of any significant natural or cultural features of historical importance.

Utilizing evaluations under 228.6, final determination of the environmental suitability of each alternative site will be made in accordance with 228.5 "General Criteria for Selection of Sites" (see table 2).

17. The process outlined above was specifically structured for identification and designation of required new sites for ocean disposal of dredged material. However, with certain exceptions, this process will also apply to designation studies of historically-used dredged material disposal sites which EPA has designated on an interim basis.

18. The primary objective of designation studies for historically-used, interim-designated sites was defined in the workbook to evaluate the suitability of each such site for continued use. Establishment of the initial geographic zone of consideration (Phase I) for this site evaluation study should be based specifically on the existing site location, and estimated zone of potential impact. At the same time the evaluation must consider both existing, as well as anticipated future, disposal requirements for each selected site.

19. If the evaluation indicates that the existing site is environmentally acceptable for continued disposal of dredged material, the site should be the prime candidate for final designation. However, any possible environmental or operational advantages that might be gained by relocation of the site, should be investigated. If there is no substantive environmental or operational advantage to relocating the site, the final designation of the existing interim designated site is recommended.

20. In the event the evaluation using the 11 specific factors and 5 general criteria (tables 1 and 2) shows that the existing site is environmentally unacceptable for continuing use, a search for an alternate site or sites should be initiated. This search would follow the screening and evaluation sequence delineated above for new sites.

21. It was the opinion of the task force that the foregoing process would lead to a determination of the most environmentally acceptable site. It also may indicate that more than one site is environmentally acceptable.

TABLE 2

GENERAL CRITERIA FOR THE SELECTION OF OCEAN DISPOSAL SITES (40 CFR 228.5)

a. The dumping of material into the ocean will be permitted only at sites or in areas selected to minimize the interference of disposal activities with other activities in the marine environment, particularly avoiding areas of existing fisheries or shellfisheries, and regions of heavy commercial or recreational navigation.

b. Locations and boundaries of disposal sites will be chosen so that temporary perturbations in water quality or other environmental conditions during initial mixing caused by disposal operations anywhere within the site can be expected to be reduced to normal ambient seawater levels or to undetectable contaminant concentrations or effects before reaching any beach, shoreline, marine sanctuary, or known geographically limited fishery or shellfishery.

c. If at any time during or after disposal site evaluation studies, it is determined that existing disposal sites presently approved on an interim basis for ocean dumping do not meet criteria for site selection set forth in Section 228.5-228.6, the use of such sites will be terminated as soon as suitable alternative disposal sites can be designated.

d. The sizes of ocean disposal sites will be limited in order to localize for identification and control any immediate adverse impacts and to permit the implementation of effective monitoring and surveillance programs to prevent adverse, long-range impacts. The size, configuration, and location of any disposal site will be determined as a part of the disposal site evaluation or designation study.

e. EPA will, wherever feasible, designate ocean dumping sites beyond the edge of the continental shelf and other such sites that have been historically used.

22. It was realized, however, that prior to finalizing the workbook a pilot study should be attempted utilizing the process. The interim disposal site at Yaquina Bay, Oregon, was selected for this pilot effort. Portland District, Corps of Engineers, and Environmental Protection Agency, Region 10, agreed to work jointly with the task force to conduct an evaluation study. It was the opinion of the task force that Yaquina Bay should have sufficient information available to conduct the evaluation, due to its proximity to the Oregon State University Marine Science Center and Marine Resources Division of Oregon Department of Fish and Wildlife.

23. Format. This report will constitute a site evaluation study, as required in 40 CFR, Parts 228.4(e), 228.5, 228.6, 228.9, and 228.12. The main body of the report addresses specifically all criteria and factors required in Parts 228.5 and 228.6. Technical information used to discuss these criteria and factors are collected in technical appendixes.

24. Procedures used to evaluate criteria and factors as discussed in the preceding section, are those developed in a draft workbook entitled, "Draft Technical Guidance for the Designation of Ocean Dredged Material Disposal Sites," EPA and USACE, October 1983.

SITE SELECTION CRITERIA

General

25. The MPRSA requires that site evaluation be performed prior to final designation for continued use as an ocean disposal site. A site evaluation study is defined in 40 CFR 228.2(c) as:

> "The collection, analysis, and interpretation of all pertinent information available concerning an existing disposal site, including but not limited to, data and information from trend assessment surveys, monitoring surveys, special purpose surveys of other Federal agencies, public data archives, and social and economic studies and records of affected areas."

26. These studies are used to comply with and discuss criteria and factors listed in Parts 228.5 and 228.6. Criteria and factors are listed in tables 1 and 2.

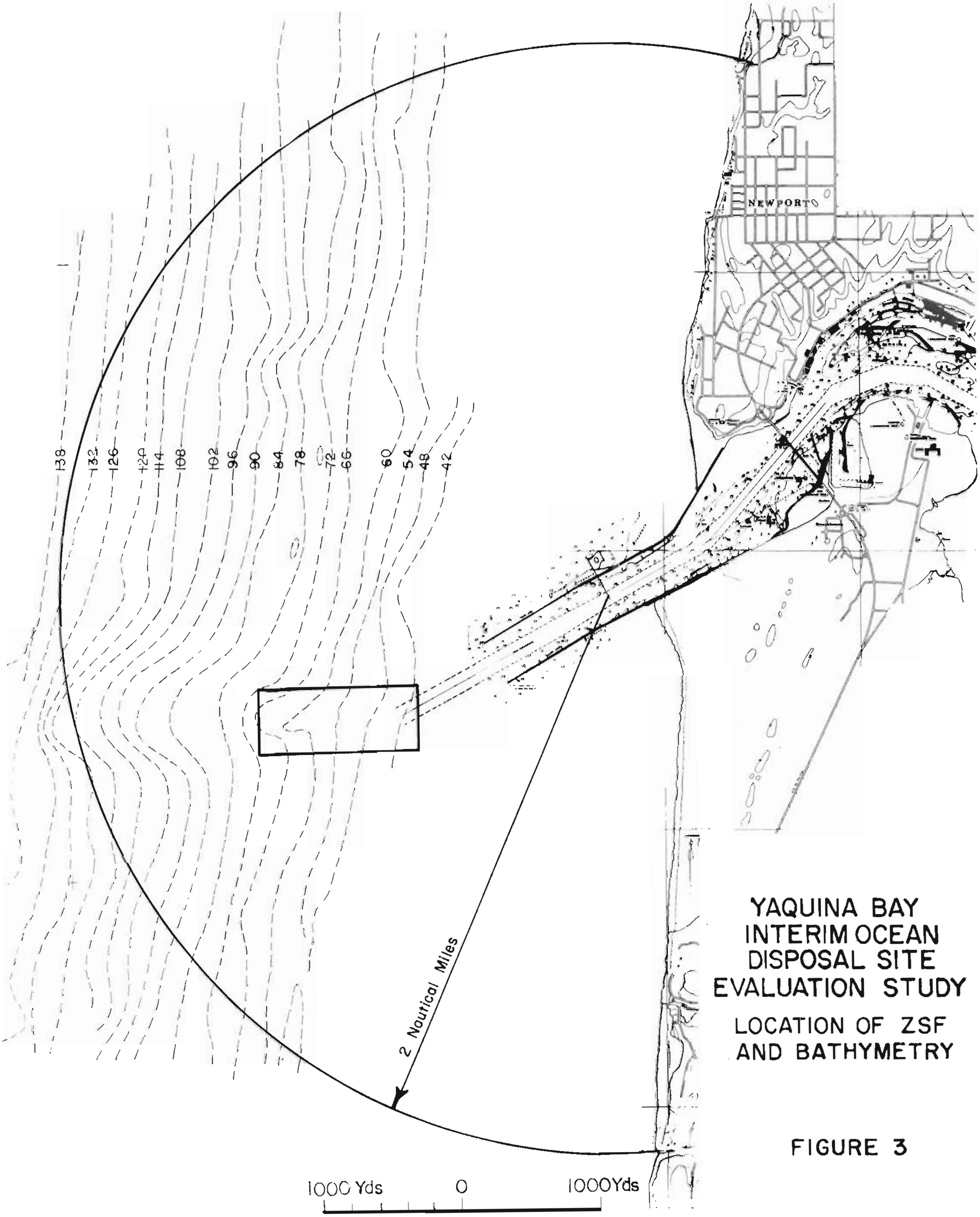
Sites Evaluated

27. The draft workbook and 40 CFR 228 separate evaluations given to new sites versus interim ODMDS. All alternative area sitings for the new ODMDS should be considered. An interim site can, however, be evaluated for continued use without examining other disposal site locations providing all factors and criteria are fully examined. If a discussion of factors demonstrate that the existing site will not have an unacceptable adverse impact upon important resources, it is suitable for continuing use.

28. This approach will be employed for the Yaquina Bay interim ODMDS evaluation. The first item under this approach is to conduct a literature search of existing information. The general bibliography of this search is provided at the back of the report. This bibliography was used as the initial step of all the technical appendixes.

29. Zone of Siting Feasibility (ZSF). The interim disposal site must be located within an economically and operationally feasible radius from the point of dredging. The draft workbook suggests establishing a ZSF. The ZSF at Yaquina Bay was set as an arc transcribed 2 nautical miles out from river mile (RM) 0 and ends both north and south at the beach (see figure 3).

30. The determination of a 2-mile limit is based on the amount of dredging necessary to maintain the channel to the authorized depth, the availability of dredging equipment that can be dedicated to that work, the volume per unit time capability of equipment to dredge and haul the material to the disposal area and the amount of time available annually to accomplish the necessary maintenance dredging.



YAQUINA BAY
INTERIM OCEAN
DISPOSAL SITE
EVALUATION STUDY

LOCATION OF ZSF
AND BATHYMETRY

FIGURE 3

31. Dredging necessary to maintain a 40-foot bar crossing is estimated to be in a range of 600,000 to 700,000 cubic yards per year. That amount of material must be removed during the period May through mid-October. Those time limits are imposed by conditions of the weather and seas during the remaining portions of the year. From mid-October through the spring of the year, a series of storms, generally from the west or southwesterly direction, come into the coastal area bringing large swells ranging from 12 to 28 feet in height. There has not been and is not presently dredging equipment on the West Coast and possibly anywhere in the world capable of operating in those severe conditions. Any one of the 3 to 5 major storms, during the fall and winter months, can shoal the entrance of this bay to less than its authorized depth. However, precipitation brought inland by these storms causes a high level of runoff from the interior drainage, which mitigates the infill problem by creating a scour condition between jetties during ebb tide periods. Shoaling does occur during the period April through September. That shoaling, generally, is not removed by either the tidal exchange or by high flows in the river and, therefore, must be removed by dredging in order to maintain the authorized depths.

32. The limit of the ZSF is controlled by the capability and availability of dredging equipment to remove up to 700,000 cubic yards. Present dredging is accomplished by a combination of Government-owned and privately-owned hopper dredges. In the past 2 years, deep-draft ships have begun to call again at this port and will continue to haul primarily wood products cargo; thus it will be necessary to maintain full project depths. Portland District is limited by policy on the number of days which it can work the Government-owned hopper dredge. Currently, 230 days are authorized, and must be allocated to other ports on the West Coast, as well as Yaquina Bay. Production capability of our dredge at this port is approximately 10,000 cubic yards per day provided the haul distance is not more than 2 miles from the entrance. A disposal area located at a greater distance would reduce the capability of the dredge. Since the Government-owned dredge would remove about 100,000 cubic yards, an estimated 600,000 cubic yard maintenance requirement would be removed by private dredge under contract to the Corps. Availability of that equipment is also limited, and has similar production capabilities to the Government plant.

Analyzing the availability of work on the West Coast and that of contractor dredges capable of dredging this port, it is unlikely that more than two pieces of contractor equipment would be available in any year and often the Corps may find there is no contractor-owned dredge available during the time period imposed by weather and sea conditions. Under current and foreseeable allocation of contractor dredge equipment available for the West Coast, it is highly unlikely that more than 60 days in a single year could be allocated to the maintenance dredging of Yaquina Bay and Harbor. The amount of dredging that could reasonably be expected to be accomplished in the commitment of 60 days is about 600,000 cubic yards. That amount combined with the 10 days of Government dredging would produce in one dredging season the 700,000 cubic yards estimated to be required to maintain the channel to project dimensions. A prerequisite for contractor equipment being able to accomplish the required volume of dredging in the time specified would be a haul distance of not more than 2 miles. Therefore, the outer limit of the ZSF is controlled by the capability of available dredging plant and limited dredging time period imposed by weather and sea conditions on the West Coast.

Overview

33. The determination to continue to use the interim disposal site, or not, will be based on a discussion of each of the 11 specific factor and 5 general criteria given in 40 CFR 228.5 and 228.6 and tables 1 and 2. The discussions on each factor and criteria which follow are general in nature, as they are discussed in detail in the technical appendixes. Each factor is examined and related to how it affects the continued use of the interim disposal site. Following the separate discussions, a comparison of all factors will be made. Resources of limited distribution within the ZSF, or which could be affected outside the ZSF, will be discussed, compared, and mapped to determine potential conflicts with the interim disposal site.

Specific Criteria (228.6)

34. Geographic Location. Figure 3 indicates the location of Yaquina Bay interim ODMDS and bottom contours. The site lies in 50 to 70 feet of water, 1.3 statute miles offshore of the entrance to Yaquina Bay. Coordinates were presented in the Purpose and Need Section of this report. The site's center-line is on a 270 degree azimuth. Appendix B discusses in detail the bottom topography of the site. In general, the interim site sits just outside a neritic reef made up of predominantly eroded basalt, and the site sits on bottom contours sloping at about 60 feet per mile.

35. Distance from Important Living Resources. Aquatic resources of the site are described in detail in Appendix A. The existing disposal site is located in the nearshore area and the overlying waters contain many nearshore pelagic organisms which occur in the water column over the site. These include zooplankton such as copepods, euphausiids, pteropods, chaetognaths and meroplankton (fish, crab and other invertebrate larvae). These organisms generally display seasonal changes in abundance and since they are present over most of the coast and those from Yaquina are not critical to the overall coastal population. Based on evidence from previous zooplankton and larval fish studies it appears that there will not be any impacts to organisms in the water column (Sullivan & Hancock, 1978). The site is also adjacent to the neritic reefs which are described in detail in Appendix A. These reefs are unusual features along the coast and support a variety of aquatic organisms, including the bull kelp (*Nerocystis lutkeana*) and its associated fish and invertebrate community. Recently, the Oregon Department of Fish and Wildlife (ODFW) has begun studying squid resources, and a spawning area offshore of the disposal site has recently been identified.

a. Benthic samples were collected at the locations shown in figure 3 and are discussed in detail in appendix A. Based on the analysis of benthic samples collected from the Yaquina disposal site and the adjacent areas to the north and south, the disposal site contains a benthic fauna characteristic of nearshore sandy wave influenced regions common along the coasts of the Pacific Northwest. The abundance and density of the infaunal were found to be low at the disposal site, typical of shallow nearshore high energy habitats. The faunal is dominated by polychaete annelids (marine worms), small crustaceans (amphipods and cumaceans) and molluscs (clams and snails) and echinoderms (sand dollars).

The particular species identified from Yaquina Bay disposal site are adapted to high energy environments and are able to withstand large sediment fluxes.

b. The disposal site is in an area where concentrations of common murres gulls and other marine foraging species occur. Large concentrations have been observed shoreward of the interim site extending to and within the confines of the Yaquina jetties. Concentrations undoubtedly occur at the site periodically. Concentrations of shorebirds, gulls, waterfowl, and other species occur in the Yaquina estuary or on ocean beaches.

c. Portland District has requested an endangered species listing for the site from U.S. Fish and Wildlife Service (USFWS) and National Marine Fisheries Service (NMFS). The brown pelican and the gray whale represent the only species which were listed. Based on previous biological assessments conducted along the Oregon coast regarding impacts to the brown pelican and the gray whale, no impact to the species is anticipated from the project. Letters of concurrence are included in Appendix F, Comments and Coordination.

36. Distance from Beaches and other Amenities. The existing site begins one mile from South Beach at Newport. The site is less than 1,000 feet seaward of a submerged reef which inhibits onshore sediment movement. Summer wave conditions may transport some sediment from the site shoreward and south, but the limiting depth for this movement is probably -40 to -50 feet mean lower low water (mllw). The majority of disposal material is deeper than -50 feet mllw, so little shoreward transport of dredged material is likely. Due to depth of disposal operations and the south reef, there is little possibility of beach nourishment by natural onshore movement of dredged material from the existing site.

37. Types and Quantities of Material to be Disposed. The interim disposal site will receive dredged materials transported by either Government or private contractor hopper dredges. The current dredges available for use at Yaquina Bay have hopper capacities from 800 to 4,000 cubic yards. This would be the range in volumes of dredged material disposed of in any one dredging/disposal cycle. Upwards of 700,000 cubic yards of material can be placed at the site in one dredging season by any combination of private and Government plant (see discussion under ZSF). The dredges would be under power and moving while disposing. This allows the ship to maintain steerage.

38. The material to be dredged consists of medium to fine grain marine sands (Appendix C, figure C-2). These materials are predominant in the entire project length, RM 0 to 2.8. Appendix C gives results of sediment analysis performed on these materials. The materials are clean sands containing no contaminants of concern in excess levels (tables C-3 through C-6), and would be excluded from further biological and chemical testing as discussed in 40 CFR 227.13(b). The materials are also very similar to bottom materials at the interim disposal site and the entire nearshore area. Appendix B provides grain size information for the disposal area and the dredged area.

39. Feasibility of Surveillance and Monitoring. The proximity of the interim disposal site to shore facilities creates an ideal situation for shore-based monitoring of disposal activities. There is routinely a Coast Guard vessel patrolling the entrance and nearshore areas so surveillance can also be accomplished by surface vessel.

40. If actual field monitoring of the disposal activities is required because of a future concern for a limited resource, several research groups are available in the area to perform any required work. The work could be performed from small surface research vessels at a reasonable cost.

41. Dispersal, Horizontal Transport, and Vertical Mixing Characteristics of the Area. The sediments dredged from the entrance of Yaquina Bay are fine marine sands identical to existing nearshore sediments. Under winter wave conditions common to this part of the Pacific Coast these fine sands are highly mobile to a depth of 90-120 ft. Summer wave conditions commonly

mobilize sands to a depth of 40-60 ft. Studies at Coos Bay (see Appendix D) show wave-generated currents can move this size sediment over 60 percent of the time during summer and winter and over 50 percent of the time during spring and fall. While waves are responsible for resuspending bottom sediment, including dredged material, it is the long-term mean current that determines the extent and direction of dispersal.

42. The nearshore mean circulation is alongshore, closely paralleling the bathymetric contours, with a lesser onshore-offshore component. Circulation patterns are variable with season and weather conditions. In winter the general shelf circulation is to the north although short periods of southerly flow occur. Coos Bay studies suggest that offshore flow is more common in winter. This would indicate a tendency for sediment in the disposal site to move north and west under winter circulation conditions. During the remainder of the year, flow is southerly with lower current velocities than in winter. Periodic changes in summer wind direction cause episodes of upwelling in which offshore near-shore water transport causes a compensating near-bottom onshore flow. These upwelling events continue for several days at a time, and occur between April and July near-bottom flow in the vicinity of the disposal site during summer should be generally southerly with onshore/offshore flow varying due to local wind conditions.

43. <u>Effects of Previous Disposals</u>. Appendix B, table B-2, gives volumes of material disposed of for the last 10 years. On the average, 460,000 cubic yards have been disposed of annually. Future volumes are expected to be 600,000 to 700,000 cubic yards per year because of deeper-draft vessels beginning to use the port. This is well within the 10-year range of disposal which has varied from 81,000 to 996,000 cubic yards (See Appendix B, table B-1). This has been required for the Corps to maintain the channel to its authorized depths (see discussion under ZSF).

44. Detailed offshore bathymetry at Columbia, Siuslaw, and Umpqua rivers, and Tillamook, Yaquina, and Coos bays shows a seaward bulge in bottom contours between about -60 and -120 feet. Figure B-9 in Appendix B shows this feature at Yaquina in October 1983 and in September 1984. Figure B-8 compares 1983 and 1984 bathymetry and shows seasonal sediment movement offshore (shaded) and

dredged material disposal (hatched). The "bulge" is probably related to the combination of river discharge and ebb tide currents creating an "ebb delta" of nearshore material, common in many areas of the world. The 1984 bathymetry clearly shows the affects of disposal as a "mound" roughly conical with a base diameter of 600 to 1,000 feet and about 16 feet high. There is a more detailed discussion of this mound and associated sediment movement in Appendix B. As discussed in Appendix B, several million cubic yards of sand in the ebb-tide delta are unavailable to the nearshore littoral system. Significant onshore or alongshore sediment movement probably does not occur at the depth of the disposal site, and the nearshore reefs prevent sediment movement onshore. Therefore, up to 5 million cubic yards of nearshore sand brought into the navigation channel over the past 10 years may be unavoidably lost to the beach north from the jetties.

45. During the initial literature and information search, no information was found on the site prior to disposal. ODFW biologists (personal communication) indicated that they felt that, beyond the yearly site-specific impacts from disposal, there had been no significant impacts to the resources, and they recommended that the site be left at its present location (see discussion Appendix A).

46. No pre- or post-disposal, water, or sediment quality studies have been performed. Based on information presented in Appendix C, there should be no historical or future chemical impacts on the marine environment surrounding the disposal site. Sediments disposed of are the same as the sample collected in close proximity to the disposal site (Appendix B), and no chemical contaminants are present in higher concentrations in either one (tables C-3 to C-6). The elutriate analysis discussed in Appendix C also showed no contaminants released during this simulated disposal operation with receiving water from the interim disposal site.

47. Interference with Other Uses of the Ocean. This section examines potential interference with other legitimate uses of the ocean.

a. Commercial Fishing. Two existing commercial fisheries occur in the inshore area, salmon trawling and Dungeness crab fishing (Appendix A). The length of the salmon fishing season varies each year depending upon the established quota; however, it normally extends from July to September. During this period, the potential exists for conflicts between the dredge and fishing boats. The Coast Guard and ODFW indicated that they were unaware that this had ever been a problem. The Dungeness crab season is from 1 December to 15 August; however, most of the fishing is done prior to June and usually ends early because of the increase in soft shell crabs in the catch which are not marketable. As a result, most crab fishing is done outside of the normal dredging season and it is unlikely that a conflict would result. ODFW has identified a potential squid fishery (see Appendix A) offshore from the existing site. No fishery exists at present, but stocks may be sufficient to support a fishery if a market develops. There are no commercial fish or shellfish aquaculture operations that would currently be impacted by use of the existing disposal site.

b. Recreational Fishing. Both private party and charterboat recreational fishing for both salmon and rock and reef fish occur in the inshore area off Yaquina River. The salmon fishing season coincides with the commercial season and extends from the summer until the quota for the area is reached. As indicated in Appendix A, most of this occurs along the south reef because of navigational hazards on the north reef. Recreational fishing boats have a potential for conflicting with dredging operations; however, none has been reported to date. It is unlikely that any significant conflict will develop in the near future (personal communication with U.S. Coast Guard).

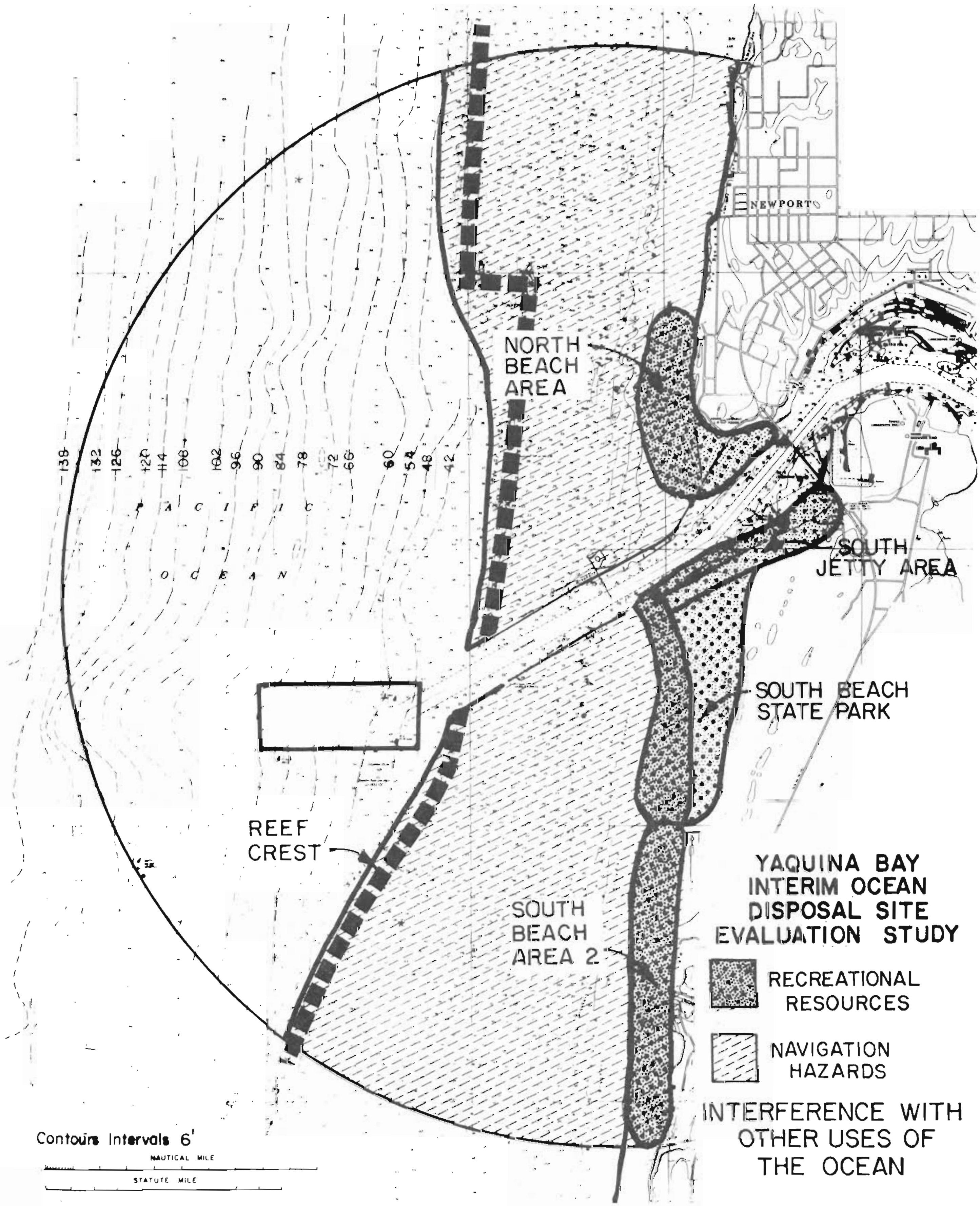
c. Offshore Mining Operations. All considerations for offshore mining and oil/gas leases are in the development stages. The disposal site is not expected to interfere with any of the proposed operations, as most exploration programs are scheduled for the outer continental shelf.

d. Navigation. No conflicts with commercial navigation traffic have been recorded in the more than 60-year history of hopper dredging activity. The probable reason for this is the light commercial traffic at Yaquina Bay.

Interviews with key Coast Guard personnel from the Newport Station also did not produce any observations of conflicts with either commercial or recreational traffic. Navigation hazards do exist within the ZSF and should be avoided when considering position of the interim ODMDS or any other disposal site location. Figure 4 indicates potential navigation hazards lying within the neritic reef area. Ships cannot navigate within this area east of the neritic reef line.

e. Scientific. The only identified scientific study location in the immediate area is the Newport hydrographic line located n 44°40'N, and extending offshore to the continental slope. This station line was established by Oregon State University to study nearshore oceanographic conditions. It has been sampled since 1960. Much of the plankton and fish larvae information used in this report came from these sampling stations. Use of the existing disposal site has not impacted this station line, and it is unlikely that any impacts will develop in the future.

f. Recreation. Yaquina Bay is situated on the Pacific Ocean at the mouth of the Yaquina River about 110 air miles south of the mouth of Columbia River. Major highways serving the area are US 101 and US 20. US 101 is the major highway serving the scenic Oregon coast and is extensively used by travelers to the Pacific Northwest. The highway passes through the city of Newport. The distance from US 101 to the mouth of Yaquina River is less than 1 mile. US 20 terminates at Newport about 3 miles from the river mouth. US 20 connects with Interstate 5, which is the primary highway linking the larger urbanized areas of the Willamette Valley, and is a major transportation route through Oregon, Washington, and California. Yaquina Bay region offers a great variety of recreational opportunities during all seasons. Activities include all kinds of fishing, hunting, camping, picnicking, beachcombing, boating, and hiking. Abundant evidence indicates a strong and healthy demand for recreation in the area and that this demand is not adequately served by existing facilities, especially during the peak summer season. Four distinct recreational resource areas have been identified (see figure 4). Two of the areas, North Shore Beach area and South Jetty area, support activities strongly influenced by the north and south jetties. The other two areas, South Beach



INTERFERENCE WITH OTHER USES OF THE OCEAN

FIGURE 4

State Park and South Beach Area 2, are strongly influenced by Oregon State Parks' development and the beach itself. Opportunities for a wide range of outdoor recreational activities are afforded at all four areas.

g. Coastal Zone Management. The Yaquina Bay Estuary Management Plan and Lincoln County Comprehensive Plan have been approved and acknowledged by the State of Oregon. Both of these plans discuss ocean disposal and recognize the need to provide for suitable offshore sites for disposal of dredged materials. In addition, this site evaluation study establishes that no significant effects on ocean, estuarine, or shoreland resources are anticipated, as goal 19 of Oregon's Statewide Planning Goals and Guidelines require.

48. The proposed action, was determined by the Corps to be consistent with the acknowledged local comprehensive plans and the State of Oregon Coastal Management Program. The State of Oregon has reviewed this consistency determination, but will withhold concurrence pending review of this document. Their preliminary concurrence letter is located in the comments and coordination appendix (F) of this report.

49. Existing Water Quality and Ecology. Water quality analysis for surface and bottom water at a station near the disposal site did not indicate an atypical or polluted condition for seawater of the Pacific Northwest (tables C-3 through C-6). The elutriate analysis discussed in Appendix C indicates no potential short- or long-term impacts on water quality associated with disposal operations.

50. The ecology of the area can be discussed in general terms based on information presented in Appendix A, and results of a Corps contract study performed by Oceanographic Institute of Oregon (1984). From available information, the offshore area is a northwest Pacific mobile sand community, bordered by a neritic reef system, also described in Appendix A. This determination is based mainly on fisheries and shellfish data. The benthic community is described in detail in Appendix A and the previously cited contract report.

51. Potential for Recruitment of Nuisance Species. All materials to be dredged and transported to the interim disposal site have been classified as noncontaminated marine sands (Appendix C, figure C-2). They have further been discussed as being similar to sediments from the interim disposal site. It is, therefore, highly unlikely that any nuisance species could be transported to the disposal site. Nuisance species are considered as any undesirable organism not previously existing at the disposal site and either transported to or attracted there because of the disposal of dredged materials and capable of establishing themselves there.

52. Existence of Significant Natural or Cultural Features. The neritic reefs off the Oregon coast comprise a unique ecological feature. They support a wide variety of invertebrates and fish species, as well as a bull whip kelp community. These areas are sheltered from the wave action and receive nutrients from both the ocean and the estuaries are usually highly productive.

53. The cultural resource literature search of the Yaquina Bay study area, conducted for Appendix E, resulted in the documentation of 12 wrecked vessels in the project area. Although the majority of these wrecks occurred on the bar, ocean currents deposited five of these vessels on South Beach. In addition, two other vessels were towed and then abandoned on South Beach.

54. Given the characteristics of Yaquina Bar, onshore current pattern, and hard sand bottom, and the fact that the ship channel over the bar has been actively maintained by dredging and removal of wrecks from the 1860's to present, it is unlikely that any wrecks have survived in the vicinity of the disposal site. Based on this information, it is unlikely that any significant cultural resources will be affected by continued use of the disposal site. Potential areas of shipwrecks are shown in figure E-1 of Appendix E.

55. Appendix E with supplementary side scan sonar data was reviewed by the Oregon SHPO. The SHPO concurred with our findings of no cultural resources concerns. The SHPO letter of concurrence is included in Appendix F.

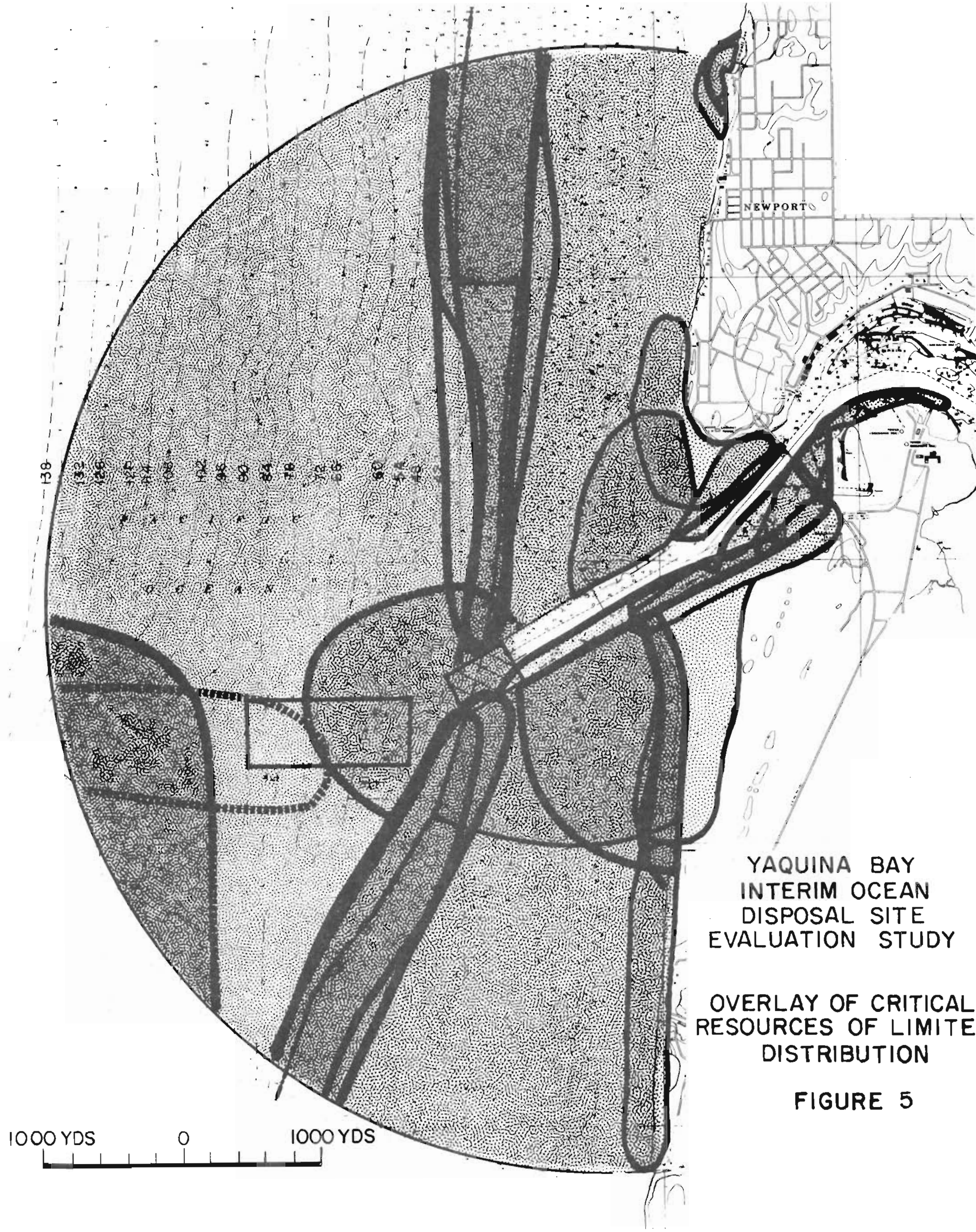
General Criteria, (228.5)

56. General. An evaluation of an ODMDS is based on the 11 specific factors in 40 CFR 228.6 of the ocean dumping regulations and criteria. The 11 factors have been discussed in the preceding section. The next step is to utilize the 11 specific factors to discuss requirements of the General Criteria (40 CFR 228.5).

57. Minimal Interference with Other Activities. The first of the five criteria require that a determination be made as to whether the site will minimize interference of the proposed disposal operations with other uses of the marine environment. This determination will be made by overlaying several individual maps presented in the technical appendixes onto a base map, giving bathymetry and location of the interim disposal site, and ZSF. The selection of figures to use for this determination was dependent on whether the resource was considered limited. A coast-wide resource, i.e., flat fish spawning area, was not considered a limited resource and was not included in the overlay evaluation technique. The following figures were selected to be included in the evaluation of resources of limited distribution.

o - Navigation Hazards Area/Other Recreation Areas	Figure 4
o - Shellfish Areas	Figure A-3
o - Critical Aquatic Resource	Figure A-4
o - Commercial and Sport Fishing Areas	Figure A-6
o - Geological Features	Figure B-5
o - Cultural, Historically Significant Areas	Figure E-1

58. Figure 5 is a composite of all of the above figures and demonstrates by various shades of gray, areas to avoid when placing a disposal site. The darker the area the more critical, as more interactions between various limited resources, are taking place. As the figure shows, the existing site is within the least utilized area in the ZSF, with the exception of the chinook salmon fishing area. This area is fished summer and fall of each year (actual length of the fishing season is set annually by Pacific Fisheries Management Council). Disposal operations can take place from May through



YAQUINA BAY
INTERIM OCEAN
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OVERLAY OF CRITICAL
RESOURCES OF LIMITED
DISTRIBUTION

FIGURE 5

October of each year. There is an overlap of times, but communications with ODFW personnel (Appendix A) indicate no observable conflicts between the two uses of the area. The remaining lighter gray area of salmonid fishery is not concentrated in one location or time of year, and there have been no observable conflicts between fishermen and disposal operations (Appendix A). Appendix A discusses all potential conflicts within the ZSF with living resources, and concludes that there have been no major conflicts in the past or predictable conflicts in the near future.

59. Minimizes Changes in Water Quality. The second of the five general criteria required changes to ambient seawater quality levels occurring outside the disposal site be within water quality standards and that no detectable contaminants reach beaches, shoreline, sanctuaries, or geographically limited fisheries or shellfisheries. Figure 5 was utilized to determine the potential for effects on items mentioned above. The nature of material has already been discussed as clean sand; because of this no contaminants or suspended solids are expected to be released. There should be no water quality perturbations to be concerned with moving toward a limited resource. Bottom movement of deposited material is discussed in Appendix B and in general shows a net offshore movement.

60. Interim Sites Which Do Not Meet Criteria. The evaluation indicates that the interim disposal site would meet the criteria and factors established in 40 CFR 228.5 and 228.6. No reported problems or complaints have been received by the Corps on use of this site. The site is environmentally acceptable for the present types and quantities of dredged material it receives on an annual basis.

61. Size of Sites. The fourth general criterion requires that the size, configuration and location of the site will be evaluated as part of the study. The Yaquina Bay interim ODMDS is 3,600 feet long and 1,400 feet wide, and is similar in size, shape, and location to the other 16 interim ODMDS located in Portland District. All disposal sites are considered dispersive and are considered the appropriate size to handle volumes of material they receive annually. Public notices issued for ocean disposal operations at various federally authorized projects, as required by MPRSA, have not generated

concerns about undue impacts from their use. Nor have any comments beenreceived about the size, shape, or location of the interim disposal sites. All interim disposal sites, including Yaquina Bay are located close enough to shore and harbor facilities that monitoring and surveillance programs, if required, could easily be accomplished.

62. Sites off the Continental Shelf. Any possible disposal sites off the continental shelf in Oregon area are at least 20 nautical miles offshore. The ZSF for Yaquina Bay is only 2 nautical miles from shore. The possibility of utilizing a continental slope disposal site is economically prohibitive. The project could not be maintained if a slope site was required. The time and costs involved would make the federally authorized Yaquina Bay project infeasible.

COORDINATION

63. Procedures used in this evaluation and the proposed continued use of the interim site has been discussed with the following State and Federal agencies.

o - Oregon Department of Fish and Wildlife
o - Oregon Department of Environmental Quality
o - U.S. Coast Guard (Newport Station)
o - Oregon Division of State Lands
o - U.S. Fish and Wildlife Service
o - National Marine Fisheries Service
o - U.S. Environmental Protection Agency

64. The agencies were briefed on the proposed technique from the task force workbook and existing information was requested of them. A formal public involvement program designed to receive comments from all State and local agencies, and private groups and individuals will be accomplished by EPA, upon formal submittal of this evaluation report containing the request for final site designation. Comments on the draft were formally requested from the above mentioned agencies. Letters received in response to the request are included in this appendix F. Responses to specific comments are included beside the appropriate paragraph of the letter.

65. A proposed Federal action requires concurrence or consistency with three Federal laws, from the responsible agency for a particular law. The three Federal laws and the responsible agencies are:

o Endangered Species Act of 1973, as amended	U.S. Fish & Wildlife Service National Marine Fisheries Service
o National Historical Preservation Act of 1966, as amended	State Historic Preservation Officer
o Coastal Zone Management Act of 1972, as amended	Oregon Department of Land Conservation and Development

Consistency or preliminary concurrence letters from the above listed agencies are included in Appendix F. State water quality certification, required by Section 401 of the Clean Water Act will be obtained for individual dredging actions.

SUMMARY/CONCLUSIONS

66. The preceding discussion has addressed each of the eleven specific factors individually and relates that discussion to the more detailed evaluation located in the technical appendixes. Following the evaluation of factors was a discussion of the five general criteria required to be evaluated prior to site designation. Review of criteria required summarizing effects of the factors on various aspects of the marine environment. Potential problems and conflicts associated with continued use of the interim ODMDS were identified, and a base map with a series of overlays indicated the locations.

67. There are 26 separable items associated with specific factors and general criteria. Each of these items has been addressed in the evaluation. Table 3 summarizes potential areas of conflict with use of the disposal site. None of the items were identified as conflicting with other needs and uses of the ocean. Ten items were identified as potentially conflicting. Seven of the ten potential conflicts (1, 5, 15, 20, 24, 25, 26) evolve around the size

TABLE 3
Yaquina Bay Interim Ocean Dredged Material Site Conflict Matrix for Evaluating Potential for Conflict with Required Considerations of the Marine Protection Research and Sanctuaries Act

FACTOR OF CONSIDERATION	CONFLICT	POTENTIAL CONFLICT*	NO CONFLICT	BENEFICIAL USE	COMMENTS	11 SPECIFIC FACTORS - NO. OF FACTOR COMPLIED WITH FROM TABLE 1	5 GENERAL CRITERIA - NO. OF CRITERION COMPLIED WITH FROM TABLE 2
1. Unusual Topography		X			If nearshore end of site used potential settlement on reef.	1, 6, 8, 11	a
2. Physical Sed. Compatibility			X			3, 4, 9	b, c, d
3. Chemical Sed. Compatibility			X			3, 4, 7, 9	a, b, c, d
4. Influence of Past Disposal		X			Changes in bottom contours might be from past disposal operations.	5, 7, 9, 10	a, b, d
5. Living Resources of Limited Distribution		X			Kelp and reef life forms could be affected by sediment transportation. No evidence of this.	2, 3, 6, 8, 11	a, b, d
6. Commercial Fisheries		X			Possible conflict with squid fisheries if it develops.	2, 8	a, b
7. Recreational Fisheries			X			2, 8	a, b
8. Breeding/Spawning Areas		X			Interferences with squid spawning depends on timing of the disposal.	2, 8	a, b
9. Nursery Areas			X			2, 8	a, b
10. Feeding/Passage Areas			X			2, 8	a, b
11. Critical Habitats of Threatened or Endangered Species			X			2, 8	a, b
12. Spatial Dist. of Benthos			X			2, 8, 10	a, b
13. Marine Mammals			X			2, 8	a, b
14. Mineral Deposits			X			1, 8	a, b, e
15. Nav. Hazard		X			Nearshore end of site is in navigation channel but due to limited navigation traffic no recorded problems.	1, 8	a, b, d
16. Other Uses of Ocean (cables, pipelines etc.)			X			8	a, b, d
17. Degraded Areas			X			4, 6, 7	a, b, d
18. Water Col. Chem./Physical Characteristics			X			4, 6, 9	a, b, d
19. Recreational Uses		X			Potential interference with recreational salmon fishing boats no documented problems.	2, 8, 11	a, b, c, d
20. Cultural/Historic Sites		X			Investigations indicate no known cultural resources in the disposal site.	11	b
21. Physical Oceanography Waves/Circulation			X			1, 3, 6, 7	a, b, d
22. Direction of Transport Potential for Settlement		X				1, 3, 6, 7	a, b, d
23. Monitoring			X			5	c
24. Shape/Size of Site (orientation)		X			Dredge capt. preferes 315° azimuth.	1, 4, 7	d
25. Size of Buffer Zone		X			50' contour minimum depth to keep dumping from transporting to reef.	2, 3, 4, 7, 11	b, d
26. Potential for Cumulative Effects		X			Potential for buildup of sediment in vicinity of site or on reef.	4, 7	c, d

* - THE POTENTIAL CONFLICTS WERE IDENTIFIED AT INITIATION OF THE STUDIES UPON COMPLETION, THEY WERE NOT CONSIDERED SIGNIFICANT. THESE ARE FULLY DISCUSSED IN THE APPENDIXES.

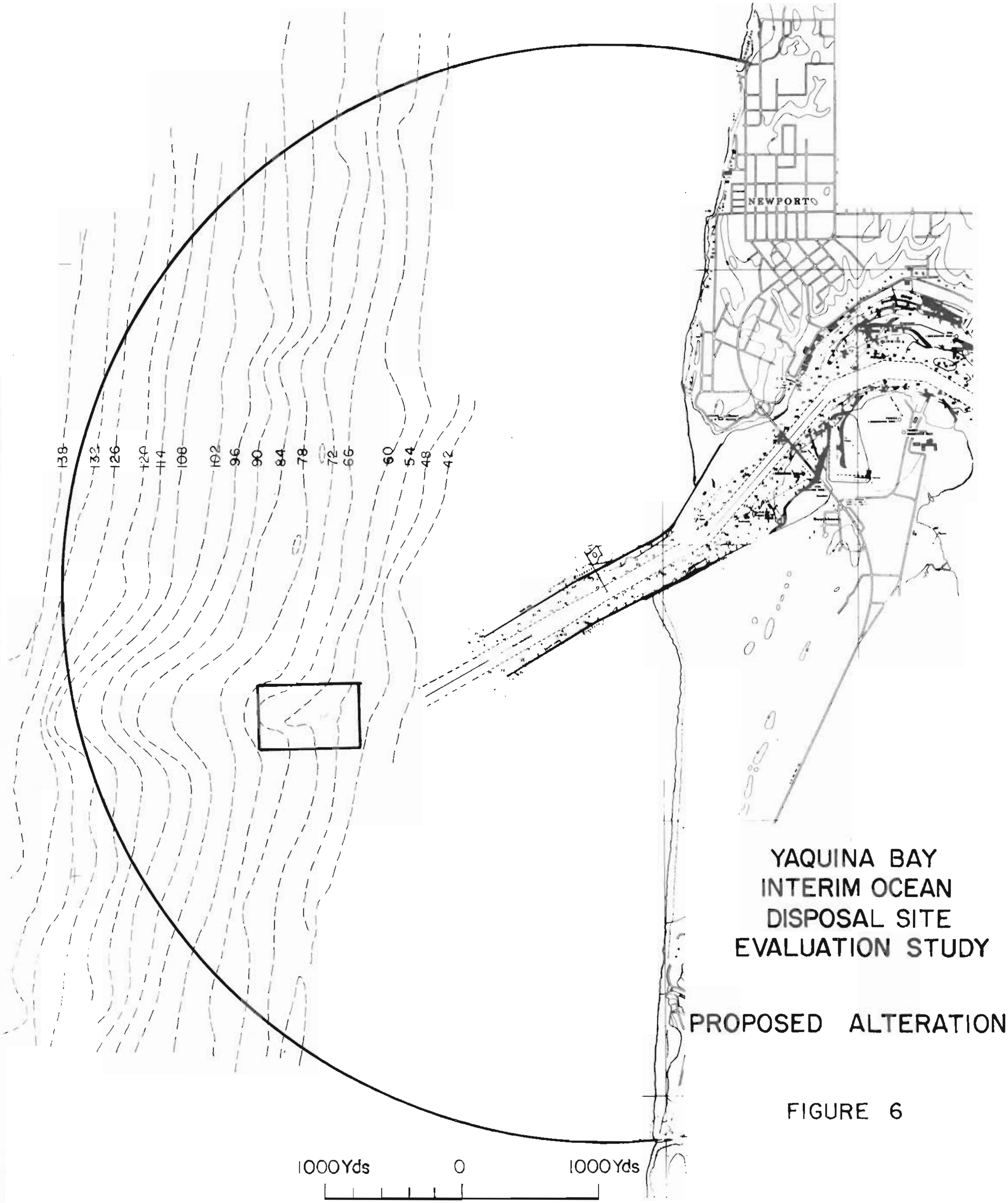
and/or shape of the existing site. Appendix B addresses the fact that all of these potential problems can be avoided by simply restricting disposal operations to deeper than the 50-foot contour. The other three potential conflict areas involve future fisheries or where no problems have been this is stored under matrix 10 and 10.1 with appendices recorded during post-disposal operations. Until documented problems are recognized by either monitoring operations or observation, no action should be taken on these items. The last two columns of table 3 strictly review each of the factors and criteria covered by the 26 areas of consideration.

68. If monitoring is required for final site designation, as discussed in 40 CFR 228.9, it should be restricted to the potential areas of conflict. This could best be accomplished by monitoring the physical parameters at the disposal site, i.e., waves, currents, and sediment transport rates and direction, to assure that suspended sediments were not affecting resources outside of the disposal site.

RECOMMENDATIONS

69. Based on the conclusions given in the preceding sections and discussion in the technical appendixes, recommend that Yaquina Bay interim ODMDS receive a final site designation with the following modifications to the site. The shoreward portion of the site, lying in less than 50 feet of water, will be eliminated from the final site designation request. The site will be shortened by 815 feet, making the northeast coordinate 44°36'31"N, 124°05'27.8"W, and the southeast coordinate 44°36'16"N, 124°05'27.8"W. Figure 6 depicts the shortened disposal site. The reduction will not cause a problem with site capacity as the area is a dispersive disposal site, and no long-term buildup of material is expected (Appendix B). By this action, the Corps can be assured of lessening potential conflicts that are indicated in table 3. Monitoring to determine the success of reducing conflicts by this adjustment may be required if any observable conflicts are reported or strongly suspected of occurring in the future. If monitoring is deemed necessary, it should follow recommendations outlined in 40 CFR 228.9. The monitoring program would be coordinated with EPA. At a minimum bathymetry of the site will be done

annually or after a dredging event if they occur less often than yearly. Grain size analysis will also be collected to assure no changes outside of the disposal site. If either of these measurements show substantial change, additional monitoring will be done.



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PROPOSED ALTERATION

FIGURE 6

GENERAL BIBLIOGRAPHY

Anderson, G.C., 1978. Biological oceanography of the coastal waters off Washington, UW/Oceanography Research Abstract.

Anderson, I., 1982. Near-inertial motions off the Oregon coast. Masters thesis, Oregon State University, Corvallis, OR.

Araniegu, J.R.L., 1975. Shoreline changes due to jetty construction on the Oregon Coast, MS, OSU, Ocean. ORESU-X2-75-007.

Baldwin, E.M., 1976. Geology of Oregon. Univ. of Oregon, Kendall/Hunt Pub. Co., 170 p.

Baldwin, E.M., 1950. Pleistocene history of the Newport, OR, region. Geol. Soc. of Oregon Newsletter pp. 77-81.

Barner, Debra Carol, 1982. Shell and Archaeology: An Analysis of Shellfish Procurement and Utilization on the Central Oregon Coast, unpublished MA thesis, OSU, Corvallis, OR.

Barnes, James Ray, 1967. The morphology and ecology of Echinorhynchus lageniformis Ekbaum, 1938 (Acanthocephala). Corvallis, Oregon. MS thesis. OSU. 42 p.

Batie, Robert Edward, 1974. Population structure of the intertidal shore crab Hemigrapsus oregonensis (Brachyura, Grapsidae) in Yaquina Bay, a central Oregon coast estuary. Corvallis, Oregon. PhD thesis. OSU. 128 p.

Bayer, R., 1983. Ore Aqua Company Biologist, Newport, OR. Personal communication.

Beals, Herbert K. and Harvey Steele, 1981. Chinese Porcelains from site 35-T1-1, Netarts Sand Spit, Tillamook County, Oregon. University of Oregon Anthropological Papers. Vol. 23. U of O, Eugene, OR.

Beardsley, Alan Jackson, 1969. Movement and angler use of four foodfishes in Yaquina Bay, Oregon. Corvallis, Oregon. PhD thesis. OSU. 173 p.

Becker, Clarence Dale, 1955. Larval setting and survival of young oysters, Ostrea lurida Carp., under laboratory conditions. Corvallis, Oregon. MS thesis. OSU. 97 p.

Beckham, Stephen Dow, 1977. The Indians of Western Oregon. This Land was Theirs. Coos Bay, OR:Arago Books.

Berglund, Lisette Aline, 1972. Laboratory studies of successional patterns in assemblages of attached estuarine diatoms. Corvallis, Oregon. MS thesis. OSU. 71 p.

Bodavarsson, G.M., 1975. Ocean wave-generated microseisms at the Oregon Coast. MS thesis, OSU, 83p.

Boettcher, R.S., 1967. Foraminiferal trends of the Central Oregon shelf, MS OSU.

Bourke, R.H., 1972. A study of the seasonal variation in temperature and salinity along the Oregon-Northern California coast. PhD thesis, Oregon State University, Corvallis, OR.

Bourke, R.H., Glenne, B., and Adams, B.W., 1971. The nearshore physical oceanographic environment of the Pacific NW coast. OSU Ref 71-45, Dept. of Oceanography, OSU, Corvallis.

Bourke, Robert Hathaway, 1969. Monitoring coastal upwelling by measuring its effects within an estuary. Corvallis, Oregon. MS thesis. OSU. 54 p.

Burt, W.V. and B. Wyatt, 1964. Drift bottle observations of the Davidson Current off Oregon. Dept. Ocean. Tech. Rept. 34, Oregon State Univ., Corvallis, OR.

Burt, W.V., 1962-63. Oregon oceanographic studies OSU/Oceanography NSF-G19783/GP-622.

Bushnell, D.C., 1964. Continental shelf sediments in the vicinity of Newport, Oregon. MS thesis, OSU, 107p.

Butler, Jerry Allan, 1968. Effects of the insecticide Sevin on the cockle clam <u>Clinocardium nuttallii</u> (Conrad). Corvallis, Oregon. MS thesis. OSU. 54 p.

Byrne, J.V. and D.A. Panshin, 1977. Continental shelf sediments off Oregon. OSU Sea Grant Pub. 8.

Byrne, J.V. and L.D. Kulm, 1967. Natural indicators of estuarine sediment movement. J. Waterways and Harbors Division, 93(WW2), Proceedings Paper 5220, p. 181-194, American Society of Civil Engineers.

Byrne, J.V., 1962. Geomorphology of the continental terrace off the central coast of Oregon. Ore Bin 24:65-74.

Byrne, J.V., 1962. Here's a look at offshore Oregon. The Oil and Gas Journal. July 23, 1962, pp. 116-119.

Byrne, J.V., 1963. "Coastal erosion, Northern Oregon", in <u>Essays in Marine Geology</u>, Clements, ed., pp 11-33.

Callaway, R.J., G.R. Ditsworth and D.L. Cutchin, 1970. Salinity, runoff and wind measurements, Yaquina Estuary, OR, EPA Working Paper 70; W72-09554, Pacific Northwest Water Lab., Corvallis, OR.

Carey, A., Pearcy, Richardson, Demory, Tyler, and Warren, 1980. Pleuronectid Production System and its Fishery; OSU/Oceanography Sea Grant Research Abstract.

Carey, A.G., 1965. Preliminary studies on animal-sediment interrelationships off the central Oregon Coast, Ocean Sci & Ocean Eng 1:100-101.

Chambers, D.M., 1969. Holocene sedimentation and potential placer deposits on the continental shelf off the Rogue River, Oregon. MS thesis, OSU, 102 p.

Choir, B., 1975. Pollution and tidal flushing predictions for Oregon's estuaries, OSU, Civil Eng. ORESU-X2-75-010.

Chriss, T.M., 1977. Optical evidence of sediment resuspension, Oregon continental shelf. EOS, 58(6),410, American Geophys. Union Spring meeting, Washington, D.C.

Collins, C.A. and J.G. Pattullo, 1970. Ocean currents above the continental shelf off Oregon as measured with a single array of current meters. J. Marine Research 28(1), 51-68.

Collins, C.A., 1968. Description of measurements of current velocity and temperature over the Oregon continental shelf, July 1965-Feb 1966. PhD thesis, Oregon State University, Corvallis, OR.

Collins, C.A., 1964. Structure and kinematics of the permanent oceanic front off the Oregon coast. Masters thesis, Oregon State University, Corvallis, OR.

Collins, C.A., H.C. Creech and J.G. Pattullo, 1966. A compilation of observations from moored current meters and thermographs, Vol. I. OSU Dept. Ocean Data Rep. 23, Ref. 66-11, Oregon State University, Corvallis, OR.

Crandell, George Frank, 1967. Seasonal and spatial distribution of Harpacticoid Copepods in relation to salinity and temperature in Yaquina Bay, Oregon. Corvallis, Oregon. PhD thesis. OSU. 137 p.

Creech, C., 1977. Five-year climatology (1972-1976) off Yaquina Bay, Oregon. Sea Grant Communications, ORESU-T-77-011, Oregon State Univ., Corvallis, OR.

Creech, C., 1981. Nearshore wave climatology, Yaquina Bay, Oregon (1971-1981). OSU Sea Grant Program Rep. ORESU-T-81-002, Oregon State University, Corvallis, OR.

Creech, H.C., 1978. An intense October NE Pacific Storm, in Mariners Weather Log 22:90-92.

Crook, Gene Ray, 1970. In situ measurement of the benthal oxygen requirements of tidal flat deposits. Corvallis, Oregon. MS thesis. OSU. 113 p.

Cutchin, D.L. and R.L. Smith, 1973. Continental shelf waves: low-frequency variations in sea level and currents over the Oregon continental shelf, J. of Physical Ocean., 3(1),73-82.

Cutchin, D.L., 1972. Low frequency variations in the sea level and currents over the Oregon continental shelf, thesis, Oregon State University, Corvallis, OR.

Deleyiannis, Steven James, 1969. Vertical distribution of surface zooplankton in Yaquina Bay, Oregon. Corvallis, Oregon. MS paper. 49 p.

DeMort, Carole Lyk, 1970. The culture and biochemical analysis of some estuarine phytoplankton species. Corvallis, Oregon. PhD thesis. OSU. 157 p.

Denner, W., 1963. Sea water temperature and@ salinity characteristics observed at Oregon coast stations in 1961, MS thesis, Oregon State University, Corvallis, OR.

DeRycke, Richard James, 1967. An investigation of evaporation from the ocean off the Oregon coast, and from Yaquina Bay, Oregon. Corvallis, Oregon. MS thesis. OSU.

Detweiler, J.H., 1971. A statistical study of Oregon coastal winds. MS thesis, Oregon State University, Corvallis, OR.

Dye, Era Emery, 1941. Boone Family Reminiscences, Oregon Historical Quarterly:42:220-229. Salem:Statesman Publishing Co.

Elvin, Patricia J., 1972. An ultrastructural study of early cleavage in Mytilus. Corvallis, Oregon. MA thesis. OSU. 60 p.

Enfield, D.B., 1974. Prediction of hazardous Columbia River bar conditions. PhD thesis. Oregon State University, Corvallis, OR.

EPA, 1971. Oceanography of the nearshore coastal waters of the Pacific Northwest relating to possible pollution, Water Pollution Control Research Series, 2 volumes, Environmental Protection Agency.

Erickson, B.H., 1967. Marine seismic studies near Newport, Oregon, MS, OSU, 46 p.

Fagan, David D., 1885. History of Benton County, Oregon . . . etc. Portland: A.G. Walling Printer.

Fogarty, Jack, 1980. Some History of Early-Day Steamboating on Yaquina Bay in Lincoln County Lore: A Reprinting of Five Early Publications of the Lincoln County Historical Society, ed. by Leslie L. Haskin, Newport: Lincoln County Historical Society.

Fonseca, T., 1982. On physical characteristics of upwelling events off Oregon and Peru. Masters thesis, Oregon State University, Corvallis, OR.

Fox, W.T., and R.A. Davis, 1974. Beach processes on the Oregon coast, July, 1973. Tech Rep 12, ONR Contract N00014-69-c-0151, Williams College, MA.

Gabriel, W.L. and Tyler, 1980. Preliminary analysis of Pacific Coast demersal fish assemblages. Mar. Fish Review 42:83-85.

Gaumer, T., Demory, Osis, and Walters, 1974. Yaquina Bay resource use study, 1970-71. Oregon Fish Commission Rep NOAA-7 4031301.

Gibbs, Jim, 1968. West Coast Windjammers in Story and Pictures. Seattle: Superior Publishing Co.

Gilbert, William Earl, 1967. A study of seiching in Yaquina Bay, Oregon. Corvallis, Oregon. MS paper. 17 p.

Glenn, J.L., 1978. Sediment sources and holocene sedimentation in Tillamook Bay, OR, USGS, Open File Rpt, 78-680 64 p.

Gnose, Charles Einar, 1968. Ecology of the striped seaperch, Embiotoca laterialis, in Yaquina Bay, Oregon. Corvallis, Oregon. MS thesis. OSU. 53 p.

Goodwin, C.R., Emmett and Glenne, 1970. Tidal study of three Oregon estuaries, OSU/CE Bull 45.

Goodwin, Carl Raymond, 1974. Estuarine tidal hydraulics - one dimensional model and predictive algorithm. Corvallis, Oregon. PhD thesis. OSU. 220 p.

Goodwin, Clinton John, 1972. Stratigraphy and sedimentation of the Yaquina formation, Lincoln County, Oregon. Corvallis, Oregon. MS thesis 1973. OSU. 121 p.

Greeney, William James, 1971. Modeling estuary pollution by computer simulation. Corvallis, Oregon. MS thesis. OSU. 77 p.

Gross, M.G., B.A. Morse, and C.A. Barnes, 1969. Movement of near-bottom waters on the Continental shelf off the northwestern US, JGR, 74:7044-7047.

Hallermeier, R.J., 1981. Seaward Limits of Significant Sand Transport by Waves: An Annual Zonation for Seasonal Profiles. CETA 81-2, USACE/CERC.

Hancock, D.R., P.O. Nelson, C.K. Sollitt and K.J. Williamson, 1981. Coos Bay Offshore Disposal Site Investigation Interim Report, Phase I, February 1979-March 1980. Report to U.S. Army Corps of Engineers, Portland District, Portland, OR, under contract no. DACW57-79-C-0040, Oregon State University, Corvallis, OR.

Hanson, Alfred Warren, 1970. The symbiotic relationships and morphology of Paravortex sp. nov. (Tubellaria, Rhabdocoelida) a parasite of Macoma nasuta Conrad 1837. Corvallis, Oregon. MS thesis. OSU. 42 p.

Harris, D.L., 1972. "Wave estimates for coastal regions", in Shelf Sediment Transport: Process and Pattern, D.L. Swift, D.B. Duane and O.H. Pilkey, eds., Dowden, Hutchinson and Ross, Inc.

Hartlett, J.C., 1972. Sediment transport on the Northern Oregon continental shelf. PhD thesis, OSU, 120 p.

Hartman, Michael Colyn, 1972. A green algal symbiont in Clinocardium nuttallii. Corvallis, Oregon. PhD thesis. OSU. 65 p.

Hawkins, Dan Lee, 1971. Metabolic responses of the burrowing mud shrimp, Callianassa californiensis, to anoxic conditions. Corvallis, Oregon. MS thesis. OSU. 43 p.

Heacock, Robert Leon, 1952. Stratigraphy and foraminifera of the Upper part of the Nye formation, Yaquina Bay, Oregon. Corvallis, Oregon. MS thesis. OSC. 48 p.

Hickey, B., 1980-81. Pollutant transport and sediment dispersal in the Washington-Oregon coastal zone. UW/Oceanography Research Abstract.

Hogue, E.W., 1982. Sediment Disturbance and the Spatial Distributions of Shallow Water Meiobenthic Nematodes on the Open Oregon Coast, in Journal of Marine Research, 40(3):551-573.

Hunter, R.E., 1980. Coastal sedimentary processes study. USGS, Menlo Park, research abstract.

Huyer, A. and J.G. Pattullo, 1972. A comparison between wind and current observations over the continental shelf off Oregon, Summer 1969. J. Geophys. Res. 77(18), 3215-3220.

Huyer, A. and R.L. Smith, 1979. Studies of the physical oceanography over the Oregon continental margin, OSU/Oceanography Research Abstract.

Huyer, A. and R.L. Smith, 1977. "Physical characteristics of Pacific Northwestern coastal waters", in The Marine Plant Biomass of the Pacific Northwest Coast, R.W. Krauss, ed., Oregon State University Press, Oregon State University, Corvallis, OR.

Huyer, A. and R.L. Smith, 1974. A subsurface ribbon of cool water over the continental shelf off Oregon Jour. Phy. Ocean. 4:381-391.

Huyer, A., 1973. Vertical distributions of temperature, salinity, and sigma-t from observations from R/V Yaquina during coastal upwelling experiment, 1972, Dept. Ocean. Data Rep. 73-6, Oregon State University, Corvallis, OR.

Huyer, A., 1974. Coherence at low frequencies in currents observed over continental shelf off Oregon and Washington, EOS 55(12), p 1135, Amer. Geophysical Union.

Huyer, A., 1971. A study of the relationship between local winds and currents over the continental shelf off Oregon. MS thesis, Oregon State University, Corvallis, OR.

Huyer, A., E.J.C. Sobey and R.L. Smith, 1979. The spring transition in currents over the Oregon continental shelf. J. Geophys. Res. 84(C11), 6995-7011.

Huyer, A., J. Bottero, J.G. Pattullo and R.L. Smith, 1971. A compilation of observations from moored current meters and thermographs. Vol. V. OSU Dept. Ocean. Data Rep. 46, Ref. 71-1, Oregon State University, Corvallis, OR.

Huyer, A., R.D. Pillsbury, and R.L. Smith, 1975. Seasonal variation of the alongshore velocity field over the continental shelf off Oregon. Lim. and Ocean. 20(1), 90-95.

James, W.P., 1970. Air photo analysis of water dispersion from ocean outfalls. PhD, OSU, CE.

Jarman, Gary Davis, 1962. Recent foraminifera and associated sediments of the continental shelf in the vicinity of Newport, Oregon. Corvallis, Oregon. MS thesis. OSU. 111 p.

Karlin, R., 1980. Sediment sources and clay mineral distributions of the Oregon Const. Jour. Sed. Pet 50:543-560.

Keene, D.F., 1971. A physical oceanographic study of the nearshore zone at Newport, Oregon. MS thesis, OSU.

Kitchen, J., 1977. Particle size distributions and the vertical distribution of suspended matter in the upwelling region off Oregon. Dept. Ocean. Contract Report, Ref. 77-10. Oregon State Univ., Corvallis, OR., also 1978 MS thesis, OSU.

Kitchen, J., J. Zaneveld and H. Pak 1978. The vertical structure and size distributions of suspended particles off Oregon during the upwelling season. Deep Sea Res. 25, 453-468.

Kjeldsen, Chris Kelvin, 1967. Effects of variations of salinity and temperature on some estuarine macro-algae. Corvallis, Oregon. PhD thesis. OSU. 157 p.

Klingemen, P.C., _et al._, 1969. Coastal processes - Oregon littoral drift, marine geotechnique preliminary study, OSU Dept. Civil Engr. CE572.

Komar, P.D., 1975. A Study of the Effects of a Proposed Extension of the Siuslaw River Jetties. OSU/Oceanography Report to USACE, Portland District.

Komar, P.D., Lizarraga-Arciniegar and Terich, 1975. Oregon coasts shoreline changes due to jetties; OSU/Oceanography report ORESU-R-76-002.

Komar, P.D., R.H. Neudeck, and L.D. Kulm, 1972. Observations and significance of deep-water oscillatory ripple marks on the Oregon continental shelf, in Shelf Sediment Transport, Swift, _et al._, eds., pp 601-619

Krygier, Earl Eldon, 1973. Distribution and reproductive biology of _Crangon franciscorum_ (Stimpson) and _Crangon nigricauda_ (Stimpson) in Yaquina Bay, Oregon. Corvallis, Oregon. MS thesis. OSU. 76 p.

Kulm, L.D. and J.V. Byrne, 1967. Sediments of Yaquina Bay, Oregon, in _ESTUARIES_, Pub 83, AAAS p226-238.

Kulm, L.D. and J.V. Byrne, 1966. Sedimentary response to hydrography in an Oregon estuary, Marine geology, v4, pp 85-118.

Kulm, L.D., 1977. Coastal morphology and geology of the ocean bottom - the Oregon region, in the Marine Plant Biomass of the Pacific NW Coast, Drauss, ed., pp 9-36.

Kulm, L.D., R.C. Roush, J.C. Hartlett, R.H. Neudeck, D.M. Chambers, and E.J. Runge, 1975. Oregon Continental Shelf Sedimentation: Interrelationships of Facies Distribution and Sedimentary Processes, in Journal of Geology, v. 83, n. 2, pp. 145-175.

Kulm, L.D., Scheidegger, Byrne and Spigai, 1968. A Preliminary investigation of the heavy mineral suites of the coastal rivers and beaches of OR and N. Calif. The Ore Bin 30:165-180.

Kulm, LaVerne Duane, 1965. Sediments of Yaquina Bay, Oregon. Corvallis, Oregon. PhD thesis. OSU. 184 p.

Lannan, James Edmund, Jr., 1973. Genetics of the Pacific oyster; biological and economic implications. Corvallis, Oregon. PhD thesis. OSU. 104 p.

Lee, D., 1967. Geopotential anomaly and geostrophic flow off Newport, Oregon, MS thesis, Oregon State University, Corvallis, OR.

Lidrich, Joseph Stanley, 1970. The behavior of the pea crab (Fabia subquadrata in relation to its mussel host, Mytilus californianus. Corvallis, Oregon. PhD thesis. OSU. 53 p.

Lizarraga-Arciniega, J.R. and P.D. Komar, 1975. Shoreline changes due to jetty construction on the Oregon coast, OSU Sea Grant Pub. No. ORESU-T-75-004, Oregon State University, Corvallis, OR.

Lizarraga-Arciniega, J.R., 1976. Shoreline changes due to jetty construction on the Oregon coast, MS thesis, Oregon State University, Corvallis, OR.

Lough, R.G., 1976. Larval Dynamics of the Dungeness Crab, Cancer magister, off the Central Oregon Coast, 1970-71. Fish. Bull. 74(2):353-376.

Lough, Robert Gregory, 1969. The effects of temperature and salinity on the early development of Adula californiensis (Pelecypoda - Mytilidae). Corvallis, Oregon. MS thesis. OSU. 92 p.

Main, Stephen Paul, 1972. The distribution of epiphytic diatoms in Yaquina Estuary, Oregon. Corvallis, Oregon. PhD thesis. OSU. 112 p.

Maloney, N.J., 1965. Geology of the continental terrace off the central coast of Oregon, PhD, OSU, 233 p.

Manske, Douglas Charles, 1968. Distribution of recent foraminifera in relation to estuarine hydrography, Yaquina Bay, Oregon. Corvallis, Oregon. PhD thesis. OSU. 176 p.

Markham, John Charles, 1967. A study of the animals inhabiting laminarian holdfasts in Yaquina Bay, Oregon. Corvallis, Oregon. MA thesis. OSU 62 p.

Marthaler, J.G., 1976. Comparison of sea level and currents off the Oregon coast using mean monthly data. MS thesis, Oregon State University, Corvallis, OR.

Martin, John Varick, 1970. Salinity as a factor controlling the distribution of benthic estuarine diatoms. Corvallis, Oregon. PhD thesis. OSU. 114 p.

Maser, C., B.R. Mate, J.F. Franklin and C.T. Dyrness, 1981. Natural History of Oregon Coast Mammals. USDA For. Serv. Gen. Tech. Rep. PNW-133, 496 p. Pac. Northwest For. and Range Exp. Stn., Portland, OR.

Mathiot, R.K., 1973. A Preliminary investigation of the land use limitations of the major landforms along a portion of the Lincoln Co. Coast, Oregon, MS, PSU, 83p.

Maughan, P.M., 1963. Observations and analysis of ocean currents above 250 m off the Oregon coast. MS thesis, Oregon State University, Corvallis, OR.

McCormick, Jon Michael, 1969. Hydrographic and tropic relationships of hydromedusae in Yaquina Bay, Oregon. Corvallis, Oregon. PhD thesis. OSU. 125 p.

McCrow, Lynne Tucker, 1972. The ghost shrimp, Callianassa californiensis Dana, 1854, in Yaquina Bay, Oregon. Corvallis, Oregon. MS thesis. OSU. 56 p.

Miller, C.B., 1980. Ecology and reproductive biology of Calanus marshallae in the Oregon upwelling zone, OSU/OCEANOGRAPH Contract OCE76-21958 A01.

Miller, M.C., 1978. Lab and Field investigations on the movement of sand tracer under the influence of water waves PhD, OSU, Ocean.

Mills, Randall V., 1950. Railroads Down the Valley: Some Short Lines of the Oregon Country:Palo Alto, Pacific Books.

Montagne-Bierly, 1977. Yaquina Bay Hopper Dredge Scheduling Analysis - Offshore Disposal Site Inspection. Report to USACE, Portland District.

Moores, C.N.K, L.M. Bogert, R.L. Smith and J.G. Pattullo, 1968. A compilation of' observations from moored current meters and thermographs, Vol II, Dept. Ocean. Data Rep. 30, Ref 68-5, Oregon State University, Corvallis, OR.

Moores, C.N.K. and R.L. Smith, 1968. Continental shelf waves off Oregon. J. Geophys. Res. 73(2), 549-557.

Moores, C.N.K., 1974. Coastal upwelling experiment. I. Profiling current meter data report. R/V Yaquina cruise Y7207-E (31 July-7 Aug 1972), R/V Cayuse cruises C7208-F1 and C7208-F2 (15-18 August and 21-24 August 1972) Dept. Ocean. Data Rep. , Oregon State University, Corvallis, OR.

Morgan, J.B. and R.L. Holton, 1977. A Compendium of Current Research and Management Programs Concerning Oregon's Estuaries, OSU Seagrant Pub. ORESU-L-77-004.

Morrison, George Edwin, 1966. An investigation of the distribution of Nephtys caecoides in Yaquina Bay. Corvallis, Oregon. MS thesis. OSU. 35 p.

Murray, R.J., 1978. Application of LANDSAT-2 data for an inventory of eelgrass and kelp beds on the Oregon Coast, OSU/ERSAL research abstract.

National Marine Consultants, 1961. Wave statistics for twelve most severe storms affecting three selected stations off the coast of Washington and Oregon, during the period 1950-1960. Report to Corps of Engineers, Portland District, Portland, OR.

National Marine Consultants, 1961. Wave statistics for three deep-water stations along the Oregon-Washington coast. U.S. Army Corps of Engineers, Seattle District, Seattle, WA.

Neal, V.T., D.F. Keene and J.T. Detweiler, 1969. Physical factors affecting Oregon coastal pollution. Dept. Oceanography Ref. 69-28, Oregon State University, Corvallis, OR.

Nelson, P.O., C.K. Sollitt, K.J. Williamson and D.R. Hancock, 1983. Coos Bay Offshore Disposal Site Investigation Interim Report, Phase II-III, April 1980-June 1981. Report to U.S. Army Corps of Engineers, Portland District, Portland, OR, under contract no. DACW57-C-0040, Oregon State University, Corvallis, OR.

Nenendorf, K.K.E., 1982. Theses and dissertations on the geology of Oregon, 1899-1982. ODGMI Sp Paper 11.

Neudeck, R.H., 1971. Photographic investigation of sediment transport mechanics on the Oregon continental margin, MS, OSU.

North, W.B. and Byrne, 1965. Coastal landslides of N. OR. Ore Bin v27 n11 p217-241 also MS, OSU 1964 85 p.

Oceanographic Institute of Oregon, 1984. An examination of the Feasibility of Extrapolating Infaunal Data From Coos Bay, Oregon, to Yaquina Bay, Oregon, Final Report, Portland District Corps of Engineers contract DACW57-84-M-1186.

O'Flaherty, Mary Louise, 1966. Taxonomy of some endophytic and epiphytic genera of Phaeophyta on the Oregon Coast. Corvallis, Oregon. MS thesis. OSU. 65 p.

Pak, H. and R.V. Zaneveld, 1977. Bottom nepheloid layers and bottom mixed layers observed on the continental shelf off Oregon, JGR 82:3921-3931.

Pak, H. and R.V. Zaneveld, 1981. Mesoscale studies of flow regimes and fluxes of particulate matter in coastal waters. Report to US Dept. Energy under contract 902688 TICNO; 0077240, School of Oceanography, Oregon State University, Corvallis, OR.

Panshin, D.A., 1967. Sea level, winds, and upwelling along the Oregon coast. MS thesis, Oregon State University, Corvallis, OR.

Parrish, Loys Phillip, 1966. The predicted influence of Kraft mill effluent on the distribution of some sport fishes in Yaquina Bay, Oregon. Corvallis, Oregon. MS thesis. OSU. 88 p.

Pattullo, J. and Denner, 1965. Processes affecting seawater characteristics along the Oregon Coast, Limn & Ocean. 10:443-450.

Pearcy, W.G. and S.S. Myers, 1974. Larval Fishes of Yaquina Bay, Oregon: A Nursery Ground for Marine Fishes? Fish. Bull. 72(1):201-213.

Peterson, C., Scheidegger and Komar, 1982. Sand disperal patterns in an active margin estuary of the NW US as indicated by sand composition, texture and bedforms Mar. Geol. 50:77-96.

Peterson, C., Scheidegger, Nem and Komar, 1983. Sediment composition and hydrography in 6 high-gradient estuaries of the NW US, Jour Sed Pet (in press).

Peterson, C.D., 1984. Sedimentation in small active margin estuaries of the NW US, PhD, OSU, Ocean. ORESU-X-84-001 R/CP-11.

Peterson, Paul Edward, 1973. Factors that influence sulfide production in an estuarine environment. Corvallis, Oregon. MS thesis. OSU 1974. 97 p.

Peterson, W.K., 1970. Coastal and offshore survey, UW/Oceanography report(s), REF-M70-2, RLO-1725, NR-083-0.

Peterson, W.T. and C.B. Miller, 1976. Zooplankton Along the Continental Shelf off Newport, Oregon, 1969-1972: distribution, abundance, seasonal cycle, and year-to-year variations. Oregon State University, Sea Grant College Program Pub. No. ORESU-T-76-002. 111 pg.

Peterson, W.T., C.B. Miller and A. Hutchinson, 1979. Zonation and Maintenance of Copepod Populations in the Oregon Upwelling Zone. Deep-Sea Research 26A:467-494.

Phebus, George and Robert M. Drucker, 1971. Archeological Investigations of Seaside, Oregon: An Intermediate Report on the Excavations of Two major Archeological Sites at Seaside, Oregon, Through September 1977. Vol. 1. No. 1. Sponsored by The Seaside Museum and Historical Society.

Pillsbury, R.D., 1972. A description of hydrography, winds and currents during the upwelling season near Newport, OR. PhD thesis, Oregon State University, Corvallis, OR.

Pillsbury, R.D., R.L. Smith and J.G. Pattulo, 1970. A compilation of observations from moored current meters and thermographs. Vol. III, Dept. Ocean. Data Rep. 40, Ref. No. 70-3

Pittock, H., W. Gilbert, A. Huyer and R. Smith, 1982. Observations of sea level, wind, and atmospheric pressure at Newport, Oregon. 1967-1980. Dept. Ocean. Data Rep. 98, Ref. No. 82-12. Oregon State University, Corvallis, OR.

Plank, W.S. and H. Pak, 1973. Observations of light scattering and suspended particulate matter off the Oregon coast, June-Oct. 1972. School of Ocean. Data Rep. 55, Oregon State University, Corvallis, OR.

Prestedge, G.K., 1977. Stabilization of landslide along the Oregon Coast, OSU, Civil Eng. ORESU-X2-75-003.

Quinn, W.H., and Enfield, 1971. The development of forecast techniques for wave and surf conditions over the bars in the Columbia River Mouth and at the entrance to Yaquina Bay. OSU Ref 71-9.

Quinn, W.H., Creech, H.C. and D.O. Zopf, 1974. Coastal wave observations via seismometer, Mariners Weather Log 18:367-369.

Richardson, S.L. and W.G. Pearcy, 1977. Coastal and Oceanic Fish Larvae in an Area of Upwelling off Yaquina Bay, Oregon. Fish. Bull. 75(1):125-145.

Richardson, S.L., 1973. Abundance and Distribution of Larval Fishes in Waters off Oregon, May-October, 1969, with Special Emphasis on the Northern Anchovy, Engraulis mordax. Fish. Bull. 71(3):697-711.

Richardson, S.L., J.L. Laroche and M.D. Richardson, 1980. Larval Fish Assemblages and Associations in the Northeast Pacific Ocean Along the Oregon Coast, Winter-Spring 1972-1975. Estuarine and Coastal Marine Science (1980) II, 671-698.

Riznyk, Raymond Zenon, 1969. Ecology of benthic microalgai of estuarine intertidal sediments. Corvallis, Oregon. PhD thesis. OSU. 196 p.

Rosenburg, D.H., 1962. Characteristics and distribution of water masses off the Oregon coast MS, OSU, Ocean.

Roush, R.C., 1979. Sediment textures and internal structures: A comparison between Central Oregon continental shelf sediments and adjacent ocean sediment, MS, OSU, Ocean. ORESU-X2-79-001.

Roush, R.C., 1970. Sediment textures and internal structures: A comparison between Central Oregon continental shelf sediments and adjacent coastal sediments. MS thesis, OSU, 75 p.

Runge, E.J., 1966. Continental shelf sediments, Columbia River to Cape Blanco, Oregon. PhD thesis, OSU, 143 p.

Russell, Howard, Jr., 1964. The endemic zooplankton poulation as a food supply for young herring in Yaquina Bay. Corvallis, Oregon. MS thesis. OSU. 40 p.

Scheidegger, K.F., L.D. Kulm and E.@ Runge, 1971. Sediment sources and dispersal patterns of Oregon continental shelf sands, Jour Sediment Petrol, v41, pp 1112-1120.

Schlicker, H.G., R.J. Deacon, G.W. Olcott and J.D. Beaulieu. 1973. Environmental Geology of Lincoln County, Oregon. Oregon Dept. of Geol. and Min. Ind. Bull. 81.

Seymour, R.J., 1981. Coastal data information program monthly reports, 1981 through present. Calif. Dept. Boating and Waterways, Scripps Institute of Oceanography, La Jolla, CA.

Sherwood, C.R., J.S. Creager, E.H. Roy, G. Gelfenbaum and T. Dempsey, 1983. Sedimentary Processes and Environments in the Columbia River Estuary. Unpublished Report to CREDDP, Astoria, Oregon.

Simons, Alexy, 1983. Cultural Resources in the Pacon Graving Dock Project Area. (Unpublished Report, on file U.S. Army Corps of Engineers, Portland District, Portland, OR.

Smallbone, N., 1974. Bays and Estuaries of Oregon. OSU/Oceanography Report.

Smith, R.L., 1964. An investigation of upwelling along the Oregon Coast PhD, OSU 83 p.

Snavely, P.D., N.S. MacLeod and W.W. Rau, 1969. Geology of the Newport Area, Oregon. in The Ore Bin, v31, n2, pp. 25-53.

Snavely, P.D., W.W. Rau and H.C. Wagner, 1964. Miocene Stratigraphy of the Yaquina Bay Area, Newport, Oregon. in The Ore Bin, v26, n8, pp. 133-151.

Sobey, E.J.B., 1977. The response of Oregon shelf waters to wind fluctuations: differences and the transition between winter and summer. PhD thesis, Oregon State University, Corvallis, OR.

Solitt, C.K., P.O. Nelson, K.J. Williamson and D.R. Hancock, 1983. Coos Bay offshore disposal site investigation final report, Report to U.S. Army, Corps of Engineers, Portland District, Portland, OR, under contract no. DACW57-79-C0040, Oregon State University, Corvallis, OR.

Spigai, J.J., 1970. Marine geology of the continental margin off southern Oregon, PhD, OSU, Ocean.

Stander, J.M. and R.L. Horton, 1978. Oregon and Offshore Oil. OSU Seagrant Pub. ORESU-T-78-004.

Steiner, R.G., 1978. Food habits and species composition of neritic reef fishes off Depoe Bay, Oregon, OSU, Fish & Wild., ORESU-X2-78-002.

Steinfeld, James David, 1972. Distribution of Pacific herring spawn in Yaquina Bay, Oregon, and observations on mortality through hatching. Corvallis, Oregon. MS thesis. OSU. 75 p.

Stevenson, M.R., 1966. Subsurface currents off the Oregon coast. PhD thesis, Oregon State University, Corvallis, OR.

Stevenson, M.R., J.G. Pattullo and B. Wyatt, 1969. Subsurface currents off the Oregon coast as measured by parachute drogues. Deep-sea Research, 16, 449-461.

Stevenson, M.R., R.W. Garvine and B. Wyatt, 1974. Lagrangian measurements in a coastal upwelling zone off Oregon. J. Phys. Ocean. 4(3), 321-336.

Stewart, R., 1967. An evaluation of grain size, shape and roundness parameters in determining depositional environment in Pleistocene sediments from Newport, OR. MS thesis, U of O.

Sullivan B. and D. Hancock, 1977. Zooplankton and Dredging, Research Perspectives and Critical Review, Water Resources Bulletin. American Water Resources Assc., Vol. B, No. 13.

Swanson, Robert L., 1965. Tidal prediction and the variation of the observed tide from the predicted tide at Newport, Oregon. Corvallis, Oregon. MS thesis. OSU 106 p.

Swedberg, Stephen Ernford, 1966. Age-fecundity relationships in the striped seaperch Embiotoca lateralis from Yaquina Bay, Oregon. Corvallis, Oregon. MS thesis. OSU 41 p.

Talbot, Theodore Webt., 1980. From the Journals of Lieut. Theodore Talbot, U.S.A. on his Journey Through Lincoln County and Along the Oregon Coast in 1849. Entries compiled and Notes on Contents by Leslie L. Haslan, Newport, OR. in Lincoln County Lore: A Reprinting of Five Early Publications of the Lincoln County Historical Society. Newport, Lincoln County Historical Society.

Thompson, Rogene Kasparek, 1967. Respiratory adaptations of two macrurous-anomuran mud shrimps, Callianassa californiensis and Upogebia pugettensis (Decapoda, Thalassinidea). Corvallis, Oregon. MS thesis. OSU. 63 p.

Thum, Alan Bradley, 1972. An ecological study of Diatomovora amoena, an interstial acoel flatworm, in an estuarine mud flat on the central coast of Oregon. Corvallis, Oregon. PhD thesis. OSU. 185 p.

Toner, Richard Charles, 1961. An exploratory investigation of the embryonic and larval stages of the bay mussel, Mytilus edulis L., as a bioassay organism. Corvallis, Oregon. MS thesis. OSU. 51 p.

Tunon, N.A.A., 1977. Beach Profile Changes and Onshore-Offshore Sand Transport on the Oregon Coast. MS thesis. OSU/Oceanography, 58 p.

USACE, 1883. Annual Report to the Chief of Engineers. Portland District Library, Portland, OR.

USACE, 1891. Yaquina Bay. Report of Mr. Gwynn A. Hyell, Assistant Engineer, (4):3193. Annual Report to the Chief of Engineers. Portland District, Portland, OR.

USACE, 1884. Improvement of Entrance to Yaquina Bay, Oregon, CPT Powell (3)2266. Annual Report to the Chief of Engineers. Portland District, Portland, OR.

USACE, 1893. Yaquina Bay. Report of Mr. J.G. Holcombe, (4):3363. Annual Report to the Chief of Engineers. Portland District, Portland, OR.

USACE, 1892. Yaquina Bay. Report of LT G.D. Fitch, (3):2699. Annual Report to the Chief of Engineers. Portland District, Portland, OR.

USACE, 1975. Yaquina Bay and River, EIS, Portland District, Oregon.

USACE, 1962. Yaquina Bay and Harbor, Design Memo. Portland District, Oregon.

USACE, Unpublished data. Littoral Environmental Observation Program (LEO). U.S. Army Corps of Engineers, Portland District, Portland, OR.

USACE, 1965. Yaquina Bay and Harbor, Oregon, Design Memo No. 3. Portland District, Oregon.

USACE, 1977. Yaquina Bay Hopper Dredge Scheduling Analysis, Offshore Disposal Site Inspections. Portland District, Portland, OR.

USACE, 1980. Findings of Compliance and Non-compliance, Operations and Maintenance Dredged Material Disposal Activities at Coastal Project. Portland District, Portland, OR.

USACE, 1974. Coastal Reconnaissance Study Oregon and Washington, June 1974. Portland District, Portland, OR.

USGS, Analysis of Elutriate, Native Water, and Bottom Material in Selected Rivers and Estuaries in Western Oregon and Washington. Open File Report 82-922.

Voth, David Richard, 1972. Life history of the caligoid copepod Lepeophtheiros hospitalis Frasser 1920 (Crustaceai Caligoida). Corvallis, Oregon. PhD thesis. OSU. 114 p.

Waldron, K.D., 1955. A survey of the bull kelp resources of the Oregon Coast in 1954, Fish Comm. of OR, Res. Brief 6(2)15.

Walker, John David, 1974. Effects of bark debris on benthic macrofauna of Yaquina Bay, Oregon. Corvallis, Oregon. MS thesis. OSU. 94 p.

White, S.M., 1970. Mineralogy and geochemistry of continental shelf sediments off the Washington-Oregon coast, Jour Sediment Petrol, v40, pp 38-54.

Willingham, William F., 1983. Army Engineers and the Development of Oregon. A History of the Portland District, U.S. Army Corps of Engineers, Portland District, Portland, OR.

Wilson, William Joseph, 1974. The effects of concentration and particle size of suspended materials on growth and condition of the Pacific oyster (Crassostrea gigas). Corvallis, Oregon. MS thesis. OSU. 65 p.

Wright, T.L., 1976. A description of the coastal upwelling region off Oregon during July-August 1973. Thesis, Oregon State University, Corvallis@ OR.

Wyatt, B., 1973. Coastal upwelling ecosystems analysis: STD measurements off the Oregon coast August 1973, Inter-American Tropical Tuna Commission Rpt 9.

Wyatt, B., D.A. Barstow, W.E. Gilbert and J.L. Washburn, 1971. Drift bottle recoveries and releases off the Oregon coast 1961 through 1970. Dept. Ocean. Data Rep. 50, Ref. no. 71-36, Oregon State University, Corvallis, OR.

Yao, N.C.G. and S. Neshyba, 1976. Bispectrum and cross-bispectrum analysis of wind and currents off the Oregon coast: I. Development., Dept. Ocean. Research Report, Ref. No. 76-!1, Oregon State University, Corvallis, OR.

Yao, N.C.G., 1974. Bispectral and cross-bispectral analysis of wind and currents off Oregon coast. PhD thesis, Oregon State University, Corvallis, OR.

Zimmerman, Steven T., 1972. Seasonal succession of zooplankton population in two dissimilar marine embayments on the Oregon Coast. Corvallis, Oregon. PhD thesis. OSU. 212 p.

Zontek, Terry, 1983. Aboriginal Fishing at Seal Rock, 35-LNC-14 and Neptune 35-LA-3; Late Prehistoric Archeological Sites on the Oregon Coast. Unpublished MA thesis, Interdisciplinary Studies, OSU, Corvallis, OR.

Zopf, D., Creech and Quinn, 1976. The wave meter: a land-based system for measuring nearshore ocean waves. OSU/Sea Grant ORESU-R-76-013.

Zopf, D.O., H.C. Creech and W.H. Quinn, 1977. ________ Mariners Weather Log 21(5), 305-306, Washington, D.C.

APPENDIX A

LIVING RESOURCES

APPENDIX A - LIVING RESOURCES

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FIGURES (continued)

LIVING RESOURCES

Introduction

1.01 Information on aquatic resources was obtained from a field sampling program conducted in May 1984. There was also a thorough utilization of a variety of published and unpublished reports, theses, and personal communications with the ODFW Marine Resources Division biologists. Critical resources were determined primarily by whether the resource was unique to the area or was in limited abundance along the Oregon coast.

Plankton and Fish Larvae

1.02 Distribution and abundance of inshore plankton species vary depending upon nearshore oceanographic conditions. In the summer when the wind is predominantly from the northwest, surface water is moving south and away from the shore. Colder, more saline, nutrient rich water then moves up from depth onto the shore. This upwelling phenomenon can extend up to 10 km offshore and last from days to weeks depending upon the strength and duration of the wind. Zooplankton taxa during this time are predominantly those from subarctic water masses.

1.03 In the winter the wind is primarily out of the west and southwest and surface waters are transported inshore. The zooplankton community during this time consists of species from the transitional or Central Pacific water masses.

1.04 Peterson and Miller (1976)[1] and Peterson *et al.* (1979)[2] have sampled the zooplankton community off Yaquina Bay and found copepods to be the dominant taxa. The species present varied with season, of the the 58 total species collected, 38 were collected in the summer and 51 in the winter. Eight occurred commonly in both summer and winter while seven occured only or predominantly in the summer and six in the winter. A list of dominant summer and winter species is given below. In general winter species are less abundant than summer species.

Table A-1
Dominant Copepod Species by Season in Decreasing Order of Abundance[1]

Winter Species	Summer Species
Pseudocalanus sp.	*Pseudocalanus* sp.
Oithona similis	*Acartia clausii*
Paracalanus parvus	*Acartia longiremis*
Acartia longiremis	*Calanus marshallae*
	Centrophages abdominalis
	Oithona similis

1.05 Other taxa collected were of minor importance[1] as compared to the copepod abundance except for a few organisms during parts of the year. A list of the other taxa collected is given in tables A-2 and A-3.

1.06 The other plankton species of importance is the megalops larval stage of the Dungeness crab (*Cancer magister*). Lough[3] has reported that megalops occur inshore from January to May and are apparently retained there by the strong longshore and onshore components of the surface currents in the winter (figure A-1). After May, the megalops metamorphoses into juvenile crabs and settle out of the plankton moving into rearing areas in the estuary.

1.07 Fish larvae are a transient member of the inshore coastal plankton community. Their abundance and distribution has been described by Richardson (1973),[4] Richardson and Pearcy (1977),[5] and Richardson *et al*. (1980).[6]

1.08 Three species assemblages have been described off the Oregon coast; coastal, transitional, and offshore. In general, the species in the coastal and offshore assemblages never overlapped while the transitional species overlapped both groups. The break between the coastal and transitional groups occurred at the continental slope.

1.09 The coastal group (figure A-2) is dominated by smelts (*Osmeridae*) making up over 50 percent of the larvae collected. Other dominant species included the English sole (*Parophrys vetulus*), sanddab (*Isopsetta isolepis*), starry flounder (*Platichthys stellatus*), and tom cod (*Microgadus proximus*). Maximum

Table A-2

TAXA	TOTAL RELATIVE DENSITY			FREQUENCY		
	1969	1970	1971	69	70	71
Calanus nauplii	119.5	695.5	172.7	21	40	28
Other Copepod nauplii	43.1	68.1	52.3	10	20	20
Amphipods	8.5	18.5	15.7	5	15	14
Euphausiid nauplii	46.3	85.9	84.0	5	26	18
Euphausiid calyptopis	13.3	14.5	17.2	4	17	11
Euphausiid furcilia	30.2	13.6	17.7	14	20	10
Thysanoessa spinifera	35.4	4.0	87.3	2	7	11
Evadne nordmanni	73.7	58.9	9.8	17	26	2
Podon leukarti	2.8	115.3	5.2	2	12	1
Pteropods	10.2	24.6	60.6	11	22	35
Chaetognaths	89.4	50.3	30.8	25	33	34
Oikopleura	69.2	85.7	66.5	11	15	21
Ctenophores	6.0	2.5	34.9	7	5	19
Scyphomedusae	22.9	70.9	22.8	13	28	22
decapod shrimp mysis	142.7	52.6	45.3	16	24	22
barnacle nauplii	59.3	168.3	231.4	8	32	28
barnacle cypris	4.4	64.0	8.3	2	19	10
polychaete post-trochophores	16.2	20.1	21.4	5	23	15
bivalve veligers	170.5	258.9	68.3	20	40	27
gastropod veligers	28.9	79.2	42.2	16	33	23
hydromedusae	6.1	3.2	10.3	2	2	11
unidentified annelid without parapodia	8.2	23.1	35.8	3	3	16
pluteus	0.0	16.0	117.6	0	5	11
large round eggs (fish)	36.8	25.0	17.8	11	13	12
Calanus eggs	870.1[a]	168.7	226.1	10	28	25
euphausiid eggs, early	55.0	686.1	449.6	11	29	24
euphausiid eggs, late	70.0	57.5	39.6	2	16	14
other fish eggs	19.1	35.1	34.3	12	18	18

a = biased by a single observation of 760 individuals/m^3.

The following taxa were found in less than five samples: radiolarians, foraminifera, siphonophores, planula larva, trochophores, *Tomopteris*, heteropods, *Clione*, phoronid larva, ascidian larva, salps, auricularia larva, imm starfish, decapod protozoeas, unusual barnacle nauplii, *Stylocheiron abbreviatum*, anchovy eggs, and four miscellaneous unidentified meroplanktonic taxa.

Total relative density and frequency of occurrence of other holoplanktonic taxa and meroplankton taken within 18 km of the coast during 1969, 1970 and 1971 upwelling seasons. Table entries are sums of average abundances at each of four stations.[1]

Table A-3

TAXA	TOTAL RELATIVE DENSITY			FREQUENCY		
	1969-70	1970-71	1971-72	69-70	70-71	71-72
Calanus nauplii	1188.7a	165.9	35.1	10	15	15
Other Copepod nauplii	29.1	122.5a	20.2	11	13	12
Amphipods	5.9	4.8	5.0	12	4	10
Euphausiid nauplii	2.8	108.4a	3.4	4	5	4
Euphausiid calyptopis	6.4	56.1a	14.5	13	4	8
Euphausiid furcilia	3.1	0.4	7.6	7	2	5
Evadne nordmanni	5.8	24.1	4.8	2	2	4
Podon leukarti	126.3a	27.3	116.4a	4	2	4
Pteropods (*Limacina*)	66.0	88.0	14.2	17	15	13
Chaetognaths	62.9	47.4	22.4	20	19	13
Oikopleura spp.	551.9	101.2	75.6	22	16	15
Ctenophores	7.0	6.2	10.3	8	8	9
Scyphomedusae	10.0	94.3	16.6	5	6	10
Salps	0.9b	***	***	9	0	0
Isopods	0.5	0.7	***	2	3	0
Mysids	0.2	3.3	2.1	2	1	2
decapod shrimp mysis	3.1	21.4	5.6	7	10	11
barnacle nauplii	309.1	192.7	77.9	11	6	12
barnacle cypris	8.7	188.1a	16.8	4	4	12
polychaete post-trochophores	41.5	13.5	70.8	12	8	11
bivalve veligers	87.8	98.2	118.4	20	18	15
gastropod veligers, assorted	31.3	27.6	37.2	19	18	15
gastropod A	***	1.0	***	0	6	0
hydromedusae	9.2	1.8	3.3	4	2	3
annelids lacking parapodia	40.0	74.9	21.9	5	4	11
echinoderm pluteus	41.7	0.8	22.1	5	2	4
large round eggs (fish)	9.0	5.5	4.9	6	11	8
Calanus eggs	36.5	36.7	4.7	10	11	4
euphausiid eggs	***	274.7a	2.8	0	6	3

a = high value the result of one station or sampling date
b = a value of 34.3/m^3 on 29 October 1969 was ommitted from the summation

The following taxa were found in less than five samples: The euphausiids *Thysanoessa spinifera* and *Euphausia pacifica*, amphipod larvae and eggs, ostracods, cumaceans, siphonophores, *Sagitta scrippsii*, *S. bierii*, *S. minima*, *Lepas* nauplii, other unidentified barnacle nauplii, echinoderm bipinnaria, imm starfish, imm sea urchins, planula larvae, trochophores, foraminifera, radiolarians, *Tomopteris*, cyphonautes larvae, other fish eggs, and six miscellaneous unidentified meroplanktonic taxa.

Total relative density and frequency of occurrence of other holoplanktonic and meroplanktonic taxa taken within 18 km of the coast during three winters. Table entries are sums of relative densities at each of four stations.[1]

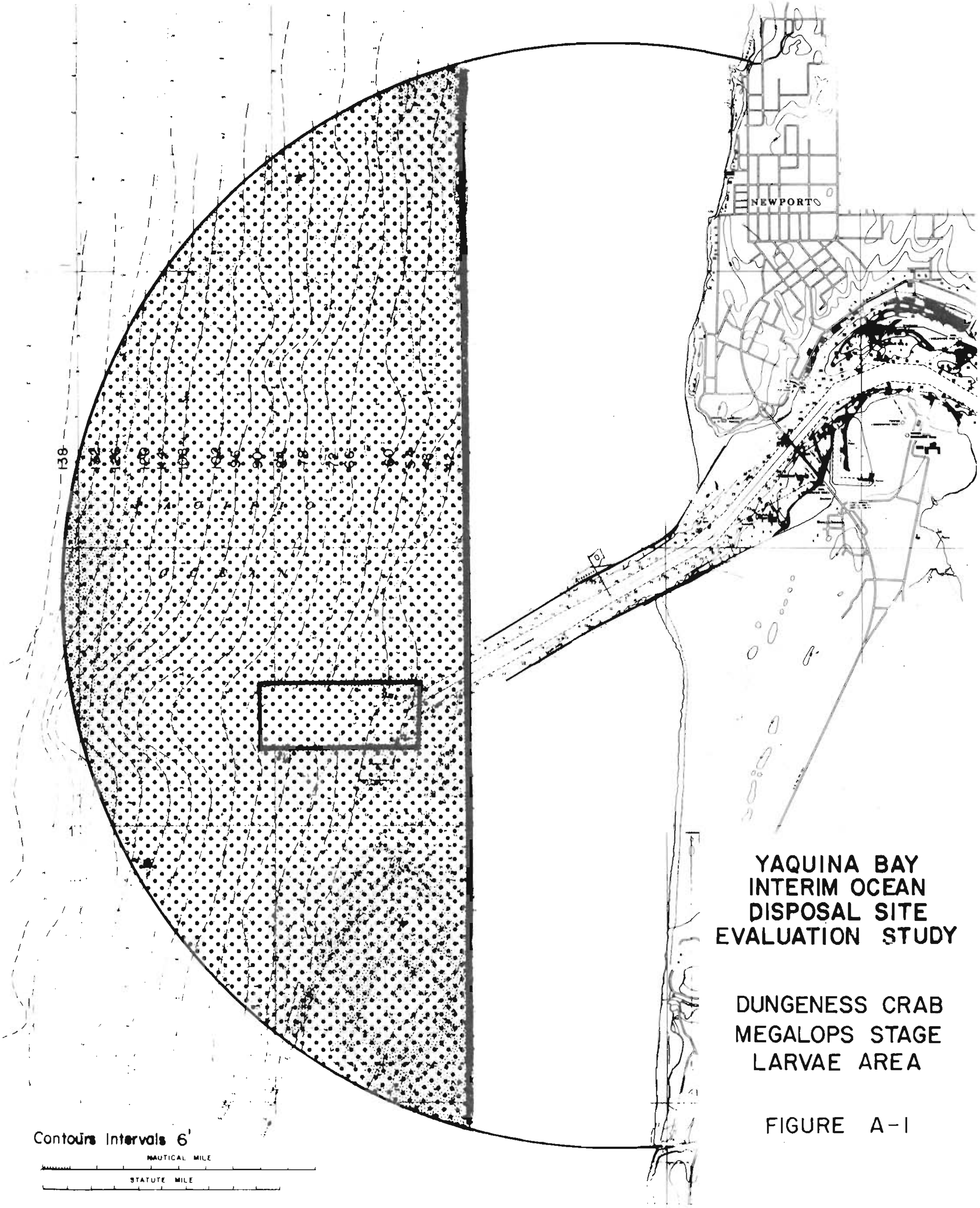
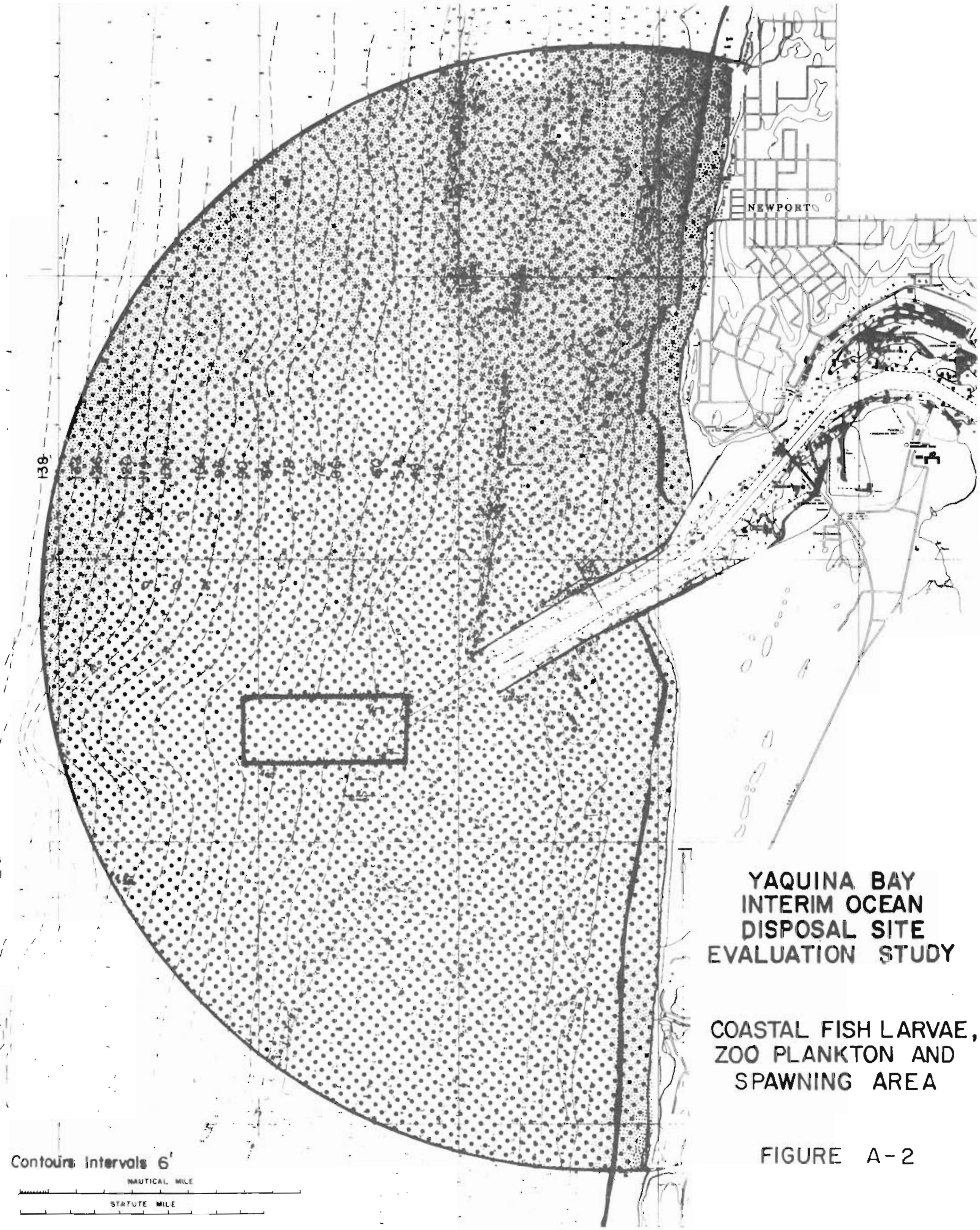

NEWPORT
O C E A N
Contours Intervals 6'
NAUTICAL MILE
STATUTE MILE
YAQUINA BAY
INTERIM OCEAN
DISPOSAL SITE
EVALUATION STUDY
DUNGENESS CRAB
MEGALOPS STAGE
LARVAE AREA

FIGURE A-1



YAQUINA BAY
INTERIM OCEAN
DISPOSAL SITE
EVALUATION STUDY

COASTAL FISH LARVAE,
ZOO PLANKTON AND
SPAWNING AREA

FIGURE A-2

abundance occurred from February to July when greater than 90 percent of the larvae were collected. Two peaks of abundance were present during this period, one in February and March (24 percent of larvae) an one in May to July (68 percent of larvae) following upwelling. Dominant species during each peak are shown below (table A-4).

Table A-4
Dominant Fish Larval Species During the Two Peaks of Abundance[5]

Species	February to March	May to July
Smelt (Osmeridae)	1.51*	4.12
English sole (Parophrys vetulus)	4.09	
Sandlance (Ammodytes hexapterus)	1.76	
Sanddab (Isopsetta isolepis)	1.73	2.21
Tom cod (Microgadus proximus)		2.03
Slender sole (Lyopsetta exilis)		1.07

* Biological index - Ranking method that averages abundance and frequency of occurrance in samples. 5 to 1 in decreasing order.

1.10 The larval species present in the inshore coastal areas[5] were similar and had the same peaks of abundance as those collected in Yaquina Bay[7]; however, the dominate species differed. In the bay two species accounted for 90 percent of the species collected, the bay goby (Lepidogobius lepidus) and the Pacific herring (Clupea harengus pallasi). Neither were present or common in the inshore coastal area. Some of the common coastal species such as English sole and starry flounder use the estuary as juvenile rearing areas.

1.11 Benthic Invertebrates. Benthic invertebrates play an important role in secondary productivity of nearshore marine systems. They are not only a direct source of food for many demersal fishes but play an active part in the shredding and breakdown of organic material and in sediment reworking.

1.12 Knowledge of the benthic communities off of the nearshore central Oregon coast is scant. A review of the literature conducted by the Portland District indicated only six quantitative benthic studies have been conducted in nearshore coastal waters off Oregon.

1.13 Investigations include evaluating offshore disposal sites near the mouth of the Columbia River by Richardson et al.,[8] a quantitative study of the meiobenthos north of Yaquina Bay[9] and an outfall study for an International Paper outfall near Gardiner Or. (Unpublished, n.d.). In addition, site specific studies of ocean disposal for the selection of the Coos Bay disposal sites (Hancock et.al.[10], Nelson et.al.[11] and Sollitt et.al.[12]) have been completed. These studies comprise the total benthic infaunal data base available for the Oregon Coast. All but one of these benthic studies were sponsored by the Portland District.

1.14 To provide site specific benthic information to supplement these data and characterize the Yaquina Interim disposal site the Oceanographic Institute of Oregon collected and analyzed benthic samples as described below (O.I.O. 1984)[13].

1.15 Five stations were located and sampled on the centerline of the disposal site onthe 40-, 50-, 60-, 80- and 100-foot contours. Four additional stations were established, two north of the centerline and two south, in 70 and 80 feet of water (figure A-3). Six replicate bottom samples were taken from each of the nine stations using a modified Gray-O'Hara box corer which sampled a .096 m^2 area of the bottom. One sample was sent to the Portland District for determination of grain size and organic content. The remaining five box-core samples were sieved through a 0.5 mm mesh screen; organisms retained on the screen were preserved in 10 percent buffered formalin. Infaunal organisms were then picked from the sediment, counted and identified to the lowest taxon practicable.

1.16 Results. In all depths sampled, the sediment from the stations in the region of the Yaquina Bay Interim Disposal site were found to consist of sand size particles (Table B-1). All centerline stations consisted of sediments in which 99 percent of the particles were larger than 0.062 mm and 90 percent of the grain size were larger than 0.125 mm. The fraction greater than 0.25 mm varied between 7 and 31 percent with the deeper stations having the highest percentages of coarser material.

1.17 The stations located to the south of the centerline transect contained sediments in which 99 percent of the particles exceeded 0.062 mm but had only 82 and 88 percent greater than 0.125 mm with the fraction greater than 0.125

mm, 6.3 and 13.7 percent for 60- and 70-foot water depths, respectively. The organic content of the sediments as measured by percent volatile solids is shown in table B-1.

1.18 The benthos of the Yaquina offshore disposal site was found to be typical of nearshore high energy environments. The community is dominated by the sand dollar Dendraster eccentricus and the surface-dwelling gastropod Olivella spp. Polychaete annelids and gammarid amphipods inhabiting the study area were generally the more motile psammnitic (sand-dwelling) forms which tolerate or require high sediment flux.

1.19 Table A-5 presents the results of comparable stations for five replicate samples taken at two depths shown in figure A-3.

1.20 Figure A-4 compares infaunal abundances and densities at the eleven stations where replicate box core samples were taken and figure A-5 compares the mean densities by depth for the stations to the north and south of the transect which bisects the interim disposal area.

1.21 Mean densities ($\#/m^2$) along the northern transect show a direct correspondence with increasing water depth ranging from a minimum of six organisms/m^2 at the 40-foot depth contour to a maximum of 215/m^2 at the 80-foot contour.

1.22 Mean density of benthic infauna in the disposal area shows an inverse relationship with water depth. Density values range from a maximum of 99/m^2 at 40-feet declining to 20 at 60-feet and increase slightly thereafter.

1.23 Only two stations of the southern transect could be sampled because hard substrate which prevented adequate penetration of the box corer was encountered. However, the 60- and 80-foot stations on the southern transect had the highest mean densities (234 & 201/m^2, respectively).

1.24 The Yaquina offshore disposal site received 100,000 cys of dredged sediments from the Hopper Dredge YAQUINA on 15-29 April 1984. These data suggest that the paucity of benthic infauna may be attributed to this disposal activity. Futher, these results suggest that the effects of the April disposal were confined to the interim disposal area and stations on transects to the north and south were not impacted.

1.25 Although the interim disposal site off of Yaquina Bay has frequently received dredged sediments, the adjacent fauna show little evidence of impacts.

1.26 The combined density of five replicate box cores ($\#/m^2$) was used to compare samples taken within the Yaquina Disposal Site (stations Y1-4) with stations to the north and south of the interim site and then compared with samples taken at similar depths at the Coos Bay Interim Disposal sites.[13] Differences between the Yaquina offshore samples were nearly as great as differences between the Coos Bay samples.

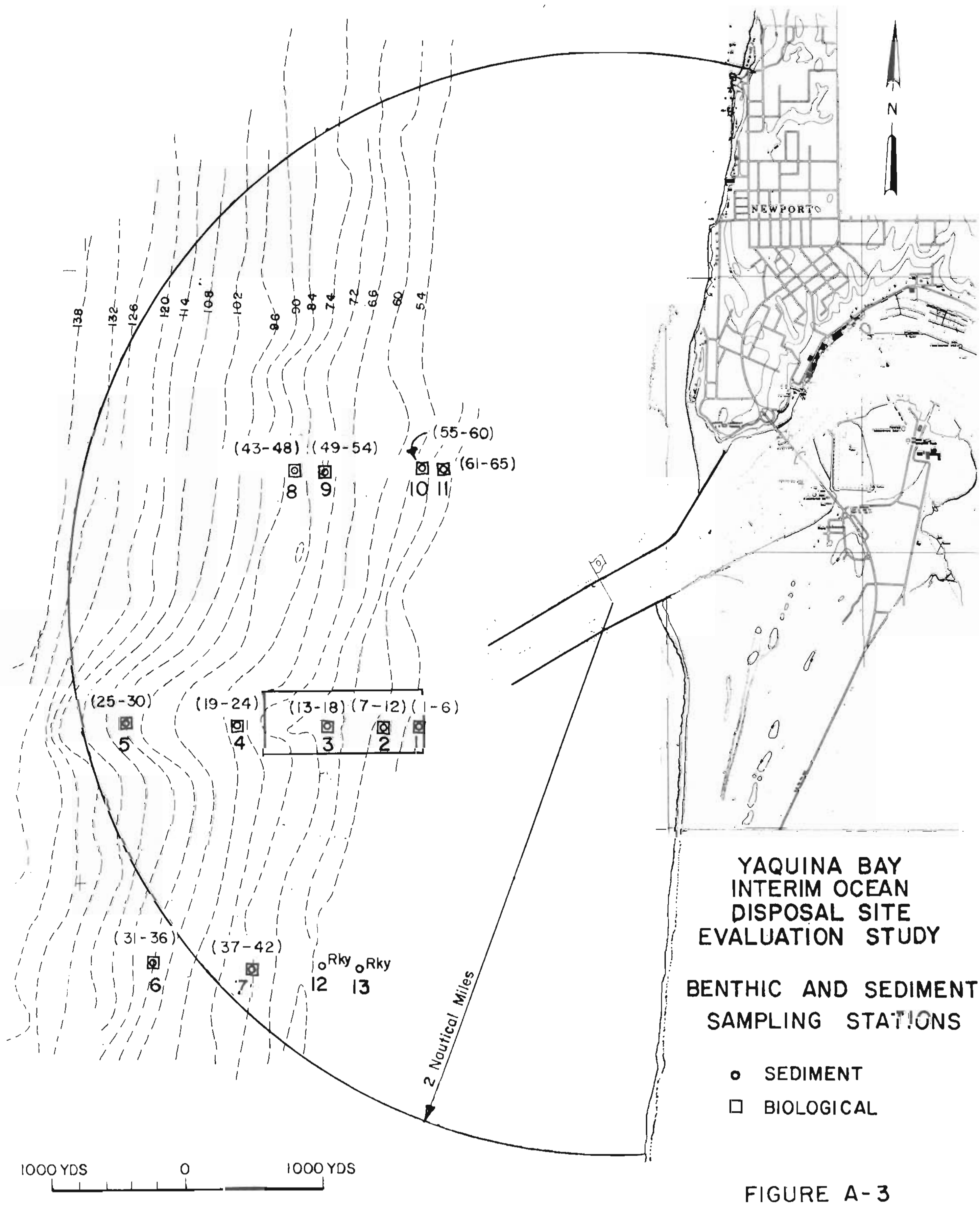
Macroinvertebrates

1.27 The dominant commercially and recreationally important macroinvertebrate species in the inshore coastal area are shellfish, Dungeness crabs and squid. Shellfish distribution is shown in figure A-6. Razor clam beds are located north and south of the jetty along the beach. Recruitment to the inshore beaches comes from the subtidal spawning areas. Gaper clams are present in large numbers near the mouth and upriver in the estuary proper. Cockles are also present in the intertidal areas near the base of the jetties. Piddock clams occur in the sandstone outcroppings north of the estuary mouth. Dungeness crab adults occur on sandflat habitat along the entire Oregon coast. They spawn in offshore areas and the juveniles rear in the estuary.

1.28 The Oregon Department of Fish and Wildlife (ODFW) has recently identified a major squid spawning area off the Yaquina estuary (figure A-7). Additional research is to be done; however, the preliminary data indicate that the population in this area could sustain commercial harvest.

Fisheries

1.29 The nearshore area off Yaquina Bay supports a variety of pelagic and



YAQUINA BAY
INTERIM OCEAN
DISPOSAL SITE
EVALUATION STUDY

BENTHIC AND SEDIMENT SAMPLING STATIONS

FIGURE A-3

TABLE A-5 INFAUNAL COMPARISON OF THREE YAQUINA BAY 70' STATIONS

	Yaquina Bay (depth 70')	Yaquina Bay (depth 70')	Yaquina Bay (depth 70')
	Stations (Y37-41 South)	Stations (Y49-53 North)	Stations (Y19-Y23)
Polychaetea			
Glycera convoluta	1		
Glycera tenuis			
Glycinde armigera		4	
Glycinde picta			
Nereis procera			
Scoloplos armiger	34	23	2
Nephthys caecoides			
Nephthys longosetosa	12	5	2
Magelona sacculata	10	5	1
Naineris uncinata			
Notocirrus californiensis			
Chaetozone setosa	34	20	17
Haploscoloplos elongatus			
Notocirrus californiensis			
Spio filicornis			
Spiophanes bombx	3	1	
Spiophanes missionensis			
Minuspio cirrifera	1		
Nothria iridescens	2		
Ophelia sp.			2
Paraonella platybranchia			1
Notomastus lineatus			
Thalenessa spinosa	19	20	2
Heteromastus filiformis	1		
Phylo felix			
Orbiniidae sp.			
Aricidea suecica	4	1	
Syllidae	8		
Nemertinea sp.		4	2
Molluscs			
Modiolus			
Macoma expansa	2	1	
Tellina modesta	5	3	
Tellina nuculoides			
Tellina Bogedensis			
Psephidea lordi			
Axinopsida serricata			
Siliqua patual			
Mitrella gouldi			
Cylichna attonsa			
Mangelia sp.			
Olivella pycna	12	15	4
Olivella biplicata	5	1	
Nassarius mendicus			
Gastrotrophon pacificus			
Dentalium rectius			

TABLE A-5 INFAUNAL COMPARISON OF THREE COOS BAY STATIONS 70' (CONT.)

<u>Crustacea</u>			
Decapoda (Hermit crabs)			1
Mysids	11	1	2
Lyssocrangon stylirostris	1	1	2
Ampelisca macrocephala	2		
Anchicoluris occidentalis	10	1	
Mandibulophoxus uncirostratus	36	35	24
Repoxynius epistomus			
Repoxynius obtusidens			
Repoxynius vigitegus	17	18	3
Eohaustorius sawyeri	1		
Eohaustorius washingtonianus			
Eohaustorius sencillus	62	34	4
Eohaustorius estuarius	3	1	4
Eohaustorius sp.	180	18	
Foxiphalus major	10	3	
Synchelidium rectipaleus			
Synchelidium shoemakeri	9	6	27
Monoclulodes spinipes	3		
Hippomedon denticulatus	25	1	
Diastylis dawsoni			
Atylus tridens			
Bathycapea daltanae	2		
Eobrolgus spinosus			
hemilamprops sp.			
Isaridae sp.			
Photis sp.	1		
Phoxocephalidae	1		
<u>Echinodermata</u>			
Dendraster eccentricus	10	39	65
Total Genera	30	23	17
Total species	34	26	18

TABLE A-5 INFAUNAL COMPARISON OF THREE YAQUINA BAY 80' STATIONS

	Yaquina Bay (depth 80') Stations (Y31-35 South)	Yaquina Bay (depth 80') Stations (Y25-Y29)	Stations (Y43-Y47 North)
Polychaetea			
Glycera convoluta			2
Glycera tenuis			
Glycinde armigera			
Glycinde picta			
Nereis procera			
Scoloplos armiger	22	6	42
Nephthys caecoides			
Nephthys longosetosa	8	4	13
Magelona sacculata	8	88	8
Naineris uncinata			
Notocirrus californiensis			
Chaetozone setosa	23	12	29
Haploscoloplos elongatus			
Notocirrus californiensis			
Spio filicornis			
Spiophanes bombx	1		1
Spiophanes missionensis			
Minuspio cirrifera			
Nothria iridescens			1
Ophelia sp.	1		
Paraonella platybranchia	2	2	
Notomastus lineatus			1
Thalenessa spinosa	29	2	34
Heteromastus filiformis			
Hesionidae sp.			
Phylo felix			
Orbiniidae sp.	1		
Maldanidae	2		
Syllidae	1		4
Nemertinea sp.	10	4	7
Molluscs			
Modiolus			
Macoma expansa	2	1	
Tellina modesta			5
Tellina nuculoides			
Tellina Bogedensis			
Psephidea lordi			
Axinopsida serricata			
Siliqua patual	1		
Mitrella gouldi			
Cylichna attonsa			
Mangelia sp.			
Olivella pycna	21	16	43
Olivella biplicata	6	5	14
Nassarius mendicus			
Gastrotrophon pacificus			
Dentalium rectuis			

TABLE A-5 INFAUNAL COMPARISON BY DEPTH (80' CONT.)

Crustacea			
Decapoda (Hermit crabs)			2
Mysids	5	11	5
Lyssocrangon stylirostris	2		1
Ampelisca macrocephala	1		
Anchicoluris occidentalis	5	1	12
Mandibulophoxus uncirostratus	82	29	65
Repoxynius epistomus			1
Repoxynius obtusidens			
Repoxynius vigitegus	25	1	32
Repoxynius sp.	1		
Eohaustorius sawyeri	17		
Eohaustorius washingtonianus			
Eohaustorius sencillus	39	1	35
Eohaustorius estuarius	3		32
Eohaustorius sp.	69		41
Foxiphalus major	4	2	8
Synchelidium rectipaleus		1	
Synchelidium shoemakeri	51	26	5
Monoclulodes spinipes			
Hippomedon denticulatus		26	
Diastylis dawsoni			
Cumella vulgaris	1		
Atylus tridens			
Bathycapea daltanae			
Eobrolgus spinosus		1	
Edotea sublittoralis	2		
Isaridae sp.			
Photis sp.			1
Phoxocephalidae		1	20
Echinodermata			
Dendraster eccentricus	40	29	46
Total Genera	27		25
Total species	32		29

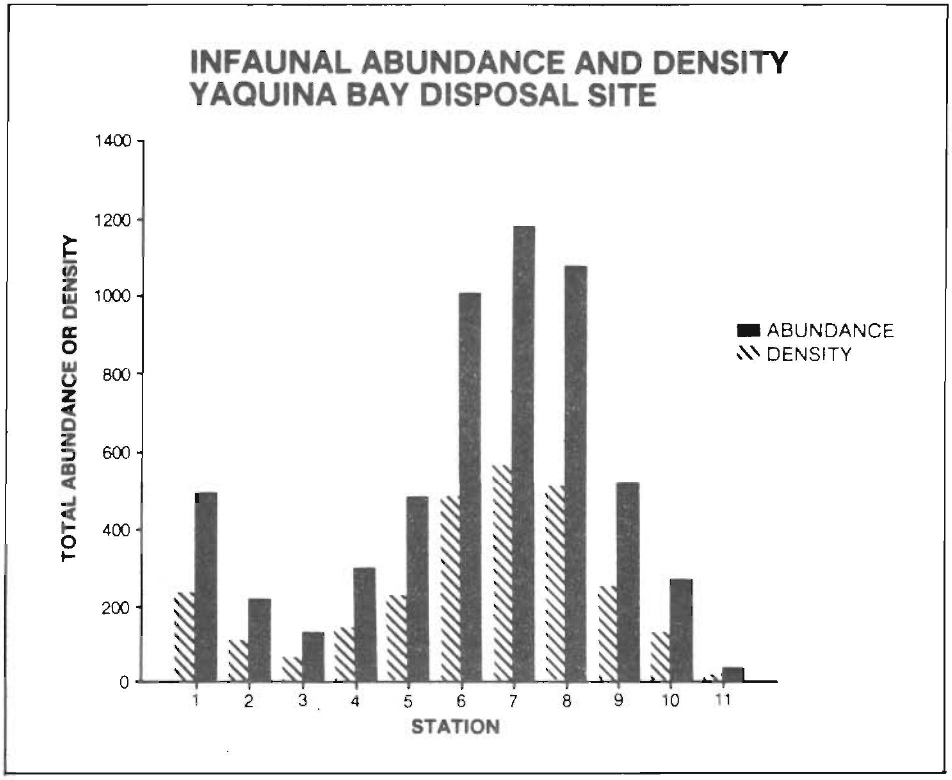


Figure A-4. Comparison of infaunal abundances and densities.

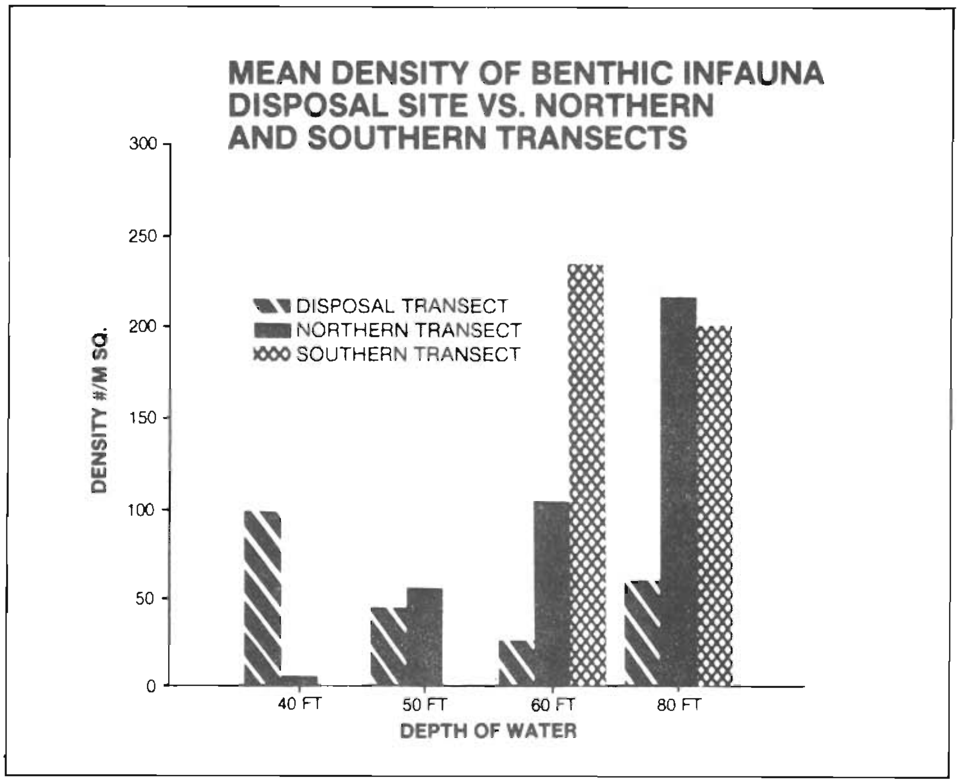
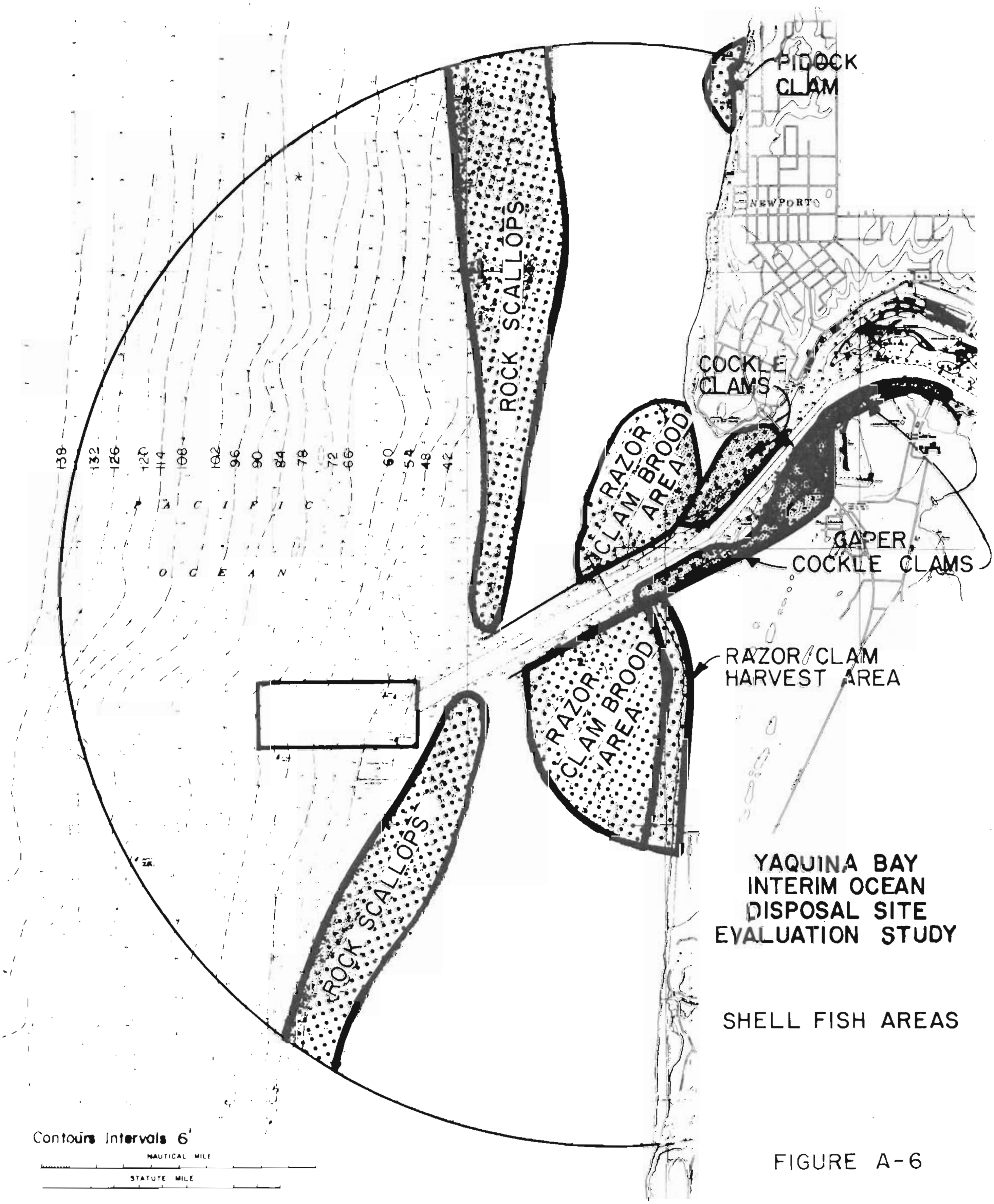


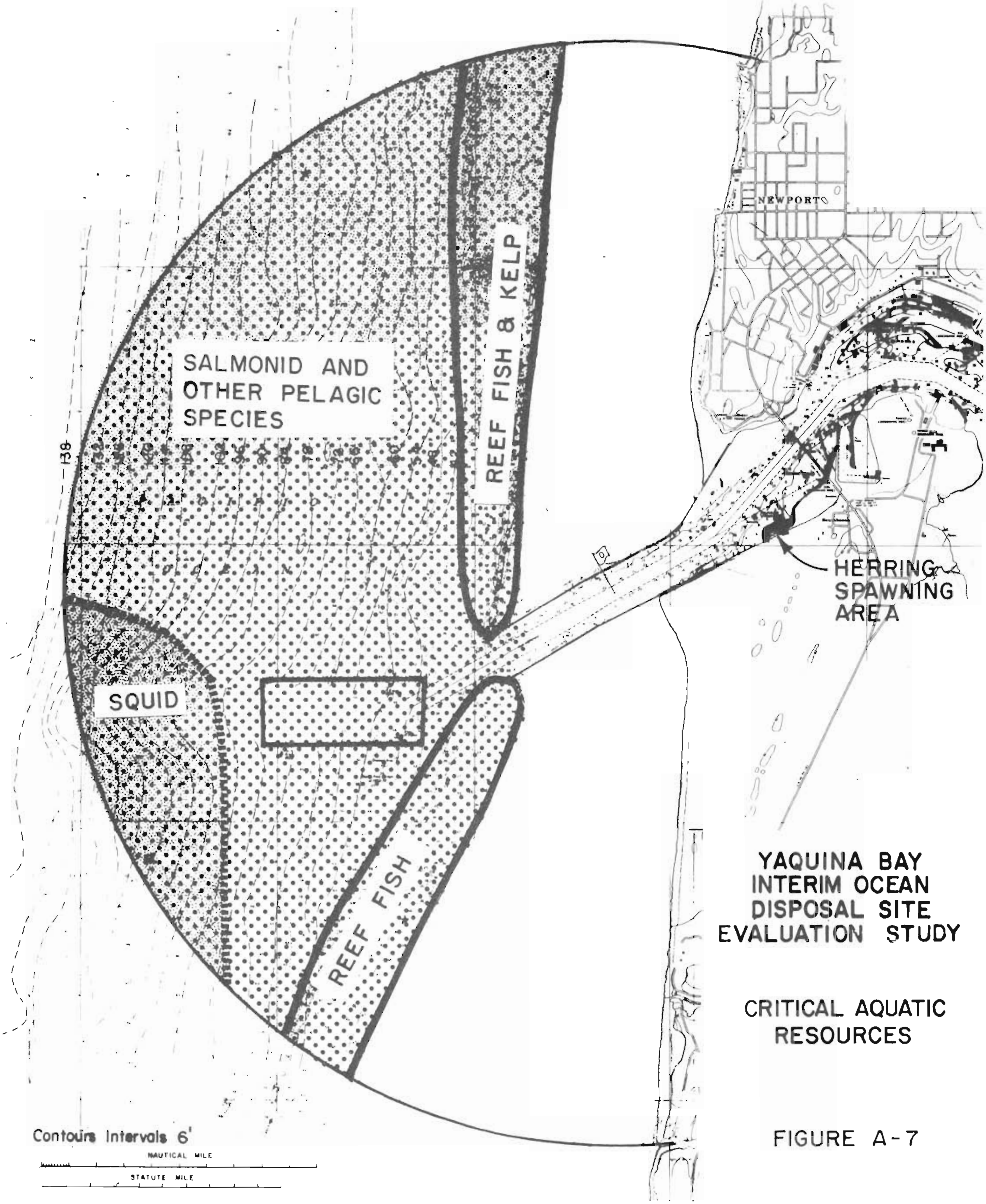
Figure A-5. Comparison of mean densities by depth for stations north and south of the disposal site.



YAQUINA BAY
INTERIM OCEAN
DISPOSAL SITE
EVALUATION STUDY

SHELL FISH AREAS

FIGURE A-6



YAQUINA BAY
INTERIM OCEAN
DISPOSAL SITE
EVALUATION STUDY

CRITICAL AQUATIC
RESOURCES

FIGURE A-7

demersal fish species. Pelagic species include anadromous salmon and steelhead and shad that migrate through the estuaries to upriver spawning areas. Other pelagic species include the Pacific herring, anchovy, smelt, and sea perch. Herring in particular spawn in the estuary and are present in large numbers during their migration inshore.

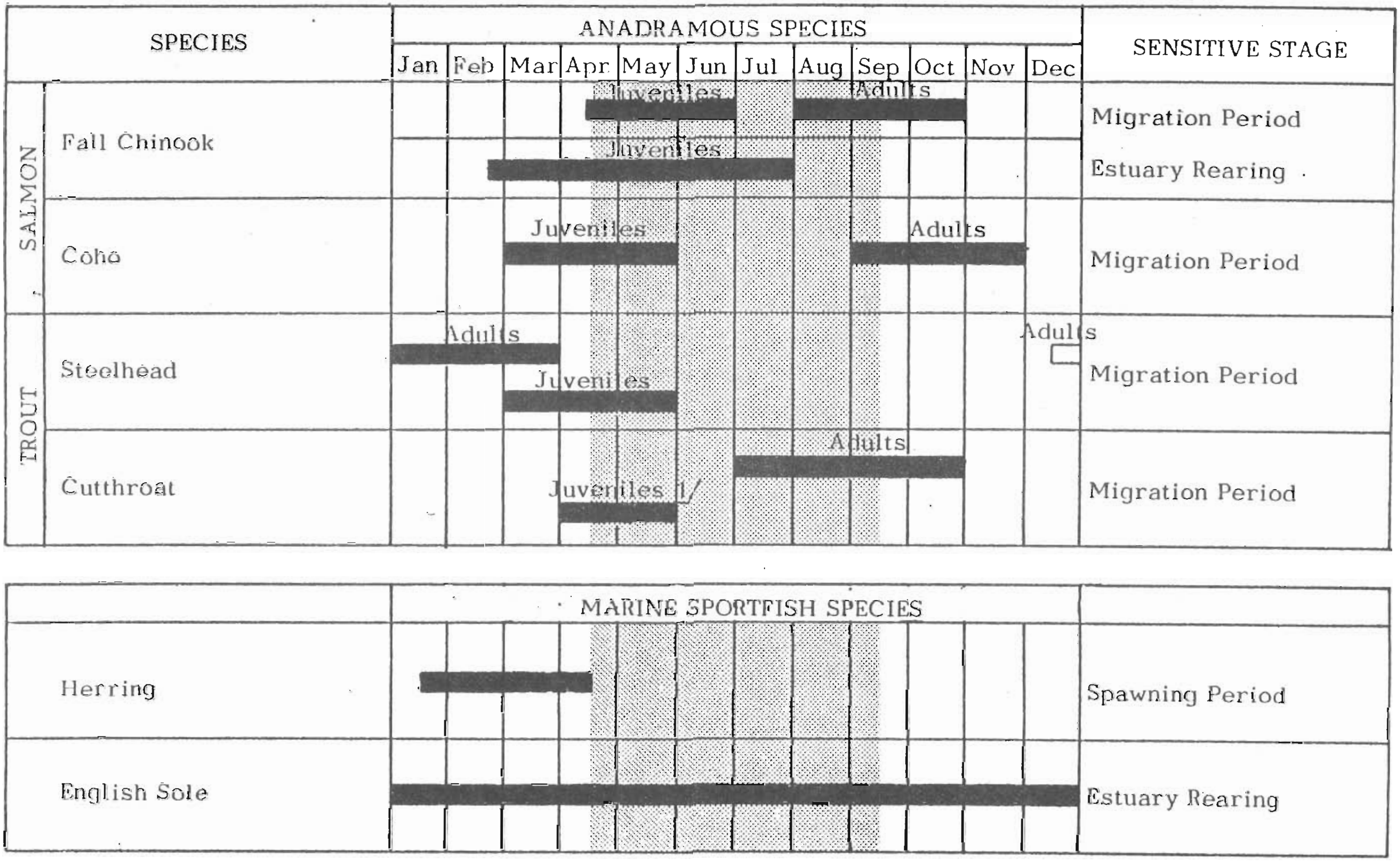
1.30 Though migratory species are present year-around, individual species are only present during certain times of the year. Tables A-6 and A-7 list the species and periods of occurrence off Yaquina Bay.

1.31 Demersal species present in the inshore area are mostly residents, and include a number of species of flatfish, sculpins, sea perch and rocky reef fish that are associated with the neritic reefs and the jetties. The flatfish species occur predominately over open sandflats. Dominant species include English sole, sanddab, and starry flounder. English sole and starry flounder spawn in the inshore coastal area (figure A-8) and juveniles of these as well as other marine species rear in the estuary.[5,7]

1.32 The neritic reefs off Yaquina are a unique feature of the coast. Off Yaquina they are associated with bull kelp (Macrocystis pyrifera) beds. These beds provide important invertebrate and fish habitat and increase the overall productivity of the reef. A 1954 survey[8] indicated approximately 114 acres of kelp beds off Yaquina Bay.

1.33 The reef fish community differs depending on the depth of the reef.[15] The shallower reefs (>20-meter depth) are dominated by the black rockfish (Sebastes melanops) while the deeper reefs (20-50 meters) are dominated by lingcod (Ophiodon elongatus), yellow rockfish (Sebastes ruberrimos) and black rockfish. Fish were generally larger on the deeper reefs than the shallower reefs, presumably due to a generalized movement offshore of individuals as they mature. Species composition also changed due primarily to a significant increase in number of lingcod on the reefs during their winter spawning period. An analysis of food habits indicated that none of the dominant species were in competition with each other.

Table A-6

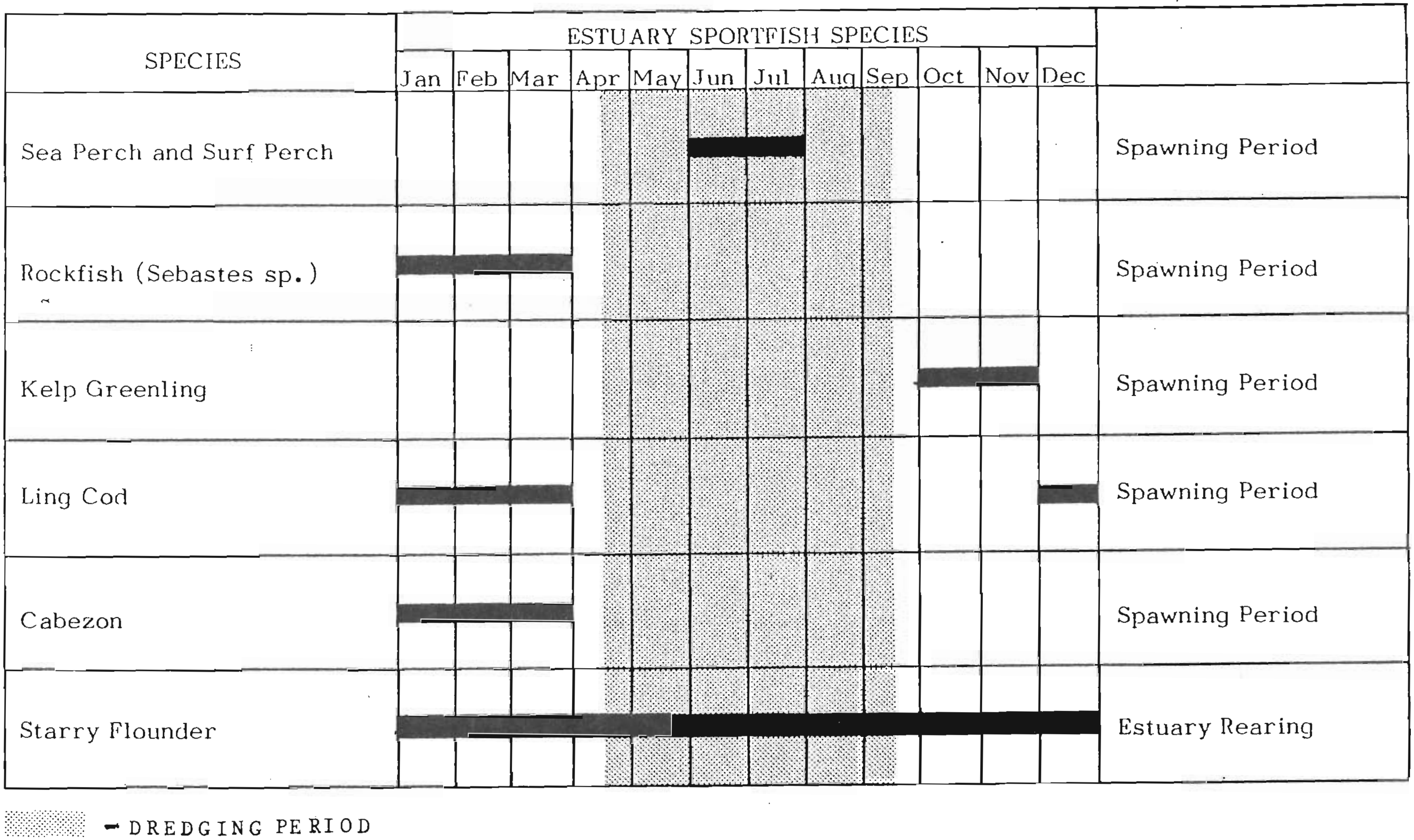


1/ May rear in bay for extended periods

DREDGING PERIOD

Periods of Occurrence of Principal Fish Species off Yaquina Bay.[12]

Table A- 7



Periods of Occurrence of Principal Fish Species off Yaquina Bay.[12]

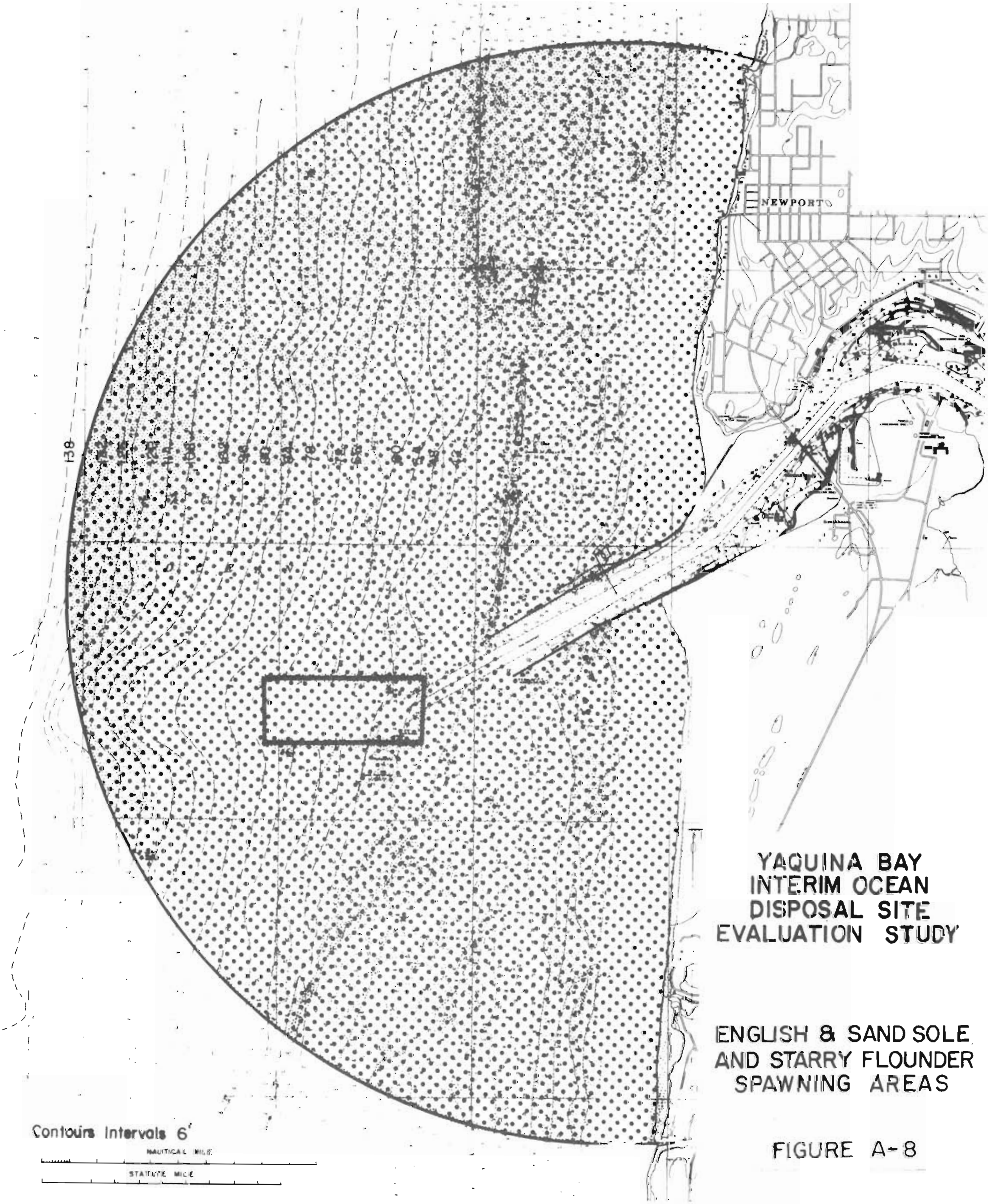

NEWPORT
YAQUINA BAY
INTERIM OCEAN
DISPOSAL SITE
EVALUATION STUDY
ENGLISH & SAND SOLE
AND STARRY FLOUNDER
SPAWNING AREAS
Contours Intervals 6'
NAUTICAL MILE
STATUTE MILE

FIGURE A-8

Commercial and Recreational Fisheries

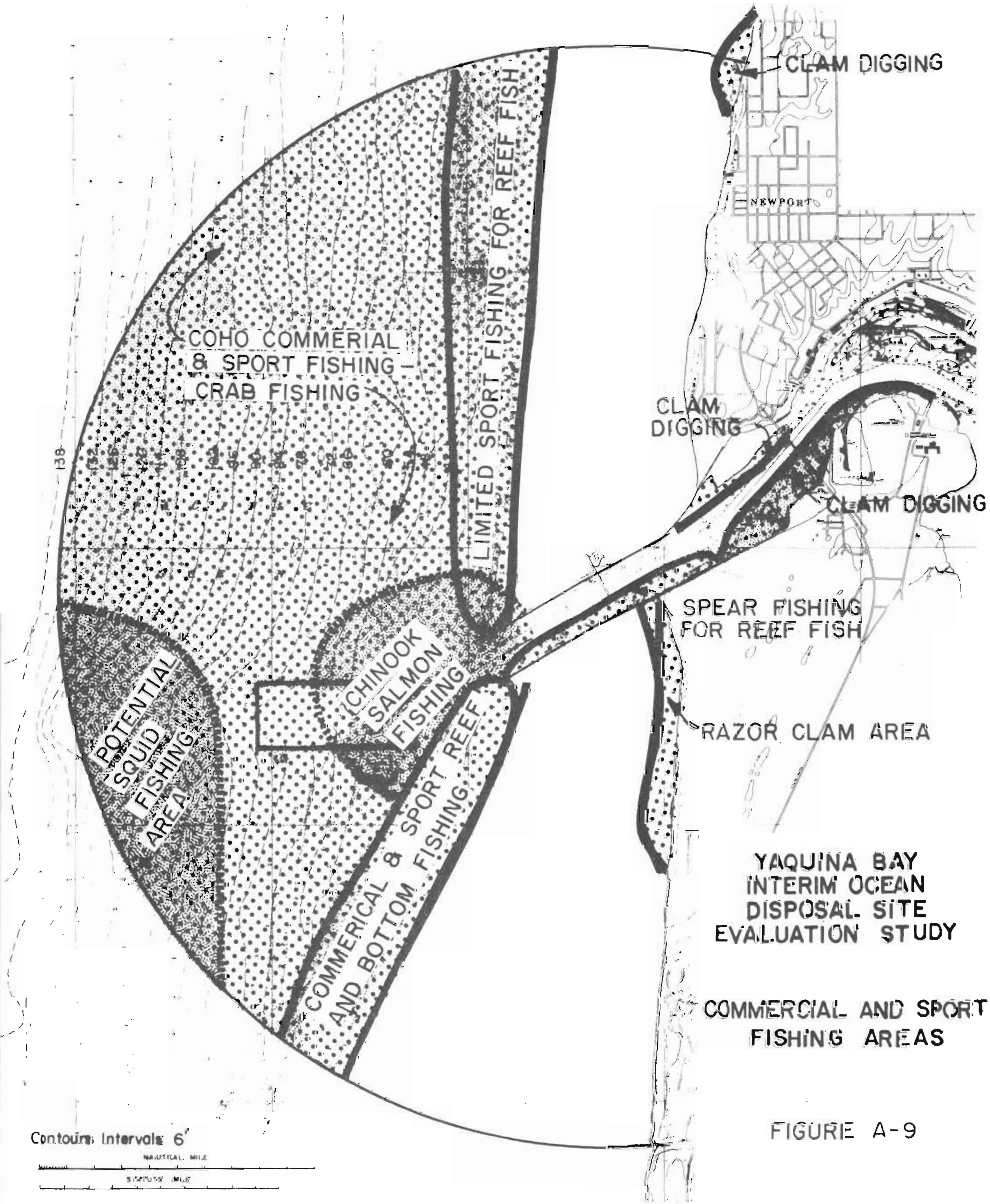
1.34 Major commercial and recreational fishing and clamming areas are shown in figure A-9. The predominant commercial fishery is for salmon and Dungeness crab. Salmon trolling and crab fishing are done over much of the area offshore of the reefs. The actual location varies from year to year depending upon the abundance of fish or crabs.

1.35 The only other commercial fishing activity in the area is for clams and this occurs in the intertidal mudflats in the bay and beaches along the coast. ODFW has identified a potential squid fishing area (figure A-4) and it is possible that a commercial fishery will develop if sufficient stocks exist and a market develops.

1.36 The principal recreational fishing that occurs off Yaquina Bay is for salmon and bottom fish. Salmon fishing is done by charter boat and private boat and occurs in the same areas as the commercial fishing but generally closer to shore. Bottom fishing is done along the south reef area by charter boat for black rockfish and lingcod. The north reef is not fished to any extent because of its hazardous navigation conditions. Other recreational activities include clamming in the bay and along the beach and spearfishing along the jetties.

Wildlife

1.37 Bayer[16] documented avian use of the project area. His observations were only for resident birds and did not account for migratory species. His observations were made from approximately April through September 1982-83 and indicated common murres were the most abundant species. Maximum numbers of common murres were 4,330 birds, with the highest monthly average of 1,000. Gulls (multi-species) were the next most common birds with maximum numbers approaching 750 birds. Cormorants frequented the project area but not in substantial numbers (e.g., maximum count 133 birds). Various other piscivorous birds (e.g., loons, shearwaters, western grebes, pigeon guillemot, Cassin's auklet, and Caspian tern) occur in the project area. Brown pelicans, an endangered species, are present in the project area in the summer and fall as post-breeding transients. They occur around the jetty and reefs foraging for fish.



YAQUINA BAY
INTERIM OCEAN
DISPOSAL SITE
EVALUATION STUDY

COMMERCIAL AND SPORT
FISHING AREAS

FIGURE A-9

1.38 Snowy plovers, listed by the State of Oregon as a threatened species, occur in the project area. Breeding populations occur on South Beach. A precipitous decline has occurred in recent years with no breeding birds observed during 1981 and 1982 surveys. Historically, 25+ snowy plovers occurred in the late 1960's at South Beach. Recreational use and predation are probable causal factors for loss of snowy plovers from South Beach.

1.39 Most marine mammals present in the area are migrants; however, Steller's sea lions, harbor seals, and harbor porpoises frequent the project area.[17] Pupping or hauling out areas are not known in the immediate project vicinity. Figure A-10gives locations of all wildlife areas. Whale activity and uses of project vicinity are discussed in the coordination section of the main report.

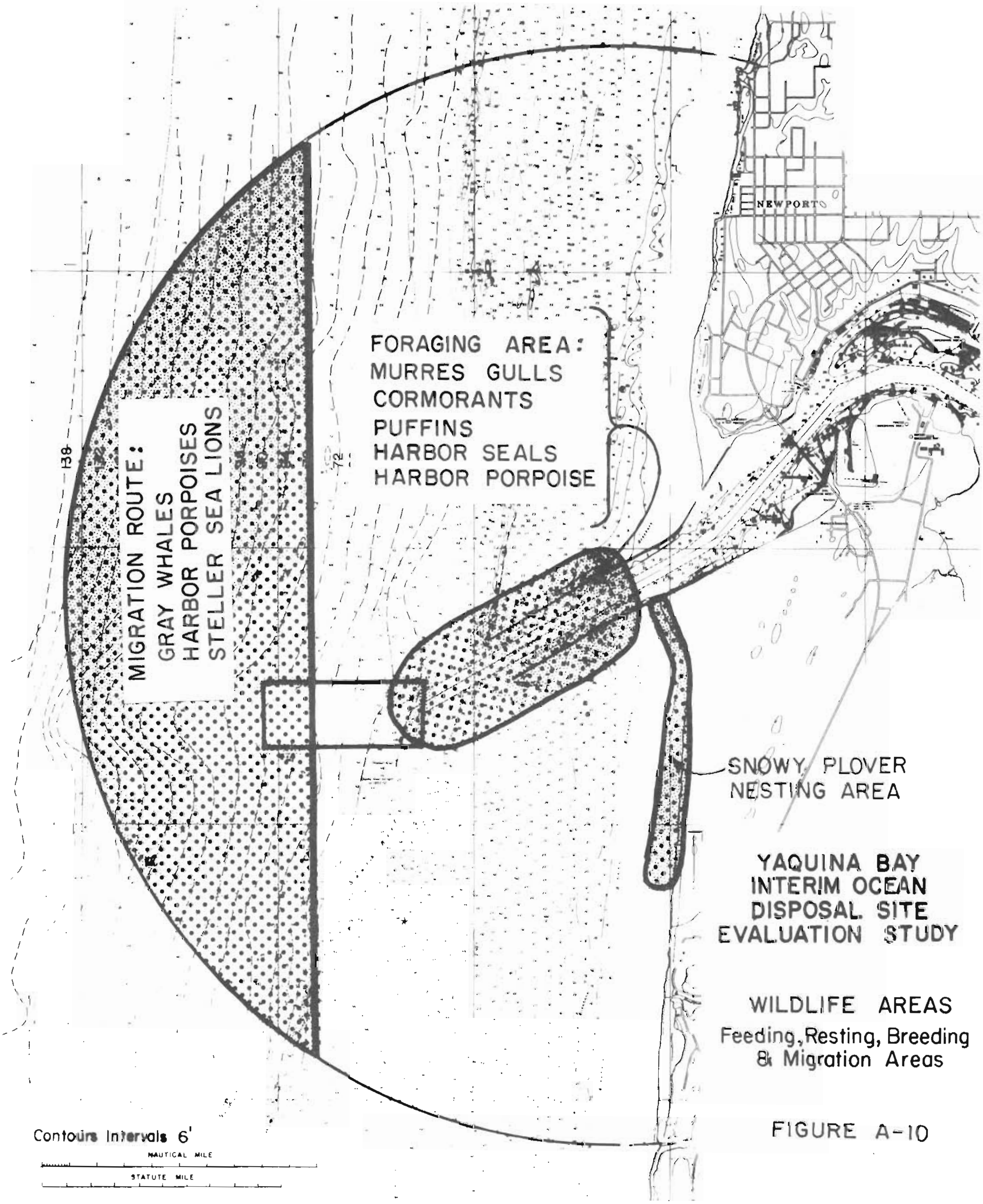

FORAGING AREA:
MURRES GULLS
CORMORANTS
PUFFINS
HARBOR SEALS
HARBOR PORPOISE
MIGRATION ROUTE:
GRAY WHALES
HARBOR PORPOISES
STELLER SEA LIONS
NEWPORT
SNOWY PLOVER
NESTING AREA
YAQUINA BAY
INTERIM OCEAN
DISPOSAL SITE
EVALUATION STUDY
WILDLIFE AREAS
Feeding, Resting, Breeding
& Migration Areas
Contours Intervals 6'
NAUTICAL MILE
STATUTE MILE

FIGURE A-10

LITERATURE CITED

1. Peterson, W.T. and C.B. Miller, 1976. Zooplankton Along the Continental Shelf off Newport, Oregon, 1969-1972: distribution, abundance, seasonal cycle, and year-to-year variations. Oregon State University, Sea Grant College Program Pub. No. ORESU-T-76-002. 111 pg.

2. Peterson, W.T., C.B. Miller and A. Hutchinson, 1979. Zonation and Maintenance of Copepod Populations in the Oregon Upwelling Zone. Deep-Sea Research 26A:467-494.

3. Lough, R.G., 1976. Larval Dynamics of the Dungeness Crab, Cancer magister, off the Central Oregon Coast, 1970-71. Fish. Bull. 74(2):353-376.

4. Richardson, S.L., 1973. Abundance and Distribution of Larval Fishes in Waters off Oregon, May-October, 1969, with Special Emphasis on the Northern Anchovy, Engraulis mordax. Fish. Bull. 71(3):697-711.

5. Richardson, S.L. and W.G. Pearcy, 1977. Coastal and Oceanic Fish Larvae in an Area of Upwelling off Yaquina Bay, Oregon. Fish. Bull. 75(1):125-145.

6. Richardson, S.L., J.L. Laroche and M.D. Richardson, 1980. Larval Fish Assemblages and Associations in the Northeast Pacific Ocean Along the Oregon Coast, Winter-Spring 1972-1975. Estuarine and Coastal Marine Science (1980) II, 671-698.

7. Pearcy, W.G. and S.S. Myers, 1974. Larval Fishes of Yaquina Bay, Oregon: A Nursery Ground for Marine Fishes? Fish. Bull. 72(1):201-213.

8. Richardson, M.D., A.G. Carey, and W.A. Colgate. 1977. An Investigation of the Effects of Dredged Material Disposal on Neritic Benthic Assemblages off the Mouth of the Columbia River. Phase II. DACW57-76-R-0025.

9. Hogue, Wayne E, 1982. Seasonal Changes in the Abundance and Spatial Distribution of a Meiobenthic Assemblage on the Open Oregon Coast and its Relationship to the Diet of 0-age Flatfishes. Ph.D. thesis, OSU, Corvallis, OR 125 pp.

10. Hancock, D.R., P.O. Nelson, C.K. Sollitt, K.J. Williamson, 1981. Coos Bay Offshore Disposal Site Investigation Interim Report Phase I, February 1979-March 1980. Report to U.S. Corps of Engineers, Portland, District, Oregon, for Constract No. DACW57-79-C-0040. Oregon State University, Corvallis, Oregon.

11. Nelson, P.O., C.K. Sollitt, K.J. Williamson, D.R. Hancock, 1983. Coos Bay Offshore Disposal Site Investigation Interim Report Phase II, III, April 1980-June 1981. Report submitted to the U.S. Army Corps of Engineers, Portland District for Contract No. DACW57-79-0040. Oregon State University, Corvallis, Oregon.

12. Sollitt, C.K., D.R. Hancock, P.O. Nelson, 1984. Coos Bay Offshore Disposal Site Investigation Final Report Phases IV, V, July 1981-September 1983. U.S. Army Corps of Engineers, Portland District, Portland, Oregon, for Contract No. DACW57-79-C-0040, Oregon State University, Corvallis, Oregon.

13. Oceanographic Institute of Oregon, 1983. An examination of the Feasibility of Extrapolating Infaunal Data from Coos Bay Oregon to Yaquina Bay Oregon. Final report USACOE, Portland District contract #DACW57-84-M-1186.

14. Waldron, K.D., 1954. A Survey of the Bull Kelp Resources of the Oregon Coast in 1954. Res. Briefs, Fish. Comm. of Oregon. 6:2:15-20.

15. Steiner, R.G., 1978. Food Habits and Species Composition of Neritic Reef Fishes off Depoe Bay, Oregon. Masters Thesis, Oregon State University.

16. Bayer, R., 1983. Ore Aqua Company Biologist, Newport, OR. Personal communication.

17. Maser, C., B.R. Mate, J.F. Franklin and C.T. Dyrness, 1981. Natural History of Oregon Coast Mammals. USDA For. Serv. Gen. Tech. Rep. PNW-133, 496 p. Pac. Northwest For. and Range Exp. Stn., Portland, OR.

18. Montagne-Bierly Associates, Inc., 1977. Yaquina Bay Hopper Dredge Scheduling Analysis. Prepared for: U.S. Army Corps of Engineers, Portland District, Navigation Division, P.O. Box 2946, Portland, OR 97208.

APPENDIX B

NONLIVING RESOURCES

APPENDIX B - NONLIVING RESOURCES

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TABLES

FIGURES

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FIGURES (continued)

NON-LIVING RESOURCES

Introduction

2.01 Despite the proximity of the study area to the OSU Marine Science Center, there is almost no field data or information available on non-living resources. The only previous studies of the geology and sediments were sponsored by USACE, Portland District, Corps of Engineers[1,2]. Detailed bathymetry outside the reef areas was first obtained by Portland District in 1983. Two PhD theses were done on sediments at Yaquina. Kulm[3] discussed the beach and littoral sediments and transport in general and Miller[4] studied sediment transport in a very small area about 1 mile north of the jetties. Fox and Davis[5] studied the beach south of South Beach. There are numerous other studies from which generalizations can be made about the study area. Interviews with regional experts supplemented published information.

Regional Setting

2.02 The study area is on the central Oregon coast offshore of Yaquina Bay (figure B-1). Yaquina Bay is the fourth largest estuary in Oregon, but the drainage basin ranks only eleventh in area.[6] The shoreline and nearshore vary from wide sand beaches to rocky headlands. Offshore rocks and reefs attest to the retreat of the coastline from erosive ocean forces. Part of this retreat has been due to a sea level rise of over 30 feet in the past 6,000 years. This is only the latest in a long series of fluctuations in sea level which have affected the area.

2.03 The sea cliffs and headlands as well as the rock underlying all the beach and nearshore sands are many millions of years old. The beach and nearshore sands are less than 1 million years old. These sands were deposited by coastal rivers when sea level was lower and eroded from the older rocks as sea level rose and fell. Little, if any, sand is presently escaping from coastal estuaries. The high wave energy has removed any fine silts and clays from

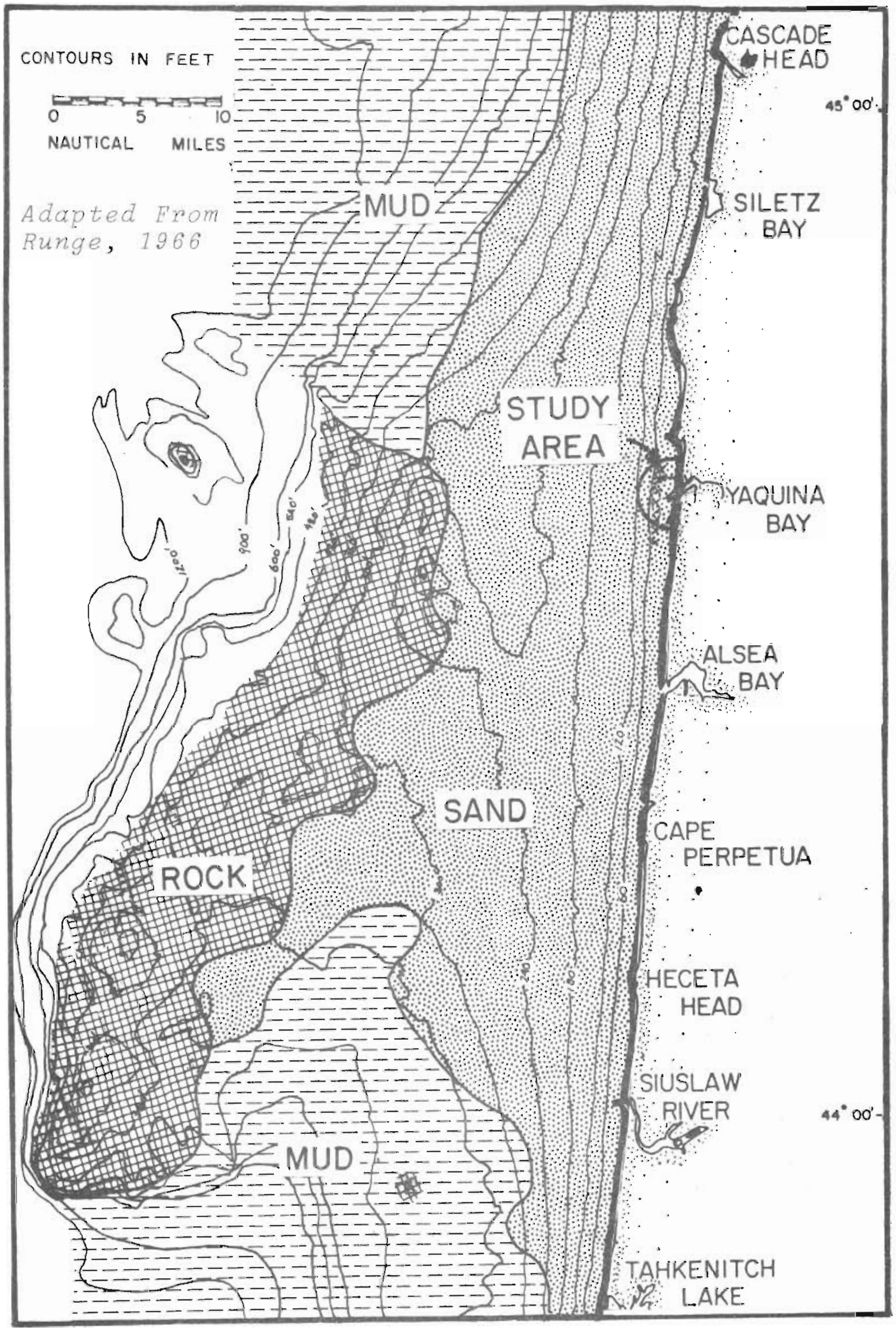


Figure B-1. Surface Features and Sediment Cover of the Continental Shelf off Central Oregon nearshore sediments leaving only fine sand covering an area offshore for 10-20 miles along much of the Oregon coast.

2.04 The continental shelf off Oregon is widest from Siuslaw to Yaquina Bay extending over 30 miles offshore (figure B-1). This is due to a large rocky bank complex beginning about 15 miles off Yaquina and trending southwest. Little silt and clay is found inshore of this bank and the sediments are predominantly fine sand out to over 300 feet deep. This sand zone narrows rapidly south of Siuslaw and less rapidly north of Yaquina. In three dimensions this inner shelf sand zone is a wedge or lens of sediment overlying much older rock.

Geologic Setting

2.05 Of the many references on coastal Oregon, Kulm (1977)[7] presents the best overview of geology and sediments. Geologically speaking, the Oregon coast is young and active. Regional uplift of several hundred feet, intense volcanic activity and tremendous erosion and sedimentation have occurred over the past few million years. Changes in sea level caused the ancient coastline to vary from several miles inland to over 10 miles offshore. This history has resulted in the variety of coastal features we now see from massive volcanic headlands such as Cape Lookout to massive sand dunes such as the Oregon Dunes. The effects of the Pacific Ocean on this geologic framework has combined to produce spectacular effects within historic time. Coastal landslides and severe beach erosion are common in certain areas and there are numerous submerged nearshore reefs and exposed offshore rock islands or stacks.

2.06 In the Newport area, marine terrace deposits over 50 feet thick overlie much older, eroded sandstones and mudstones. These terrace deposits form the steep sea cliffs north from the jetties but are absent for 1-1/2 miles to the south where modern sands form the South Beach area. Figure B-2 shows the geology of the Newport area.

2.07 A limited number of borings[1] and surface geology indicate the nature of the underlying rock. A succession of siltstones, mudstones and sandstones

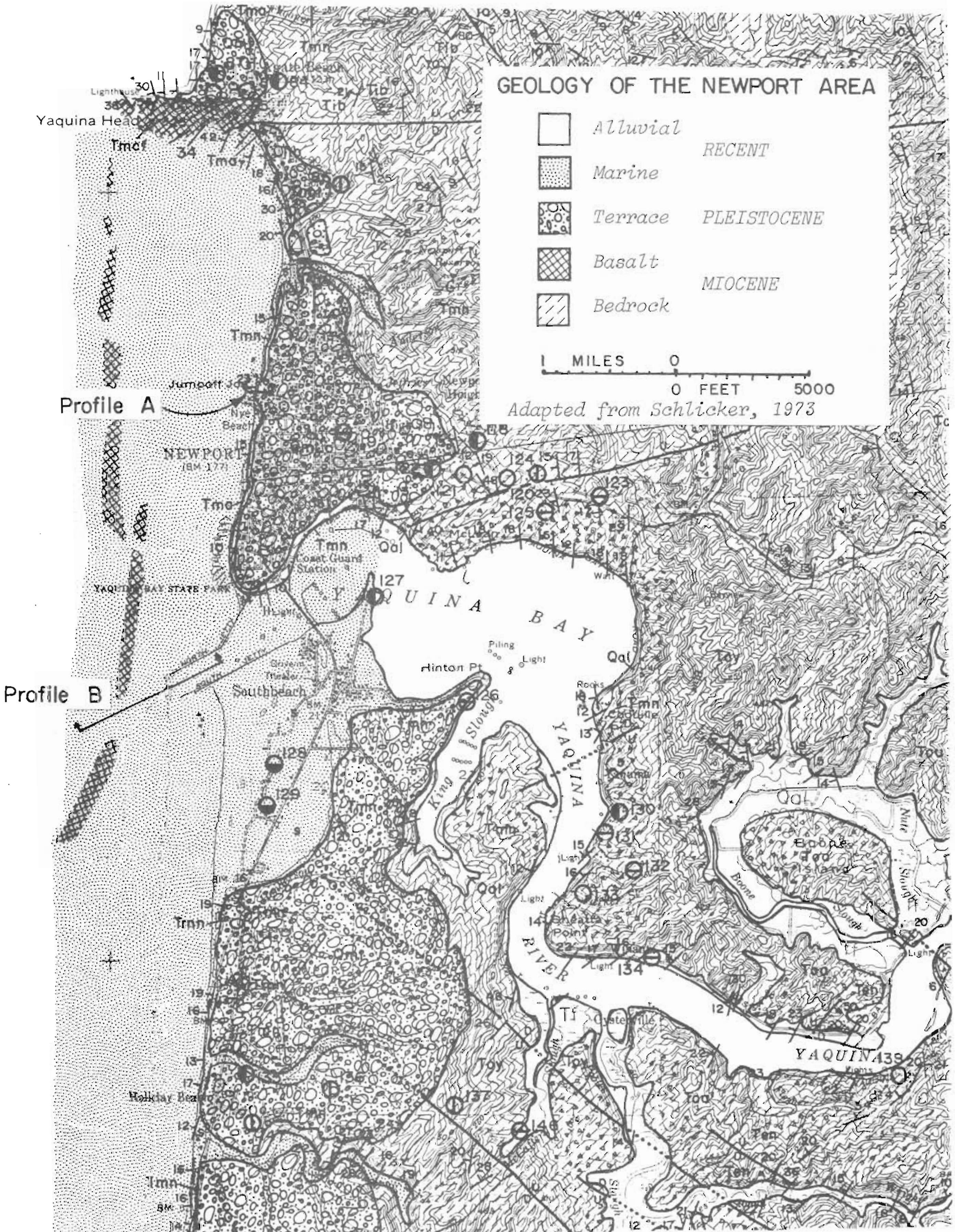


Figure B-2. Surface Geology of the Newport Area dip seaward from 10° or 20°. A layer of basalt intrudes the sandstone layer and forms Yaquina Head and the offshore reefs. Onshore these beds are overlain by much younger terrace deposits of semiconsolidated sands and silts and occasional gravel formed by marine forces less than 1 million years ago. Erosion of these deposits is rapid with several feet per year occurring in the Jumpoff Joe area along with occasional landslides (figure B-3).

2.08 Figure B-3 also shows a detailed cross section prepared from cores drilled by the Corps throughout the navigation channel. Recent marine sand forms a discontinuous cover over the underlying rock. At the contact between the less resistant mudstone and more resistant sandstone a thick lens of sand has accumulated. This has also happened at the basalt-sandstone contact. Not shown but present are discontinuous layers of highly resistant tuff within the sandstone. The extent and type of rock are unknown beyond the basaltic layer. Figure B-4a and B-4b compares a generalized cross section of the entire study area with subbottom seismic profiles obtained in 1984. The sand layer ranges from 5 to 35 feet thick over an irregular rock surface throughout the area. A geologic map of the ZSF prepared from sidescan and seismic data is discussed in paragraph 2.28.

Bathymetry

2.09 The nearshore bathymetry at Yaquina Bay is influenced by the underlying geology, marine forces, and human action. From the tip of the north jetty a pronounced reef extends northward to Yaquina Head. This reef, with depths less than 12 feet in places, is an eroded basalt layer related to the basalt headland at Yaquina Head. There are numerous submerged rock outcrops between the reef and North Beach which is relatively narrow (figure B-5). These outcrops are probably part of the sandstone formation found in channel borings and shown on figure B-4. South of the jetties the offshore reef turns seaward and is less continuous. There are few indications of submerged rock outcrops inshore of the reef and the South Beach area is a wide expanse of recent sand.

2.10 A combination of littoral transport and jetty construction has resulted in significant beach advance south of the jetties. This process began in 1882 with the first attempt to build the south jetty[8] and has continued as the jetty has been progressively extended (figure B-6). This process has not been

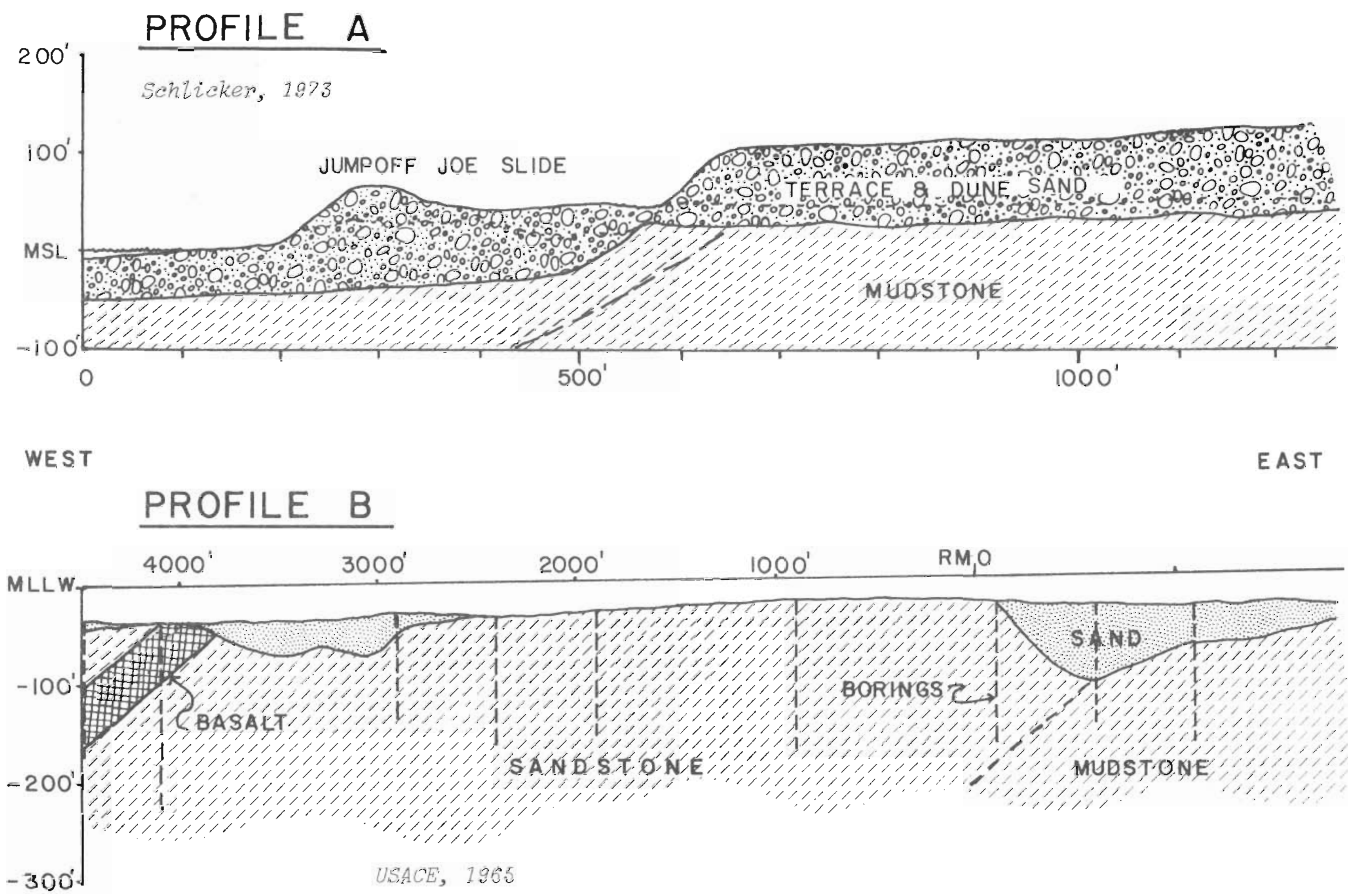


Figure B-3. Subsurface Geologic Profiles at Newport

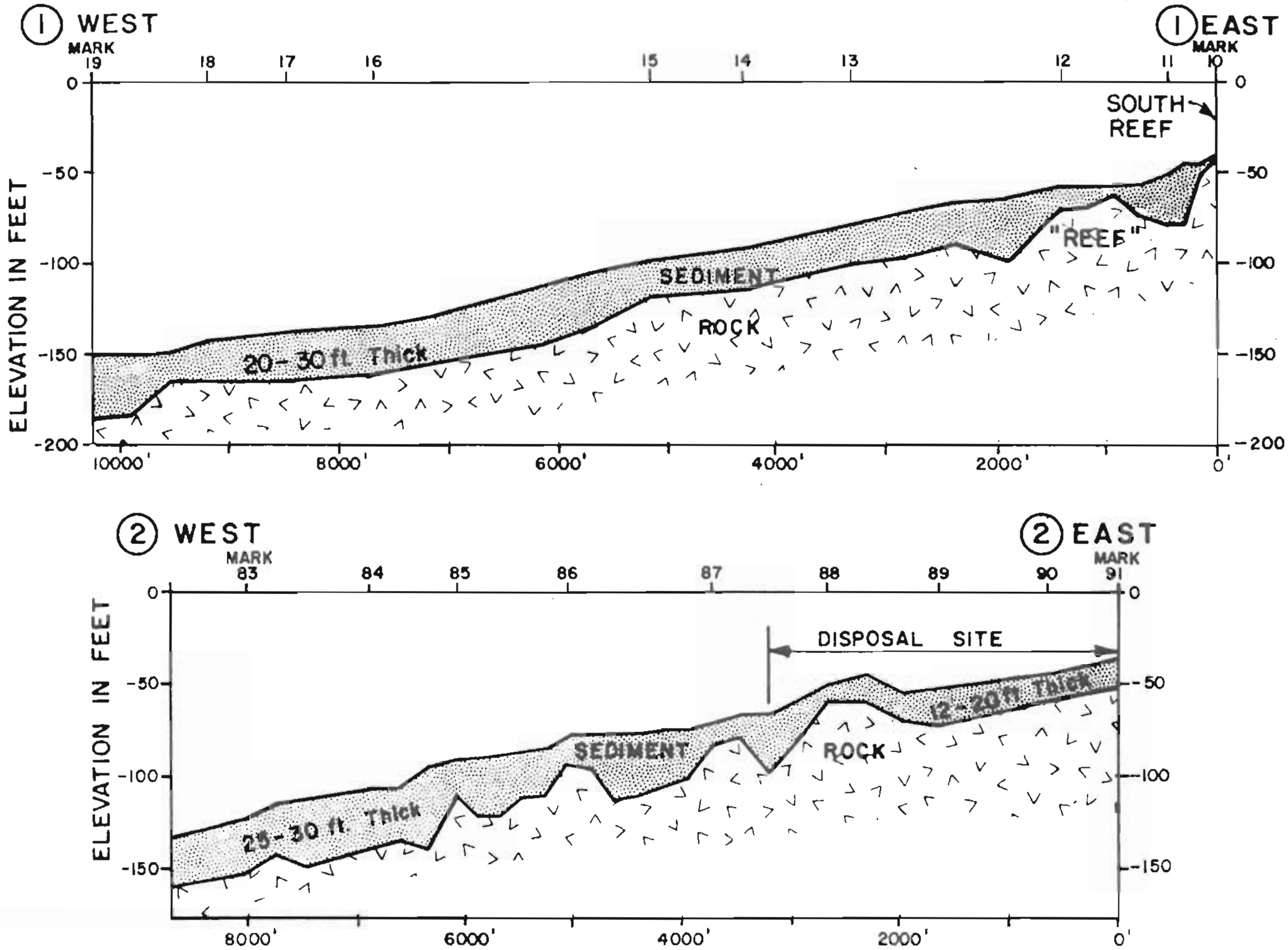


Figure B-4(a). Yaquina Bay Profiles

NOTE:
Elevation Datum is MLLW from Fathometer Recordings. Located by Portland District, COE

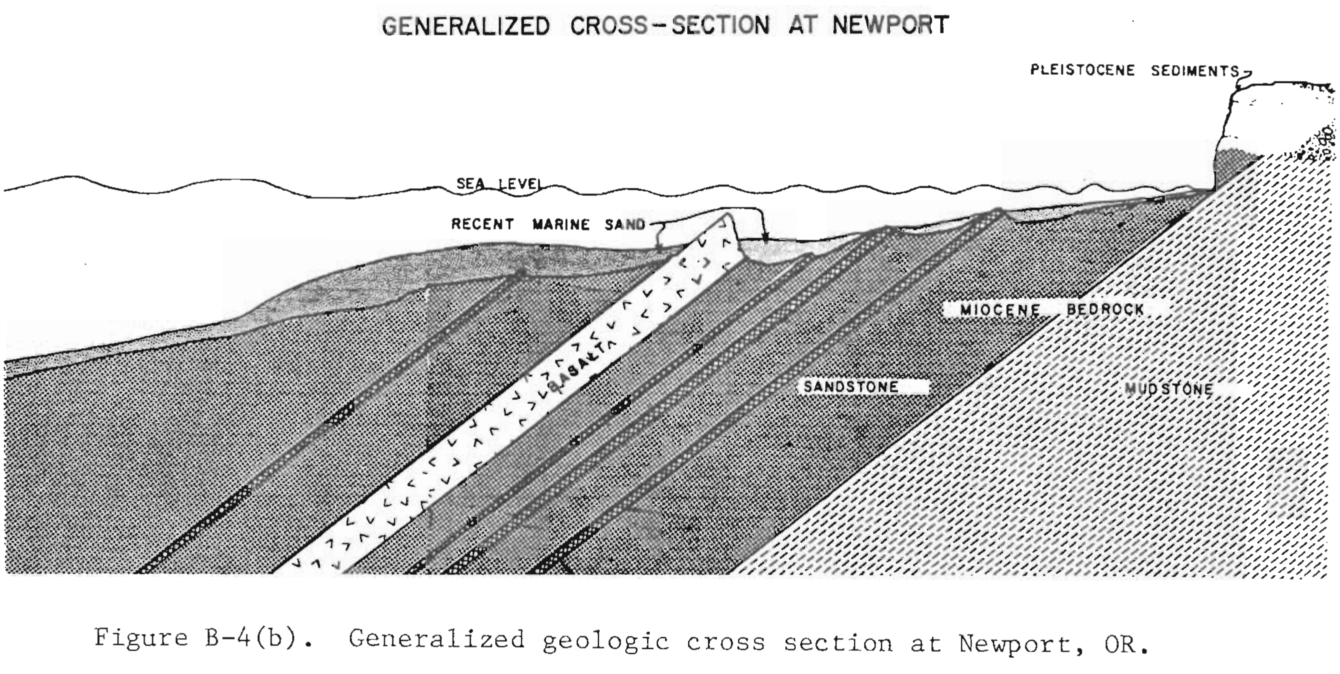
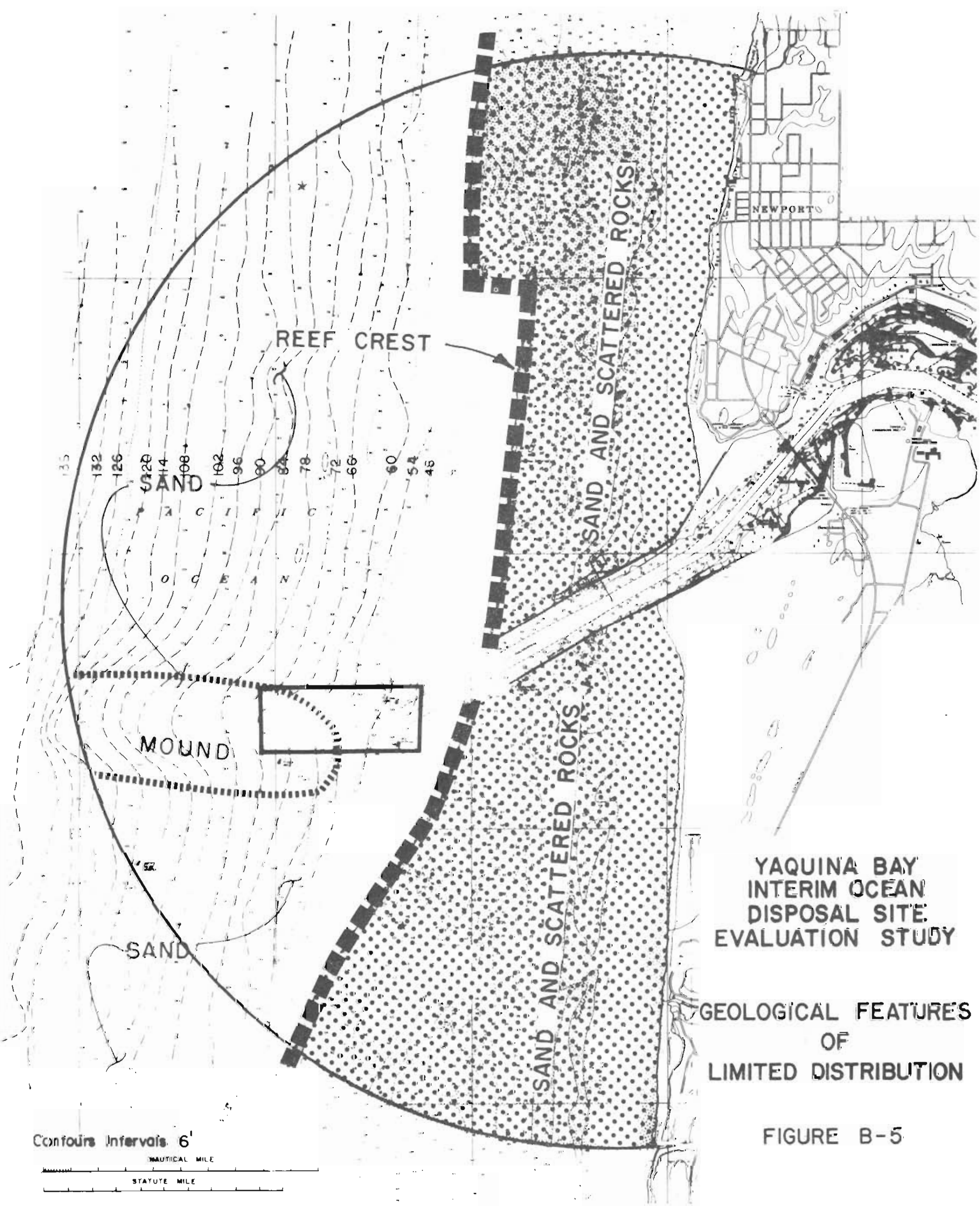


Figure B-4(b). Generalized geologic cross section at Newport, OR.



YAQUINA BAY
INTERIM OCEAN
DISPOSAL SITE
EVALUATION STUDY

GEOLOGICAL FEATURES
OF
LIMITED DISTRIBUTION

FIGURE B-5

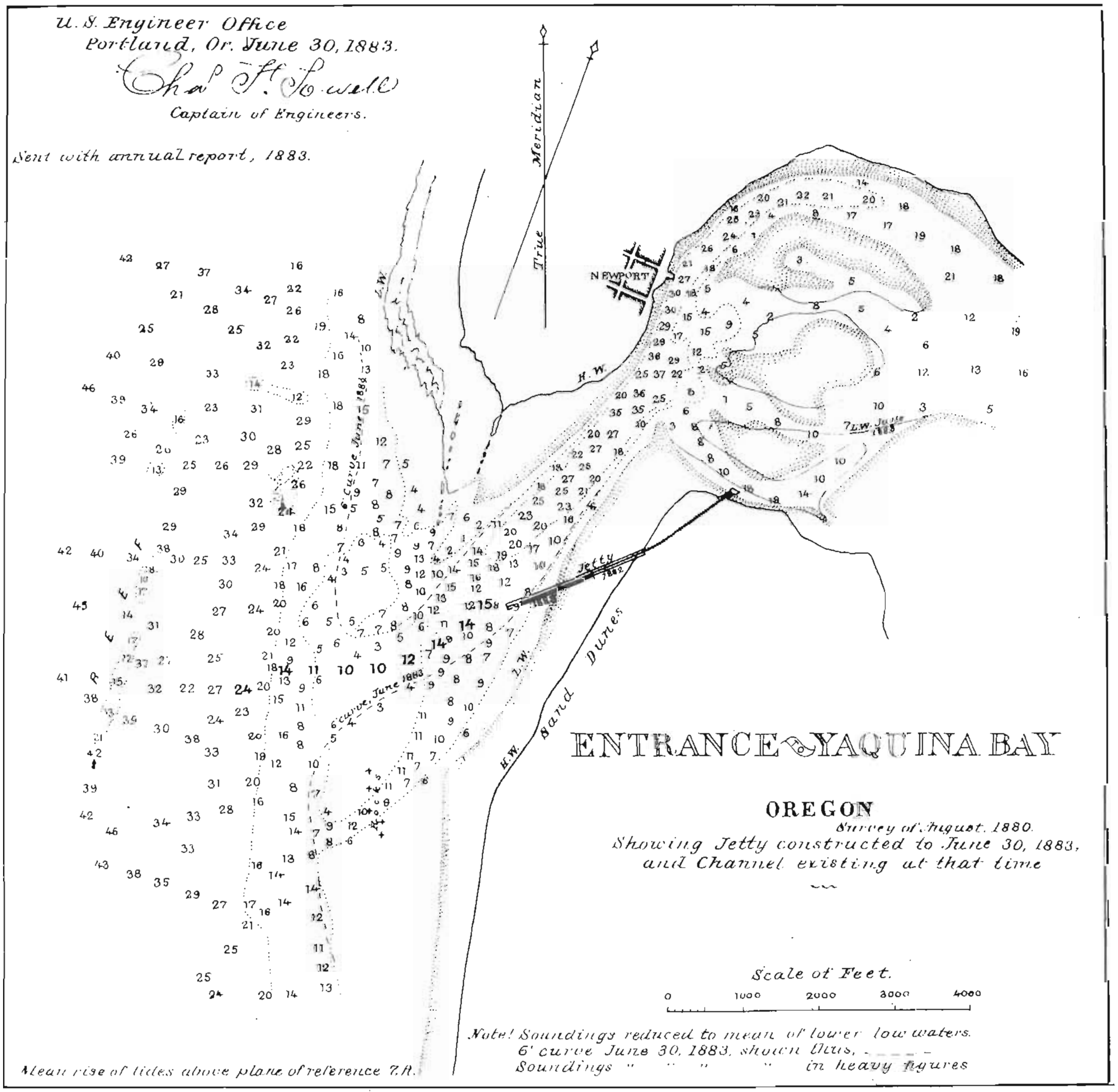


Figure B-6. Yaquina Bay Entrance Surveys 1880 and 1883, Before and After Initial South Jetty Construction apparent north from the jetties except for the area immediately adjacent to the north jetty. The offshore reef apparently limits onshore sand transport in the area between the North Jetty and Yaquina Head.

2.11 Seaward of the reef complex the bottom slopes about 60 feet per mile out to below -120 feet (MLLW) where the slope flattens to about 20 feet per mile out to over -250 feet. There is a pronounced seaward bulge of bottom contours between -60 feet and -120 feet extending west from the existing disposal site as shown on figure B-7. The relationship of this bulge to disposal operations is discussed under the sedimentation section.

Sedimentation

2.12 Existing Sediments. As shown on figure B-1[9,10,11] the surface sediments on the inner shelf are all fine sand. Analysis of 41 samples between Columbia River and Cape Blanco in less than 120 feet of water shows the average grain size ranges from .125-.188 mm. Samples from near Newport in from 9-33 meters of water averaged .165 mm.[4] Surf zone samples near Newport averaged .188-.250 mm.[3] Table B-1 lists the grain-size data for sixteen samples collected within the ZSF in depths ranging from 44 to 144 feet. The median grain sizes, listed as d50, are all in the fine sand size class.

TABLE B-1
YAQUINA OFFSHORE SEDIMENT SAMPLES

	DEPTH	GRAIN SIZE (MM)							d50[1]	organics[2]
		4	2	1	0.5	0.25	0.125	0.062		
SAMPLE 1	44	0	0	0.4	1.2	11.2	98.2	99.8	0.19	1.0
SAMPLE 2	51	0	0	0.2	1	5.4	87.7	99.9	0.18	1.3
SAMPLE 3	59	0	0.1	0.7	2.1	8.9	86	99.8	0.18	1.4
SAMPLE 4	71	0	0	0.1	0.8	2.3	70.6	97.9	0.16	2.7
SAMPLE 5	83	0	0.6	1.5	3.3	22.6	94.5	99.7	0.2	1.1
SAMPLE 6	103	0	0	0.4	2.4	24.3	97.3	99.7	0.21	0.7
SAMPLE 7	123	0	0	0.1	1.6	26.1	98.3	99.9	0.21	0.9
SAMPLE 8	143	0	0	0	1.6	19.3	98.3	99.8	0.2	0.6
SAMPLE 9	140	0	0	0	0.4	10	96.3	99.5	0.19	1.1
SAMPLE 10	113	0	0	0.2	1	11.7	86.1	99.2	0.18	0.8
SAMPLE 11	80	0	0	0.1	0.8	3.7	76	99.2	0.17	1.5
SAMPLE 12	55	0.2	0.6	2.1	4.1	12.2	90.8	99.7	0.19	1.4
SAMPLE 13	61	0.1	0.7	2.7	5.1	20.9	96.1	99.5	0.2	1.5
SAMPLE 14	83	0	0	0.1	1.5	18.5	95.9	99.8	0.2	0.8
SAMPLE 15	114	0	0	0.2	1.5	15.6	98.3	99.9	0.2	0.6
SAMPLE 16	144	0	0	0.1	2.1	27.9	98.4	99.7	0.21	0.9

Notes: [1] Median grain size
[2] Volatile Solids Percent

2.13 There is a complete lack of finer silts and clays offshore of Newport with fine sands abutting the northeast extension of Stonewall Bank. Silt appears at -300 feet immediately north from Newport and as the inner shelf narrows this boundary moves to about -450 feet. The lack of fine silt or clay is probably due to the high wave energy regime. Summer wave conditions produce bottom sediment ripples to depths over 300 feet while winter storm waves can produce ripples to over 600 feet.[12] Thus surface waves keep silts and clays resuspended allowing net offshore movement to -600 feet or beyond where they can settle out.

2.14 From the basaltic Yaquina Reef at the outer end of the jetties out to Stonewall Bank over 15 miles west occasional rock outcrops can contribute coarser sediment. These occur as isolated samples indicating the underlying rock is not widely exposed. Figure B-7, shows scattered rock exposures and a coarse sand deposit in an otherwise fine sand throughout the ZSF. The sand in the study area is predominantly quartz and feldspar with occasionally significant amounts of heavy minerals ("black sands") or shell fragments.

2.15 Sediment Sources. Fine sand found nearshore at Yaquina and elsewhere is predominantly relict or left over from lower sea levels during the past 1 million years. This sand originated from as far south as the Klamath Mountains of southern Oregon-northern California and was carried north by the prevailing littoral currents as sea level rose.[13] No sand is presently being delivered to the ocean by Oregon coastal streams studied: Alsea[14] Yaquina[3] Siuslaw[15] and Columbia River.[16] All material carried as bedload by these rivers is trapped within the estuary and in each estuary marine sand intrudes for a mile or more into the estuary due to tidal currents. The only sediment bypassing the estuaries is a portion of silt and clay carried in suspension.

2.16 A minor source of sediment comes from coastal erosion as readily seen along the north beach at Newport and especially at Jumpoff Joe. Rapid erosion takes place at isolated locations such as Jumpoff Joe due to the unconsolidated terrace sediments exposed to wave attack. Despite such visible erosion Runge[9] estimated only about 780,000 cubic yards of material were annually added to the continental shelf along the entire coast of Oregon. This can be compared to the over 2 million cubic yards of dredged material annually deposited in offshore disposal sites from Tillamook south.

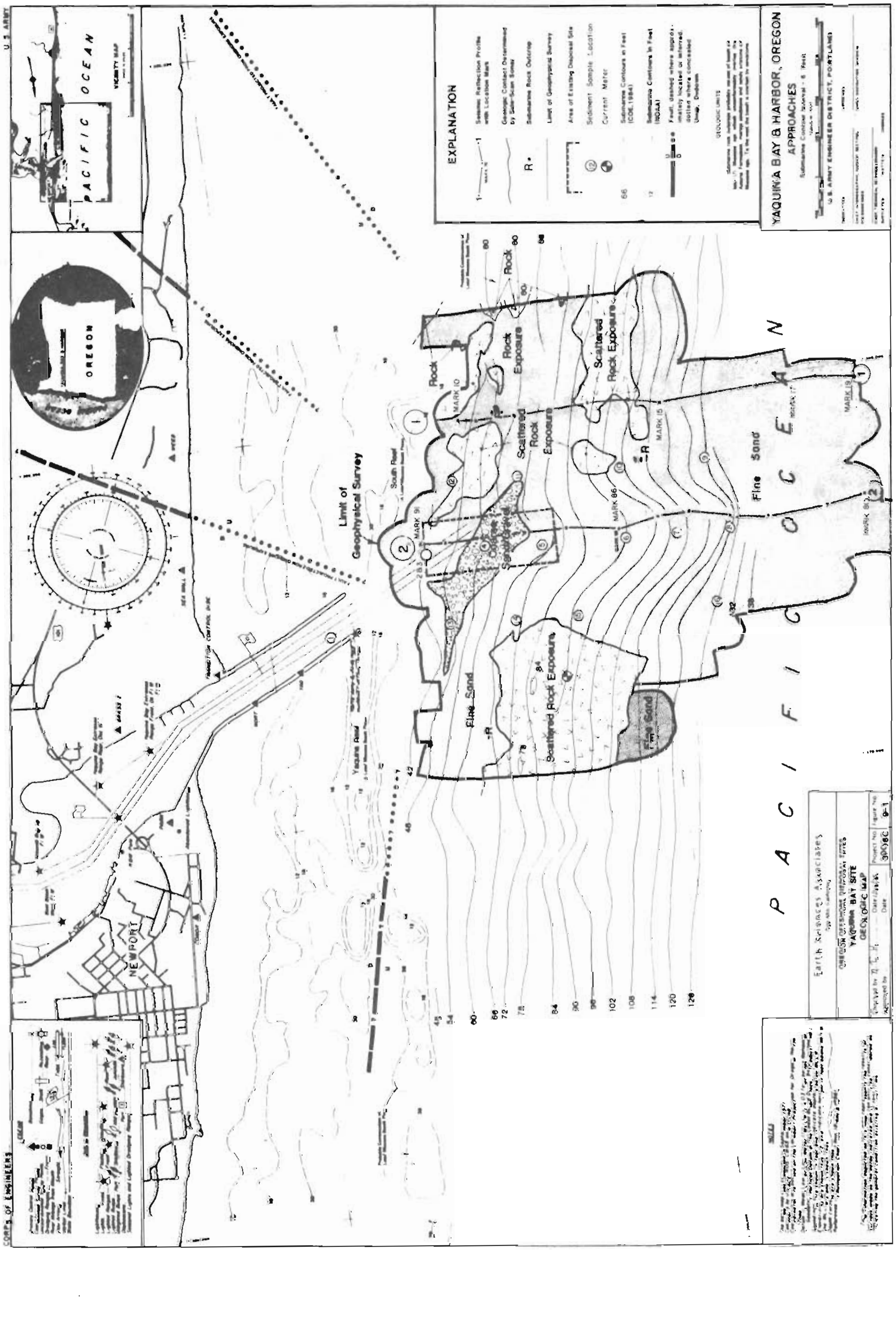


Figure B-7. Geologic map of Yaquina Bay study area.

2.17 Sediment Transport. Sediment movement on the Oregon continental shelf consists of two mechanisms depending upon the size of the sediment. Anything finer than sand size is carried in suspension in the water and is relatively quickly removed far offshore. The almost total lack of silts and clays within 10 miles or more of most of the Oregon coast attests to the efficiency of this mechanism. Sediments sand size or coarser may be occasionally suspended by wave action near the bottom, and are moved by bottom currents or directly as bedload. Komar[12] found evidence of wave-induced bottom sand movement as deep as 204 meters off Oregon and concluded that summer wave action reached 50 to 100 meters.

2.18 Hallermeier[17] defined two zones of sand transport, inner and outer, based on wave conditions. The inner littoral zone is the area of significant year-round alongshore and onshore-offshore transport by breaking waves. The outer shoal zone is affected by wave conditions regularly enough to cause significant onshore-offshore transport. A similar model is described by Komar[18] and Tunon[19] for the Oregon coast where winter storms erode and transport sand offshore and summer swell moves sand onshore. Comparison of aerial photos along the Oregon coast shows a dramatic increase in width of the surf zone during the winter.

2.19 Using Hallermeier's definition, the littoral zone at Yaquina extends to at least -40 to -50 feet (MLLW) with the outer shoal zone out to over -150 feet. Combining this with Komar's[18] model we can propose that the area between the beach and about -40 feet experiences net offshore movement in winter when the prevailing littoral current is northward and net onshore movement in summer when the current is southward. Seaward of about -40 feet the sand moved by wave action is influenced by near-bottom currents and downslope movement. At Yaquina the -40 foot boundary coincides with the offshore reef complex for several miles north and south of the jetties.

2.20 There is net sand transport toward the south jetty as shown by historic shoreline accretion. Shoaling patterns in the navigation channel also support northward sand transport around the end of the south jetty. Movement of sand seaward of the reefs and deeper than about -40 feet is predominantly offshore. Away from the tidal exchange effects of the entrance channel, however, net bottom movement may have either a northward component[13] or southward.[20] There is no onshore sand movement from beyond Yaquina Reef and no sand movement around the jetties toward the north. This limits sand transport into the nearshore north of the jetties so there is a potential for a net loss of material. This is supported by significant shoreline erosion throughout much of the area from the North Jetty to Yaquina Head.

2.21 Figure B-8 is a generalized picture of sand transport in the study area. The heavy line seaward of the reefs is the theoretical boundary between the littoral and shoal zones. Bottom sediment moves both onshore and offshore inside this line, but in deeper water the offshore transport predominates with a trend either north or south. Sand movement inshore of the reefs is complicated and little factual information is available so this figure should be used with caution.

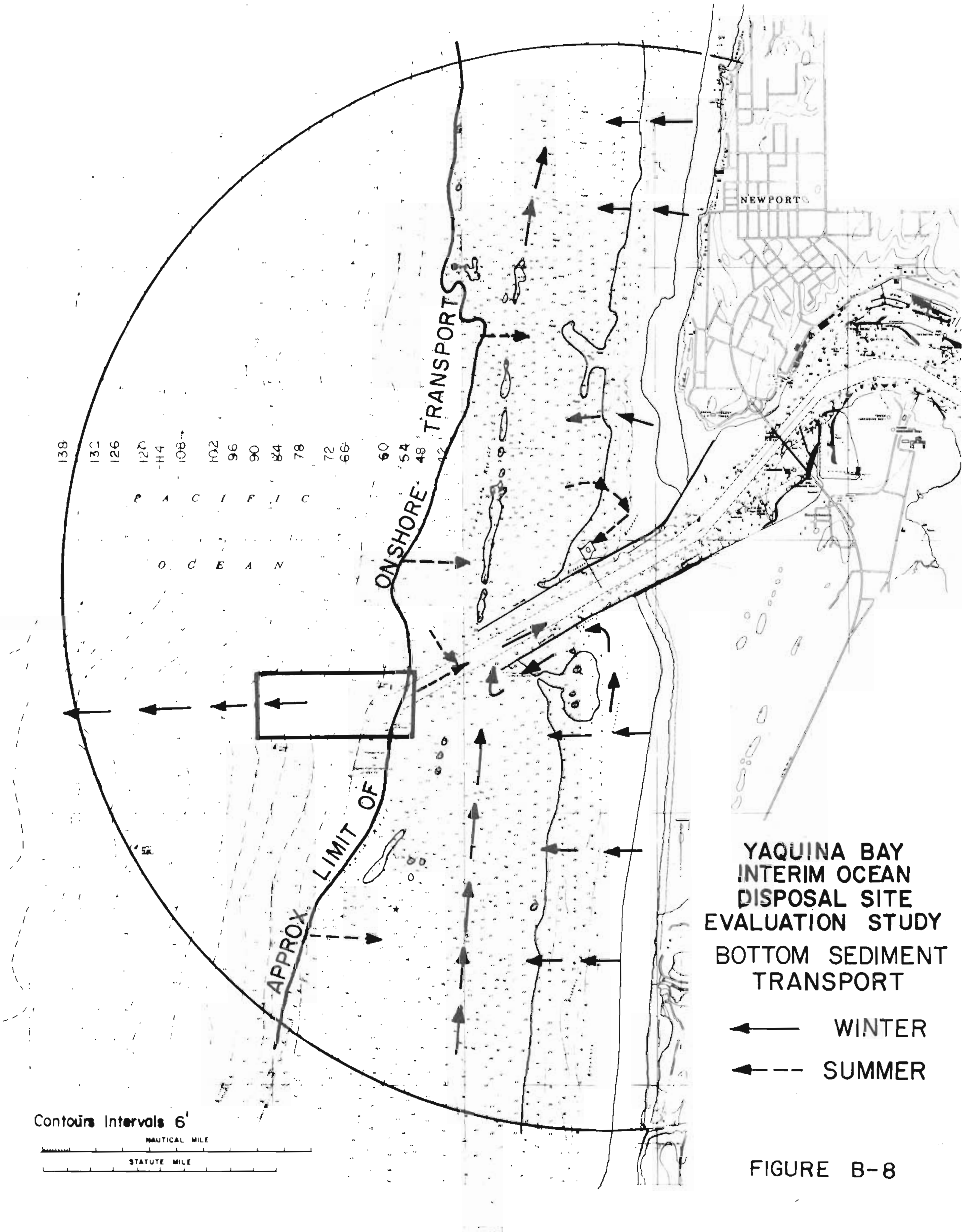
Dredging and Disposal

2.22 Dredging Operations. During the past 10 years, dredging volumes at Yaquina have ranged from 81,000 to 996,000 cubic yards as shown in the following table.

Table B-2
Dredging Volumes at Yaquina Bay

Year	Cubic Yards (C.Y.)
1974	996,488
1975	671,763
1976	642,764
1977	414,039
1978	490,496
1979	378,191
1980	81,146
1981	141,460
1982	331,000*
1983	453,000*
10-Year Average	460,000
1984	671,000*

*Includes both Corps and contract hopper dredging.



YAQUINA BAY
INTERIM OCEAN
DISPOSAL SITE
EVALUATION STUDY

BOTTOM SEDIMENT
TRANSPORT

FIGURE B-8

2.23 The average for the past 10 years is 460,000 cubic yards (cy). For part of this period the channel was only maintained to -35 feet due to lack of larger vessel traffic. The average figure then should be considered the minimum amount dredged annually. Dredging is done during summer months. For example, in 1983, 350,000 cy were dredged in July and 103,000 cy in August and in 1984, 100,000 cy were dredged in April and 571,000 cy between June and October.

2.24 The material is dredged from the outer channel bar and is fine sand with a mean grain size of 0.2 mm. There is predominantly marine sand for about 1.5 miles into the bay. Therefore the material dredged is similar to native sediments in the disposal area. The existence of a "mound" of sediment seaward of the disposal area may result from an excess of material over the capability of marine forces to remove it.

2.25 Disposal Site. One of the key concerns is the fate of dredged material disposed in the ocean - how much material moves outside the disposal site and in what direction? Disposal and bathymetry at Yaquina were monitored in 1983 and 1984. No prominent disposal mound appears in the October 1983 bathymetry. This may result from both a smaller total disposal quantity (453,000 cubic yards) and the 2-3 month interval between disposal and bathymetric surveying. This is substantiated by the September 1984 bathymetry which shows a roughly conical disposal mound with a base diameter of 600-1000 feet and a height of 16 feet in a water depth of 60 feet. This survey was immediately after a period from June through September when 571,000 cubic yards were disposed at the site. Figure B-9 compares 1983 and 1984 bathymetry. Shaded areas as show where the labeled depth contour has moved shoreward.

2.26 Profiles A-A', B-B' and C-C' in figure B-10 show the downward displacement of the bottom that is reflected in the shoreward contour "movement". Throughout most of the area represented by A-A' and C-C' from 1 to 4 feet of material was removed. Profile B-B' shows little change between -65 and -102 foot depth and the prominent mound at -60 feet. Substantial sediment movement occurred between 1983 and 1984 from as shallow as -48 feet to over -120 feet deep. The lesser change along profile B-B" may be due to material available from disposal operations. If so this figure shows no onshore movement from

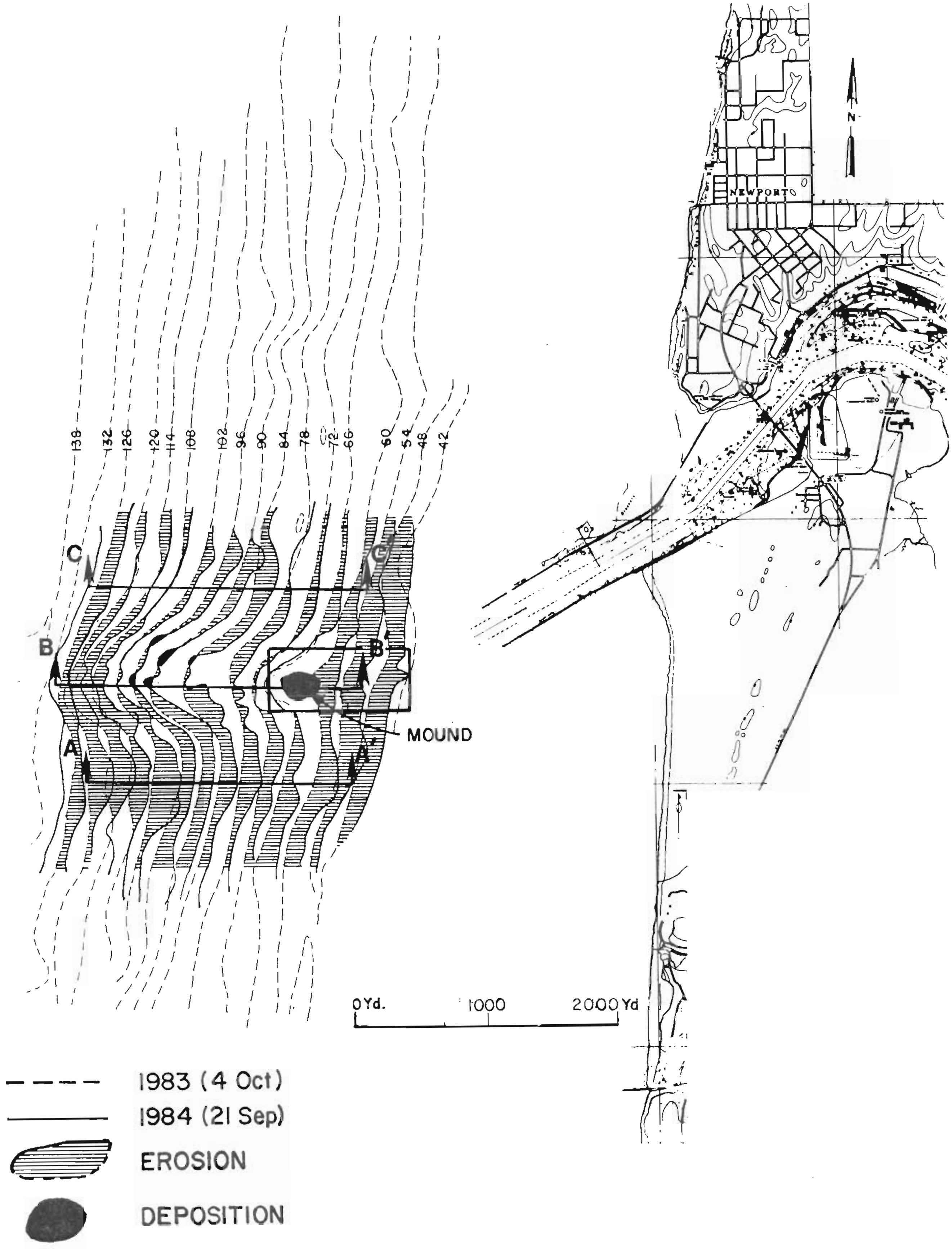


Figure B-9. Comparison of bathymetry at Yaquina Bay study area between 1983 and 1984.

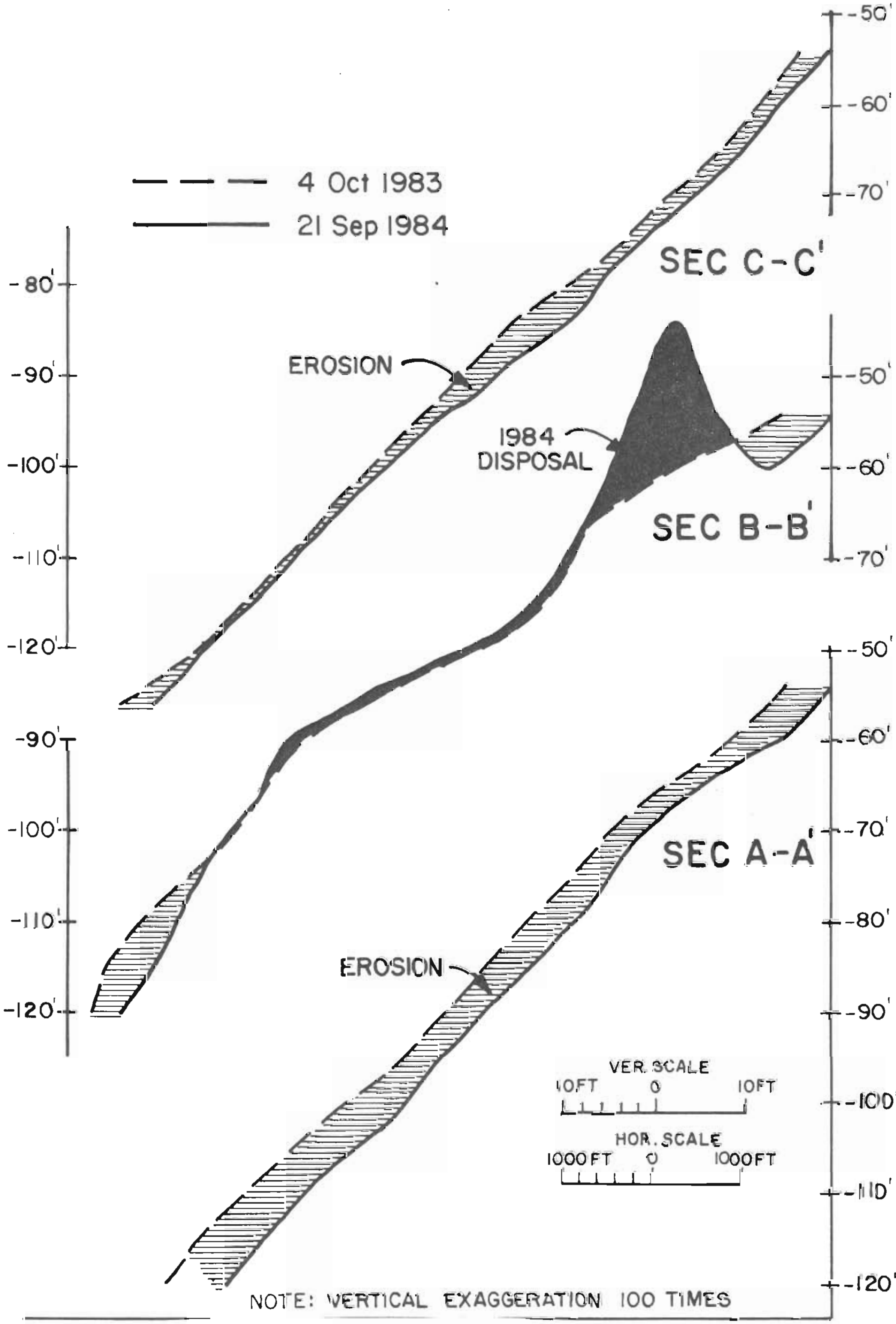


Figure B-10. Comparison of Bottom profiles off Yaquina Bay between 1983 and 1984.

the disposal mound area and a lessening of offshore movement at -100 feet. Care should be taken in using only 2 survey dates for comparison. Longer term monitoring at Coos Bay and Columbia River shows the importance of winter wave activity in sediment transport.

2.27 At Yaquina and other projects on the Oregon coast, there is concern about beach erosion related to the jetties. This may be particularly important at Yaquina where the north jetty abuts the offshore reef. This prevents any sediment bypassing the jetties to the north from entering the nearshore littoral zone. Since Yaquina Head acts as a similar sediment barrier for sand moving south, the beach between the jetties and Yaquina Head has no outside source of replenishment for erosion losses. Offshore disposal may represent almost 5 million cubic yards of littoral sand "lost" to the beach over the past 10 years at Yaquina.

2.28 <u>1984 Survey Results</u>. In the spring and summer of 1984 a geological/geophysical survey of the Yaquina Bay ZSF was accomplished[22]. The survey consisted of bathymetry, sidescan sonar imagery, subsurface seismic profiles and bottom samples. Figure B-7 represents an interpetation of the geology of most of the area of the ZSF from the survey results and published information. Also shown on B-7 are the sediment sample locations, seismic track lines and current meter station. A "mound" (see figure B-9) resulting from ocean disposal of almost 600,000 cubic yards of dredged material during the summer of 1984 is coincident with a lens of coarse sand/gravel. Sediment samples in this area earlier in the spring showed only fine sand size material. The implied association of disposal activity with the coarser deposit requires further study.

2.29 The area surveyed is predominantly fine sand with scattered rock exposures. This fine sand layer is only 5-35 feet thick overlying subsurface rock throughout the offshore area. The two seismic profiles of the subsurface indicated on Figure B-10 are shown in figure B-4b. Profile 1 begins near the basaltic outcrop known as South Reef and shows a subsurface "reef" covered with 5-10 feet of sediment and then 20-30 feet of sediment over a seaward sloping rock surface. An area labeled scattered rock exposure near marks 13 and 14 is not reflected on the subsurface rock. Profile 2 begins inshore of the disposal site and shows a very irregular rock subsurface overlain by 10 to 20 feet of sediment in the disposal site thickening offshore to 25-30 feet of sediment.

2.30 The 1984 survey results largely substantiate the geologic and structural setting inferred from published accounts. Surprising perhaps is the extent of rock exposure offshore and the relative thinness of the surface sediment layer. Sediment movement inferences from the bathymetry/sidescan survey are somewhat contradictory when taken with the wave/current monitoring results from Appendix D. Both should be used cautiously due to the limited amount of data. The bathymetric comparison seems to show erosion everywhere except along the axis of the contour bulge which could show either less net transport or more sediment available. The coincidence of the 1984 disposal mound with a NE-SW trending lens of coarse sand may show summer movement of material in about 60 feet of water, except the volume of the mound is roughly equivalent to the quantity disposed. 1984 current and wave monitoring, described in Appendix D, will continue in 1985 at Newport and other sites. Additional annual bathymetry will be compared with disposal operations and wave/current conditions as appropriate. Further work will use this and related data to refine our knowledge of sediment transport as it affects the disposal site and nearby areas.

LITERATURE CITED

1. USACE, 1965. Yaquina Bay and Harbor, Oregon - Design Memorandum No. 3, Appendix A - Geology. Portland District Library.

2. Montagne-Bierly Associates, Inc., 1977. Yaquina Bay Hopper Dredge Scheduling Analysis - Offshore Disposal Site Inspection. Report to USACE, Portland.

3. Kulm, L.D., 1965. Sediments of Yaquina Bay, Oregon. PhD thesis, OSU, 184 p.

4. Miller, M.C., 1978. Lab and Field Investigations on the Movement of Sand Traces Under the Influence of Water Waves, PhD thesis, OSU.

5. Fox, W.T. and Davis, R.A., 1974. Beach Processes on the Oregon Coast, July 1973. Williams College, Tech. Rep. 12. 81 p.

6. Percy, K.L., et al., 1974. Descriptions and Information Sources for Oregon Estuaries. OSU Sea Grant, p. 3.

7. Kulm, L.D., 1977. Coastal Morphology and Geology of the Ocean Bottom - The Oregon Region, in The Marine Plant Biomass of the Pacific NW Coast, Krauss, ed. OSU Press, p. 9-35.

8. USACE, 1883. Annual Report to the Chief of Engineers. p. 2065. Portland District Library.

9. Runge, E.J., 1966. Continental Shelf Sediments, Columbia River to Cape Blanco, Oregon. PhD thesis, OSU, 143 p.

10. Maloney, N.J., 1965. Geology of the Continental Terrace off the Central Coast of Oregon. PhD thesis, OSU, 233 p.

11. Bushnell, D.C., 1964. Continental Shelf Sediments in the Vicinity of Newport, Oregon. MS thesis, OSU, 107 p.

12. Komar, P.D., R.H. Neudeck and L.D. Kulm, 1972. Observations and significance of deep-water oscillatory ripple marks on the Oregon continental shelf, in Shelf Sediment Transport, Swift, et al., eds. pp. 601-619.

13. Kulm, L.D., et al., 1975. Oregon Continental Shelf Sedimentation: Interrelationship of Facies Distribution and Sedimentary Processes in Jour. of Geology, V.83, No. 2, pp. 145-175.

14. Peterson, C., Scheidegger, K. and Komar, P., 1982. Sand dispersal patterns in an active margin estuary of the NW United States as indicated by sand composition, texture and bedforms, in Marine Geology, V.50, p. 77-96.

15. Komar, P.D., 1975. A Study of the Effects of a Proposed Extension of the Siuslaw River Jetties. Report to USACE, Portland.

16. Sherwood, C.R., et al., 1983. Sedimentary Processes and Environments in the Columbia River Estuary. Unpub. draft Report to CREDDP, Astoria, Oregon.

17. Hallermeier, R.J., 1981. Seaward Limit of Significant Sand Transport by Waves. CETA 81-2, USACE/CERC, 23 p.

18. Komar, P.D., 1975. Beach Processes and Sedimentation. Prentice-Hall, pp. 288-324.

19. Tunon, N.A.A., 1977. Beach Profile Changes and Onshore-Offshore Sand Transport on the Oregon Coast. MS thesis, OSU, 58 p.

20. Huyer, A. and Smith R.L., 1977. Physical Chracteristics of Pacific Northwest Coastal Waters, in The Marine Plant Biomass of the Pacific NW Coast, Krauss, ed. OSU Press, pp. 37-56.

21. Schlicker, H.G., et al., 1973. Environmental Geology of Lincoln County, Oregon. Oregon Dept. Geol. and Mineral Ind. Bull. 81.

22. E.S.A./GEORECON, 1985. Geologic and Seismic Investigation of Oregon Offshore Disposal Sites. Final Contract Report to Portland District, COE.

APPENDIX C

WATER AND SEDIMENT QUALITY

APPENDIX C - WATER AND SEDIMENT QUALITY

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TABLES

FIGURES

General

3.01 General criterion (b) and specific factors 4, 9, and 10 of 40 CFR 228.5 and 228.6 all require sediment and water quality analysis of both the disposal and dredging areas. The only analyses available were conducted by Portland District, Corps of Engineers in June of 1980 as part of a coastal evaluation of authorized Federal navigation channels.[1] Sediment samples were collected for the entire length of the project and a marine water sample was collected for reference and elutriation water. Locations of these sampling stations are given in figure C-1 and table C-1.

3.02 Physical sediment analysis, bulk sediment analysis, and elutriate analysis were performed on the samples for several organic and inorganic parameters. Details of the sampling, lab analysis and procedures can be found in U.S. Geological Survey open file report 82-922.[2] A summary of results of tests from the above-mentioned publication will be discussed in the following sections.

3.03 Water Quality. Basic water quality parameters were taken in the field during collections of samples to return to the laboratory. Results of the field measurements collected with an automated multi-parameter water quality analyzer are given in table C-2. The measurements reported in the table were taken in the vicinity of the interim disposal site. Water from the same area was analyzed for parameters given in tables C-3 and C-4. The results were used to determine receiving water quality and aid in analyzing the elutriate results. As shown in all of the above tables, water quality is excellent at the disposal area. All parameters measured fall well within normal ranges expected for near shore ocean waters off the Oregon Coast.

3.04 Sediment Quality. Grain size distribution curves shown in figure C-2 and physical analysis of the sediments given in table C-5 indicates the sediments to be dredged at Yaquina Bay to be of uniform grain size and contain very little (0 to 10 percent) silts and clays. The sample for river mile (RM) 0.0 in very close proximity to the boundaries of the interim disposal site is a fine to medium marine sand. This analysis concurs with observations taken in 1977 by divers at the interim site[3] which reported gray fine sands, average size of 1/2 to 1 mm with some shell fragment. When these analyses are compared to those from RM 1.2, 1.7, and 2 (figure C-2) it is observed that the material being dredged is very similar to that found at the disposal site.

3.05 Chemical analyses on both bulk content and elutriation of the sediments show that the sediments in Yaquina Bay between RM 0.0 and 2.8 are very clean, consisting of sand without organic material, heavy metals or other toxic substances. Results of all the chemical tests performed are given in tables C-5 and C-6. All dredged materials scheduled for dredging from the authorized Federal navigation channel, for the Yaquina Bay project meet the exclusion clause in 40 CFR 227.13(b) which basically excludes these types of materials from further chemical or biological testing, prior to ocean disposal at an approved ocean disposal site.

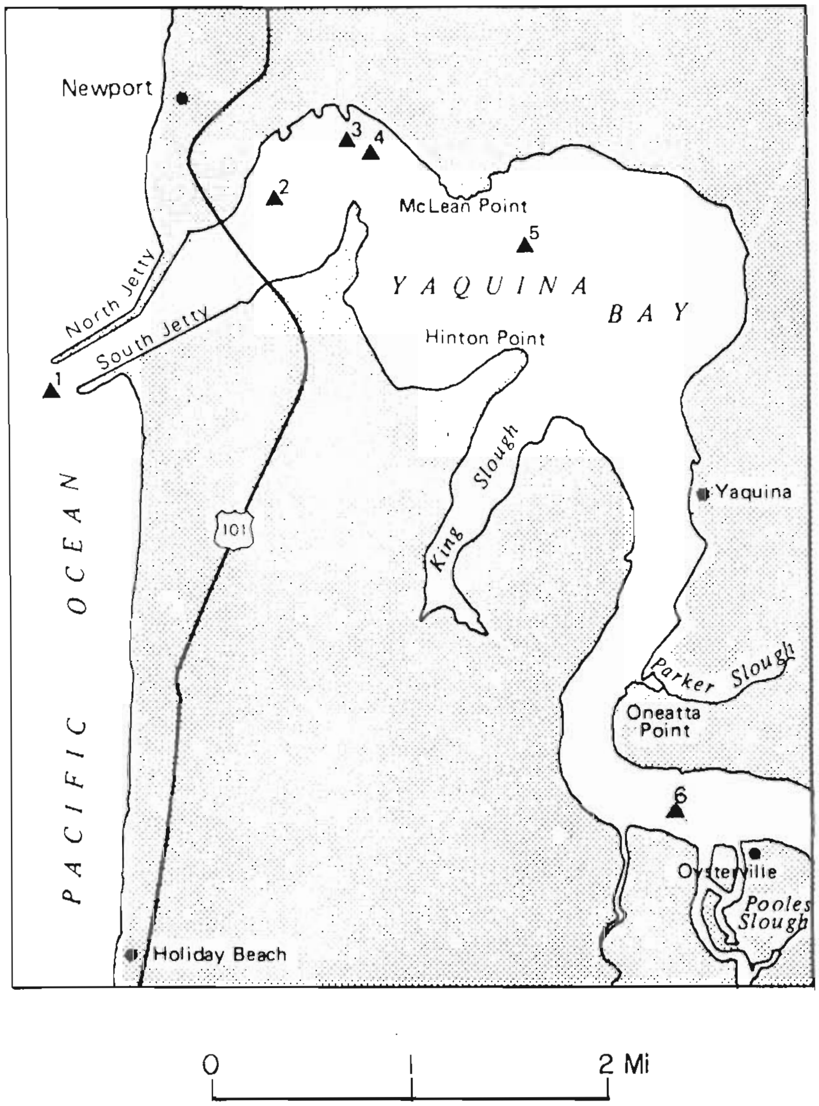
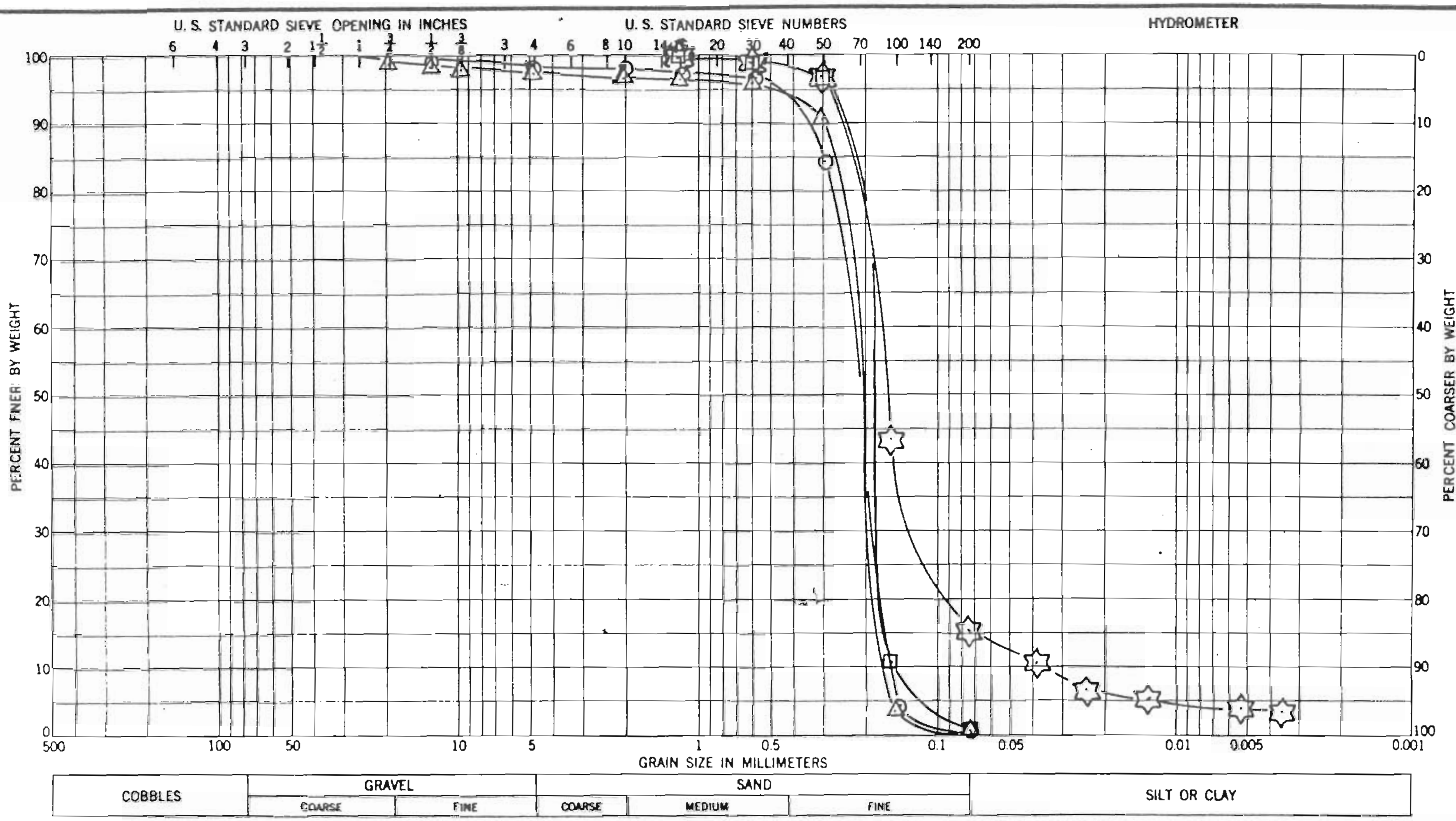


Figure C-1. Map of sampling sites for the Yaquina River, OR, project.



Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
△ YRM 0.0	13 Jun 80	SAND (SP)				
⊙ YRM 1.2	12 Jun 80	SAND (SP)				
⊡ YRM 1.7	12 Jun 80	SAND (SP)				
✡ YRM 2.0	12 Jun 80	Silty SAND (SM)				

Project RIVER SEDIMENT ANALYSIS

Area Yaquina River

Boring No.

Date

GRADATION CURVES

Figure C-2. Gradation curves for sediment samples collected in Yaquina Bay (YRM - Yaquina River Mile).

Table C-1
Location of Sampling Sites, Yaquina River, Oregon

Site No.	Site Designation		Collection Date	Site Location	
				Latitude	Longitude
1	Pacific Ocean		06-11-80	44°36'38"	124°04'49"
2	Yaquina RM	1.2	06-12-80	44°37'31"	124°03'05"
3	do.	1.7	do.	44°37'47"	124°02'38"
4	do.	1.8	do.	44°37'43"	124°02'31"
5	do.	2.8	do.	44°37'13"	124°01'43"
6	do.	6.3	do.	44°34'52"	124°00'46"

Table C-2
Basic Water Quality Data For Yaquina Bay Ocean Dredged Material Disposal Site
(Taken 6-11-80 With Hydrolab System 8000 Water Quality Probe

PARAMETER	OCEAN		
Depth (in meters)	15.4	8.2	Surface
Dissolved Oxygen (PPM)	15.4	13.91	12.42
Conductivity mmho/cm	51.2	50.3	40.8
ORP	541	523	492
Temperature (in °C)	12.1	12.6	14.4
pH	8.19	8.23	8.22
Turbidity (JTU)			1.2

Table C-3

Yaquina River, Oregon Project
Dissolved Chemicals in Native Water and Elutriates

[For type of sample, refer to codes: NE=Native Estuarine Water, NH=Native Euryhaline Water, NF=Native Fresh Water, EE=Elutriate with Estuarine Water, EH=Elutriate with Euryhaline Water, EF=Elutriate with Fresh Water, BM=Bottom Material. The number following the two-digit code indicates: For native water samples, the number of samples analyzed and for elutriates, the respective mixing water. Values = "--" indicate that a chemical analyses has not been made.]

Site No.	Site Description		Code	Date	Cadmium 1/ (ug/l as Cd)	Chromium (ug/l as Cr)	Copper (ug/l as Cu)	Iron (ug/l as Fe)	Lead (ug/l as Pb)	Manganese (ug/l as Mn)	Mercury (ug/l as Hg	Zinc 2/ (ug/l as Zn)	Carbon, Organic (mg/l as C)	Nitrogen Ammonia (mg/l as N)	Phosphorus Orthophosphate (ug/l as P)	Phenols (ug/l)
1	Pacific Ocean			06/11/80	1.30	--	2	100	2	30	<0.1	11.0	6.4	0.1	14	<1
2	Yaquina	RM 1.2	EE1	06/12/80	0.88	<1	1	120	<1	40	<0.1	1.8	3.7	1.4	19	9
3	Yaquina	RM 1.7	EE1	06/12/80	0.09	<1	1	120	<1	140	<0.1	1.2	3.2	0.86	64	<1
3	Yaquina	RM 1.7	EH2	06/12/80	0.41	<1	2	40	2	60	0.1	1.8	6.9	1.3	116	42
4	Yaquina	RM 1.8	EE1	06/12/80	0.12	--	3	130	<1	90	<0.1	1.8	7.4	1.6	77	12
4	Yaquina	RM 1.8	EH2	06/12/80	0.41	--	1	40	<1	40	<0.1	5.4	15.0	1.4	76	51
5	Yaquina	RM 2.8	EE1	06/12/80	0.32	<1	3	160	<1	380	0.2	3.4	10.0	1.9	19	7
5	Yaquina	RM 2.8	EH2	06/12/80	0.05	--	4	60	<1	180	<0.1	2.6	11.0	1.8	16	<1
6	Yaquina	RM 6.3	EE1	06/12/80	0.01	--	2	110	1	410	0.2	5.4	19.0	5.3	67	190
6	Yaquina	RM 6.3	EH2	06/12/80	0.25	<1	6	40	<1	160	<0.1	1.7	27.0	4.1	87	200

Additional Dissovled Chemicals in Native Water and Elutriates

Site No.	Site Description		Code	Date	Arsenic (ug/l as As)	Barium (ug/l as Ba)	Beryllium (ug/l as Be)	Cyanide (ug/l as Cn)	Nickel (ug/l as Ni)	Nitrogen, Ammonia + Organic (mg/l as N)	pH (Units)	Specific Conductance (Micromhos/cm)	Phosphorus, (ug/l as P)
1	Pacific Ocean		NE1	06/11/80	1	--	--	1	<1	0.4	8.2	56300	33
4	Yaquina	RM 1.8	EE1	06/12/80	4	<100	10	2	4	2.9	--	42600	135
4	Yaquina	RM 1.8	EH2	06/12/80	5	<100	<10	2	2	3.2	7.8	18700	233

Table C-4

Yaquina River, Oregon Project
Dissolved Insecticides and Herbicides in Native Water and Elutriates

[For type of sample, refer to codes: NE=Native Estuarine Water, NH=Native Euryhaline Water, NF=Native Fresh Water, EE=Elutriate with Estuarine Water, EH=Elutriate with Euryhaline Water, EF=Elutriate with Fresh Water, BM=Bottom Material. The number following the two-digit code indicates: For native water samples, the number of samples analyzed and for elutriates, the respective mixing water. Values = "--" indicate that a chemical analyses has not been made.]

Site No.	Site Description		Code	Date	Aldrin (ug/l)	Ametryne (ug/l)	Atratone (ug/l)	Atrazine (ug/l)	Chlordane (ug/l)	Cyanazine (ug/l)	Cyprazine (ug/l)	DDD (ug/l)	DDE (ug/l)	DDT (ug/l)	Dieldrin (ug/l)	Endosulfan (ug/l)
1	Pacific Ocean		NE1	06/11/80	<.01	<.1	<.1	<.1	<.1	<.1	<.1	<.01	<.01	<.01	<.01	<.01
4	Yaquina	RM 1.8	EE1	06/12/80	<.01	<.1	<.1	<.1	<.1	<.1	<.1	<.01	<.01	<.01	<.01	<.01
4	Yaquina	RM 1.8	EH2	06/12/80	<.01	<.1	<.1	<.1	<.1	<.1	<.1	<.01	<.01	<.01	<.01	<.01

Site No.	Site Description		Code	Endrin (ug/l)	Heptachlor (ug/l)	Heptachlor Epoxide (ug/l)	Lindane (ug/l)	Methoxychlor (ug/l)	Mirex (ug/l)	PCB (ug/l)	Naph-thalenes, Polychlor. (ug/l)	Perthane (ug/l)	Prometone (ug/l)	Prometryne (ug/l)	Propazine (ug/l)
1	Pacific Ocean		NE1	<.01	<.01	<.01	<.01	<.01	<.01	<.1	<.1	<.1	<.1	<.1	<.1
4	Yaquina	RM 1.8	EE1	<.01	<.01	<.01	<.01	<.01	<.01	<.1	<.1	<.1	<.1	<.1	<.1
4	Yaquina	RM 1.8	EH2	<.01	<.01	<.01	<.01	<.01	<.01	<.1	<.1	<.1	<.1	<.1	<.1

Site No.	Site Description		Coee	Silvex (ug/l)	Simazine (ug/l)	Simetone (ug/l)	Simetryne (ug/l)	Toxaphene (ug/l)	2, 4-D (ug/l)	2, 4-DP (ug/l)	2, 4, 5-T (ug/l)
1	Pacific Ocean		NE1	<.01	<.1	<.01	<.1	<.1	<.01	<.01	<.01
4	Yaquina	RM 1.8	EE1	<.01	<.1	<.01	<.1	<.1	<.01	<.01	<.01
4	Yaquina	RM 1.8	EH2	<.01	<.1	<.01	<.1	<.1	<.01	<.01	<.01

Table C-5

Ocean and Lower Yaquina River Physical Sediment Analysis Taken 14 June 1980

Sample	Identification	Specific Gravity of Water	Density of Mat'l in place gms/liter	Density of Median Solids gms/liter	Void Ratio	Percent Volatile Solids	Percent Wtr Content in place	Roundness Grade
YRM 0.0	13 Jun 80	1.000	2,045	2,667	0.596	0.97	22.3	Subangular to Subrounded
YRM 1.2	12 Jun 80	1.0146	2,023	2,719	0.690	0.53	25.8	Subangular to Subrounded
YRM 1.7	12 Jun 80	1.0146	2,040	2,742	0.684	0.60	25.3	Subangular to Subrounded
YRM 2.0	12 Jun 80	1.0146	1,805	2,710	1.144	2.64	42.8	Subangular to Subrounded
YRM 2.8	12 Jun 80	1.0146	1,980	2,716	0.762	1.51	28.5	Subangular to Subrounded
YRM 6.3	12 Jun 80	1.0135	1,585	2,669	1.896	3.85	72.0	Subangular to Subrounded

Table C-6

Yaquina River, Oregon Project
Total Recoverable Insecticides, Herbicides, and Chemicals in Bottom Material

[For type of sample, refer to codes: NE=Native Estuarine Water, NH=Native Euryhaline Water, NF=Native Fresh Water, EE=Elutriate with Estuarine Water, EH=Elutriate with Euryhaline Water, EF=Elutriate with Fresh Water, BM=Bottom Material. The number following the two-digit code indicates: For native water samples, the number of samples analyzed and for elutriates, the respective mixing water. Values = "--" indicate that a chemical analyses has not been made.]

Site No.	Site Description		Code	Date	Aldrin (ug/kg)	Chlordane (ug/kg)	DDD (ug/kg)	DDE (ug/kg)	DDT (ug/kg)	Dieldrin (ug/kg)	Endosulfan (ug/kg)	Endrin (ug/kg)	Heptachlor (ug/kg)	Heptachlor Epoxide (ug/kg)	Lindane (ug/kg)
4	Yaquina	RM 1.8	BM	06/12/80	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1

Site No.	Site Description		Code	Methoxychlor (ug/kg)	Mirex (ug/kg)	PCB (ug/kg)	PCN (ug/kg)	Perthane (ug/kg)	Silvex (ug/kg)	Toxaphene (ug/kg)	2, 4-D (ug/kg)	2, 4, 5-T (ug/kg)	2, 4-DP (ug/kg)
4	Yaquina	RM 1.8	BM	<.1	<.1	26	<.1	<.1	<.1	<.1	<.1	<.1	<.1

Site No.	Site Description		Code	Date	Arsenic (ug/g)	Barium (ug/g)	Beryllium (ug/g)	Cadmium (ug/g)	Chromium (ug/g)	Copper (ug/g)	Cyanide (ug/g)	Iron (ug/g)	Lead (ug/g)	Manganese (ug/g)	Mercury (ug/g)
4	Yaquina	RM 1.8	BM	06/12/80	6	10	2	1	10	8	<0.5	7200	10	50	0.02

Site No.	Site Description		Code	Nickel (ug/g)	Zinc (ug/g)	Carbon, Inorganic (g/kg)	Carbon, Inorg + Organic (g/kg)	Nitrogen, NH4 (mg/kg) as N	Nitrogen, NH4 + Org. (mg/kg) as N	Phosphorus (mg/kg)
4	Yaquina	RM 1.8	BM	10	40	1.2	8	36	530	250

LITERATURE CITED

1. Findings of Compliance and Non-compliance, Operations and Maintenance, Dredged Material Disposal Activities at Coastal Projects. U.S. Army Corps of Engineers, Portland District, 1980.

2. Analysis of Elutriates, Native Water, and Bottom Material in Selected Rivers and Estuaries in Western Oregon and Washington. U.S. Geological Survey Open File Report 82-922.

3. Yaquina Bay Hopper Dredge Scheduling Analysis, Offshore Disposal Site Inspection, U.S. Army Corps of Engineers, Portland District, June 1977.

APPENDIX D

PHYSICAL PROCESSES

APPENDIX D - PHYSICAL PROCESSES

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FIGURES

Circulation of Oregon Continental Shelf Waters

4.01 Circulation of continental shelf waters is on the average subparallel to bathymetric contours. It is highly variable in direction and speed on time scales of several days with fluctuations correlating with changes in sea level and the alongshore component of the wind.[1] The alongshore component of flow is substantially stronger and more responsive to changes in wind conditions than is the onshore-offshore component.[2] Fluctuations in the mean alongshore circulation seem to be coherent over distances of at least 200 km (125 miles) and are independent of depth in both phase and magnitude to at least 20 m depth.[1] The magnitude of such fluctuations decreases rapidly with distance offshore. Currents averaged over very long periods, e.g., longer than 50 days, correlate better with changes in sea level than with winds to depths of 40 m. By 80 m depth, the influence of both sea level and winds appears to have been substantially diminished and other processes exert their influences.[3]

4.02 Huyer has developed generalized models for the seasonal changes in alongshore circulation[3, 4] and for the upwelling season of strong onshore/offshore flow.[5] Two oceanographic seasons predominate in the alongshore flow model--winter and summer. The mean circulation is northward at all depths in the winter (December-March) but is highly variable in direction over periods of several days; southerly flow can sometimes occur. Winter currents are nearly uniform in speed and direction throughout the water column except where density stratification exists; e.g., in the nearshore where low salinity water from coastal runoff can create stratified conditions. Surface drift bottles released from the Newport Hydro Line during November-February 1959-1963 generally had shore recoveries in the vicinities of the Columbia River and Grays Bay, Washington.[6] Drift rates for these bottles averaged between 0.4 and 0.5 knots or about 25 cm/s.

4.03 The transition from the winter circulation regime to the spring or summer regime is abrupt, occurring in only about a week's time during a strong southward wind event. The transition is the result of a large cumulative offshore transport of water caused by local wind stress and the resulting establishment of strong offshore density gradients in shelf waters. Upwelling is associated with the transition and continues into July or August. The offshore density gradients are associated with the persistent southward surface current characteristic of the summer oceanographic season. During this season, a strong vertical gradient or shear in alongshore velocity is to be found in the lower half of the flow over the middle and outer shelf. The mean alongshore current is weak near the bottom and strongly southward at the surface, almost never reversing. Maximum speeds occur over the midshelf (15-30 km offshore) during spring when the southward flow is reinforced by strong northerly winds. Drift bottle releases during the summer wash ashore south of Coos Bay and have average drift rates similar to winter drift rates.

4.04 While the direction of nearshore flow is almost always southward in summer, the offshore shear zone expands upward and shorewards under the influence of fall and winter southeasterly winds until the winter regime of northward flow is reestablished throughout the water column.[7]

4.05 The circulation during the upwelling season of February through July has been studied in detail from its initial stages (the WISP Program) to its fully developed condition[19] (the CUE Programs).[5] It is during this season that significant offshore/onshore circulation occurs. Figure D-1 illustrates the mean circulation in this season.[8] The shaded zone is the permanent pycnocline or zone of rapid change of density with depth. This zone lies deeper than 40 m offshore but rises towards shore due to the upwelling of water in the nearshore zone. When upwelling is fully developed, the permanent pycnocline intersects the surface some 10-20 km offshore. Above and offshore of the pycnocline, mean flow is to the south as expected for the summer season. Below about 40 m, flow is to the north with a tendency for concentrated flow just beneath the inclined portion of the pycnocline near depths of 100 m. Under strong upwelling conditions, the southward flowing surface current is reinforced and the deeper north flowing current weakens or may even disappear to depths of 200 m. Mean currents in the surface 10 to 20 m of water are offshore at speeds on the order of 15 cm/s due to the influence of the wind.

4.06 Where the pycnocline intersects the surface, surface currents converge from both sides of the convergence.[9] Surface flow has a northward component

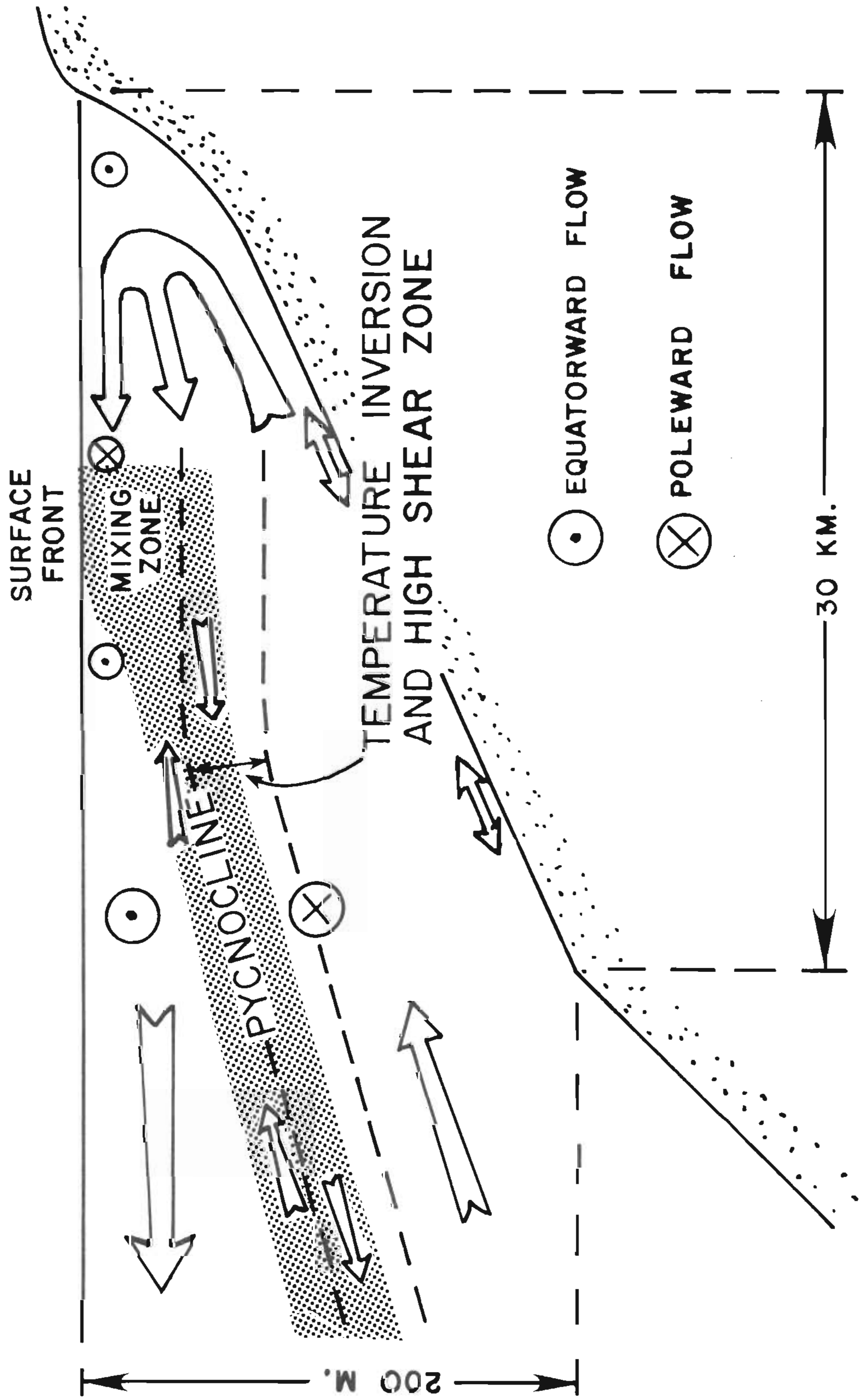


Figure D-1. Mean circulation in the coastal upwelling region off central Oregon on the coastal side of the convergence and a southward component on the seaward side. The mean circulation in the upper part of the pycnocline (20-60 m) is also towards the convergent zone at speeds of under 5 to 10 cm/s, maximum speeds occurring over the inner shelf. Mixing of these waters at the convergence produces a water type that sinks and spreads offshore at mid-depth (40 to 80 m). Deeper flow is shoreward on the average with strongest flows just below the maximum vertical density gradient; it is this water that actively upwells in the nearshore. Maximum vertical velocities associated with upwelling occur very near shore and well above the bottom.[5] Upwelling rates of 20 cm/hr have been claimed for the Yaquina Bight (between the jetties and Yaquina Head[10] but more common offshore upwelling rates are 5 cm/hr.[3] Weak onshore or offshore flow may occur in the 10 to 20 m of water overlying the bottom due to bottom friction effects and to fluctuations in coastal winds.

4.07 Actual field measurements of currents have been made in shelf waters using drogues[11, 12] and moored current meters[13, 14]. Since 1966, Oregon State University has periodically published data reports for current meter deployments on the Oregon continental shelf. Only a few analyses of these data have been published. Indirect current measurements have been made through drift bottle releases[6] and through analysis of hydrographic data - temperature and salinity - collected from several periodically reoccupied lines of hydrographic stations. Only one study addressed circulation immediately offshore of Yaquina Bay.[15]

4.08 The Newport and Depoe Bay hydrographic lines include stations as near shore as three and five nautical miles, respectively, 6 and 9 km. Some of these stations have been occupied with moored current meters[13, 16, 17]. At the Depoe Bay station DB-5 in 80 m of water, Mooers et al.[13] observed oscillatory currents with periods of several days to a week. The magnitude of the oscillations decreased offshore. The average current speed at 20 m was 23 cm/s and 14 cm/s at 60 m. Mean circulation was to the south at 18 cm/s and offshore at 2 cm/s at 20 m but to the north at 6 cm/s and onshore at 3 cm/s at 60 m depth. Such a regime is characteristic of summer upwelling. Maximum currents ranged 30 cm/s for both onshore-offshore and north-south flows at 20 m depth while the range at 60 m depth was 15 cm/s onshore-offshore and 40 cm/s north-south. Huyer et al.[16] present summer current conditions observed at

Newport Hydro Line station NB-3, 3 nautical miles (6 km) offshore of Yaquina Bay and in 47 m of water. Current speeds at 20 m averaged 17 cm/s with net transport at 5 cm/s to the south and slightly onshore.

4.09 Estimates of the geostrophic (frictionless) flow based on hydrographic observations from the Newport Hydro Line[18] agree well with the seasonal variation of flow inferred from direct current observations.[4] Figure D-2 illustrates the seasonal variation of the geostrophic currents between 9 and 24 km offshore. Relatively uniform northward flow occurs to at least 30 m depth between October and March at 5 to 10 cm/s. Southward flow occurs during the remainder of the year with maximum speeds approaching 40 cm/s in June. A strong vertical gradient in the alongshore current speed is clearly present during summer and lacking in winter. Pillsbury[19] computed geostrophic currents through a triangle of summer hydrographic stations, a method that improves the computation. In general, the currents were along bathymetric contours with northerly mean flows deeper than 20-50 m and southerly flows above (figure D-3). Speeds were frequently in excess of 5 cm/s.

Yaquina Bight Circulation

4.10 Oregon State University conducted a single nearshore circulation survey inshore of the reef and between the north jetty and Yaquina Head as part of a thermal dispersion study of a pulp mill outfall.[15] The circulation in this area was characterized as a large eddy whose dominant driving forces are primarily the wind and secondarily the tides. Wave approach angle and hydraulic effects associated with the jetty also had significant effects. Keene[10] provides provisional predictive equations for currents based on wind speed and wave approach angles. Currents in the surface 3 m (10 feet) of the water column had speeds between 6 and 18 cm/s (0.2 to 0.6 fps), both to the northeast and to the south-southwest.[20] Southflowing currents paralleled the reef and had offshore components. Upwelling was estimated to occur at a rate of 20 cm/hr.

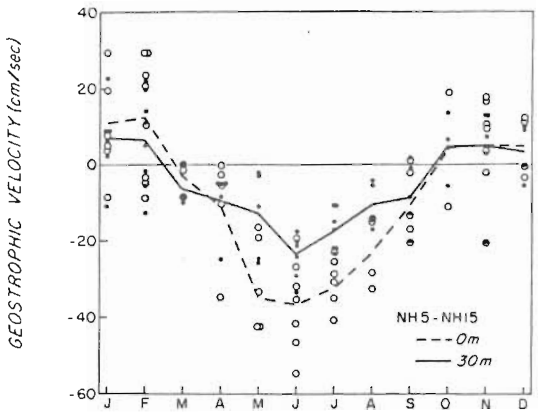


Figure D-2. Estimated mean alongshore geostrophic flow (lines) between Newport hydrographic line stations NH-5 (9 km) and NH-15 (24 km), at surface (open circles, dashed line) and 30 m (solid circles and line).

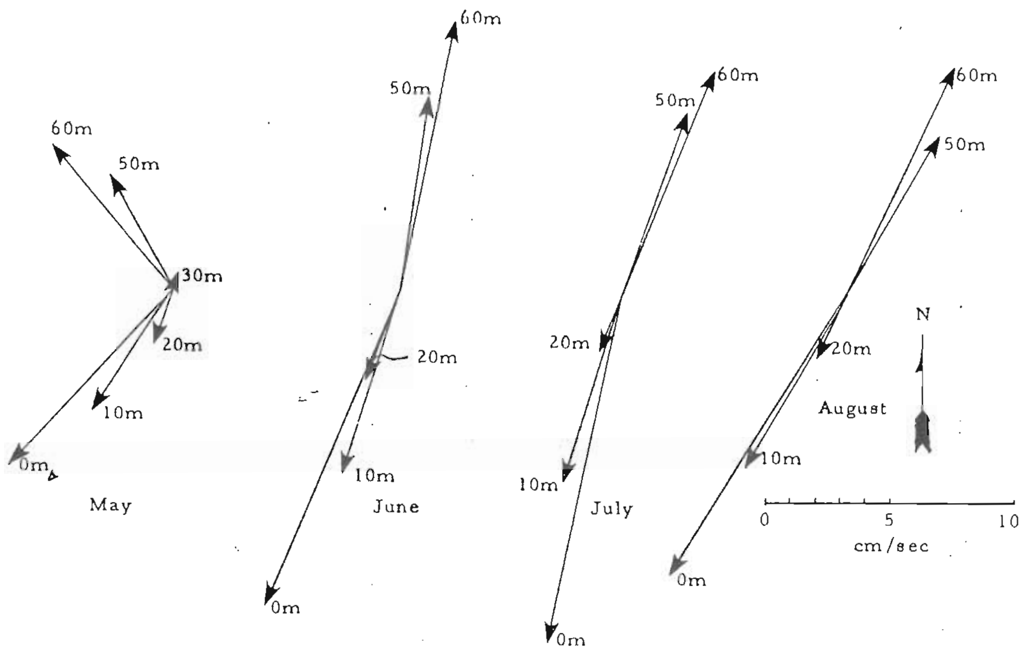


Figure D-3. Absolute geostrophic velocities computed from 10-year mean hydrography.

Disposal Site Currents

4.11 Bottom currents in the interim disposal site were observed by SCUBA divers during June 1977.[21] Bottom currents were oriented northeast-southwest at 16 to 22 cm/s during calm seas with 2- to 4-foot-high swells. Wave-generated surge along the bottom was particularly severe - 5 feet - at 61 feet depth but decreased to 1 foot at the 47- and 77-foot contours. The disposal site is clearly in an active hydraulic environment during the summer season.

4.12 Detailed current measurements have been obtained from other similarly-situated Oregon nearshore dredge material disposal sites. The most thorough study has been conducted at Coos Bay, Oregon.[22, 23, 24] Seasonal measurements made over two-week periods showed currents at the 25-m-deep disposal site averaged between 20 and 30 cm/s at one-third the water depth during the summer and between 30 and 60 cm/s during the winter and spring. Near-bottom currents were generally between 10 and 20 cm/s with downslope flow components predominating over upslope components. Near-bottom waters exhibited downslope movement to depths in excess of 40 m during the summer and deeper than 70 m during the winter. Similar conditions are expected to exist at the interim Yaquina disposal site since both sites are in similar depth regimes.

Long-Period Waves

4.13 Superimposed upon the slowing-varying regional or seasonal circulation are periodic currents due to the tides, inertial currents, internal waves, etc. While variations in wind speed and direction at periods longer than 2.5 days are reflected in surface currents, shorter period variations in the wind can give rise to inertial currents that have 17.4-hour periods and speeds exceeding 10 cm/s.[25, 1]

4.14 Tidal currents are rotary currents that change direction periodically with time. The tidal currents generally flood towards 60 degrees T. and ebb towards 240 degrees T.[26] Offshore, tidal current speeds have been measured at between 5 and 12 cm/s and according to Stevenson et al.[12] account for more than half of the water motion over periods of several days. The tidal current may, however, be partially masked or entirely over-ridden by wind-driven and other nontidal currents. Moreover, the fortnightly neap-to-spring tidal cycle causes tidal currents to respectively decrease and then increase some 20 percent relative to currents under mean tide conditions.[8]

4.15 Continental shelf waves are long waves generated by atmospheric pressure system movements and other phenomena. These waves have periods of 4.6 days and propagate only toward the north along the western coast of North America. The magnitude of the current associated with these waves is on the order of 3 cm/s.[27] Since the flow is uniform throughout the water column and across the shelf, and since onshore-offshore flow alternates with alongshore flow during the 4.6-day period,[5] this type of flow may have a significant long-term effect on the rate of offshore sediment transport.

4.16 Internal waves propagate along a surface defined by a strong vertical gradient of density in the water column, e.g., at the seasonal and permanent pycnoclines. These waves have variable amplitudes which may approach 10 m and periods varying from one-quarter or one-half hour to one hour.[28, 29, 1] These waves become unstable where the vertical density stratification weakens - as in upwelling areas - and can break, much like a surface wave. The breaking internal wave may facilitate the resuspension of bottom sediments and improve vertical mixing throughout the water column.

Surface Waves

4.17 Surface waves are generated by local and global wind conditions. National Marine Consultants[30] tabulated predicted (hindcast) monthly-average and annual-average frequency distributions of significant wave height and significant period by compass sector for deepwater waves off Newport. Waves generated by local winds, i.e., seas, generally approach the coastline from the SW-S sectors during autumn and winter but from the N-NW sectors in spring and summer. The longer period swells generated by more distant storms approach generally from the NW-W or W-SW sectors. Local storms are considered to generate higher waves than swell with the highest waves always occurring during the winter and approaching from the SW-S sectors. Shortest sea and swell periods occur during the summer. Longest swell periods generally occur during autumn while longest period seas occur during winter.[26] National Marine Consultants [31] also tabulate deepwater wave conditions off Newport for 12 of the most severe storms of the 1950-1960 decade. Significant heights, periods, and mean approach angle are given. Maximum significant deepwater wave height was estimated to range between 21 and 30 feet while the significant wave period ranges between 11 and 14 seconds.

4.18 Deepwater waves are modified by shoaling and refraction as they approach shore. Variation in the topography of the continental shelf can focus or unfocus wave energy on a given point on the shore, depending on the angle of approach of the deepwater wave and upon the wave period. Bathymetric contours to depths of 80 m (240 feet) are subparallel to the coast, except for the Stonewall Bank that lies southwest of Newport. This bank refracts the longer period - 13 second and longer - surface waves approaching from the southwest in such a fashion that their energy is diverted from the vicinity of Yaquina Bay.[32] Similarly approaching waves with periods as short as 8 seconds may also be somewhat affected. Waves approaching from the north through west quadrant ultimately approach shore within 40 degrees of the orthogonal to the reef structure. Breaking waves tend to be parallel to the reef structure or to the shoreline.

4.19 The U.S. Army Corps of Engineers Coastal Engineering Research Center is presently engaged in a program to provide improved hindcast estimates of both deepwater and shallow water wave conditions for the coastal United States. Products of the Sea-State Engineering Analysis System (SEAS) are expected to be available for the West Coast in late 1984.

4.20 Since 1971, Oregon State University has been recording nearshore breaking wave conditions using a seismometer installed in the Marine Science Center in Newport. The collected data has been provisionally calibrated to wave conditions in 13 m (40 feet) of water. The system was designed under a Seagrant program to provide a usable wave monitoring system to Coast Guard facilities. Consequently, the accuracy of the system is limited and there is some suspicion that the periods computed since 1977 are 4 to 5 seconds too long.[33, 34] The significant wave height is, however, thought to correlate reasonably well over alongshore distances of some 240 km (130 nautical miles).[33] The entire seismic data collection system would require validation and calibration before the data can be relied upon in engineering applications. Nevertheless, the data is qualitatively useful in understanding the nature and variation of the wave climate.

4.21 Figure D-4 illustrates the seasonal variation of significant wave height in 40 feet of water as computed from seismic measurements at Newport.[34] Winter mean wave height is estimated at 7.6 feet while summer mean height is 4.1 feet. These figures agree well with earlier estimates[35] which were associated with mean wave periods of 10.3 and 8.4 seconds, respectively. Figure D-5 illustrates the percentage of time that a given significant wave height can be expected to be exceeded as well as the general recurrence interval. Consequently, a significant wave height of 10 feet can be expected to occur about 1 percent of the time during the summer but nearly 20 percent of the time during the winter. Also, the largest significant height that should occur only once a year in the winter might be as large as 20 feet and the summer maximum annual significant height might only be 14 feet.

4.22 The U.S. Army Corps of Engineers conducted a 5-year program (1977-1982) of coastal wave and littoral current observation at each of the major navigation projects of the United States.[36] Preliminary analysis of the relationship between the visually observed data and automatically collected data suggests that the data may best be used in a qualitative manner. Quantitative predictions of sediment transport, wave height, etc., are not recommended. Figure D-6 illustrates the qualitative similarity between these data and the seismometer data.

4.23 In a program complementary to SEAS, the Corps of Engineers and the State of California have since November 1981 been monitoring wave conditions on the Oregon continental shelf under the Coastal Data Information Program.[37] Data buoy accelerations automatically recorded in 600 feet (199 m) of water offshore of Bandon, Oregon, are analyzed to produce water surface elevation spectra at 6-hour intervals which are assumed to be representative of deep-water wave conditions along the Oregon coast. Detailed studies have yet to be

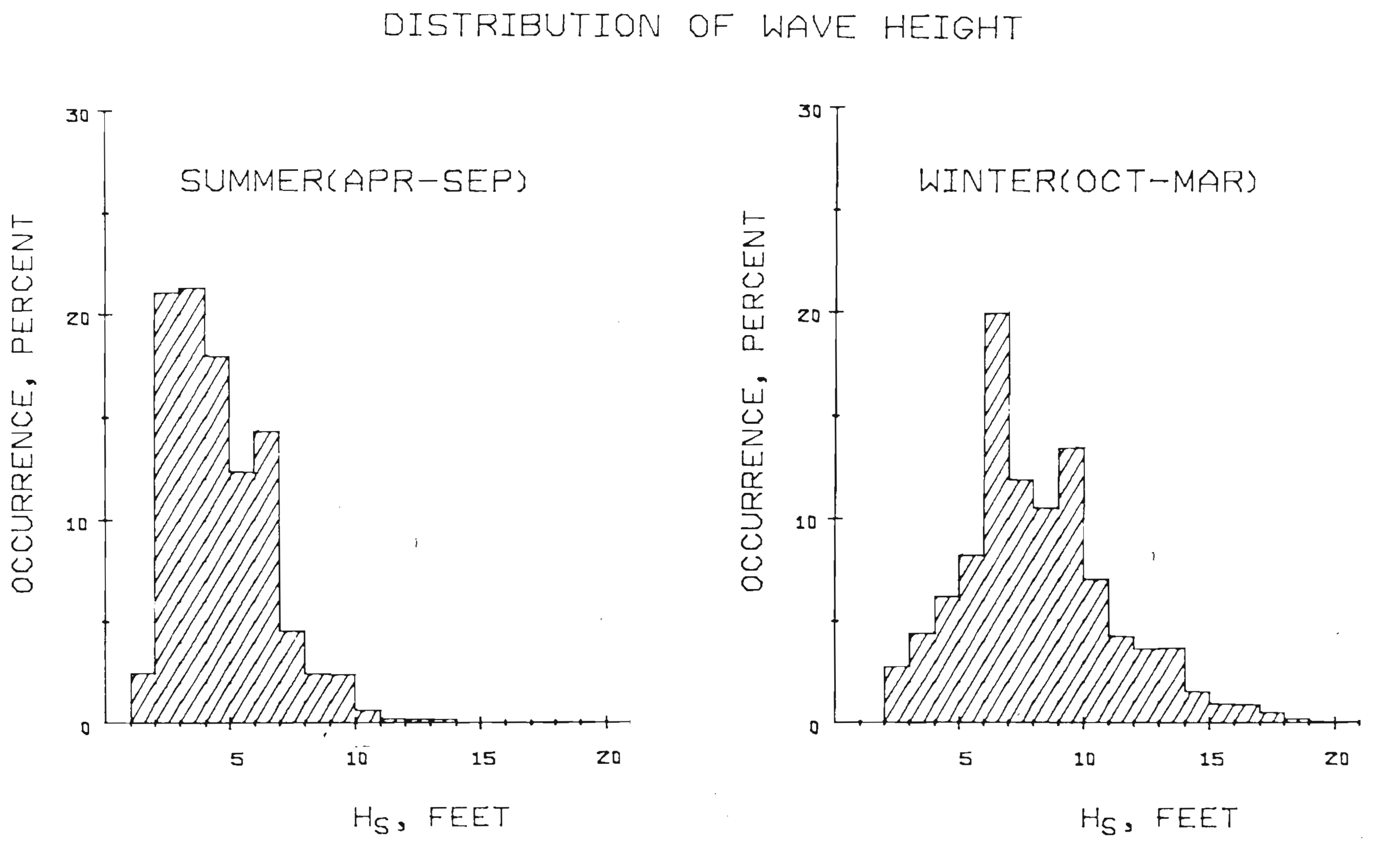


Figure 4. Distribution of significant wave height in 40m of water, as computed from Newport seismometer data for the summer (Apr-Sep 1972-80) and the winter (Oct-Mar 1971-81).

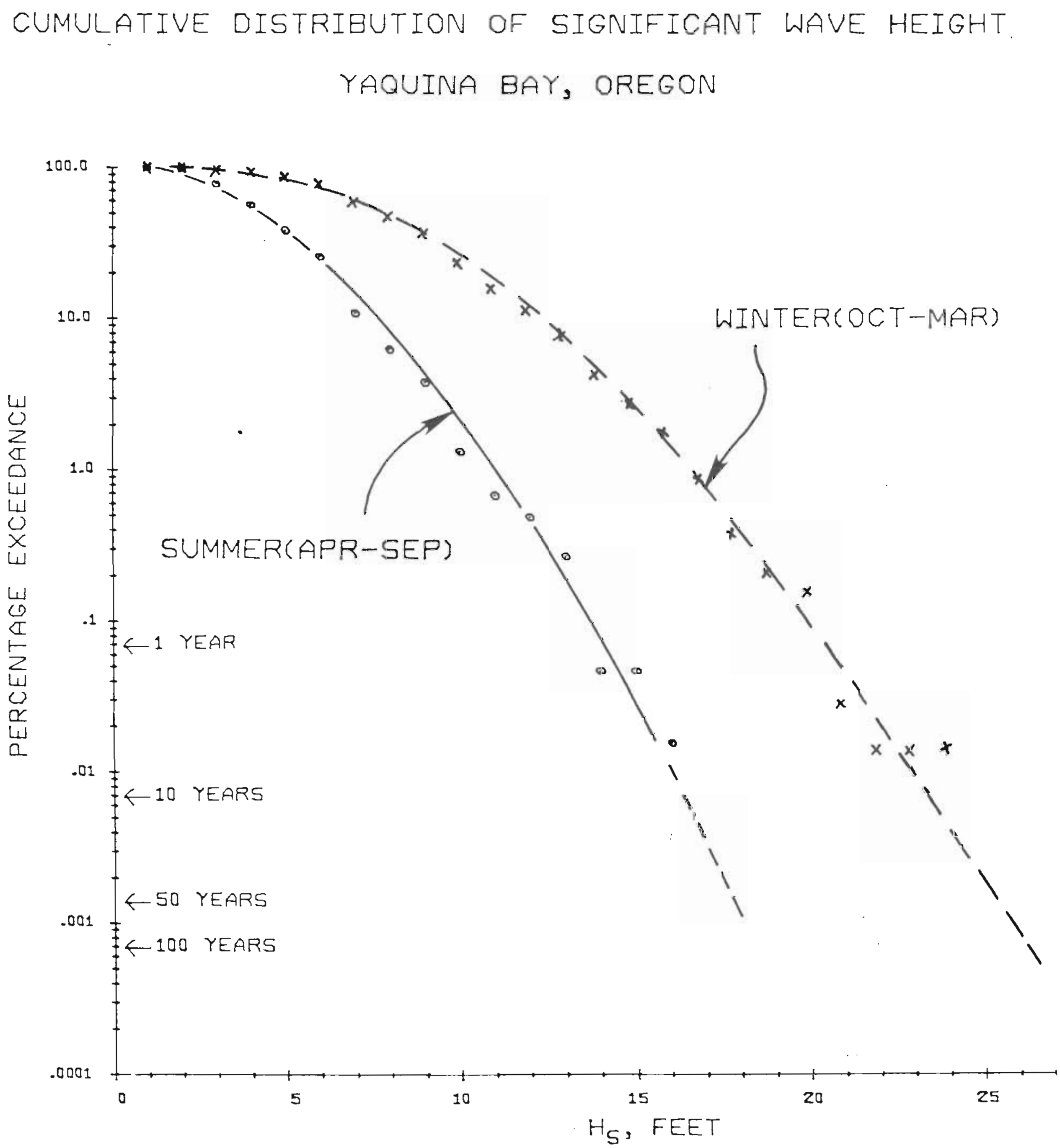


Figure D-5. Cumulative frequency distribution of significant wave heights computed from Newport seismometer data.

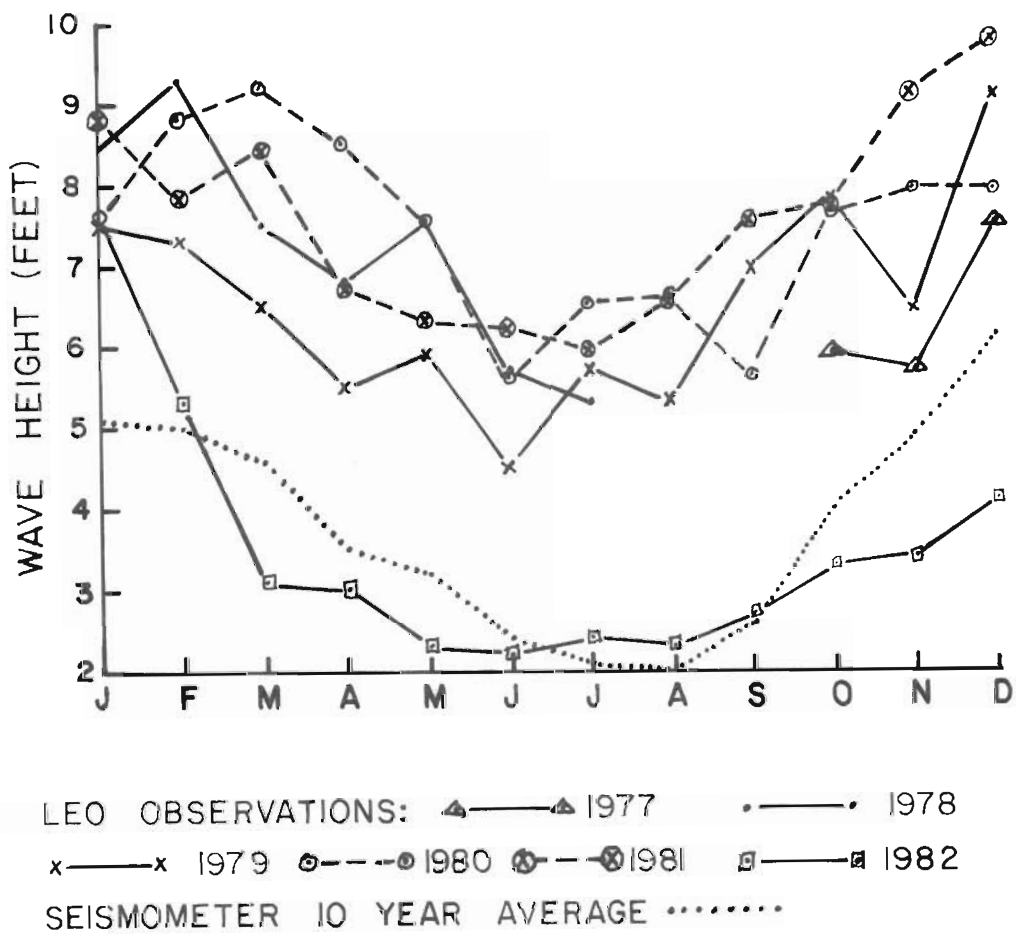


Figure D-6. Comparison of monthly average wave heights observed during LEO program and 10-year average monthly wave height for Newport seismometer.

made to confirm this assumption and it is likely that local winds and bathymetric effects will produce substantial differences between the Coquille wave height distribution and the local nearshore wave climate. Such studies should be possible through a comparison of wave-generated microseisims recorded at the Oregon State University Marine Science Center with the Coquille records. The most simple comparison of total spectral energy of water pressure observations offshore of Coos Bay[23, 24] and Bandon suggests that while summer spectra may be reasonably similar along the coast, winter spectra may strongly reflect local meteorological conditions.

Wave and Current Monitoring

4.24 Current meters were deployed near the ocean disposal site between 22 February and 5 March 1984.[38] The meters were attached to a single mooring at depths of about 70 and 90 feet. The deeper meter was about 4 feet above the bottom and made detailed current measurements every 4 hours. The shallower meter recorded vector averaged velocities at hourly intervals. Figure D-7 summarizes the current observations observed during the 12-day period. The bottom figure shows that average currents were nearly unidirectional (60 percent of the time) to the north and slightly offshore. Speeds were uniformly high at between 30 and 60 cm/s. Currents at 70 feet depth (top figure, figure D-7) were more variable in speed and direction with more southerly and onshore transport. Average speeds in excess of 15 cm/s occurred more than 50 percent of the time.

4.25 Significant wave heights and periods were computed for this period, as shown in figure D-8.[39] Wave heights ranged from 4 to 20 feet with an average near 8.5 feet. Wave period ranged from 10 to 20 seconds with an averge near 13 seconds. During the 13-day record there were 3 storm events of about 2 days duration each. During each event both wave height and period increased concurrently. Wave records at Coquille and Newport were compared with the seismic wavemeter system at the Marine Science Center. There was good statistical correlation lending credibility to the 10-year record of waves at Newport.

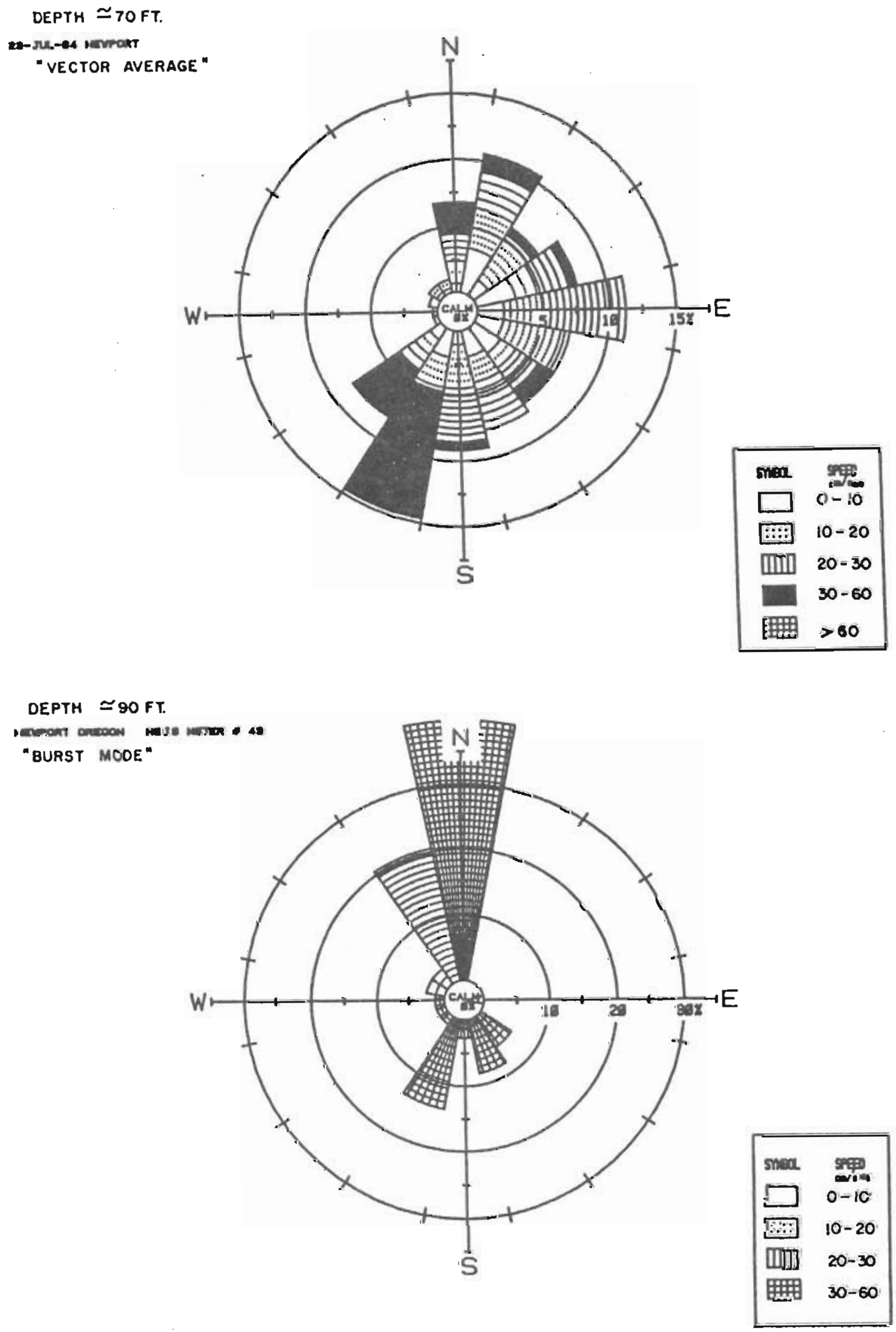
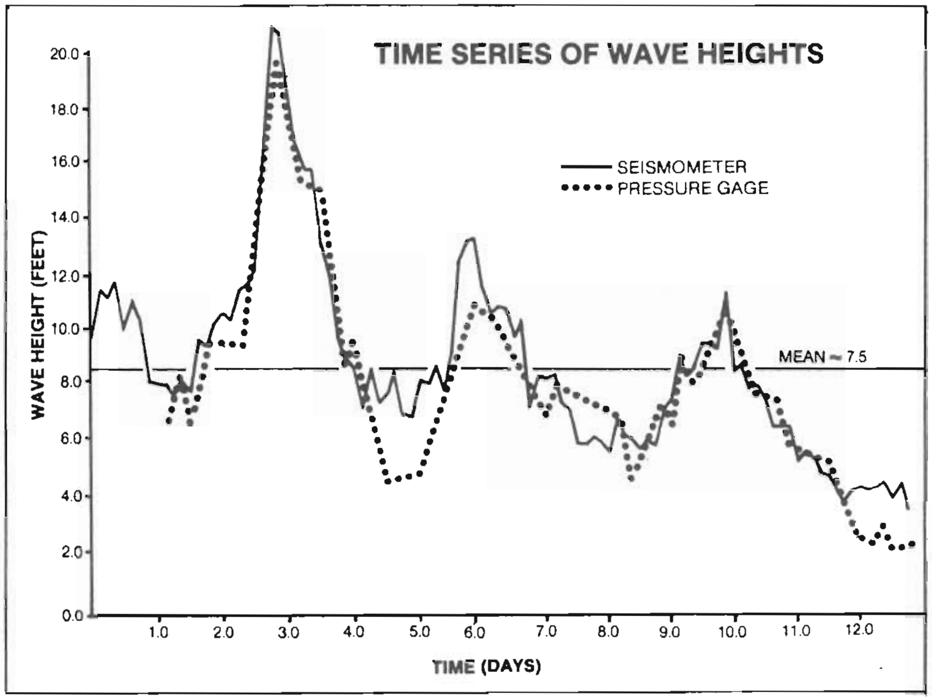
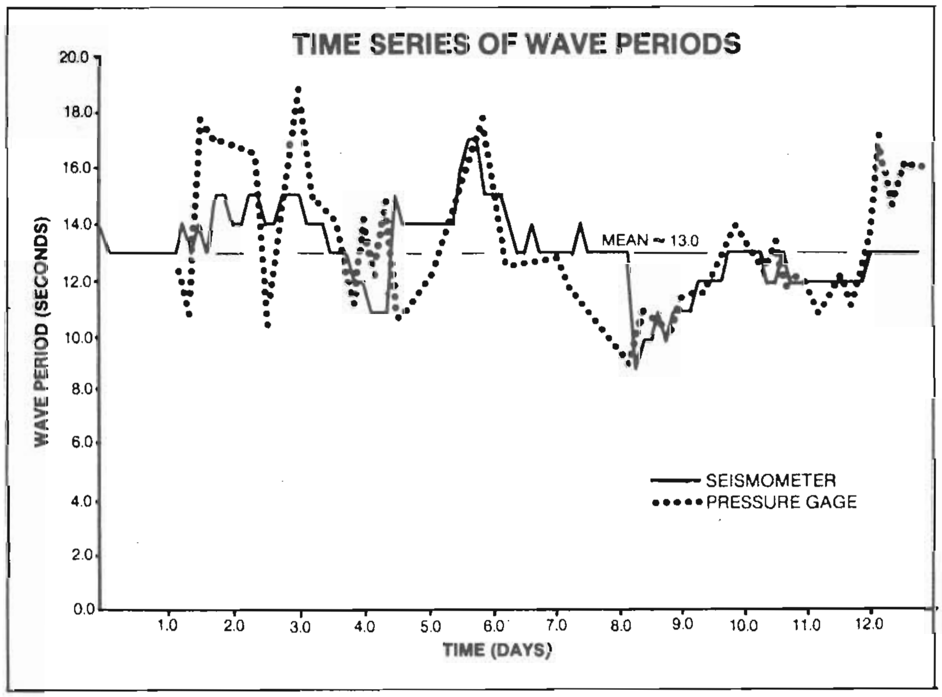


Figure D-7. Current observations observed during 12-day field deployment, 22 Feb 5 Mar 84.



Time history of significant wave height from seismometer and pressure gage during February 22 through March 5, 1984.



Time history of significant wave period from seismometer and pressure gage during February 22 through March 5, 1984.

Figure D-8. Significant wave heights and periods for 12-day field deployment, 22 Feb - 5 Mar 84.

PHYSICAL OCEANOGRAPHY REFERENCES

1. Huyer, A. and R.L. Smith 1977. Physical characteristics of Pacific Northwestern coastal waters, in the Marine Plant Biomass of the Pacific Northwest Coast, R.W. Krauss, ed., Oregon State University Press, Oregon State University, Corvallis, OR.

2. Collins, C.A. and J.G. Pattullo 1970. Ocean currents above the continental shelf off Oregon as measured with a sinble array of current meters. J. Marine Research 28(1), 51-68.

3. Huyer, A., E.J.C. Sobey, and R.L. Smith 1979. The spring transition in currents over the Oregon continental shelf. J. Geophys. Res. 84(C11), 6995-7011.

4. Huyer, A., R.D. Pillsbury and R.L. Smith 1975. Seasonal variation of the alongshore velocity field over the continental shelf off Oregon. Lim. and Ocean. 20(1), 90-95.

5. Huyer, A. 1976. A comparison of upwelling events in two locations: Oregon and Northwest Africa, J. Marine Research, 34(4), 531-545.

6. Burt, W.V. and B. Wyatt 1964. Drift bottle observations of the Davidson Current off Oregon. Dept. Ocean. Tech. Rept. 34, Oregon State Univ., Corvallis, OR.

7. Sobey, E.J.B. 1977. The response of Oregon shelf waters to wind fluctuations: differences and the transition between winter and summer. PhD thesis, Oregon State University, Corvallis, OR.

8. Bourke, R.H. and B.W. Adams 1971. The nearshore physical oceanographic environment of the Pacific Northwest coast. OSU Dept. Ocean. Reference 71-45, Oregon State University, Corvallis, OR.

9. Stevenson, M.R., R.W. Garvine and B. Wyatt 1974. Lagrangian measurements in a coastal upwelling zone off Oregon. J. Phys. Ocean. 4(3), 321-336.

10. Keene, D.F. 1971. A physical oceanographic study of the nearshore zone at Newport, Oregon. Masters thesis, Oregon State University, Corvallis, OR.

11. Maughan, P.M. 1963. Observations and analysis of ocean currents above 250 m off the Oregon coast. Masters thesis, Oregon State University, Corvallis, OR.

12. Stevenson, M.R., J.G. Pattullo and B. Wyatt 1969. Subsurface currents off the Oregon coast as measured by parachute drogues. Deep-sea Research, 16, 449-461.

13. Moores, C.N.K., L.M. Bogert, R.L. Smith and J.G. Pattullo 1968. A compilation of observations from moored current meters and thermographs, Vol II, Dept. Ocean Data Rep. 30, Ref 68-5, Oregon State University, Corvallis, OR.

14. Collins, C.A., H.C. Creech and J.G. Pattullo 1966. A compilation of observations from moored current meters and thermographs, Vol. I. OSU Dept. Ocean Data Rep. 23, Ref. 66-11, Oregon State University, Corvallis, OR.

15. Neal, V.T., D.F. Keene and J. Detweiler 1969. Physical factors affecting Oregon coastal pollution. Dept. Oceanography Ref. 69-28, Oregon State University, Corvallis, OR.

16. Huyer, A., J. Bottero, J.G. Pattullo and R.L. Smith 1971. A compilation of observations from moored current meters and thermographs. Vol. V. OSU Dept. Ocean. Data Rep. 46, Ref. 71-1, Oregon State University, Corvallis, OR.

17. Pillsbury, R.D., R.L. Smith, and J.G. Pattullo 1970. A compilation of observations from moored current meters and thermographs. Vol. III, Dept. Ocean. Data Rep. 40, Ref. No. 70-3.

18. Huyer, A. 1977. Seasonal variation in temperature, salinity, and density fields over continental shelf off Oregon. Limnology and Ocean. 22(3), 442-453.

19. Pillsbury, R.D. 1972. A description of hydrography, winds and currents during the upwelling season near Newport, OR. PhD thesis, Oregon State University, Corvallis, OR.

20. James, W.P. 1970. Air photo analysis of waste dispersion from ocean outfalls. PhD thesis, Oregon State University, Corvallis, OR.

21. Montagne-Bierly Associates 1977. Yaquina Bay hopper dredge scheduling analysis—Offshore disposal site inspection. Report prepared for the U.S. Army Corps of Engineers, Portland District, Portland, OR.

22. Hancock, D.R., P.O. Nelson, C.K. Sollitt and K.J. Williamson 1981. Coos Bay Offshore Disposal Site Investigation Interim Report, Phase I, February 1979-March 1980. Report to U.S. Army Corps of Engineers, Portland District, Portland, OR, under contract no. DACW57-79-C0040, Oregon State University, Corvallis, OR.

23. Nelson, P.O., C.K. Sollitt, K.J. Williamson and D.R. Hancock 1983. Coos Bay Offshore Disposal Site Investigation Interim Report, Phase II-III, April 1980-June 1981. Report to U.S. Army Corps of Engineers, Portland District, Portland, OR, under contract no. DACW57-79-C0040, Oregon State University, Corvallis, OR.

24. Sollitt, C.K., P.O. Nelson, K.J. Williamson and D.R. Hancock 1984. Coos Bay offshore disposal site investigation final report, Report to U.S. Army Corps of Engineers, Portland District, Portland, OR, under contract no. DACW57-79-C0040, Oregon State University, Corvallis, OR.

25. Huyer, A. and J.G. Pattullo 1972. A comparison between wind and current observations over the continental shelf off Oregon, Summer 1969. J. Geophys. Res. 77(18), 3215-3220.

26. EPA 1971. Oceanography of the nearshore coastal waters of the Pacific Northwest relating to possible pollution, Water Pollution Control Research Series, 2 volumes, Environmental Protection Agency.

27. Moores, C.N.K. and R.L. Smith 1968. Continental shelf waves off Oregon. J. Geophys. Res. 73(2), 549-557.

28. Collins, C.A. 1968. Description of measurements of current velocity and temperature over the Oregon continental shelf, July 1965-Feb 1966. PhD thesis, Oregon State University, Corvallis, OR.

29. Komar, P.D., R.H. Neudeck and L.D. Kulm 1972. Observations and significance of deep-water oscillatory ripple marks on the Oregon continental shelf, in Shelf Sediment Transport: Process and Pattern, D.L. Swift, K.B. Duane and O.H. Pilkey, eds., Dowden, Hutchinson and Ross, Inc. p. 601-619.

30. National Marine Consultants 1961. Wave statistics for three deep-water stations along the Oregon-Washington coast. U.S. Army, Corps of Engineers, Seattle District, Seattle, WA.

31. National Marine Consultants 1961. Wave statistics for twelve most severe storms affecting three selected stations off the coast of Washington and Oregon, during the period 1950-1960. Report to the U.S. Army, Corps of Engineers, Portland District, Portland, OR.

32. USAED 1962. Yaquina Bay and Harbor, Oregon, Design Memorandum No. 2, General Design, U.S. Army, Corps of Engineers, Portland District, Portland, OR.

33. Enfield, D.B. 1974. Prediction of hazardous Columbia River bar conditions. PhD thesis. Oregon State University, Corvallis, OR.

34. Creech, C. 1981. Nearshore wave climatology, Yaquina Bay, Oregon (1971-1981). OSU Sea Grant Program Rep. ORESU-T-81-002; NOAA-82060305 submitted to National Oceanic and Atmospherics Administration, Rockville, MD, Oregon State University, Corvallis, OR.

35. Creech, C. 1977. Five-year climatology (1972-1976) off Yaquina Bay, Oregon. Sea Grant Communications, ORESU-T-77-011, Oregon State Univ., Corvallis, OR.

36. USAED unpublished data. Littoral Environmental Observation Program (LEO). U.S. Army Corps of Engineers, Portland District, Portland, OR.

37. Seymour, R.J. 1981. Coastal data information program monthly reports, 1981 through present. Calif. Dept. Boating and Waterways, Scripps Institute of Oceanography, La Jolla, CA.

38. Sollitt, C.K. and D.R. Standley, 1984. Unpublished Data Report to Portland District, COE.

39. Thompson, E.F., G.L. Howell and J.M. McKee, 1985. Unpublished Draft Report to Portland District, COE.

APPENDIX E

CULTURAL RESOURCES

APPENDIX E - CULTURAL RESOURCES

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TABLES

FIGURE

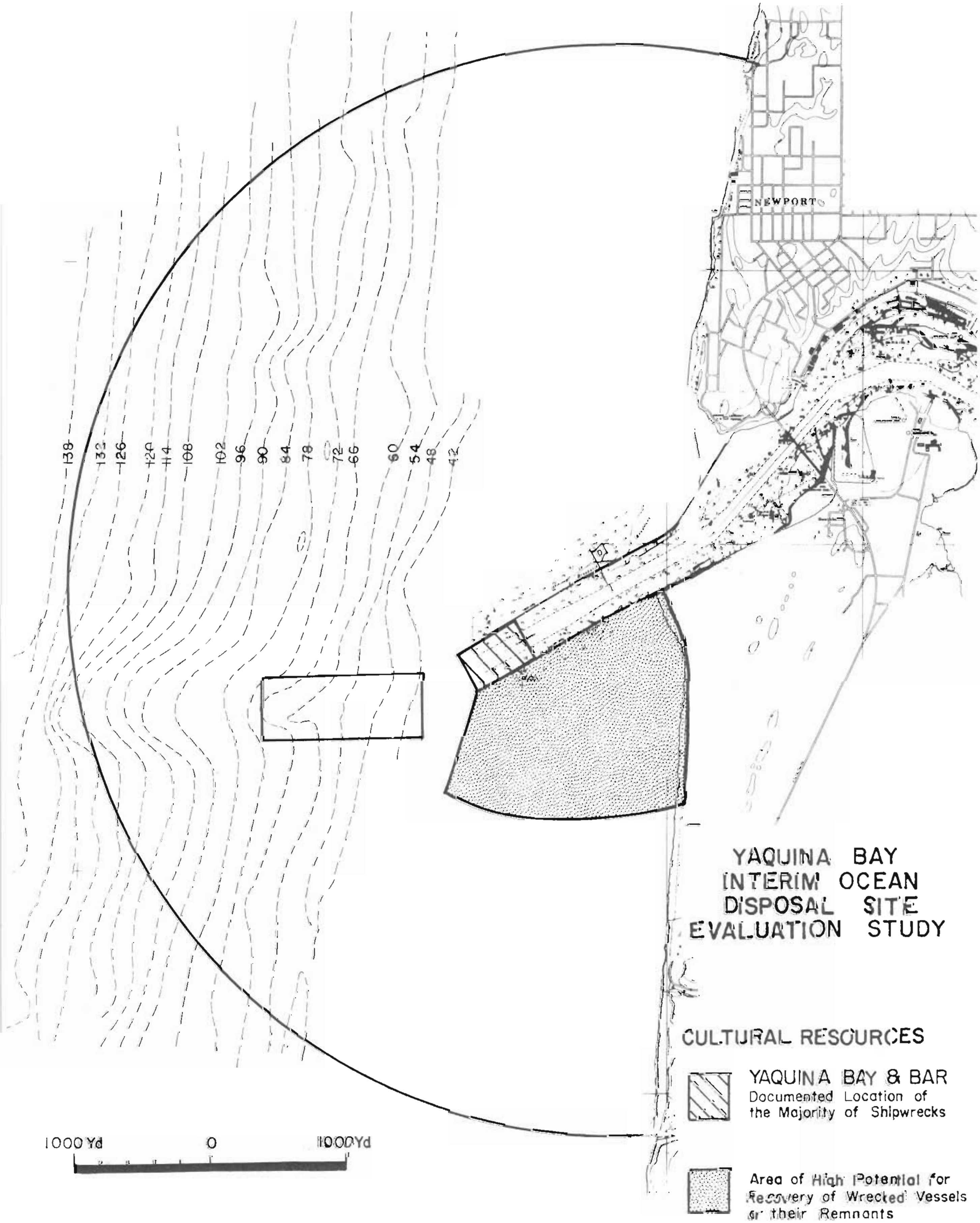
Introduction

5.01 The purpose of this cultural resource literature search of the Yaquina Bay study area is to use existing information to determine: (1) what type of cultural resources could be expected in the study area, (2) where these resources are likely to be, and (3) if these resources will be affected by the proposed project. The study area extends from the mouth of the Yaquina River out into the ocean for approximately 2 miles. The area of primary concern is a rectangular disposal site located just off the ship channel on the ocean side of the Yaquina Bar (see figure E-1).

5.02 This cultural resource study focused on those activities of both Native Americans and EuroAmericans, that were dependent on the ocean for transportation and/or subsistence activities. The conclusions of the study are that: (1) examination of the literature can determine the existence of cultural resources in the project area, in this instance the remnants of shipwrecks; and (2) the most likely area for recovery of these resources, in this instance, is at South Beach.

Native American: Potential

5.03 The probability of substantial prehistoric cultural resources within the project area is very low. It is possible that prehistoric Native Americans may have used portions of the project area, the Yaquina and south reefs as an offshore fishery. Evidence suggesting this activity is present at sites along the Oregon Coast. For example the remains of small numbers of fish favoring reef type habitats such as ling cod, Cabazon and black rockfish have been recovered in middens at Netarts, Seal Rock;[1,2] and at Cape Perpetua (Ruth Greenspand, personal communication). The subsistence value of these reef fish is uncertain as these middens are dominated by a faunal assemblage composed primarily of rock mollusks, seal, sea lion and land mammal bones[3]. However, the comparatively small numbers of reef fish bones offers little support for an intensive prehistoric offshore fishery. The literature does indicate the importance of estuary resources, crab, oyster, flounder, for local, ethnographicaly known Native Americans[4,5] (for comparison with the Coos Bay Indians see Simons)[6].


NEWPORT
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YAQUINA BAY
INTERIM OCEAN
DISPOSAL SITE
EVALUATION STUDY
CULTURAL RESOURCES
YAQUINA BAY & BAR
Documented Location of the Majority of Shipwrecks
Area of High Potential for Recovery of Wrecked Vessels or their Remnants
1000 Yd
0
1000 Yd

FIGURE E-1

5.04 Even in an area where a maritime fishery is suggested, the likelihood of recovering procurement technology from the project area is minimal. For example, artifacts analyzed as part of a fishing technology were identified at the Par-Tee site in Seaside, Oregon. Implements include, "eyed fish hook," "hook barbs," and "perforated stone disc" (fishing weights). However, the setting in which these implements were used is not clear, as the faunal analysis refers only to fish remains not to species.[7]

5.05 Continued use of the disposal site should not affect any significant prehistoric cultural resources.

5.06 Historic Period. A review of the history of the Yaquina vicinity indicates that shipwrecks and their remnants exist within the project area. In general, the majority of documented shipwrecks occurred between 1849-1895.[7,8] This period covers the establishment and closure of the Siletz Indian Reservation, early EuroAmerican settlement, initiation of the local export economy and the construction of jetties and other navigation improvements by the Corps.[5,8,9,10] It is also possible that wrecks of earlier periods, for example vessels engaged in coastal exploration and the fur trade, may appear within the project area. In addition, numerous Chinese junks and Japanese boats have drifted from the Asian mainland and washed ashore on the Pacific Northwest Coast.[11]

5.07 Wrecks of the Coastal Trade. During the 1849-1895 period, schooners and barks engaged in the coastal trade transported supplies for coastal settlements and their respective export products. Typically, these vessels operated in harbors too shallow for deeper draft vessels or where the amount of goods or export products did not justify the use of larger vessels. At first, the vessels carrying these goods depended on sail power. Later developments included supplementing the sail with steam, steam powered vessels, and the use of steam powered tugs to tow sailing vessels from harbors into the ocean shipping lanes. Ships powered by sail operated along the coast through the 1920's.

5.08 Shipwrecks in the Yaquina Study Area. Table E-1 details the shipwrecks which occurred within the Yaquina Project area. Included on the chart are the vessels' name, mode of power, cargo, date of wreck, location of wreck, final location of wreck, and source(s) of information.

5.09 There are references to other vessels said to have wrecked in the Yaquina vicinity (table E-2). These wrecks were not included in the preceding chart because there were problems concerning the reliability of the information, (quality of the reference), or lack of pertinent locational information or name of vessel. These wrecks are mentioned, however, because they do indicate the possibility of undocumented wrecks within the project area.

5.10 Potential for Recovery of Shipwrecks in the Yaquina Area. The most likely area for documenting remnants of coasting vessels is South Beach. This assumption is supported by the pattern of wrecks deposited on South Beach by the local Yaquina Bay currents. Of the seven vessels wrecked at the bar, five are reported to have been carried to South Beach by inshore currents. (Two vessels were towed to this location.) This suggests that other vessels not documented by the literature search (especially those earlier than 1850) may be present on the beach.

5.11 Survival of these vessels on the beach is another important problem. Wrecked vessels were frequently burned in order to recover scrap metal or salvaged for their useful materials. For instance, the schooner JULIET is reported to have been burned. Burned vessel sites may be relocated by magnetometer surveys.

5.12 In general, the exact locations of beached vessels is not recorded. However, at Yaquina, the location of the wreck of the steamship YAQUINA BAY was noted in the Annual Reports to the Chief of Engineers. Assistant Engineer Holcombe used the location of the wreck as a bearing point, while commenting on the rate of sand accretion behind the south jetty.[12] This site may be relocated based on this information.

5.13 Though the pattern of wreck locations suggests that ocean currents deposit wrecks on South Beach, it is also possible that wrecks are still present on the ocean floor. The likelihood of this event is dependent on a number of variables such as type of material the vessel is constructed of and its cargo. (Wood vessels will drift farther than steel, depending on the

Table E-1. Documented Wrecks in the Yaquina Project Area.

Date of Wreck	Name (type)	Cargo	Location of Wreck (Fate of Wreck)	Reference
1849 March (1852)	JULIET	Oysters	Yaquina Bay; drifted to South Beach - wreck burned.	Wright, 1895:43; Gibbs, 1957:275.
25 Nov 1853	JOSEPH WARREN (Bark)	Oysters	Wreck beached short distance south of Yaquina Bay	Wright, 1895:50; Gibbs, 1957:276.
11 Mar 1862	[LARRY] DOYLE (Schooner)	Oysters	Yaquina Bay (Unknown)	Wright, 1895:144; Fagan, 1885,482.
13 Oct 1864 (19 Oct 1864 Gibbs)	CORNELIA TERRY (Schooner)	Oysters	Yaquina Bay ( )	Wright, 1895:130. Gibbs, 1957:277; Beckham, 1977:160
11 Mar 1865	[ANNA] DOYLE (Schooner)	----	Yaquina Bay Bar	Wright 1895:144, Gibbs, 1957:277; Fogarty, 1980:67.
16 Feb 1865 (Fagan, 1876)	LIZZIE (Schooner)	Oysters hides	Yaquina Bay Bar (South Beach)	Wright, 1895:246; Fagan, 1885:482; Hays, 1976:64; Fogarty 1980:67.
5 Apr 1874	CAROLINE MEDEAU (schooner)	Oysters	Yaquina Bay Bar (South Beach - salvaged)	Wright, 1895:246; 1885:482; Gibbs, 1957:279; Fogarty, 1980:67.
26 Sep 1874	ONA (Steam Schooner)		Yaquina Bay North Spit (grounded on South Beach)	ARCE Powell, 1884 (3): 2266, Wright, 1895:314; Gibbs, 1957:279; Fogarty, 1980:67.
4 Dec 1887	YAQUINA CITY (Steamship)	-	Yaquina Bay (beached on South Beach)	Wright, 1895:350; ARCE, 1893(4):3363; 1900(5):4299; Gibbs, 1957:282; Fogarty, 1980:68
19 Dec (9 Dec 1888 Gibbs)	YAQUINA BAY (Steam Schooner)	-	Wrecked on south jetty, (vessel towed and beached on South Beach)	Wright, 1895:360; ARCE, 1891:3193; 1893(4):3363; Gibbs, 1957:282; Fogarty, 1980:68.
8 Dec 1891	MAGGIE ROSS (Steamship)	Lumber	Off Oregon Coast (wreck towed to Yaquina Bay)	Wright, 1895:394; Gibbs 1957:283.
11 Dec	GENERAL BUTLER (Bark)	Lumber	100 miles SW Cape Argo parts of hull drifted into Yaquina & (Wright) took out 80 feet of south jetty.	Wright, 1895:394; Gibbs, 1957:283

Table E-2. Other Wrecks

Date of Wreck	Name (type)	Cargo	Location of Wreck	Reference
early 1849	Unknown	Chinese silk - cargo salvaged by Indians/ settlers	Yaquina vicinity	Dye, 1941:227
late 1873	John Hunter	Unknown	Yaquina (wrecked on beach)	Fagan,1885, 482
December 1892	Unknown	Unknown	Capsized derelict vessel drifted into Yaquina Bay between jetties - took out portions of construction tramway	ARCE 1892(3): 2699.

degree of damage to the hull.) One wreck, JOSEPH ASPEDAL, on the Yaquina Reef, is a concrete barge sunk in the 1940's. Another factor, environment of the wreck site (ocean current patterns and the type of material composing the ocean bed), may be important. For example, wrecks in rock reefs may be held for longer periods of time than wrecks on ocean beds with smooth, harder surfaces. The area to the south of the south jetty (between the reef and beach) is a continuous sand bottom; an informant (a diver) indicated that he had not seen any wrecks within that area (Gaumero, ODFW, personal communication).

Conclusion

5.14 The literature search of the Yaquina Bay study area resulted in the documentation of twelve vessels wrecked in the project area. Though the majority of these wrecks occurred on the bar, ocean currents deposited five of these vessels on South Beach. In addition, two other vessels were towed and then abandoned on South Beach.

5.15 Given the characteristics of the Yaquina Bar, onshore current pattern and hard sand bottom, and the fact that the ship channel over the bar has been actively maintained by dredging and removal of wrecks from the 1860's to the present, it is unlikely that any wrecks have survived in the vicinity of the disposal site. Based on the above information, it is unlikely that any significant cultural resources will be affected by continued use of the disposal site.

LITERATURE CITED

1. Barner, Debra Carol, 1982. Shell and Archaeology: An Analysis of Shellfish Procurement and Utilization on the Central Oregon Coast, unpublished M.A. thesis, Oregon State University, Corvallis, Oregon.

2. Zontek, Terry. 1983. Aboriginal Fishing at Seal Rock, 35-LNC-14 and Neptune 35-LA-3; Late Prehistoric Archeological Sites on the Oregon Coast. Unpublished M.A. Thesis, Interdisciplinary Studies, Oregon State University, Corvallis, Oregon.

3. Ross, Richard E., 1983. Archeological Sites and Surveys on the North and Central Coast of Oregon, in Prehistoric Places on the Southern Northwest Coast, ed. Robert E. Greengo, Seattle: Thomas Burke Memorial Washington State Museum, p. 213.

4. Talbot, Theodore Webt. 1980. From the Journals of Lieut. Theodore Talbot, U.S.A. on his Journey Through Lincoln County and Along the Oregon Coast in 1849. Entries complied and Notes on Contents by Leslie L. Haslan. Newport, Oregon.) in Lincoln County have: A Reprinting of Five Early Publications of the Lincoln County Historical Society. Newport, Lincoln County Historical Society.

5. Beckham, Stephen Dow. 1977. The Indians of Western Oregon. This Land was Theirs. Coos Bay:Arago Books.

6. Simons, Alexy. 1983. Cultural Resources in the Pacon Graving Dock Project Area. (unpublished Report, on file Portland District, Corps of Engineers).

7. Phebus, George and Robert M. Drucker. 1971. Archeological Investigations of Seaside, Oregon: An Intermediate Report on the Excavations of Two major Archeological Sites at Seaside, Oregon, Through September 1977. Vol 1. No. 1. Sponsored by The Seaside Museum and Historical Society, fig 2.

8. Fagan, David D. 1885 History of Benton County Oregon . . . etc. Portland: A.G. Walling Printer.

9. Mills, Randall V. 1950. Railroads Down the Valley: Some Short Lines of the Oregon Country:Palo Alto, Pacific Books.

10. Willingham, William F. 1983. Army Engineers and the Development of Oregon. A History of the Portland District, U.S. Army Corps of Engineers. Government Printing Office, Washington, D.C.

11. Beals, Herbert K. and Harvey Steele. 1981. Chinese Porcelains from site 35-Tl-1, Netarts Sand Spit, Tillamook County, Oregon. University of Oregon Anthropological Papers. Vol. 23. Eugene. University of Oregon.

12. ARCE (Annual Report of the Chief of Engineers). 1893. Yaquina Bay, (4):3363. Report of Mr. J.G. Holcombe; Washington: Government Printing Office.

13. Wright, E.W., 1895. Lewis and Dryden's Marine History of the Pacific Northwest. The Lewis and Dryden Printing Company, Portland, pp. 43-394.

14. Gibbs, Jim. 1968. West Coast Windjammers in Story and Pictures. Seattle: Superior Publishing Company.

15. Fogarty, Jack. 1980. Some History of Early-Day Steamboating on Yaquina Bay in Lincoln County Lore: A Reprinting of Five Early Publications of the Lincoln County Historical Society, ed. by Leslie L. Haskin, Newport: Lincoln County Historical Society.

16. Hayes, Majorie M. 1976, The Land that Kept Its Promise. Newport: Lincoln County Historical Society.

17. ARCE (Annual Report of the Chief of Engineers) 1884. Improvement of Entrance to Yaquina Bay, Oregon, CPT Powell (3)2266. Washington: Government Printing Office.

18. ARCE (Annual Report of the Chief of Engineers). 1891. Yaquina Bay. Report of Mr. Gwynn A. Hyell, Assistant Engineer. (4):3193. Washington: Government Printing Office.

19. Dye, Era Emery. 1941. Boone Family Reminiscenes, Oregon Historical Quarterly:42:220-229. Salem:Stateman Publishing Co.

APPENDIX F

COMMENTS AND COORDINATION

APPENDIX F - COMMENTS AND COORDINATION

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
ENVIRONMENTAL & TECHNICAL SERVICES DIVISION
847 NE 19th AVENUE, SUITE 350
PORTLAND, OREGON 97232-2279
(503) 230-5400

June 20, 1984 F/NWR5

Mr. Eugene D. Pospisil, P.E.
Chief, Advance Planning Branch
Portland District, Corps of Engineers
P.O. Box 2946
Portland, Oregon 97208

Dear Mr. Pospisil:

We regret that we were not able to attend the May 30, 1984 meeting you hosted to discuss the Yaquina Bay Interim Ocean Dredged Material Disposal Site Evaluation Study. Nevertheless, we did review the study and offer the comments herein to assist you in preparing the final version of the report.

We appreciate and share your concern for the often expensive and time-consuming task in making a final selection of ocean dredged material disposal sites. That concern, however, does not lessen our first concern to protect marine resources. As you are aware, the National Marine Fisheries Service has statutory responsibility for the management of the nation's living marine resources. These renewable resources support a food producing commercial and recreational fishing industry of great economic importance to the nation. The quality and quantity of these resources are directly related to quality and quantity of their habitat. Industry, State, and Federal agencies responsible for the management of these resources to the benefit of the nation have identified habitat loss and modification as the greatest threat to these resources. Our policies are determined by our responsibility to manage the nation's living marine resources to obtain an optimum yield as mandated by Congress.

We generally support 1) the intent of the "Draft Technical Guidance for the Designation of Ocean Dredged Material Disposal Sites," and 2) the concept that site designation relating to small coastal navigation projects involving frequent dredging and disposal of small quantities of sandy material would usually be treated with less detail than projects requiring frequent disposal of larger volumes of various sediment types. The selection of Yaquina Bay to apply new guidance as a trial application is realistic since it is a smaller application of ocean disposal activities.

We request that you consider in your Phase I evaluation the following comments:

1. Appendix A fairly consistently shows the absence of living resources within the boundaries of the interim disposal site. An obvious assumption we must make is that the absence of living resources may be the result of dumping dredged material and that they would become reestablished if the activity was terminated.

1. We concur with the comment; however, areas outside of the disposal site boundaries are still productive (Appendix A). Reductions in benthic abundance at the disposal site are unavoidable.

2. For historically used sites, the procedure should first be aimed at preliminary evaluations to determine if unacceptable adverse impacts have occurred. This may be the case with Yaquina Bay.

3. Page 5, paragraph 10: The statement, " ... evaluations were taking too long, costing too much, and very few resulted in final designation ... " is not reassuring. If exhaustive and expensive studies disqualified most disposal sites, it appears that less research could bias a decision toward accepting sites that are not appropriate.

4. We must point out that data to be used in the evaluation must be site-specific. Assumptions, data extrapolations, or interpretations concerning one area may not be appropriate for another area. Fishery agency expertise must be consulted to determine the adequacy of the data and the need for additional surveys.

5. The use of Yaquina Bay as a test of the new evaluation scheme is based on the readily available information on fish resources, fishing activities, etc. Although this would seem reasonable, we remind you that this is a "best case" situation. Subsequent use of the evaluation procedure for areas with less information is expected to be more difficult and controversial.

6. Appendix C, Table C-6 shows an inordinately high level of zinc (7200 ug/g) at Site Number 4. Since this value has been determined from only one sample, it would seem appropriate to obtain additional samples.

Thank you for the opportunity to comment. We look forward to reviewing the results of this first attempt to use a much simpler and hopefully expedient means of resolving the problem of identifying acceptable ocean dredged material disposal sites.

Sincerely yours,

Dale R. Evans
Division Chief

cc: ODFW
EPA
FWS-ES-Portland

2. Benthic field studies were conducted offshore of Yaquina Bay (Appendix A). No adverse impacts were shown outside of the disposal site.

3. Past studies did not disqualify sites, but costs prohibited many sites from being studied. The new approach of making better use of existing information and local expertise, results in more cost effective studies and more sites being evaluated. Monitoring of the sites on a continuing basis will assure that they remain appropriate. This comment was considered and paragraphs 65 and 66 were changed in the final report, to more completely address monitoring of the site.

4. Site-specific field surveys for benthic samples, sediment analysis, bathymetry and hydrographic conditions were conducted for the final report (Appendixes A, B, and D). However, 40 CFR 228.4(e)(1)(ii) does allow for the utilization of generic information.

5. Concur field studies have been scheduled for remaining Portland District ocean disposal sites.

6. The level of zinc in Table C-6 of the Draft report was a mistake. The actual value is 40 ppm.

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Division of Ecological Services
Portland Field Office
727 N. E. 24th Avenue
Portland, Oregon 97232

Reference DH:mm

June 20, 1984

Colonel Robert L. Friedenwald, District Engineer
Portland District, Corps of Engineers
P. O. Box 2946
Portland, Oregon 97208

Re: NPPPL-AP-PP

Dear Colonel Friedenwald:

This is in response to your letter dated May 21, 1984, requesting our comments on the Yaquina Bay Interim Ocean Dredged Material Disposal Site Evaluation Study. We have reviewed the document and offer the following comments.

We have some concern as to the applicability of this new procedure at sites where specific physical, chemical, and biological data are virtually nonexistent. There were adequate baseline data at Coos Bay, but less than adequate biological data at Yaquina Bay. We question the validity of extrapolating the Coos Bay data to other systems such as the Columbia River, or to areas which are far removed geographically and biologically from the baseline data areas. Specifically, we do not believe that Coos Bay biological data can be used north of Yaquina Bay. We are also concerned that the proposed procedure will not be able to adequately predict and monitor impacts on benthic communities and bottom feeders, particularly at new sites. We would also be interested in knowing how it is determined which existing data can or cannot be used for extrapolation. What criteria are used to determine whether variation between new data and existing data is significant, or within the realm of background variation? We would anticipate benthic and epibenthic organisms and bottom feeders to be most sensitive to changes in bottom habitat as a result of ocean disposal. Accordingly, we recommend that benthic and epibenthic communities and bottom habitats be sampled at and near new dredged material disposal sites.

1. Benthic and epibenthic communities will be sampled for all Portland District ocean disposal sites and was accomplished for Yaquina Bay based on this comment and others received on the draft document. Discussions in appendix A show promise for extrapolating from a long term data base, i.e., Coos Bay to a shorter term data base such as Yaquina Bay. More examination of this will be accomplished as additional sites are studied.

We also recommend that the topography, bottom habitats, and seasonal current patterns be described in finer detail than proposed. This information is needed to assess impacts beyond the proposed disposal sites.

2. We concur and this information was collected and is included in the final.

We believe monitoring to be important in assessing impacts and recommend that a monitoring plan be developed. While it may not be important for every disposal area or estuary to be monitored, we believe that some

3. A more detailed monitoring plan is included in the final.

disposal areas should be selected for further study and adequately monitored on a seasonal basis. This would be required to determine the short- and long-term impacts of ocean disposal on bottom habitats and fisheries resources.

Finally, we note that zinc levels in the bottom material are 7,200 ug/g. Will ocean dumping of this material resuspend high levels of zinc in the environment and pose any danger of bioaccumulation in bottom organisms and feeders?

Thank you for the opportunity to comment on this trial procedure and we look forward to working with you on its refinement and subsequent use.

Sincerely,

Russell D. Peterson

cc:
EPA
NMFS
ODFW

4. The zinc level reported in Table C-6 was wrong and has been corrected to read 40 ppm.

U.S. ENVIRONMENTAL PROTECTION AC NCY

REGION X

1200 SIXTH AVENUE
SEATTLE, WASHINGTON 98101

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REPLY TO ATTN OF: MS 423

JUN 1 5 1984

Colonel Robert L. Friedenwald
District Engineer, Portland District
Corps of Engineers
P. O. Box 2946
Portland, Oregon 97208

ATTN: Jim Reese, NPPPL-AP-FP

RE: Yaquina Bay Interim Ocean Dredged Material Disposal Site Evaluation Study

Dear Colonel Friedenwald:

We have reviewed the referenced document and offer the attached comments to assist you in preparing the final site evaluation study.

In general, we are pleased with the efforts of your staff in attempting to follow the draft technical guidance for the designation of ocean dredged material disposal sites prepared by the Corps/EPA joint task force. This study follows the format envisioned in the guidance manual and identifies the important environmental issues of concern to EPA. In addition, your staff has been responsive to our requests for data to characterize the benthic community in and around the existing disposal site.

The attached comments contain recommendations for changes which would improve the quality of the study. Since this particular document will serve as a model for nationwide implementation of the task force guidance manual, important environmental issues must be thoroughly discussed and any uncertainties resolved before adoption.

Thank you for the opportunity to provide early input on the site evaluation study. If you have any questions on our comments, please contact Mr. Gary Voerman of my staff at FTS 399-1448.

Sincerely,

Robert S. Burd
Director, Water Division

cc USFWS-Portland
ODFW
NMFS
ODSL
ODEQ
LCDC

Detailed Comments

Comment	Response
- Under Syllabus, Paragraph 3; The second sentence should be changed to read " The evaluation study will also be submitted to the Environmental Protection Agency with...". Responsibility for final site designation rests with EPA Headquarters and the final site evaluation study must be submitted to them for their review.	1. Noted and corrected.
- Paragraph 40, Page 17 and Table C-6, Page C-9; We are concerned about the very high levels of zinc reported in bottom sediments taken at Yaquina River Mile 1.8. The 7,200 ppm of zinc greatly exceeds background levels and is far in excess of what will be allowed for ocean disposal. We recommend this value be verified by additional testing. If further tests show similar high levels of zinc, we recommend a study to delineate the source and extent of such contamination.	2. The zinc value of 7200 ppm has been changed in Table C-6 to the correct value of 40 ppm.
- Paragraph 45, Page 19; There is no substantive discussion of the environmental effects of previous disposal operations. Such a discussion must be included in the final site evaluation survey.	3. The discussion request is now presented in Appendix B.
- Paragraph 46, Page 19; Some discussion of the source of the pronounced "mound" noted in bathymetric surveys should be included in any final site evaluation study. We are especially interested to know if this "mound" is the result of previous dredged material disposal operations (as suggested in this paragraph) or is a natural phenomenon. If it is the result of previous dredged material disposal operations, consideration should be given to either moving the existing disposal site or more closely monitoring dumping operations to determine if barge operators are dumping at the proper location. The results of the Spring 1984 bathymetric survey should be summarized in the final document.	4. The mound is now discussed in Appendix B and the results of the Spring 1984 bathymetry is discussed.
- Paragraph 47, Page 19, and Paragraph 52, Page 25; It is obvious from this discussion that additional data is needed on dredged material disposal impacts to the benthic community. We understand the Corps has commissioned a benthic survey and comparative benthic community analysis to address this issue. The results of that survey and analysis should be summarized in	5. Results of the benthic survey accomplished after publication of the draft are included in the final in Appendix A.

the final site evaluation study.

- Paragraph 4.12, Page D-7; The results of the most recent survey and analysis of disposal site currents should be summarized in the final site evaluation study.

- It would be useful if this document contained a Coastal Zone Management Program consistency statement from the State of Oregon. EPA will require this State "approval" before final site designation.

6. A two week current meter study was conducted in February 1984. The results of these studies are included in the final (appendix B & D).

7. A CZMA Letter from Oregon Department of Land Conservation and Development is included. Final consistency will be determined during formal rule making by EPA.

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Endangered Species
2625 Parkmont Lane SW, B-2
Olympia, Washington 98502

March 8, 1984

Richard N. Duncan
Chief, Fish and Wildlife Branch
Portland District, Corps of Engineers
P.O. Box 2946
Portland, Oregon 97208

Refer to: 1-3-84-SP-225

Dear Mr. Duncan::

This is in response to your letter, dated February 14, 1984 and received by us February 21, 1984, requesting information on listed and proposed endangered and threatened species which may be present within the area of the Yaquina Offshore Dredged Disposal Site, located .95 mile offshore of South Newport State Park, Lincoln County, Oregon. Your request and this response are made pursuant to Section 7(c) of the Endangered Species Act of 1973, 16 U.S.C. 1531, et seq.

To the best of our present knowledge there are no listed or proposed species under our jurisdiction occurring within the area of the subject project. However, you should request a list of listed or proposed endangered or threatened marine species from the National Marine Fisheries Service. Should a species become officially listed or proposed before completion of your project, you will be required to reevaluate your agency's responsibilities under the Act. We appreciate your concern for endangered species and look forward to continued coordination with your agency.

Sincerely,

Jim A. Bottorff
Project Leader

Attachment

cc: RO (AFA-SE)
ES, Portland
ODFW (Nongame)
ONHP

JLM:gb

LISTED AND PROPOSED ENDANGERED AND THREATENED SPECIES AND CANDIDATE SPECIES THAT MAY OCCUR WITHIN THE AREA OF THE PROPOSED YAQUINA OFFSHORE DREDGED DISPOSAL SALE, LINCOLN COUNTY, OREGON

1-3-84-SP-225

LISTED:

None

PROPOSED:

None

CANDIDATE:

None

Attachment A

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Environmental & Technical Services Division
847 N.E. 19th Avenue, Suite 350
Portland, Oregon 97232-2279
(503) 230-5400

March 11, 1985 F/NWR5-418:AG

Richard N. Duncan
Chief, Fish and Wildlife Branch
Portland District Corps of Engineers
P.O. Box 2946
Portland, Oregon 97208

Dear Mr. Duncan:

This letter is in response to your request of February 27, 1985 for lists of threatened and endangered species under jurisdiction of the National Marine Fisheries Service (NMFS) that may be present in offshore dredge disposal sites at Yaquina and Coos Bays, Oregon.

The only listed species likely to occur in these areas is the gray whale, Eschrichtius robustus.

Sincerely,

Dale R. Evans
Division Chief

RECEIVED
MAR 13 1985
NPP PL-FW

COOS AND YAQUINA BAYS, OREGON
DREDGED MATERIAL DISPOSAL SITE DESIGNATION

BIOLOGICAL ASSESSMENT
GRAY WHALE

Coastal waters of Oregon serve as a migrational corridor for gray whales moving to and from their breeding, calving, and assembly areas off mainland Mexico-Baja California and their primary foraging areas in the Arctic (Sumich, 1984). Southward migration occurs in November-December with northbound migrants present from February-April. Recently, it has become apparent that summer occurrence of gray whales off the west coast of North America is more common than previously assumed (Sumich, 1984).

Gray whales summer along the Oregon Coast (Sumich, 1984). Over 1200 gray whale sightings were reported during a 1977-1980 study of gray whale occurrence off coastal Oregon by Sumich (1984). A 100 km section of coastline from the Siuslaw River to Government Point just north of Depoe Bay, appeared to be relatively important to gray whales as 60 percent of the 460 observations in 1977 occurred in that portion of the coastline (Sumich, 1984). The author noted that it was not determined if whales were more numerous or just easier to detect along that section of coast, than along other portions of the Oregon Coast. Sumich (1984) concentrated 1978 study efforts in the 100 km section from Siuslaw River to Government Point because of the higher incidence of sightings. His 1978 data indicated that gray whales were most commonly observed in the northern half of his study area; approximately Alsea River to Government Point which contrasted with 1977 results. Sumich (1984) reported a maximum observed occurrence of 0.2-0.3 whales/km of coastline for the 100 km study area for the 1977 and 1978 study years.

Most sightings of gray whales occurred within 500 m of shore (Sumich, 1984). Gray whales frequented surf or foam lines. Nearshore areas with silty sediments appear to be foraging areas for gray whales; presumably because of high amphipod populations in silty sediments (D. Hancock, USACE, pers. comm., 1985). Confirmation of foraging areas, prey populations, foraging substrate, and foraging strategy are necessary. Present tentative conclusions are based on foraging ecology of gray whales in their summer grounds in the Arctic and observed behavior and site use off Oregon. Sightings also occurred at distances 5-80 km offshore in water depths of 50-2700 m (Sumich, 1984); number of sightings was only 14 comprising 27 whales, however.

Site specific use by gray whales varied both daily and annually (Sumich, 1984), thus the period of maximum occurrence was undetectable. Additionally, weather, sea state, observer effort, the presence or absence of strategic observation points, and the unreliability of aerial counts due to the predominant occurrence of gray whales in surf and foam lines also contribute to the large variation in observed abundance. Because of these factors, Sumich considered his abundance estimate of 0.2-0.3 whales/km as conservative.

Sumich (1984) states that the primary activity of summer gray whales off the Oregon coast appears to be feeding. It is not known what the prey item(s) are. Benthic infauna, primarily gammarid amphipods, are the principal food items of gray whales in the Arctic. He speculated that the offshore sightings (14 occurrences) may indicate pelagic foraging by the species.

Sumich (1984) also determined size of gray whales whenever possible. His results indicated that calves and yearlings comprised a significantly greater proportion of the Oregon coast population than would be expected from a random sample of the population as a whole. His analysis of length data on gray whales larger than yearlings led to the conclusion that summer gray whales on the Oregon Coast are predominantly immature or atypically small mature animals. These animals may be shortening their migration due to insufficient energy reserves.

Advantages to gray whales discontinuing their migration and foraging along the Oregon coast may lie in the energetic savings associated with such behavior (Sumich, 1984). He concluded that the shallow, inshore waters of the Oregon coast should be considered as a supplementary summer feeding grounds. As a complete count of gray whales which summer off Oregon is unavailable, the proportion of the population which is present remains an unknown. However, it seems reasonable that only a small proportion of the population does exhibit this tendency to shorten their migration.

Disposal Site Information

Yaquina Bay - The proposed disposal site is located approximately 1.61 km offshore in approximately 15 m of water. Dimensions of the disposal area are approximately 1036 x 366 m or 38 hectares. The site is located in a tow boat lane, hence receives commercial boating traffic.

Recreational use, principally private and charter salmon fishing, also occurs in the disposal area during summer. Commercial fishing operations, primarily bottom fishing, salmon trolling, crabbing, and squid fishing are also present in the project area.

Dredged material disposal operations will occur generally from mid-April to mid-October with most dredging conducted from May to September. Dredging will require approximately two weeks for completion. Material disposed of will primarily be sandy sediments. The substrate of the disposal site is similar to that of the area dredged. Amphipod population levels are relatively low at the disposal site.

Coos Bay - Three sites (E,F, and H) are proposed for receipt of dredged material off Coos Bay, Oregon. Sites E and F are each approximately 1.61 km offshore and are located in 18-31 m of water. Site H is 5.8 km offshore in 55-67 m of water. Dimensions of all sites are similar; approximately 1097 x 427 m or 47 hectares.

Dredging will be completed in about one months time and will occur between mid-April and mid-October with most dreding generally occurring between May and September. Dredged material from the lower estuary is primarily clean fine sands of marine origin. Above RM 14, sediments are finer and contain more organic material. Sediments at disposal sites E, F, and H are also clean fine sands with grain size becoming progressivley smaller from the nearshore sites (E and F) to site H. Amphipod populations at the disposal sites are relatively low.

The disposal sites are located in areas which receive heavy sport and charter salmon fishing pressure. Commercial fishing operations for crab, salmon, squid, and bottom fish also occur in these areas.

Project Impacts

Gray whales occur in the project areas during distinct seasonal periods; fall and spring migration and summer. Disposal operations will have no effect on migrating gray whales as their is a distinct temporal difference in use of the sites (i.e. dredging occurs between the migratory periods). Migrant whales also would use the disposal areas only as a travel route.

Based on the limited information available on summer gray whales on the Oregon Coast, disposal operations should have no effect on this particular component of the population, either. Disposal locations are located offshore beyond the nearshore areas most commonly frequented by gray whales. Substrate composition of disposal locations is different than that in which gray whales are speculated to forage in along the Oregon Coast. Prey populations of the disposal locations are relatively low which suggests that they are unsuitable or at best marginally suitable for gray whale foraging. The disposal sites are relatively small which coupled with their low prey populations and distance offshore from apparent preferred foraging sites would result in minimal if any impact on forage availability for gray whales. The recreational and commercial fishing uses, in addition to commercial cargo traffic would preclude or reduce the probability of whale use of these sites, also.

Conclusion

We conclude, based upon the above analysis, that designation and use of the offshore disposal locations will have no effect to gray whales.

LITERATURE CITATION

Sumich, James L. 1984. Grey Whales Along the Oregon Coast in summer, 1977-1980. The Murrelet. 65:33-40.

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Environmental & Technical Services Division
847 N.E. 19th Avenue, Suite 350
Portland, Oregon 97232-2279
(503) 230-5400

April 15, 1985 F/NWR5-418:AG

Richard N. Duncan
Chief, Fish and Wildlife Branch
Portland District, Corps of Engineers
P.O. Box 2946
Portland, Oregon 97208

Dear Mr. Duncan:

The National Marine Fisheries Service (NMFS) concurs with your Biological Assessment of March 26, 1985, that gray whales are unlikely to be affected by dredged material as described at offshore disposal sites at Coos Bay and Yaquina Bay, Oregon.

Unless new information should indicate otherwise, no further consultation is required.

Sincerely,

Dale R. Evans

Dale R. Evans
Division Chief

VICTOR ATIYEH
GOVERNOR

Department of Land Conservation and Development

1175 COURT STREET N.E., SALEM, OREGON 97310-0590 PHONE (503) 378-4926

April 4, 1985

Patrick Keough, P.E.
Chief Planning Division (NPPPL-NR-EQ)
Corps of Engineers
P.O. Box 2946
Portland, OR 97208-2946

Re: Yaquina Bay Interim Ocean Dredged Material Disposal
Site Evaluation Study

Dear Patrick:

Thank you for your letter regarding consistency of the draft report, "Yaquina Bay Interim Ocean Dredged Material Disposal Site Evaluation Study" with the Oregon Coastal Management Program (OCMP). We support the new procedures for evaluating disposal sites outlined in your manual "Technical Guidance for the Designation of Ocean Dredged Material Disposal Sites." We do not anticipate any problems with the Yaquina Bay report. However, we would like to postpone our consistency determination until public review of the document has occurred. An important aspect of our consistency determinations is public review. For projects which require environmental impact statements (EIS), we normally do not make a consistency determination until the FEIS phase. This allows review of the DEIS and the selected project alternative.

We do have one additional comment on the substance of the report. The discussion of coastal zone management on page 23 should be expanded to address Goal 19, Ocean Resources, which is the most applicable state standard for the review of ocean activities. Goal 19 requires inventory information necessary to understand the impacts and relationship of the proposed activity to continental shelf and nearshore ocean processes. The impacts of the proposed project must be identified. In addition, for compliance with Goal 19, it must be demonstrated that dredged material discharge will not substantially interfere with or detract from the use of the shelf for fishing, navigation, aesthetic purposes or from the long-term protection of renewable resources. The applicable standards of Goal 19 should be addressed in this section. It appears that the intent of the MPRSA is quite similar to the intent of Goal 19.

We appreciate the opportunity to comment on the draft evaluation study at this time. We do not anticipate any problems with CZM concurrence with the project, but request that formal determination occur after public review of the document. If you have any questions regarding our response, please contact Patricia Snow of my staff.

Sincerely,

James F. Ross
Director

JFR:cmv
3637DPS/4B

VICTOR ATIYEH
GOVERNOR

Department of Transportation

STATE HISTORIC PRESERVATION OFFICE

Parks and Recreation Division
525 TRADE STREET S.E., SALEM, OREGON 97310

April 24, 1985

Owen J. Mason
Natural Resources Branch
U.S. Army Corps of Engineers
PO Box 2946
Portland, OR 97209

RE: Yaquina Bay Bar
Dredging Proposal
Cultural Resource Survey
Lincoln County

Our staff archeologist has reviewed the cultural resource report prepared by your staff archeologist Michael A. Martin. Since the area was checked with a side-scan sonar study by Earth Sciences Associates we concur with the findings that the proposed project would have no effect on sites on or eligible for inclusion on the National Register of Historic Places.

Our staff was pleased with the inclusion of a study of potential impacts on shipwreck sites for this project. If during dredging a shipwreck is encountered, our office should be contacted as soon as possible.

If you have any questions you can contact Dr. Leland Gilsen at 378-5023.

Sincerely,

D.W. Powers, III, Deputy
State Historic Preservation Officer

DWP:tsb
6117C