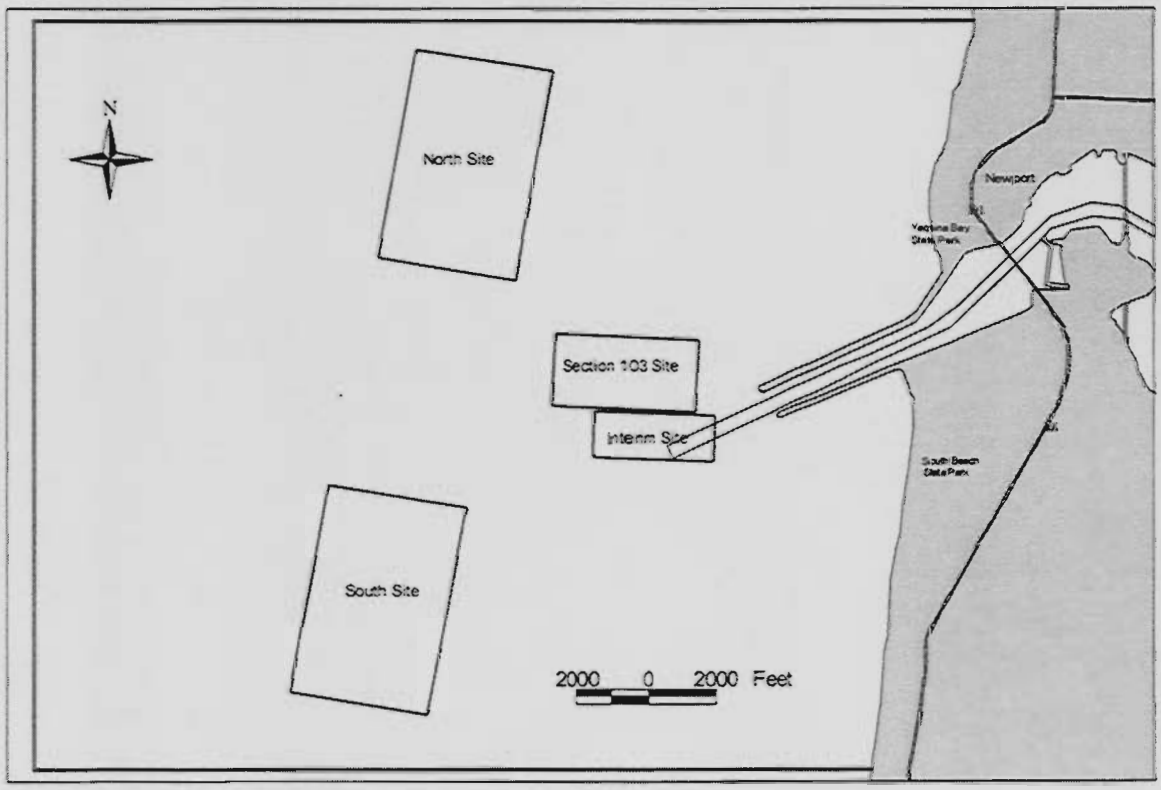
US Army Corps
of Engineers ®
Portland District

EPA
Region 10

# YAQUINA BAY
## Ocean Dredged Material Disposal Site Evaluation Study and Environmental Assessment




**Final Report**
**July 2001**

# YAQUINA BAY AND HARBOR OCEAN DREDGED MATERIAL DISPOSAL SITE EVALUATION AND ENVIRONMENTAL ASSESSMENT

**USACE, Portland District**

**EPA, Region 10**

**Final Report**

**July 2001**

## *Syllabus*

*This Evaluation and Environmental Assessment was prepared by the U.S. Army Corps of Engineers (USACE), Portland District and EPA Region 10, to describe conditions at the existing interim/Section 103 and the two proposed adjusted Ocean Dredged Material Disposal Site (ODMDS) at Yaquina Bay, Oregon. The evaluation also documents compliance of the ODMDS with requirements of the following laws:*

*Marine Protection, Research and Sanctuaries Act (MPRSA) of 1972,*
*National Environmental Policy Act of 1969,*
*Endangered Species Act of 1973,*
*National Historic Preservation Act of 1966, and the*
*Coastal Zone Management Act of 1972, all as amended.*

*The existing Section 103 site has experienced mounding, generating a potentially hazardous navigation safety condition, and has limited site capacity to receive future dredge material disposals. Commercial shippers, crab fishermen, and the US Coast Guard expressed concern over this situation to both the Corps and EPA. While the current situation may not constitute an imminent hazard to life and property which would warrant an emergency, the EPA and the Corps are in agreement that prudent management action is required in order to prevent any further adverse conditions from developing. The need for ocean dumping and implementation of the Corps' and EPA's management solution are at a point where the ability to maintain the Yaquina Bay project is at risk. Unless the Yaquina Bay project can be maintained, continued commercial use of the existing navigation channel at its authorized depth would not be possible.*

*The Yaquina Bay interim ODMDS received its interim designation from the Environmental Protection Agency (EPA) in 1977. Because of mounding in the EPA-designated interim site the USACE selected an alternate "Section 103" site in 1985 under its MPRSA Section 103 authority. This 103 site has been used for the placement of dredged material since 1986. The MPRSA requires that, for a site to receive a final ODMDS designation, the site must satisfy the specific and general disposal site criteria set forth in 40 CFR 228.5 and 228.6, respectively. This document evaluates the EPA interim site, USACE Section 103 site, and the currently proposed adjusted disposal sites (North and South Sites). The North and South sites, which have shoreward edges approximately 2 nautical miles off the beach beyond the neritic reef in 115 to 150 feet of water, are recommended for final site designation. The new adjusted sites will be used to dispose of sediments dredged by USACE to maintain the Federally authorized navigation project at Yaquina Bay with sufficient disposal capacity for approximately 20 years each. It may also be used for disposal of material dredged during other actions from federal and non-federal projects as authorized under the MPRSA.*

*The main report contains an analysis of all 40 CFR criteria and factors required selection, use and for final designation of an Ocean Dredged Material Disposal Site under MPRSA. The report also serves as an Environmental Assessment, addressing the requirements under the National Environmental Policy Act. Technical data and coordination letters gathered to address these criteria are contained in the appendices.*

# Yaquina Bay and Harbor
# Ocean Dredged Material Disposal Site Evaluation and Environmental Assessment

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# Yaquina Bay and Harbor
# Ocean Dredged Material Disposal Site Evaluation and Environmental Assessment

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# Yaquina Bay and Harbor
# Ocean Dredged Material Disposal Site Evaluation and Environmental Assessment

## PURPOSE AND NEED

This Ocean Dredged Material Disposal Site (ODMDS) Evaluation and Environmental Assessment has been jointly prepared by the U.S. Army Corps of Engineers (Corps) and U.S. Environmental Protection Agency (EPA). The purpose of this evaluation is to provide documentation in support of final designation by EPA of two ODMDSs needed for long-term use by the authorized Yaquina Bay navigation projects. This evaluation will determine if the proposed new ODMDS at Yaquina Bay, Oregon, 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 the criteria set out in Sections 102 and 103 of the Marine Protection, Research and Sanctuaries Act (MPRSA) of 1972. Further, this document is intended to provide sufficient information to determine compliance with the National Environmental Policy Act, the National Historic Preservation Act, the Coastal Zone Management Act, and Endangered Species Act. Use of the sites would be for disposal of material dredged for operation and maintenance of the Federally-authorized navigation projects at Yaquina Bay, and, through separate Section 103 permit evaluation, for disposal of dredged material from other dredging projects.

The availability of ODMDSs in the vicinity of Yaquina Bay are necessary to maintain safe deep-draft navigation through authorized federal channels and permitted actions. The existing Section 103 site has experienced mounding, generating a potentially hazardous navigation safety condition, and has limited site capacity to receive future dredge material disposals. Commercial shippers, crab fishermen, and the US Coast Guard expressed concern over this situation to both the Corps and EPA. While the current situation may not constitute an imminent hazard to life and property which would warrant an emergency, the EPA and the Corps are in agreement that prudent management action is required in order to prevent any further adverse conditions from developing. Efforts were undertaken by the federal government to temporarily expand existing sites in 1998 and to manage distribution of the maintenance dredged material within the available site while seeking a more permanent management solution. The need for ocean dumping and implementation of the Corps' and EPA's management solution are at a point where the ability to maintain the Yaquina Bay projects is at risk. Unless the Yaquina Bay projects can be maintained, continued commercial use of the existing navigation channels at their authorized depth would not be possible.

The rough seas encountered at the Yaquina Bay entrance preclude the safe and efficient operation of any dredge other than a hopper dredge. Upland disposal of dredged material from a hopper dredge operation is not economical due to the need to double handle the material and sufficient upland capacity is unavailable. Disposal of material dredged from the Yaquina Bay, therefore, must occur at an in-water site.

While it is possible to dredge and transport material back into the estuary for disposal, there is a lack of suitable estuarine and upland disposal sites. Further, estuarine habitats are unique and far less extensive than are sandy nearshore oceanic habitats. Estuarine disposal would cause greater adverse environmental impacts than would ocean disposal.

Table 1 provides dredged material volumes estimated for the Yaquina Bay federal navigation projects. Future estimated total disposal quantity for the long-term maintenance dredging of the navigation channel, is expected to remain relatively constant.

*Table 1. Volumes Dredged from Yaquina Bay Federal Navigation Project*

[in thousands of cy]

| Fiscal Year | Hopper Dredge |
|---|---|
| 1986 | 237.3 |
| 1987 | 543.0 |
| 1988 | 324.6 |
| 1989 | 383.8 |
| 1990 | 216.7 |
| 1991 | 425.7 |
| 1992 | 213.0 |
| 1993 | 358.4 |
| 1994 | 207.0 |
| 1995 | 456.3 |
| 1996 | 286.8 |
| 1997 | 313.5 |
| 1998 | 185.4 |
| 1999 | 238.9 |
| Average | 313.6 |

Though the volume is expected to be minor compared to the federal dredging volumes, the designated sites may receive material dredged by non-Corps entities and disposed under specific permits issued by the Corps. With the fundamental need for ocean dumping having been demonstrated, the Corps and EPA had to consider the needed disposal capacity which influences the number and/or size of site(s).

Twenty year site capacity needs were modeled and the results are discussed Appendix B.

Two sites, the North Site and the South Site, are proposed. Due to their size, disposal capacity was considered sufficient for approximately 20 years each. These proposed sites replace the Section 103 Site in the federal government's preferred action for management of dredged material at Yaquina Bay. The need for designation of these sites pursuant to 40 CFR 227 Subpart C is considered demonstrated.

## BACKGROUND

### Statutory and Regulatory Requirements

The Marine Protection, Research and Sanctuaries Act of 1972, as amended (MPRSA), also known as the Ocean Dumping Act, was passed in recognition of the fact that the disposal of material into ocean waters could potentially result in unacceptable adverse environmental effects. Under Title I of the MPRSA, the EPA and the Corps were assigned responsibility for developing and implementing regulatory programs to ensure that ocean disposal would not "... unreasonably degrade or endanger human health, welfare, or amenities, or the marine environment, ecological systems, or economic potentialities."

The EPA administers and enforces the overall program for ocean disposal. Under Section 102 of the MPRSA, the EPA in consultation with the Corps, established environmental criteria that are to be addressed before an ocean dredged material disposal permit can be granted. The Corps issues permits for the transportation of dredged material for the purpose of ocean disposal, after consultation with the EPA, that are in compliance with these criteria. While the Corps does not administratively issue itself a permit, the requirements that must be met before dredged material derived from Corps projects can be discharged into ocean waters are the same as those where a permit would be issued.

The MPRSA Criteria (40 CFR, Part 228) states that final site designation under Section 102(c) must be based on environmental studies of each site and on historical knowledge of the impact of dredged material disposal on areas similar to such sites in physical, chemical, and biological characteristics. General criteria (40 CFR 228.5) and specific factors (40 CFR 228.6) that must be considered prior to site designation are described and evaluated in this evaluation. Related federal statutes applicable to the site designation process include the National Environmental Policy Act of 1969, as amended; the Coastal Zone Management Act of 1972 as amended; the National Historic Preservation Act and the Endangered Species Act of 1973, as amended. As required by Section 104(a)(3) of the MPRSA, ocean disposal of dredged material can occur only at a site that has been designated to receive dredged material. Pursuant to Section 102(c), the EPA has the responsibility for site designation. Section 103(b), while encouraging use of EPA-designated sites where feasible, does provide for alternative site selection by the Corps when a suitable EPA-designated site is not available. However, the same Ocean Dumping Criteria (40 CFR 228.5 -6) are used in the evaluation process that leads to alternative site selection and the EPA must concur with the selection.

An EPA-designated site requires a site management and monitoring plan. Use of the designated site is subject to any restrictions included in the management and monitoring plan and EPA's designation regulations. These restrictions are based on an in-depth evaluation of the site pursuant to the regulations (40 CFR 220-229) and potential disposal activity as well as public review and comment. Designation of an ODMDS in itself does not result in disposal of dredged material. A separate evaluation of the suitability of dredged material for ocean disposal must be undertaken for each proposed use of the site by either the Corps or non-Corps permit applicant. Typically, as in this case, this involves

evaluation of the specific disposal activity under the Criteria, circulation of a *Public Notice* (which can include multiple years of use), and specific coordination with stakeholders as well as concurrence by the appropriate EPA Region.

**Yaquina Bay Navigation**

Yaquina River enters the Pacific Ocean near the city of Newport, Oregon, approximately 115 miles south of the Columbia River. Yaquina Bay is the fourth largest estuary in Oregon. The estuary is fed mainly by the Yaquina River, which drains 253 square miles and is 58.8 miles from its mouth to headwaters. 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 the 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 in the bay in 1919. The presently authorized project includes jetties, groins, and river channel outside the scope of the present study (Figure 1).

The Yaquina Bay federal navigation project was authorized for the following purposes:

- Provide an entrance channel, which would allow the upriver channel to be fully utilized.
- Decrease tide-caused delays for commercial ships crossing the bar.
- Provide improved safety by reducing the possibility of commercial ship grounding and a channel that allows for compatible use by commercial and noncommercial vessels.
- Provide mooring facilities for small boats that take advantage of project facilities.
- Permit barge and small boat traffic upstream to river mile 14.
- Provide a harbor of refuge.

The Federal navigation project at Yaquina Bay includes the entrance channel, authorized at 400-feet wide and 40-feet deep, which runs from deep-water approximately one mile to RM 0.0. In the past, this area was dredged to a depth of 35-feet, but since the return of deeper draft vessels in 1988, dredging is to the authorized depth of 40-feet MLLW. With advanced maintenance the entrance is actually dredged to between 42 and 44-feet to ensure that the full depth is available between dredging operations.

From RM 0.0, the authorized channel is 30-feet deep and 300-feet wide to the turning basin at McClean Point at RM 2.0. The turning basin is authorized at 30-feet deep, 900 to 1,200-feet wide, and 1,400-feet long. Advanced dredging to 32 to 33 feet ensures the needed year-round depths of 30-feet. Shoaling occurs along the outside quarter of the channel between RM 1.3 and RM 1.6, and around the periphery of the turning basin. The shoals can be removed using hopper dredges or clamshell dredges and barges.

The authorized channel from the turning basin (RM 2.4) to RM 4.0 is 18-feet deep and 200-feet wide. The Corps does not currently maintain the channel from the turning basis to RM 4.0.

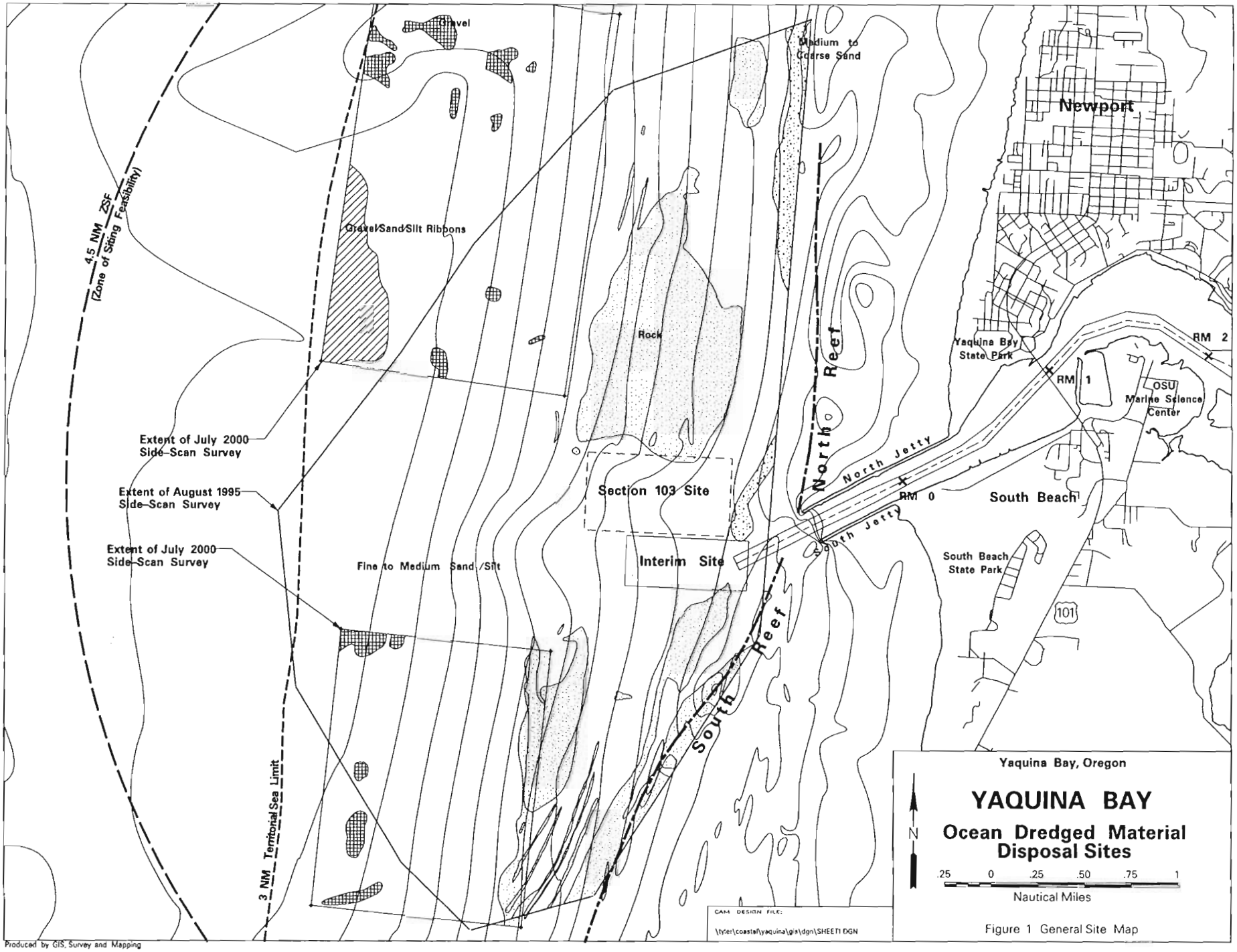



Figure 1 General Site Map

Produced by GIS, Survey and Mapping

The federal authorized project also includes a small 10-foot deep boat basin ("north basin") at Newport. East of the highway 101 bridges is the South Beach Marina with an authorized access channel 10-feet deep, 100-feet wide, and 2,035-feet long.

The authorized project in the Yaquina River consists of a channel 10-feet deep from approximately RM 4.0 (at the town of Yaquina) to RM 14.0. Generally, the channel is 150-feet wide. At Toledo, the channel widens to 200-feet, and extends into Depot Slough. A turning basin at RM 14.0, 350-feet wide and 500-feet long, completes the project.

**Historic Offshore Disposal (pre-1977)**

Sediment has been deposited at one of two Yaquina Bay ocean dredged material disposal sites (ODMDSs). After 1977 but prior to 1986, all material was placed at the 1977 EPA interim ODMDS (Figure 1).

Prior to the Interim Site receiving designation in 1977, the Corps had historically used the general area for dredged material disposal. Interim site designations in 1977 were an attempt by EPA to document and establish coordinates for historically used Corps disposal sites. At Yaquina Bay, the Corps had used the Interim Site, or areas in the same vicinity, since 1916 when the hopper dredge COL PS MICHIE conducted trial disposal operations to determine the feasibility of keeping the bar open year round. These trials led to project authorization in 1919. Since that time, the majority of the dredged material has been placed 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 annually were dredged from the project from 1919 to 1968, when the project was deepened to its present depth. Corps records of dredging the entrance bar, inner channel, and turning and small boat basins from 1959 to 1969 (excluding 1968) show that 247,737 cubic yards was fairly typical of quantities removed (Percy et al. 1974). Appendix B of the *Yaquina Bay Interim Ocean Dredged Material Disposal Site Evaluation Study* (USACE 1985) provides dredged material quantities from 1974 to 1984 (Table 2).

*Table 2. Volumes Dredged for the Yaquina Bay Project, 1974-1984*

| Fiscal Year | Hopper Dredging (thousands of cubic yards) |
|---|---|
| 1974 | 996.5 |
| 1975 | 671.8 |
| 1976 | 642.8 |
| 1977 | 414.0 |
| 1978 | 490.5 |
| 1979 | 378.2 |
| 1980 | 81.1 |
| 1981 | 141.5 |
| 1982 | 331.0 |
| 1983 | 453.0 |
| 10-year Average | 460.0 |
| 1984 | 671.0 |

**Current Offshore Disposal (post-1977)**

In January 1977, the Interim Site received its interim designation when EPA issued the final Ocean Dumping Regulations (40 CFR 228). At that time, the boundaries for the rectangular disposal site were fixed geographically in terms of corner coordinates. The Interim Site was "sized" based on the objective to minimize the areal extent over which dredged sediments would affect the receiving water column and seabed during disposal. The interim designation was to lead to final designation or termination of their use within 3 years of the interim designation. Since the 3-year period ended in 1980, extensions had been approved for continuing use of the Interim Site, pending completion of required studies for final designation. The Corps completed an evaluation study (USACE 1985) recommending the final designation of the 1977 EPA Interim Site.

No prominent mound appears in the October 1983 bathymetry at the Interim Site. By September 1984, a roughly conical mound with a base diameter of 600 to 1,000 feet and a height of 16 feet in a water depth of 60 feet was evident. The September 1984 survey was conducted immediately following the placement of 571,000 cubic yards of material between June and September 1984. The August 1985 survey indicates increased mounding to 22 feet of accumulation in water depths of 64 feet at the Interim Site.

Due to the increased mounding at the Interim Site and its potential adverse effect on navigation safety, in 1986 the Corps selected an alternate ODMDS under its Section 103 authority. Between 1985 and 1998, no dredged material was placed at the Interim Site. Mounding at the Interim Site decreased in 1986, 1987, and 1988 such that by August 1988, the bathymetric surveys show little or no mounding. Better than 20-feet of material present in 1985 had been removed by natural processes and depth contours had returned to their 1983 condition.

The 1986 Section 103 Site is located to the north and further offshore of the interim site in water depths ranging from 50 to 102 feet (see Figure 1). Dredged material has continued to accumulate at this site. As of May 1998, the maximum accumulation was 19 feet at an original water depth of approximately 84 feet. All contour lines continue to be shifted offshore. Since 1990, dredged material disposal has been managed by restricting placement to only portions of the Section 103 Site; however, management options have become limited due to continued mounding. In 1998, dredged material placement was managed by restricting the areas available for placement to the northeast and southwest corners of the site. In 1998, the Section 103 Site was enlarged to include the outer two thirds of the 1977 EPA Interim Site. In 1999, material placement was restricted to the new southern portion of the Section 103 Site. In 2000, a total of 79,800 cubic yards of dredged material was placed in the southwest corner of the 1986 Section 103 Site.

## ANALYSIS OF ALTERNATIVES

### Overview of Dredge Types

Three basic types of dredges exist: mechanical dredges (which include clamshell), pipeline or suction dredges, and hopper dredges. Hopper dredges are self-propelled, seagoing vessels and are the only type of dredge that can work effectively in rough open water. Larger hopper dredges can work in sea swell conditions to about 10 feet. Hopper dredges are very mobile and can move quickly to minimize interference with navigation traffic and can adjust to rapidly changing weather and sea conditions. Pipeline and clamshell dredges are typically not self-propelled and cannot operate safely and effectively in conditions where the waves are greater than 3 to 4 feet. They also are unable to handle strong currents such as occur during tidal shifts. Both pipeline and clamshell dredges employ spuds and/or anchors to station them in the work area and so cannot be as quickly moved to accommodate traffic, changing weather, or sea conditions. The different dredge types do not necessarily foreclose any of the different disposal options. For example, sediments removed by a pipeline dredge can be placed into a barge and the material dumped into the ocean. However, greater efficiencies can be realized by matching the dredge type to the disposal option [also see the section on Defining a Zone of Siting Feasibility (ZSF)].

The typically rough seas and strong currents encountered at the entrance to the Yaquina Bay project are too dangerous for safe operation of pipeline or mechanical dredges and hopper dredges must be used. Pipeline and mechanical dredges can operate within the estuary to maintain the main and smaller navigation channels as well as harbor or marina areas. Hopper dredges also have been used historically to maintain the Coos Bay, Columbia River, and the other small coastal navigation channels.

### Overview of Disposal Options

The alternatives for ocean dumping of dredged material from the Yaquina Bay project that were considered by the EPA and Corps include no action, upland/beach disposal, and estuarine disposal. The alternatives considered under the ocean disposal option include disposal off the continental shelf, continued use of existing sites, and designation of new ocean disposal sites.

### No Action Alternative

Within the context of ocean dumping alone, the no action alternative would be for EPA to refrain from designating new ODMDSs for the placement of dredged material. One option under this alternative would include continuing use of the existing Section 103 Site. However, the site already has mounded and further use is restricted by the Corps and EPA. By regulation, if there are no suitable EPA designated sites, the Corps has the authority to select alternate sites under its MPRSA Section 103 authority, although the selection would still be subject to meeting the criteria and would have to receive the concurrence of EPA. As the substantive requirements for information and evaluation of a Section 103 action are

similar to those of an EPA formal designation under Section 102. However, use of a Section 103 site is limited to 5-years with one possible 5-year extension. ODMDS "selections" by the Corps are "temporary" and offer only a stopgap solution.

The most plausible outcome of the no action alternative is that existing and proposed navigation projects may be terminated. Future temporary actions are not seen as desirable by the government or the private sector. None of the disposal options under the no action alternative meet the needs for long-term maintenance of the Yaquina Bay project. Terminating maintenance dredging would reduce the safety of the channel for both small and large ships, and would have an adverse economic impact to the Pacific Northwest and the nation. For these reasons, the no action alternative is judged by both the Corps and EPA to be an unacceptable alternative and has been dropped from further evaluation.

**Upland/Beach Disposal Alternative**

Upland disposal for all of the material from the Yaquina Bay project is not feasible for operational, economic, and environmental reasons. Material from the entrance must be dredged with a hopper dredge. Upland disposal would require suitable pump-out facilities or construction of an in-bay sump. Stockpiling of material and re-dredging and transporting of the material to upland sites is not considered environmentally acceptable or economically feasible. In addition, there are no known suitable upland areas in the immediate vicinity of the estuary with sufficient capacity to meet long-term disposal needs. Most of the lands adjacent to the ocean and estuary are wetlands, or too steep, or are already developed (including state park lands). On an irregular basis, small quantities are dredged from the South Beach Marina with a small pipeline dredge and upland disposal. Material from Depot Slough dredged under permit has also gone upland, but again the quantities dredged were small. No suitable upland area that could be accessed by a hopper dredge or that could accept the large volume of material annually dredged for the Yaquina Bay project has been identified.

Placement of dredged material directly on ocean beaches by hopper dredge is not practicable at Yaquina Bay. As with upland disposal, direct placement on the beach would require suitable pump-out facilities or construction of an in-bay sump. Stockpiling of material and re-dredging and transporting it directly to the beach with a pipeline dredge is not considered environmentally acceptable or economically feasible.

Placement of material offshore in the active littoral zone at Yaquina Bay is complicated by the unique neritic reef structure. Seaward of about –40 feet, the sand movement by wave action is influenced by near-bottom and downslope movement. At Yaquina, the –40 foot boundary coincides with the offshore reef complex for several miles north and south of the jetties. 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 bottom, movement may have either a northward component or southward. There is no onshore sand movement 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 net loss of material. This is supported by significant shoreline erosion throughout much of the area from the North Jetty to Yaquina Head.

The shoreline north of Yaquina Head has also experienced erosion to the point portions of Highway 101 have failed. Some portions of the highway have been moved. While there is a recognized need in the area for beach nourishment, no local sponsor has been identified. Further studies for suitable nearshore feeder berms that would feed the beach would be required. These studies are beyond the scope of this Yaquina Bay ODMDS site evaluation study. Because of the need to dredge the Yaquina Bay federal navigation project with a hopper dredge, the lack of sufficient upland or beach nourishment disposal sites, and no identified local sponsorship for a beneficial use option, the use of upland or beach disposal as an alternative to ocean disposal is not considered to be practicable.

**Estuarine Disposal Alternative**

Estuarine habitat is limited and environmentally sensitive. The estuary is comprised primarily of its major tributary, the Yaquina River, which drains 252 square miles and is relatively short with a length of 58.8 miles. Tidelands cover between 35% and 61% of the total area that are mostly within three tide flats at Sally's Bend, King's Slough, and the area between Idaho Point and the Marine Science Center. From its mouth to the head of high tide at RM 26, the river has one major tributary (Elk Creek at RM 22.3) and about 30 smaller creeks and sloughs. No suitable estuarine disposal areas that could be accessed by a hopper dredge or accept the large volume of material annually dredged have been identified. In 1994 however, several hopper loads of dredged material consisting primarily of large shell hash from RM 1.5 were placed at an estuarine location near RM 8. The Oregon Department of Fish and Wildlife (ODFW) requested that this dredged material be placed at selected locations in the upper estuary for the purpose of restoring native oyster (*Ostrea lurida*) habitat.

**Ocean Disposal Alternatives**

Based on evaluation of the alternative solutions previously discussed, continued disposal of dredged material from the Yaquina Bay project into the ocean is necessary and unavoidable. Options include disposal of the material off the continental shelf, continued use of existing sites (including expansions of those sites), and the designation of new ODMDSs.

*Disposal Off the Continental Shelf*

The direction for EPA to locate dump sites off the continental shelf is one of the five general criteria [40 CFR 228.5(e)]; however, that direction is subject to a determination of feasibility. At Yaquina Bay, potential disposal areas located off the continental shelf would be at least 20 nautical miles offshore in water depths of 600 feet or greater. This distance is well beyond the economical haul distance for hopper dredges working the Yaquina Bay project given the size of the west coast hopper fleet (see the section describing development of the ZSF).

Transporting dredged material off the continental shelf presents potentially significant environmental concerns. Benthic and pelagic ecosystems near the shelf contain important fishery resources and the effects of disposal operations on them are not well understood. Fine-grain sediment and rocky habitats would be directly impacted by disposal. These deep-water areas are stable and generally not disturbed by wave action or sediment movement. Consequently, the benthic invertebrate communities in these deep, offshore environments are adapted to very stable conditions and would be less able to survive disturbance from the immediate impact of disposal and the long-term alteration of substrate type. Little is known of the ecology of benthic communities on the continental slope; however, disposal onto those communities would cause severe and long-term impacts. Bottom gradients can be 5% to 25% on the continental slope, making accumulated unconsolidated sediments susceptible to slumping. Deposited sediments could be transported long distances downslope as turbidity currents and offshore by near-bottom currents, potentially affecting organisms outside of any designated site.

The cost for site evaluation necessary to designate a site and subsequent baseline and monitoring, along with unanswered environmental concerns about the effects of disposal in such areas, makes off-shelf disposal undesirable as well as infeasible. Further, disposal off the continental shelf would remove natural sediments from the nearshore littoral transport system, a system that functions with largely non-renewable quantities of sand in Oregon. While the loss of the present volumes of Corps dredged material are unlikely to result in disruption of the mass balance of the littoral system, the State of Oregon is already experiencing erosion/accretion patterns that are adversely impacting beaches, spits, wetlands, and other shoreline habitats.

*Continued Use of Existing Sites*

The small size of the existing Section 103 Site and the large quantity of material requiring ocean disposal have resulted in mounding of material and potential navigation hazards (see the previous section on the No Action Alternative). This situation would persist and become worse with continued use without significant expansion. Continued use would result in further growth of the existing mound and worsen a potentially hazardous condition to navigation. Local fishers, their associations, the Port of Newport, and the Coast Guard have expressed strong opposition to the continued use of the Section 103 Site and its surrounding area. Use of the expanded Section 103 Site, the result of the Corps' Section 103 action in 1998, will expire in 2003 unless it receives final site designation from EPA. Because of its limited size, continued mounding, and navigational safety concerns, the Section 103 Site is not considered by the Corps and EPA as suitable for long-term use.

*New Ocean Dredged Material Disposal Sites*

Based on evaluation of the alternatives previously discussed, the Corps and EPA concluded that the designation of new ODMDSs was necessary to meet the long-term disposal needs for Yaquina Bay.

## OCEAN DUMPING SITE DESIGNATION PROCESS

### Overview

The dumping of material, including dredged sediments, into the ocean is permitted only at sites or in areas selected to minimize the interference of disposal activities with other activities in the marine environment. Formal designation of ocean dumping sites is the responsibility of EPA as stated in 40 CFR 228 of the ocean dumping regulations. The process followed by the EPA, Region 10, and the Corps for the Yaquina Bay project generally follows the site designation procedures developed by a joint task force of EPA and Corps personnel titled, *General Approach to Designation Studies for Ocean Dredged Material Disposal Sites* (EPA/USACE 1984).

The procedures utilize a hierarchical framework that initially establishes the broadest economically and operationally feasible area of consideration for site location. A step-by-step sequence of activities is then conducted to eliminate critical and/or unsuitable subareas. Further evaluation of alternative sites (candidate sites) within this area entails various levels of assessment as suggested by the sensitivity and value of critical resources or uses at risk, and potential for unreasonable adverse impact presented by the dredged material to be disposed. The site designation criteria at 40 CFR 228.5 and 228.6 are applied to the information assembled through this process, and a final site or sites are selected and proposed for formal designation.

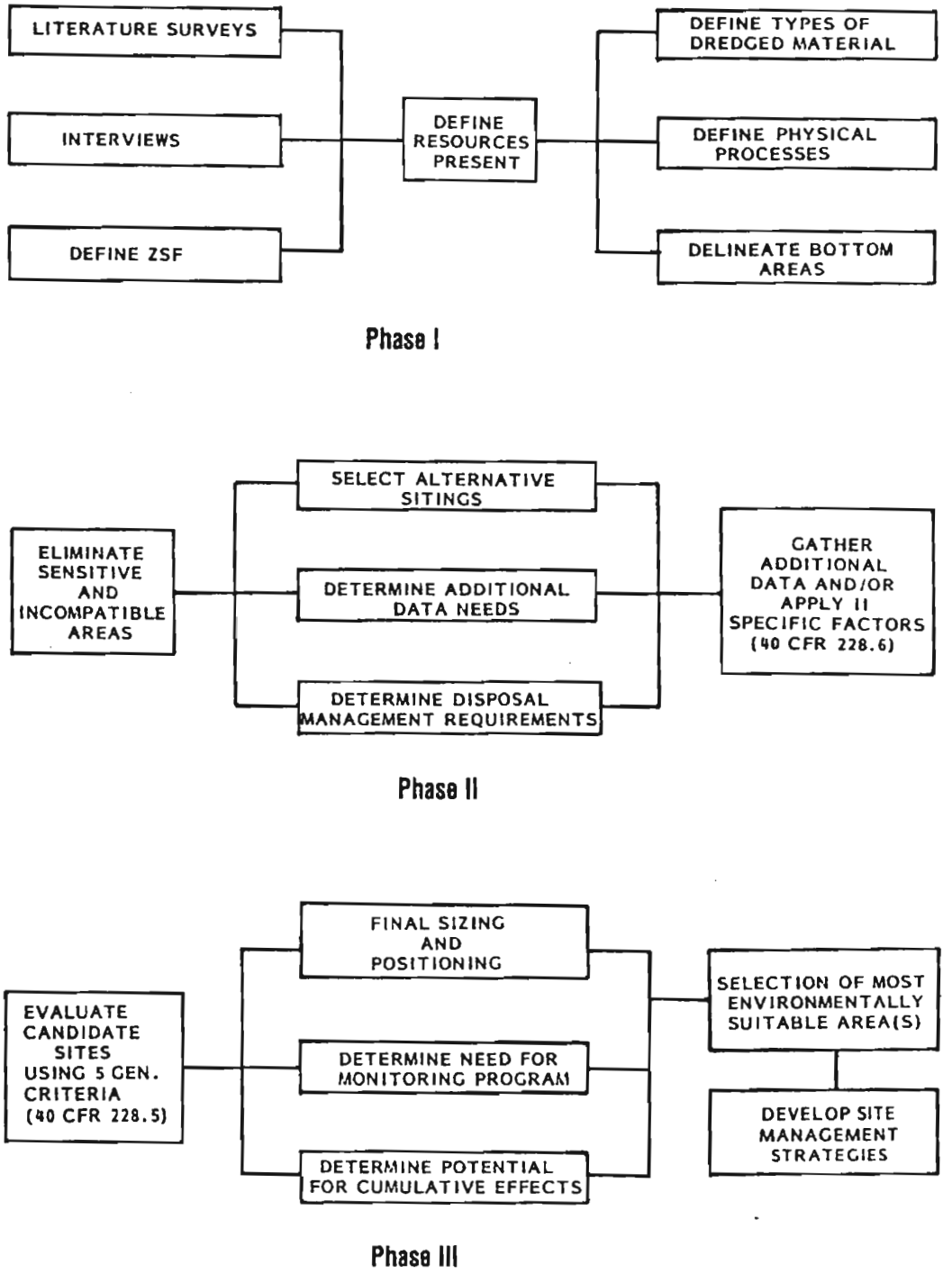
The site designation process is structured into three major phases (Figure 2). Phase I includes the delineation of the general area being considered for locating a site and the identification and collection of the necessary information on critical resources and uses and on the physical and environmental processes for the area. Reasonable distance of haul is the determining factor and will be affected by considerations such as available dredging equipment, energy use constraints, costs, and safety considerations. Then a preliminary analysis, based on available data, is applied to identify and map reach boundaries for critical resources as well as areas of incompatibility. Such critical areas and resources may include clustered areas of geographically limited habitats, fisheries and shellfisheries, navigation lanes, beaches, and marine sanctuaries.

Phase II primarily involves the elimination of sensitive and incompatible areas, determining additional data needs, and identification of candidate sites within the area based on the information collected and processed in Phase I. Phase III primarily involves the evaluation of candidate sites, selection of a proposed site or sites for designation, and the development of management strategies.

### Defining a Zone of Siting Feasibility

Joint EPA and Corps guidance for site designation suggests establishing a ZSF, as ocean disposal sites must be located within an operationally and economically feasible distance from the point of dredging (EPA/USACE 1984). By doing so, study efforts can be focused on areas that will actually meet project needs.

*Figure 2. Phases of the Site Designation Process*



Presently, the availability of dredging equipment is a major constraint that must be considered in the determination of a ZSF for any navigation project, but particularly so for ocean entrance projects on the west coast of the United States. The Jones Act precludes the Corps from contracting with foreign-owned vessels, limiting the accessible pool to U.S. Government or privately owned (contract) equipment. The Corps evaluates the availability of U.S. Government or contract equipment annually and allocates the use of government dredges for the nation. As described previously, hopper dredges are the only feasible equipment for dredging most ocean entrance channel/bar situations.

Hopper dredge availability on the West Coast has been limited. Many hopper dredges working in the United States are often committed to maintaining projects on the Atlantic and Gulf of Mexico coasts and are not available for use elsewhere, except perhaps on an emergency basis. As a result, there are typically three hopper dredges working on the West Coast that can work safely at Yaquina Bay and these dredges must also maintain other projects in Oregon, Washington, California, as well as occasionally Hawaii and Alaska. Additional capability could occur through construction of new dredges by the U.S. Government or private industry.

Weather is also a significant limiting factor for dredging and ocean dumping of material along the West Coast that must be considered in development of the ZSF. Typically, hopper dredges are able to work safely in Pacific Northwest coastal waters, including the Yaquina Bay project, from May to mid-October, with a very high and consistent probability of down time due to rough seas or other adverse weather conditions at either end of that period. During this same May through October window, all other West Coast entrance dredging also must occur.

**Yaquina Bay Zone of Siting Feasibility**

The 14-year average (1986 to 1999) for dredging at Yaquina Bay is 313,600 cubic yards. The amount of time necessary to maintain a coastal project (exclusive of weather downtime) is a function of dredging a hopper full of material (loading), then transporting that material to and placing it at the disposal site(s). This is called "cycle time" and the cycle time can be different for each dredge. Loading time is essentially fixed based on the characteristics of the sediments being dredged, the dredge itself (pumps, size of hopper, drag arms, etc.) and the dredging site conditions. The time to discharge material also is basically fixed for a given dredge and the type of material. Transport time depends primarily on the haul distance to the disposal site because the speed of different hopper dredges is similar.

Therefore, the critical element for new construction or maintenance dredging is the haul distance between the dredging site and the disposal site from both a time and cost perspective. A significant haul distance will affect the ability to construct or maintain the individual project and very probably would have repercussions on the Corps' ability to maintain other West Coast projects.

The 1985 evaluation study (USACE 1985) calculated a 2 nautical mile ZSF for the project. This calculation was based upon the removal at that time of up to 700,000 cubic yards of dredged material using both contract and government dredges. A total of 60 days for a contract dredge and 10 days for a government dredge were allocated for the work at Yaquina Bay. Production capability with a 2 nautical mile ZSF was determined to be 10,000 cubic yards per day.

Under current and foreseeable conditions at the project, the estimated volume of material to be removed annually is expected to remain at the current average of 313,600 cubic yards. Based upon workload, available funding and other constraints, the government owned hopper dredge YAQUINA is typically available 35 days at the Yaquina Bay project or a contract dredge is available for a similar length of time. This translates into an 8,943 cubic yards per day average production requirement. The rated capacity for the YAQUINA is 1,000 cubic yards. Load time typically is around 1 hour for most projects; however, Yaquina Bay is the deepest project that the YAQUINA dredges and productivity is likely less. Dump time is 5 to 10 minutes. The dredge typically works 24 hours per day except for Thursday when crews are changed.

The ZSF can be calculated as follows:

Assume 9 loads per day (8,943 cubic yards ÷ 1,000 cubic yards/load = 8.9 loads)
Load time (1 hour) + Dump time (0.17 hour) = 1.17 hour/load or 10.5 hours/day
24 hours/day - 10.5 hours/day = 13.5 hours/day for transit to/from the disposal site
13.5 hours/day ÷ 9 loads/day = 1.5 hour transit time for one round trip
1.5 hour ÷ 2 = 0.75 hour transit time for one way
0.75 x 6 nautical mile vessel speed = 4.5 nautical miles

Therefore, the outer limit of the ZSF as defined by the capacity of the available dredging plant, average annual dredging quaintly, and limited dredging time period is 4.5 nautical miles for the Yaquina Bay project.

**Conflict Matrix Analysis**

The Corps developed a conflict matrix format to simplify and consolidate scoring for the general and specific site criteria review process. The Corps and EPA have employed the conflict matrix method since 1984. Each area of consideration on the conflict matrix addresses at least one general or specific criterion. The following Tables 3-5 are conflict matrices developed to compare the existing Interim/Section 103 site to the proposed new sites and their potential conflicts with the 5 general and 11 specific site selection criteria. In general, the proposed new sites result in fewer conflicts with the criteria than the Interim/Section 103 site. A legend defining the matrix categories follows the tables (Figure 3).

*Table 3. ODMDS Conflict Matrix for Interim and Section 103 Sites*

# Interim/Section 103 Site

| AREA OF CONSIDERATION[1/] | CONFLICT[2/] | POTENTIAL CONFLICT | NO CONFLICT | BENEFICIAL USE | COMMENTS | RELEVANT SPECIFIC FACTORS Eleven Specific Factors[3/] (40CFR 228.6) | RELEVANT SPECIFIC FACTORS 5 General Criteria[4/] (40CFR 228.5) |
|---|---|---|---|---|---|---|---|
| 1. Unusual Topography/Unique Bottom Features | X | | | | Close Proximity to Neritic Reef. | 1, 6, 8, 11 | a |
| 2. Physical Sediment Compatibility | | | X | | Similar Material though ~5% is finer. | 3, 4, 9 | b, c, d |
| 3. Chemical Sediment Compatibility | | | X | | | 3, 4, 7, 9 | a, b, c, d |
| 4. Influence of Past Disposal | X | | | | Excessive Mounding. | 5, 7, 9, 10 | a, b, d |
| 5. Living Resources of Limited Distribution | | X | | | Kelp and reef life forms could be affected by sediment transport. | 2, 3, 6, 8, 11 | a, b, d |
| 6. Commercial Fisheries | | | X | | | 2, 8 | a, b |
| 7. Recreational Fisheries | | X | | | Minor conflict with dredge traffic. | 2, 8 | a, b |
| 8.Breeding/Spawning Areas | | X | | | Resident and migrating fish use the area. | 2, 8 | a, b |
| 9. Nursery Areas | | X | | | Juvenile flatfish. | 2, 8 | a, b |
| 10. Feeding Areas | | X | | | Feeding areas could be affected. | 2, 8 | a, b |
| 11. Migration Routes | | X | | | Anadromous fish route. | 2, 8 | a, b |
| 12. Critical Habitat of Threatened or Endangered Species | | | X | | | 2, 8 | a, b |
| 13. Spatial Distribution of Benthos | | | X | | | 2, 8, 10 | a, b |
| 14. Marine Mammals | | X | | | Feeding area. | 2, 8 | a, b |
| 15. Mineral Deposits | | | X | | | 1, 8 | a, b, c |
| 16. Navigation Hazard | X | | | | Wave amplification due to excessive mounding. | 1, 8 | a, b, d |
| 17. Other uses of Ocean (cables, pipelines etc.) | | | X | | | 8 | a, b, d |
| 18. Degraded Areas | | | X | | | 4, 6, 7 | a, b, d |
| 19. Water Column Chem./Phys. Characteristics | | | X | | | 4, 6, 9 | a, b, d |
| 20. Recreational Uses | | X | | | See item 7. | 2, 8, 11 | a, b, c, d |
| 21. Cultural/Historic Sites | | | X | | | 11 | b |
| 22. Physical Oceanography: Waves/Circulation | X | | | | Wave amplification due to mounding, potential current effects. | 1, 3, 6, 7 | a, b, d |
| 23. Direction of Transport/Potential For Settlement | | | | X | Reintroduces sand to littoral budget. | 1, 3, 6, 7 | a, b, d |
| 24. Monitoring | | | X | | | 5 | c |
| 25. Shape/size of Candidate Site | X | | | | No remaining capacity. | 1, 4, 7 | d |
| 26. Size of Buffer Zone | | X | | | See item 1. | 2, 3, 4, 7, 11 | b, d |
| 27. Potential for Cumulative Effects | | | X | | No known adverse activities. | 4, 7 | c, d |

*Table 4. ODMDS Conflict Matrix for the North Site*

# North Site

| AREA OF CONSIDERATION[1/] | CONFLICT [2/] | POTENTIAL CONFLICT | NO CONFLICT | BENEFICIAL USE | COMMENTS | RELEVANT SPECIFIC FACTORS Eleven Specific Factors[3/] (40CFR 228.6) | RELEVANT SPECIFIC FACTORS 5 General Criteria[4/] (40CFR 228.5) |
|---|---|---|---|---|---|---|---|
| 1. Unusual Topography/Unique Bottom Features | | X | | | Gravel areas. | 1, 6, 8, 11 | a |
| 2. Physical Sediment Compatibility | | | X | | Similar Material though ~5% is finer. | 3, 4, 9 | b, c, d |
| 3. Chemical Sediment Compatibility | | | X | | | 3, 4, 7, 9 | a, b, c, d |
| 4. Influence of Past Disposal | | | X | | | 5, 7, 9, 10 | a, b, d |
| 5. Living Resources of Limited Distribution | | | X | | | 2, 3, 6, 8, 11 | a, b, d |
| 6. Commercial Fisheries | | X | | | Interference with dredge during disposal. | 2, 8 | a, b |
| 7. Recreational Fisheries | | X | | | Interference with dredge during disposal. | 2, 8 | a, b |
| 8.Breeding/Spawning Areas | | X | | | Resident and migrating fish use area. | 2, 8 | a, b |
| 9. Nursery Areas | | X | | | Juvenile flatfish. | 2, 8 | a, b |
| 10. Feeding Areas | | X | | | Resident and migrating fish use area. | 2, 8 | a, b |
| 11. Migration Routes | | X | | | Anadromous fish/ mammals/ flatfish. | 2, 8 | a, b |
| 12. Critical Habitat of Threatened or Endangered Species | | | X | | | 2, 8 | a, b |
| 13. Spatial Distribution of Benthos | | | X | | | 2, 8, 10 | a, b |
| 14. Marine Mammals | | X | | | Feeding area/ migration route. | 2, 8 | a, b |
| 15. Mineral Deposits | | | X | | | 1, 8 | a, b, c |
| 16. Navigation Hazard | | | X | | | 1, 8 | a, b, d |
| 17. Other uses of Ocean (cables, pipelines etc.) | | | X | | | 8 | a, b, d |
| 18. Degraded Areas | | | X | | | 4, 6, 7 | a, b, d |
| 19. Water Column Chem./Phys. Characteristics | | | X | | | 4, 6, 9 | a, b, d |
| 20. Recreational Uses | | X | | | See item 7. | 2, 8, 11 | a, b, c, d |
| 21. Cultural/Historic Sites | | | X | | | 11 | b |
| 22. Physical Oceanography: Waves/Circulation | | | X | | | 1, 3, 6, 7 | a, b, d |
| 23. Direction of Transport/Potential For Settlement | | X | | | Loss of sand from the littoral budget. | 1, 3, 6, 7 | a, b, d |
| 24. Monitoring | | | X | | | 5 | c |
| 25. Shape/size of Candidate Site | | | X | | | 1, 4, 7 | d |
| 26. Size of Buffer Zone | | | X | | | 2, 3, 4, 7, 11 | b, d |
| 27. Potential for Cumulative Effects | | | X | | No known adverse activities. | 4, 7 | c, d |

*Table 5. ODMDS Conflict Matrix for the South Site*

# South Site

| AREA OF CONSIDERATION[1/] | CONFLICT [2/] | POTENTIAL CONFLICT | NO CONFLICT | BENEFICIAL USE | COMMENTS | RELEVANT SPECIFIC FACTORS Eleven Specific Factors[3/] (40CFR 228.6) | RELEVANT SPECIFIC FACTORS 5 General Criteria[4/] (40CFR 228.5) |
|---|---|---|---|---|---|---|---|
| 1. Unusual Topography/Unique Bottom Features | | X | | | Gravel areas. | 1, 6, 8, 11 | a |
| 2. Physical Sediment Compatibility | | | X | | Similar Material though ~5% is finer. | 3, 4, 9 | b, c, d |
| 3. Chemical Sediment Compatibility | | | X | | | 3, 4, 7, 9 | a, b, c, d |
| 4. Influence of Past Disposal | | | X | | | 5, 7, 9, 10 | a, b, d |
| 5. Living Resources of Limited Distribution | | | X | | | 2, 3, 6, 8, 11 | a, b, d |
| 6. Commercial Fisheries | | X | | | Interference with dredge during disposal. | 2, 8 | a, b |
| 7. Recreational Fisheries | | X | | | Interference with dredge during disposal. | 2, 8 | a, b |
| 8.Breeding/Spawning Areas | | X | | | Resident and migrating fish use area. | 2, 8 | a, b |
| 9. Nursery Areas | | X | | | Juvenile flatfish. | 2, 8 | a, b |
| 10. Feeding Areas | | X | | | Resident and migrating fish use area. | 2, 8 | a, b |
| 11. Migration Routes | | X | | | Anadromous fish/ mammals/ flatfish. | 2, 8 | a, b |
| 12. Critical Habitat of Threatened or Endangered Species | | | X | | | 2, 8 | a, b |
| 13. Spatial Distribution of Benthos | | | X | | | 2, 8, 10 | a, b |
| 14. Marine Mammals | | X | | | Feeding area/ migration route. | 2, 8 | a, b |
| 15. Mineral Deposits | | | X | | | 1, 8 | a, b, c |
| 16. Navigation Hazard | | | X | | | 1, 8 | a, b, d |
| 17. Other uses of Ocean (cables, pipelines etc.) | | | X | | | 8 | a, b, d |
| 18. Degraded Areas | | | X | | | 4, 6, 7 | a, b, d |
| 19. Water Column Chem./Phys. Characteristics | | | X | | | 4, 6, 9 | a, b, d |
| 20. Recreational Uses | | X | | | See item 7. | 2, 8, 11 | a, b, c, d |
| 21. Cultural/Historic Sites | | | X | | | 11 | b |
| 22. Physical Oceanography: Waves/Circulation | | | X | | | 1, 3, 6, 7 | a, b, d |
| 23. Direction of Transport/Potential For Settlement | | X | | | Loss of sand from the littoral budget. | 1, 3, 6, 7 | a, b, d |
| 24. Monitoring | | | X | | | 5 | c |
| 25. Shape/size of Candidate Site | | | X | | | 1, 4, 7 | d |
| 26. Size of Buffer Zone | | | X | | | 2, 3, 4, 7, 11 | b, d |
| 27. Potential for Cumulative Effects | | | X | | No known adverse activities. | 4, 7 | c, d |

*Figure 3. Conflict Matrix Legend*

**1/ Definition of "Areas of Consideration"**

**1. Unusual Topography/Unique Bottom Features**: Would placement of material in this candidate site affect physical bottom feature that is unique within the local or regional area?

**2. Physical Sediment Compatibility**: Does the candidate site have similar sediment characteristics to anticipated dredged material?

**3. Chemical Sediment Compatibility**: Does the candidate site have similar chemical characteristics to anticipated dredged material?

**4. Influence of Past Disposal**: Would placement of material in this candidate site be affected by previous disposal of dredge material?

**5. Living Resources of Limited Distribution**: Would placement of material in this candidate site affect any living resources that do not have a coast-wide distribution?

**6. Commercial Fisheries**: Would placement of material in this candidate site affect any commercial fishing activity (resource impacts are covered in 8-11)?

**7. Recreational Fisheries**: Would placement of material in this candidate site affect any recreational fishing activity (resource impacts are covered in 8-11)?

**8. Breeding/Spawning Areas**: Would placement of material in this candidate site affect breeding and spawning areas of any species?

**9. Nursery Areas**: Would placement of material in this candidate site affect nursery areas of any species?

**10. Feeding Areas**: Would placement of material in this candidate site affect feeding areas of any species?

**11. Migration Routes**: Would placement of material in this candidate site affect migration routes of species?

**12. Critical Habitat of Threatened or Endangered Species**: Would placement of material in this candidate site affect critical habitat of threatened or endangered species?

**13. Spatial Distribution of Benthos**: Would placement of material in this candidate site change the benthic invertebrate community structure, e.g., fine-grain species to coarse-grain species, etc?

**14. Marine Mammals**: Would placement of material in this candidate site affect marine mammals or their habitat, e.g., gray whale feeding areas etc?

**15. Mineral Deposits**: Would any known mineral deposits be affected by the placement of material?

**16. Navigation Hazard**: Would the placement of material create a navigation hazard?

**17. Other Uses of Ocean**: Would placement of material impact other uses of the ocean not addressed elsewhere, such as cables, pipelines, tow boat lanes, and pilot transfer points?

**18. Degraded Areas**: Would disposal in this candidate site continue to affect or improve the degraded area?

**19. Water Column Chemical/Physical Characteristics**: Would placement of material in this candidate site affect water column chemical/physical characteristics?

**20. Recreational Uses**: Would placement of material affect recreational uses?

**21. Cultural/Historic Sites**: Would placement of material in this candidate site impact or protect a cultural/historic site?

**22. Physical Oceanography: Waves/Circulation**: Would placement of material affect wave/circulation patterns?

**23. Direction of Transport/potential for Settlement**: Would placement of material affect direction of sediment transport and/or potential for settlement?

**24. Monitoring**: Would use of this candidate site affect either on-going monitoring or the ability to monitor using conventional methods? Monitoring typically would include periodic hydrographic surveys, could include sediment sampling or biological data collection.

**25. Shape/size of Candidate Site**: Is the candidate site suitable for the operation of a dredge?
Maneuverability of the dredge?
Is it orientated so the dredge can place material while heading into the waves?
Is the depth of water sufficient to open the hopper doors/dump scow?
Can the dredge operate safely?
Is the size of the candidate site large enough for long term use?

**26. Size of Buffer Zone**: Is the candidates site a sufficient distance from important resources or features to protect them from any affect of disposal?

*Figure 3 (continued). Conflict Matrix Legend*

**27. Potential for Cumulative Effects**: Would placement of material contribute to cumulative affects from other activities?

**2/ Definition of Degrees of Conflict**

**Conflict**: There will definitely be an adverse impact on the resource or the use.
**Potential Conflict**: There is a possibility of an adverse impact; however, extent and significance are unknown.
**No Conflict**: There will definitely not be an adverse impact on the resource or the use.
**Beneficial Use**: There will be a positive impact on the resource or the use.

**3/ Eleven Specific Factors for Ocean Disposal Site Selection**

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 waste proposed to be disposed 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.

**4/ General Criteria for the Selection of Ocean Disposal Sites**

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 shell fisheries, 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 shell fishery.
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 Sections 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, whenever feasible, designate ocean dumping sites beyond the edge of the continental shelf and other such sites that have been historically used.

## Eleven Specific Factors for Ocean Disposal Site Selection

The determination to designate an ODMDS will be based on the Federal Government's evaluation of compliance with the 11 specific factors and 5 general criteria at 40 CFR 228.6 and 228.5. A discussion of each factor and criteria for the proposed North and South sites follow.

## Application of Eleven Specific Criteria (40 CFR 228.6)

**Geographical Position, Depth of Water, Bottom Topography and Distance from the Coast (1).** Figure 4 shows the location and bottom topography of the North Site and the South Site. Designated sites would be used for disposal of dredged material from the Yaquina Bay navigation project and other permitted projects.

Site coordinates (degrees, minutes, seconds; North American Datum 1983) and dimensions of North Site and the South Site are as follows:

**North Site**

| *Corner Coordinates*: | *Dimensions*: |
|---|---|
| 44° 38' 17.98" N, 124° 07' 25.95" W | 4,000' width by 6,500' long |
| 44° 38' 12.86" N, 124° 06' 31.10" W | 597 Acres |
| 44° 37' 14.33" N, 124° 07' 37.57" W | Azimuth (long axis): 10° T |
| 44° 37' 09.22" N, 124° 06' 42.73" W | Depth: 112-152' |

**South Site**

| *Corner Coordinates*: | *Dimensions*: |
|---|---|
| 44° 36' 04.50" N, 124° 07' 52.66" W | 4,000' wide by 6,500' long |
| 44° 35' 59.39" N, 124° 06' 57.84" W | 597 Acres |
| 44° 35' 00.85" N, 124° 08' 04.27" W | Azimuth (long axis): 10° T |
| 44° 34' 55.75" N, 124° 07' 09.47" W | Depth: 112-152' |

Based upon consideration of the location, depth of water, bottom topography, and distance from the coast, the North and South Sites are suitable for the disposal of dredged material when placed in accordance with the Site Management and Monitoring Plan (Appendix D).

**Location in Relation to Breeding, Spawning, Nursery, Feeding, or Passage Areas of Living Resources in Adult of Juvenile Phases (2).** Aquatic resources of the oceanic region off the mouth of the Yaquina Bay are described in detail in Appendix A. The North and South sites are located partly in the nearshore area and many nearshore pelagic organisms occur in the water column over the sites. These include zooplankton (copepods, euphausiids, pteropods, and chaetognaths) and meroplankton (fish, crab and other invertebrate larvae). These organisms generally display seasonal changes in abundance. Since they are present over most of the coast, those directly off Yaquina Bay are not critical to the overall coastal population. Based on evidence from previous zooplankton and larval fish studies, it appears that there will be no impacts to organisms in the water column (Sullivan and Hancock 1977).

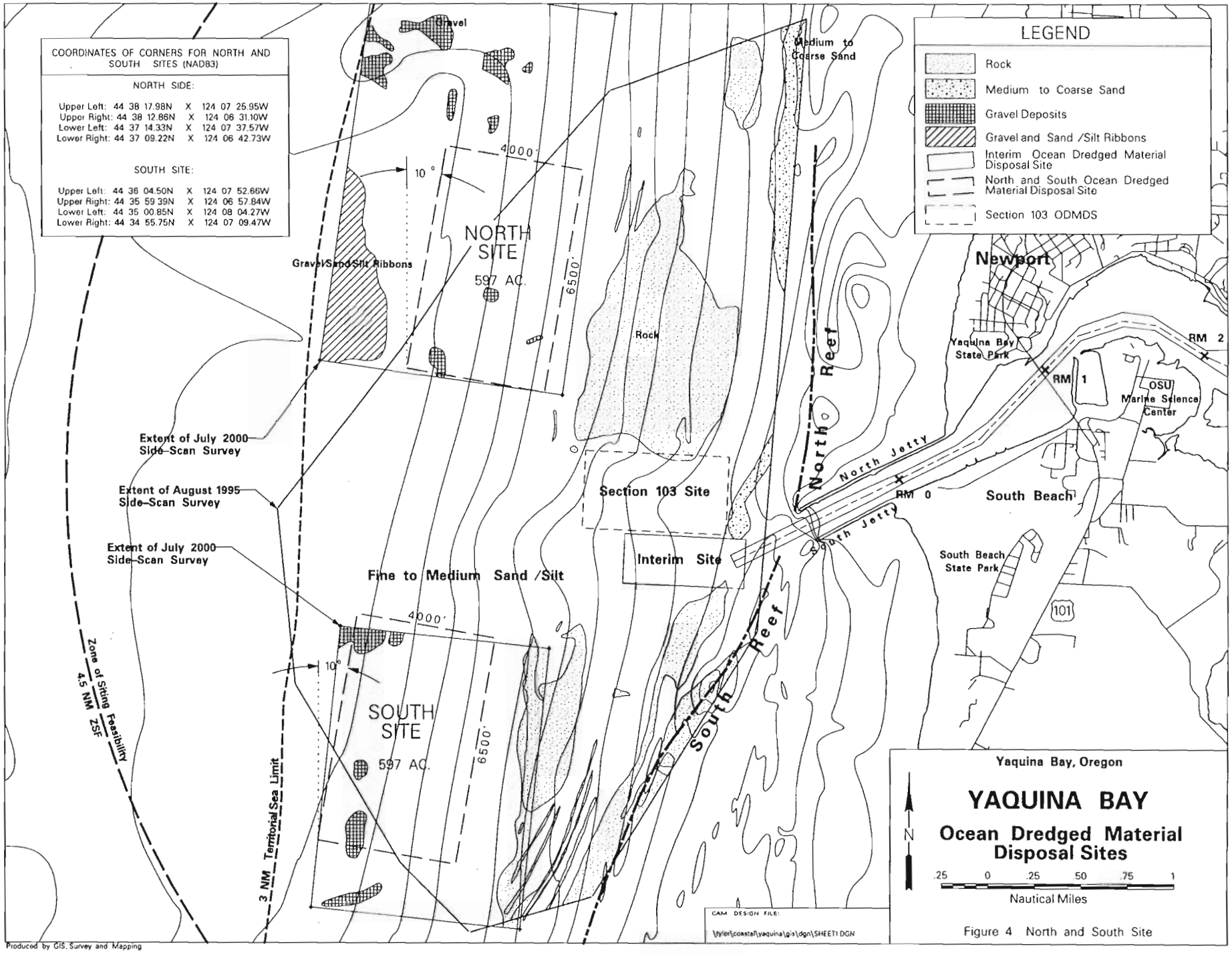



Figure 4 North and South Site

The North Site and South Site are located in areas that generally have lower densities and more numbers of species of benthic infauna than the close inshore areas. The September 2000 densities were higher than had previously been recorded. These high densities were due to the large recruitment of one or two species. This large increase in recruitment was likely the result of a reestablishment of the upwelling currents off the coast due to changing ocean conditions. Increased upwelling brings large quantities of detritus to the coastal areas from the depths and this increases populations of phytoplankton and zooplankton, which in turn provides food for the benthic invertebrate species. Benthic infaunal sample locations are shown in Appendix A.

The area off the mouth of the Yaquina Bay also supports a variety of pelagic and demersal fish species as well as shellfish including Dungeness crab. Many of these species have a reproductive strategy of releasing a large quantity of eggs so that they can survive a substantial mortality during the larval and juvenile stage. Crabs in particular release large number of eggs into the water column. The larvae that hatch from the eggs are planktonic for several months before settling to the bottom of the estuary and nearshore ocean as young crab. During this time, they are subjected to a variety of environmental factors that affect their survival and have a direct affect on population numbers of adults.

Pelagic fish species include anadromous salmon, steelhead, cutthroat trout, striped bass, lamprey, smelt, herring, sturgeon, and shad that migrate through the estuary to upriver spawning areas. Juveniles of these species are present in the area following their migration out of the river or estuary into the ocean. Some remain in the nearshore area for various periods of time feeding and rearing, while others move directly offshore. Other pelagic species include the Pacific herring, anchovy, surf smelt, and sea perch. Surf smelt are in nearshore areas and in the estuary in large numbers during the summer to spawn. Demersal species present in the nearshore area include juvenile flatfish which rear in the inshore area and estuaries. Resident species occur in the offshore area throughout the year with many using the estuary as a rearing and nursery area. Species present include various flatfish and rockfish species.

Potentially 30 cetacean species can occur along the coast although their numbers are generally limited. Most cetacean species occur in inslope waters (600- to 6,000-foot depths) or in offshore waters (greater than 6,000 feet deep). Harbor porpoises and gray whales were prevalent in shelf waters less than 600 feet deep. The larger cetaceans (whales) typically occur as migrants in the spring and fall. Smaller cetaceans, principally dolphins, porpoises, and some small whales also are present.

Five species of pinnipeds are known to occur along the coast: northern sea lion, California sea lion, harbor seal, northern elephant seal and northern fur seal. Harbor seals are resident whereas the four other species of pinnipeds are more transient in nature. Harbor seals and California/northern sea lions are the principal species observed in the estuary. All three species are known to forage within the estuary and adjacent ocean waters.

Four species of marine turtles (loggerhead, green, Pacific ridley, and Pacific leatherback) have been recorded from strandings along the coastline since 1982. Marine turtles are

unusual in their occurrence along the Pacific Coast and are typically associated with warmer marine waters.

Pelagic birds are extremely numerous in the offshore area. Studies have found that seabird populations were most densely concentrated over the continental shelf (less than 600 feet in depth). Shearwaters, storm petrels, gulls, common murres and Cassin's auklets numerically dominated the pelagic bird fauna from late spring through late summer. Phalaropes, fulmars and California gulls are important constituents of the fall pelagic bird flocks. The principal species in the winter are phalaropes, California gulls, fulmars, other gulls, murres, auklets, and kittiwakes. Red-throated, Pacific and common loons occur as spring and fall migrants. Western, red-necked, horned, and eared grebes also occur in the area. Brown pelicans occur from late spring to mid-fall along the coast. This species forages in nearshore waters of the Pacific Ocean and estuarine waters. Three species of cormorants and three species of terns occur and forage in nearshore Pacific Ocean waters and the estuary.

The federally listed threatened and endangered species which may occur within the area of the proposed sites include: listed salmon and steelhead stocks; blue, finback, sei, right, hump-backed and sperm whales; loggerhead, green, Pacific ridley, and Pacific leatherback sea turtles; northern (Steller) sea lion; marbled murrelet; bald eagle; Aleutian Canada goose; peregrine falcon; and brown pelicans. Occurrence of these species varies by season and location in the offshore area.

Disposal at the sites will result in the mortality of benthic organisms and some of the crabs and fish that are in the disposal location. With respect to the other living resources that use the sites have been located in areas that are not limited or unique breeding, spawning, nursery, feeding, or passage areas. Use of the disposal sites is not expected to adversely impact any federally listed threatened or endangered species.

**Location in Relation to Beaches and other Amenity Areas (3).** The proposed North Site and South Site are to the north and to the south of the entrance to the mouth of Yaquina Bay. The shoreward edges of both are approximately 2 nautical miles off the beach in 115 feet of water beyond the neritic reefs. The seaward edge extends beyond the 150-foot contour. Use of the proposed ODMDSs, in lieu of the present ODMDSs, would result in dredged material being placed where it would not contribute to the littoral sediment budget. The shoreline area adjacent to the Yaquina Bay entrance will be evaluated to determine if there appears to be any effects from this action. If there appears to be any significant erosion resulting from this action, the Corps will consider appropriate actions within the limits of its authorities.

**Types and Quantity of Wastes Proposed to be Disposed of, and Proposed Methods of Release, including Methods of Packing the Waste, if Any (4).** Dredged material subject to the MPRSA is not a waste. Sites that are designated will receive dredged materials transported by either government or private contractor hopper dredges or dump barges. Current hopper dredges or dump barges available for use have hopper capacities ranging from 800 to 6,000 cubic yards. This would be the likely volume range of dredged material

deposited in any one dredging placement cycle. The approximately 313,000 cubic yards estimated to be removed annually from Yaquina Bay could be placed at the sites in one dredging season by any combination of private and government dredges. The dredges or barges would be under power and moving during disposal, allowing the maintenance of steerage.

The majority of the dredged material disposed in the ocean traditionally comes from shoals in the Yaquina Bay entrance channel. They consist primarily of marine sand transported into the entrance. The material is clean, contains no contaminants of concern in excess levels, is far removed from known sources of contaminants, and is acceptable for unconfined open-water disposal. Material proposed to be dredged from the turning basin (RM 2+00 to 2+25), the South Beach Marina, North Marina, and Depot Slough is finer but has been evaluated and found acceptable for unconfined open-water disposal. Fine-grained material from these areas ad other side channels or backwater areas may be placed offshore in the future which will require testing and evaluation. The sites have been sized to accommodate the quantity of material to be placed.

**Feasibility of Surveillance and Monitoring (5).** Monitoring shall be in accordance with the Site Management and Monitoring Plan (Appendix D). At a minimum, annual bathymetric surveys will be conducted in areas that receive dredged material. More frequent surveys will be conducted when necessary to ensure unacceptable mounding is not occurring that could pose a threat to navigation safety. If actual field monitoring of the disposal activities is required because of a future concern for habitat changes or limited resources, several research groups are available in the area to perform any required work. All of the sites are readily accessible. Most monitoring work can be performed from small, surface research vessels at a reasonable cost.

**Dispersal, Horizontal Transport and Vertical Mixing Characteristics of the Area Including Prevailing Current Direction and Velocity, if Any (6).** Appendix B provides a detailed discussion regarding this criterion. The proposed North and South Sites are located in water depth of 115 to 150 feet along the boundary between the inner shelf and the mid-shelf. Waves and wind-driven currents are the most important factors influencing water motion (and potentially transport of bottom sediment) on the inner and mid-shelf. Mean circulation on the shelf tends to be along the bathymetric contours and is subject to seasonal reversal, being northward during winter and southward during summer. Mean depth-averaged current during winter is about 1.3 feet/second @ 298° (T); during summer it is 0.5 feet/second @ 202° (T). During winter storms, waves can exceed 30 feet and depth averaged currents can exceed 2 feet/second. Superimposed on the mean circulation of the shelf are tidal currents that are believed to account for more than half of the water motion over periods of several days. Appendix B provides additional information. Although intense winter storms are capable of transporting sand at depths of 150 feet, the transport will be episodic over the long term. Consequently, sand placed at the proposed North and South Sites will likely remain within the sites for 10 to 20 years. The direction of net transport during significant winter storm activity will be to the north and offshore. During summer, transport will be much less but will be toward shore.

Generally speaking, the proposed North and South Sites are located within the area of coastal upwelling, which typically occurs during summer. However, the proposed sites are well inshore of the "mixing" zone (or surface front) associated with the convergence of dense bottom water from the outer shelf and warmer less dense water from the inner shelf.

**Existence and Effects of Current and Previous Discharges and Dumping in the Area (Including Cumulative Effects) (7).** No dredged material has been placed in the proposed North Site or South Site or in their vicinity. All previous disposal has occurred in the vicinity of the mouth of Yaquina Bay. Between 1977 and 1985, material was placed in the EPA Interim Site. Since 1986, dredged material has been placed in the Section 103 Site selected by the Corps. Due to mounding, the Section 103 site was expanded in 1998 to include the outer two-thirds of the EPA Interim Site; material was placed in this expanded area in 1999.

As with other areas along the Oregon Coast, mounding of dredged material has been the most significant effect within and in the vicinity of the existing disposal site at Yaquina Bay. Biological studies of the Section 103 Site conclude that site use should not significantly impact the community structure of a faunal community as those living in the clean well sorted sands of the nearshore coastal zone.

**Interference with Shipping, Fishing, Recreation, Mining Extraction, Desalination, Fish and Shellfish Culture, Areas of Special Scientific Importance and Other Legitimate Uses of the Ocean (8).**

**Commercial and Recreational Fishing**. Major commercial and recreational fishing areas occur in the offshore area. 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, and seasonal restrictions. The only other commercial fishing activity in the area is for clams in the bay and beaches along the coast. The 1984 Yaquina Bay ODMDS evaluation study states that the ODFW has identified potential squid stocks large enough to support a fishery. The squid resources have not developed and consequently no fishery has developed in this area. There are no commercial fish or shellfish aquaculture operations that would be impacted by use of the two proposed sites.

The principal recreational fishing occurring off Yaquina Bay is for salmon and bottom fish. Charter and private boats do salmon fishing and although it occurs in the same areas as commercial fishing, it is generally closer to shore. Private and charter boats also conduct bottom fishing for halibut, rockfish, and lingcod, which are generally associated with rocky areas. Other recreational activities include claming in the bay and along the beach and fishing off the jetties.

The potential exists for conflicts between the dredge and fishing boats; however, this has not appeared to be a problem in the past. Crab fishermen have stated that disposal of material at the existing ODMDS has affected their fishery by creating mounds which affects small boat navigation. This is a major concern at the existing Yaquina Bay

ODMDS and is a key factor for the need to expeditiously identify suitable new disposal sites for this area. Bathymetric monitoring will be conducted to prevent creating disposal mounds that would cause navigation hazards. The proposed shift to the larger North Site and South Site will provide greater site management opportunity to reduce the potential effects of mounding. Disposal at these sites will create a permanent bathymetric change; however, greater water depths, mound height restriction, and site monitoring will avoid interference with small and large vessel navigation.

**Mineral Extraction**. There are no known mineral extraction operations or proposed operations in the vicinity of the disposal sites. The disposal sites are not expected to interfere with any future offshore mining or oil/gas exploration or extraction.

**Desalination**. There are no desalination plants in the area of Yaquina Bay.

**Fish and Shellfish Culture**. There are no fish or shellfish culture operations in the area of Yaquina Bay that would be affected by disposal of dredged material at the proposed disposal sites.

**Shipping and Other Legitimate Uses.** Conflicts with commercial navigation traffic have been reported at the existing Section 103 Site. Conflicts at the North Site and South Site are not expected. The potential for conflict with dredges or tug and barge combinations transiting to the sites are recognized but can be managed through coordination with the boat pilots, the Coast Guard, and others.

**Special Scientific Importance.** There are no known transects or other scientific study locations that would be impacted by disposal at the proposed sites.

**Coastal Zone Management**. The preferred action (designation and use of the North Site and South Site) has been determined by the Corps and EPA to be consistent with the acknowledged local comprehensive plans and State of Oregon Coastal Zone Management Programs. The Oregon Department of Land Conservation and Development will review this consistency determination with a request to provide written notification of their findings. A synopsis of their comments will be included in Appendix F.

**The Existing Water Quality and Ecology of the Site as Determined by Available Data or by Trend Assessment or Baseline Survey (9).** Water and sediment quality analyses conducted in the study area and experience with past disposals in this region have not identified any adverse water quality impacts from ocean disposal of dredged material. The ecology of the offshore area is a Northeast Pacific mobile sand community. This determination is based mainly on fisheries and benthic data. Neither the pelagic or benthic communities should sustain irreparable harm due to their mobility and widespread occurrence off the Oregon Coast.

**Potentiality for the Development or Recruitment of Nuisance Species in the Disposal Site (10).** Nuisance species are considered as any undesirable organism not previously existing at the disposal site. They are either transported or recruited to the site because the

disposal of dredged materials created an environment where they could establish. Materials dredged and transported to the disposal sites historically have been classified as uncontaminated marine sands similar to the sediment at the ODMDSs. Potential material dredged from the federal turning basin (RM 2+00 to RM 2+25), South Beach Marina, Depot Slough, or other in-bay area may include fine-grained material. Limited quantities of fine-grained material form the turning basin and Depot Slough have been placed in the ocean. Any material proposed for placement at any site would be subject to sediment quality evaluation. Therefore, it is highly unlikely that any nuisance species could be established at the disposal site since habitat or contaminant levels are unlikely to change over the long-term.

**Existence at or in Close Proximity to the Site of any Significant Natural or Cultural Features of Historical Importance (11).** 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.

The cultural resource literature search conducted for the Yaquina Bay study area (Appendix E) resulted in the documentation of 15 wrecked vessels in the nearshore 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.

Given the characteristics of Yaquina Bar, onshore current pattern, 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 1860s to present, it is unlikely that any wrecks have survived in the vicinity. Wrecks within these areas would likely be torn apart due to the high-energy wave climate. Deeper water would buffer the high-energy wave climate so shipwrecks in deeper water would be less prone to damage. The shipwrecks in deeper water tend to have more cultural value than shipwrecks nearshore.

Undiscovered wrecks could occur in the area, however. Several sidescan sonar studies were conducted at the two proposed sites. No potential shipwrecks or other cultural feature was noted. Based on this information, it is unlikely that any significant cultural resources will be affected from designation and use of the disposal site. The Oregon State Historic Preservation Officer (SHPO) concurs with our findings of no cultural resources concerns. Our request for concurrence and the corresponding SHPO response is documented in Appendix E.

### Application of Five General Criteria (40 CFR 228.5)

**Minimize Interference with Other Activities (a.).** The first of the five general criteria requires that a determination be made as to whether the proposed sites or their use will minimize interference with other uses of the marine environment. This determination was made by overlaying individual uses with the resources presented in the *Yaquina Bay Interim Ocean Dredged Material Disposal Site Evaluation Study* (USACE 1985) and the

appendices prepared for this evaluation. The 1985 report presents the overlays on a base map, giving bathymetry and location of the 1985 proposed disposal sites. The more interactions between various uses and limited resources exist, the more critical the area. The overlay process is used to minimize interference with other uses of the ocean. The 1985 selection of features to use for this determination was dependent on whether the resource was considered limited. A coast-wide resource, flat fish spawning area, was not considered a limited resource and not included in the overlay evaluation. The following were selected to be included in the evaluation of resources of limited distribution:

1. Navigation Hazards Area/Other Recreation Areas
2. Shellfish Areas
3. Critical Aquatic Resource
4. Commercial and Sport Fishing Areas
5. Geological Features
6. Cultural, Historically Significant Areas

Areas seaward of the neritic reef were shown to be less critical than the reef or areas shoreward. The 1985 study presented information restricted to a 2 nautical mile arc as that was the ZSF at that time. The proposed sites, while further offshore, overlap or are adjacent to the area identified as less critical. The information gathered under this present effort has not identified any potential limited resources in the proposed disposal areas that would eliminate them from consideration for final ODMDS designation.

**Minimizes Changes in Water Quality (b.).** The second of the five general criteria requires changes to ambient seawater quality levels occurring outside the disposal site to be within water quality criteria, and that no detectable contaminants reach beaches, shoreline, sanctuaries, or geographically limited fisheries or shellfisheries. No significant contaminant or suspended solids releases are expected. Based on previous work at Yaquina Bay, disposal of either sandy or fine-grained material would not have any long-term impact on the water quality. There would be no water quality perturbations to be concerned with moving toward any beach, shoreline, marine sanctuary, or known geographically limited fishery or shellfishery. Bottom movement of deposited material generally shows a net offshore movement for the finer fractions. Coarser size fractions stay in the same general area as deposited.

**Interim Sites Which Do Not Meet Criteria (c.).** An EPA Interim Site was identified in 1977. In 1985, the Corps issued a final *Interim Ocean Dredged Material Disposal Site Evaluation Study* (USACE 1985) recommending final site designation. By 1986, the Interim Site was shown to be limited in capacity due to its small size, shallow depth, and the large quantity of material dredged placed at the site. Because of the limited site capacity and interference with other activities in the marine environment, the Corps and EPA determined that the Interim Site did not meet the criteria and factors established in 40 CFR 228.5 and 228.6. The Corps selected an alternate ODMDS (Section 103 Site) in 1986, using its authority under Section 103 of the MPRSA. In 1998, the Corps extended the Section 103 Site to include the outer two-thirds of the Interim Site. The Interim and Section 103 Sites have shown consistent mounding. Continued use would exacerbate the

situation and ultimately lead to unacceptable impacts to navigation safety. This and local opposition to continued use of the nearshore area in the vicinity of the Interim Site has lead to the conclusion that it does not meet the criteria necessary for EPA final site designation.

**Size of Sites (d.).** The fourth general criterion requires that the size, configuration and location of the site be evaluated as part of the study and that the size be limited. Ocean disposal sites are sized to localize, for identification and control, any immediate adverse impact and permit the implementation of effective monitoring and surveillance programs to prevent long-ranged impacts. This in the past was interpreted to mean the absolute minimum size possible. The size of the Interim Site was based upon the minimum size site that a hopper dredge can operationally use. This narrow interpretation maximized the effects of disposal in these small sites. As a result, mounding of dredged material occurred to the point that the wave climate was altered and imperiled navigation safety, especially for small boats transiting the area. Therefore, the only management option available was to discontinue placement of material in the Interim Site and select an alternate site.

The proposed North and South Sites have been sized to provide sufficient capacity to accommodate material dredged from the Yaquina Bay project as well as material from other projects. The size of the North and South Sites was based on the requirement to provide at least 20 years of disposal capacity per site, without the sites accumulating dredged material to a height that could potentially amplify waves. Since the average water depth at the proposed sites is 135 feet, dispersion of dredged material was assumed to be negligible. This required that the each site have the capacity to "store" all material placed without forming a mound higher than 14 feet which led to minimum required size of 3,900 feet x 3,900 feet. The effective usable area for each proposed site was set at 5,500 feet x 2,800 feet (equivalent to the minimum required size). The addition of a 500-foot buffer zone along the perimeter of each site produced the dimensions of 6,500 feet x 3,800 feet per site. The overall site dimensions were rounded up to 6,500 feet x 4,000 feet for clarity. Management of placement of material in these larger, deeper sites will assure the wave climate will not be significantly affected and navigational safety not compromised.

Bathymetric surveys of the "placement area" will be conducted as part of the Site Management and Monitoring Plan (Appendix D). The results will be used to document the fate of the dredged material and provide information for future management.

**Sites Off the Continental Shelf (e.).** Potential disposal areas located off the continental shelf would be at least 20 nautical miles offshore in water depths of 600 feet or more. The haul distance to an off-shelf disposal site is much greater than the 2.75 nautical mile average operational limit of the Yaquina Bay project, making an off-shelf site infeasible for maintenance of the project. Material dredged by clamshell could be transported feasibly off the continental shelf by barge. However, the cost for evaluation and monitoring along with unanswered environmental concerns about disposal in such areas makes off-shelf disposal undesirable. Further, disposal would remove sediments from the nearshore littoral transport system, a system that functions with largely non-renewable quantities of sand in Oregon. Disruption in the mass balance of this system could alter erosion/accretion patterns impacting beaches, spits, wetlands, and other shoreline habitats.

Benthic and pelagic ecosystems near the shelf contain important fishery resources and the effects of disposal operations are not well understood. Fine-grain sediment and rocky habitats would be directly impacted in disposal operations. These deep-water areas are stable and generally not disturbed by wave action or sediment movement. Consequently, these areas have benthic invertebrate communities that are adapted to very stable conditions and would not likely be able to survive disturbance from disposal operations. Little is known of the ecology of benthic communities on the continental slope, and disposal in this area could cause impacts of unknown severity and duration. Bottom gradients can be 5% to 25% on the continental slope, making accumulated unconsolidated sediments susceptible to slumping. Deposited sediments could be transported long distances downslope as turbidity currents, and offshore by near-bottom currents.

## DETERMINATION OF COMPLIANCE AND SELECTION FOR FORMAL DESIGNATION (40 CFR 227)

**Determination of Environmental Acceptability of Ocean Disposal (Subpart B)**. The Corps and EPA have documented for the record via this evaluation the anticipated environmental effects from designation of ocean dredged material disposal sites offshore of Yaquina Bay and from the potential future regulated use of those sites pursuant to the Site Management and Monitoring Plan (Appendix D) for disposal of dredged materials. Designation of ocean dredged material disposal sites does not mandate use; however, once designated, use of sites is anticipated. Material that could be disposed in the ocean is anticipated to be clean gravel, sand, silt and clay from the Yaquina Bay and estuary.

By regulation, dredged sediments suitable for ocean dumping may not contain any materials listed in Section 227.5 or contain any of the materials listed in Section 227.6 except as trace contaminants. Determination of trace contaminants is accomplished by Corps and EPA evaluation of the dredged material employing the procedures of applicable national and regional testing manuals. Compliance with the applicable prohibitions, limits, and conditions for site use will assure that formal designation of ocean dredged material disposal sites and their use will not unduly degrade of endanger the marine environment.

With respect to this subpart, it is concluded that site designation and use would present:

(a) no unacceptable adverse effects on human health and no significant damage to the resources of the marine environment;
(b) no unacceptable adverse effect on the marine ecosystem;
(c) no unacceptable adverse persistent or permanent effects due to the dumping of dredged materials; and
(d) no unacceptable adverse effect on the ocean for other uses as a result of direct environmental impact.

**Determination of Need for Designation of Sites (Subpart C)**. The need for ocean dumping has been adequately documented by a thorough evaluation of the factors listed in Section 227.15. No practicable alternatives presently exist to manage dredged sediments

from the Yaquina Bay federal project. Designation of ocean dredged material disposal sites to fulfill the present and anticipated future need is required. While the use of designated sites is anticipated, that use is not mandated by the designation. Notwithstanding compliance with the other ocean dumping criteria, ocean dumping of dredged material may not be authorized if there is no need for the dumping, and alternative means of disposal are available, as determined in accordance with Subpart C. These factors must be evaluated and documented for the record for each proposed dumping on an individual project basis.

**Impact on Esthetics, Recreational and Economic Values (Subpart D).** In itself, designation of the proposed ODMDSs has no effect on esthetics, recreational or economic values. Designation of the ODMDSs does not mandate use. However, use of sites once designated is anticipated and the potential for unacceptable adverse effects results from the individual and cumulative disposals at the designated sites and management by the government.

Sites are located to minimize resource impacts and use conflicts to acceptable levels, not necessarily to avoid all conflicts. Potential impacts of using designated sites offshore of Yaquina Bay were evaluated by the Corps and EPA and are documented in this evaluation study. The EPA's site designation rule will define site use conditions that, in conjunction with the Site Management and Monitoring Plan, will limit the extent and severity of any impacts to acceptable levels. Also, the impact of dumping on esthetic, recreational and economic values must be evaluated on an individual project basis for each proposed dumping. Placement of dredged material into the proposed sites will be managed to avoid formation of mounds that could interfere with commercial fishing activities.

The government must also consider the consequences of not authorizing disposal sites and use of those sites, including without limitation, the impact on esthetic, recreation and economic values with respect to the municipalities and industries involved. Without ocean dumping, the federal entrance channel and main navigation channel in Yaquina Bay cannot be economically maintained. The benefits associated with continued ocean commerce of the Yaquina Bay system are substantial on a regional and national scale. While all economic values would not be completely lost, failure to maintain the navigation projects would necessarily result in severe economic disruption to municipalities, industries, and individuals throughout the Pacific Northwest. Failure to maintain the navigation projects would not be expected to directly impact recreational uses or esthetic values defined by this subpart.

With respect to this subpart, it is concluded that designation and use of the proposed ODMDSs would not result in unacceptable adverse effects to esthetic, recreational and economic values. Further, it is concluded that in the absence of ocean dumping, unacceptable adverse economic effects to municipalities and industries will occur throughout the interior portion of the Pacific Northwest region and the western potion of the nation.

**Impact on Other Uses of the Ocean (Subpart E).** This evaluation study identified and assessed the nature and extent of existing and potential uses of the disposal sites themselves and of any areas that reasonably may be affected by designation of sites and their use. Temporary and long-range effects were evaluated within the state of the art with particular emphasis on any irreversible or irretrievable commitment of resources that would result from use of the designated sites. Based on these evaluations, it is concluded that there would be no unacceptable adverse effect on other uses of the ocean as defined by this subpart.

## SELECTION OF OCEAN DISPOSAL SITES FOR FORMAL DESIGNATION

Based upon the evaluation of the criteria contained in 40 CFR Parts 220 through 228, the Corps and EPA have determined that the proposed North Site and South Site are suitable for designation and use as disposal sites for ocean dumping of dredged material when disposal and site management is performed in accordance with the Site Management and Monitoring Plan which as been developed under 40 CFR 228.9 and with use restrictions that will be specified as part of this designation. The Corps and EPA have further determined that material dredged from the Yaquina Bay and estuary projects meet the criteria for dredged material dumping. The North Site and South Site are proposed for designation by EPA through formal rulemaking, adopting this ODMDS Evaluation/EA/Section 103 study and the appendices to support this action. The Section 103 Site selected by the Corps in 1998 will expire at the end of its authorized life or will be terminated once EPA's formal rulemaking is completed.

## AFFECTED ENVIRONMENT

### Physical Resources

#### *General*

The Yaquina River flows into the Pacific Ocean through a jettied entrance approximately 115 miles south of the Columbia River. Although Yaquina Bay is the fourth largest estuary in Oregon, its drainage basin ranks only eleventh in area. The estuary is fed mainly by the Yaquina River, which drains 253 square miles and has a relatively short length of 58.8 miles from its mouth to headwaters. From its mouth to head of high tide at RM 26, it has one major tributary (Elk Creek at RM 22.3) and about 30 smaller creeks and sloughs discharging into it. The normal flow rate has been estimated at 1,078 cubic feet per second (cfs). The basin consists of 87% forest; 4% cropland; 2% rangeland; and 7% "other." Elevations range from sea level to 2,300 feet. Annual rainfall averages 60 inches along the coast to 100 to 110 inches in the eastern portions.

The bay is described as being moderately exposed to waves at the throat. Tidal influences extend as far as RM 26 of the Yaquina River and several miles up Elk Creek. The mean tide range is 5.9 feet with a diurnal range of 7.9 feet and an extreme range of 11.5 feet. Tidal prism on mean range is 8.35 x 10 cubic feet with a diurnal range of 11.5 x 10 cubic

feet. Currents off Newport are quite variable and reportedly exhibit the characteristics of a large eddy.

*Yaquina Bay Sediments*

Material dredged in the main federal channel has an average resuspended density ranging between 1,810 and 1,969 grams/liter. From 1986 to 1999, the total amount of sediment dredged from the entrance channel averaged 313,600 cubic yards/year. Material in the turning basin has an average resuspended density on the order of 1,295 grams/liter. Total sediment dredged from the turning basin averages 27,200 cubic yards/year. The material dredged from the South Beach Marina channel consists of silty sand in the outer portion with an average resuspended density between 1,325 and 1,549 grams/liter. The inner channel is a sandy silt with up to 55% fines. Biological testing in 1991 and chemical tests in 1995 showed that this material is acceptable for placement in-water or upland. South Beach Marina sediments are dredged about every 5 years with an average of 13,000 cubic yards/year. Depot Slough is dredged about every 15 years with the latest dredging totaling 36,000 cubic yards in 1995. Sediment evaluation reports, including sample locations, grain size, elutriate and bulk sediment test results are included in Appendix C.

*ODMDS Sediments*

The topography of the seabed in the vicinity of the ODMDS sites is fairly uniform. Depths at the sites range from 115 to 155 feet. Bottom sediments collected at the sites are a fairly uniform poorly graded sand (SP), averaging 0.163 millimeters (mm) in size. Sediments in the area offshore of Yaquina Bay are mostly medium- to fine-grained marine sands with 99% larger than 0.062 mm in size. Some shell debris is also present and rock outcrops were found at three of the sampling stations. Sandy sediments such as these are common along the Oregon Coast with natural variation in percent fines occurring at different stations depending upon variations in local current patterns. The 1999 data showed a similar sand environment out to a depth of 160 feet off Yaquina Bay. Material finer than silt constitutes less than 2.3%. Volatile solids are less than 1.3%. The material at the proposed sites is very similar to that collected at the existing ODMDS sites. While fine-grained sediments placed at the disposal site would be carried in suspension and quickly removed from the site by longshore and offshore currents, the coarser sediments would remain at the site for longer periods. The zone of active sediment movement in the area extends to a depth of about -150 feet. The thinness of the sediment layer indicates that there is no long-term accumulation of sediment offshore from Yaquina Bay.

*Oceanographic Circulation*

Circulation of the coastal waters on the continental shelf (near Yaquina Bay) results from an interaction of regional oceanic circulation, astronomical tides, local wind-generated surface waves and current, swell, and Yaquina River flow as affected by inland meteorological events. Time scales for coastal circulation processes range from seconds for wind generated waves to months for seasonal weather patterns to years for large-scale events such as El Nino and La Nina.

A generalized model for the seasonal changes in the along shore and offshore circulation along the Pacific Coast of Oregon has been developed. The summer circulation of surface water on the continental shelf is influenced by the southward flowing California current, which attains maximum strength during the summer when surface winds are consistently from the north-northwest. Winter circulation of shelf waters is dominated by the northward flowing Davidson current, which attains maximum strength due to winter storm (wind stress) patterns. The subsurface part of the Davidson current (below 300 feet in depth) is believed to flow northward throughout the year, although the surface waters respond to seasonally varying wind stress patterns (reversals). Therefore, the net direction of bottom currents on the mid- and outer continental shelf (120 to 600 feet in depth) is believed to be northward and along shore.

The time-varying circulation of coastal waters controls the transport and seasonal distribution of bottom sediments and suspended material within the water column. Circulation that is consistent through time (flow through the Yaquina Bay jetties) tends to produce identifiable and relatively constant bathymetry features. Circulation that is highly variable (typically, flow along the open coast) tends to produce homogenous bathymetry having ephemeral features.

Inner Continental Shelf. The most active region along the continental shelf is the inner shelf (depth less than 120 feet), over which shoaling wind waves and swell, shelf-modified tidal currents, and estuarine-induced currents are at least as important as wind-driven currents for promoting the transport of bottom sediments. These variable processes act on ebb tidal shoal sediments at Yaquina Bay (depths less than 120 feet) to produce the bathymetric condition observed at any particular time. Circulation of coastal (inner shelf) waters is subject to seasonal reversal, generally being northward during winter and southward during summer. Bottom currents along the inner-shelf often reach speeds high enough to transport sand-sized sediment.

Middle and Outer Shelf. Circulation along the middle shelf (120 to 300 feet in depth) is governed mainly by wind-driven currents. Circulation along the outer shelf (300 to 600 feet in depth) is affected by shoaling internal waves and seasonally modified regional currents. Bottom currents along the middle and outer shelf generally do not reach speeds high enough to transport sand-sized sediment, but are capable of transporting fine-grain sediments (silt-size and smaller).

*Geology*

The coastal area of Oregon has been influenced by a combination of tectonic forces and glacial effects during the past few million years. Regional uplift, coupled with a fluctuating sea level, is evidenced by marine terraces up to 100 feet above present sea level. Beneath deposits of recent sands are rocks up to 40 million years old. At the maximum extent of the continental glaciers sea level was as much as 400 feet below present. Delta-like features formed from massive amounts of sediments, estimated up to 10 times present volumes. The last episode of glacial retreat began less than 20,000 years ago with sea level rising rapidly until 5,000 to 6,000 years ago. Filling the valley bottoms and the estuary are modern river sediments. These grade into marine sands near the river

mouth, which continue offshore. Extensive coastal dunes and beaches have been formed in modern times by wind forces acting upon river/marine sands.

A succession of siltstones, mudstones, and sandstones dip seaward from 10° to 20°. A layer of basalt intrudes the sandstone layer and forms Yaquina Head and the offshore reefs. In the Newport area, marine terrace deposits over 50 feet thick overlie the much older eroded sandstones and mudstones. These terrace deposits form the steep sea cliffs north from the jetties but are absent for 1.5 miles to the south where modern sands form the South Beach area. Little, if any, sand is presently escaping from the estuary.

**Biological Resources**

*Introduction*

This section summarizes biological conditions in the ocean environment offshore of Yaquina Bay. The data has been obtained from several years (seasons) of sampling conducted in this area. More detailed information on the sampling and results are included in Appendix A.

*Plankton and Fish Larvae*

Peterson and Miller (1976) and Peterson et al. (1979) sampled the zooplankton community off Yaquina Bay and found copepods to be the dominant taxa. The species of copepods present varied with season. Of the 58 species collected, 8 occurred commonly in both summer and winter, 7 occurred only or predominantly in the summer, and 6 only or predominately in the winter. In general, winter species are less abundant than summer species.

Distribution and abundance of inshore plankton species vary depending upon near shore 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 moves up from depth on shore. This upwelling phenomenon can extend up to 10 kilometers (km) offshore and last for days to weeks depending upon the strength and duration of the wind. Zooplankton taxa during this time are predominantly those from subarctic water masses. In the winter the wind is primarily out of the west and southwest which transports surface waters inshore. The zooplankton community during this time consists of species from the transitional or Central Pacific water masses.

Other taxa collected were of minor importance, compared to the copepod abundance, except for a few organisms during parts of the year. For instance, the megalops larval stage of the Dungeness crab *Cancer magister* is abundant inshore from January to May. They are apparently retained there by the strong longshore and onshore components of the surface currents Lough (1976).

Fish larvae are transient members of the inshore coastal plankton community. Their abundance and distribution has been described by Richardson (1973), Richardson and Pearcy (1977), and Richardson et al. (1980).

Three species assemblages of fish larvae 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 over lapped both groups. The break between the coastal and transitional groups occurs at the continental slope; consequently, only the species of the coastal group would be effected by ocean disposal. Smelts (Osmeridae), which make up to over 50% of the larvae collected, dominate the coastal group. Other dominant species included the English sole *Parophrys vetulus*, sanddab *Isopsetta isolepis*, starry flounder *Platichthys stellatus*, and tom cod *Microgadus proximus*. Maximum abundance occurred from February to July when greater than 90% of the larvae were collected.

*Benthic Invertebrates.*

Benthic invertebrates play an important role in secondary productivity of near shore marine systems. They are not only a direct source of food for many species but play an active part in the shredding and breakdown of organic material and in sediment reworking. Extensive benthic invertebrate studies have been conducted offshore of Yaquina Bay since 1984. Samples were taken in March 1984, May 1986, October 1989, May and September 1999 and May and September 2000. Most of the studies were done in conjunction with the ODMDS program. The information has been used to help adjust ocean disposal sites to avoid mounding of dredged material.

The invertebrate fauna collected during these studies is typical of the nearshore high-energy environment found along the Oregon Coast. The benthic community is dominated by highly mobile organisms that are adapted to a shifting sand environment. Dominant species and groups include gammaridean amphipods, sand dollars *Dendraster eccentricus*, surface-dwelling gastropods *Olivella* spp., and various species of polychaete worms. These organisms provide a direct food source for other benthic organisms and demersal fishes, and also play an active role in the breakdown of organic debris, which reintroduces it back into the system.

Densities in the 1999 sampling showed reduced numbers and little variation between the May and September sampling for both all the groups together and with the polychaetes densities removed indicating a more stable situation. A similar pattern was apparent for various species of crustaceans. The dominant polychaete species had a marked variability during all sampling events. There was a large increase in density of all four species during 1986. There was no apparent correlation between this peak and any available physical data.

The variability noted throughout the sampling events is consistent with other areas along the Oregon Coast and does not necessarily represent an impact from previous disposal actions. The increase in populations in 1986 and the subsequent decrease in 1999 could be related to several factors but was mostly likely the result of sample timing. Sampling in

the spring when there are large numbers of newly recruited juveniles in the population can show large increases in the densities of some species. This increase may not be representative of the actual population; however, since many of these juveniles are lost by natural causes to the community by fall. A similar situation can also occur in the fall, which was the case in the September 2000 sampling when very large numbers of *Spiophanes bombyx* were present. Sampling during certain times than can give an unrealistic estimate of actual changes in species and population numbers. In addition, many of the organisms that live in this dynamic area are short lived or transitory, continually moving to better feeding sites. As a result, distributional data can also naturally be highly variable.

*Macroinvertebrates*

The dominant commercially and recreationally important macroinvertebrate species in the inshore coastal area are shellfish, Dungeness crabs and squid. 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. The ODFW had identified a potential squid spawning area off the Yaquina estuary. Preliminary data indicate that the population in this area could sustain commercial harvest. This area never developed to the extent projected, however.

*Fish*

The nearshore area off Yaquina Bay supports a variety of pelagic and 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 spawn in the estuary and are present in large numbers during their migration inshore. Though migratory species are present year-round, individual species are only present during certain times of the year.

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 sand flats. Dominant species include English sole, sanddab, and starry flounder. The neritic reefs off Yaquina Bay 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 indicated approximately 114 acres of kelp beds off Yaquina Bay. The reef fish community differs depending on the depth of the reef. The shallower reefs (> 20 meters in depth) are dominated by the black rockfish *Sebastes melanops* while the deeper reefs (20 to 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.

*Commercial and Recreational Fisheries*

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. The only other commercial fishing activity in the area is for clams in the bay and beaches along the coast. The ODFW has identified a potential squid fishing area off of Yaquina Bay but a commercial fishery has not developed. 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 claming in the bay and along the beach and spear fishing along the jetties.

*Wildlife*

Bayer (USACE 1985) 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 1982 through September 1983 and indicated common murres were the most abundant species. Maximum numbers of common murres were 4,330 birds, with a 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 (maximum count 133 birds). Various other piscivorous birds (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. Snowy plovers, listed by the 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 1960s at South Beach. Recreational use and predation are probable causal factors for loss of snowy plovers from South Beach. Most marine mammals present in the area are migrants; however, Steller's sea lions, harbor seals, and harbor porpoises frequent the project area. Pupping or hauling out areas are not known in the immediate project vicinity.

Potentially 30 cetacean (whales and porpoises) species occur in ocean waters along the coast of the Pacific Northwest at different times of the year; although their individual numbers are generally limited. Harbor porpoises and gray whales were prevalent in shelf waters less than 600 feet deep. The larger cetaceans, such as the California gray whale, typically occur as migrants in the spring and fall. Smaller cetaceans, principally dolphins, porpoises, and some small whales are also present in these same waters.

Since 1982, four species of marine turtles (loggerhead, green, Pacific ridley, and Pacific leatherback) have been recorded from strandings along the coastline. Marine turtles are unusual in their occurrence along the Pacific Coast and are typically associated with warmer marine waters. Five species of pinnipeds are known to occur along the coast: northern sea lion, California sea lion, harbor seal, northern elephant seal and northern fur seal. Harbor seals are resident whereas the four other species of pinnipeds are more transient in nature. Harbor seals and California/northern sea lions are the principal species observed in the estuary. All three species are known to forage within the estuary and adjacent ocean waters.

Pelagic birds are extremely numerous in the offshore area. Studies have found that seabird populations were most densely concentrated over the continental shelf (less than 600 feet in depth). Shearwaters, storm petrels, gulls, common murres and Cassin's auklets numerically dominated the pelagic bird fauna from late spring through late summer. Phalaropes, fulmars and California gulls are important constituents of the fall pelagic bird flocks. The principal species in the winter are phalaropes, California gulls, fulmars, other gulls, murres, auklets, and kittiwakes. Red-throated, Pacific and common loons occur as spring and fall migrants. Western, red-necked horned, and eared grebes also occur in the area. Brown pelicans occur from late spring to mid-fall along the coast. This species forages in nearshore waters of the Pacific Ocean and estuarine waters of the Columbia River. Concentrations up to 1,000 birds have been reported. Three species of cormorants and three species of terns occur and forage in nearshore Pacific Ocean waters and the estuary.

*Endangered Species*

Fish. Oregon coastal runs of coho salmon were listed as threatened on August 10, 1998. Critical habitat was designated on February 16, 2000. Although the Yaquina River estuary and river were designated as critical habitat, the ocean area off Yaquina Bay in the vicinity of the disposal sites was not.

Coho are present in the area of the disposal site as both adults and juveniles. Adults hold in the offshore area prior to entering the estuary to migrate up river to spawn. Juveniles rear in the nearshore ocean area after migrating downstream and transitioning to saltwater. Coastal steelhead is listed as a candidate species. It was determined when they were originally proposed for listing that listing was not warranted at that time. However, there was sufficient concern with the population to retain them as a candidate species for later listing if population levels declined. Coastal steelhead are also present in the nearshore area as juveniles and adults during migrations to and from the ocean.

Wildlife. The federally listed threatened and endangered wildlife species which may occur within the ZSF include: blue, finback, sei, right, hump-backed and sperm whales; loggerhead, green, Pacific ridley, and Pacific leatherback sea turtles; northern (Steller) sea lion; marbled murrelet; bald eagle; Aleutian Canada goose; peregrine falcon; and brown pelicans. These species vary by season and location in the offshore area.

## Socio-Economic Resources

### *Cultural Resources*

Prehistoric cultural resources are unlikely to be found within the offshore area. It is possible that prehistoric Native Americans may have used portions of the Yaquina offshore reefs as a fishery. Any remaining remnants of prehistoric fishing activity are unlikely or not retrievable. Shipwrecks are the most probable cultural resources expected to exist within the offshore area. Historical review indicates several recorded wrecks in the Yaquina offshore area. All known shipwreck remnants are located in the South Beach area. It is possible that unrecorded wrecks exist elsewhere in the Yaquina offshore area. A sidescan sonar survey was conducted over a large area in and around the proposed disposal sites. No shipwrecks or other historic remnants were detected from this survey.

### *Recreational Uses*

The Yaquina Bay vicinity offers a wide variety of recreation opportunities during all seasons of the year. The primary activities include sightseeing, fishing, beachcombing and boating. Nearby beaches and entrance jetties receive a continual influx of recreationists. South Beach State Park is located adjacent to the Yaquina Bay south jetty and provides camping and day-use facilities and beach access. Yaquina Bay and the nearshore ocean are heavily used by recreational fishermen and boaters. Claming is also a popular recreation activity along local beaches. Fishing in the vicinity of the proposed disposal sites is primarily for salmon and bottom fish.

### *Commercial Uses*

The Yaquina Bay offshore area supports a number of valuable commercial fisheries. The major offshore fisheries include Dungeness crab, salmon and bottom fish. Fishing for salmon and bottom fish, however, has declined in the last several years because of declining stocks of these species. There has been a shift to other fisheries such as crabs, tuna, and halibut. Tuna and halibut fishing are predominately in the offshore area beyond the ZSF. A potential squid fishery has been identified by ODFW to the west of the proposed disposal sites. Commercial claming and oyster harvesting occurs within the bay.

# ENVIRONMENTAL EFFECTS

## Physical Resources

Sand deposited at the proposed site most likely will disperse somewhat between annual dredging events. Sediment transport will be similar to that described in the *Interim Ocean Dredged Material Disposal Site Evaluation Study* (USACE, 1985) and the Section 103 Evaluation in 1986. This would include movement predominately to the northwest in the winter with some southerly movement either onshore or offshore in the summer. A 500-foot "buffer zone" should be inscribed within the proposed sites to keep material within the

ODMDS during dredged material placement. Dispersal would occur at a lower rate overall at the proposed sites since they are deeper than the existing sites.

Placement of material at the site will be managed to avoid creation of single conical mound features. Based on sediment fate modeling (Appendix B) the seabed at the ODMDSs would likely experience various degrees of accumulation. On a per dump basis, the seafloor at the sites could be subjected to individual burial events ranging from .01 to .3 feet thick covering an area of 5-20 acres. On a seasonal basis, the sites may be subjected to accumulations ranging from 1-10 feet thick covering an area of 100-500 acres. Total bottom accumulation would be limited to a maximum of generating wave height increases of 10% or less over existing conditions based upon model predictions.

Sediment characteristics would be modified from finer-grained bottom sediments to coarser-grained over much of the site for a short time following disposal. Prevailing conditions will redeposit finer-grained sediments within an estimated 6 months based on monitoring data for ocean disposal sites at similar depth off the mouth of the Columbia River (Siipola et al. 1993). Chemical analysis of sediments likely to be placed at the disposal sites indicate contaminants are well below levels of concern for in-water placement.

**Biological Resources**

In general, dredged material disposal presents four potential problems to aquatic organisms: (1) direct burial, (2) temporary increases in turbidity, (3) changes in physical and chemical characteristics of sediments (habitat), and (4) the possible introduction of pollutants. It is difficult to distinguish significant effects caused by sediment disposal from changes due to natural variability in species abundances.

Releases of dredged material do not produce a persistent turbidity plume (Boone et al., 1978), thus decreased light transmission with a concomitant decrease in phytoplankton primary productivity is not expected to occur. In addition, no detectable changes in dissolved nutrient or trace metal concentrations accompany disposal. Therefore, no significant adverse impacts on phytoplankton productivity are expected from pollutants or turbidity.

Benthic organisms at the expanded sites would be subjected to burial and slight changes in sediment texture. The larger disposal areas can reduce burial effects by spreading placement in thinner layers. Larger disposal areas would also reduce frequency of disposal at any one site allowing longer recovery periods between disposal events. Disposal of dredged material from the entrance channel would introduce coarser-grained sediments that would have a short-term impact on benthic organism distribution as well as food sources for demersal fish and shellfish.

In general, benthic organisms that either burrow up through the substrate or migrate into the site from the adjacent shelf repopulate the dredged material disposal sites. Benthic sampling following ocean disposal at similar sites has shown little change occurring in overall species abundance or diversity (Hinton et al. 1992; Hinton and Emmett 1994, 1996).

The effects of disposal on demersal fish and shellfish were evaluated by Durkin and Lipovsky (1977). Conclusions drawn from this study at the mouth of the Columbia River were affected by limited predisposal data and by seasonal variability in the abundances of natural populations at the site. Nevertheless, the authors suggest that dumping results in a 3 to 6 month decrease in the numbers of finfish species and individuals. In addition, food sources following dumping changed from benthic invertebrates to fish and shrimp.

Adverse impacts due to disposal-related turbidity are improbable because post disposal, suspended particulate concentrations are not significantly different from predisposal concentrations. Similarly, because no detectable amounts of trace contaminants are released from the dredged sediments subsequent to dumping, significant impacts on the benthos due to the introduction of pollutants are not expected (Richardson et al. 1977).

Dredged material disposal involves negligible risk to marine mammals. Marine mammals tend to avoid human activities; therefore, the probability of an animal colliding with a hopper dredge or released dredged sediments is small. In addition, dumping will not likely cause injury. Pinnipeds (seals and sea lions) and cetaceans (whales, dolphins, and porpoises) are strong swimmers and can escape the sediment release zone.

Threatened and Endangered Species. Biological Assessments have been prepared to formally address impacts to all listed species. Corps biologists have made a preliminary determination that the proposed ODMDSs and their use would not likely affect these species or their habitats.

**Socio-Economic Resources**

Dredging activities are expected to have beneficial impacts to commercial and recreational boating. Some short-term interference to sea going tugs and barge operations could occur during dredging and transportation of dredged material to the ocean dumping site. The new disposal sites are expected to reduce the possibility of navigational hazards, since disposal can be relocated within the new site as mounding occurs and then dissipates. No impacts to cultural resources are expected in either dredging or disposal sites.

Shipwrecks are the most probable (and recoverable) cultural resources expected to exist in the Yaquina Bay offshore area. In general, areas beyond the 60-foot contour are low probability areas for shipwrecks because this is the area of minimum current transport of sand. Most vessels wrecked on beaches, surf lines or shoals; thus, low frequency of vessels loss and poor preservation context support the low probability designation for locations deeper than the 60-foot contour.

Prehistoric cultural resources are unlikely to be found in the project area. The assumption that Native Americans could have been present in the project area is based on the fact that prior to 5,000 to 6,000 years ago sea level was considerably lower than present levels. However, any prehistoric sites present on former shorelines are now inundated by present ocean levels and buried under substantial amounts of sand deposited during recent geological times.

## COORDINATION

Procedures used in this evaluation and the proposed use of the adjusted new sites has been Coordinated with the following State and Federal agencies:

- Oregon Department of Fish and Wildlife
- Oregon Department of Environmental Quality
- Oregon Department of Land Conservation and Development
- Oregon Division of State Lands
- U.S. Fish and Wildlife Service
- National Marine Fisheries Service

This evaluation was issued to Federal, State, and local agencies, private groups, and individuals for a 30-day public review. No adverse comments were received in response to this public notice. Formal notice will also be carried out by the EPA during the final site designation process. Coordination letters received in response to the public notice are included in Appendix F.

This proposed federal action requires concurrence or consistency for the following federal laws from the responsible agencies as indicated below.

| | |
|---|---|
| * Marine Protection, Research and Sanctuaries Act | U.S. Environmental Protection Agency |
| * Endangered Species Act of 1973, as amended | U.S. Fish & Wildlife Service<br>National Marine Fisheries Service |
| * National Historic Preservation Act of 1966, as amended | State Historic Preservation Officer |
| * Coastal Zone Management Act of 1972, as amended | Oregon Department of Land Conservation and Development |
| * Clean Water Act of 1977, as amended | Oregon Dept. of Environmental Quality |

Consistency or concurrence letters from the above listed agencies are included in Appendix F or obtained prior to use of the sites.

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# APPENDIX A

# LIVING RESOURCES

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## Introduction

Information on aquatic resources off Yaquina Bay was obtained from a variety of published and unpublished reports, thesis, and personal communications. Field sampling has also been done, since 1984, to collect information on distribution and abundance of benthic invertebrate populations.

## Plankton and Fish Larvae

Distribution and abundance of inshore plankton species vary depending upon near shore 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 moves up from depth on shore. This upwelling phenomenon can extend up to 10 km offshore and last for days to weeks depending upon the strength and duration of the wind. Zooplankton taxa during this time are predominantly those from subarctic water masses. In the winter the wind is primarily out of the west and southwest which transports surface waters inshore. The zooplankton community during this time consists of species from the transitional or Central Pacific water masses.

Peterson and Miller (1976) and Peterson et al. (1979) sampled the zooplankton community off Yaquina Bay and found copepods to be the dominant taxa. The species of copepods present varied with season. Of the 58 species collected, eight occurred commonly in both summer and winter, seven occurred only or predominantly in the summer and six only or predominately in the winter. In general winter species are less abundant than summer species. A list of dominant summer and winter species is given below in Table A-1.

**Table A-1 Dominate copepod species by season in decreasing order of abundance (Peterson and Miller, 1976).**

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

Other taxa collected were of minor importance, compared to the copepod abundance, except for a few organisms during parts of the year. For instance, the megalops larval stage of the Dungeness crab *Cancer magister* is abundant inshore from January to May.

They are apparently retained there by the strong longshore and onshore components of the surface currents Lough (1976) (figure A-1). After May, the megalops metamorphoses into juvenile crabs and settle out of the plankton moving into rearing areas in the estuary.

Fish larvae are a transient member of the inshore coastal plankton community. Their abundance and distribution has been described by Richardson (1973), Richardson and Pearcy (1977), and Richardson et al. (1980) (Figure A-1).

Three species assemblages of fish larvae 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 over lapped both groups. The break between the coastal and transitional groups occurs at the continental slope, consequently only the species of the coastal group would be effected by ocean disposal.

The coastal group is dominated by smelts (Osmeridae) which make up to over 50 percent of the larvae collected. Other dominant species included the English sole *Parophrys vetulus*, Pacific sanddab *Citharichthys sordidus*, Butter sole *Isopsetta isolepis* starry flounder *Platichthys stellatus*, and tom cod *Microgadus proximus*. Maximum abundance occurred from February to July when greater than 90 percent of the larvae were collected. Two peaks of abundance occurred, one in February and March (24 percent of larvae) and one in May to July (68 percent of larvae). Dominant species during each peak are shown below in Table A-2.

**Table A-2 Biological index* of dominant fish larval species during the two peaks of abundance.**

| 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 (*Isopetta isolepis*) | 1.73 | 2.21 |
| Tom cod (*Microgadus proximus*) | | 2.03 |
| Slender sole (*Lyopsetta exilis*) | | 1.07 |

*Biological index is a ranking method that averages abundance and frequency of occurrence in samples. 5 to 1 in decreasing order of importance.

The larval species present in the inshore coastal areas were similar and had the same peaks of abundance as those collected in Yaquina Bay; however, the dominate species differed. In the bay two species accounted for 90 percent of the larvae collected, the bay goby *Lepidogobius lepidus* and the Pacific herring *Clupea harengus pallasii*. Neither was 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 a rearing area.

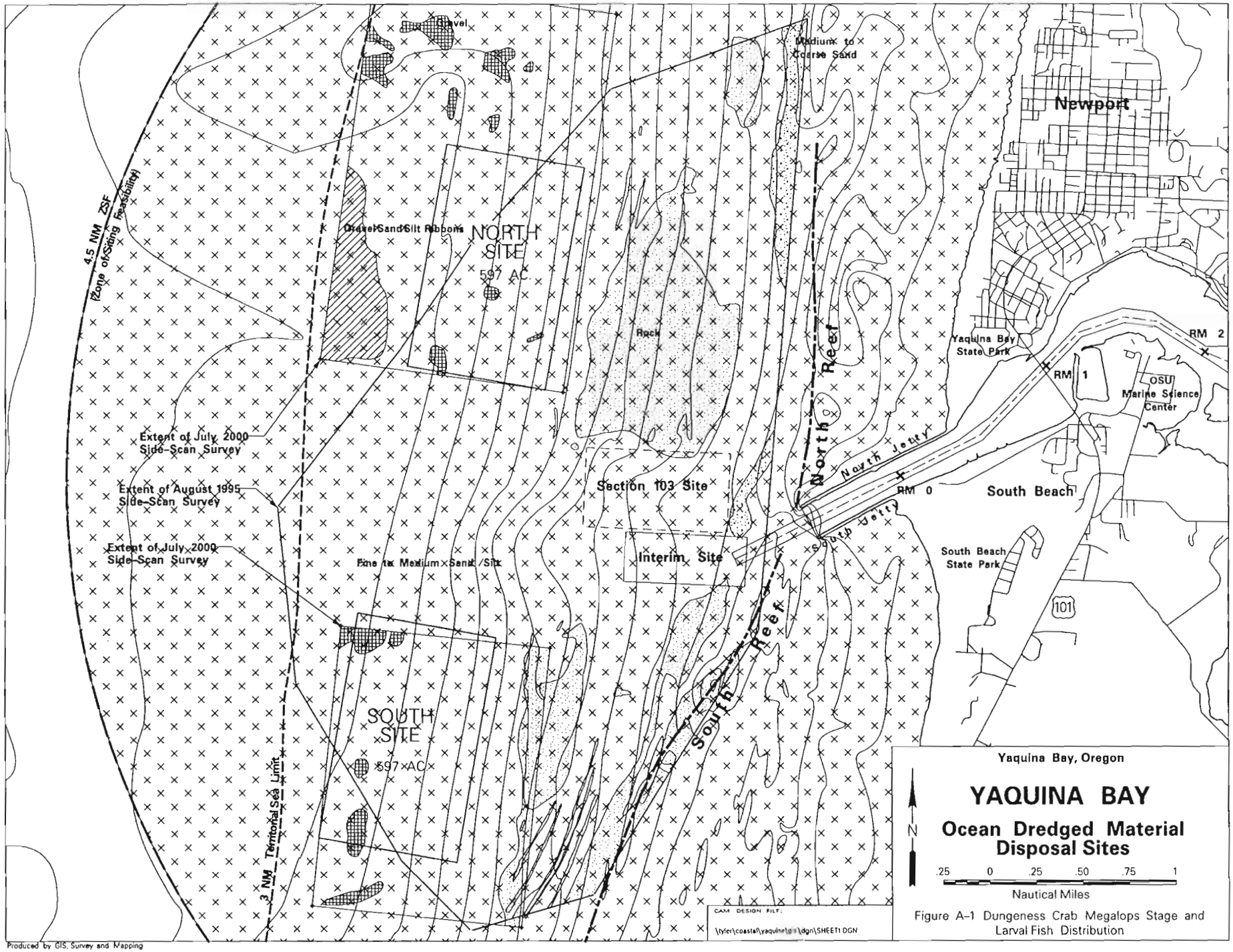



Figure A-1 Dungeness Crab Megalops Stage and Larval Fish Distribution

**Benthic Invertebrates.**

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

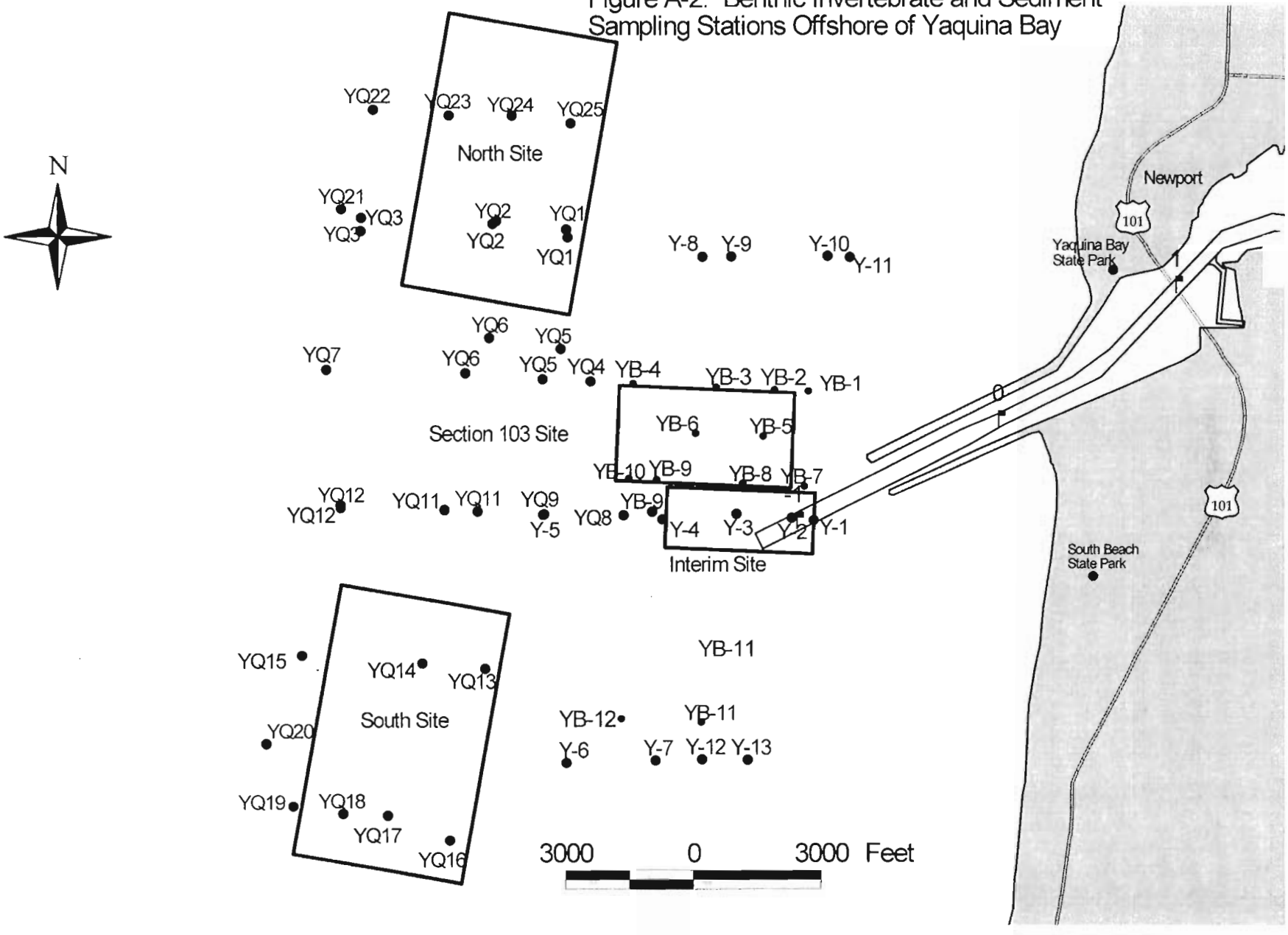
Benthic invertebrate studies have been done in March 1984, May 1986, October 1989, May and September 1999 and May and September 2000. Most of the studies were done in conjunction with the ODMDS program to help assess existing disposal sites or locate new sites, because of mounding problems at the existing site. In 1984 nine stations were sampled in the vicinity of the previously established interim disposal site to characterize the benthic resources. In 1986 and 1989 14 and12 stations respectively were sampled to the west and north of the interim site, to aid in establishing a new site. In 1999, 17 stations were sampled that were further west and to the north and south of the previous stations. Sampling was done at 20 stations in 2000 to evaluate two proposed new sites, which are located further offshore than has previously been sampled. Some of the stations have been sampled during each study since 1984. Most stations have only been sampled during one study. Table A- 3 lists the stations that have been sampled and what stations they corresponded to in the other years. All stations sampled are shown in Figure A-2.

**Table A-3 Comparable stations sampled offshore of Yaquina Bay from 1984-2000.**

| 1984 Stations | 1986-1989 Stations | 1999 Stations | 2000 Stations |
|---|---|---|---|
| Y 9 | YB 3 | | |
| Y 8 | YB 4 | YQ 4 | |
| Y 2 | YB 7 | | |
| Y 3 | YB 8 | | |
| Y 4 | YB 10 | YQ 8 | |
| Y 7 | YB 11 | YQ 13 | YQ13 |
| Y 6 | YB 12 | YQ 14 | YQ14 |
| Y 5 | | YQ 9, YQ 10 | |
| | | YQ15 | YQ15 |
| | | YQ16 | YQ16 |
| | | YQ17 | YQ17 |
| | | | YQ18-25 |

After the 1999 sampling a study was done to compare the results between all the previous studies (Marine Taxonomic Services, 2000). This information was then used to design the 2000 sampling program and to prepare the discussion below.

Figure A-2: Benthic Invertebrate and Sediment Sampling Stations Offshore of Yaquina Bay



Sediments in the area offshore of Yaquina Bay are mostly medium to fine grain marine sands with 99% larger than 0.062mm in size. Some shell debris is also present and there were rock outcrops found at stations YB 11, YB 13, and YB 14. Sandy sediments such as these are common along the Oregon coast with natural variation in percent fines occurring at different stations depending upon variations in local current patterns. The 1999 and 2000 data showed a similar sand environment out to a depth of 160 foot off Yaquina Bay.

The invertebrate fauna collected during these studies is typical of the nearshore high-energy environment found along the Oregon coast (Tables A-4 to A-10). It is similar to the communities found near other disposal sites along the Oregon coast, such as Coos Bay sites E and F, Rogue River, Siuslaw River and Chetco River (Hancock et. al., 1984, USACE 1985, USACE 1988). The community is dominated by highly mobile organisms that are adapted to a shifting sand environment. Dominant species and groups include gammaridean amphipods, sand dollars *Dendraster eccentricus*, surface-dwelling gastropods *Olivella* spp and various species of polychaetes worms. These organisms provide a direct food source for other benthic organisms and demersal fishes, and also play an active role in the breakdown of organic debris, which reintroduces it back into the system.

Invertebrate diversity was fairly constant at comparable stations throughout the studies with the exception of station YB 11 in 1986 (Table A-5). This station had a rocky and coarse shell substrate, which had a more diverse and different species composition than the sandy stations. Stations YB 4-11 in 1986 and most stations in September 2000 showed larger densities as compared to the other stations. Most of this increase was due to the polychaete *Spiophanes bombyx*, a surface feeding polychaete that can have large population explosions after a disturbance or large increase in prey items. It is a short lived species and its peak of abundance usually only occurs for a short period of time and then is replaced by less opportunistic species.

**Table A-4 Relative densities of major taxa March, 1984**

| Station | # Of Polychaetes | #/m2 | Molluscs | #/m2 | Crustaceans | #/m2 | Echino. | #/m2 |
|---|---|---|---|---|---|---|---|---|
| Y-1 | 33 | 69 | 51 | 106 | 101 | 210 | 4 | 8 |
| Y-2 | 32 | 67 | 4 | 8 | 60 | 125 | 12 | 25 |
| Y-3 | 20 | 42 | 5 | 10 | 14 | 29 | 22 | 46 |
| Y-4 | 30 | 63 | 4 | 8 | 69 | 144 | 66 | 138 |
| Y-5 | 114 | 238 | 23 | 48 | 89 | 185 | 32 | 67 |
| Y-6 | 109 | 227 | 32 | 67 | 317 | 659 | 46 | 96 |
| Y-7 | 131 | 273 | 26 | 54 | 392 | 817 | 15 | 31 |
| Y-8 | 135 | 281 | 62 | 129 | 268 | 558 | 58 | 121 |
| Y-9 | 69 | 144 | 20 | 42 | 119 | 248 | 42 | 88 |

**Table A-5 Relative densities of major taxa May, 1986**

| Station | # Of Polychaetes | #/m2 | Molluscs | #/m2 | Crustaceans | #/m2 | Echino. | #/m2 |
|---|---|---|---|---|---|---|---|---|
| YB-1 | 108 | 225 | 11 | 23 | 183 | 381 | 10 | 21 |
| YB-2 | 148 | 308 | 24 | 50 | 200 | 417 | 8 | 17 |
| YB-3 | 121 | 252 | 11 | 23 | 144 | 300 | 8 | 17 |
| YB-4 | 435 | 906 | 38 | 79 | 297 | 618 | 27 | 56 |
| +YB-5 | 730 | 1518 | 88 | 183 | 496 | 1032 | 20 | 42 |
| YB-6 | 168 | 350 | 30 | 63 | 285 | 593 | 19 | 40 |
| YB-7 | 986 | 2052 | 48 | 96 | 366 | 763 | 1 | 2 |
| YB-8 | 262 | 546 | 25 | 52 | 374 | 779 | 2 | 4 |
| YB-9 | 585 | 1217 | 40 | 83 | 502 | 1044 | 5 | 10 |
| YB-10 | 1979 | 4123 | 89 | 185 | 815 | 1695 | 20 | 42 |
| *YB-11 | 691 | 1440 | 31 | 65 | 489 | 107 | 14 | 29 |
| YB-12 | 172 | 358 | 62 | 129 | 88 | 183 | 4 | 8 |
| YB-13 | 76 | 158 | 60 | 125 | 77 | 160 | 14 | 29 |
| YB-14 | 22 | 46 | 11 | 23 | 83 | 173 | 59 | 123 |

**Table A-6 Relative densities of major taxa, October, 1989**

| Station | # Of Polychaetes | #/m2 | Molluscs | #/m2 | Crustaceans | #/m2 | Echino. | #/m2 |
|---|---|---|---|---|---|---|---|---|
| YB-1 | 26 | 52 | 14 | 28 | 74 | 148 | 0 | 0 |
| YB-2 | 15 | 30 | 14 | 28 | 167 | 334 | 271 | 542 |
| YB-3 | 33 | 66 | 22 | 44 | 78 | 156 | 52 | 104 |
| YB-4 | 63 | 126 | 138 | 276 | 126 | 252 | 50 | 100 |
| YB-5 | 23 | 46 | 8 | 16 | 305 | 610 | 76 | 152 |
| YB-6 | 51 | 102 | 22 | 44 | 50 | 100 | 125 | 250 |
| YB-7 | 34 | 68 | 26 | 52 | 182 | 364 | 1 | 2 |
| YB-8 | 84 | 168 | 21 | 42 | 105 | 210 | 16 | 32 |
| YB-9 | 40 | 80 | 20 | 40 | 105 | 210 | 58 | 121 |
| YB-10 | 60 | 125 | 24 | 48 | 88 | 176 | 76 | 158 |
| YB-11 | 293 | 586 | 46 | 92 | 104 | 208 | 4 | 8 |
| YB-12 | 120 | 240 | 135 | 270 | 235 | 470 | 20 | 40 |

Densities in the 1999 sampling showed less abundance and little variation between the May and September sampling for both, all the groups together and with the polychaetes densities removed. (Table A-7 and A-8). This similarity indicates a more stable situation then in previous years. A similar pattern was apparent for various species of custaceans including grammaridean amphipods and cumacea. The density of Echinoderms, principally *Dendraster excentricus* showed a peak in abundance at station YB2 in 1989. Significant peaks of abundance also occurred at stations YB 6 and YB 11 or their comparable stations in the May 1999. *D. excentricus* is a very mobile organism and tends

to congregate in areas of large food sources. Consequently, their distribution and abundance is highly variable.

**Table A-7 Relative densities of major taxa May 1999.**

| Station | # Of Polychaetes | #/m2 | Molluscs | #/m2 | Crustaceans | #/m2 | Echino. | #/m2 |
|---|---|---|---|---|---|---|---|---|
| YQ 1 | 147 | 306 | 42 | 87 | 162 | 337 | 7 | 15 |
| YQ 2 | 158 | 329 | 29 | 60 | 183 | 381 | 6 | 12 |
| YQ 3 | 776 | 1614 | 124 | 258 | 43 | 89 | 9 | 19 |
| YQ 4 | 87 | 181 | 16 | 33 | 214 | 445 | 20 | 42 |
| YQ 5 | 127 | 264 | 96 | 200 | 101 | 210 | 25 | 52 |
| YQ 6 | 89 | 185 | 77 | 160 | 220 | 458 | 8 | 17 |
| YQ 7 | 159 | 331 | 35 | 73 | 58 | 121 | 8 | 17 |
| YQ 8 | 62 | 129 | 37 | 77 | 313 | 651 | 23 | 48 |
| YQ 9 | 54 | 112 | 50 | 104 | 47 | 98 | 30 | 62 |
| YQ 10 | 53 | 110 | 68 | 141 | 34 | 71 | 35 | 73 |
| YQ 11 | 83 | 173 | 33 | 69 | 40 | 83 | 22 | 46 |
| YQ 12 | 124 | 258 | 30 | 62 | 68 | 141 | 22 | 46 |
| YQ 13 | 123 | 256 | 70 | 146 | 89 | 185 | 104 | 216 |
| YQ 14 | 100 | 208 | 17 | 35 | 65 | 135 | 38 | 79 |
| YQ 15 | 96 | 200 | 51 | 106 | 43 | 89 | 25 | 52 |
| YQ 16 | 112 | 233 | 91 | 189 | 30 | 62 | 57 | 119 |
| YQ-17 | 128 | 266 | 5 | 10 | 42 | 87 | 119 | 248 |

**Table A-8 Relative densities of major taxa September 1999.**

| Station | # Of Polychaetes | #/m2 | Molluscs | #/m2 | Crustaceans | #/m2 | Echino. | #/m2 |
|---|---|---|---|---|---|---|---|---|
| YQ 1 | 285 | 593 | 49 | 102 | 216 | 449 | 1 | 2 |
| YQ 2 | 230 | 478 | 50 | 104 | 77 | 160 | 1 | 2 |
| YQ 3 | 1134 | 2359 | 42 | 87 | 104 | 216 | 4 | 8 |
| YQ 4 | 165 | 343 | 116 | 241 | 173 | 360 | 21 | 44 |
| YQ 5 | 225 | 468 | 43 | 89 | 112 | 233 | 7 | 15 |
| YQ 6 | 283 | 589 | 57 | 119 | 162 | 337 | 2 | 4 |
| YQ 7 | 1212 | 2521 | 68 | 141 | 88 | 183 | 11 | 23 |
| YQ 8 | 57 | 119 | 52 | 108 | 108 | 225 | 20 | 42 |
| YQ 9 | 206 | 428 | 104 | 216 | 106 | 220 | 24 | 50 |
| YQ 10 | 103 | 214 | 103 | 214 | 71 | 148 | 22 | 46 |
| YQ 11 | 143 | 297 | 83 | 173 | 66 | 137 | 15 | 31 |
| YQ 12 | 328 | 682 | 92 | 191 | 74 | 154 | 6 | 12 |
| YQ 13 | 190 | 395 | 53 | 110 | 98 | 204 | 7 | 15 |
| YQ 14 | 193 | 401 | 60 | 125 | 172 | 358 | 23 | 49 |
| YQ 15 | 194 | 404 | 100 | 208 | 217 | 451 | 11 | 23 |
| YQ 16 | 176 | 366 | 42 | 87 | 62 | 129 | 30 | 62 |
| YQ-17 | 152 | 316 | 37 | 77 | 66 | 137 | 30 | 62 |

The dominant polychaete species had a marked variability during all sampling events. There was a large increase in density of all four species during 1986 with no apparent correlation between this peak and any available physical data. The large increase in

density of polychaetes in September 2000 was likely due to a increase in coastal upwelling which dramatically increased food sources.

The dominant molluscs in these studies was the carnivorous gastropod *Olivella* spp. Three species of *Olivella* occur along the Oregon coast, two of which, *O. biplicata* and *O.pycna*, were collected off Yaquina Bay. Both of these species were present in significant numbers during 1984,1986 and 1989 studies. In 1999 *O. biplicata* was not present in any samples. The 1999 samples, however, were taken in deeper water and *O. biplicata* is a shallow water species while *O. pycna* is more abundant offshore in depths from 30-150 feet. Most stations showed this relationship with the possible exception of YB 4 and YB 9 in 1989.

Dominant species of gammaridean amphipods included *Mandibulophoxus gilesi, Synchelidium shoemakeri*, and *Psammonyx longimerius*. These amphipods are scavengers and feed primarily on particles of organic debris found in the sediment. *M. gilesi* and another species, *Eohaustorius sencillus*, showed a great deal of variability between stations and over time. This variability seems to be normal when compared to other studies (Hancock et al 1981, USACE 1985. The 1999 data showed few or no *M. gilesi* in the deeper water samples.

The data collected from the June 2000 cruise (Marine Taxonomic Services, 2000) was similar to the 1999 data. The data collected from the same sites in the September 2000 cruise, however, were very different. Benthic invertebrate abundance was several orders of magnitude higher in September than June (Tables A- 9 and A-10).

**Table A-9. Relative Densities of Major Taxa, June 2000**

| Station | # Of Polychaetes | #/m2 | Molluscs | #/m2 | Crustaceans | #/m2 | Echino. | #/m2 |
|---|---|---|---|---|---|---|---|---|
| YQ 1 | 158 | 328.6 | 58 | 120.6 | 209 | 434.7 | 8 | 16.6 |
| YQ 2 | 193 | 401.4 | 41 | 85.3 | 110 | 228.8 | 10 | 20.8 |
| YQ 3 | 954 | 1984.3 | 30 | 62.4 | 61 | 126.9 | 5 | 10.4 |
| YQ 11 | 132 | 274.6 | 52 | 108.2 | 91 | 189.3 | 10 | 20.8 |
| YQ 12 | 170 | 353.6 | 50 | 104.0 | 66 | 137 | 12 | 25.0 |
| YQ 13 | 202 | 420.2 | 54 | 112.3 | 72 | 149.8 | 31 | 64.5 |
| YQ 14 | 192 | 399.4 | 50 | 104.0 | 202 | 420.2 | 20 | 41.6 |
| YQ 15 | 187 | 389.0 | 107 | 222.6 | 67 | 139.4 | 18 | 37.4 |
| YQ 16 | 177 | 368.2 | 36 | 74.9 | 70 | 145.6 | 18 | 37.4 |
| YQ-17 | 212 | 441.0 | 33 | 68.6 | 58 | 120.6 | 16 | 33.3 |
| YQ 18 | 229 | 476.3 | 44 | 91.5 | 97 | 201.8 | 18 | 37.4 |
| YQ 19 | 169 | 351.5 | 48 | 99.8 | 68 | 141.4 | 24 | 50.0 |
| YQ 20 | 187 | 389.0 | 148 | 307.8 | 91 | 189.3 | 13 | 27.0 |
| YQ 21 | 994 | 2067.5 | 36 | 74.9 | 51 | 106.1 | 21 | 43.7 |
| YQ 22 | 641 | 1333.3 | 44 | 91.5 | 65 | 135.2 | 16 | 33.3 |
| YQ 23 | 1079 | 2244.3 | 39 | 81.1 | 93 | 193.4 | 4 | 8.3 |
| YQ 24 | 342 | 711.4 | 21 | 43.7 | 98 | 203.8 | 4 | 8.3 |
| YQ 25 | 215 | 447.2 | 69 | 143.5 | 225 | 468.0 | 21 | 43.7 |

**Table A-10. Relative Densities of Major Taxa, September 2000.**

| Station | # Of Polychaetes | #/m2 | Molluscs | #/m2 | Crustaceans | #/m2 | Echino. | #/m2 |
|---|---|---|---|---|---|---|---|---|
| YQ 1 | 4364 | 9077.1 | 145 | 301.6 | 297 | 617.8 | 17 | 35.4 |
| YQ 2 | 2751 | 5722.1 | 72 | 149.8 | 75 | 156.0 | 3 | 6.2 |
| YQ 3 | 14686 | 30546.9 | 71 | 147.7 | 504 | 1046.3 | 4 | 8.3 |
| YQ 11 | 4801 | 9986.1 | 142 | 295.4 | 135 | 280.8 | 8 | 16.6 |
| YQ 12 | 2838 | 5903.0 | 193 | 401.4 | 107 | 222.6 | 18 | 37.4 |
| YQ 13 | 3344 | 6955.5 | 117 | 243.4 | 170 | 353.6 | 14 | 29.1 |
| YQ 14 | 1604 | 3336.3 | 76 | 158.1 | 80 | 166.4 | 17 | 35.4 |
| YQ 15 | 2145 | 4461.6 | 206 | 428.5 | 169 | 351.5 | | |
| YQ 16 | 10572 | 21989.8 | 140 | 291.2 | 124 | 257.9 | 16 | 33.3 |
| YQ-17 | 7884 | 16398.7 | 61 | 126.9 | 76 | 158.1 | 17 | 35.4 |
| YQ 18 | 11230 | 23356.4 | 129 | 268.3 | 82 | 170.6 | 18 | 37.4 |
| YQ 19 | 13691 | 28477.3 | 129 | 268.3 | 114 | 237.1 | 15 | 31.2 |
| YQ 20 | 12373 | 25735.8 | 272 | 565.8 | 142 | 295.4 | 29 | 60.3 |
| YQ 21 | 19350 | 40248.0 | 85 | 176.8 | 174 | 361.9 | 4 | 8.3 |
| YQ 22 | 14838 | 30865.1 | 103 | 214.2 | 364 | 757.1 | 2 | 4.2 |
| YQ 23 | 15297 | 31817.8 | 80 | 166.4 | 591 | 1229.3 | 9 | 18.7 |
| YQ 24 | 19774 | 41129.9 | 54 | 112.3 | 87 | 181.0 | 7 | 14.6 |
| YQ 25 | 8481 | 17460.5 | 128 | 226.2 | 177 | 368.2 | 9 | 18.7 |

The large increase in abundance during the September cruise was from a huge recruitment of mostly a single, short lived, polychaete species (*Spiophanes bombyx*). *Magelona sacculata* another polychaete species also showed a lesser but still large increase. Mollusca and Crustacea also increase in abundance in September but it was not due to a single species. Though there was a random distribution of species between sampling June and September the increase in abundance was due in part to the recruitment of several different species, which varied between stations depending somewhat on station depth. The miscellaneous species group also showed a large increase of the juvenile Anthozoa *Halcampoides* sp., which increased overall abundance of this group in the September samples. Most all of the individuals in all the groups that had large increase were juveniles, indicating there had been a recent recruitment to the populations.

This large population recruitment could have many triggers but it seems most likely that the strong upwelling that occurred in the summer and fall along the Oregon coast could be a dominant factor. Oceanic conditions in previous years have reduced or eliminated upwelling which moves the nutrient rich water from the deeper ocean depths to the surface and provides an abundant food resource for most benthic invertebrate populations. Without the nutrient rich waters, productivity is generally much lower. Most of the increase in abundance in September 2000 was due to the large juvenile recruitment that occurred in most species. A large increase in the number of juveniles in a population is usually directly related to a large increase in food availability, which seems to be what happened in the fall of 2000

The variability noted throughout the sampling events is consistent with other areas along the Oregon coast and does not necessarily represent an impact from previous disposal actions. The increase in populations in 1986 the subsequent decrease in 1999 and increase again in fall 2000 could be related to several factors but was mostly likely the result of normal population fluctuations due to changing ocean conditions. Sampling at different times of the year can also shown large increases in population levels that may not be representative of the overall population. For instance sampling in the spring when there are large numbers of newly recruited juveniles in the population can show large increases in the densities of some species. Many of these juveniles are lost by natural causes to the community by the fall and therefore do not represent an actual long-term increase in population numbers. A similar situation can also occur in the fall, as was the case in September 2000 sampling when very large numbers of juvenile *Spiophanes bombyx* and of other species were present. This condition however may represent an actual increase in populations since it appeared to be associated with a change in ocean conditions that increased

**Macroinvertebrates**

The dominant commercially and recreationally important macroinvertebrate species in the inshore coastal area are shellfish, including Dungeness crabs and squid. Shellfish distribution is shown in figure A-3. 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. The Oregon Department of Fish and Wildlife (ODFW) had identified a potential major squid spawning area off Yaquina Bay. This area never developed to the extent projected, however, and there are currently no know squid spawning areas offshore of Yaquina Bay.

**Fisheries**

The nearshore area off Yaquina Bay supports a variety of pelagic and demersal fish species. Pelagic species include anadromous salmon, 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 spawn in the estuary and are present in large numbers during their migration inshore. Though migratory species are present year-around, individual species are only present during certain times of the year. Figure A-4 lists the species and periods of occurrence off Yaquina Bay. 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. Flatfish species occur predominately over open sand flats. Dominant species include English sole, sanddab, and starry flounder. English sole and starry

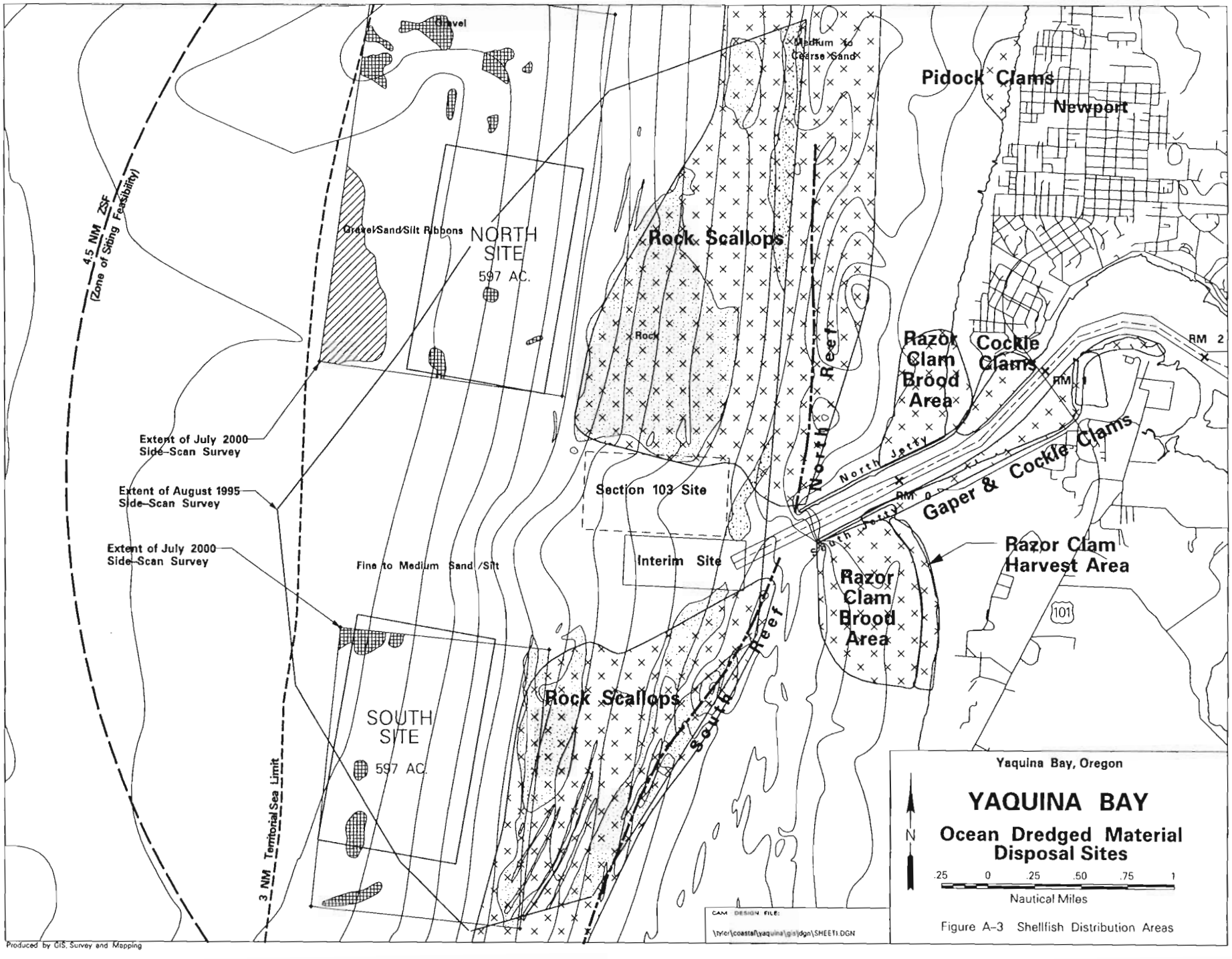



Figure A-3 Shellfish Distribution Areas

Figure A-4. Periods of Occurrence for Different Life History Stages of Principal Fish Species off Yaquina Bay.

| SPECIES | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Life History Stage |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Fall chinook salmon | | | | | | | | ▬ | ▬ | ▬ | | | Migration |
| | | | | | | | | | | | | | Estuary Rearing |
| Coho salmon | | | | | | | | | ▬ | ▬ | ▬ | | Migration |
| Steelhead | ▬ | ▬ | ▬ | | | | | | | | | ▬ | Migration |
| Cutthroat | | | | | | | ▬ | ▬ | ▬ | ▬ | | | Migration |
| Herring | ▬ | ▬ | ▬ | | | | | | | | | | Spawning |
| English sole | | | | | | | | | | | | | Estuary Rearing |
| Sea and Surf perch | | | | | | ▬ | ▬ | | | | | | Spawning |
| Rockfish | ▬ | ▬ | ▬ | | | | | | | | | | Spawning |
| Kelp Greenling | | | | | | | | | | ▬ | ▬ | | Spawning |
| Ling Cod | ▬ | ▬ | ▬ | | | | | | | | | ▬ | Spawning |
| Cabezon | ▬ | ▬ | ▬ | | | | | | | | | | Spawning |
| Starry Flounder | | | | | | | | | | | | | Estuary Rearing |

Juvenile

▬ Adult

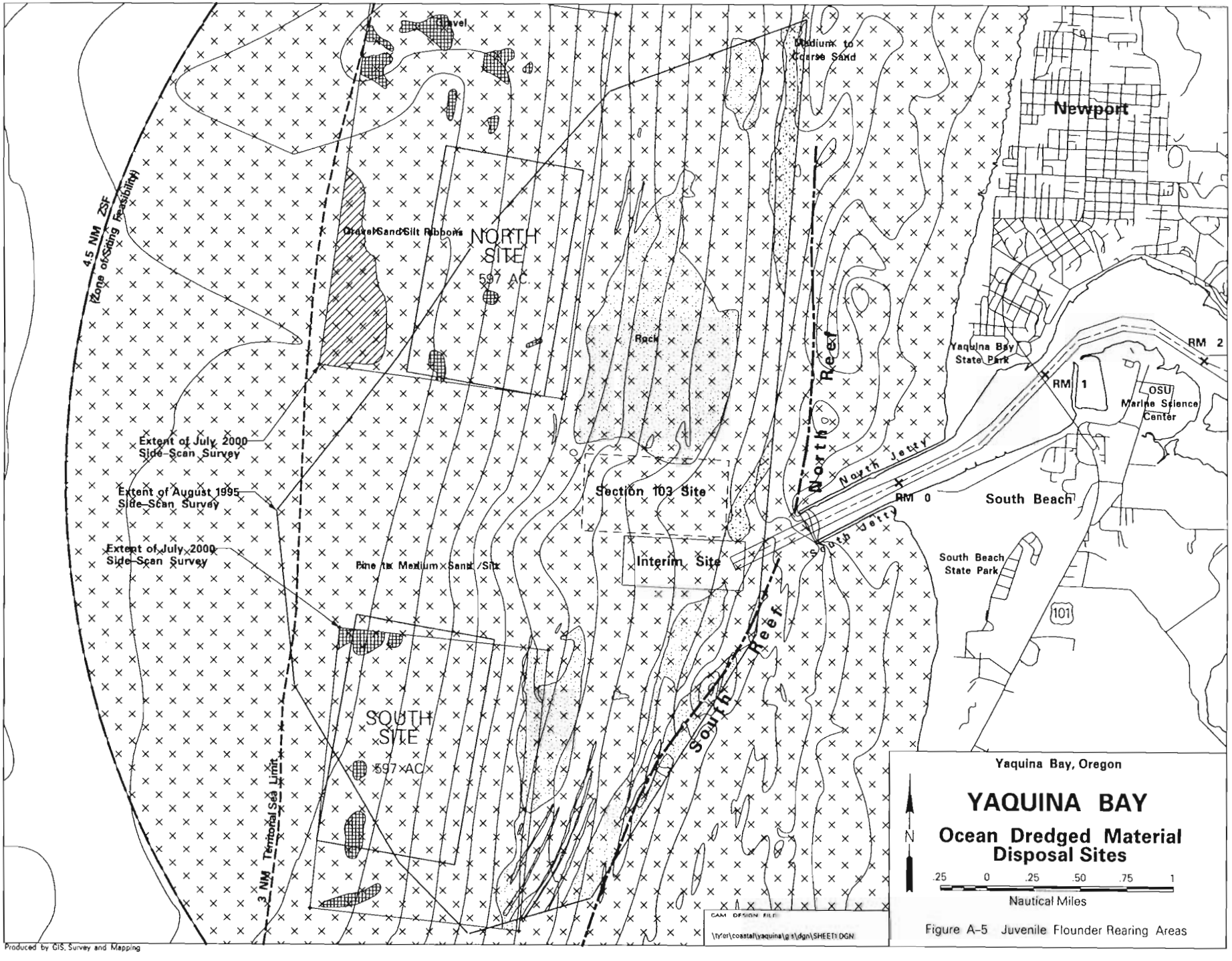



Figure A-5 Juvenile Flounder Rearing Areas

Produced by GIS, Survey and Mapping

flounder spawn in the inshore coastal area (Figure A-5) and juveniles of these as well as other marine species rear in the estuary. The neritic reefs off Yaquina Bay are a unique feature of the coast. Off Yaquina Bay 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 indicated approximately 114 acres of kelp beds off Yaquina Bay. The reef fish community differs depending on the depth of the reef. 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. Figure A-6 shows the distribution of fisheries resources off shore of Yaquina Bay.

**Endangered Fish Species**

Oregon coastal runs of coho salmon were listed as threatened on August 10, 1998. Critical habitat was designated on February 16, 2000. The Yaquina River estuary and river were designated as critical habitat but the ocean area off Yaquina Bay in the vicinity of the disposal sites was not. Coho are present in the area of the disposal site as both adults and juveniles. Adults hold in the offshore area prior to entering the estuary to migrate up river to spawn. Juveniles rear in the nearshore ocean area after migrating downstream and transitioning to saltwater. Coastal steelhead is listed as a candidate species. It was determined when they were originally proposed for listing that listing was not warranted at that time. There, however, was sufficient concern with the population to retain them as a candidate species for later listing if population levels declined. Coastal steelhead are also present in the nearshore area as juveniles and adults during migrations to and from the ocean.

**Commercial and Recreational Fisheries**

Major commercial and recreational fishing and claming areas are shown in figure A-7. 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. The only other commercial fishing activity in the area is for clams in the bay and beaches along the coast. ODFW had identified a potential squid fishing area off of Yaquina Bay but a commercial fishery did not develop. 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 claming in the bay and along the beach and spear fishing along the jetties.

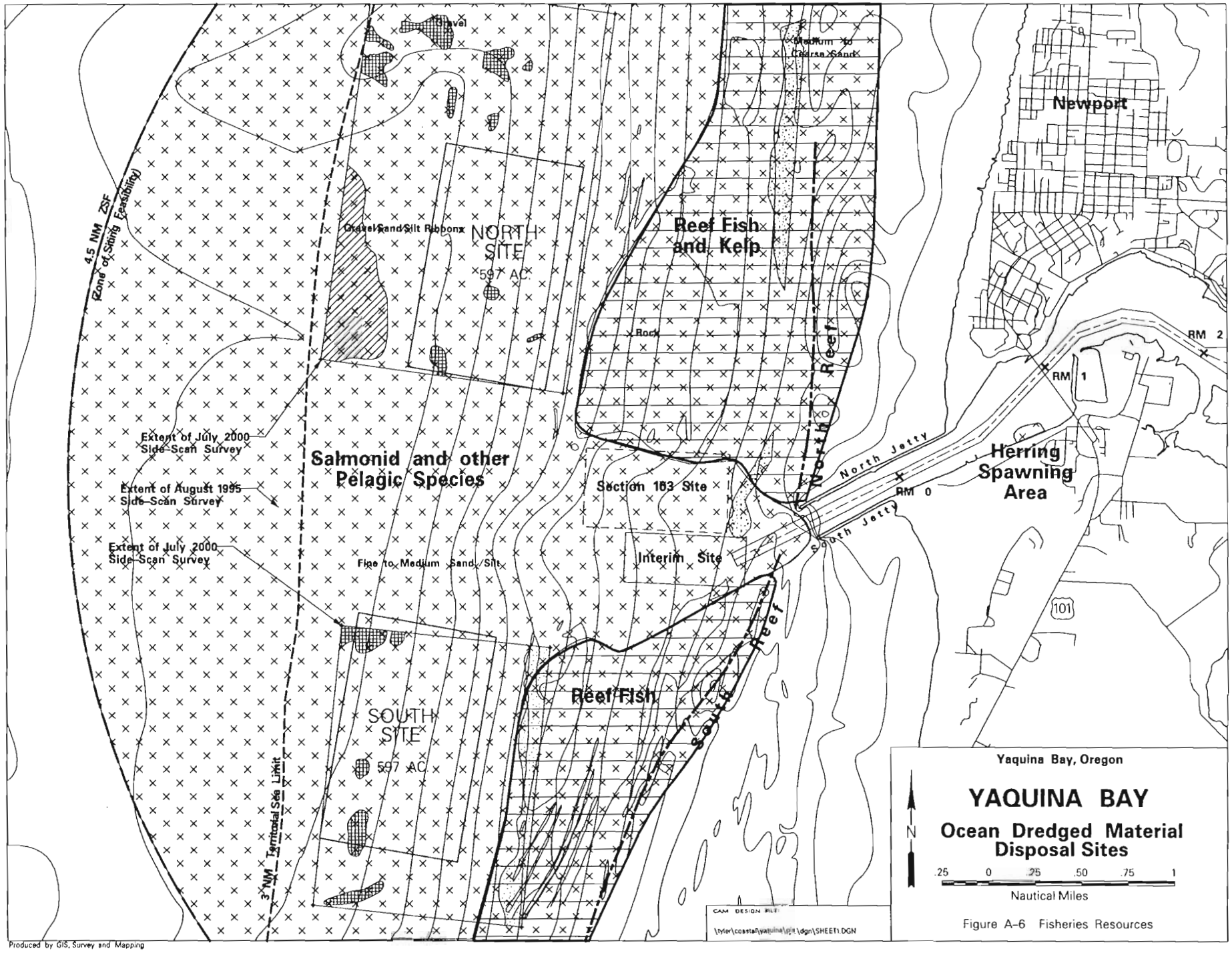



Figure A-6 Fisheries Resources

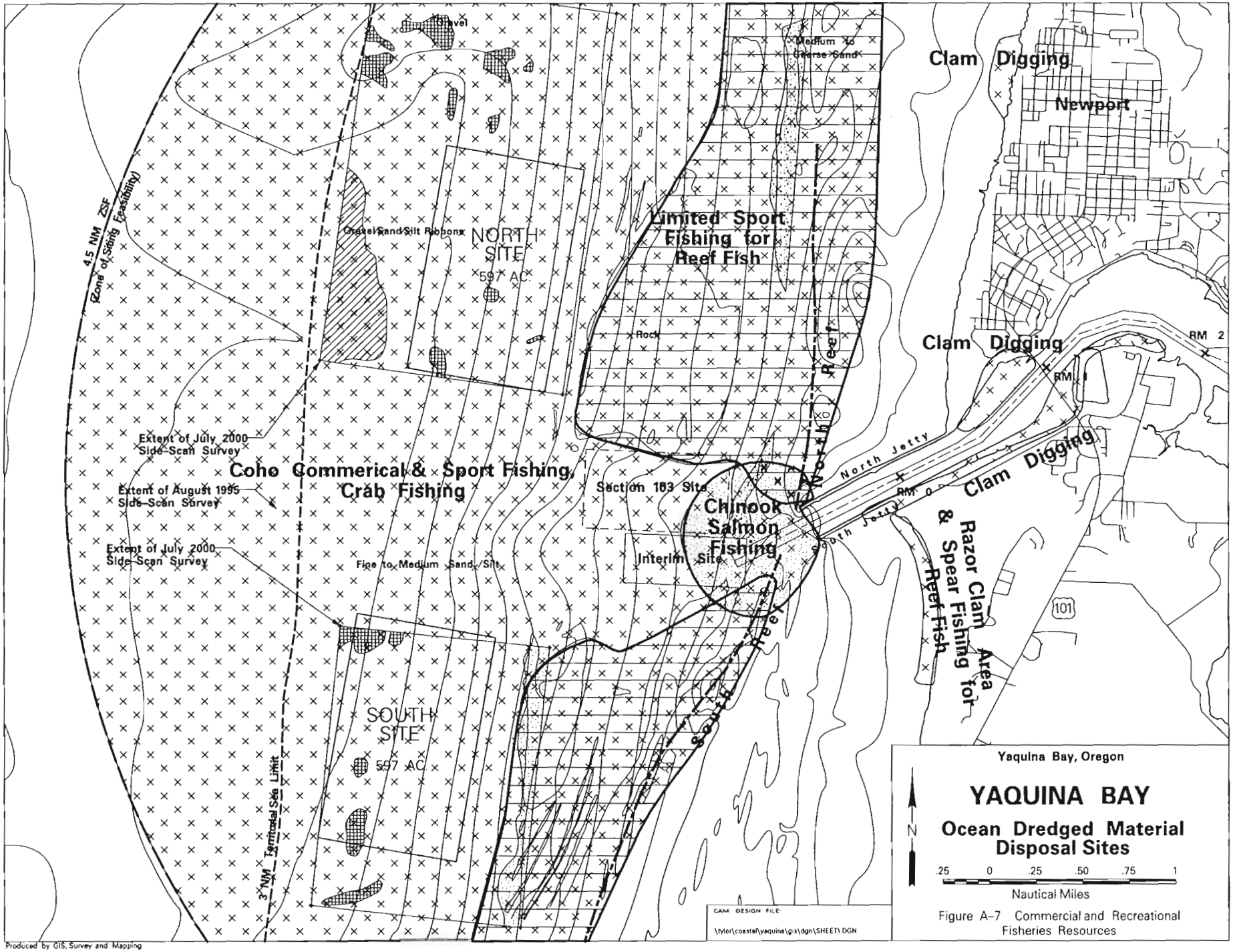



Figure A-7 Commercial and Recreational Fisheries Resources

**Wildlife**

The previously used dredge disposal site, which is located between the two proposed dredge disposal sites at the same distance from shore, was previously evaluated for wildlife use (USACE, 1985). Because of their adjacent locations, conclusions drawn from the previously used site are valid for the two proposed sites. In the 1985 report, Bayer, Ore Aqua Company biologist, documented avian use of the project area. All species documented are protected by the Migratory Bird Treaty Act. In the vicinity of the previously used site, common murres, gulls, and cormorants were noted in abundance and other piscivorous birds including loons, shearwaters, western grebe, pigeon guillemot, Cassin's auklet, Caspian tern, and brown pelican were noted as occurring.

The federally listed marbled murrelet, protected by the Endangered Species Act occurs in the vicinity of the project area. In a study along the coast of Oregon, Strong et al. (1993) reported greatest abundance within 500 m of shore. Abundance was reduced to 10% of nearshore levels 1,200 m from shore. The proposed project is located approximately 2 mi (3,200 m) from shore. In addition, offshore habitat and prey resource abundance are not considered limiting factors for marbled murrelets populations (Figure A-7).

Bayer (USACE, 1985) noted that marine mammals are present in the project area mostly as migrants and that pupping and hauling out areas are not present in the vicinity. Marine mammals are protected by the Marine Mammal Protection Act. Five species of pinnipeds are known to occur off Oregon and Washington: northern (Steller's) sea lion, California sea lion, harbor seal, northern elephant seal and northern fur seal (Bonnell et al. 1989) and Bayer noted that Steller's sea lions, and harbor seals frequent the area.

Potentially 30 cetacean species can occur along the Oregon coast (Green et al. 1989) although their numbers are generally limited. Six species, including Risso's dolphin, Pacific white-sided dolphin, northern right whale dolphin, harbor porpoise, Dall's porpoise, and gray whales comprised 97 percent of the cetaceans observed by Green et al. (1992). Cetaceans typically occur as migrants in the vicinity of the project site but Bayer (USACE, 1985) noted that harbor porpoises frequent the area (Figure A-7).

Four species of marine turtles including loggerhead, green, Pacific Ridley, and Pacific leatherback have been recorded from strandings along the Oregon and Washington coastline since 1982 (J. Scordino, NMFS, pers. Comm. Cited by Green et al. 1992). Green et al. (1992) recorded 16 Pacific leatherbacks during their survey of Oregon and Washington coastal waters and found that they were associated with warmer waters over the Pacific slope during summer (Green et al. 1992). Pacific leatherback, loggerhead, green, and Pacific Ridley occurrences off the Oregon Coast are associated with the appearance of albacore. Albacore occurrence is strongly associated with the warm waters of the Japanese Current which tends to approach the Oregon Coast in late summer. Typically, warm water associated with this current does not closely approach the Oregon Coast (i.e. 1-5 mi), generally occurring 30-60+ mi offshore. During El Nino events, warm water may occur much closer to the Oregon coast than usual.

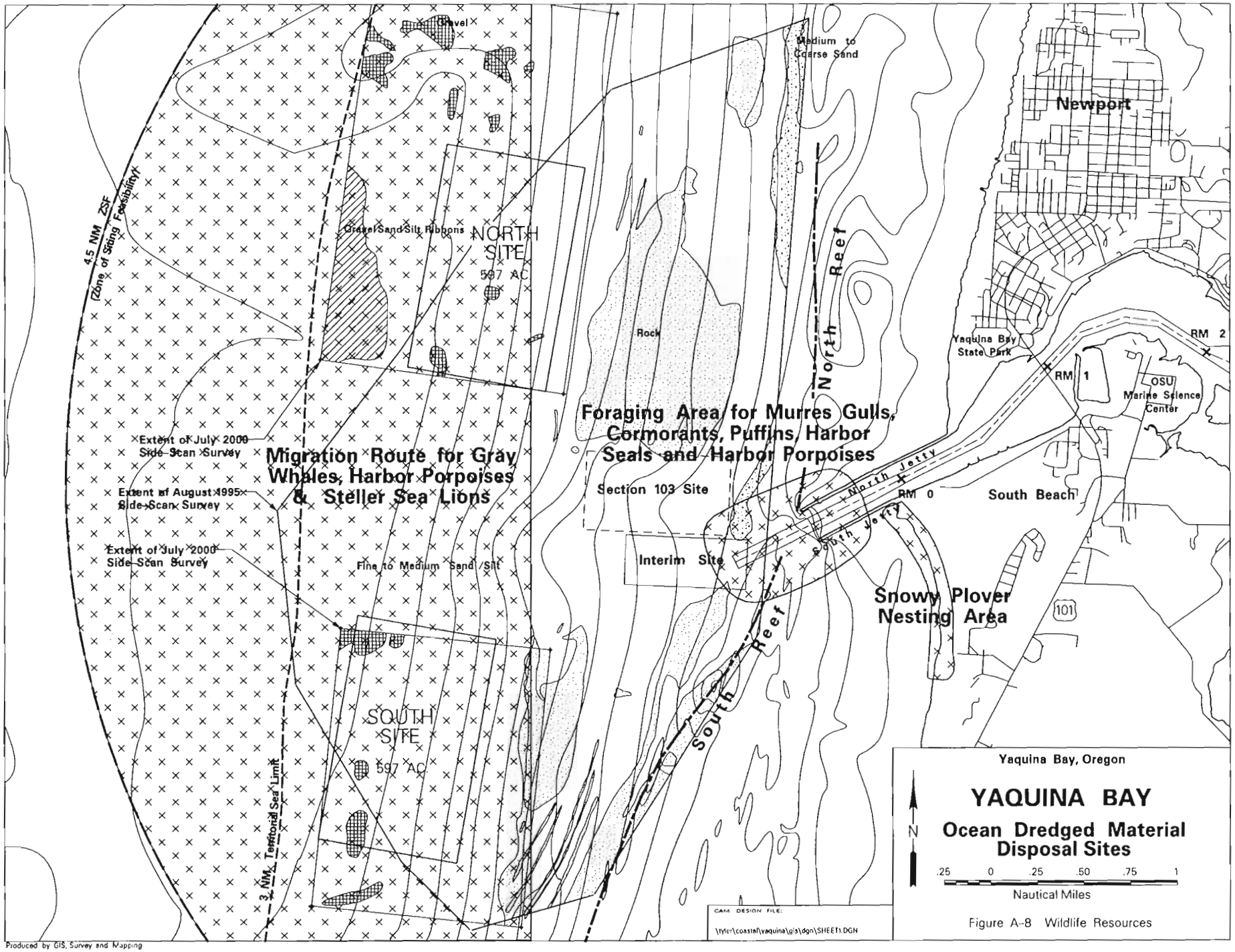



Figure A-8 Wildlife Resources

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# APPENDIX B

Ocean Dredged Material Disposal Sites for Yaquina Bay

Physical Processes and Geologic Features

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## APPENDIX B
Physical Processes and Geologic Features


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# APPENDIX B - Physical Processes and Geologic Features

## EXECUTIVE SUMMARY

Geographic Location: Northwest Pacific Coast of continental United States, deep draft ocean entrance to Newport at Yaquina Bay along Central Oregon.

Organizational Oversight: U.S. Army Corps of Engineers - Portland District and U.S. Environmental Protection Agency - Region X

Project Features Addressed: Ocean Dredged Material Disposal Sites 2 miles Offshore of Yaquina Bay

Appendix B describes the physical evaluation of dredged sediment placed at Yaquina Bay Ocean Dredged Material Disposal Sites (ODMDS). This appendix presents assessments highlighting the short-comings of existing ODMDSs (the Interim site and Section 103 site) and develops analyses that support the optimal selection of new ODMDS locations. Appendix B was compiled during August-October 1997 and revised in January 2001.

Two new ODMDSs (North site and South site) are proposed. Each site is capable of providing at least 20-years of capacity for dredged material disposal. The proposal for two sites is based on the need to provide disposal capacity and to accommodate operational flexibility. Additional consideration was given to providing enough ODMDS area for distributing dredged material to a relatively thin (vertical) accumulation on an annual basis, if needed. This approach was considered for minimizing the vertical accumulation resulting from repeated disposal at one location. The proposed North and South ODMDSs are located offshore of the existing sites, at an average water depth of 135 ft, and within the 3-mile zone of siting feasibility.

Siting criteria used to assess new ODMDSs are discussed. Physical assessments of open water dredged material disposal are performed with regard to the insitu conditions at proposed ODMDS sites. Potential physical impacts resulting from the longterm use of the proposed North and South ODMDSs are identified.

Appendix B is composed of 9 sections. Section 1 describes the relevant navigation project features at Newport, Oregon (Yaquina Bay). Section 2 reviews the life cycle of Yaquina Bay ODMDSs and identifies deficiencies of existing ODMDSs. Section 3 assesses bathymetric change at existing ODMDSs and related affects on the local wave climate. Section 4 identifies the need for new larger ODMDSs and formulates site selection criteria necessary for successful long-term ODMDS management. Section 5 describes the fate modeling approach used to select the new ODMDS. Section 6 proposes ODMDS sites based on the fate modeling results. Sections 7 and 8 describe the oceanographic process affecting Yaquina Bay ODMDSs. Section 9 describes relevant geologic resources at existing and proposed ODMDS locations.

Ocean Dredged Material Disposal Sites at Yaquina Bay

# Utilization of Existing ODMDSs And Proposed New ODMDS

## Section 1
## INTRODUCTION

### Entrance to Yaquina Bay - Physical Setting

The Yaquina River enters the Pacific Ocean near the city of Newport, Oregon, approximately 115 miles south of the Columbia River (figure 1). Yaquina Bay is the fourth largest estuary in Oregon in terms of area . The estuary is fed mainly by the Yaquina River, which drains 253 square miles and is 59 miles long from its mouth to headwaters. The river's annual discharge is marked by a high seasonal variability, typically ranging from 100 cubic feet per second (cfs) to 2,500 cfs. Highest discharges occur during November through February due to rain runoff . Lowest flows occur during July through September [USGS 1990]. The tidal prism of the Yaquina River estuary is about 40 $mi^2$-ft [Jarrett 1976].

The shoreline and nearshore vary from wide sand beaches to rocky headlands. Offshore rocks and neritic reefs attest to the retreat of the coastline from erosive ocean forces. Part of this shoreline 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.

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 nearshore sands are less than one million years old. Coastal rivers deposited some of the these sands when sea level was lower (>6,000 years ago). Other sources include erosion from rock outcrops and bluffs as sea level rose and fell. Little, if any, sand is presently escaping from coastal estuaries. In fact, the Yaquina Bay estuary is being filled by marine sand entering from the ocean and deposition of fluvial sediment entering the estuary from upland sources [Komar 1997]. In the nearshore area, wave energy has removed any fine silts and clays from sediments leaving only medium-fine sand covering an area 3 to 10 miles offshore along much of the Oregon coast.

The continental shelf off Oregon is widest from Siuslaw River to Siletz Bay, extending over 30 miles offshore. This is due to a large rocky outcrop complex (Stonewall Bank) beginning about 15 miles offshore of Yaquina Bay and trending southwest (refer to figure 22). Little silt and clay is found inshore of this bank and sediments are predominantly fine sand out to depths of 300 feet. This sand zone narrows rapidly south of Siuslaw River and less rapidly north of Yaquina Bay. In three dimensions, this inner shelf sand zone is a wedge

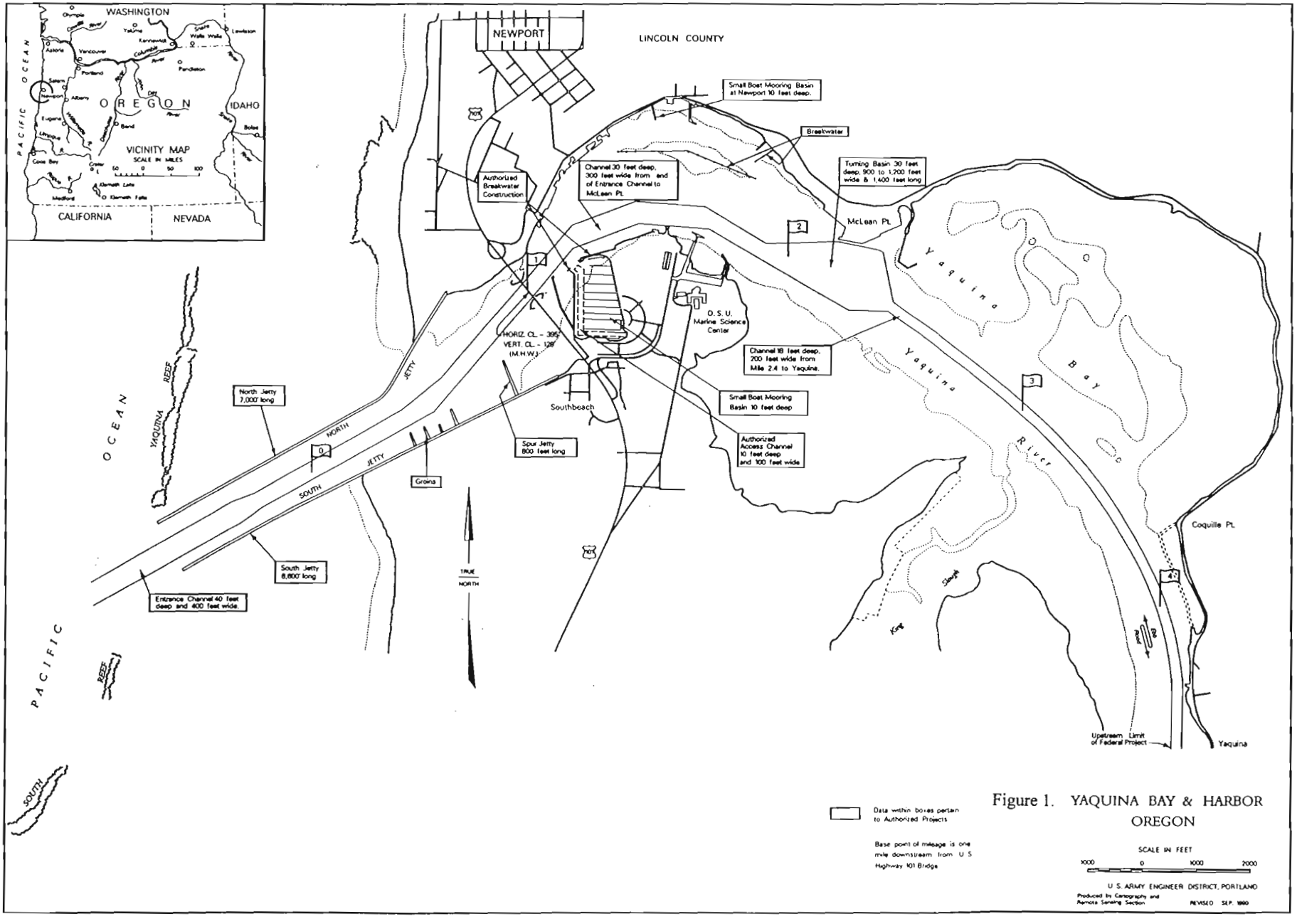



Figure 1. YAQUINA BAY & HARBOR OREGON

or lens of sediment overlying much older rock. See Section 9 - *Geologic Resources* for additional discussion of seabed and related geological characteristics.

## Yaquina Bay Navigation Project Background

The deep draft navigation project located at the ***Yaquina Bay*** consists of a dredged entrance channel 40 ft deep, 400-foot wide, and 4,280 ft long which extends through a jettied entrance between the Yaquina River and the Pacific Ocean (figure 1). A smaller channel (30 ft deep and 300-foot wide) continues from the landward end of the entrance channel (river mile 0) and proceeds 2 miles northeast into Yaquina Bay, where the channel leads to a 1,200 ft wide turning basin at Mclean Point.

The process of maintaining a jettied navigation channel at an estuary entrance such as Yaquina Bay involves the periodic relocation of sediment that shoals within the entrance channel. The activity of removing shoaled sediment is called *dredging*. At the ocean entrance to Yaquina Bay, the shoaled sediment is marine sand and originates from littoral areas on the ocean-side of the entrance. Shoaling of sediment within the navigation channel is driven by waves and currents, and occurs throughout the year. The dredged sediment is placed into designated ocean dredged material disposal sites (ODMDS) that are located in open water within 1-2 miles of the entrance channel. Dredging is typically performed during the summer, when ocean waves are small and dredging can be safely performed at the jettied entrance channel.

Federal navigation improvements at Yaquina Bay began in 1879, when Congress authorized the Portland District USACE to begin construction of the south jetty. In 1896, the north jetty was constructed, with the intention of maintaining a 12-foot project depth over the entrance bar. The natural channel had averaged about 7 feet deep and shifted frequently both during and between seasons. Appreciable quantities of sediments have been dredged from Yaquina Bay and the entrance channel since 1928, when consistent dredging was initiated to establish and maintain an 18-foot deep channel across the entrance bar.

In 1949, the entrance channel was deepened to 26 ft. Additional entrance channel deepening to 40 feet was authorized in 1958 and completed in 1969. Presently, the north jetty is 1.3 miles long and the south jetty is 1.6 miles long.

Typically, the Yaquina Bay deep draft project has two main shoaling areas. The sediment dredged from the 40-foot deep entrance channel and associated bar crossing is composed of fine-medium sand (median grain size is 0.18 mm with fines content less than 2%) and accounts for 95% of the annual dredging volume. The interior 30-foot channel (and turning basin) accounts for 5% of the total annual dredging and dredged material properties are more variable, than the entrance channel and bar [see section 8 of this appendix]. In its present configuration, the entrance channel and bar, interior channel, and turning basin require annual average dredging of 310,000 cubic yards (cy) of shoaled sediment (fine-medium sand with some silt) to maintain the authorized

## DREDGED MATERIAL DISPOSAL AT YAQUINA BAY ODMDSs SINCE 1928

Volume in Cubic Yards (CY) of Fine-Medium Sand (dredge logs)

| YEAR | Dredging Vessel | Life-cycle Period | ODMDS LOCATION Interim | Sec 103 | Year Total |
|---|---|---|---|---|---|
| 1928-1940 * | | | 80,000 | | 960,000 |
| 1941-1967 * | | | 200,000 | | 5,200,000 |
| 1968-1981 * | | | 460,000 | | 5,980,000 |
| 1982 | Yaquina<br>Westport | | 81,190<br>249,990 | | 331,180 |
| 1983 | Yaquina<br>Westport | | 103,325<br>349,994 | | 453,319 |
| 1984 | Yaquina<br>Westport | | 99,850<br>570,923 | | 670,773 |
| 1985 | Padre Island | | 302,764 | | 302,764 |
| 1986 | Yaquina<br>Atchafalaya | | | 32,236<br>210,232 | 242,468 |
| 1987 | Yaquina<br>Westport | | | 187,257<br>350,586 | 537,843 |
| 1988 | Yaquina<br>Newport | | | 101,451<br>223,068 | 324,519 |
| 1989 | Yaquina<br>Padre Island | | | 57,296<br>276,511 | 333,807 |
| 1990 | Yaquina<br>Padre Island | | | 43,362<br>173,334 | 216,696 |
| 1991 | Yaquina | | | 316,956 | 316,956 |
| 1992 | Yaquina | | | 321,652 | 321,652 |
| 1993 | Yaquina | | | 358,407 | 358,407 |
| 1994 | Yaquina | | | 206,971 | 206,971 |
| 1995 | Yaquina | | | 393,641 | 393,641 |
| 1996 | Yaquina | | | 314,636 | 314,636 |
| 1997 | Yaquina | | | 370,000 | 370,000 |
| 1998 | Yaquina<br>Newport | | | 201,000<br>150,000 | 351,000 |
| 1999 | Yaquina<br>Westport | | | 165,000<br>95,000 | 260,000 |
| 2000 | Yaquina | | | 105,000 | 105,000 |
| | | Total: 1928-1981 | 12,140,000 | | |
| | | Total: 1982-2000 | 1,758,036 | 4,653,596 | 6,411,632 |
| | | **Total: 1928-2000** | **13,898,036** | **4,653,596** | **18,551,632** |
| | | Average for 1928-1981 | | | **229,057** |
| | | Average for 1982-1985 | | | **439,509** |
| | | Average for 1986-2000 | | | **310,240** |

* = Volumes are approximate and are estimated based on USACE records (80,000 cy/yr for 1928-1940, 200,000 cy/yr for 1941-1967, and 460,000 cy/yr for 1968-1981). Placement was at or in vicinity of the Interim ODMDS.

*Westport, Padre Island, and Atchafalaya* = contractor (split-hull) dredge

*Yaquina* = government (bottom-door) hopper dredge.

Table 1. Volume of Dredged Material Placed at Yaquina Bay ODMDSs.

depth. The above annualized dredging volume is based on an average for 1986-2000. The amount and frequency of maintenance dredging depends on the volume of sediments transported into the project area by storm conditions. The sandy dredged material is placed in EPA-designated ocean dredged material disposal sites (ODMDS). Dredging and disposal of dredged material is performed by hopper dredges.

## Ocean Dredged Material Disposal Sites

The consistent use of an ocean site for disposal of sediment dredged from Yaquina Bay began in the 1920's and has continued to the present. Prior to EPA *Interim* site designation in 1977, the location of the ocean disposal site was not precisely specified and the placement of dredged material within the disposal site was not strictly controlled, in terms of vessel positioning. The volume of dredged material placed at Yaquina Bay ODMDSs since 1928 is summarized in table 1.

In January 1977, the Yaquina Bay ocean disposal site received *interim* designation when EPA issued the final Ocean Dumping Regulations (40 CFR 228). At this time, the *Interim* site was classified as an ocean dredged material disposal site (ODMDS). At the time of interim site designation, the boundaries for the rectangular ODMDS was fixed geographically in terms of corner coordinates. Figure 2 denotes the boundaries for the EPA *interim*-designated disposal site (solid line). The *Interim* ODMDS was "sized" based on the policy of minimizing the areal extent over which dredged sediments would affect the receiving water column and seabed during disposal. Smaller sites were considered more environmentally acceptable than larger sites.

A Corps-sponsored site evaluation report [USACE 1985] prepared in April 1985, recommended final EPA-approval of the *Interim* ODMDS. In late 1985, it became apparent that significant mounding of dredged sediments placed at the *Interim* ODMDS was occurring. The mounding was affecting incoming waves, resulting in unstable (breaking) wave conditions at the jetty entrance to Yaquina Bay. The mounding of dredged placed material was completely unexpected and was contrary to the assumptions advanced in the USACE 1985 site evaluation report.

To avert additional dredged material mounding and wave-related impacts at the *Interim* site, the Portland District selected a new (temporary) ODMDS under the section 103 authority of the MPSRA (figure 2). The *Section 103* ODMDS, situated north of the *Interim* ODMDS, has been used for dredged material disposal since 1986 (no dredged material was placed in the *Interim* ODMDS until 1999). By 1995 it became apparent that dredged material was accumulating within the *103* ODMDS and as of 1998 a significant mound feature was forming within the site. To avert additional mounding with the *Section 103* site, the *Section 103* site was expanded in 1999 - southward into the previously used *Interim site* in 1999 (material previously placed within the *Interim* site had been completely dispersed by 1999). Since 1999, use of the Section 103 site (the only disposal site available) has been reduced to the minimum necessary, due to concerns of mounding. This has limited the volume of dredging that can be performed at Yaquina Bay entrance.

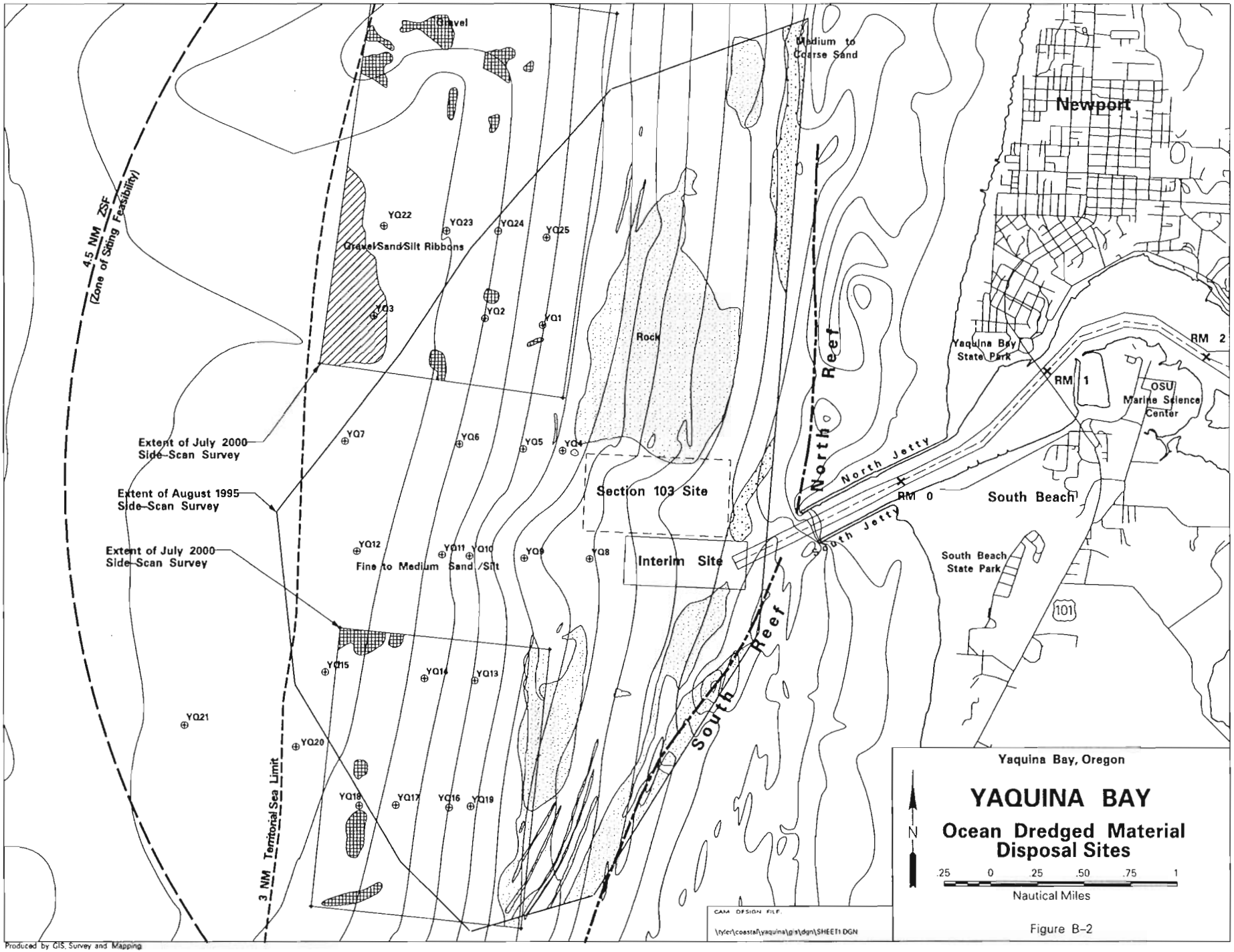

Gravel
Medium to Coarse Sand
Newport
4.5 NM ZSF (Zone of Siting Feasibility)
YQ22
YQ23
YQ24
YQ25
Gravel/Sand/Silt Ribbons
YQ3
YQ2
YQ1
Rock
Yaquina Bay State Park
RM 2
RM 1
OSU Marine Science Center
North Reef
North Jetty
Extent of July 2000 Side-Scan Survey
YQ7
YQ6
YQ5
YQ4
Section 103 Site
RM 0
South Beach
Extent of August 1995 Side-Scan Survey
South Jetty
Extent of July 2000 Side-Scan Survey
YQ12
YQ11
YQ10
YQ9
YQ8
Fine to Medium Sand /Silt
Interim Site
South Beach State Park
101
South Reef
YQ15
YQ14
YQ13
YQ21
YQ20
YQ18
YQ17
YQ16
YQ19
3 NM Territorial Sea Limit
Yaquina Bay, Oregon
YAQUINA BAY
Ocean Dredged Material Disposal Sites
N
.25 0 .25 .50 .75 1
Nautical Miles
CAM DESIGN FILE
\tyler\coastal\yaquina\gis\dgn\SHEET1.DGN
Produced by GIS, Survey and Mapping

Figure B-2

# Section 2
# MANAGEMENT OF YAQUINA BAY ODMDSs

Two ODMDSs have been utilized by the Portland District for disposal of sediments dredged from the Yaquina Bay navigation project (table 1). Prior to 1986, only the *Interim* ODMDS had been used. In 1986 the *103* ODMDS was selected and used in place of the *Interim* site to increase disposal site capacity and reduce hazards associated with the mounding of placed dredged material at the *Interim* site. In 1998, mounding of placed dredged material within the *103* ODMDS became an issue of concern motivating the need for a new and much larger ODMDS. Note that from 1928-1981, 12 million cy (mcy) of dredged material had been placed at (or within the vicinity of) the *Interim* ODMDS resulting in little mounding of placed dredged material. During 1982-1998, there was 1.7 mcy placed at the *Interim* ODMDS and 4.6 mcy placed at the *103* ODMDS, resulting in pronounced mounding of dredged material within both sites.

Dredged material mounding at the Yaquina Bay ODMDSs has been attributed to changes in disposal site utilization. The rationale for ODMDS management has changed significantly since the initial use of an ocean disposal area in 1928. The transition in ODMDS management at Yaquina Bay is characterized by three (3) important shifts in USACE and EPA policy which are outlined below.

## Yaquina Bay Ocean Dredging Disposal Before 1977

Prior to formal designation of the *Interim* ODMDS in 1977, the offshore dredged material disposal area was located only in terms of approximate location and areal configuration. Placement of dredged material within the disposal area was governed by the need to minimize dumped dredged material being transported back into the navigation channel and minimize haul distance. Mounding did not appear to be a concern due to the spatial variability of dredged material disposal within a given site: The site boundaries were not fixed and it was not required to place material strictly within the disposal site. The operational "flexibility" of disposal site boundaries and vessel control during material placement resulted in a higher degree of dredged material dispersal than at present. Prior to 1977, dredged material was placed over a wider areal expanse than the configuration of the ODMDS indicate.

## Yaquina Bay Ocean Dredging Disposal: 1977 to 1985

Between 1977 and 1985, management of the offshore dredged material disposal site at Yaquina Bay was characterized by the transition from unregulated dredged material disposal to a regulated program. In January 1977, the active ocean disposal site at Yaquina Bay received interim designation as an ODMDS when EPA issued the final Ocean Dumping Regulations (40 CFR 228). The *Interim* ODMDS configuration was governed by the requirement to minimize the benthic area of impact due to openwater disposal of dredged sediments. The areal size of the *Interim* ODMDS at Yaquina Bay was based on:

ODMDS length = average dumping run for one dump
= (disposal vessel speed while dumping) **x** (time to empty disposal vessel)

ODMDS width = average turn during one dump = disposal vessel turning radius while dumping

ODMDS long axis orientation = preferential approach-heading during dredged material disposal. (site orientation is set by disposal vessel operators and is based on dumping efficiency and vessel sea-keeping due to incident wave direction)

The lineal dimensions, boundary coordinates, and water depth variation for the *Interim* ODMDS are described below. Disposal boundary coordinates are in state plane, Oregon north zone, NAD 27 (ft). Geographic coordinates are in NAD27. These boundaries apply to present *Interim* ODMDS configuration, as shown in figure 2.

***"Interim"*** ODMDS : dimensions = 3,600 ft x 1,400 ft, azimuth = 270°, average depth = 60 ft
1996 elevation variation = -72 MLLW to -42 MLLW

| | | | |
|---|---|---|---|
| Northwest corner - | Easting=1,062,478 ft, | Northing=364,249 ft | Lat=44 36 31 N, Lng= -124 06 04 W |
| Northeast corner: - | Easting=1,065,939 ft, | Northing=364,146 ft | Lat=44 36 31 N, Lng= -124 05 16 W |
| Southwest corner: - | Easting=1,062,411 ft, | Northing=362,885 ft | Lat=44 36 17 N, Lng= -124 06 04 W |
| Southeast corner: - | Easting=1,065,879 ft, | Northing=362,730 ft | Lat=44 36 31 N, Lng= -124 05 16 W |

The *Interim* ocean disposal site was intended to receive final EPA designation as an ODMDSs in August 1986, but did not due to the rapid accumulation of placed dredged material between 1982 to 1985. The unintended consequence of using the aerially restricted *Interim* ODMDS has been creation of potentially adverse impacts to navigation at the Yaquina Bay entrance, by mounding of placed dredged material. The reason for dredged material mounding in the *Interim* site was not associated with increased dredging/disposal volumes. The average annual volume of dredged material placed in the *Interim* ODMDS between 1982 and 1985 was 439,000 cy/year, which is lower than the 14-year year average of 460,000 cy/yr previous to 1982. The reason for rapid accumulation (mounding) of dredged material within the *Interim* ODMDS has been attributed to two factors:

(A) The restriction of dredged material disposal within relatively small EPA-designated ODMDSs, rather than in larger unconfined areas and in a dispersive manner of placement.

(B) Increased use of contractor operated split-hull hopper dredges in 1982, which enhanced the vertical extent of dredged material placed on the seabed within the ODMDSs.

Prior to the 1982, sediment dredged at the Yaquina Bay and placed in the ODMDS was accomplished using government hopper dredges. ***Government*** hopper dredges utilize a series of "doors" located on the hull bottom to release each load of dredged material. The bottom doors are sequentially opened during disposal until the entire load of dredged material is released form the vessel, resulting in a gradual release of dredged material from the vessel.

Between 1982 and 1985, more than 80% of the material dredged at Yaquina Bay was accomplished using contractor split-hull hopper dredges. ***Contractor*** split-hull hopper dredges release their load of dredged material by opening (splitting) the entire hull of the vessel. The split-hull method of disposal is more rapid than bottom-door hopper dredges. While the use of split-hull hopper dredges reduces the time required for material disposal, split-hull dredges reduce the horizontal dispersal of dumped dredged material on the seabed while increasing the vertical extent of accumulation per dump.

In addition to the type of hopper dredge used, the capacity (volume per dump) of the hopper dredge also affects the amount of vertical accumulation. Since 1982, the bottom-door hopper dredge *Yaquina* (capacity = 850-1000 cy) has been used as the government dredge at Yaquina Bay. Between 1982-1984, the split-hull dredge *Westport* (capacity = 1,000 cy) was used as the contractor dredge at Yaquina Bay. Beginning in 1985, larger split-hull dredges such as the *Padre Island* and *Newport* (capacity = 2,600 cy) were used as the contractor dredge.

To comply with the Ocean Dumping Regulations (40 CFR 228), the Portland District contract specifications required dredges to place dredged material entirely within the ODMDS boundaries. The ODMDS corner coordinates and a single disposal location (coordinate or buoy) were given as a reference for disposal position within the ODMDSs. Conceptually, placement of dredged material was done randomly at some "radius" about the assigned disposal point. Dredged material was usually placed on the side of the disposal area (or specified disposal point) closest to the location of dredging, to shorten the haul distance. This effectively minimized the aerial extent over which dredged material was dispersed within the ODMDS. This method of dredged material disposal is referred to as "point-dumping". Point-dumping enhanced the vertical accumulation of dredged material within a small area of the ODMDS.

In 1985, mounding of dredged material at the *Interim* ODMDS began causing incoming waves to shoal and break at the approaches to the jettied entrance channel of Yaquina Bay. Numerous reports by the commercial and private mariners and the Coast Guard had implicated the dredged material mounding to the hazardous wave conditions at the jettied entrance.

## Yaquina Bay Ocean Dredging Disposal: 1986 to Present

The *Interim* ODMDS which was designated by EPA in 1977 was not given "final" approval by EPA in 1986, as recommended by a Portland District report compiled early in 1985 [USACE 1985]. Rather, another ODMDS was selected by the Portland District under the Section 103 authority of MPRSA. The *103* ODMDS was located directly north of the *Interim* site in an average water depth of 70 ft (10 ft deeper than the *Interim* site). The *103* ODMDS was sized with 80% greater area than the *Interim* site. The lineal dimensions, boundary coordinates, and water depth variation for the *103* ODMDS are described below. Disposal boundary coordinates are in state plane, Oregon north zone,

NAD 27 (ft). Geographic coordinates are in NAD27. These boundaries apply to present *103* ODMDS configuration, as shown in figure 2.

***"103"*** ODMDS : dimensions = 4,070 ft x 2,220 ft, azimuth = 270°, average depth = 70 ft
1996 elevation variation = -90 MLLW to -50 MLLW

| | | | |
|---|---|---|---|
| Northwest corner - | Easting=1,061,352 ft, | Northing=366,679 ft | Lat=44 36 32 N, Lng= -124 06 21 W |
| Northeast corner: - | Easting=1,065,463 ft, | Northing=366,501 ft | Lat=44 36 54 N, Lng= -124 06 21 W |
| Southwest corner: - | Easting=1,061,249 ft, | Northing=364,459 ft | Lat=44 36 32 N, Lng= -124 05 24 W |
| Southeast corner: - | Easting=1,065,372 ft, | Northing=364,276 ft | Lat=44 36 54 N, Lng= -124 05 24 W |

Beginning in 1986, all sediment dredged from the Yaquina Bay deep draft navigation channel was placed within the *103* ODMDS. Additionally, disposal site management became increasingly proactive in the year to year operation of the Yaquina Bay ODMDSs. Proactive disposal site management was required to maximize site capacity utilization of the Corps-designated *103* ODMDS and minimize mounding within the site. Refer to Section 4 of this appendix for definition of ODMDS capacity. Important facets of ODMDS management now include consistent site monitoring and uniform distribution of dredged material within the entire site during placement.

## Recent Management Actions for Yaquina Bay ODMDSs

Bathymetric surveys serve as the method of choice to monitor the physical environment at ODMDSs. Consistent annual bathymetric surveys have been conducted at Yaquina ODMDSs and vicinity since 1983; the x,y,z data have been digitally stored. The annual monitoring is necessary to track bathymetric change at the ODMDSs, ensure that the Corps of Engineers does not un-intentionally worsen a mounding problem, or place dredged material outside of the active ODMDS boundaries.

Since 1997, bathymetric monitoring of the *103* ODMDS has been used to direct the location of dredged material disposal within the site and avoid "hitting" high spots created by the previous years' disposal operation. Despite the effort to evenly distribute dredged material within the *103* ODMDS, dredged material has slowly accumulated within this site since 1986 when the *103* ODMDS was first used. While exclusively utilizing the *103* site for dredged material disposal between 1986 and 1996, the mound at the *Interim* ODMDS was completely dispersed by waves and currents to an elevation consistent with the ambient seabed .

In 1995, shoaling (breaking) waves associated with mounding at the *103* ODMDS were reported by fishermen and the US Coast Guard. Bathymetric surveys of the *103* ODMDS indicated the formation of a mound within the site. In 1998, the size of the dredged material mound in the *103* ODMDS was sufficient to warrant adjustments to site management. See Section 3 of this appendix for an analysis of mound-induced wave amplification at Yaquina Bay ODMDSs. Since 1998, use of the 103 ODMDS has been

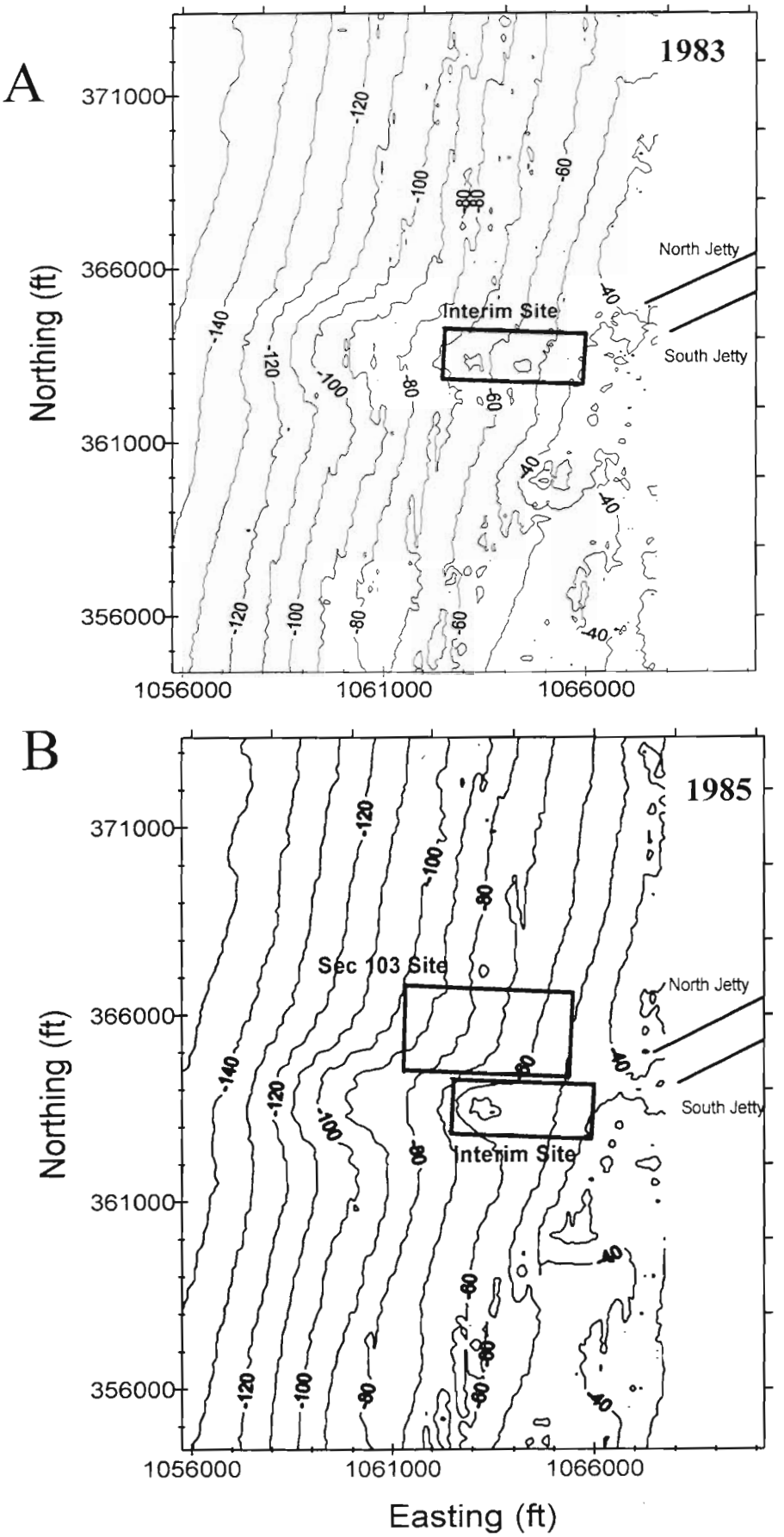



Figure 3. Approach and ODMDS bathymetry offshore of Yaquina Bay for 1983 (A) and 1985 (B)

restricted to isolated areas that have not exhibited mounding: By 2001, it is estimated that the 103 ODMDS will have no capacity for receiving additional dredged material.

# Section 3
# PAST BATHYMETRIC CHANGE AND RELATED IMPACTS AT YAQUINA BAY ODMDSs

This section discusses site specific bathymetric ***change*** at Yaquina Bay ODMDSs, in terms of the accumulation (or mounding) of dredged material placed within the sites. The change in wave conditions at the Yaquina Bay entrance due to the dredged material mounding is also discussed.

## *Interim* ODMDS

Prior to formal designation of the *Interim* Yaquina Bay ODMDS in 1977, approximately 10.6 million cy of dredged sediment had been placed within or in vicinity of the *Interim* ODMDS. Between 1977 and 1981, approximately 1.8 million cy of dredged material was placed within the boundaries of the *Interim* ODMDS. During this time, no mounding of dredged material was reported or observed within the *Interim* site boundary. Prior to 1982, dredged material was placed using government-operated multiple bottom-door hopper dredges.

Between 1982 and 1985, approximately 1.8 million cubic yards of dredged material was placed within the western half of the *Interim* ODMDS boundaries; 88% of which was placed by Contractor-operated split-hull hopper dredges. The baseline condition (1983) bathymetry for Yaquina Bay ODMDSs and vicinity is shown in the top of figure 3. In 1985, significant mounding of dredged material was observed within the western half of the *Interim* ODMDS as shown in the bottom of figure 3 and top of figure 4.

The top graphic of figure 4 shows the "difference" between the 1983 survey and the 1985 survey. The mound feature associated with 3 years (1983-1985) accumulation of dredged material disposal was 20 ft high and 1,800 ft wide at the base with respect to the 1983 site bathymetry. Note that 1,430,000 cy was placed within the *Interim* ODMDS between 1983-1985 (annualized average of 477,000 cy/yr). Approximately 780,000 cubic yards was estimated to have been contained within the 20-foot high mound, or 55% of the total placed between 1983 and 1985. The other 45% of dredged material unaccounted was likely dispersed by waves and currents to a thickness below the survey detection threshold (±1.5 ft). This dispersion rate translates into 214,000 cy/yr, which defines the estimated "dynamic" capacity of the *Interim* ODMDS (the volume that can be placed per year without accumulating, refer to Section 4 for capacity definitions). Note that the above estimated dispersion rate is based in part on the presence of the dredged material mound. Waves and currents interact with the mound to enhance dispersion: The higher the mound for a given water depth, the greater the potential sediment dispersion rate. Dispersion of dredged material placed on a "flat" bottom at the *Interim*

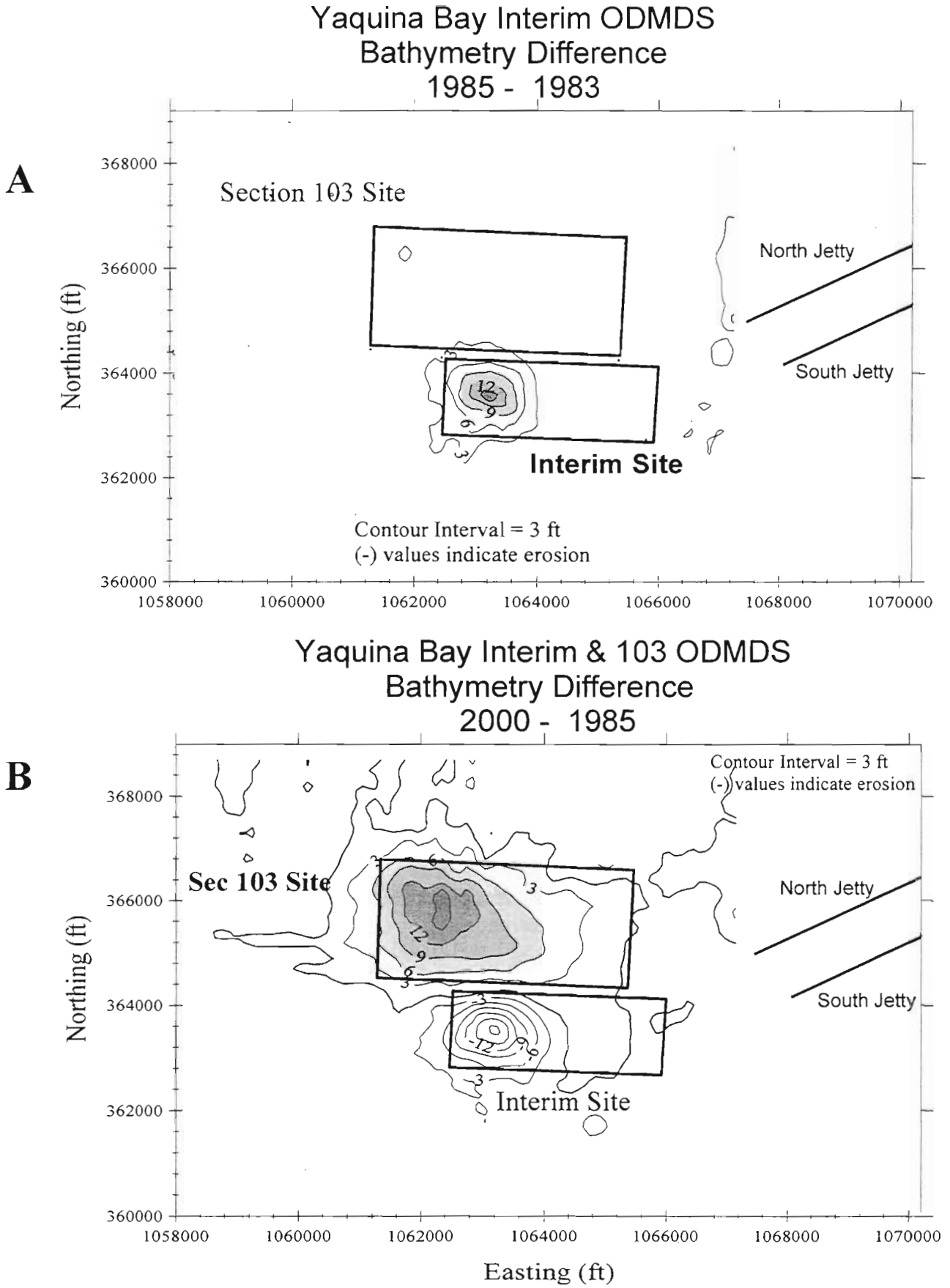



Figure 4. Bathymetric change at Yaquina ODMDSs during 1983 and 2000. Top graphic (A) is bathymetry change for 1983-1985. Bottom graphic (B) is bathymetry change for 1985 to 2000.

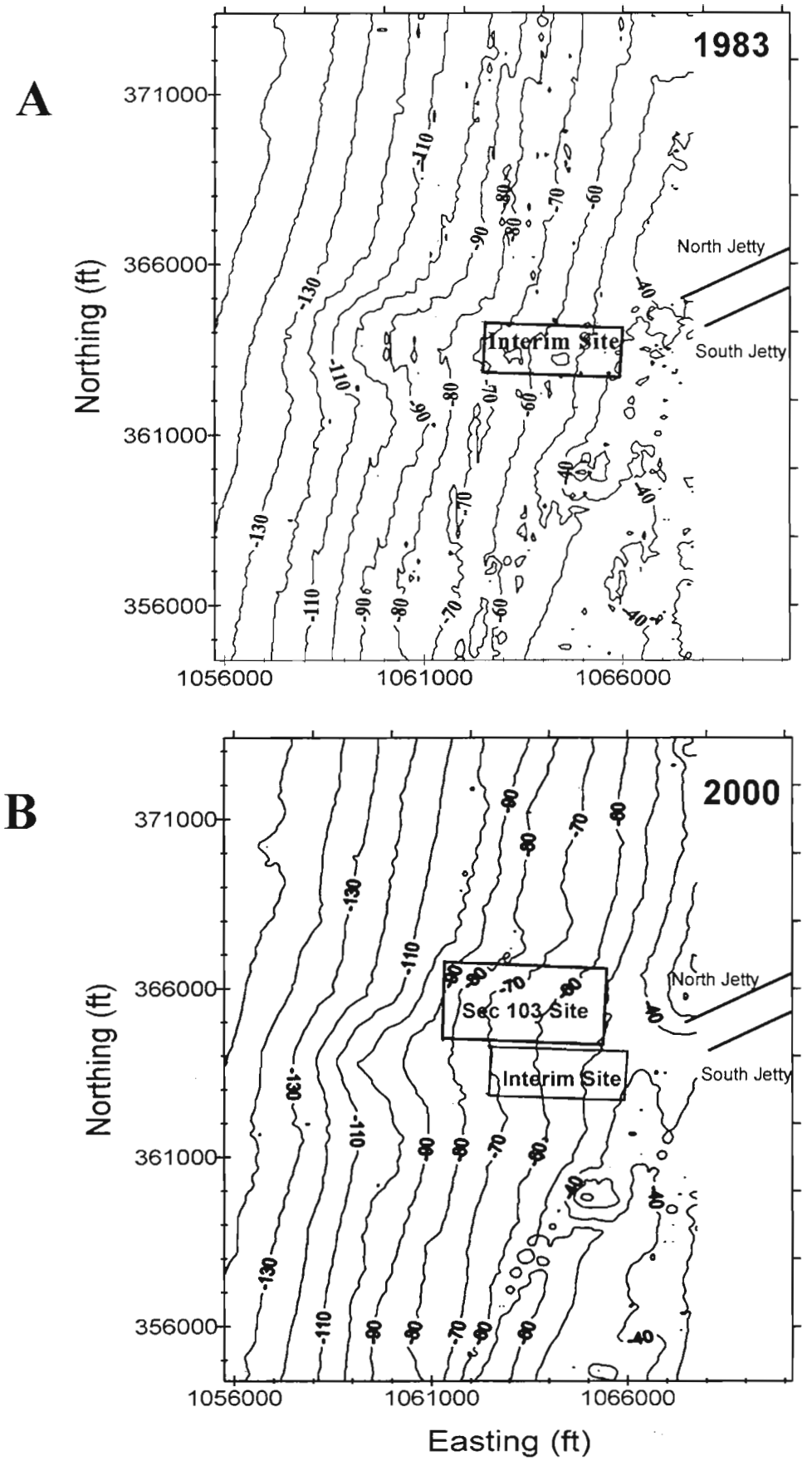



Figure 5 . Approach bathymetry offshore Yaquina Bay for 1983 (A, top) and 1999 (B, Bottom)

ODMDS would likely be significantly less than on a "mounded" bathyemtry. Despite the dispersiveness of the *Interim* ODMDS, rapid accumulation of dredged material occurred during 1983-1985. This is because the volume of dredged material placed at the *Interim* ODMDS during 1983-1985 exceeded the site's dispersive capacity (i.e. 477,000 cy/yr was "placed" vs. 214,000 cy/yr "dispersed") resulting in the formation of a pronounced mound, approximately 20 ft high.

The rapid accumulation of dredged material at the *Interim* site indicates that changes in ODMDS management likely contributed to the mounding of placed material between 1982-1985. Initially, the "stage was set" in 1977 when the disposal of dredged material was formally restricted to the boundaries of ODMDSs. During 1982-85, the extensive use of Contractor-operated split-hull hopper dredges and point-dumping within the confines of the *Interim* ODMDS resulted in rapid accumulation of dredged material within the site (i.e. mounding). In 1985, the placement of dredged material disposal within the *Interim* ODMDS was halted due to concern of potential wave shoaling associated with the dredged material mound.

By 1999, the mound within the *Interim* ODMDS was completely obliterated (negative contour values shown in the bottom graphic of figure 4). In fact, complete dispersal of the *Interim* ODMDS mound was achieved by 1990. Note that the *Interim* site is aligned with the Yaquina Bay jetty entrance. The high dispersion rate of the *Interim* ODMDS appears to be due to localized currents generated by the Yaquina Bay jetties. The jetties act to funnel the Yaquina Bay estuarine (ebb tide) flow over the *Interim* site. Additionally, the jetties act on the littoral current redirecting the littoral current oceanward over the *Interim* site. The direction of sediment transport at the *Interim* site could not be inferred from observed bathymetry change. Based on the curvature of the –90 to –130 ft contours (bottom figure 5), it is likely that some of the dredged material placed within the *Interim* ODMDS was transported offshore to an undetectable thickness (±1.5 ft). The jetty intensification of the estuarine and littoral current is assumed to be the main cause for the high rate of dredged material dispersion within the *Interim* ODMDS. This assessment infers that other sites (such as the *103* ODMDS) would be expected to have a lower dispersion rate than the *Interim* ODMDS.

## *103* ODMDS

After 1985, the *103* ODMDS was used for disposal of sediments dredged from the Yaquina Bay project. Between 1986 and 2000, approximately 4.7 mcy of dredged sediment was placed within the *103* ODMDS; 30% of which was placed using Contractor-operated split-hull hopper dredges. Despite the enhanced use of a more dispersive (*government*, bottom-door) type of hopper dredge and avoidance of point dumping, progressive accumulation of placed dredged material has occurred at the *103* ODMDS. Within the *103* ODMDS, bathymetric change between the baseline condition (1983) and 1999 is shown by comparing the contours in the top and bottom of figure 5.

The mounding of dredged material that has occurred within the western half of the *103* ODMDS during 1986-2000 is shown in the bottom of figure 4 (positive values). During

1986-2000, the average annual volume of dredged material placed within the *103* ODMDS was 310,000 cy/yr. The mound feature associated with 15 years (1985-2000) accumulation of dredged material disposal was 18 ft high and 2,000 ft wide x 3,500 ft long at the base with respect to the 1985 site bathymetry. As of 2000 approximately 2.5 mcy was estimated to have been contained within the 18-foot high mound, or 53% of the total placed between 1986 and 2000. The other 47% of dredged material unaccounted was likely dispersed by waves and currents to a thickness below the survey detection threshold (±1.5 ft). This dispersion rate translates into 157,000 cy/yr, which defines the estimated dynamic capacity of the *103* ODMDS (the volume that can be placed per year without accumulating). Recall that this apparent dispersion rate is in part due to the presence of the dredged material mound within the *103* ODMDS: Without the high relief of the dredged material mound, the dispersion rate (due to waves and currents) would likely be much lower.

Despite the moderate dispersiveness of the *103* ODMDS, accumulation of dredged material occurred during 1986-2000. This is because the volume of dredged material placed at the *103* ODMDS during 1986-2000 exceeded the site's dispersive capacity (i.e. 310,000 cy/yr "placed" vs. 157,000 cy/yr "dispersed") resulting in the formation of a pronounced mound.

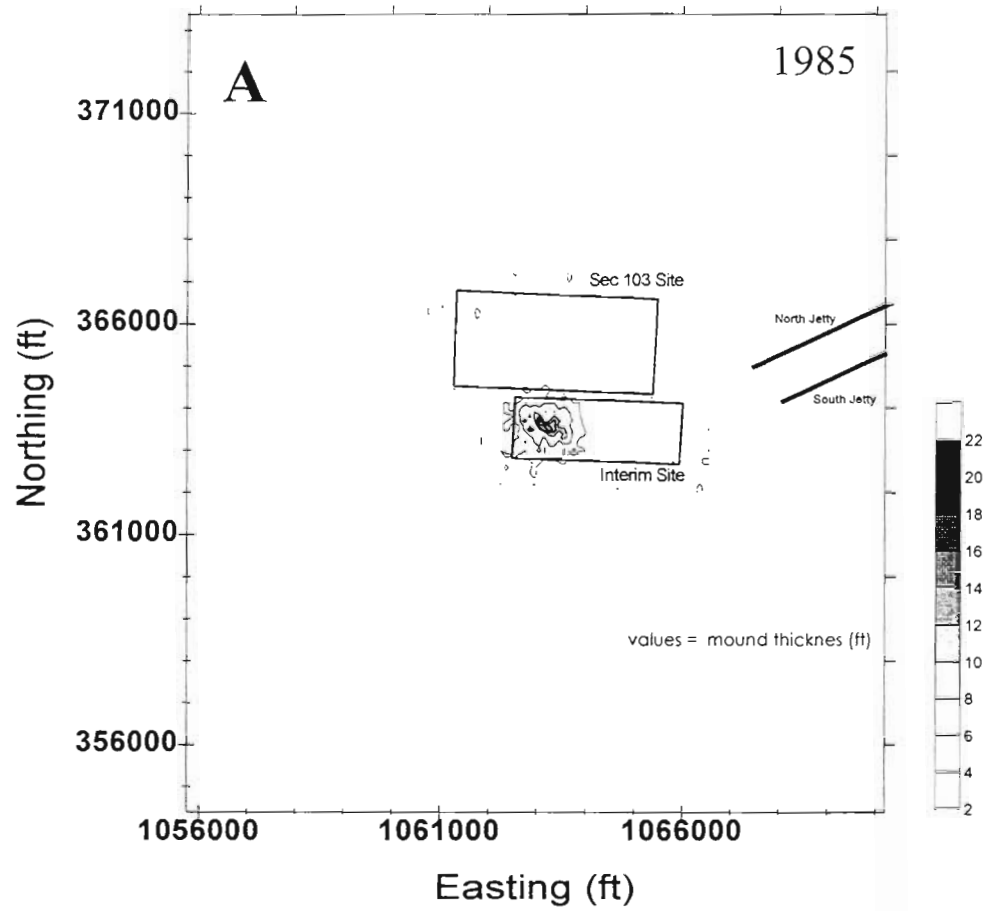
Based on the 0 contour interval (bottom caption of figure 4), it appears that dredged material dispersal at the *103* ODMDS is dependent upon location within site. Dredged material placed in the western half of the site appears to be transported to the north and west. Dredged material placed in the eastern half of the site appears to be transported to the south and east. The jetty intensification of the estuarine current (during ebb flow) is assumed to have some contribution for the moderate rate of dredged material dispersion within the *103* ODMDS. It is likely that the estuarine current is stronger in the southeastern part of the site.

**Observed Sediment Dispersion at Yaquina ODMDSs**

Table B-2 summarizes the estimated annual dispersion rate and associated bathymetric change at the *Interim* and *103* ODMDS, based on surveys obtained during 1983 to 2000. Note that the values shown in table B-2 arise from: A) The presence of the dredged material mounds within the ODMDSs, B) An energetic current and wave environment associated with a jettied estuary entrance, and C) Relatively shallow water depth. Without the high relief of a dredged material mound in shallow water near an estuary entrance, the dispersion rates at the *Interim* and *103* ODMDSs (due to waves and currents) would have been much lower.

Table B-2. Observed dispersion potential at Yaquina ODMDSs, based on survey differencing.

| Disposal Site | Observed Vertical Erosion Rate, (ft/yr) | Estimated Net Erosion Volume, (cubic yards/yr) | Average Water Depth at Erosion Area, (ft) |
|---|---|---|---|
| Interim ODMDS | 5 | 214,000 | 60 |
| Section 103 ODMDS | 3 | 157,000 | 70 |



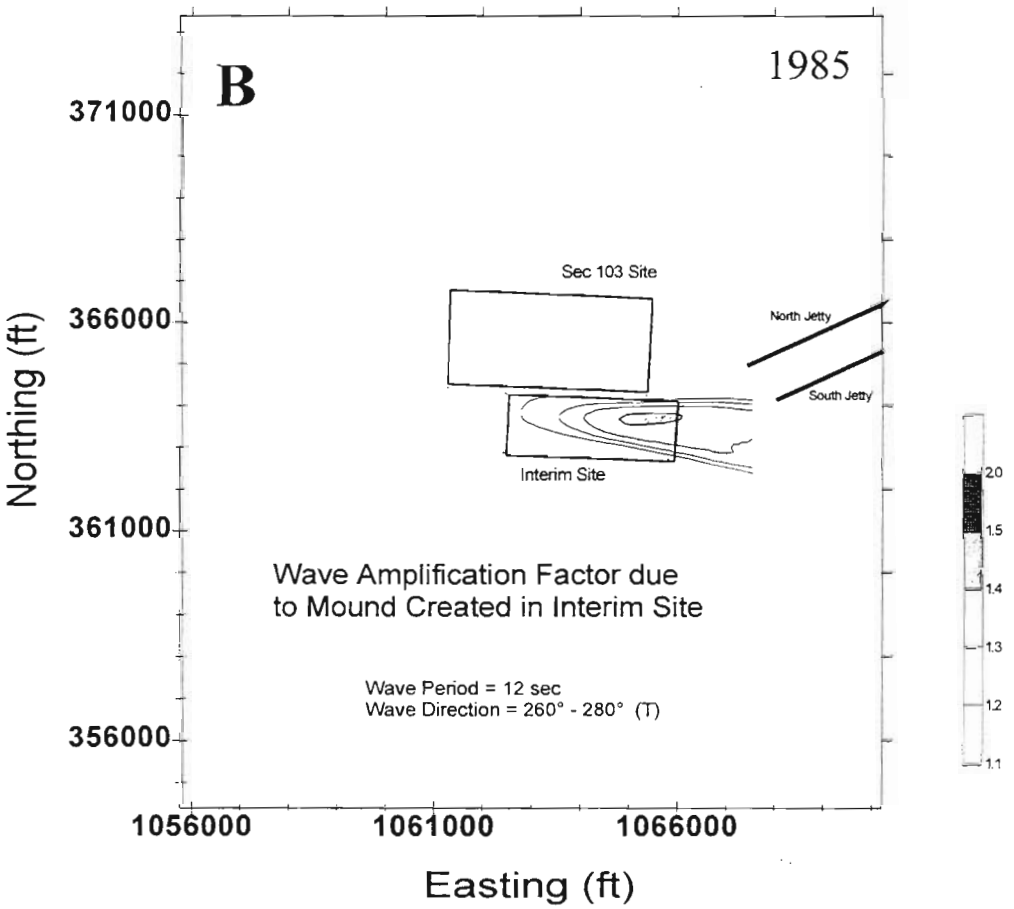




Figure 6 . Mounded Bathymetry in 1985 (Final Year of Interim Site Use) Dredging Season (A, top) and Resultant Wave Amplification for 12 second Wave Period (B, bottom).

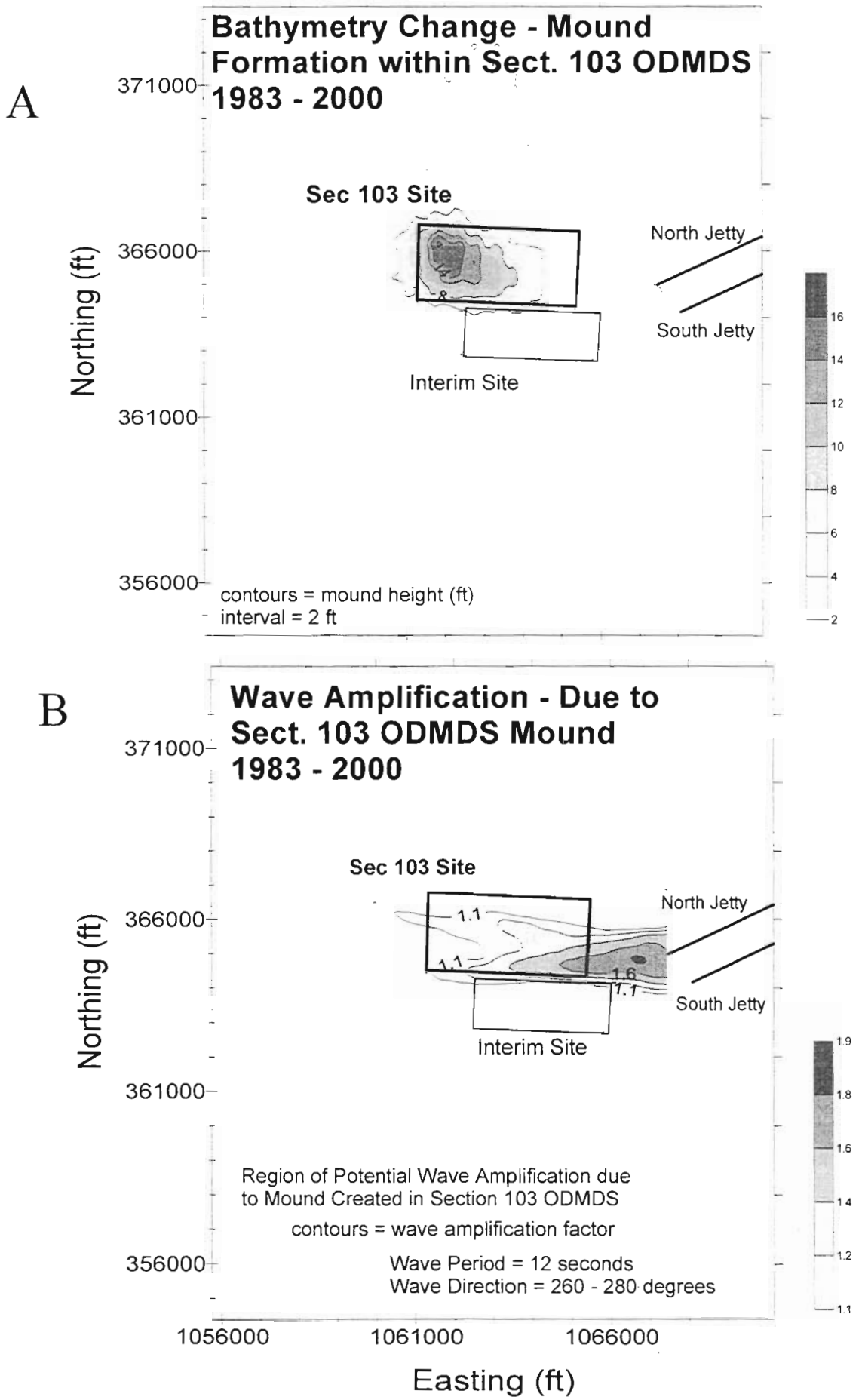



Figure 7. Mounded bathymetry within Section 103 ODMDS in 2000 (A, top) and potential amplification for 12 second waves (B, bottom).

At it's greatest extent, the volume of dredge material mound contained within the *103* ODMDS (2.5 mcy) was 3.2 times larger than the mound that had formed within the *Interim* ODMDS (780,000 cy). The 20-ft high dredged material mound that had formed within the *Interim* ODMDS during 1983-1985 was dispersed within 5 years after dredged material placement was discontinued at the site (1985). This was in accordance with the 214,000 cy/yr dispersion rate observed during 1983-1985. If use of the *103* ODMDS was discontinued in 2001, it is estimated that the 18-ft high *103* mound would be dispersed within 16 years, based on the observed dispersion rate of 157,000 cy/yr.

By comparing the erosion rates of dredged material placed at the *Interim* and *103* ODMDSs during the active periods of site use, it was estimated that the *Interim* site was 36% more dispersive than the *103* site. The higher dispersion rate for the *Interim* ODMDS is likely due to the site's shallower water depth and more direct exposure to tidal and littoral currents associated with the Yaquina jetties.

If the present *Interim* and *Section 103* sites could be relied upon for their combined full dispersive capacity ( 214,000 cy/yr + 157,000cy/yr) , those ODMDSs could hypothetically accept up to 370,000 cy/yr of dredged material. This would require that the sites maintain pronounced mounding to provide full dispersion potential: Likely, an unacceptable proposition to the navigation community.

It must be stressed that without the presence of the high-relief mounds, the rate of dredged material dispersion within Yaquan Bay ODMDSs would be significantly lower (less than half the rates shown in table B-2). While a highly dispersive ODMDS may be desirable from the standpoint of continual renewing site capacity, the presence of large dredged material mounds capable of adversely affecting navigation is not. Without the presence of pronounced mounding, the present Yaquina ODMDSs are not large enough to accommodate the placement of annual O&M dredged material (310,000 cy/yr).

## Capacity Limitations for Present ODMDSs

Since the 1980's, the volume (per year) of dredged material placed within Yaquina Bay ODMDSs has been at least twice the rate at which the dredged material was eroded out of the sites. The result has been rapid accumulation of dredged material within the ODMDSs and associated undesirable effects.

Yaquina Bay ODMDSs that were intended to be moderately dispersive, but have reached capacity within 10 years of initial designation. ODMDS capacity is defined as that quantity of material that can be placed within the legally designated disposal site without extending beyond the site boundaries or interfering with navigation [Poindexter-Rollings 1990]. Exceedence of ODMDS capacity at Yaquina Bay creates a serious operational problem for the users of the deep-draft navigation project. Dredged material within the ODMDSs has accumulated to an areal and vertical extent which creates adverse sea conditions. In some cases, mounds rise 20 ft above ambient bathymetry producing depth-limited wave conditions. Mariners report that the ODMDS "mounds" cause waves to steepen or break in vicinity of the ODMDSs. These wave conditions are hazardous to

navigation at the entrance to Yaquina Bay and may contribute to the degradation of the North jetty.

Figures 6 and 7 illustrate the creation of potentially undesirable wave conditions at the Yaquina Bay entrance due to unanticipated mounding of dredged material placed within ODMDSs.

Figure 6 documents the potential change (amplification) in wave height due to the change in bathymetry at the *Interim* ODMDS between 1983 and 1985. The top graphic of figure 6 shows the change in bathymetry within the *Interim* ODMDS. The bottom graphic shows the corresponding estimated change in wave height, in terms of an amplification factor, due to the bathyemtric change (mounding of dredged material) within the *Interim* ODMDS from 1983 to 1985. Based results shown in figure 6, the dredged material mound at the *Interim* ODMDS may have increased the height of incident waves by 40% for 12- second waves as compared to the (baseline)1983 bathymetry.

Figure 7 documents the potential change (amplification) in wave height due to the change in bathymetry at the *103* ODMDS between 1983 and 1999. The top graphic of figure 7 shows the change in bathymetry within the *103* ODMDS. The bottom graphic shows the corresponding estimated change in wave height, in terms of an amplification factor, due to the bathymetric change within the *103* ODMDS from 1983 to 2000. Based on results shown in figure 7, the present dredged material mound at the *103* ODMDS may have increased the height of incident waves by 50% for 12- second waves as compared to the (baseline)1983 bathymetry. Note that the effect of wave amplification at the *Interim* and *Section 103* ODMDS was estimated to extend into the Yaquina Bay entrance channel. The method used to estimate the above wave amplification is discussed in Section 5, *Simulating the Fate of Dredged Material Placed at ODMDSs.*

The issue of dredged material accumulating at the *Interim* ODMDS (and associated affects on wave conditions) was ***temporarily*** resolved by USACE selecting an additional ODMDS (the *Section 103* site). This was only a short term solution to the ODMDS site capacity problem at Yaquina. As of 2000, an 18 ft high dredged material mound had formed within the *103* ODMDS and is believed to be negatively affecting the wave climate at the entrance to Yaqunina Bay. By 2001, the *103* ODMDS is expected to have no remaining capacity for accepting additional dredged material. Due to past and present mounding-related problems at the *Interim* and *Section 103* ODMDSs, the local navigation community has voiced strong opposition to continued use of either site (for the purpose of dredged material disposal); whether mounds are present or not.

New Yaquina Bay ODMDS are being designated to avert additional mounding and related navigation consequences at existing ODMDSs. It is obvious, based on past experiences with the *Interim* and *103* sites, that the new ODMDS must be much larger than its predecessors to reliably handle 20-years of dredging disposal without creating additional mounding issues. The new ODMDS must be large enough to allow distribution of dredged material over a large enough area so that excessive vertical accumulation of placed dredged material is averted.

# Section 4
# SITING and MANAGEMENT REQUIREMENTS FOR NEW ODMDS AT YAQUINA BAY

The recent operational performance of the ODMDSs at Yaquina Bay indicates that past site selection objectives and management practices are unreliable. If ODMDS selection methods are unreliable, an expensive redesignation process could still result in unacceptable future conditions. The key to successful ODMDS designation and long-term management is knowing in advance (or reliably predicting) the fate of dredged material placed at the ODMDS. This is especially true if a new ODMDS is required to have the minimum dimensions necessary to provide adequate site capacity for a 20-year life-cycle.

## ODMDS Requirements

The operational requirements for future site use were assessed to ensure that expanded or new ODMDSs fulfill a minimum life-cycle of 20 years. The total volume of dredged material expected to be placed within Yaquina ODMDSs for the next 20 years is estimated to be 6.2 million cy (or 310,000 cy/yr, based on table 1). ODMDS site capacity should be sufficient to handle the expected volume of placed dredged material without negatively affecting the environment outside the ODMDS boundaries. Objectives for successful ODMDS designation and management at Yaquina Bay will:

- Provide ODMDS(s) with a combined 50-year capacity for disposal of dredged material originating from the Yaquina Bay navigation project.

- Avoid disposal of dredged material on areally limited habitats, rock outcrop (reef) areas, or on sediment (gravel or silt/clay) that is dissimilar to the dredged material.

- During the process of placing dredged material within the ODMDS, the deposition of dredge material (on the seabed) should be confined within the formal ODMDS boundaries.

- Locate the new ODMDS so that average haul distance is within the zone of siting feasibility (ZSF). The ZSF for hopper dredges is a 4.5 mile radius from RM 0.

- Avoid navigation impacts at the new ODMDS due to excessive accumulation of placed dredged material over the life-cycle of the proposed ODMDSs . Designate new ODMDSs with large areal configuration and reserve capacity. If needed, manage sub-units of the new ODMDS on an annual rotational basis to minimize cumulative environmental impacts within the ODMDS.

- If large displacement split-hull hopper dredges are used at Yaquina Bay (ie. the *Newport* @ 3,000 cy/load vs. the *Westport* @ 1,000 cy/load), attention should be focused on ensuring dispersal of dredged material during the disposal process. Large displacement dredges can produce rapid mounding of placed dredged material.

- Enhance the distribution of dredged material placed at new ODMDSs by evenly distributing dredged material on the seabed. Dredged material mound height must be managed to prevent excessive amplification of waves due to shoaling. The new ODMDS could be divided into several sub-areas and each sub-area would be used until the height of accumulated dredged material reaches the maximum vertical limit.

- Ensure that new ODMDSs conform to the five general and eleven specific criteria for the selection of ocean disposal sites (40 CFR 228.5), as specified in tables 1 and 2 of the main report .

Where the need exists and it was practical and possible, consideration was given to locating new ODMDSs in nearshore waters 60 ft deep or less, to facilitate introduction of dredged material into the littoral zone. Consideration for locating new ODMDSs nearshore was warranted, since most all sediment dredged from the Yaquina entrance channel is marine sand and originates from the adjacent littoral environment. However, due to the presence of rock outcrops (reefs) parallel to shore in water depth of 45-50 ft, this initiative was precluded from additional consideration.

## ODMDS Capacity – General Considerations

The total site capacity for a given ODMDS consists of two components; static site capacity and dynamic site capacity.

**Total ODMDS site capacity = dynamic site capacity + static site capacity**

***Dynamic*** ODMDS ***capacity*** is defined as the volume of placed dredged material which is transported out of an ODMDS, by waves and currents. The shallower a given ODMDS location, the greater its potential for dispersing placed dredged sediments and the higher its dynamic capacity. Generally, the deeper a given site, the lower its dynamic capacity. For a given water depth, dynamic capacity may be higher for areas closer to a estuary inlet (such as the *Interim* ODMDS near the Yaquina entrance), than in areas further offshore.

Dynamic capacity is specified in terms of a volume rate (cubic yards per year, cy/yr) at which sediment leaves a given site. Dynamic capacity at a given site can change with time based on changes in site bathymetry (mounding increases dynamic capacity) or changes in waves/currents (winter storms disperse more sediment than summer calm).

***Static*** ODMDS ***capacity*** is defined as the limiting volume of dredged material which can be placed within a given area before the resultant mound feature begins to have a negative impact on either navigation or the ambient environment. Navigation impacts associated with static capacity, include reducing vessel keel clearance to an unsafe margin or degrading the sea state by causing waves to steepen, amplify in height, or break. Environmental impacts associated with static capacity, include exceeding a pre-determined burial depth over the site's pre-disposal substrate or promoting downslope distribution of placed material onto areas beyond the designated ODMDS boundaries.

For the case of Yaquina ODMDSs, static site capacity is governed by the need to avoid navigation impacts. This focuses on wave shoaling constraints: Wave amplification effects on the approaches to the navigation entrance, jetties, and channel. To meet wave amplification constraints, a given ODMDS mound must not significantly amplify incident waves with respect to a baseline (pre-disposal) bathymetric condition. The wave amplification criteria is generally more restrictive than keel clearance. Generally, the shallower a given ODMDS location, the lower its static capacity and vice-versa.

## ODMDS Selection – Specific Considerations

Dredging and dredged material disposal practices at Yaquina Bay continually balance the competing interests of: Providing a safe navigation channel, minimizing adverse impacts to the environment, optimizing dredging and disposal efficiency, and using dredged material as a littoral resource (when it is practical and when required). The over-riding considerations governing the selection of a new ODMDS include the avoidance of mound-induced wave shoaling, avoidance of impacts on sensitive benthic areas (rock "reefs"), and locating the new ODMDS within the ZSF. The new ODMDS should be located away from the *Interim* and *103* sites, due to the mounding issues associated with the existing sites and attendant wave shoaling problems.

Management of new Yaquina ODMDS's will avoid the amplification of incoming waves, due to the formation of large dredged material mounds. At a minimum, new Yaquina ODMDSs should be large enough to permit the distribution of 20- to 50-years of dredged material disposal (facilitate the distribution of 6-15 million cy of dredged material on the seabed) without allowing the accumulated material to exceed a height which would cause significant wave amplification. At any given location within a proposed ODMDS, accumulation of dredged material will be controlled so that incident waves are not significantly amplified as compared to the baseline condition, due to dredged material mounding. The ***baseline condition*** for new ODMDSs refers to the bathymetry and associated wave environment BEFORE the ODMDS becomes operational (is used).

The placement strategy has a large influence on the overall impact of dredged material disposal in an ODMDS. Therefore, the size/location of the proposed ODMDS(s) must accommodate various potential site management scenarios and placement strategies; for the purpose of minimizing mounding of placed dredged material and minimizing impacts to the benthic environment (infauna/epifauna). Such management scenarios may be mutually exclusive in approach. Two examples are described below:

1) The annual operational foot-print (area affected by disposal) would be minimized. This placement method would concentrate dredged material within a small foot-print, on an annual basis, while avoiding the formation of excessively high dredged material mounds. An ODMDS would be divided into several sub-areas; each sub-area would be used on an annual rotational basis. One sub-area would be used in any given disposal year, after which the cell would be left "fallow" for a number of years until it would again be used for dredged material disposal. This would allow benthic recovery within each cell following disposal

2) The annual operational foot-print (seabed area affected by disposal) would be maximized. This placement method would distribute dredged material over a wide area annually (perhaps an entire ODMDS), minimize vertical accumulation, and promote immediate benthic recovery within the area affected by dredge material disposal. If two (2) new ODMDSs were available, each ODMDS could be used alternatively, on an annual basis. This would allow the area of an entire ODMDS to be left "fallow" for a year, similar to management scenario (1) but much less vertical accumulation of dredged material in any given year.

To ensure that the new Yaquina ODMDS provides adequate capacity, the size of the proposed site(s) was based solely upon static capacity criteria. In other words, the dynamic capacity for proposed new ODMDS(s) was assumed to be 0. Although the proposed site(s) will exhibit some degree of dynamic capacity, the sites were assumed to be non-dispersive as a conservative measure for ensuring sufficient life-cycle capacity. Results of static capacity estimates are presented in Section 6 , *Fate Modeling and Impact Assessment for the Proposed ODMDS*. Additionally, the proposed ODMDSs should facilitate redundant site capacity. For example: If at sometime in the future, ocean disposal of dredged material is restricted within one ODMDSs, say a site located north of the Yaquina Bay entrance, another ODMDS located south of the entrance would have sufficient capacity to handle all dredged material disposal; and vice-versa. For this reason two (2) new ODMDSs were proposed: a North ODMDS and a South ODMDS. Each new site would have capacity for more than 20-years of dredged material disposal. Refer to figure 14 for location and layout of the proposed North and South ODMDSs

The management of the proposed ODMDSs may change with time, depending on monitoring results, changes in resources agency criteria, or other unforeseen conditions. For example: At sometime in the future, it may be required that dredged material be dispersed to minimize vertical accumulation on the seabed, per disposal season. This would maximize the area over which dredged material would be placed. Therefore, proposed ODMDSs must be "sized" to permit adaptive management practices: Hence the large areal configuration and redundancy in capacity.

The objective of this appendix was to determine the size for each new ODMDS sufficient to handle 6.2 million cy of dredged sediment (placed over a period of 20 years) and to locate the new ODMDSs in terms of the required size vs. other competing criteria. Consideration of proposed ODMDSs in terms of size and location is described in Sections 5 & 6, of this appendix. Development of a management plan for proposed ODMDSs, to ensure that new sites meet operational requirements, is described in Appendix F, *Management and Monitoring Plan*.

Littoral Considerations

Although hopper dredge access to the littoral zone may be attained by transiting 4-5 miles north or south of the Yaquina Bay entrance (the height of the north or south reef may diminish at that point), the long transit distance would render hopper dredge disposal in the littoral zone uneconomical. Other potential biological and operational restrictions also

preclude designation of a new ODMDS within the littoral zone (nearshore waters less than 60 ft deep).

The proposed ODMDS(s) will be located offshore of the reefs (active littoral zone) and not facilitate re-introduction of dredged material into the littoral zone. Dredged material placed within the proposed North or South ODMDS will in all likelihood be removed from the littoral zone for an extended period of time (10-20 years). Other statutory authorities may be invoked to permit USACE to place dredged material in the nearshore (littoral zone), but will require local-sponsorship to address cost-sharing arrangements and permitting issues.

# Section 5
# SIMULATING THE FATE OF DREDGED MATERIAL PLACED AT ODMDS

Coupled Strategy for Numerical Modeling and ODMDS Management

The key to successful ODMDS designation and management is knowing in advance (or reliably predicting) the fate of dredged material placed at the ODMDS. The Ocean Dumping Act require that field-verified, state of the art procedures be used for the assessment of possible physical impacts due to the operation of proposed ODMDSs

During the USACE Dredging Research Program (DRP), several sediment fate (FATE) numerical models were developed or enhanced in order to improve the reliability of ODMDS management. These FATE models incorporate state-of-the-art techniques for simulating the behavior of dredged material placed in open water, and account for a variety of disposal operations and environmental conditions. Results from FATE model application at Yaquina Bay were used to guide site selection for new ODMDS and facilitate life-cycle management of the proposed site in terms of operational requirements. Site physical impact assessments focused on:

**Wave conditions** - The use of new ODMDSs would not significantly increase (worsen) the wave environment at the ODMDS location or adjacent areas, with respect to the site's baseline condition.

**Impacts to biologic community** - The use of new ODMDSs would minimize potential biological impacts (refer to Appendix A, *Living Resources*). Proposed sites were located to avoid placement of dredged material on a limited habitat or seabed substrate (rock reef) that is significantly different from the sediment dredged at the navigation channel. If needed, proposed ODMDSs may be managed to minimize areas of impact or degradation.

**Transport of dredged material into the littoral zone** – It would be desirable for new ODMDSs to promote the littoral re-introduction of placed dredged material along the Oregon and Washington Coasts. The nearshore part of new ODMDSs may be located in water depths of 30-60 ft to facilitate shoreward movement of placed material. After placement in the nearshore part of new ODMDSs, dredged material would be transported

by waves and currents to the littoral zone. Nearshore placement of dredged material would be performed within the context of minimizing navigation and environmental impacts. Due to the presence of the north and south reefs at the Yaquina Bay entrance, operational constraints and biological sensitive areas preclude designation of a new ODMDS within the littoral zone.

FATE model results that were used to asses the long-term suitability of the proposed Yaquina Bay ODMDS are described in Section 6, *Fate Modeling Results And Impact Assessment for the Proposed ODMDS.* The following paragraphs describe FATE model components and the strategy for using the FATE models in this ODMDS assessment.

## Fate of Dredged Sediment Placed in Open Water

The physical processes affecting dredged material placed in open water include gravity, surface waves, and currents. At the point of release from the disposal vessel, dredged material falls through the water column, convects/diffuses laterally, and eventually comes to rest on the seafloor. This scenario characterizes the ***short-term fate*** of dredged material placed in open water. Figure 11a illustrates dredged material behavior, when placed in open water by a hopper dredge or split-hull barge. During the disposal operation, dredged material can be spread out on the seabed to varying degrees, depending upon the speed of the disposal vessel, water depth, water column current, ambient bathymetry, and other variables. The time-frame for processes affecting the short-term fate of placed dredged material is: During and immediately after the disposal operation (minutes to hours).

After dredged material has come to rest on the seabed, it can be eroded by waves and currents. If the dredged material is cohesive, it can experience self-consolidation due to gravity. If many loads of dredged material are placed one on top of another such that a steep aggregate mound develops on ambient bathymetry, the mound will avalanche and material will be transported downslope. The combination of these processes define the ***long-term fate*** of dredged material placed in open water. The time-frame for processes affecting the long-term fate of placed dredged material is: After the disposal operation (days to years).

## Predictive Methods: Applicable Numerical Models

STFATE, LTFATE, and MDFATE are numerical models which incorporate state-of-the-art techniques for simulating short- and long-term bathymetric change due to dredging disposal operations and environmental processes. The models were developed at USACE, Waterways Experiment Station (WES) and are briefly described below.

**Short-Term FATE**: Predicts the distribution of dredged material thru the water column and bathymetric distribution of dredged material on the seabed after it has passed through the water column, on an individual "dump" (disposal vessel load) basis. The time-frame of interest for the STFATE model is on the scale of minutes to hours, during dredged material disposal. The model accounts for various disposal vessel, water column, and material parameters. In this investigation, STFATE was used in a 2 dimension capacity.

**Long-Term FATE**: Simulates bathymetric change due to self-weight consolidation and sediment transport arising from the interaction of waves and currents. The time-frame of interest for the LTFATE model is from days to years, after dredged material disposal. The model accounts for waves, currents, tidal, and material parameters. LTFATE is a 2 dimensional model.

**Multiple-Dump FATE**: Predicts the change in bathymetry at an ODMDS resulting from a series of "dumps" and simulates long-term change of the resultant bathymetry. MDFATE uses components of STFATE and LTFATE to simulate a disposal operation which could extend over a year and consist of hundreds of "dumps". The model accounts for overall disposal operation and long-term environmental processes. The time-frame of interest for the MDFATE model is from minutes to years, and simulates processes during and after dredged material disposal. MDFATE is a 2 dimensional model and uses the same parameters as used in STFATE and LTFATE.

Predictions of dredged sediment behavior, when it is placed into the open waters of the ocean, can only be as good as the poorest estimate for the forcing environment (i.e. waves, currents, and other processes). To address this need for input data, tide and wave prediction techniques were developed by WES to provide realistic wave and current data to the FATE models.

The computer programs **HPDPRE** and **HPDSIM** were used to simulate a time series representation for wave height, period, and direction [Borgman and Scheffner 1991]. The **ADCIRC** model was used to simulate equilibrium Newtonian tide in terms of ocean surface elevations and current [Hench et al 1994].

The numerical model **RCPWAVE** [Ebersol et al 1986] was used in this investigation to assess the effect of bathymetry change (dredged material mounds) upon the wave environment at existing and proposed Yaquina Bay ODMDSs. RCPWAVE is a 2 dimensional numerical model that simulates the transformation of wind-generated waves, as the waves propagate into shallow water and eventually break. The model accounts for the two dimensional behavior of wind-generated waves (shoaling and refraction) as the waves are affected by an irregular (mild-sloping) seabed. The model does not include the effects of current, wind, or wave-wave interaction upon the wave transformation process. Therefor, the results presented in this wave analysis consider ONLY the effect of waves interacting with bathymetry (the seabed). It has been observed that the RCPWAVE model overestimates the amplification of waves due to shoaling (the model is conservative). Since USACE would rather "err" by overestimating the potential wave amplification (rather than underestimating), a conservative estimator of potential wave amplification is desirable. If we err, it would be such that: Wave amplification would be predicted to occur, when in fact, waves would not actually be affected by dredged material accumulation (mounding).

The above models have been calibrated, verified, and successfully applied at several locations within and outside the Portland District [USACE 1999 and 1995, Clausner et al 1998 (a and b), Moritz and Randall 1995, Johnson 1978, Johnson and Fong 1995, Thevenot and Johnson 1994, Scheffner 1992, EPA 1978, and Schubel et al 1978].

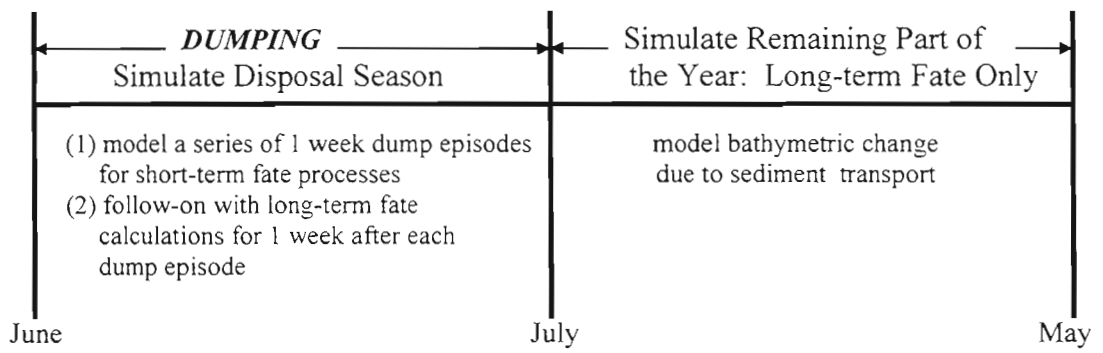
Collectively, the above numerical models were used to resolve future ODMDS site management issues related to physical aspects.

## ODMDS Modeling Strategy

As a first step toward modeling sediment fate at ODMDSs, existing oceanographic information was consolidated for use in the modeling effort. The year 1996 was chosen as the "base year" for simulating the behavior of dredged material mounds at candidate Yaquina Bay ODMDSs. This was based on the availability of the most recent bathymetric survey for the Yaquina Bay approaches and ODMDSs.

For modeling purposes , the annual dredging and disposal season at Yaquina Bay was broken into two (2) discrete time periods. Dredging disposal at the Yaquina Bay ODMDS normally begins during June and continues through the summer until July or August. After August, the ODMDSs are generally not used and are affected by the energetic wave/current environment until the following May when dredged disposal again commences. The schematic shown below describes how the MDFATE model was applied to simulate dredged material disposal at the proposed Yaquina Bay ODMDS.

***Modeling of the Annual Dredged Material Disposal Cycle at Yaquina ODMDS***




During a given ODMDS year, short-term fate processes (dredged material disposal) were simulated for a 2-month period (June - July). Long-term fate processes were then simulated for a 10-month period, until the following year when the annual cycle was repeated.

### Short-term Fate

The STFATE model was used to estimate the geometry of dredged material deposited on the seafloor, on an individual dump basis. These results determined whether flat or peaked "mounds" are produced from dredged material disposal, on an individual dump basis. The above estimates were be performed for the two dredging vessels which have been most used at Yaquina Bay. Results are described in Section 6 of this exhibit. STFATE results were used to optimize ODMDS capacity based on the need to distribute

dredged material within the site in terms of thickness, deposition rate, and areal extent per load placed.

Long-term Fate

The LTFATE and MDFATE models were used to estimate the capacity of proposed ODMDSs for a 20-year life-cycle. The definition of ODMDS site capacity is discussed in section 4 of this appendix. The MDFATE model was used to simulate the long-term accumulation of dredged material placed at various locations within proposed ODMDSs. MDFATE results were used to determine the ODMDS dimensions required to "acceptably" operate a site over the life-cycle. MDFATE model results were also used to ensure that life-cycle management of the proposed ODMDS would meet operational requirements (based on the need to distribute dredged material within a given site, in terms of verifying accumulation thickness and areal extent per year). Results are described in Section 6, *Fate Modeling Results and Impact Assessment for Proposed ODMDS*.

Future management of Yaquina ODMDS's will prevent the amplification (shoaling) of incident waves due to the formation of new dredged material mounds by limiting the size (height and plan-form) of new dredged material mounds. Dredged material mound accumulation will be restricted to prevent wave amplification. The RCPWAVE model was used to assess wave shoaling characteristics of various dredged material mound sizes vs. water depth and wave parameters. The wave amplification criteria was used for purposes of minimizing undesirable wave conditions due to excessive accumulation of dredged material mounds. Results are described in Section 6, *Fate Modeling Results and Impact Assessment for the Proposed ODMDS* and in the *Management and Monitoring Plan*.

## Calculating Bottom Sediment Transport Potential

The calculation of closure depths [Hallemeier 1981] gives a ***qualitative*** indication of the depth limit for sediment transport rate due to shoaling waves for average and storm wave conditions. Sediment transport closure depths give a general indication for the extent (water depth) of sediment transport, but do not define how much sediment transport will occur.

Hallermeier Sediment Transport Limits

The nearshore region of the seabed can be divided into different transport zones based upon relative rates of littoral sediment transport. Two (2) water depth zonal limits, $\mathbf{d}_\ell$ and $\mathbf{d}_S$ are typically used to describe the transportability of sediment at the seabed due to shoaling waves [Hallemeier 1981]. These depth values are commonly referred to as *closure depths*.

(1) The water depth corresponding to $\mathbf{d}_\ell$ gives a seaward limit for sediment transport associated with highly turbulent surf-zone (or littoral) effects. This depth is a function of

the annual mean significant wave height ($H_{1/3}$) and defines the *littoral* zone for which all significant alongshore/cross-shore transport occurs. Algebraically, the littoral closure depth ($\mathbf{d}_\ell$) for typical nearshore sand is defined as:

$\mathbf{d}_\ell = 2H_{1/3} + 11\sigma$ where, $H_{1/3}$ = average annual significant wave height applicable at $\mathbf{d}_\ell$
$\sigma_h$ = annual standard deviation of $H_{1/3}$

The $H_{1/3}$ used for the $\mathbf{d}_\ell$ calculation for Yaquina Bay was determined by transforming the deepwater $H_{1/3}$ (specified by WIS-II station 46, $H_{1/3}$= 9.0 ft and $\sigma_h$ =4.2 ft) to a water depth of 60 ft. The resultant annualized nearshore $H_{1/3}$ = 8.8 ft with $\sigma_h$ =3.8 ft. Using the nearshore wave criteria, $\mathbf{d}_\ell$ was calculated to be 59 ft (say 60 ft).

(2) The water depth corresponding to $\mathbf{d}_S$ gives the extreme seaward (outer) limit of wave-induced sediment motion due to extreme waves (storm effects) and is a function of annual mean significant wave height, the annual mean significant wave period, and median sediment grain size. The nearshore zone located seaward of $\mathbf{d}_\ell$ and landward of $\mathbf{d}_S$ (between the two depths) defines the *shoal* zone. The shoal zone between $\mathbf{d}_\ell$ and $\mathbf{d}_S$ is a "gray" area where typical waves have neither a strong nor negligible effect on the bottom sediment transport during a typical year of wave action [Hallemeier 1981].

$\mathbf{d}_s = (H_{1/3} - 0.3\sigma)T_s(g/5000D_{50})^{1/2}$ where, $H_{1/3}$ = 9 ft, estimated average annual significant wave height applicable at $\mathbf{d}_s$
$T_s$ = wave period (associated with $H_{1/3}$) = 11 sec
$g$ = 32.2 ft/sec$^2$
$D_{50}$ = median sediment grain size = 0.15-0.25 mm
= 0.000492 – 0.00082 ft

The median grain size for dredged material to be placed at Yaquina ODMDSs was estimated to be 0.20 mm (Section 8, <u>*Measured Oceanographic Data*</u>). The median grain size for in "native" situ material at candidate areas for new ODMDSs was estimated to be 0.15 mm. The corresponding values for closure depths were calculated to be:

$\mathbf{d}_\ell$ = seaward limit of active littoral zone at (all sediments) = -60 ft MSL
$\mathbf{d}_S$ = extreme seaward limit for wave-induced sediment motion (0.15mm) = -250 ft MSL.
$\mathbf{d}_S$ = extreme seaward limit for wave-induced sediment motion (0.25mm) = -200 ft MSL

In terms of closure depth, the *Interim* and *103* ODMDSs should experience littoral sediment transport at locations shallower than $\mathbf{d}_\ell$ = -60 ft MSL (about –57 ft MLLW). This in fact has been the case (Section 3 of this appendix). Using closure depths as general criteria for selecting an ODMDs is illustrated as follows. If a new Yaquina ODMDS was needed to prevent any long-term transport of placed dredged material, then the non-dispersive site should be located in water depths deeper than -200 ft MLLW. This criteria would provide for a completely ***non-dispersive*** ODMDS, if the placed dredged material had a median grain size of 0.25 mm . Conversely, if a ***dispersive*** ODMDS was required to promote rapid transport of placed dredged material back into

the littoral environment, then the proposed site should be located in water depths equal to or shallower than -55 ft MLLW.

If new proposed ODMDSs were to be located in average water depth of 135 ft, dredged sand placed at the sites would be dispersed slowly during infrequent storm events. This would be the case for the proposed North and South ODMDSs.

Modified Ackers-White Sediment Transport Estimates

To obtain a more detailed description of sediment behavior, several relationships have been developed to ***quantitatively*** estimate sediment transport rates [Ackers and White 1973]. The LTFATE model uses the "modified" Ackers and White [1973] equations as the basis for the non-cohesive (total load) sediment transport model. The equations are applicable for uniformly graded noncohesive sediment in the range of 0.06-0.4 mm. The Ackers-White equations are based on depth-averaged current. Because many ODMDSs are located in relatively shallow water (less than 200 ft), a modification of the Ackers-White equations was made to reflect an increase in the transport rate when ambient currents are accompanied by surface waves [Scheffner et al 1995]. The net direction of sediment transport is governed by current direction only: Wave direction has no effect on sediment transport direction.

Several sensitivity tests were conducted to demonstrate the sensitivity of the sediment transport rate with respect to wave height, current speed, water depth, and sediment grain size. Results of the of the Ackers-White sensitivity tests are shown in figure 8 (six graphs).

Wave height and current are the governing parameters for sediment transport (upper left and bottom two graphs). If wave height is increased from 7 ft to 20 ft in 48-foot water depth, sediment transport potential increases by a factor of 10 for a current of 1.5 ft/sec (such would be the case of the eastern part of the *Interim* site, during a storm). For water depth less than 125 ft, depth is equally important as wave height in controlling the magnitude of sediment transport (upper right and bottom two graphs), assuming other parameters remain constant. For a water depth of 48 ft (high point of *Interim* ODMDS mound in 1985) with a 20 ft wave and current of 1.5 ft/sec, sediment transport rate is estimated to be about 7 times higher than at 125-foot depth (eastern part of the proposed North or South ODMDSs, see section 6). Note that regardless of the wave height or water depth, if the depth-averaged current is lower than a threshold value of 0.5 ft/sec, there is no ***net*** sediment transport predicted by Ackers-White formulation.

Sediment grain size has some effect upon sediment mobility (middle left graph of figure 8), but only at high values of depth-averaged current. The variability in wave period (middle left graph, figure 8) does not appear to have an appreciable effect upon sediment transport rates.

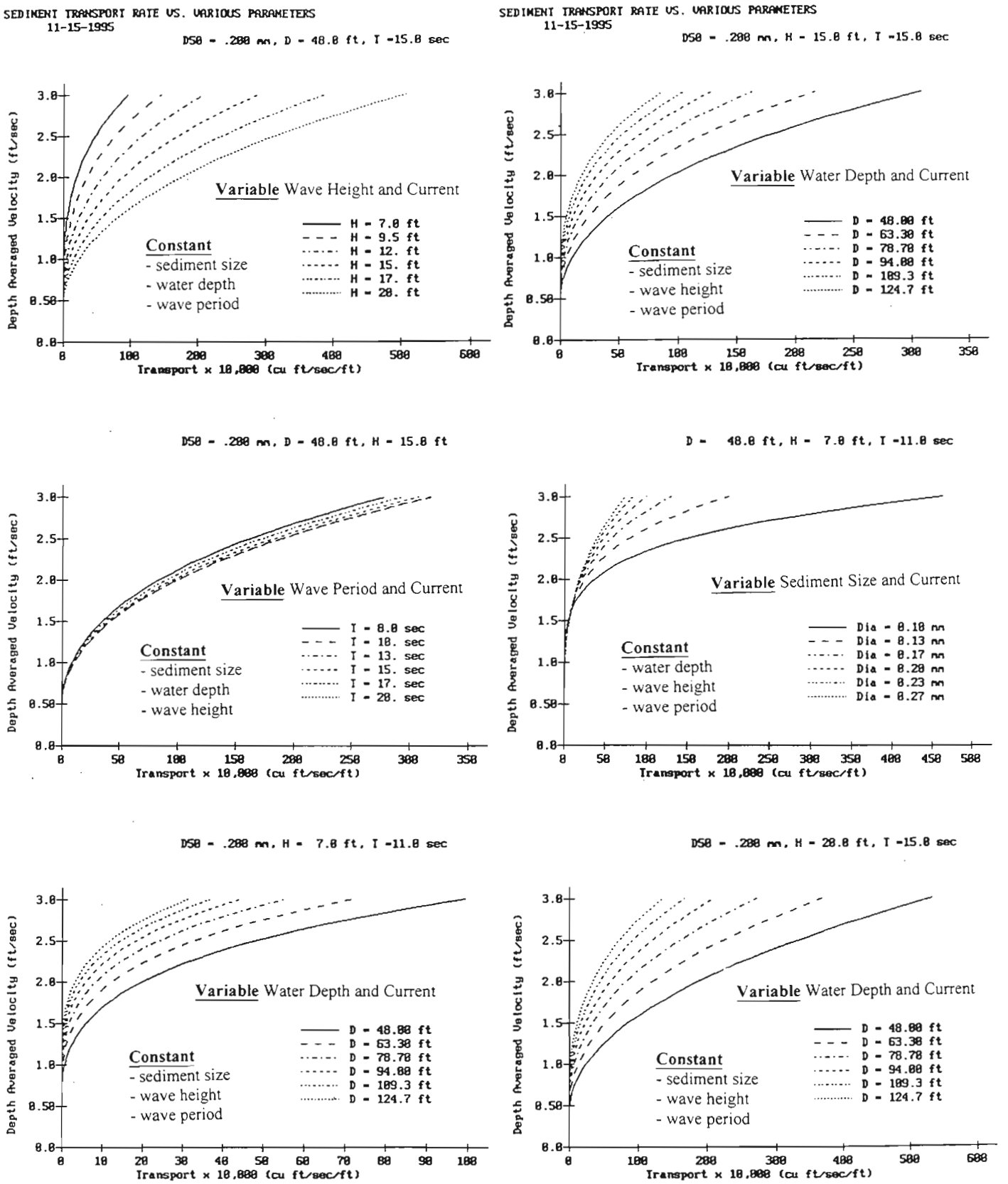



Figure 8. Results form Ackers-White patch-test of point values for sediment transport potential

## Limitations of Simple Sediment Transport Estimates

Even though the modified Ackers-White equations may provide a realistic estimate of sediment transport potential, the result is only 1-dimensional. The actual (2-dimensional) response of the dredged material placed at an ODMDS would still remain uncertain, until hindsight from the actual disposal operation is gained through post-disposal condition surveys.

Reliance on 1-dimensional estimates for characterizing sediment transport can be a costly proposition for disposal site selection, if ODMDS selection does not provide an disposal site with intended dispersive properties or sufficient static capacity. The FATE sediment fate models use the Ackers-White and other equations to estimate physical processes affecting 2-dimensional sediment transport on the seabed. Application of the FATE numerical models provide the needed predictive means to reliably select a new site or expand an existing ODMDS. The FATE models can also be used to optimize dredged material management at ODMDSs.

It must be noted that the FATE models are only tools that provide estimates of sediment behavior and related processes. The accuracy of FATE model-generated results is highly dependent upon the parameters input to the models. Controlling parameters are physical characteristics of the dredged material, disposal operation sequencing, and forcing environment (waves and currents). As discussed in Section 7 and 8 of this exhibit, much effort was expended to develop reliable input for FATE modeling. Based on previous applications of FATE models and data development outlined above, it is assumed that FATE model results obtained for Yaquina ODMDSs will meet an accuracy standard of 80% (the difference between predicted and actual conditions is expected to be within ± 20%).

## FATE Model Data Requirements

Before reliable modeling of dredged material fate could be conducted, environmental processes which govern sediment transport at Yaquina Bay ODMDSs had to be defined. The following prioritization of various environmental parameters is presented in terms of the requirement for FATE model result accuracy:

**First** Priority = depth-averaged current magnitude and direction, resolve into seasonal regimes
**Second** Priority = Wave height time series, year-long data record with 3-hour record interval
**Third** Priority = Characteristic physical properties for dredged sediment and ambient bottom sediments at ODMDSs
**Fourth** Priority = Wave period time series, year-long data record with 3-hour record interval

Section 7, *Oceanographic Processes* provides a general description of regional oceanographic process offshore of Yaquina Bay. Section 8, *Measured Oceanographic Data* quantitatively describes site specific parameters relevant to FATE modeling.

## Section 6
## FATE MODELING RESULTS AND IMPACT ASSESSMENT FOR PROPOSED *ODMDS* Locations

This section describes procedures that were used to define ODMDS site selection criteria based on physical processes relevant to Yaquina Bay offshore. The physical process criteria was used, in conjunction with other considerations, to evaluate the proposed ODMDS location. Proposed ODMDSs were assessed for life-cycle performance, in terms of physical processes, using the fate models. Long management for proposed ODMDSs is discussed in the *Management and Monitoring Plan*.

### Vertical Limit for Dredged Material Mound Height

As stated in Section 4, *Requirements For The New Yaquina Bay ODMDS*, the areal size of new ODMDS was determined based upon the site requirement to provide static capacity for 6.2 million cy of dredged material over a 20-year life-cycle ***without significantly affecting baseline wave conditions***. Management of new Yaquina ODMDSs will avoid the amplification of incident waves (sea and swell), due to the formation of large dredged material mounds. At any given location within a proposed ODMDS, accumulation of dredged material will be controlled so that incident waves are not significantly amplified over the baseline (pre-disposal) condition. Biological considerations may impose additional controls to limit annual accumulation rates.

The RCPWAVE model was used to determine the maximum limiting height of a (dredged material) mound feature for various conditions. Figure 9 summarizes the RCPWAVE results from estimating limiting mound height for several mound geometries in water depths from 40 to 200 ft. The lower bold solid line applies to a large mound feature (2,000 ft wide x 4,000 ft long, with 1.2° or 1V:50H sideslopes) and was used to determine to maximum mound height applicable for the new (proposed) ODMDS.

Specification of the (baseline condition) water depth of the proposed ODMDS determines the limiting mound height, based on figure 9. Once the limiting mound height is determined, the required areal extent of the ODMDS can be calculated from geometric constraints based on the desired volume of static capacity. Refer to Section 4 of this exhibit for the definition of static capacity. All that is needed to begin the ODMDS size calculation is the water depth at the candidate ODMDS location. An example is shown below.

Given:
Water depth at a hypothetical ODMDS = D = 120 ft
Desired static capacity volume = Vs = 6.2 million cy = 167.4 million cubic feet
Side slope for accumulated dredged material = theta = 1.2 ° =1V:50H = 0.020

**Required:**
**Maximum limiting mound height = Hm**
**Areal Dimensions for ODMDS (assume square site boundaries, length=width) = Ls = Ws.**

Solution:

$\boxed{Hm = 14 \text{ ft}}$ (obtained form figure 9, lower curve using 120 ft water depth)

$Vs = 1/6*Hm*(A + 4B + C)$, where $A = (Ls-2*Hm/theta)*(Ws-2*Hm/theta)$

= volume of a prismatoid $B = [(Ls-2*Hm/theta)+Ls]*[(Ws-2*Hm/theta)+Ws]/4$

$C = Ls*Ws$

$\approx 0.95$ * Volume of a solid trapezoid

Volume of a solid trapezoid $= ½*Hm[Ws+(Ws-2*Hm/theta)]*Ls$

$Vs \approx 0.95*\{½*Hm[Ws+(Ws-2*Hm/theta)]*Ls\}$, since $Ws = Ls$

$Vs \approx 0.95*\{Ls^2*Hm - Hm^2*Ls/theta\}$, at this point Vs can be solved for, or if Vs is known then Ls can be determined by $0 = Ls^2 - Hm*Ls/theta - Vs/(0.95*Hm)$, by solving for Ls in terms of the quadratic solution for the root.

for this example, $Ls = \{14/0.02 + [(14/0.02)^2 + 4*167{,}400{,}000/(0.95*14)]^{1/2}\}/2 = 3{,}900$ ft

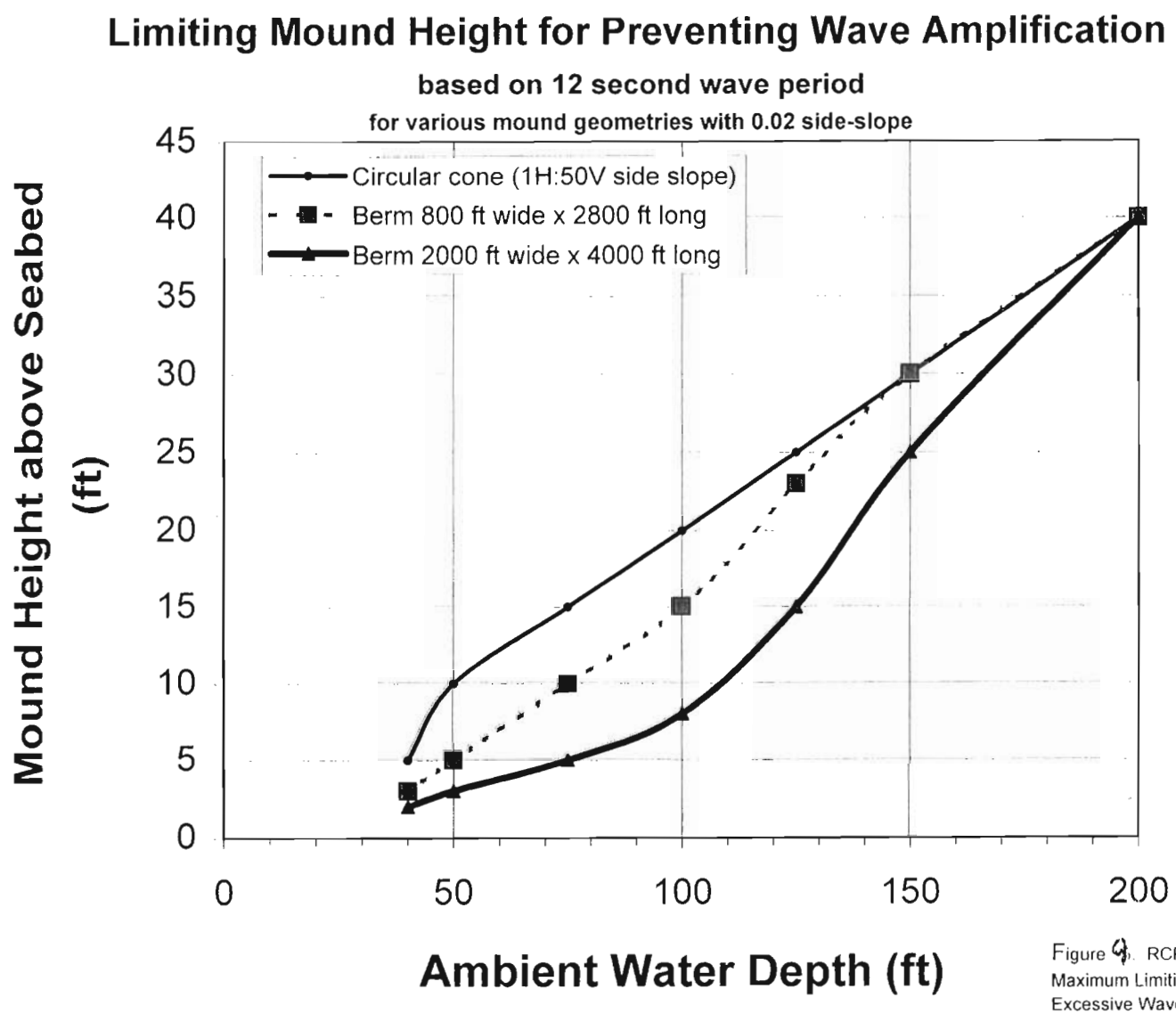
The length of each side of ODMDS (assuming a square ODMDS layout), = $\boxed{Ls = 3{,}900 \text{ ft}}$

Note that if figure 9 were applied to the designation of an "appropriately sized" *Section 103* ODMDS (located in average water depth 70 ft), the maximum mound height should have been limited to 5 ft. This would have required that the length of each side (for a square site) of the site to be at least 6,100 ft, resulting in an ODMDS 4 times larger than the present *Section 103* ODMDS.

## General Location for New ODMDS and Required Size

Locating the new ODMDS was accomplished by a method of default. As stated in Section 5, the new ODMDS could not be located shoreward of the "reefs". Nor should the new site be located over any exposed bottom rock areas offshore of the north and south "reefs". Finally, it was desirable for the new ODMDS not to be located near existing ODMDSs <u>or</u> near the "mounded" bathymetry located 1 mile due west of the entrance channel. The above restrictions lead to the new ODMDS being located either northwest or southwest of the existing *103* site, and west of the exposed rock area shown in figure 2. Additionally, it was determined that the boundary of a new ODMDS should be located at least 1,000 ft away from any exposed bottom rock area to avoid habitat impacts: This set the location of the landward boundary of the new ODMDS. The width (east-west) and length (north-south) dimensions of the new ODMDS were set such that the middle of the ODMDS would be located as close as possible to the entrance channel. These restrictions confined the general location of the proposed ODMDS to an area: Either north or south of the bathymetric "bulge" located 0.75 miles due west of the *Interim* ODMDS, having sandy-bottom, and a minimum water depth of about 120 ft.

Based on a water depth of 120 ft and the limiting mound height criteria shown in figure 9, the maximum vertical accumulation of dredged material placed within the new ODMDS was determined to be 14 ft (see above example calc. for Hm) . The data used in the example static capacity calculation (water depth and required static capacity, shown above) was also applied to determine the minimum area needed for the proposed




Mound orientation: Length axis is perpindicular to waves.

Note: Mound height results are shown for preventing wave amplification greater that 10% as compared to a "no mound" condition.

Figure 9. RCPWAVE Estimates for Maximum Limiting Mound Height to Avoid Excessive Wave Shoaling.

Figure 9

ODMDS. The length per side (assuming a square site) must be at least 3,900 ft (or have an area of 350 acres).

To accommodate for the variable operational aspects of dredged material disposal and other life-cycle uncertainties, the new ODMDS should be "sized" to provide more than the minimum capacity requirement. The following FATE assessments address these considerations.

## Short-Term Fate Modeling: Bathymetry Impact Assessment

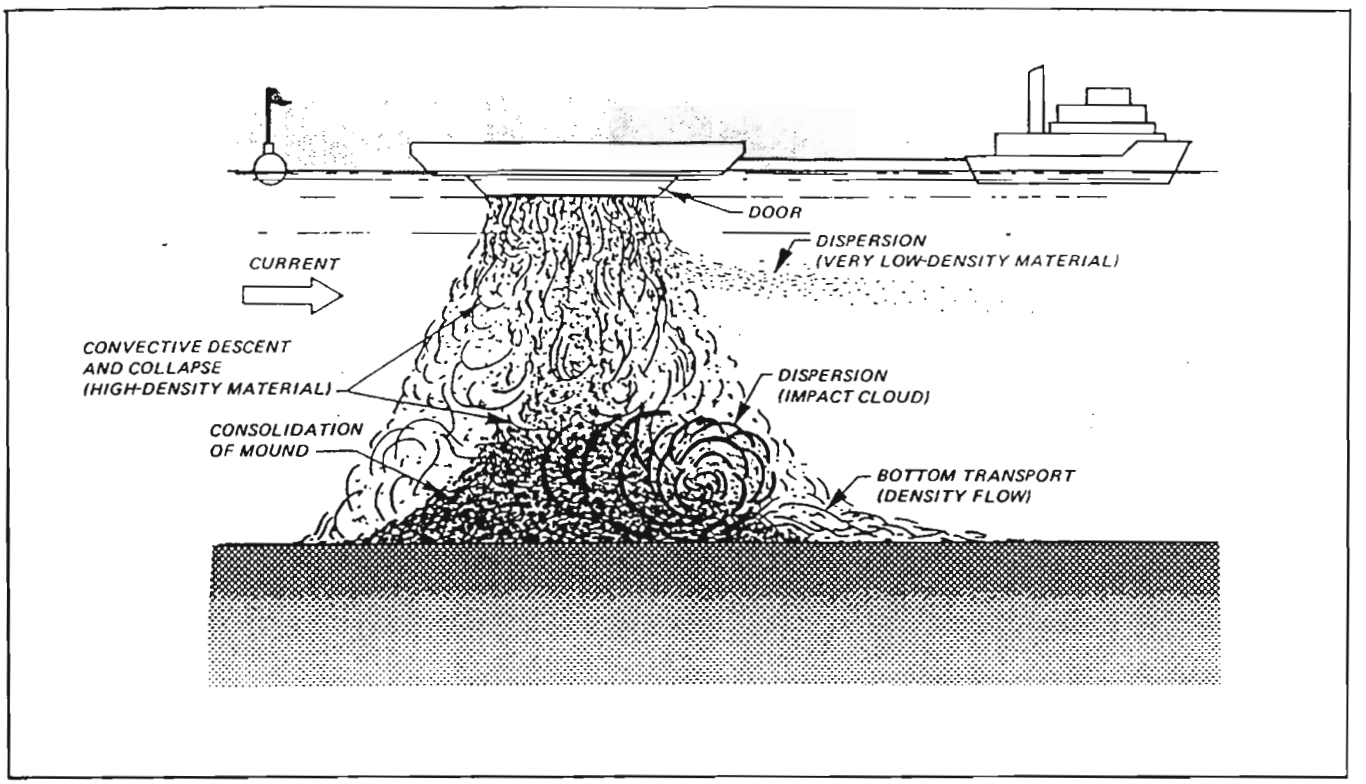
When dredged material is released in open water by a disposal vessel, the material falls through the water column, mixes with ambient water, and forms a plume. This process is called convective descent. When the diluted dredged material plume encounters the seabed, the plume spreads radially along the seabed. This process is called dynamic collapse. After the plume has expended all of its momentum along the seabed, the dredged material slowly settles under the influences of gravity and the ambient current environment. This process is called passive transport and diffusion. Figure 9a illustrates dredged material behavior, when placed in open water by a hopper dredge.

Bathymetric impacts were defined in terms of the short-term behavior of dredged material on a per dump basis; as dredged material is released from the disposal vessel and accumulates on the seabed. The objectives of the short-term fate assessment were to:

- **Estimate the disposal foot-print geometry (per dump) in terms of thickness and areal extent after the placed material comes to rest on the seabed**: This data describes the coverage of dredged material on the seabed data and provides insight to the potential bathymetric impacts in the immediate vicinity of disposal..

- **Determine the distance that placed dredged material is displaced away from the point of release during disposal**: This parameter describes the size of the ODMDS "buffer" zone that is located along the site's perimeter. The buffer zone inscribes the outer area of the ODMDS and is intended to prevent transport of dredged material (by currents or bottom surge motion) beyond the formal site boundary during placement operations.

Short-term fate simulations were conducted for the disposal of dredged material from two types of hopper dredges: (A) a split-hull hopper dredge - *Westport*; and (B) a multiple bottom door hopper dredge - *Yaquina*. Since 1982, about half of all dredging disposal at Yaquina Bay ODMDSs has been performed by the *Yaquina*. The *Westport* has performed about 30% of the Yaquina Bay dredging disposal. Operating parameters for each dredge that has recently been used at Yaquina Bay are shown below.



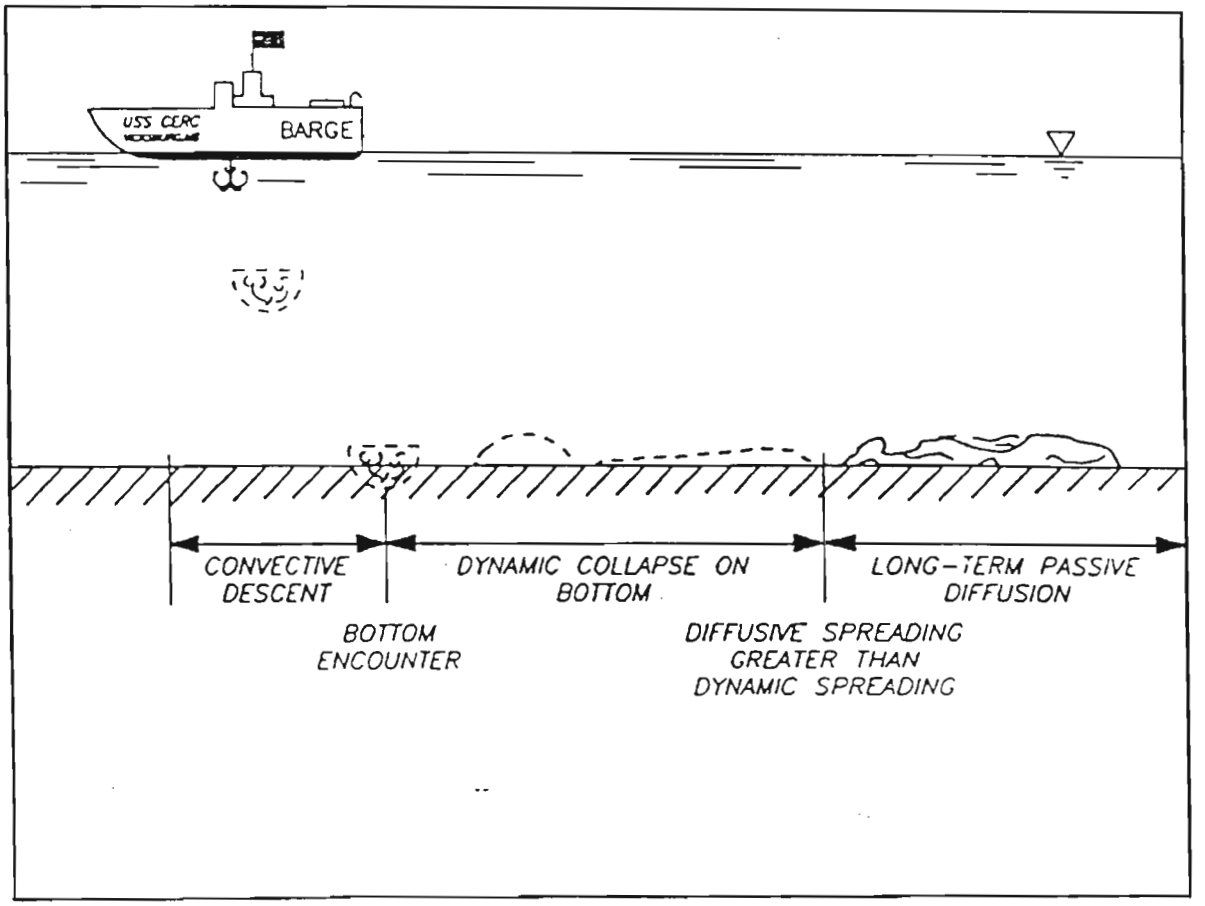




Figure 9A. (Top) Four phases of dredged material behavior when the material is discharged subaqueously . (Bottom) Computational phases of the short-term fate model,

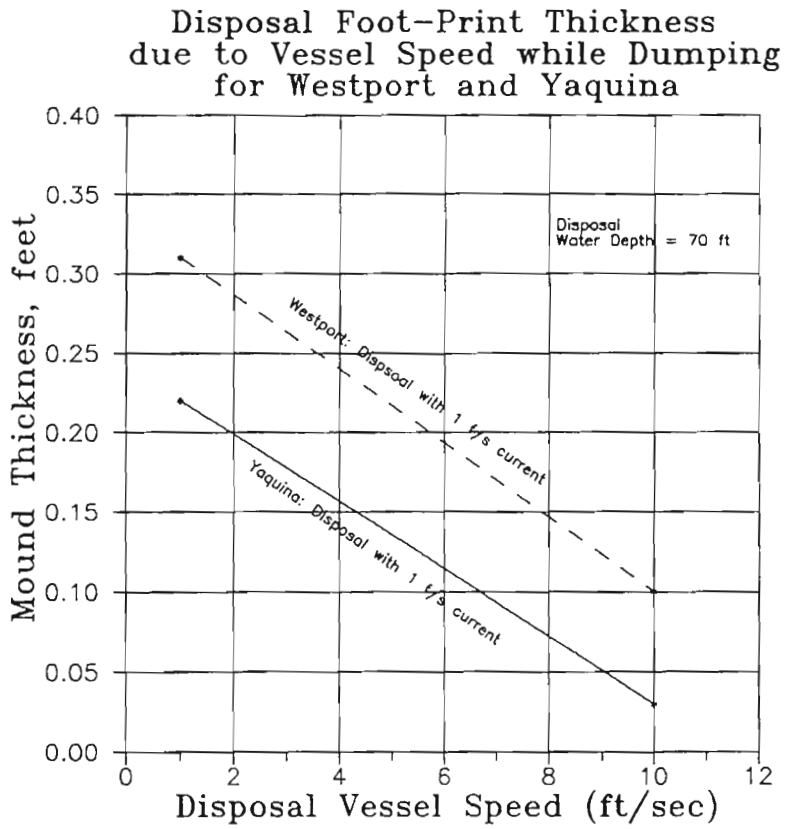
| DREDGE | OVERALL DIMENSIONS length (ft) | beam (ft) | draft(ft) loaded/empty | WORKING CAPACITY average (cy) | VESSEL SPEED during disposal (knots) | DISPOSAL vessel type (# of doors/size of each) | DURATION placement of each load (minutes) |
|---|---|---|---|---|---|---|---|
| ***Westport*** | 270 | 50 | 14 / 8 | 1.000 | 2 to 6 | split-hull/ 160x25 ft | 2 to 6 |
| *Padre Island* | 281 | 52 | 19/8 | 2.600 | 2 to 6 | split-hull/ 190x30 f t | 4 to 6 |
| *Atchafalya* | 197 | 41 | 15/6 | 1.300 | 2 to 6 | split-hull/ 120x20 f t | 4 to 6 |
| ***Yaquina*** | 200 | 58 | 14/10 | 1.000 | 2 to 8 | bottom doors(6)/ 4x4 ft | 2 to 6 |

For simulation purposes, the vessel speed during disposal was assumed to be 2 knots (3.5 ft/sec) for both dredges. The duration of placement for an individual load of dredged material was assumed to be 3 minutes for the *Westport* and the *Yaquina*. Short-term fate simulations were conducted for disposal water depths ranging from 40 to 200 ft. Three types of current conditions were also tested: No current, a 1 ft/sec current , and a 4 ft/sec current. Currents were modeled as being oriented 45° into the heading of the disposal vessel. The current regime at Yaquina ODMDSs ranges from 0.5 ft/sec to 3 ft/sec. The characteristics of sediment dredged from the Yaquina Bay project and placed at ODMDSs are described in Section 8, *Measured Oceanographic Data* .

STFATE Results

As dredged material is released from a disposal vessel and falls through the water column, the material mixes with ambient environment and forms a plume. The dredged material plume slowly settles to the seabed under the influences of gravity and the ambient current environment. The time required for dredged material to fall to the seabed and completely settle out of suspension is largely dependent upon the water column environment and the material type placed at a given disposal site. At Yaquina Bay ODMDSs, approximately 98% of dredged material placed is composed of sand and 2% is composed of fines (silt), on a per load basis. Based on STFATE results for typical conditions, the **time** required for ***sand*** to completely settle out of the water column during dredged material disposal and deposit onto the seabed is approximately 200 seconds (after the completion of the disposal operation). The time required for ***silt*** to completely settle out of the water column and deposit onto the seabed is approximately 2,000 seconds (after the completion of the disposal operation). The above results were obtained for 100-foot water depth with no current. Short-term fate (STFATE) modeling results are summarized graphically in figures 10-13 and are described below for parameters governing mound height, mound width, and displacement distance.

Mound length is directly related to disposal vessel speed during disposal (figure 10). For normal operating conditions in water depth of 70 ft , the *Yaquina* and *Westport* produce a dump foot-print 600 to 3,200 ft long for vessel speeds ranging from 1 to 10 ft/sec, respectively. Mound thickness is also affected by vessel speed. For normal operating conditions in water depth of 70 ft , the *Yaquina* (*Westport*) produces a dump foot-print 0.2 to 0.05 (0.3 to 0.1) ft thick for vessel speeds ranging from 1 to 10 ft/sec, respectively.



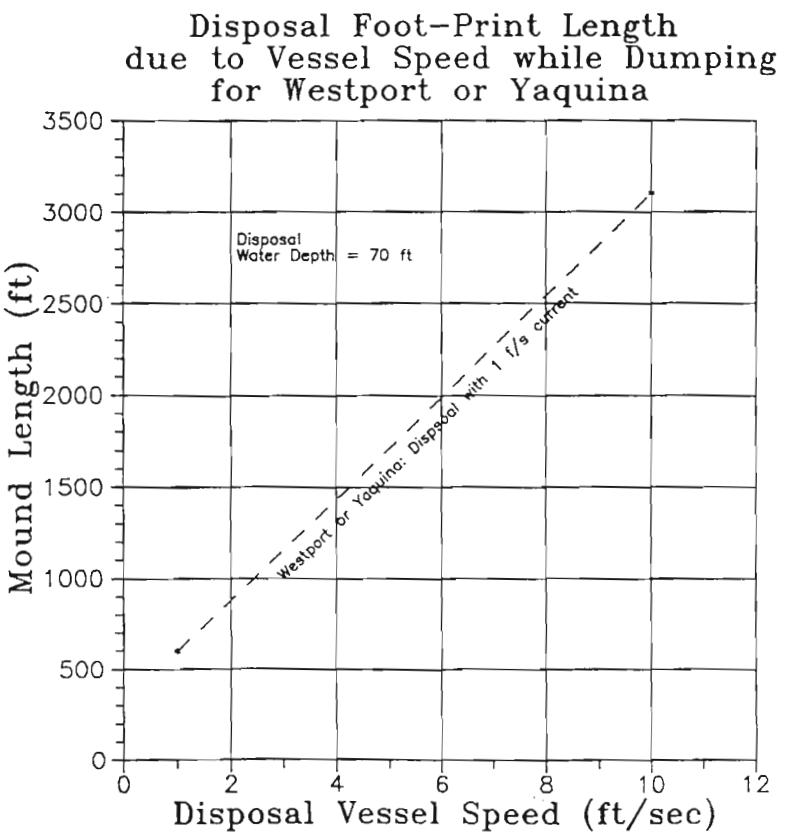
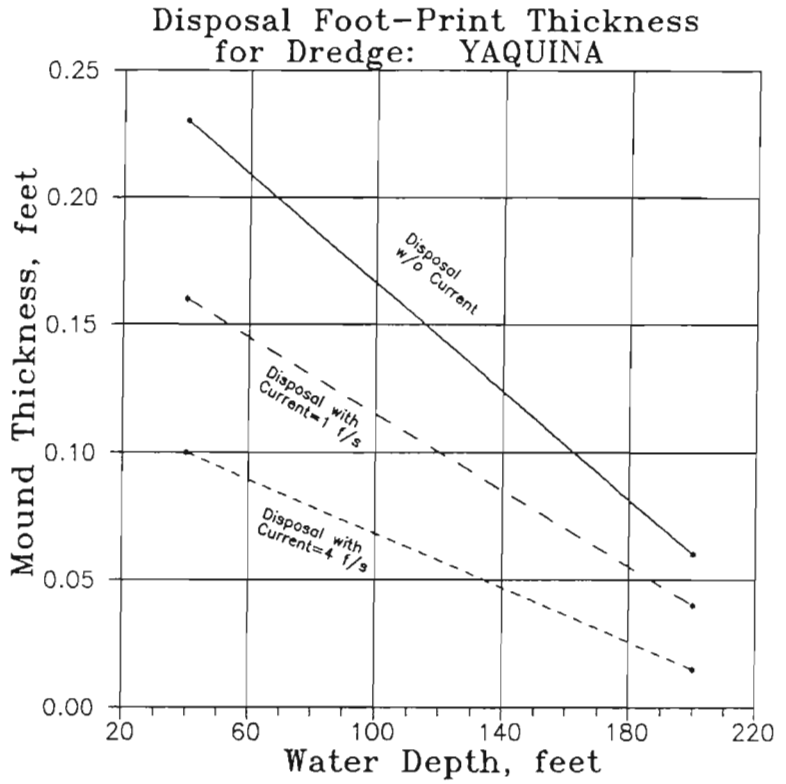




Figure 10. Predicted Disposal Foot-print Geometry as a function of Disposal Vessel Speed. Top graphic is for *Mound Thickness* vs. Vessel Speed. Bottom graphic is for *Mound Length* vs. Vessel Speed.



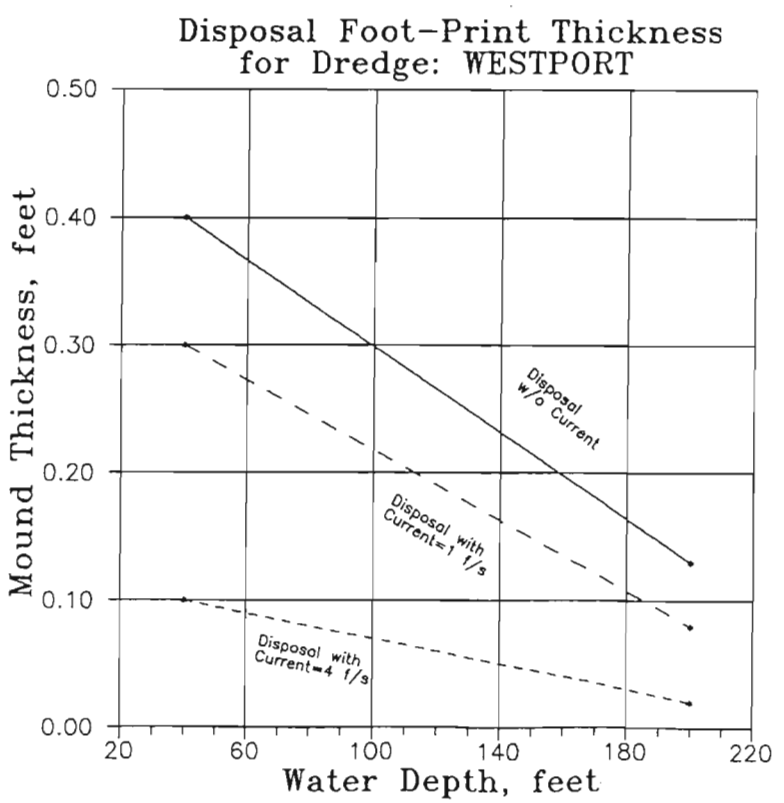
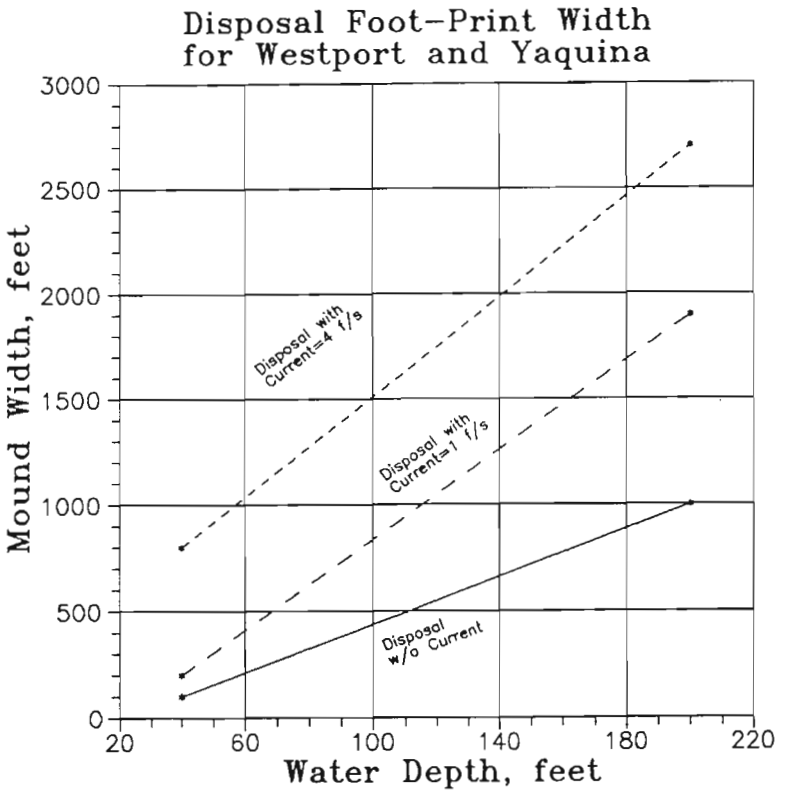




Figure 12. Predicted Disposal Foot-print Thickness for Dredges *Westport* and *Yaquina* as a function of current speed. Top graphic is for the dredge *Yaquina*. Bottom graphic is for the dredge *Westoprt.*



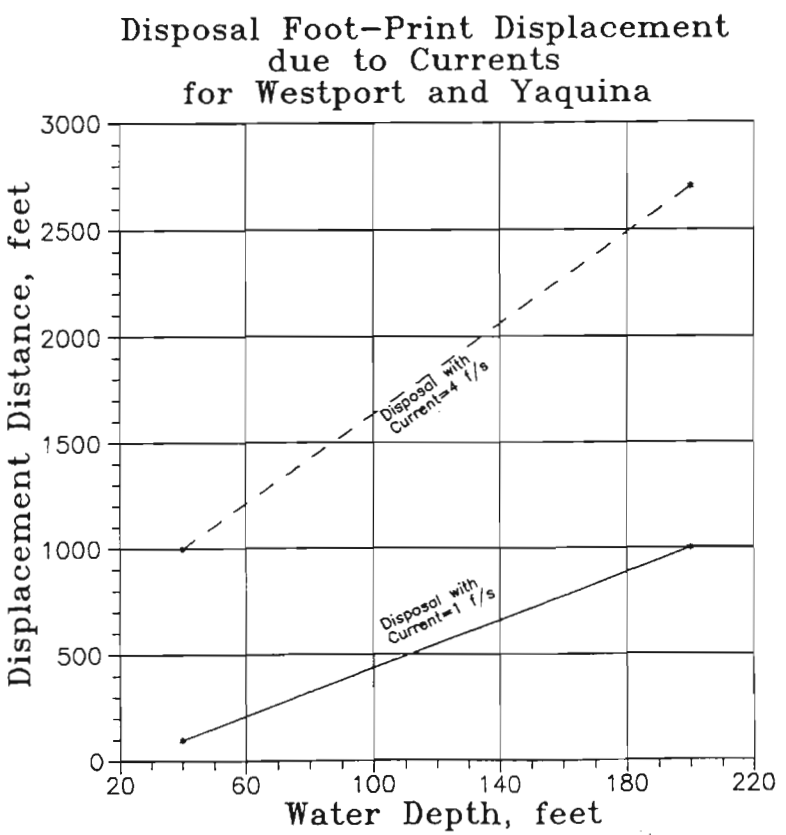




Figure 17. Predicted Disposal Foot-print Geometry as a function of Current Speed. Top graphic is for *Foot-print* Width vs. Current Speed. Bottom graphic is for *Displacement Distance of Foot-print from Point of Disposal* vs. Current Speed..

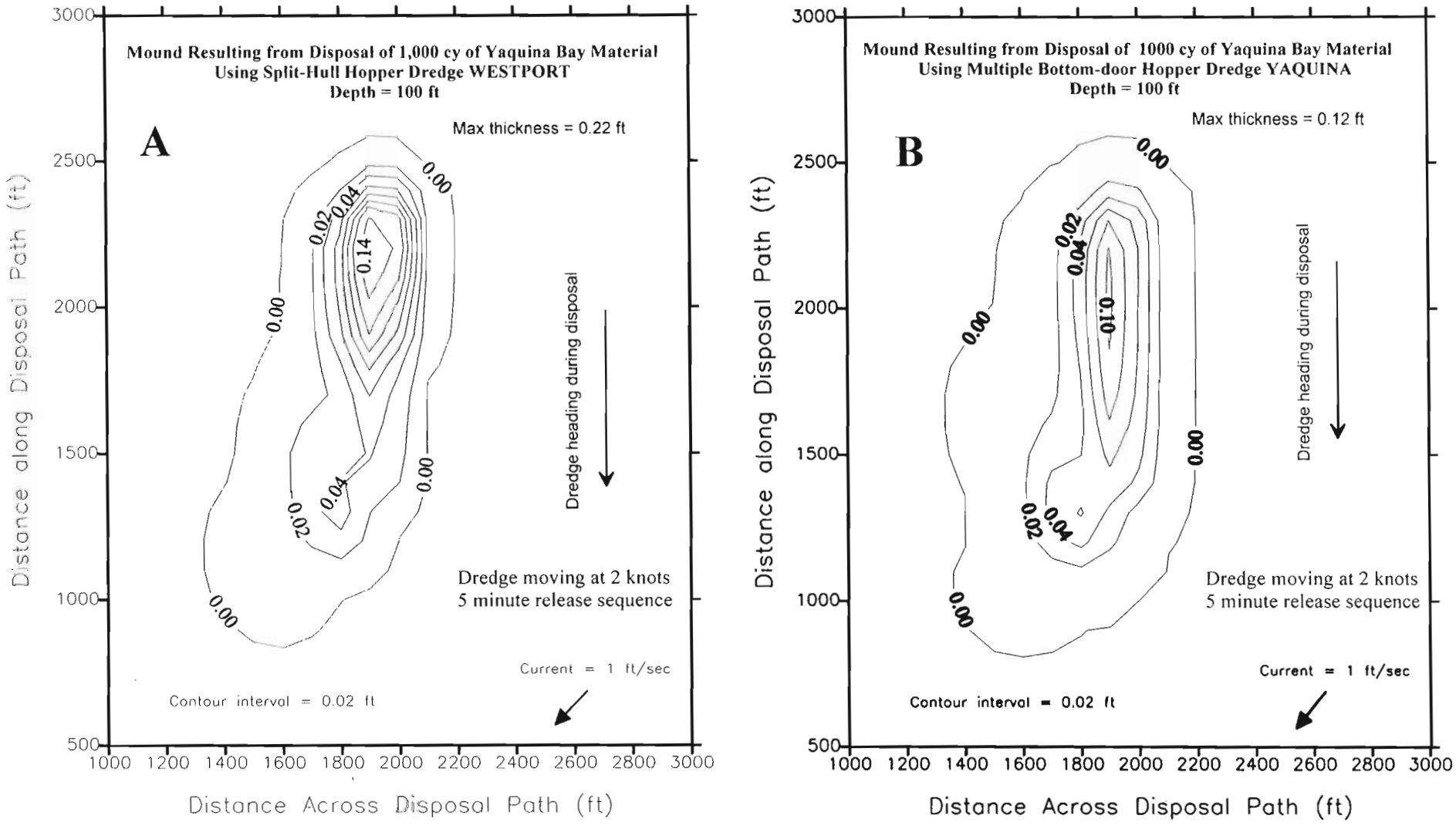



Figure 13. Predicted bottom distribution resulting from the release of 1 load of sandy dredged material in a water depth of 100 ft; for two types of hopper dredges: (A) Westport and (B) Yaquina

For similar operating conditions (vessel speed, vessel capacity, water depth, and currents), split-hull hopper dredges produce a thicker (higher) resultant mound foot-print than multiple bottom-door hopper dredges (figure 11). For average operating conditions in 100 feet of water, without a current, the dredge Yaquina will produce a deposition mound with maximum height of 0.17 ft . The *Westport* will produce a mound with maximum height of 0.3 ft.

The most significant parameter affecting mound geometry (width and height) is water depth. Increasing the water depth by a factor of 3 (60 ft to 180 ft) will decrease disposal mound height for a single dump by a factor of 3 for both types of hopper dredges (figure 12). Increasing the water depth by a factor of 3 (60 ft to 180 ft) will increase disposal mound width for a single dump by a factor of 3 for both types of hopper dredges (figure 13). This applies to dredges disposing in all current conditions tested.

Increasing current speed from 1 to 4 ft/sec (in 100 ft of water) reduces mound height by a factor of 3 for both dredges (figure 12). The presence of a current acts to displace placed dredged material away from the location of release, before the material impacts the seabed (figure 13). For disposal in a water depth of 100 ft, a 1 ft/sec current will displace dredged material 400 ft from the site of disposal before most of the material hits the seabed. For the same water depth, a 4 ft/sec current may displace dredged material 1,600 ft from the site of disposal before most of the material hits the seabed.

The nominal configuration of a dredged material mound resulting from disposal of one load by the dredge *Westport* and *Yaquina* in 100 ft water depth with a current of 1 ft/sec is shown in figure 13. The estimated areal coverage of a mound resulting from a single load placed by the *Westport* in 100 ft water depth is about 17 acres with maximum mound height of 0.22 ft, however, 90% of the mounded area is less than 0.10 ft (1.2 inches). The estimated areal coverage of a mound resulting from a single load placed by the *Yaquina* in 100 ft water depth is about 21 acres with maximum mound height of 0.12 ft, however, 90% of the mounded area is less than 0.07 ft (0.84 inches). The *Westport's* dump foot-print is samller aerially and thicker than the *Yaquina's* dump foot-print. The *Yaquina's* foot-print is more uniform in terms of deposition (thickness).

For locations offshore of Yaquina Bay where water depths range between 60-150 ft and currents are 1 ft/sec, the mound resulting from an ***individual dump*** could be expected to have the following configuration:

Mound Length: 1,200 – 2,400 ft
Mound Width: 400 – 1,300 ft
Maximum Mound Thickness: 0.1 - 0.3 ft
Displacement of Mound during Disposal: 200 – 700 ft

STFATE Conclusions

The bottom encounter processes associated with dredged material disposal (convective descent and dynamic collapse) are mainly a function of disposal water depth. For shallow water disposal (in 50 ft depth), the "impact" of the dredged material plume on the

seabed is more concentrated (in terms of dredged material plume velocity and density at the seabed) than for disposal in 100 ft of water. However, disposal at deeper water depths increases the areal extent of bottom impact as compared to disposal in shallower water depths. The seabed area affected by the convective descent phase is about 10% of the total dredged material foot-print (resulting from completion of the passive transport and diffusion phase).

The thickest area of bottom accumulation for an individual dump represents a small fraction (10% or less) of the overall foot-print coverage. For a typical disposal event, most of the disposal foot-print area is composed of a thin apron of dredged material (less than 0.10 ft thick, depending on disposal water depth).

Based on the characteristics of dredging vessels typically used at Yaquina Bay, split-hull hopper dredges (*Westport*) are estimated to produce a disposal foot-print per dump that has a maximum thickness 50% greater than the multiple bottom-door hopper dredge (*Yaquina*). Dredged material can be dispersed (spread-out on the seabed) by increasing the speed of the disposal vessel while it is placing the dredged material. If the hopper dredge speed is increased while dumping, the mound thickness of individual dumps can be significantly reduced at the expense of increasing mound length. Mound height can be reduced by 45% by increasing the speed of the disposal vessel from 2 ft/sec (1 knot) to 6 ft/sec (3.5 knots). Based on STFATE results assessing displacement of placed dredged material from the point of release, an ODMDS "buffer zone" of 500 ft (minimum) is recommended to prevent the drift or deposition of dredged material on areas outside of the ODMDS boundary, during disposal.

**Specification of Proposed ODMDS Size and Location**

The size, location, and layout of the proposed ODMDSs was based on the "site selection and management criteria" described in Section 4 of this appendix and the "general location and required size" discussed above. To summarize:

a) Based on mound height restrictions and simple geometry, the minimum size of each proposed ODMDS (for static capacity) was calculated to be 3,900 ft x 3,900 ft. See Section 6.

b) To reduce the risk of dredged material being placed outside of the ODMDS boundaries, a 500-foot "buffer" zone was inscribed within the formal site boundary. No dredged material disposal is proposed within the site's "buffer zone", although it is formally part of ODMDS. The "buffer" zone functions to keep material within the ODMDS while the placed material is falling through the water column.

c) The orientation of the proposed ODMDSs was such that the primary axis of the sites was aligned with the bathymetry contours.

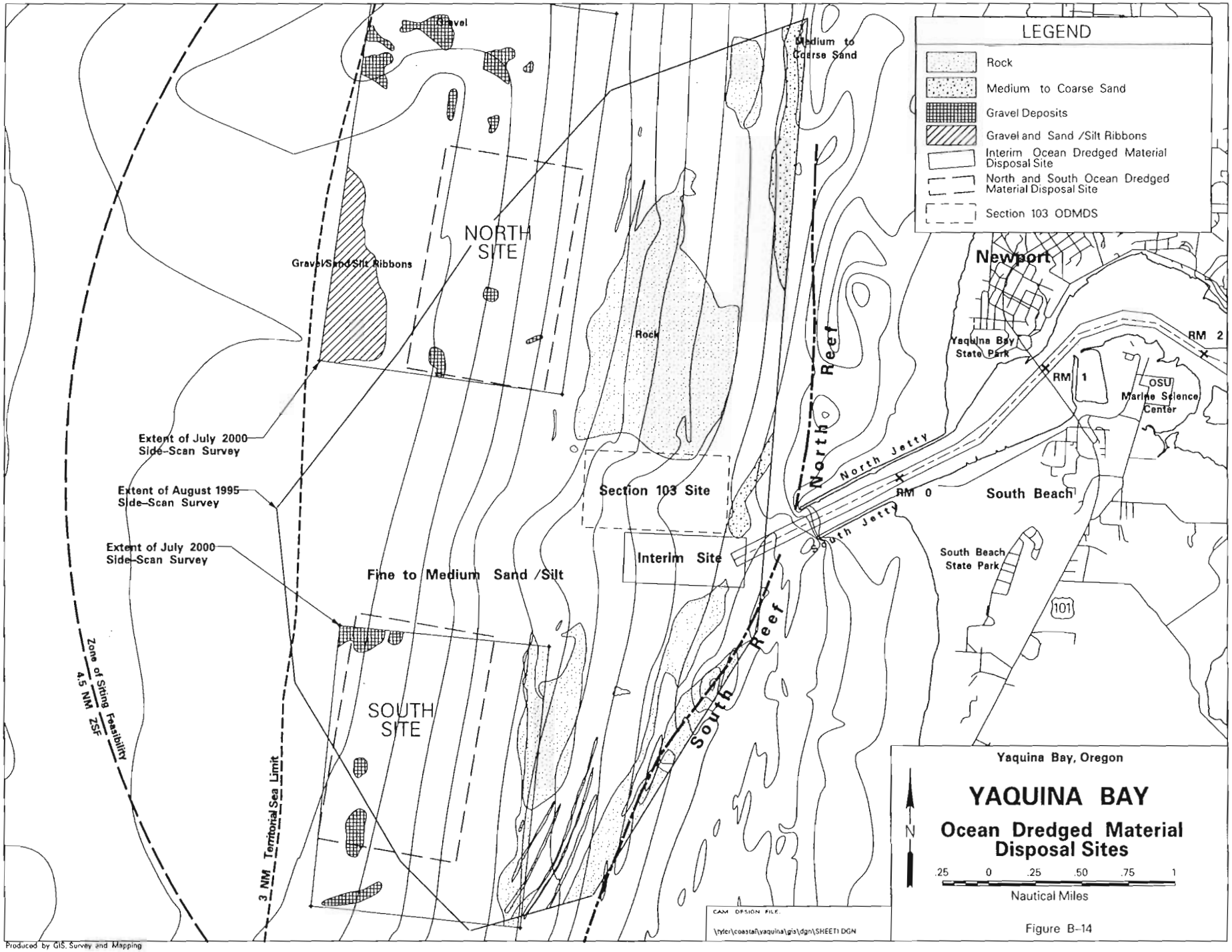

LEGEND
Rock
Medium to Coarse Sand
Gravel Deposits
Gravel and Sand /Silt Ribbons
Interim Ocean Dredged Material Disposal Site
North and South Ocean Dredged Material Disposal Site
Section 103 ODMDS
Gravel
Medium to Coarse Sand
NORTH SITE
Gravel/Sand/Silt Ribbons
Rock
North Reef
Newport
Yaquina Bay State Park
RM 2
RM 1
OSU Marine Science Center
North Jetty
RM 0
South Beach
South Jetty
Section 103 Site
Interim Site
South Beach State Park
101
Extent of July 2000 Side-Scan Survey
Extent of August 1995 Side-Scan Survey
Extent of July 2000 Side-Scan Survey
Fine to Medium Sand /Silt
SOUTH SITE
South Reef
Zone of Siting Feasibility
4.5 NM ZSF
3 NM Territorial Sea Limit
CAM DESIGN FILE
\tyler\coastal\yaquina\gis\dgn\SHEET1.DGN
Yaquina Bay, Oregon
YAQUINA BAY
Ocean Dredged Material Disposal Sites
N
.25 0 .25 .50 .75 1
Nautical Miles
Produced by GIS, Survey and Mapping

Figure B-14

d) Two ODMDS (identical in size) were proposed to facilitate adaptive management and variable dredged material placement strategies. The proposed sites are referred to as the "North" ODMDS and the "South" ODMDS.

Discounting the buffer zone, the effective usable area for each proposed ODMDS was set at 5,500 ft x 2,800 ft. This is equivalent to the minimum required size of 3,900 ft x 3,900 ft (see the ODMDS "size" calculation in Section 6). The buffer zone along the northern, southern, and western perimeters of the ODMDSs was set at 500 ft. For the purpose of FATE modeling, a larger buffer zone (800 ft) was applied to eastern perimeter of the proposed ODMDSs to account for the presence of potentially sensitive rocky bottom areas east of the proposed ODMDSs. If FATE model results show that a 800 ft buffer is not needed along the eastern perimeter of the ODMDS, the buffer can be reduced to 500 ft. Including the offset buffer zone, the overall dimensions of each proposed ODMDS is 6,500 ft x 4,000 ft.

The lineal dimensions, boundary coordinates, and water depth variation for the proposed *NEW* ODMDS are described below and shown in figure 14. Disposal boundary coordinates in state plane are Oregon north zone, NAD 27 (ft). Disposal boundary coordinates in geographic coordinates are in latitude-longitude, NAD83 (deg min sec).

***Proposed "North"*** ODMDS : dimensions = 6,500 ft x 4,000 ft, area = 597 acres, axis azimuth = 10°, average depth = 135 ft. Baseline bathymetry elevation variation = -115 MLLW to -150 MLLW

| | | | |
|---|---|---|---|
| Northwest corner - | Easting=1,057,355 ft, | Northing=375,434 ft | Lat=44 38 17.98 N, Lng= -124 07 25.95 W |
| Northeast corner: - | Easting=1,061,294 ft, | Northing=374,740 ft | Lat=44 38 12.86 N, Lng= -124 06 31.10 W |
| Southwest corner: - | Easting=1,056,226 ft, | Northing=369,033 ft | Lat=44 37 14.33 N, Lng= -124 07 37.57 W |
| Southeast corner: - | Easting=1,060,166 ft, | Northing=368,339 ft | Lat=44 37 09.22 N, Lng= -124 06 42.73 W |

***Proposed "South"*** ODMDS : dimensions = 6,500 ft x 4,000 ft, area = 597 acres, axis azimuth = 10°, average depth = 135 ft. Baseline bathymetry elevation variation = -115 MLLW to -150 MLLW

| | | | |
|---|---|---|---|
| Northwest corner - | Easting=1,054,819 ft, | Northing=362,018 ft | Lat=44 36 04.50 N, Lng= -124 07 52.66 W |
| Northeast corner: - | Easting=1,058,758 ft, | Northing=361,323 ft | Lat=44 35 59.39 N, Lng= -124 06 57.84 W |
| Southwest corner: - | Easting=1,053,890 ft, | Northing=355,617 ft | Lat=44 35 00.85 N, Lng= -124 08 04.27 W |
| Southeast corner: - | Easting=1,057,629 ft, | Northing=354,922 ft | Lat=44 34 55.75 N, Lng= -124 07 09.47 W |

## Long-Term Fate Modeling: Typical Disposal Year

Assessment of life-cycle capacity for the proposed ODMDSs was based on applying the FATE models to the "North" ODMDS. Since the physical environment is basically the same at the North site and the South site, similar FATE results are expected for the "South" ODMDS.

The bottom accumulation of dredged material placed within the proposed North ODMDS was estimated based on an annualized sequence of disposal. This was done using two different types of dredging equipment: Split-hull and Multiple-bottom door hopper

dredges. The **MDFATE** model was used to predict the bathymetric distribution of dredged material in response to a year-long disposal cycle. The focus of this endeavor was to assess the "operational dispersiveness" of the multiple-door hopper dredge (*Yaquina*) and the split-hull dredge (*Westport*). Factors under consideration include the areal extent of placed dredged material and the maximum mound height attained after a given year-long disposal cycle. Disposal parameters assumed for both types of dredging vessels are:

- Volume placed = 310,000 cy or 310 loads (annual average 1986-2000)

- Dredged material placed randomly about the center of the proposed ODMDS, using a maximum placement radius of 1,000 ft from the centroid. Water depth at the centroid of the ODMDS was about 135 ft.

- The hopper dredge approaches the disposal release point from the southeast for each dump placed.

- Other operational parameters are as stated above or in Section 8, *Measured Oceanographic Data*.

Results from the year-long simulations are shown in figure 15 in terms of accumulated placed dredged material, resulting from a one-year disposal scenario. The left-hand graphic (A) applies to the split-hull dredge *WESTPORT* placing 310,000 cy, and the right-hand graphic (B) applies to the multiple bottom-door dredge *YAQUINA* placing 310,000 cy. Note that the dredge *Westport* produced a 40% taller and more compact mound (13% smaller), than did the dredge *Yaquina*. This result is consistent with the short-term fate results, described above. Both disposal vessels produced an aggregate mound that was higher than 5 ft.

Given the above results, it would be hard to prevent accumulation of dredged material to heights less than 14 ft during a 20-year life-cycle (assuming dredged material is placed in a similar manner each year): Discrete mounds would likely overlap and accumulate to heights greater than 14 ft. Recall from the ODMDS "size" calculation shown in Section 6 (figure 9), that for an areally large mound in 135 ft depth, the maximum mound height that will not affect waves is 14 ft.

It is apparent from both the *Westport* and *Yaquina* disposal scenarios shown in figure 15, that "point" disposal methods (random placement about a specified point) are not sufficiently distributive, in an operational sense, for the successful long-term management of site capacity within the configuration of the proposed ODMDSs. To avert future static site capacity problems at the proposed ODMDSs, it is recommended that a pro-active approach be used to enhance the uniform distribution of dredged material during disposal. Basically, this entails the use of a placement grid to evenly distribute the placement of dredged material within the ODMDS by assigning the "starting point" of each dump within specified grid cells. The "placement grid" method of dredged material disposal is discussed below.

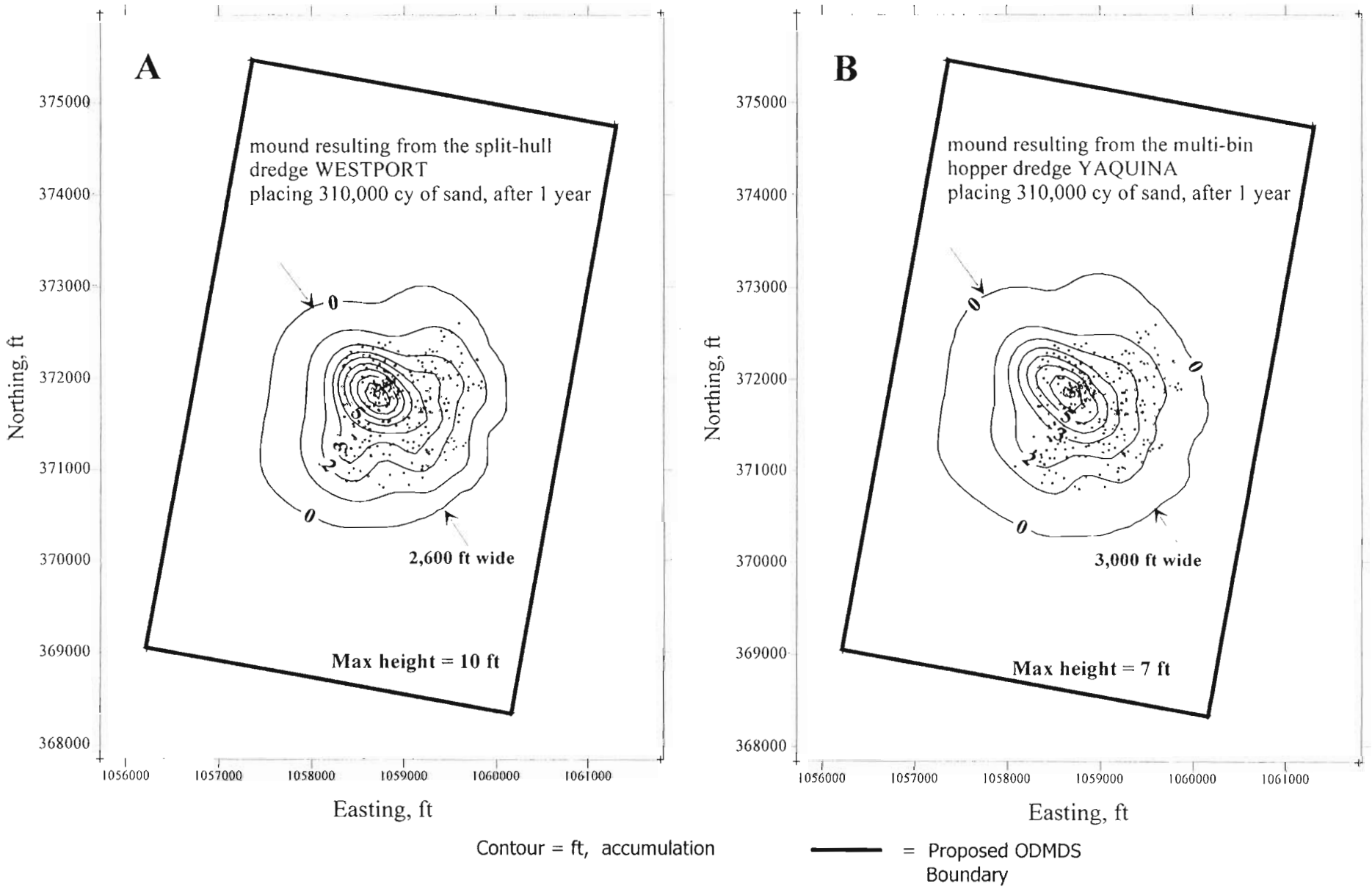



Figure 15. Accumualiton of dredged sand placed within center of proposed North ODMDS for a SPLIT-HULL hopper dredge, 1000 cy per load (A), and MULTI-BIN hopper dredge, 1000 cy per load (B).

Long-Term Fate Modeling: 20-Year Life-Cycle

The "operational" capacity of the proposed North ODMDS was assessed for a 20-year life-cycle by conducting 20 back-to-back year-long disposal operations. The goal was to verify that by distributing the placement of dredged material throughout the usable part of the ODMDS that: A) dredged material is not deposited outside the formal boundaries of the ODMDS during the placement; and B) dredged material does not accumulate higher than 14 ft after 20 years of site use. The MDFATE model was used for this series of simulations. For each year of simulation, disposal processes (short-term fate) and bottom transport processes (long-term fate) were included. The left graphic in figure16 shows the baseline bathymetry condition of the proposed North ODMDS.

ODMDS Disposal Placement Grid

For this life-cycle assessment, uniform thin-layer placement of dredged material was accomplished by using a grid of 32 - 700 ft x 700 ft cells to establish the *release point* for each load of dredged material. The "placement grid" was contained inside of the ODMDS buffer zone. The "placement grid" was used to guide the distribution of dredged material disposal for each year.

9-10 dumps per grid cell were needed for the dredge *Westport* (*Yaquina*) to place 310,000 cy of dredged material within the site per year. It was assumed that both the *Westport* (30%) and *Yaquina* (70%) would be used for dredging/disposal during the 20 year period. The selection of each simulated dump location was chosen randomly based on a 500-foot radius from the center coordinate for each cell. The center of each grid cell is shown in figure 16 (left graphic, "+"). Note that "usable" area of the ODMDS is inscribed by the buffer zone (dashed line).

Year 1 of 20-Year Disposal Sequence

The first year of the 20-year "operational" capacity assessment was simulated based on the dredge *Yaquina* performing dredged material disposal within the proposed North ODMDS. The 32-cell "placement grid", described above, was used to control the disposal of 310 loads of dredged material within the North ODMDS boundaries. The resultant dredged material accumulation, after 1 year of disposal, is show in the right graphic of figure 16. The maximum height of dredged material accumulation is estimated to be 1.2 ft and all placed dredged material is contained within the North ODMDS boundaries. Due to the low relief of the dredged material mound, very little material was affected by waves/currents during the first year of simulation.

Comparison of figure 16 (right graphic) with figure 15 (left graphic) clearly shows that the "placement grid" method of disposal control is superior to "point dump" methods for dispersing material uniformly with an ODMDS.

Complete 20-year Disposal Sequence

The disposal of 6.2 million cy of dredged material (sand) was simulated based on the dredge *Yaquina* placing 70% of the material and the *Westport* placing 30%. Results of the 20-year disposal sequence are shown in figure 17. The left graphic of figure17 shows the predicted 20-year bathymetry within the proposed ODMDS. Note that the depth contours are displaced oceanward from the baseline condition. The right graphic of figure 17 shows the vertical and areal extent of the dredged material mound resulting from 6.2 million cy of disposal. Note that the maximum height of the resultant dredged material mound is estimated to be 12 ft, which is 2-ft lower than the limiting mound height required to meet the wave amplification constraint (see the ODMDS "size" calculation in Section 6).

Based on the above long-term simulation results, each proposed ODMDS is expected to provide sufficient static capacity for at least a 20 year life-cycle without impacting wave conditions at the site. Although the dynamic capacity of the proposed ODMDS (after 20 years of dredged material accumulation) is estimated to be 100,000 cy/year, this was not considered part of the site's operational capacity. Collectively, both the North and South sites are estimated to provide over 40 years of capacity for the placement of Yaquina Bay dredged material. The net direction and distance of sediment movement off of the mound is estimated to be toward the WNW (300°) at 120 ft/year. Based on the estimated deposition pattern shown in figure 17B and the direction of dredged material movement (after placement at the North or South sites), a uniform 500-foot buffer area is appropriate for the proposed sites. In other words, the 800-ft buffer area along the eastern perimeter of the proposed sites is not needed.

## Summary of Fate Modeling Results

The proposed North ODMDS shown in figure 10 (and left graphic of figure 16) appears to be capable of receiving 310,000 cy/yr of dredged material disposal for a period of 20-years (6.2 million cy total) without impacting the present wave climate. This assessment is based on results obtained using the MDFATE model.

The 20-year capacity of each proposed ODMDS can only be met if a "placement grid" or equivalent method of disposal control is used to evenly distribute dredged material within the site during disposal. The "placement grid" would consist of 32 - 700 ft x 700 ft cells to "distribute" the *release point* for each load of dredged material.

Net long-term movement of the dredged material placed at the proposed ODMDS would be toward the north-northwest, away from any known rock outcrop features. A 500-foot "buffer zone" should be inscribed within the proposed North and South ODMDS boundaries to keep material within the ODMDS during dredged material placement.

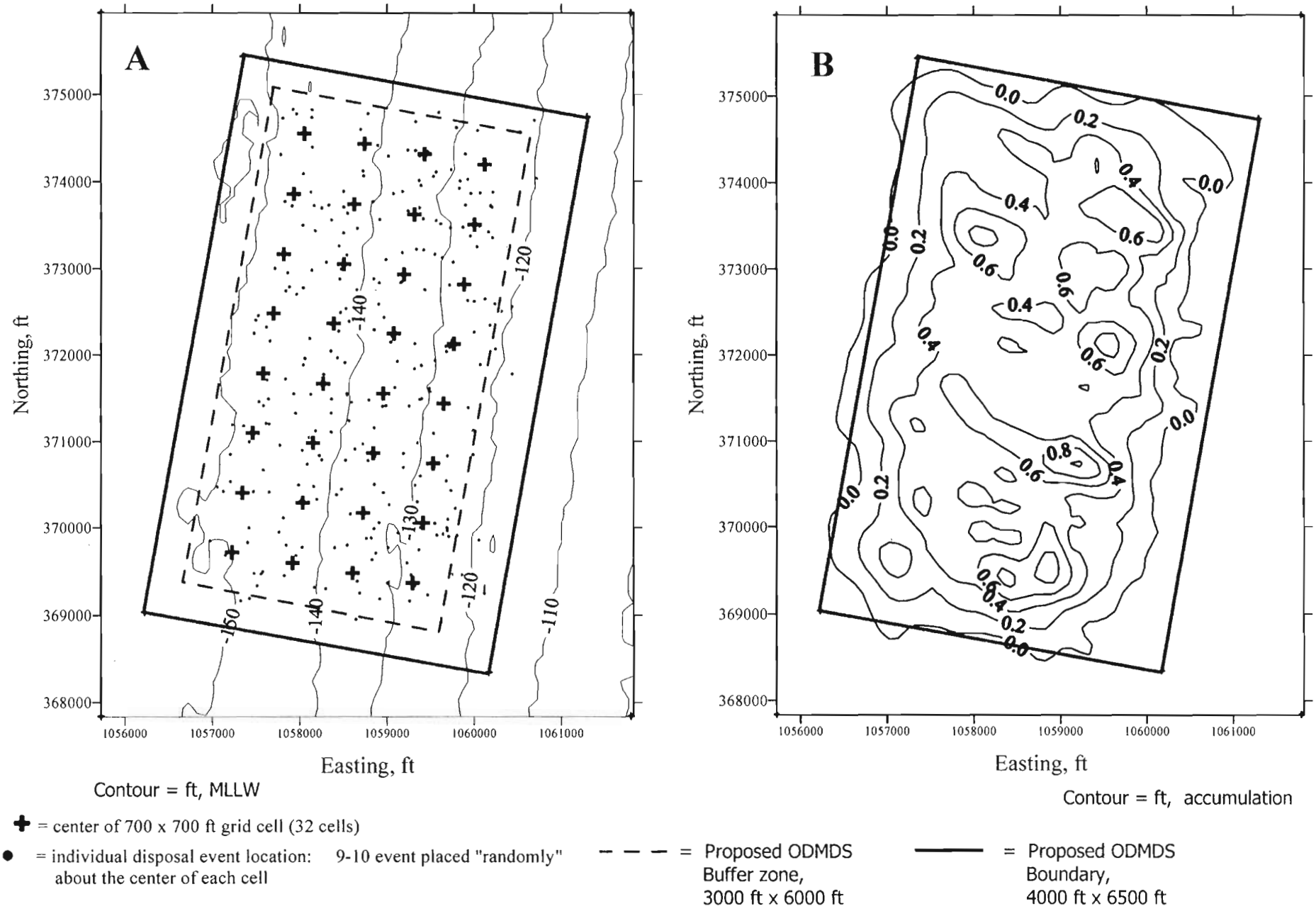



Figure 16. Baseline (2000) bathymetry at the proposed "North " ODMDS (A) and estimated accumulation after 1 year of dreged material placement by the hopper dredge Yaquina (B)

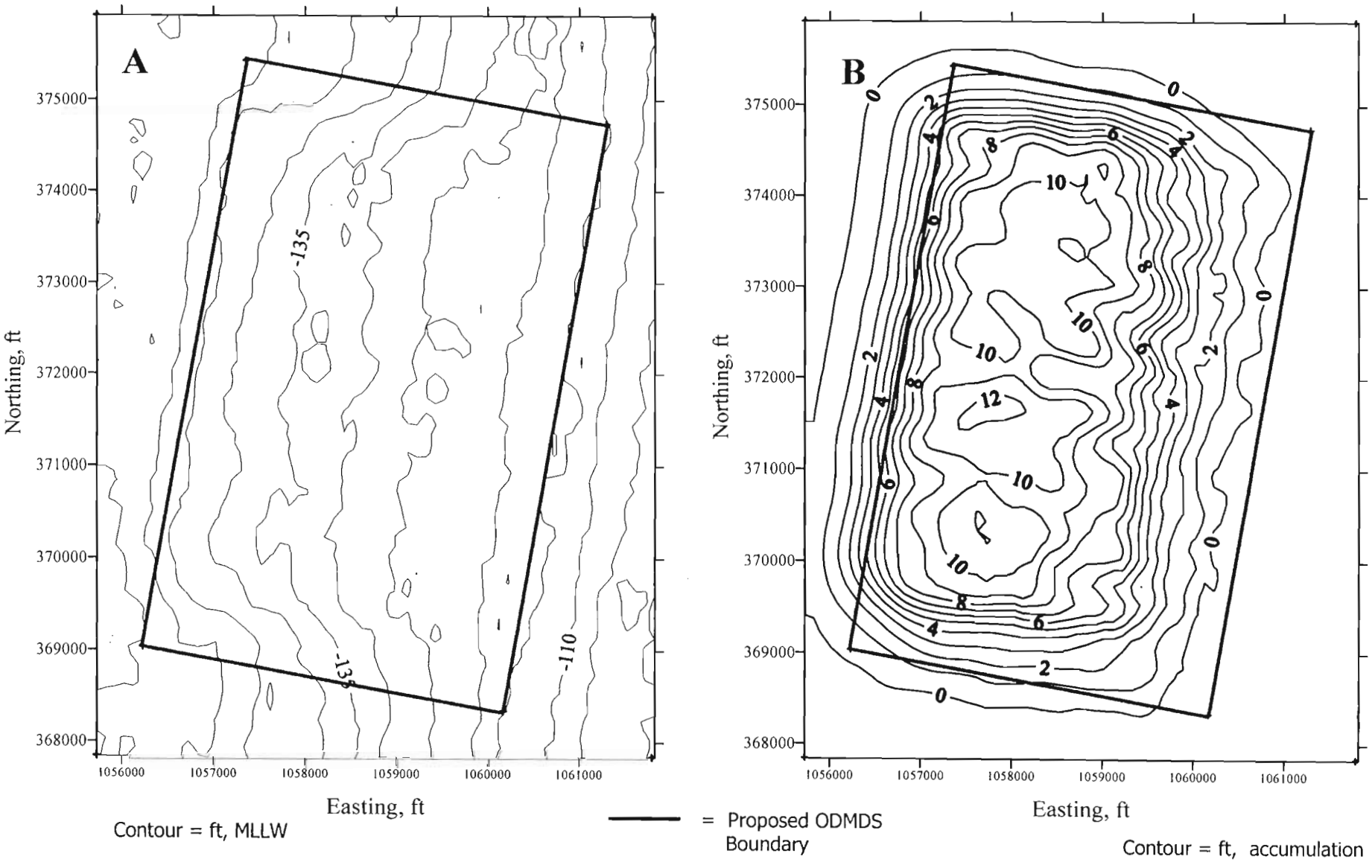



Figure 17. Predicted bathymetry at porposed North ODMDS after 20 years of dredged material placement (A) and corresponding vertical accumulation (B).

**Physical Impacts due to Dredged Material Disposal at Proposed ODMDSs**

Accumulation of Dredged Material Placed. The seabed at the proposed North and South ODMDSs will be subjected to various degrees of dredged material accumulation (burial) during dredged material disposal operations. On a per dump (individual disposal vessel load) basis, the seafloor at the ODMDSs could be subjected to individual burial events ranging from 0.01 – 0.3 ft thick and covering 5-20 acres of seafloor. On a seasonal basis (after an entire dredging-disposal season), the sites may be subjected to dredged material accumulation ranging between 1-10 ft thick covering an area of 100 – 500 acres; depending upon the disposal scenario. Generally speaking, the more confined the area over which dredged material placement occurs, the higher the accumulation.

Modification of In-Situ Surface Sediment Gradation. There could be a slight change of the surface sediment texture (grain size) at the proposed ODMDSs, in response to dredged material disposal. Specifically, the average grain size of seabed sediment within the sites will likely increase due to the placement of dredged material that is slightly coarser than in situ sediments. The overall physical properties of the pre-disposal seabed sediment within the proposed ODMDSs would not be changed: Sand (sediment dredged from the Yaquina Bay project, which is about 95% of all sediment dredged at Yaquina Bay) will be placed on sand (in situ sediment residing on the seabed of proposed ODMDSs). The mean grain-size of in situ seabed sediment within the ODMDSs varies between 0.10-0.20 mm and has a fine-grain material content of 0-10%. The mean grain-size of 95% of the dredged sediment to be placed within ODMDSs varies between 0.15-0.25 mm and has a fine-grain material content of 1-4%.

A small amount of fine-grained dredged sediment may be placed at the proposed ODMDSs. This dredged material originates from periodic dredging of South Beach marina, North Bay marina, Depot Slough, and potentially other permitted projects. The quantities of fine grained sediment to be placed at the proposed ODMDSs is about 5% of the total volume dredged at Yaquina Bay. It is expected that placement of such small amounts of fine-grain sediment within the proposed ODMDSs will not significantly alter the characteristic grain size of native sediment within or outside the ODMDSs.

Modification of Existing Wave Environment. Use of the proposed North and South ODMDSs will not degrade the existing wave environment either within or outside the ODMDS boundaries.

Modification of Existing Current Environment. Placement of dredged material within the proposed North and South ODMDSs may have a minor affect on circulation within or outside of the site boundaries. Due to the size of the mound resulting from accumulated dredged material placed at the sites (10-14 ft high covering a 0.6 sq. mile area) over a period of 20 years, it is possible that currents in vicinity of ODMDSs could be affected by disposal operations. A vertical accumulation of 14 ft of dredged material within a water depth of 115 ft will directly affect 10% of the water column: This amount of "protrusion" may modify currents at the disposal site. If realized, the effects upon the

site's current field would not occur until a substantial volume of dredged material has been placed a the site ( 4-6 mcy, or after 15-20 years disposal).

Littoral Budget. Most of the sand dredged from the Yaquina Bay entrance channel originates from the marine environment. It is possible that dredged sand placed at the proposed North and South ODMDSs could be removed from the littoral budget for 10-20 yrs (until infrequent large storms can transport the sand back toward the shore). An important question relating to the siting and longterm management of proposed ODMDSs at Yaqunia Bay are: Will the use of the proposed North and South ODMDSs affect the littoral sediment budget in vicinity of the Yaquina Bay entrance? And, if the littoral budget is affected, could there be an associated effect on coastal beaches near the jettied entrance? To address the above questions, some assumptions must be made:

1) An undetermined but substantial percentage of the sand dredged from the entrance channel originates from active littoral area immediately north and south of the jettied entrance. The active littoral area is the upper shoreface, generally where depths are less than 60 ft. Further assume that a percentage of dredged material that has been placed at past/present (Interim and Section 103 sites) ODMDSs was transported back to the active littoral budget.

2) The present littoral budget is in equilibrium with present dredging and disposal practices. That is, use of past/present ODMDSs has not significantly altered the littoral budget or affected coastal beaches near the entrance.

3) The dredged sand placed at the proposed ODMDSs will be removed from the active littoral budget for a number of years (until infrequent large storms can transport the sand back onto the upper shoreface). Longterm removal of sand from the active littoral budget could produce a recession response of the upper shoreface.

Based on the above assumptions, use of the proposed ODMDSs may remove a percentage of sand from the active littoral budget at the Yaquina Bay entrance. If the active littoral budget is reduced, recession of the upper shoreface may occur. Using the proposed North and South ODMDSs for placement of all sediment dredged from the Yaquina entrance channel could result in erosion of the upper shoreface (and possibly beaches) within close proximity to the jettied entrance. Although this finding is based on conjecture, engineering judgement and experience; it describes the potential for shoreface recession in response to the use of the proposed new ODMDSs for the placement of all sediment dredged from the Yaquina entrance channel.

Changes at Existing ODMDSs. Designation (and use) of the proposed North and South ODMDSs will result in discontinuation of dredged material disposal with the Interim and Section 103 ODMDSs. The 18-foot high dredged material mound within the existing Section 103 ODMDS will be reduced by 1-3 feet per year: The mound will be completely dispersed by waves and currents within 14 years, after dredged material placement within the site ceases. The sediment within the Section 103 site will be returned to its pre-disposal condition as the dredged material mound is dispersed. The present bathymetry and seabed composition within the Interim ODMDS resembles the native environment.

## Section 7
# OCEANOGRAPHIC PROCESSES

## Offshore Regional-Scale Circulation

Circulation processes in the coastal waters near the Yaquina Bay result from an interaction of regional oceanic circulation, astronomical tides, wind-generated surface waves and currents, and estuarine flow. One of the direct effects of circulation processes at the entrance to Yaquina Bay is on the transport and seasonal distribution of sediments. These processes act on ebb-tidal shoal and littoral sediments (depths <120 ft) to produce the bathymetric condition observed at any particular time. Time scales for circulation processes range from seconds for wind generated waves to months for seasonal weather patterns to years for large-scale events such as El Nino.

From a sediment transport point of view, the Oregon continental shelf can be divided into three cross-shore regions [Sternberg 1986]. The first of these regions is the outer shelf (depth >300 ft) where shoaling internal waves and large scale wind-driven currents affect the movement of bottom sediments. The second cross-shore region is the mid-shelf (120-300 ft depth), over which wind-driven currents are the most important factor. The third and most active region is the inner shelf (depth <120 ft), on which shoaling waves and tidal (and estuarine) induced currents are at least as important as wind-driven currents for transport of bottom sediments. For the most part, the assessment of existing and proposed Yaquina ODMDSs is limited to the inner and mid shelf region.

Circulation of the continental shelf waters off Oregon is thought to be nearly geostrophic, i.e. friction plays a minor role in determining the water column circulation when compared to sloping sea surfaces, sloping internal density surfaces, and the rotation of the earth. Consequently, mean circulation on the shelf tends to be along the bathymetric contours.

Circulation of coastal (inner shelf) waters is subject to seasonal reversal, being northward during winter and southward during summer. On time scales of several days, coastal circulation can be highly variable in direction and speed with fluctuations correlating with changes in sea level and the alongshore component of wind [Huyer 1977]. The alongshore component of the coastal current regime is substantially stronger and more responsive to changes in wind conditions than is the onshore-offshore component of current [Collins 1970]. Fluctuations in the mean alongshore circulation appear to be coherent over distances of 125 miles and are independent of depth in both phase and magnitude to approximately 70 ft depth [Huyer 1977]. The magnitude of alongshore current fluctuations decreases rapidly with distance offshore and increasing water depth. Currents averaged over very long periods, e.g., longer than 50 days, correlate better with sea level changes than with winds to depths of 120 ft. By 250 ft depth, the influence of both sea level and winds appears to be substantially diminished and other processes such as tides, regional circulation, and internal waves control the current regime.

## California and Davidson Currents

Net regional circulation along the continental shelf of the Washington and Oregon coasts has been characterized in terms of two seasonal current regimes: summer and winter [Bourke 1971]. Offshore of the continental shelf break (>20 miles from the coast), surface flow down to 500 ft depth is dominated by the California current. The California current is a broad, shallow, slow moving current which flows southward throughout the year at speeds of 0.1-0.7 ft/sec as a diffuse band about 300 miles wide. Inshore (east) of the California is a seasonally varying flow called the Davidson Current.

The Davidson current is a northward flowing current attaining speeds of 0.3 to 1.0 ft/sec over extensive distances. On the surface waters of the continental shelf, this current responds to the seasonal wind patterns of the northeast Pacific: The Davidson current develops off of the Oregon-Washington coast in September and becomes well established in January in response to southerly winds. The surface expression of the Davidson current diminishes towards the spring, disappears by May, and becomes incorporated into the permanent California current [Bourke 1971]. The subsurface part of the Davidson current is believed to flow northward throughout the year.

## Shelf Circulation

A generalized model for the seasonal changes in the alongshore and offshore circulation along the Pacific Coast of Washington and Oregon has been developed [Huyer 1977 ]. The *summer circulation* of surface water on the continental shelf is influenced by the southward flowing California current which attains maximum strength during the summer when surface winds are consistently from the north-northwest. *Winter circulation* of shelf waters is dominated by the northward flowing Davidson current which attains maximum strength due to winter storm (wind stress) patterns. The subsurface part of the Davidson current (below 300 ft depth) is believed to flow northward throughout the year, although the surface waters respond to seasonally varying wind stress patterns (reversals). Thus, the net direction of bottom currents on the mid- and outer continental shelf is believed to be northward and along shore.

### Inner-Shelf Circulation

Vertical mixing of the inner shelf waters is at a maximum during the winter (December - March) when currents are nearly uniform in speed and direction throughout the water column. During winter, significant wind-generated currents develop in response to strong southerly storm winds. Wind-induced currents may exceed 2 ft/sec flowing northward with event persistence of 5 to 7 days. Wind-driven currents develop within a few hours of the onset of strong winds, then decrease slowly over several days following cessation of the winds.

With the onset of southerly winter winds resulting in northward flow, surface coastal waters are directed northward and landward due to Coriolis deflection resulting in downwelling along the coast: Bottom water is directed offshore. The mean alongshore

circulation of surface coastal waters during winter is northward at 0.3 - 0.8 ft/sec. The inner shelf current can be highly variable over periods of several days: Southerly flow (north to south) can sometimes occur during the winter.

Mid-Shelf Circulation

The transition from the winter circulation regime to the spring and summer regime is abrupt along the middle and inner shelf , occurring only in about a week during a strong northerly wind event. The transition is the result of a large cumulative offshore transport of surface water caused by local wind stress and the establishment of strong offshore density gradients in the shelf waters. Upwelling is associated with the spring current transition and continues into July or August. The offshore density gradients are associated with the persistent southward surface current and upwelling due to the summer oceanographic season.

During the summer, southward surface currents can approach 1.3 ft/sec. Reversals in current direction rarely occur during summer. With onset of northerly summer winds (southward coastal current), surface coastal waters are directed offshore due to Coriolis deflection resulting in upwelling along the coast: Bottom water is directed onshore.

During summer, a strong vertical gradient (shear) of the alongshore current can be found over the middle and outer shelf. The subsurface current is northward while the surface current is southward. Maximum surface current speed over the midshelf (5-10 miles offshore) occur during June when the southward flow is reinforced by strong northerly winds. The bottom current along the mid-shelf is reduced, due to the high gradient between surface and bottom waters. The bottom current for inner shelf waters is dominated by surface circulation ands tends to be stronger and more consistently southerly (during the summer) than the bottom circulation further offshore.

The transition between summer and winter nearshore circulation is gradual. The offshore shear zone between the northward flowing bottom waters of the outer-shelf and the southward flow of nearshore coastal waters expands upward and shoreward under the influence of fall and winter southerly winds. Reversal of surface water circulation over the shelf occurs when the winter regime of northward flow (Davidson current) is re-established throughout the water column [Sobey 1977 ].

## Littoral Sediment Transport

Along the inner- and mid-shelf zone of the Oregon coast (water depths less than 300 ft), currents induced by wind, waves, and tides are primarily responsible for sediment transport through the water column and on the seafloor. Wave-induced currents tend to diminish inversely with (water depth)$^{1/2}$ [Komar et al 1972]. The closer one moves toward shore (the shallower the water depths), the more energetic the effects of wave shoaling will be throughout the water column. Increased wave shoaling accompanied by an ambient current can produce a high sediment transport potential (see Hallermeier Sediment Transport Limits, Section 5, of this appendix). The seaward limit of active

littoral zone coincides with the Hallermier closure depth $\mathbf{d}_{\ell}$ , which is 60 ft at Yaquina Bay. In water depths less than 60 ft along the project area coast, wind- and wave-induced currents dominate the transport of sediment along the seabed. This area is called the ***littoral zone***. Within the littoral zone of Oregon, the seabed sediment is primarily composed of sand, gravel, and cobbles. Sediment smaller than sand (silt and clay) generally does not reside within the littoral zone of the Pacific NW due to the high mobility of fine-grain sediment. Near the Yaquina Bay entrance, littoral sediments are composed of fine-medium sand. In fact, much of the sediment dredged from the Yaquina Bay entrance is littoral sand or marine origin (the sand was either transported to the coast via rivers long ago or the sand is a product of bluff/rock outcrop erosion).

The transport of bottom sediment within the littoral zone, due to waves and currents, is called ***littoral transport***. In general, littoral transport is a function of wave height and period, bottom sediment size, and strength of ambient current. There are two directional components of littoral transport: cross-shore or perpendicular to shore (onshore-offshore) and alongshore (updrift-downdrift). As waves approach the coast, water depth becomes progressively shallower causing the waves to shoal. Eventually, the shore incident waves break due to bottom friction and conservation of momentum. The dissipation of energy due to wave shoaling and breaking acts to transport bottom sediment, (usually) in the direction of wave propagation. The angle at which waves approach the coast dictates the degree of alongshore and cross-shore littoral transport. For example, waves that approach the shore obliquely tend to produce more alongshore transport than waves which approach the shore straight-on. Cross-shore transport is more complex than alongshore transport: Under some wave conditions bottom sediment can be transported offshore while at other times bottom sediment can be transport onshore. In general, the direction of cross-shore transport for sand-sized sediments along coastal areas of the Pacific Northwest is assumed to be onshore during summer and both onshore and offshore during winter.

Although the dominance of southerly waves (and associated northward littoral transport) during the 5-month period of December - March is a documented fact, the remainder of the year is characterized by northerly waves and an attending southward littoral transport. It is possible that the wave and current regime present during the remaing 7 months could generate littoral transport that approaches the transport experienced during the more energetic 5-month period of the year. The onset of long-term climatic perturbations such as El Nino and La Nina can modify the directionality of waves making landfall on the Northwest US coast, greatly affecting the directionality and strength of the littoral current. Long-term changes in the littoral environment are likely responsible for whether littoral sediment (sand) is transported north or south along the Northwest US coast.

Estimates for gross alongshore transport (direction independent) along the Oregon-Washington Coast exceed 1 million cy per year. In many locations along Oregon, the net longterm average long shore transport rate is postulated to be close to 0 [Komar 1997]. Due to the complexities of the nearshore reef system north and south of Yaquina Bay, a conclusive description for the net direction and magnitude of alongshore transport along coastal areas north and south of Yaquina Bay entrance is not available.

Based on longterm average annual conditions and the orientation of beach alignment north and south of the jettied entrance at Yaquina Bay, it appears that net littoral transport at Newport is slightly toward the north. The issue of "north vs. south" littoral transport at the Yaquina Bay entrance is an important consideration for an ODMDS which is to be located within the littoral zone. However, the proposed North and South ODMDSs are not located within the littoral zone (60 ft or less); minimum water depth for the proposed ODMDSs will be 115 ft. It is anticipated that "littoral transport" at the proposed ODMDSs will occur only during severe (storm) wave conditions. Dredged material placed within the proposed ODMDSs may be impounded from the littoral zone for 10-20 years.

If the opportunity arose for dredged material to be placed in the nearshore, it is recommended that an equal volume be placed north and south of the Yaquina Bay entrance at alongshore distances no closer than 2,000 ft from the entrance. If the opportunity arose to place dredged material directly on the beach, it is recommended that the dredged material be placed further than 300 ft to the north of the north jetty.

## Summary of Seasonal Changes in Circulation

In general, there are three oceanographic seasons for circulation of coastal waters on the inner shelf of Oregon [Borgeld 1978]. These seasons are briefly defined as:

> **Fall -Winter** - Onset of the Davidson current occurs and the coastal current is directed northward by southerly winds. The Fall-Winter season is generally defined as November - March.
>
> **Spring** - Onset of the upwelling regime along the continental shelf. Transition between the Davidson and California current regimes occurs in offshore waters. The coastal current begins reversal from northward to southward flow. The Spring season is defined as April - June.
>
> **Summer** - Southerly circulation of shelf waters induced by the California current. The coastal water is directed southward by northerly winds. The Summer season is generally defined as July - October.

## Cross-shore Circulation

The upwelling and downwelling circulation due to Coriolis deflection induces seasonally varying cross-shore transport of shelf bottom water (Ekman transport) and sediments. Offshore transport of shelf bottom water occurs during winter and onshore transport occurs during summer. Within the immediate vicinity of Yaquina Bay, estuarine circulation also induces cross-shore transport during ebb-tide (offshore flow), flood-tide (onshore flow), and periods of high river discharge (offshore flow).

Significant cross-shore circulation occurs along the Oregon Coast during the upwelling (summer) season [Pillsbury 1972 and Huyer 1976]. This occurs when shelf bottom water moves onshore and converges with less dense (warmer) water of the inner shelf.

The cross-shore section shown in figure 18 illustrates the mean circulation induced by the upwelling along Oregon continental shelf. The shaded zone is the permanent pycnocline (zone of rapid density change w.r.t. depth), which is normally located at depths greater than 130 ft in offshore waters deeper than 200 ft deep (6-10 miles offshore).

With the onset of coastal upwelling, the pycnocline rises and is pushed shoreward. When upwelling is fully developed, the pycnocline intersects the water surface within 10 miles from shore. Above and offshore of the pycnocline, mean flow is to the south as expected for the summer season. About 130 ft below the permanent pycnocline, flow is to the north. Under strong upwelling conditions, southward circulation is reinforced in the nearshore waters and the deeper north flowing current weakens and may disappear. Mean currents within 60 ft from the surface are south and offshore at speeds of 0.5 ft/sec due to the influence of the summer wind field combined with upwelling conditions.

Generally speaking, the proposed North and South sites are located within the area of coastal upwelling, but are well inshore of the "mixing" zone (or surface front) associated with the convergence of dense bottom water from the outer shelf and warmer less dense water from the inner shelf. While upwelling increases biological productivity along the coast, the location of the surface front is where intense biologic activity occurs.

## Long-Period Waves

Superimposed upon the slowly varying regional or seasonal circulation are periodic currents due to tides, inertial currents, and internal waves. While variations in wind speed and direction at durations longer than 2 days are reflected in surface currents, shorter duration wind events can give rise to inertial currents that have 17 hour periods and speeds exceeding 0.3 ft/sec [Huyer 1977 ].

Continental shelf waves are long waves typically generated by atmospheric pressure/system movements. These shelf waves have periods of 4 - 6 days and propagate toward the north along the western coast of North America. The magnitude of the current associated with shelf waves is on the order of 0.10 ft/sec [Moores 1968 ]. Shelf-wave flow is uniform throughout the water column and is directed along the shelf. This type of flow may have a significant long-term effect on the transport of fine (silt-clay) sediments, if placed in water depths greater than 120 ft.

Astronomical tides at the Yaquina Bay entrance have diurnal inequality typical of the Pacific Coast with a long ebb from higher high to lower low water. Mean tidal elevation is + 4.15 ft mean low lower water (MLLW). The mean tidal range at the Yaquina Bay entrance is 5.9 ft, the range from MLLW to MHHW is 7.9 ft. Extreme tides range form -3 ft MLLW to +11.5 ft MLLW [NOAA 1994]. Offshore Yaquina Bay, tidal currents are believed to account for more than half of the water motion over periods of several days [Stevenson 1974 ].

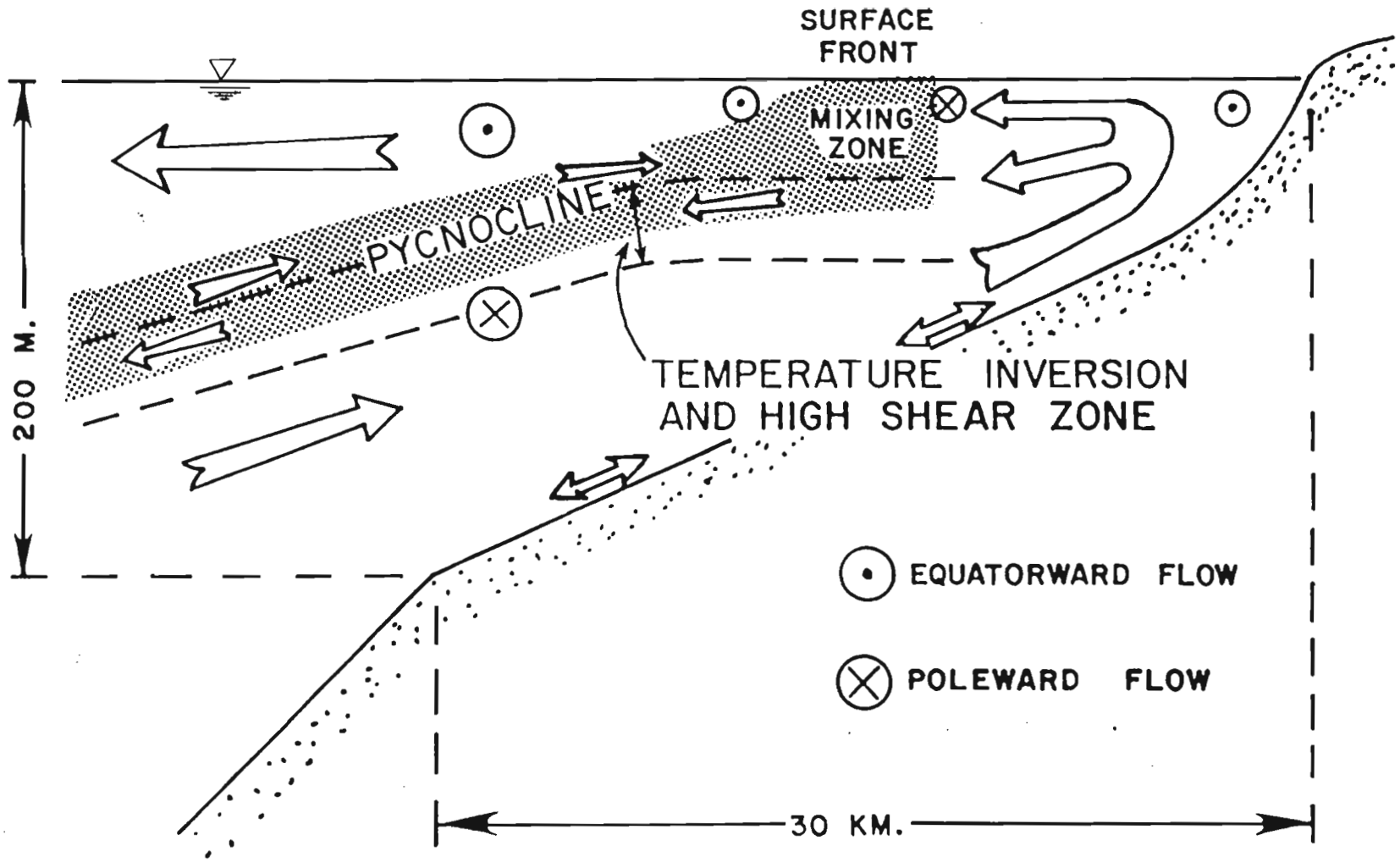



Figure 18. Mean Circulation in the Coastal Upwelling Region off Central Oregon

The tidal current for a given coastal location can be described in term of two components: (A) The **shelf tidal current** driven by the approach and passage of the tidal wave over the continental shelf and is uniform throughout the water column, and (B) The **estuarine tidal current** generated by flood and ebb flow from a nearby estuary/embayment, which is generally confined to depths shallower than 70 ft. Offshore of Yaquina Bay, the shelf tidal current is rotary. The estuarine (plume) driven tidal current at locations within ½ mile of the jettied entrance at Yaquina Bay is appreciable due to the size of Yaquina Bay and the constricting nature of the jettied entrance. The shelf tidal current offshore of the Yaquina Bay entrance may at times be partially or entirely masked by wind-driven, river discharge, or estuarine tidal currents.

Offshore Rotary Currents

Rotary currents are tidal currents that continually change direction, periodically with time, so that in 12.5 hours the current will have set in all directions of the compass. The rotary current Offshore of Yaquina Bay generally floods towards 60° (T), and ebb towards 240° (T). Rotary current speeds have been measured at between 0.2 ft/sec and 0.5 ft/sec [Stevenson 1969].

## Section 8
## MEASURED OCEANOGRAPHIC DATA

Predictions of future ODMDS capacity requirements are highly dependent upon the quality of oceanographic data available. Analyses of the fate of dredged material placed in open water, can only be as accurate as the poorest estimate for the forcing environment and dredged sediment composition. relevant oceanographic data used in this appendix to simulate dredged material disposal at Yaquina Bay include:

- bathymetric surveys at existing and proposed ODMDS locations
- physical/textural properties for native seabed sediments at and dredged materials to be placed at ODMDSs
- wind-generated surface wave characteristics
- Newtonian tidal signal (for surface elevation and currents)
- residual currents for each oceanographic season

### Hydrographic Survey Data

Hydrographic surveys at the Yaquina Bay "approaches" and ODMDS have been digitally recorded since 1983. Areal coverage of the ***approach surveys*** is from the seaward jetty ends to 2 miles offshore and 2 miles north and south of the navigation channel. Survey frequency is about once every 2 years . Areal coverage of each ***disposal site*** survey typically extends 500 feet beyond the sites' formal boundary, the survey frequency is twice per year. Elevation (z) values for the hydrosurvey data are recorded in ft, MLLW

which is -4.15 NGVD. The horizontal datum (x,y) is Oregon State Plane, north zone, NAD 27.

Survey Error Assessment

Horizontal control (x,y) for the Yaquina surveys is ±3.3 ft (±10 ft before 1987). The vertical accuracy of the wave motion compensator is 5% of the vertical displacement: For a 6-foot swell, this is about ±0.5 ft. The accuracy for vertical data (z), corrected for heave-pitch-roll, at 100-foot water depth is ±1.5 ft. This represents the **random error** inherent in the depth data (z) for hydrosurveys. In summary , the estimated accuracy statistics for the hydrographic surveys are:

Random error for X,Y data = ±3.3 ft (±10 ft before 1987)
Random error for Z data = ±1.5 ft

Digital hydrographic survey data were used in this appendix to assess past and future bathymetric change at Yaquina ODMDSs. All results involving bathymetry change assessment, for both past and future conditions, should be assessed within the data accuracy limits stated above.

## Sediments at Yaquina Bay Proposed ODMDSs

The material that is dredged from the channel entrance to RM 1, closely resembles the ambient seafloor sediments in the vicinity of the ODMDSs. Sixteen samples collected within the 4.5-mile ZSF, at depths ranging from 44 to 144 feet, were all classified as fine sand. The average grain size of the seafloor sediment samples was 0.19 mm [USACE 1985]. Recent sediment sampling/testing specifically conducted to establish baseline conditions for the seabed within the proposed North and South ODMDSs produced the following results: North site $D_{50}$ = 0.22 mm, sand content = 98.1%, fines content = 1.9%; South site $D_{50}$ = 0.20 mm, gravel content = 0.3%, sand content = 98.1%, fines content = 1.6%. The type of sediment in the federal channel is fine to medium sand with average grain size of 0.22 mm, which is very similar to the ambient seafloor sediments.

## Dredged Sediment Characteristics

The type of the sediment dredged from the Yaquina Bay Navigation project material depends on the location. More than 95% of dredged materials historically placed at the Yaquina ODMDSs has been dredged from the entrance channel and classified as poorly graded sand (SP sand, ASTM D 2487) with $D_{50}$ = 0.17-0.23 mm [Appendix C]. A small amount of finer grain material is dredged from the turning basin (RM 2.0 to 2.4), South Beach marina, or Depot Slough and is placed in the ODMDSs.

Analysis of sediments from the channel entrance to the "outer" part of the bay (RM –1.0 to 2.0) indicate these sediments are of uniform grain size and contain very little silts and clays (less than 2 percent). This sediment is composed of fine to medium sand having a

mean grain size ($D_{50}$) of 0.18 mm. The sediment is also low in organic content as measured by volatile solids (0.60 percent) [Appendix C].

Two samples taken from the turning basin at Mclean Point (RM 2) in 1995 show more variability. One sample had a large fines content of 72.3 percent and was classified as silt, while the other sample was classified as a medium sand with $D_{50}$ =0.23 (and had a fines content of less that 2 percent). The amount of material dredged from the turning basin is small. Dredge logs indicate that 4% percent of the sediment placed at the ODMDs is dredged from the turning basin, on an average annual basis.

## Physical Properties of Dredged Material Placed at ODMDSs

The specific gravity of the material dredged from the entrance channel at Yaquina was determined to be 2.65 and the resuspended density was 1,920 g/l from sediment analysis completed in 1990 [Appendix C]. The resulting resuspended void ratio ($e_{ss}$) for fine-sand dredged from the channel entrance at Yaquina was calculated to be 0.815 using a standard volumetric method outline below:

$\forall t = \forall s + \forall v$, assume $\forall t = 1.0$ units

where $\forall v$ = volume of voids (entrained water) in sample

$\forall s = 1 - \forall v$ $\forall s$ = volume of solids (sediment constituent) in sample

$\forall t$ = total unit volume of sediment in sample

relating volume ($\forall$) to mass (M),

$M_t = M_s + M_v$, $M_v$ is due to entrained water = $\rho_v * \forall v$

$\rho_t \forall t = \rho_s \forall s + \rho_v \forall v$ $\rho_t = \rho_{ss} = 1920$ g/l (lab data)

$\rho_t = \rho_s \forall s + \rho_v \forall v$ $\rho_v = 1024$ g/l, $\rho_s = 2650$ g/l (S.G = 2.65)

$\rho_t/\rho_s = (1 - \forall v) + \rho_v \forall v/\rho_s$ = S.G. *1,000 g/l

$0.7245 = (1 - \forall v) + 0.3864 * \forall v$

$\forall v = 0.4490$

$\forall s = 1.0 - 0.4831 = 0.5510$

$e_{ss} = \forall v / \forall s$

**$e_{ss}$ = 0.815**

### Dredged Material Solids Content and Void Ratio

Normally, material which is dredged hydraulically has a low solids content: The concentration of solids for hydraulically dredged sediments (Cs, by volume) varies between 0.18 to 0.35. Since hopper (hydraulic) dredges are used to remove channel sediments from Yaquina, it could be concluded that the solids content for each load of dredged material placed at the Yaquina ODMDS would be lower than 0.35. However, the operating practice of overflow dredging is used at Yaquina for sand-based dredged material placed at the ODMDS. This allows for water to be drained out of the hopper bins as dredged sediment is pumped in. The practice of overflow dredging can substantially increase the solids content of each load of dredged material placed at the ODMDS. The concentration of solids for sand in the hopper dredges operating at

Yaquina (Cs in dredge) was assumed to be the same as for the resuspended sediment tests (i.e. $\rho ss = 1{,}920$ g/l and ess=0.815) and was calculated by:

$Cs_{\text{in dredge}} = \forall s_{\text{in dredge}} / \forall t_{\text{in dredge}}$ = concentration of solids by volume in the hopper dredge

$ess = \forall v / \forall s = 0.815$, $\forall v_{\text{in dredge}} = \forall s_{\text{in dredge}} * 0.815$

ess = resuspended void ratio

einsitu = insitu void ratio at site of dredging in channel

= 0.68 (assumed value based on typical range)

in a volumetric analysis, $\forall t = \forall s + \forall v$, assume $\forall t = 1.0$ units

$$\begin{aligned}\forall t &= \forall v_{\text{in dredge}} + \forall s_{\text{in dredge}} \\ &= 0.815 \forall s_{\text{in dredge}} + \forall s_{\text{in dredge}} \\ &= \forall s_{\text{in dredge}} (1+0.815)\end{aligned}$$

since $\forall t = 1.0$, $\forall s_{\text{in dredge}} = 1.0/(1+0.815) = 0.551$

$Cs_{\text{in dredge}} = \forall s_{\text{in dredge}} / \forall t = 0.551/1.0 = 0.551$ similarly, $Cs_{(\text{insitu})} = 0.595$ (einsitu = 0.68)

Usually, the volume of sediment reported as placed at an ODMDS is different from the volume of sediment removed from the site of dredging. This is due to the cumulative difference between the: (a) the insitu void ratio of the sediment before dredging, (b) the resuspended void ratio of the dredged sediment after being placed into the disposal vessel, 0.815 this case; and (c) the depositional void ratio of the dredged sediment after placement at an ODMDS. The change in specific volume of dredged material from the site of dredging to the site of disposal is commonly referred to as a "bulking factor". The bulking factor for dredged sediments placed at Yaquina ODMDSs can be calculated by noting the relationship between the volume of sediment removed from the channel ($\forall$insitu), the volume of dredged material in the disposal vessel ($\forall$in dredge), and volume deposited on the seabed ($\forall$d).

The depositional void ratio for dredged material placed on the seabed (ed) for sand-based dredged material placed at ODMDSs was assumed to be equivalent to the resuspended case (ed=ess).

$$\forall t_{ss} = Cs_{(\text{insitu})} * \forall t_{\text{insitu}} (1+ess) = \forall t_{\text{in dredge}}$$

$$\begin{aligned}\forall t_{\text{in dredge}} &= Cs_{(\text{in dredge})} * \forall t_{\text{in dredge}} (1+ed) \\ &= Cs_{(\text{insitu})} Cs_{(\text{in dredge})} \forall t_{\text{insitu}} (1+ess)(1+ed) = (0.595)(0.551) \forall t_{\text{insitu}} (1+0.815)(1+0.815) \\ &= 1.190 \forall t_{\text{insitu}}\end{aligned}$$

where, ed = depositional void ratio

Bulking Factor from dredging site to disposal vessel = 1.190

Bulking Factor from disposal vessel to disposal site = 1.000, or $\forall_{\text{seabed}} = \forall_{\text{disposal}}$

The volume of dredged material hauled to the ODMDS is based on the "dredge logs" for each disposal vessel. The dredge log volume is the volume of dredged material in the disposal vessel before placement at a disposal site ($\forall$disposal): It is <u>not</u> equivalent to the undisturbed volume of insitu sediment ($\forall$insitu). The "dredge log" volume is equal to

the volume of material placed on the seabed at the ODMDSs. Therefore, the dredging volume statistics reported in table 1 indicates the "actual" volume of dredged material placed at ODMDSs.

Subaqueous Angle of Repose - Avalanching of Dredged Sediments

As dredged sediments are continually placed (load by load) within a specific open water area, the material builds laterally and vertically. Geometrically, the extend at which the material accumulates is limited by the steepest angle at which the material can attain before gravity (and environmental forces) forces the material to avalanche and redistribute downslope. The avalanched sediment comes to rest when some equilibrium angle is reached. The limiting angle of repose (shearing angle, $\varnothing_s$) for subaqueous dredged sediments is steepest angle the material can attain before avalanching. The post-sheared angle ($\varnothing_{ps}$), defines the slope of the avalanched dredged material after is has come to rest [Larson and Krause 1989 and Allen 1970]. The areal and vertical configuration of aggregate dredged material mounds at ODMDSs are controlled by the shearing angle and post-sheared angle of the dredged material.

The range in avalanche angles vary considerably with material type and the forcing environment. The angle of repose for dry loose sand is 26°-30°, form horizontal [Hough 1957]. Reported values for the subaqueous angle of repose (shearing angle) for sand placed on the seabed range from 1.8°- 8°[USACE 1995 and Johnson 1995]. Reported values for the angle of repose for highly disturbed and minimally disturbed cohesive sediments placed on the seabed are 0.3° and 10°, respectively.

At the Yaquina ODMDS, the angle at which sandy dredged material begins to avalanche (shearing angle, $\varnothing_s$) varies between 1.7° and 2.5° ($\tan f = \Delta z/\Delta x = \Delta z/\Delta y$). These values are based upon the assessment of recent bathymetric surveys of the dredged material mound at the Section 103 ODMDS. The angle at which avalanching stops (post-sheared angle, $\varnothing_{ps}$) once it has begun was estimated to be 1.5°. These values will define the steepness at which dredged material is permitted to accumulate during the MDFATE simulation.

## Summary of Yaquina Dredged Material Parameters

The following dredged material parameters will be used in the DRP fate models when simulation activities are pursued in later phases of this investigation:

Dredged material type = fine to medium sand, SP
$D_{75}$ material dredged from channel = 0.20 mm
$D_{25}$ material dredged from channel = 0.15 mm
Fines content (D<0.0625 mm) = 2 % (silt)
S.G.of dredged material solids = 2.65
$C_{s(disposal)}$ = concentration of solids by volume in the disposal vessel = 0.551
ed = depositional void ratio = 0.815
$\varnothing_s$ = subaqueous shearing angle = 1.7°, $\varnothing_{ps}$ = subaqueous post-shearing angle = 1.5°

## Surface Waves - Simulated Data

A synthetic time series for the annualized wave environment offshore of Yaquina Bay was generated using HPDSIM, a PC-program developed by USACE [Borgman and Scheffner 1991]. The program uses a finite length wave record to compute a matrix of coefficient multipliers that can be used to generate arbitrarily long time sequences of simulated wave data which preserve the primary statistical properties of the source finite data set. The wave height, period, and direction for the synthetic data set are based upon the 20-year Wave Information Study (WIS) station 41 - Phase II database [Corson et al 1987]. WIS station 41 is located 30 miles offshore Yaquina Bay. The summary statistics for station 41 are:

Mean WIS Parameters

Water depth at WIS II-41 = 1500 ft
$H_{1/3}$ = average annual significant wave height = 9.8 ft
$\sigma_h$ = annual standard deviation of $H_{1/3}$ = 4.2 ft
$T_s$ = wave period (associated with $H_{1/3}$) = 11.2 sec
$\sigma_h$ = annual standard deviation of $T_s$ = 2.5 sec
Most frequent wave direction band = 292°(T)
Wave direction for largest wave height = 209 °(T)

An example of the simulated wave environment for wave height ($H_{1/3}$) and wave period ($T_s$) for a 1-year duration (time = 0 corresponds to January 1) is shown in figure 19. Note that the waves are more severe during the late fall, winter, and early spring than other times of the year. The maximum and minimum significant wave heights ($H_{1/3}$) for the synthetic wave year were about 30 ft and 3 ft, respectively.

Based on favorable comparisons of synthetically generated wave data (WIS) and observed wave data for other locations on the Oregon coast [USACE 1995], the WIS data were considered adequate for simulating the wave environment at Yaquina Bay and for use as input for sediment fate modeling.

## Simulated Shelf Tidal Elevations and Currents

The shelf tidal environment at the Yaquina Bay ODMDSs was simulated using the 5 primary tidal constituents generated from the ADCIRC-derived database for the Eastern North Pacific Coast [Hench et al 1994 and Luettich 1995]. ADCIRC (Advanced CIRCulation) is a two-dimensional finite-element model developed by USACE to simulate hydrodynamic circulation (tides) along shelves and coasts. The time series shown in the top of figure 20 represents a simulated equilibrium shelf tide 5 miles offshore Yaquina Bay for 1 month (720 hours). The referenced tidal datum is MLLW. An equilibrium tide is harmonically correct to the actual case, but is not referenced to a specific date or time. The maximum tidal range for the simulated tide shown in figure

20 is 11 ft, which agrees with the observed range for the Yaquina bar. The tidal phasing of the simulated and observed tidal data also compared favorably.

Depth-averaged tidal currents (u,v), applicable for the Yaquina bar, are shown in the bottom of figure 20 and were also produced using the ADCIRC model. The tidal current simulated by the ADCIRC model accounts only for the **shelf tidal current ,** based on the approach and passage of the tidal wave. The **estuarine tidal current** generated by flood and ebb flow from the Yaquina Bay estuary is not included in the ADCIRC-predicted tidal current.

Based on favorable comparisons of synthetically-generated shelf tidal data (ADCIRC) and observed tidal data for other locations on the Oregon coast [USACE 1995], the ADCIRC data were considered adequate for simulating the wave environment at Yaquina Bay and for use as input for sediment fate modeling.

## Observed Currents Applicable for Yaquina Bay ODMDSs

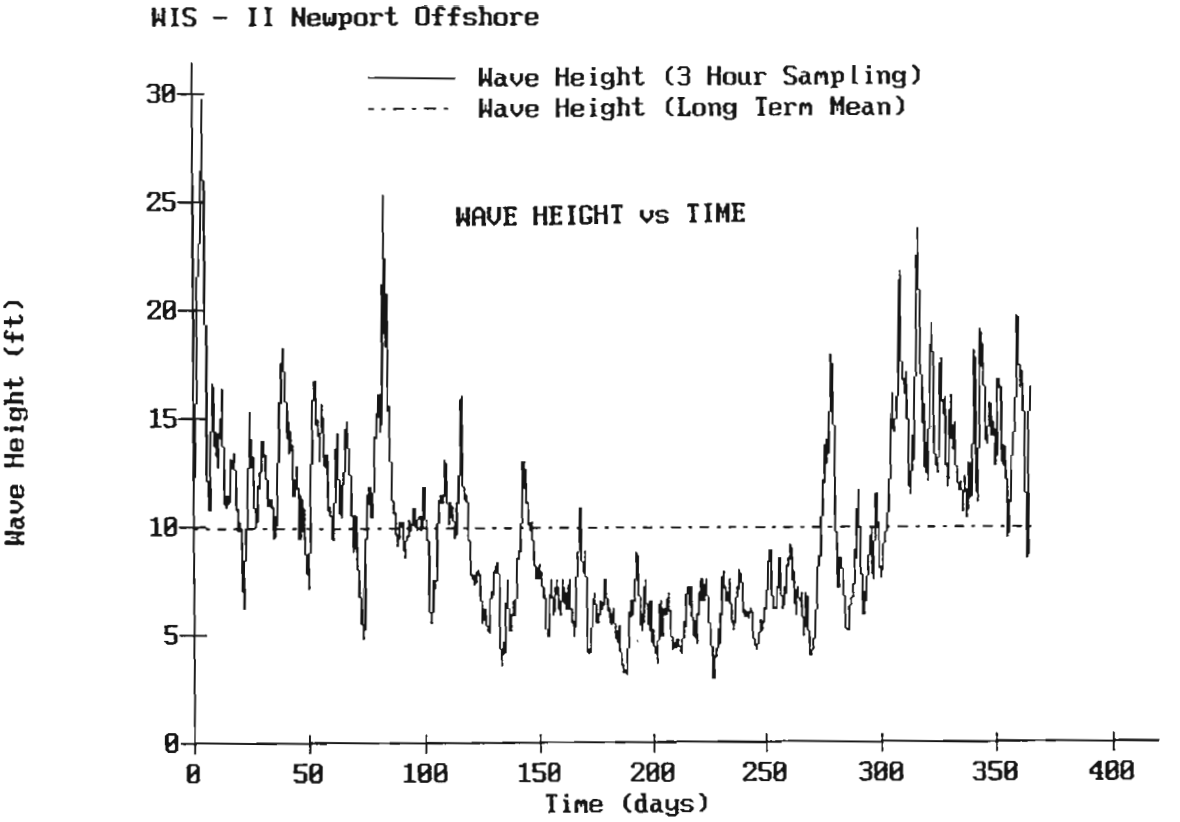
Definition of the residual current regime is of prime importance, since currents significantly affect the short-term fate of dredged material and completely control the long-term fate. For inner-shelf waters (depths <120 ft), the residual current regime is influenced by wind-stress, waves, tidal, and esuarine processes.

The term *residual* refers to a time-averaged or long-term net (over days, weeks, or months) result, which does not include short-term (hours to days) variations. A residual currents describes the net flow (direction and speed) for a given location during a given time interval and does not include shelf tidal currents, storm-induced currents, and other episodic events.

In close vicinity to the jetty entrance to Yaquina Bay, discharge from the estuary influences nearshore circulation from the surface to depths of 70 for distances of 1-2 miles offshore. Large scale oceanic currents such as the California or Davidson currents generally influence the direction of the shelf current regime, but do not directly affect the magnitude of inner shelf currents. Considerable effort was invested to reliably specify the residual current regime near the Yaquina Bay. Residual current data relevant to Yaquina Bay ODMDS designation and management are summarized below.

### Bottom Currents due to Estuarine Discharge and Jetty Effects

During 21 August 1993, an acoustic doppler current profiler (ADCP) was used to measure bottom velocities in the vicinity of the Yaquina Bay jetty entrance. The ADCP velocity data was measured 2 hours after high tide, during an accelerating ebb-tide condition, but before maximum ebb tide. Point measurements of seaward flow at the mouth of the jetties reported near bottom velocities exceeding 3 ft/sec with total volume flow out of the jettied entrance measured by the ADCP at over 81,000 cfs [USACE 1993]. The riverine discharge from the Yaquina River was considered to have a negligible contribution to the observed estuarine discharge. Rainfall within the Yaquina



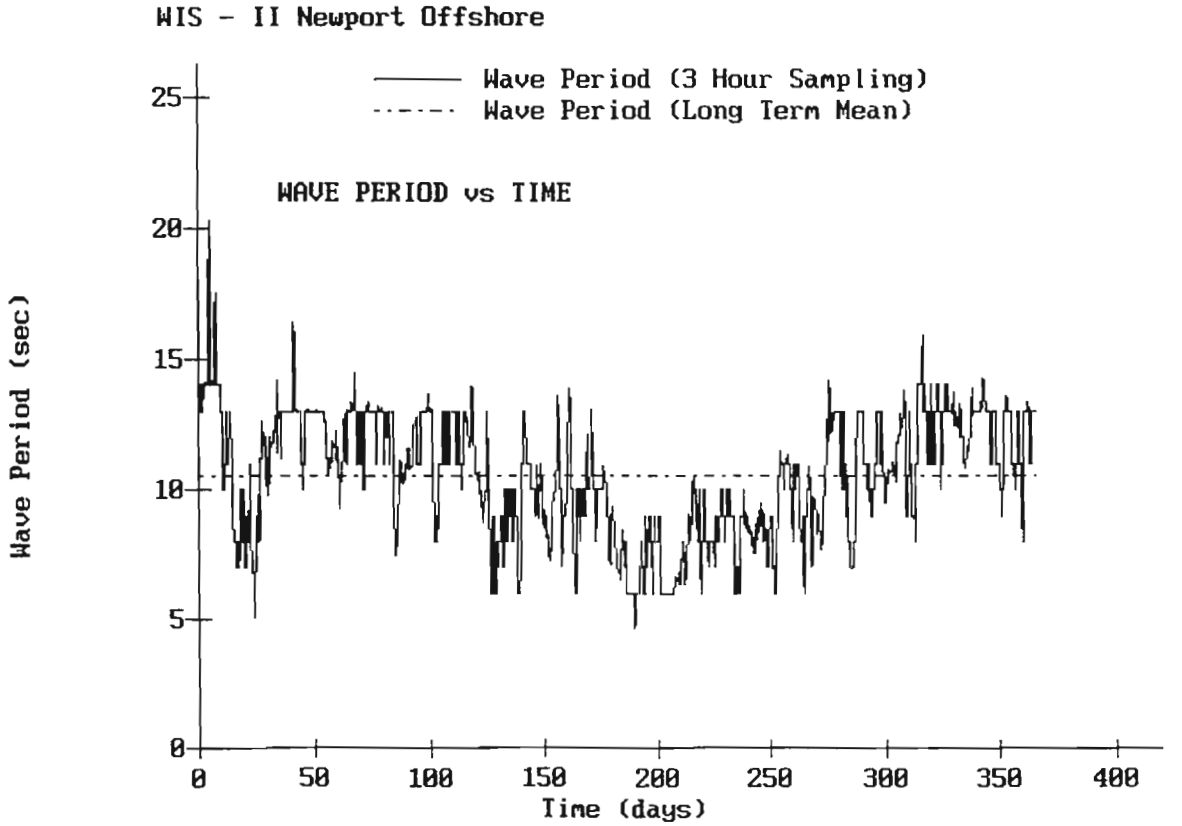
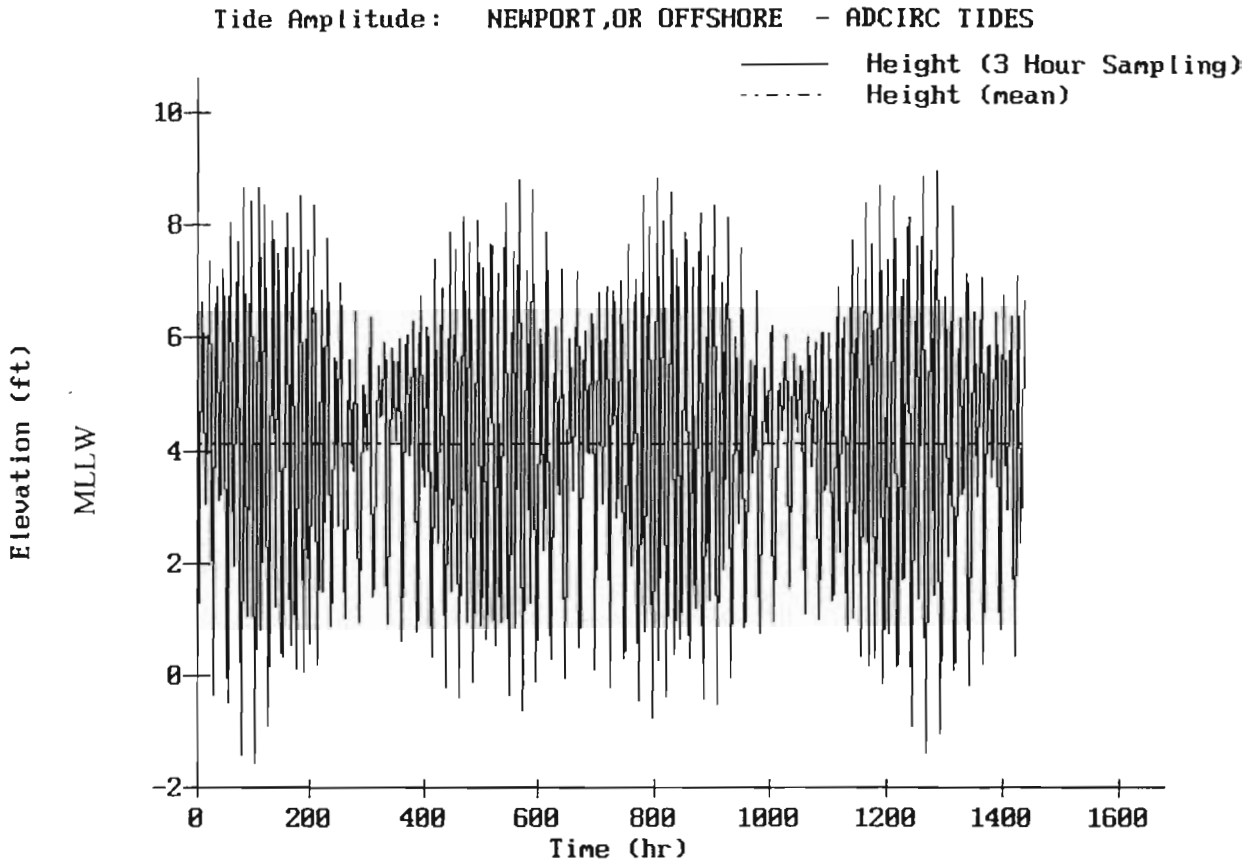




Figure 19. Wave Environment Offshore Yaquina Bay Simulated from WIS-II data. Top graphic is for Wave Height. Bottom graphic is for Wave Period. Time 0 corresponds to January 1 and Time 365 corresponds to December 31.



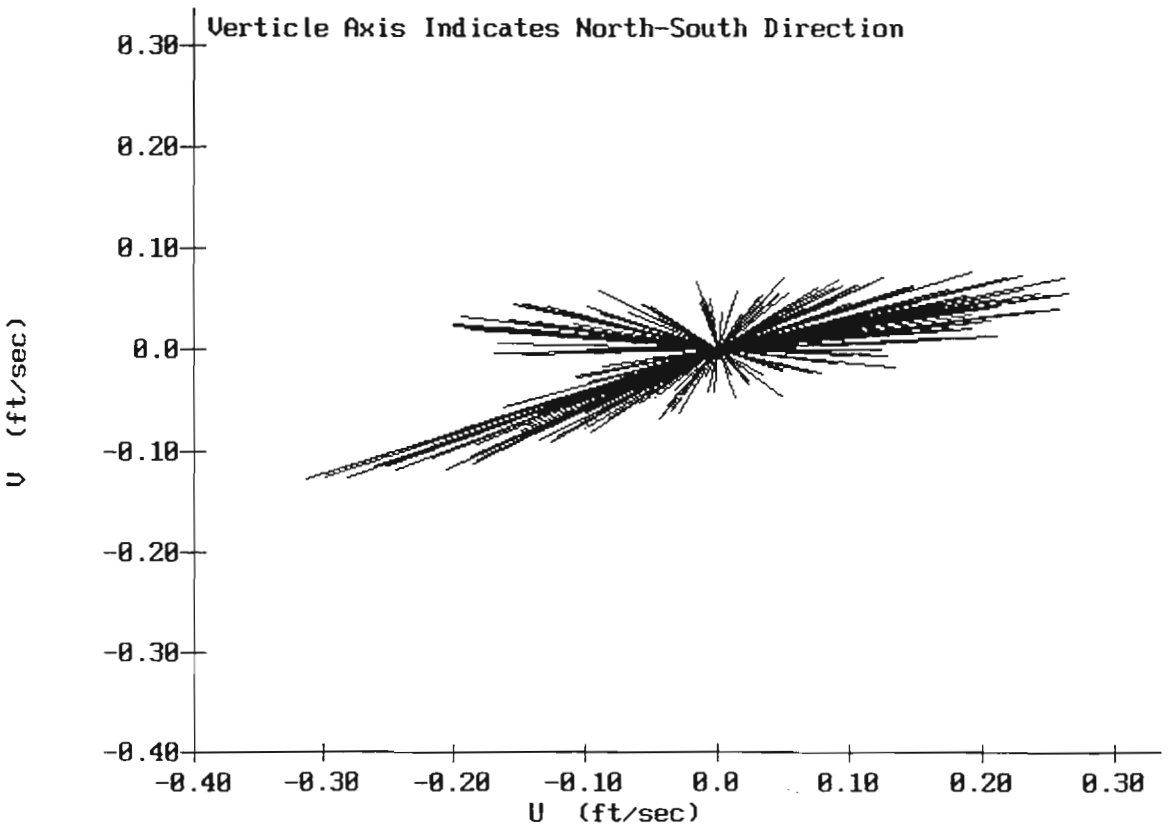




Figure 20. ADCIRC-Simulated Tidal elevation and Current at Yaquina Bay ODMDSs for a two week period. . Top graphic is Tidal Variation of Water Surface. Bottom graphic is for Tidal-induced Current.

River catchment was minimal during the time of data collection. The ADCP measured bottom current is summarized as:

$$V_{ADCP} = 3 \text{ ft/sec at } 240° \text{ (T)} \quad \text{during ebb-flow applicable throughout year}$$

A mild wind out of the northeast was present producing a current velocity field tending toward the south-southwest (alongshore) during most measurements taken north and west of the northern jetty and north reef. Tidal outflow dominated the current filed at locations between the jetties and seaward of and in line with the entrance channel. Current measurements obtained north of the north jetty and inshore of the north reef showed a redirection of the alongshore flow in the offshore direction. Although a slight intensification of current velocity was observed at the head of the north jetty, the potential for greater current velocities can be realized with a stronger alongshore wind (current) being present [USACE 1993].

The flow field observed at the Yaquina Bay jetty entrance on 21 August 1993 was assumed to represent typical estuarine ebb-flow conditions. Given that the alongshore wind field (and associated current) were minimal during the above measurement period, it is assumed that the combined current (estuarine flow + deflection of littoral current along jetties) at the jetty entrance is typically higher than that which was observed on 21 August 1993. Given that the combined current field is typically higher than the above measured data, the observed current is assumed to represent average conditions for the combined current field at the jetty entrance.

Surface Currents at the North Reef

Oregon State University conducted circulation measurements inshore of the north reef between the north jetty and Yaquina Head [Neal 1969]. Wave approach angle and hydraulic (flow redirection) effects of the north jetty had significant affect upon the observed nearshore flow field. Observed currents in the near surface (upper 10 ft) of the water column are summarized below:

November – February: $V_{reef} = 0.4$ ft/sec @ 45° (T)
March – October : $V_{reef} = 0.4$ ft/sec @ 225° (T)

Bottom Current at the Interim ODMDS

Bottom currents in the Interim ODMDS were observed by SCUBA diver during June 1977 [Montagne-Bierly Associates 1977]. Bottom currents were oriented toward the southwest and were heavily influenced by surge caused by waves passing overhead. The wave conditions during current observation were 4-foot swells from the northwest. Observed bottom currents are summarized below:

June : $V_{ODMDS} = 0.62$ ft/sec @ 225° (T)

Surface Currents 10 miles Offshore of Newport

A description of the seasonal mid-shelf surface current has been developed from transport data obtained by the transit of surface drift bottles released between 1959-1963 [Burt 1964]. The infered surface currents are summarized below

November – February: $V_{offshore}$ = 0.82 ft/sec @ 0° (T)
March – October : $V_{offshore}$ = 0.82 ft/sec @ 180° (T)

Geostrophic Currents

Estimates of geostrophic currents based on hydrographic observations from the Newport Hydro Line [Huyer 1977] agree well with seasonal observation of flow inferred from direct measurement [Huyer 1975]. In general, geostrophic currents were aligned with bottom contours with northerly mean flows deeper than 160 ft and southerly flows above. The summer geostrophic current at three varying cross-shore locations is summarized below:

June – September : $V_{G70}$ = 0.6 ft/sec @ 187° (T) **water depth = 70 ft**
$V_{G150}$ = 0.2 ft/sec @ 202° (T) **water depth = 150 ft**
$V_{G200}$ = 0.2 ft/sec @ 63° (T) **water depth = 200 ft**

Currents Observed at a Similar Nearshore Location – Coos Bay

Detailed current measurements have been obtained from other similarly situated Oregon nearshore ODMDSs. The most thorough study has been conducted at Coos Bay, Oregon [Sollitt et al 1984]. Seasonal measurements were made over two-week periods are summarized below (values reported from measurements at 1/3 total depth) :

November – March: $V_{Coos}$ = 0.75 ft/sec @ 30° (T)
April – July : $V_{Coos}$ = 0.75 ft/sec @ 210° (T)
August – October : $V_{Coos}$ = 0.50 ft/sec @ 205° (T)

## Calculation of Residual Current for Yaquina Bay ODMDSs

To represent the residual current at the proposed North and South ODMDSs, an annualized residual (depth averaged) current was developed based on a 2-point value for seasonal representation. The individual current observations described above were vector-averaged according to the proper seasonal sequence of each current observation. This provided a realistic estimate for seasonally varying depth-averaged currents; data which was used to simulate the fate of dredged material to be placed at the proposed

North and South ODMDSs. The ***annualized residual current*** applicable for locations with the 4.5-mile ZSF and where the water depth is 100-150 ft is described below:

| |
|---|
| May – October: $V_{residual}$ = 0.53 ft/sec @ 202° (T) |
| November – April: $V_{residual}$ = 1.25 ft/sec @ 298° (T) |

Note that the current affecting the proposed North and South ODMDSs is primarily a function of open coast flow, being influenced mainly by wind/waves, tide, and offshore processes. Estuarine current affects are, at best, weak within the North and South ODMDSs. This is reflected in the residual current described above.

The **total** depth-averaged current at any given point in time is estimated by adding the seasonal residual bottom current (above) to the simulated depth-averaged tidal (ADCIRC) current. The preceding section defined all oceanographic data required to successfully simulate dredged material behavior using the FATE models.

# Section 9
# GEOLOGIC FEATURES

## Introduction

Geologically speaking, the Oregon coast is young and active. Regional uplift of several hundred feet, intense volcanic activity, and tremendous erosion and sedimentation has occurred over the past several million years to change the shape of the coastline. 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 near Florence. The Pacific Ocean has affected this geologic framework to produce spectacular effects within historic times. 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.

## General Geology

The geologic sequence at the outer portion of Yaquina Bay consists of over 50 feet of terrace deposits of semi-consolidated sands and silts and occasional gravel formed by marine forces less than one million years ago overlying much older, eroded sandstones, siltstones, and mudstones. These terrace deposits form the steep sea cliffs north of the North Jetty but are absent for 1-1/2 miles to the south where modern sands form the South Beach area. A geologic map and generalized cross-section of the Yaquina Bay area are shown in Figures 20A and 21.

A limited number of borings and surface geology identifies the nature of the underlying rock. A succession of Miocene siltstones, mudstones, and sandstones form the bedrock material beneath the bay. The oldest sequence, the Nye Mudstone, comprises the majority of the bedrock portion of western Yaquina Bay. The Nye Mudstone is a predominantly medium to dark gray, massive-bedded sequence of mudstones with some siltstone and sandstone lenses. Within Yaquina Bay, the formation is approximately 4,400 feet thick and extends from near the eastern edge of the bay to a point about 2,400 feet west of the Highway 101 Bridge. West of the bridge these strata have an average strike of north 5 degrees west, and a dip of 18 degrees toward the west. Beds of this formation are exposed at low tide on the north shore of the bay west of the highway bridge.

The Astoria Formation unconformably overlies the Nye Mudstone and is found in the outer navigation channel area from about 2,400 feet west of the highway bridge and westward. Precise location of the contact between the Nye and Astoria Formations is difficult to recognize, as the lower Astoria beds are very similar to the upper Nye beds. A small wedge of this formation is exposed near the base of the sea cliff on the north side of the bay. It has been determined through drill cores taken from navigation channel explorations in 1961 that the strike of the beds is north 8 degrees east, with a dip of 15 degrees toward the west. The most common beds of this formation are olive-gray, fine to medium grained arkosic sandstones, carbonaceous siltstones, mudstones and claystones. These beds were deposited in a nearshore environment (Snavely and others, 1964).

Just offshore of the jetties is an unnamed unit that unconformably overlies the Astoria Formation. This unit consists of a basalt flow, water-laid fragmental basaltic debris, tuffs, and fine-grained sandstone. The more resistant basalt flow at the base of this unit forms northerly-trending Yaquina Reef, located about 4,000 feet offshore, which in this area is about 55 feet thick. The Yaquina Reef is located immediately north and south of the Yaquina Bay jetties and appears to be offset by a north-south trending fault that might extend southward along the eastern margin of the project area (Snavely and others, 1964).

Figure 21, which shows a generalized cross section applicable to Yaquina Bay and offshore vicinity, was obtained using sub-bottom profiling techniques (Earth Sciences Associates and others, 1984). 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. The sand layer ranges from 5 to 35 feet thick over an irregular rock surface throughout the nearshore area adjacent to Yaquina Bay.

## Unconsolidated Marine Deposits

Sediment movement on the Oregon continental shelf consists of two mechanisms depending on the size of the sediment. Anything finer than sand size (0.0625 mm) is

carried in suspension in the water column and removed far offshore. The almost total lack of silts and clays within ten miles or more of most of the Oregon coast attests to the efficiency of this mechanism. Sediments sand-size or coarser may be suspended by wave action near the bottom, and are moved by bottom currents as bedload transport. There is almost a complete lack of finer silts and clays offshore of Yaquina Bay. Silt appears offshore from Yaquina Bay at a depth of 300 feet. The lack of silt or clay is likely due to the high wave energy regime. Summer wave conditions produce bottom ripples to depths over 300 feet while winter storm waves can produce ripples to over 600 feet (Komar, 1972). The generalized bathymetry and surface sediment coverage of the central Oregon continental shelf is shown in Figure 22.

## Seabed Sediments Near Yaquina Bay

Fine sand underlies the major portion of area within the Yaquina Bay 4.5-mile Zone of Siting Feasibility (ZSF). Figure 10 shows the seabed distribution of sand vs. exposed rock outcroppings within the 4.5 mile ZSF. Note the large area of seabed rock exposure occurs in the area directly to the north of the *Section 103* disposal site. These seabed rock outcroppings contribute coarser sediment to the nearshore area as the rock surfaces are eroded by wave action. The classification of bottom sediments shown in Figure 10 was developed from a high-resolution side-scan sonar survey conducted during July 1995 (Geo Recon International, Inc., 1995).

The underlying geology, marine forces, and human action influence the nearshore bathymetry at Yaquina Bay. From the tip of the full-authorized end of the North Jetty the Yaquina Reef extends northward to Yaquina Head. This reef, with depths less than twelve feet in places, is an eroded layer related to the basalt headland at Yaquina Head. There are numerous submerged rock outcrops between the reef and North Beach. Note the irregularity of this region shown in Figure 10. These outcrops are probably part of the more resistant sandstone layers. 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.

## Sediment Accretion

A combination of littoral transport and jetty construction has resulted in significant beach advance south of the jetties (i.e. South Beach State Park). This accretionary process began in the 1882 with the first attempt to build the South Jetty and has continued as the jetty has been progressively extended. Beach accretion has not been 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 (4 miles to the north).

Seaward of the reef complex, the bottom slopes about 60 feet per mile out to below elevation -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 *Interim* disposal site as shown on Figure 10. This

bulge feature is composed of previously placed dredged material and sediment transported out of the Yaquina Bay estuary during high ebb-tide discharge conditions.

## 1993 Geophysical Explorations

Geophysical explorations were conducted in 1993 in an area just offshore and adjacent to the North Jetty. These explorations were conducted in an effort to better identify the physical characteristics adjacent to the North Jetty, and to aid in determining the cause for repeated failures of the structure. Explorations consisted of sidescan sonar surveys, seismic reflection and seismic refraction techniques, subbottom profiling, and water jet probes. These techniques combined to map out better the location of the Yaquina Reef, show the subbottom characteristics of the different geologic units, and identify the presence and depth to bedrock in the vicinity of the North Jetty. Scattered bedrock exposures present within Yaquina Reef and on the north side of the North Jetty are located and shown on Figure 10.

## 1995 Sidescan Sonar Survey Results

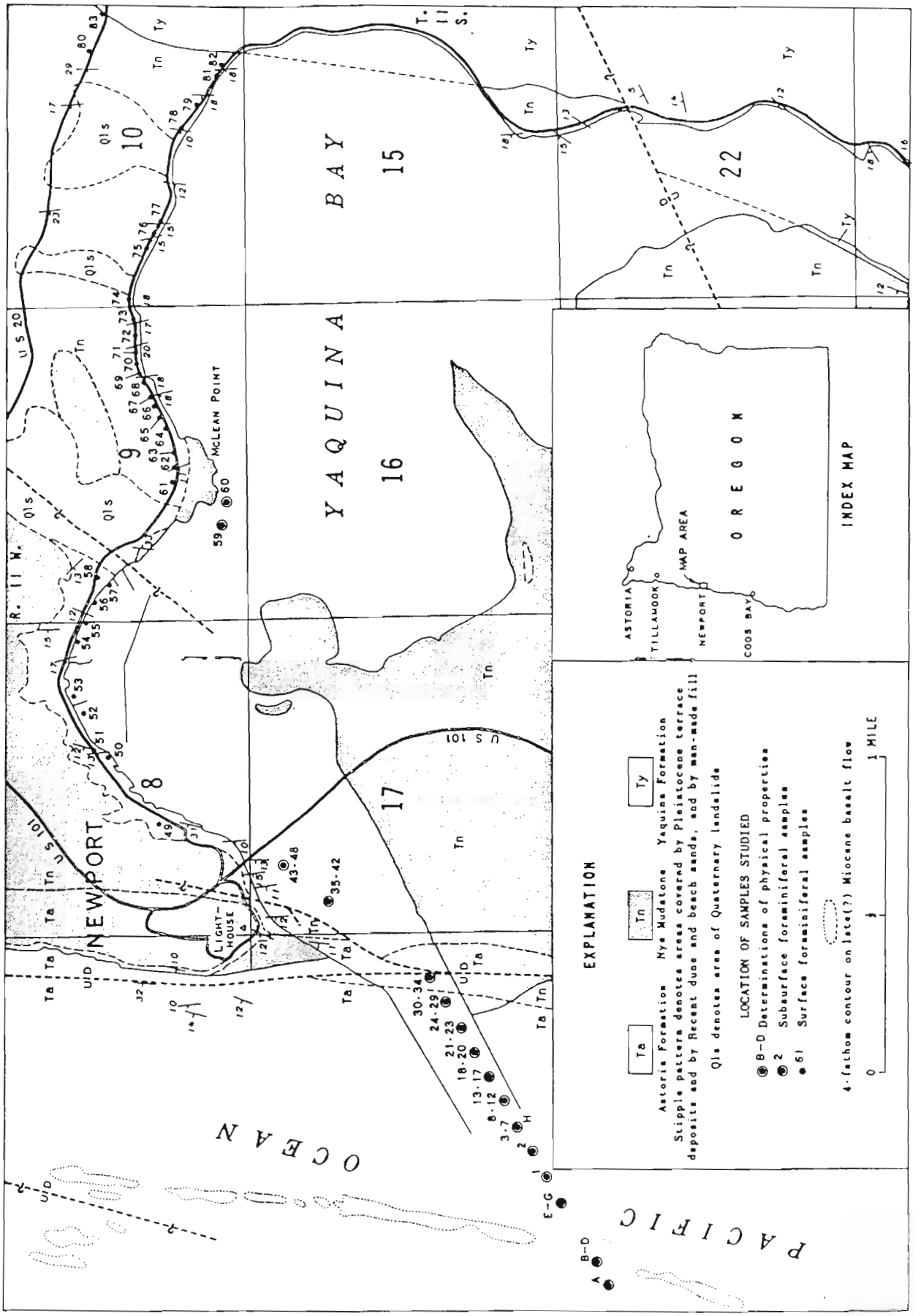
A sidescan sonar survey was conducted in 1995 of an area approximately 4 miles long by 2 miles wide, of the area immediately offshore of the Yaquina jetties. The purpose of this study was to gain a better understanding of the surficial material types on the ocean floor for the potential of identifying future offshore disposal sites. Figure 10 shows the location of the different material types within this study area.

This survey identified areas of bedrock outcroppings on the westward side of the Yaquina Reef, extending out a distance of up to a mile. These outcroppings follow the basic trend of the geology in the area, with beds dipping towards the west. The truncated edges of the more resistant layers provide the relief that is visible in sidescan images of the sea floor. A zone of coarse to medium sand is present adjacent to the westward side of the Yaquina Reef north of the North Jetty between the reef and outer rock exposures.

Surrounding the outcrops and the coarser sand is a blanket of fine to medium sand and silt, which is the most prevalent material seen offshore of this area. This material is also present immediately offshore of the jetties and entrance channel and obscures any bedrock exposures present there.

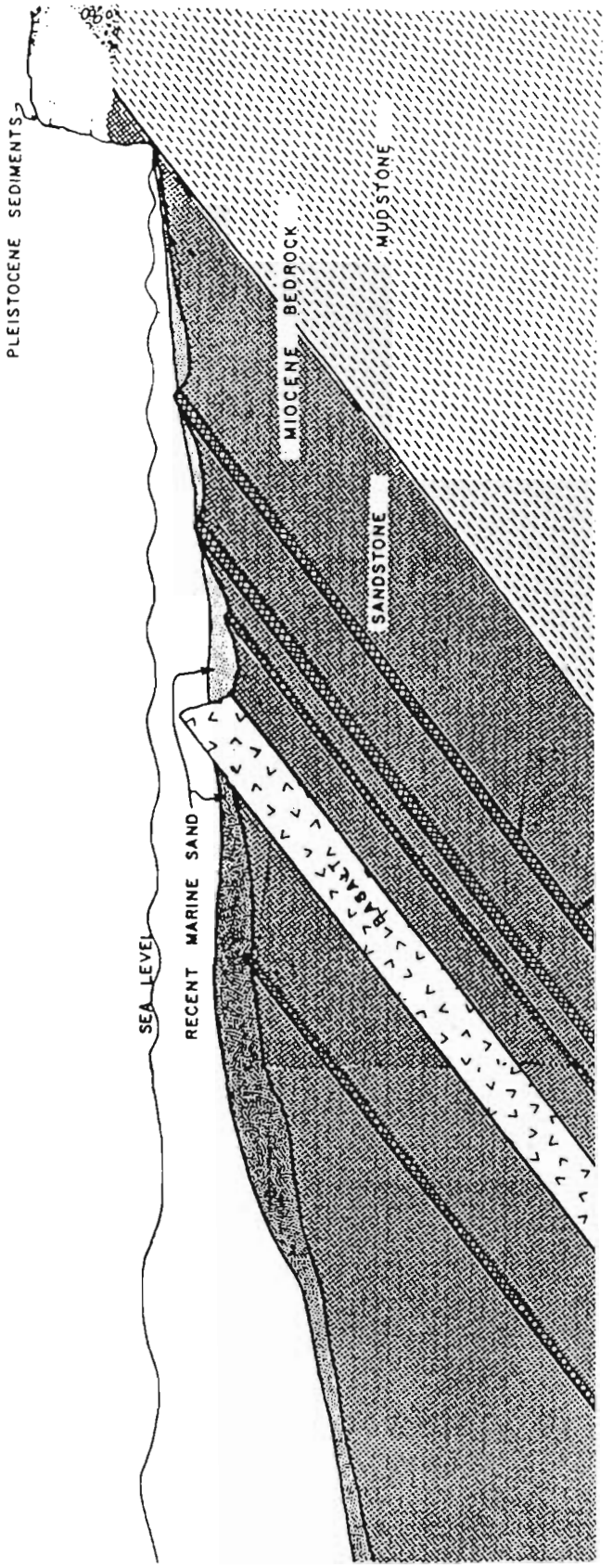
## 2000 Sidescan Sonar Survey

Additional surveys were conducted in 2000 to further identify material adjacent to the outer margins of the 1995 survey, but concentrating on two areas located both north and south of the jetties. The north area measured approximately 2 miles long by 1.25 miles wide, and the south area was 1.5 miles long by 1.25 miles wide. This survey utilized digital image processing techniques with a mosaicing feature to more accurately define where the different material types occurred. Figure 10 shows the location of the study area and the material types represented.




Geologic Map of the Yaquina Bay Area, Newport, Oregon
(From Snavely, et. Al., 1964)

Figure 20A




Generalized Geologic Cross-Section at Newport, Oregon

Figure 21

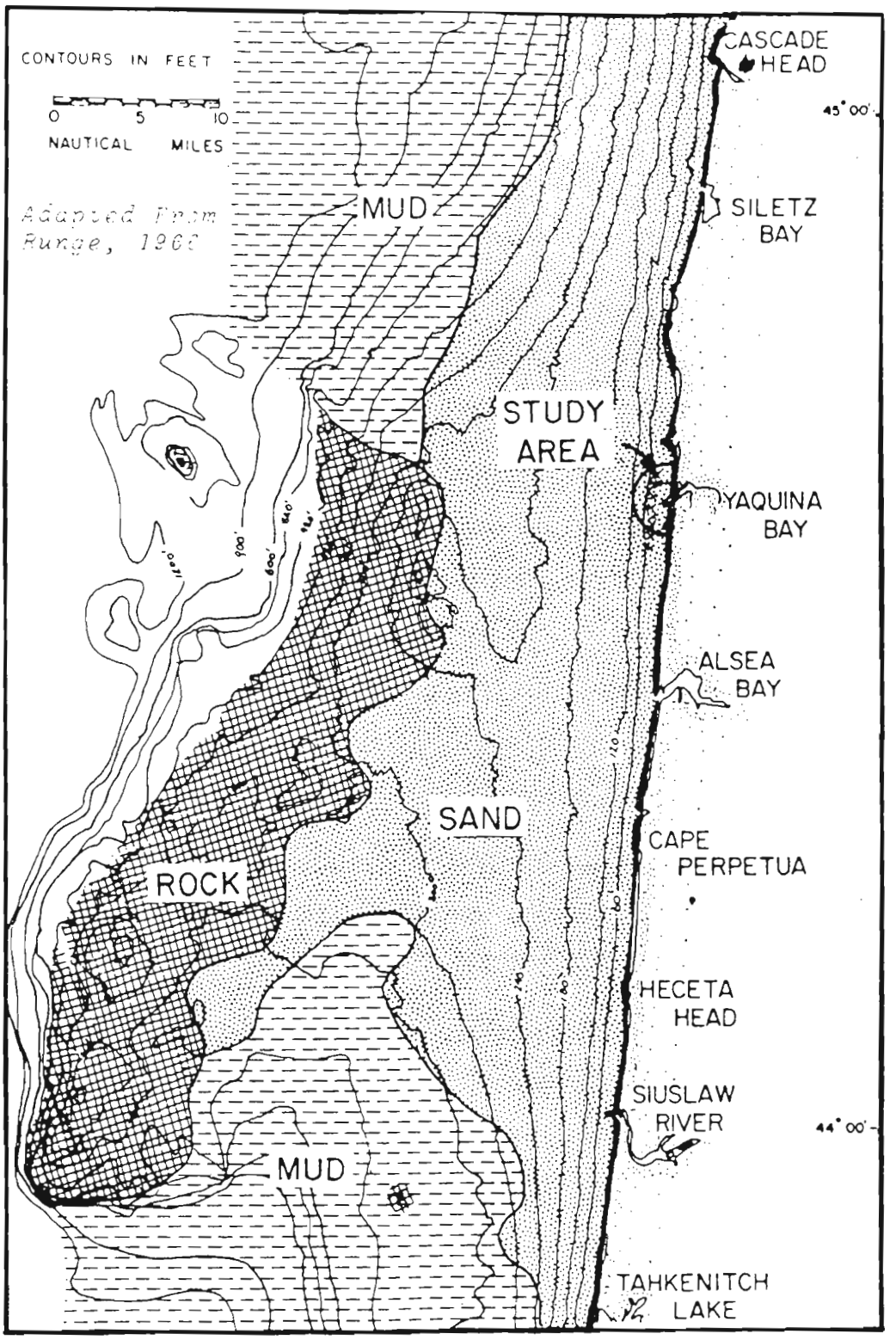



Figure ~~B-1~~ 22. Surface Features and Sediment Cover of the Continental Shelf off Central Oregon

Results of this survey verified the existence of rock outcroppings in the inner portion of the southern area. The predominant material type present on the bottom in both areas was also verified to be fine to medium sand and silt. This survey also showed the presence of gravel deposits, and gravel interspersed with sand and silt ribbons. Both of these material types occur mostly in the western portion of the study areas.

# Section 10
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# APPENDIX C

Sediment and Water Quality

**APPENDIX C**
**Sediment and Water Quality**
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# SEDIMENT AND WATER QUALITY

## GENERAL

Sediment and water quality analyses of dredged material and ocean dredge material disposal sites are required to adequately address general criterion (b) and specific factors 4, 9, and 10 of 40 CFR 228.5 and 228.6. These general criterion and specific factors also require sediment and water quality analysis of both the disposal and dredge areas. These physical and chemical analyses are to perform two functions: establish baseline conditions at the Ocean Dredged Material Disposal Sites (ODMDSs) and to help determine the contamination potential of the dredged materials to be placed in ODMDS sites.

The Marine Protection, Research and Sanctuaries Act (MPRSA) require that five general criteria and eleven specific factors be addressed during the designation process (40CFR 228.5 and 228.6). These criteria and factors have been interpreted as 27 different "areas of consideration" that cover the proposed ODMDS site and the dredged material it receives. These areas of consideration are listed in an ODMDS conflict matrix (see main text), which is used to evaluate each candidate site on its compliance with the requirements for disposal site designation. The results of the candidate ODMDS conflict matrixes are compared with each other, and are used to select the best ODMDS. The areas of consideration involving sediment quality are:

1. Physical and chemical sediment compatibility,
2. Water column chemistry and physical characteristics,
3. Influence of past disposal,
4. Size and shape of the disposal site,
5. Size of the buffer zone.
6. Degraded areas
7. Potential for Cumulative Effects

The information including baseline data needed for the seven sediment quality areas of consideration is provided in this appendix. As part of evaluations of authorized Federal navigation channels and ODMDS, there are a total of fifteen sampling events associated with the Yaquina area and ODMDSs spanning from 1980 to 2000. Twelve sampling events are on the Yaquina estuary, which includes the Yaquina River, Yaquina Bay, and Depot Slough. These sampling events and their maps are listed in the summary table below. Three sampling events were taken at Yaquina ODMDS sites to establish baseline conditions: One taken in 1984 at the Yaquina interim ODMDS site; one taken in May 1986 at the Section 103 site; and one taken on July 2, 2000 at the Yaquina proposed North and South ODMDS sites. Most samples were tested for some or all Tier II analyses as defined by the Dredged Material Evaluation Framework (DMEF)

(USACE, 1998). The DMEF manual defines the Tier II testing to include physical sediment analysis, and chemical analysis for metals; organometallic compounds; and organics. The organic analyses include chlorinated hydrocarbons, phthalates; phenols; pesticides; miscellaneous extractables; and other organics. Three sediment samples and a reference, collected from South Beach Marina on May 7, 1991, were subjected for Tier III analyses. Sediment samples taken in April 1990 included analyses for dioxins/furans. Samples collected in June 10-13, 1980 were analyzed for elutriate water tests. A summary of tests results for the fifteen sampling events will be discussed in the following sections and are shown on Tables C-1 through C-19. Figures C-1 through C-12 show the sampling station locations for the fifteen sampling events.

**SUMMARY OF 15 SAMPLING EVENTS**

| LOCATION | DATE | SAMPLE NAMES | FIGURE |
|---|---|---|---|
| Yaquina Bay and River | 6/11-13/80 | 1 through 14 | C-1 |
| ODMDS Interim Site | 1984 | Y-1 through Y-13 | C-2 |
| ODMDS Section 103 site | 5/16/86 | 100-6 through 100-83 | C-3 |
| Yaquina Bay | 7/28/86 | YQA-1 through YQA-11 | C-4 |
| ODMDS Section 103 site | 10/18/89 | YB-1 through YB-12 | C-5 |
| Depot Slough | 11/21/89 | 1E,M,W through 4 E,M,W | C-6 |
| Yaquina Bay | 4/4-5/90 | BC-1 – BC-11 & EPA-1 – EPA-14 | C-7 |
| Newport South Beach Marina | 5/7/91 | SMB-BC-1 through SMB-BC-7 | C-8 |
| Yaquina River | 2/8/94 | YR-1 through YR-6 | C-9 |
| Depot Slough | 2/11/94 | T-GC-1 – T-GC-3 & | C-10 |
| Yaquina Bay | 3/15/95 | YB-1 – YB-5 | C-11 |
| Yaquina Bay/ Newport Breakwater | 3/16/95 | NYMJ-1 – NYMJ-3 | C-12 |
| Newport Breakwater | 7/15/96 | DH-96-1 – DH-96-4 | C-13 |
| Yaquina Bay and South Beach Marina | 6/1/00 | YB-BC-01-5 & 9; YB-GC-6-9 | C-14 |
| Yaquina Proposed North and South ODMDS sites | 7/2/00 | YQ1-25; YOC-BC-1-5 | C-15 |

The Yaquina lab results cover a 20-year period and throughout that time, there were many technological changes that affected what and how sediments were tested. These changes included several significant areas:

• Sample Type: Originally, the emphasis was on what contaminates were released to the water column, so eultriate samples were collected, along with bulk sediment samples. With time, the sediments were found to be the depository for contaminates, not the water column. The types of analyses performed on bulk sediment samples changed to include a wide array of chemicals.

• Analytes: Analytes changed from primarily metals to include metals and a wide array of organic chemicals. The wide array of chemicals added for testing includes tributyltin, dioxin, PAHs, phthalates, phenols, PBCs and pesticides. Originally, samples were tested for total metals, which changed to total recoverable metals, which we currently test for.

• Detection Limits: Detection limits decreased as much as 1000%. As new technologies were developed with the capacity to test for chemicals at lower levels, the detection limits dropped. For example, the detection limit for pentachlorophenol was 1,600 ug/kg during the 11/21/89 sampling, 350 ug/kg in 4/4/91 and 20 ug/kg in 2/8/94. Currently, the detection limit is 1.7 ug/kg.

• Lab Methods: Extraction and test methods have changed through the years and can be seen most clearly in metal analyses. For instance, test methods and final results for total recoverable metals are different from those for total metals. As discussed in the metals section, various extraction methods were used throughout the last 20 years.

• Screening Levels: In November 1998 state and federal agencies in Oregon and Washington formally adopted screening levels, which are listed in the Dredged Material Evaluation Framework for the Columbia River (USACE, 1998). Before then, various screening levels were adopted and used as informal guidelines. The adoption and use of screening levels is on going and will change as new information through research and analyses become available in the future.

The concept of "trace contaminates" influences the interpretation of the chemical concentrations and what actions are acceptable. The MPRSA, section 227.6 prohibits dumping of certain constituents into ODMDS other than as trace contaminates unless they are rapidly rendered harmless. Trace contaminates are not defined in terms of numerical chemical limits, but rather in terms of persistence, toxicity and bioaccumulation that will not cause an unacceptable adverse impact after dumping.

## WATER QUALITY

On June 10-13, 1980, the US Geological Survey (USGS), under contract with the USACE-Portland District, collected samples from 14 stations from the Yaquina Bay and River and conducted elutriate tests. The dissolved chemical analyses were performed and the results are shown in Tables C-1 through C-3. As shown in these tables, water quality was excellent at Yaquina Bay. All parameters measured well within normal ranges expected for nearshore ocean waters off the Oregon Coast and meet states water quality standards . The detailed analysis and results were included in "The USGS Survey in Western Oregon and Washington" (Fuhrer, 1983). Figure C –1 shows the station locations. Because of the extensive studies conducted in the early 1980's, a large data set regarding the impact of dredged material disposal on the water column was established. Since that time, focus has shifted away from water column pathway to more direct contact with the bulk sediment. Therefore, water column test are rarely performed, unless there is a "reason to believe" a water column release may occur.

## SEDIMENT QUALITY

In order to adequately address the areas of consideration, 15 sediment sampling events were performed over twenty years and in the various locations of the Yaquina estuary and ODMDS. These sampling events provided information used to assess sediment quality in the harbors and river and establish the baseline conditions for the Yaquina ODMDS. The sediment quality analytical data covers ten general categories:

1. Physical Analyses
2. Metals
3. Phenols
4. Pesticides and Insecticides
5. Low Polynuclear Aromatic hydrocarbons
6. High Polynuclear Aromatic hydrocarbons
7. Dioxins and Furans
8. Chlorinated hydrocarbons
9. Miscellaneous extractables
10. Phthalates

The sediment quality analytical data is summarized in 19 tables (Tables C-1 through C-19). Most of these concentrations are considered trace contaminates. The established screening levels (SL) provide the chemical concentrations at or below which there is no reason to believe that dredged material disposal would result in unacceptable adverse effects. The bioaccumulation trigger (BT) indicates the concentration above which the chemical may accumulate at levels that pose a risk to aquatic biota and/or human health. All chemical concentrations are compared to their established screening levels and bioaccumulation triggers. These levels are listed at the bottom of each table. The ten general categories that cover sediment quality analytical data will be discussed for ODMDS baseline and Yaquina estuary.

## ODMDS BASELINE SEDIMENT QUALITY:

**Physical Analyses:** The data on the Yaquina interim ODMDS, Section 103 and proposed North and South sites shows the sites have fine to medium marine sand, with very little (0 to 6 percent) silts and clays, as shown in Table C-6. This analysis concurs with observations taken in 1977 by divers at the interim site (USACE, 1977), which reported gray fine sands, average size of 1/2 to 1 mm with some shell fragment.

The physical properties of sediments at Yaquina ODMDS are similar to the majority of the dredged materials. The physical analyses associated locations in the federal navigation channel that are dredged sites are similar to the ODMDS physical analyses in the percent of sand, fines and total organic carbon (TOC). The percent TOC at sample locations in the navigation channel are within the

same range as the ODMDS. They are considered compatible and comply with the "like-on-like" principle.

**Elemental Metals:** Total metal analyses were performed only on the July 2, 2000 samples collected from the proposed Yaquina North and South ODMDS. As shown on Table C-5, low concentrations were detected for most of the metals, but these concentration were far below the established screening levels.

**Organotin Compounds**: Tributyltin analyses were not performed on any of the sediments collected at ODMDS.

**Phenols**: Phenol compounds analyses were performed only on the July 2, 2000 samples collected from the proposed Yaquina North and South ODMDS. As shown on Table C-11, no phenol compounds were detected.

**Pesticides and Insecticides:** Pesticides and insecticides compounds analyses were performed only on the July 2, 2000 samples collected from the proposed Yaquina North and South ODMDS. As shown on Table C-12, pesticides or PCBs were detected at the ODMDS stations.

**Low Polynuclear Aromatic hydrocarbons(LPAH):** Low polynuclear aromatic hydrocarbons compounds analyses were performed only on the July 2, 2000 samples collected from the proposed Yaquina North and South ODMDS. As shown on Table C-14, no LPAH compounds were detected.

**High Polynuclear Aromatic hydrocarbons(HPAH):** High polynuclear aromatic hydrocarbons compounds analyses were performed only on the July 2, 2000 samples collected from the proposed Yaquina North and South ODMDS. As shown on Table C-15, no LPAH compounds were detected.

**Dioxins/Furans:** Dioxins/furans analyses were no performed on any OMDMDS sediments samples.

**Chlorinated Hydrocarbons:** Chlorinated hydrocarbons analyses were performed only on the July 2, 2000 samples collected from the proposed Yaquina North and South ODMDS. As shown on Table C-16, none were detected.

**Miscellaneous Extractables:** Miscellaneous extractables analyses were performed only on the July 2, 2000 samples collected from the proposed Yaquina North and South ODMDS. As shown on Table C-18, none were detected.

**Phthalate Compounds:** Phthalate compounds analyses were performed only on the July 2, 2000 samples collected from the proposed Yaquina North and South ODMDS. As shown on Table C-17, dis(2-ethylhexyl) phthalate and diethyl phthalate were detected. Concentrations of dis(2-ethylhexyl) phthalate varied from 3.8 to 6.3 ppb, which is just above the detection limit of 4.3 ppb, but far

below the established screening level of 8,300 ppb. A concentration of 3.8 ppb of diethyl phthalate was detected at YOC-BC-02, which is just above the detection limit of 3.1 ppb, but far below the established screening level of 1,200 ppb.

## YAQUINA ESTUARY SEDIMENT QUALITY:

**Physical Analyses:** Physical analyses are the most plentiful type of data available on Yaquina estuary, and are covered in Tables C-7 through C-9. The sediment quality of dredged material from the turning basin, South Beach marina and Depot Slough are different from the ODMDS. The South Beach marina, Depot Slough and turning basin sediments have a much higher percent fines. Since the turning basin is dredged on a regular basis, it has high fines in only a few areas, which can be seen in the physical analyses of samples YB-BC-05 and YB-BC-06 taken on May 31, 2000. As shown on Table C-7 and C-8, some samples from the Depot Slough have greater than 90% silt. Some of these fine grain materials were disposed at the Section103 site, but the amount makes up only about 5% of the entire amount dredged annually. From 1986 to 1999, the total amount dredged from the Yaquina Estuary averages 313,600cy/year. The following list provides dredged material volumes estimated for the Yaquina Bay federal navigation project.

Volumes Dredged
Yaquina Bay Federal Navigation Project
[in thousands of cy]

| Fiscal Year | Hopper Dredge |
|---|---|
| 1986 | 237.3 |
| 1987 | 543.0 |
| 1988 | 324.6 |
| 1989 | 383.8 |
| 1990 | 216.7 |
| 1991 | 425.7 |
| 1992 | 213.0 |
| 1993 | 358.4 |
| 1994 | 207.0 |
| 1995 | 456.3 |
| 1996 | 286.8 |
| 1997 | 313.5 |
| 1998 | 185.4 |
| 1999 | 238.9 |
| Average | 313.6 |

This is over ten times the total amount dredged from the turning basin, which is less than half fine grain material. During the last six years, the turning basin (River Mile 1+40 to 2+25) was dredged three times, with an average of 27,200 cy/year disposed into the ODMDS Section 103 site.

South Beach Marina is dredged approximately every five years with an average amount of 13,000 cy/year. (21,000 cy were dredged in 1992, and 5,000 cy in 1997.) Although it may go in water, the South Beach Marina dredged material has historically gone upland. Depot Slough is dredged approximately every 15 years with 36,000 cy. dredged in 1995. The dredged material from Depot Slough historically went upland for economic reasons. However, in 1995 it was disposed at the ODMDS Section 103 site. Table C-9 shows general physical data useful for dredging projects.

**Elemental Metals:** The elemental metal levels in the sediments were well below the established screening levels in all samples (USACE and USEPA, 1991). As shown on Tables C-4 and C-5, the lab results for the other metals show levels far below the established screening levels at the riverine/habor stations. The concentration of every heavy metal at riverine/habor stations is higher than those associated with ODMDS sediments. This is probably because high fines/organics sediments tend to accumulate metals.

Some of the metal concentrations cannot be directly compared with each other because the methods of extraction and analyses have changed over the years. In the June 10-13, 1980 sediment samples, the earliest Yaquina sediment analyses, extraction method 3005 was used. Extraction method 3005 analyzed for total recoverable metals using hot, dilute mineral acid for digestion to remove metals from the sediment's lattice structure. A change in extraction methods can be seen in the July 28,1986 sediment metal analyses, where extraction method 3030(1) was used to test for total metals. Extraction method 3030(1) used sulfuric and nitric acids with hydrogen peroxide in the sediment digestion.

Currently, extraction method 3050(A) is used to analyze for total metals and it uses nitric and hydrochloric acids. This change in extraction methods may account for the higher concentrations of metals in the earlier sampling events.

**Organotin Compounds**: Tributyltin concentration in the sediments is the only metal that exceeded established screening levels. As shown on Table C-10, a tributyltin (TBT) level of 278 ppb was detected in sample EPA 2, during the April 4-5, 1990 sampling event at Yaquina Bay, near South Beach Marina. A level of 278 ppb tribuyltin was above the established screening level of 73 ppb (dry weight), and triggered bioassay testing.

As follow-up, on May 7, 1991, three sediment samples, a reference and a control, collected from South Beach Marina were subject to Tier III analyses. The Tier III biological testing included 10 day and 20 day Neanthese sp. Bioassays, two 48 hour oyster larva (Crassostrea gigas) bioassays and a 10 day amphipod (Rhepoxynius sp.) bioassay for a total of five separate tests. The bioassays were conducted on three sediment samples (SBM-BC-1, 2 and 3), a reference (SBM-BC-7) and a control. The reference was collected from a quite water area near River Mile 2.1, an area that had been sampled and analyzed previously under the joint USACE/EPA 1991 sediment characterization study (sample EPA-9). The control sediment was collected at the time and location where the amphipods for the amphipod bioassays were collected. This location is along the sandy beach on the main bay just upstream of the South Beach Marina entrance. The results of the solid phase tests revealed no significant differences between control, reference and South Beach Marina sediments in the test endpoints (Siipola, 1991).

As follow-up, four sediment samples were collected on May 7, 1991 and underwent Tier II A and B testing, including organotin compounds and phenols. The follow-up sampling showed low levels (12 ppb) of organotin compounds at South Beach Marina. In this follow up chemical testing, all chemical of concern were below established screening levels.

**Phenols**: The phenol compounds concentrations were below the established screening and bioaccumulation levels for all sample stations except the April, 4-5, 1990 sample station EPA 2. This is the same sample station that exceeded the TBT established screening and bioaccumulation levels. It had a phenol

concentration of 480 ppb, which exceeds the phenol established screening level of 120 ppb. As follow-up, four sediment samples were collected on May 7, 1991 and tested for phenol compounds and bioassay, as shown on Table C-11. The follow-up sampling did not show elevated concentrations of phenol, TBT or phenol compounds.

The analyses from Yaquina River and harbor have much higher levels of phenols than the ODMDS stations that were sampled. This is probably because phenols occur naturally in bark and are associated with decaying vegetation, log rafting and forest product wastes. Since rivers and harbors have more of these materials than the ocean, it is natural to see higher phenol concentrations as can be seen on Table C-11. Phenols are highly soluble in water and in high concentrations are bactericidal, but in lower concentrations are rapidly degraded by bacteria. (Britton, J., 1991)

**Pesticides and Insecticides:** The sediment samples from six sampling events were tested for pesticides and polychlorinated biphenyls (PCBs). PCB-1254 was the main chemical of concern detected. As shown on Tables C-12 and C-13, the concentrations of PCB-1254 vary from 20 to 100 ppb, which was below the established screening levels of 130 ppb.

**Low Polynuclear Aromatic hydrocarbons(LPAH):** Major sources of PAHs to the environment are industry emissions, cars, trucks, airplanes, trains, and other off road vehicles (USEPA, 1996). Because PAHs are common in the environment, it is not unusual for some PAH to be detected in estuary sediment samples if the detection limit is low. Sediment samples from five sampling events were tested for low polynuclear aromatic hydrocarbons (LPHAH). Phenanthrene was the only chemical of concern detected, as shown on Tables C-14. Phenanthrene concentrations vary from 20 to 130 ppb, which was far below the established screening level of 1,500 ppb.

**High Polynuclear Aromatic hydrocarbons(HPAH):** The sediment samples from five sampling events were tested for high polynuclear aromatic hydrocarbons (HPHAH), as listed in the Dredged Material Evaluation Framework. Fluoranthene, pyrene, and chrysene were the three chemicals of concern detected, as shown on Tables C-15. Concentrations varied from 21 to 270 ppb, which were far below the established screening levels of 1,400 ppb, 1700 ppb and 2,600 ppb respectively. Chrysene is a known carcinogen.

**Dioxins/Furans:** Sediments samples from the April 4-5, 1990 sampling event were the only ones analyzed for dioxins/furans. As shown on Table C-19, concentrations were detected for all 17 congeners analyzed. Samples were collected at eight sample locations, which are shown on Figure 5. As part of the Puget Sound Dredged Disposal Analysis (PSDDS) program, the Washington State agencies developed an approach for evaluating dioxin/furan concentrations. Discussed in the February 2000 "Dredged Material Evaluation and Disposal

Procedures"( USACE/USEPA/WDNR/WDOE, 2000), this approach provided guidance on how to evaluate the toxic effect of dioxin/furans concentrations detected. It list the toxic equivalency factors (TEF) for the dioxin/furans, which are used to normalized the dioxin/furan concentrations to the toxic equivalent of 2,3,7,8 TCDD, the most toxic of the dioxins. The toxic equivalent concentration (TEC) then can be calculated for each sample location and totaled. The total TECs can be compared to the guidance values. This guidance values considers that sediments with concentrations below 5 ppt TEC for TCDD and 15 ppt TECs for all the major constituents, are considered suitable for unconfined open water disposal. This is based mainly on human health considerations and pathways.

Using this approach, the total toxic equivalent concentration for 2,3,7,8 TCDD was 2.7 ppt, which is less than the 5 ppt TEC guidance value. Most of the 2.7 ppt TEC is a result of detection limit TEC calculations. The PSDDS guidance recommends the detection limit for undetected congeners be divided by two and used in the calculations. When the detection limit is high, the TEC concentrations for undetected congeners could add significantly to the total TEC concentrations, which is the case for the 2,3,7,8 TCDD.

The total TEC congeners concentrations for the eight sample locations varied from 0.89 to 11.88 ppt, which is less than the 15 ppt TEC guidance standard for all the major constituents. EPA-3 (figure C-5) had the highest TEC concentration with a 11.88 ppt.

Two samples showed trace amounts of the most toxic congeners 2,3,7,8-TCDD. These were sample EPA-9 with 0.38 ppt and sample EPA-13 with 0.29 ppt 2,3,7,8 TCDD. Sample EPA-9 showed the highest percent fines (75.9%) and second highest TOC (3.08%) of all the April 4-5, 1990 samples. If 2,3,7,8 TCDD were to be found, one would expect to find it in a location with high fines and TOC since dioxin/furans tend to accumulate in fine-grained, organics enriched materials. It also can persist for a long time in the environment. Sample EPA-13, on the other hand, showed the lowest level of percent fines (13.1%) and TOC(0.51%) of all the dioxin/furan sampling stations. It also showed the lowest concentrations for 15 or the 17 congeners tested in those samples where congeners were detected. These samples probably revealed the inherent variability of the method used in measuring such low concentrations. The mean detected limit for the other 6 samples was 0.77 ppt, which indicates that the values for EPA-9 and 13 are near the detection limit for the method and type of sample (Britton, J., 1991). As shown on Figure C-5, samples EPA-9 and EPA-13 are located outside of the federal navigational channel. The sediments from these areas have a low probability to be dredged and disposed in the ocean disposal sites.

**Chlorinated Hydrocarbons:** Chlorinated hydrocarbons analyses were performed on four sampling events in the Yaquina estuary. As shown on Table C-16, none were detected.

**Miscellaneous Extractables:** Miscellaneous extractables analyses were performed on four sampling events in the Yaquina estuary. As shown on Table C-18, none were detected.

**Phthalate Compounds:** Phthalate compounds analyses were performed on four sampling events in the Yaquina estuary. As shown on Table C-17, dis(2-ethylhexyl) phthalate was detected at riverine and harbor stations at concentrations varying from 18 to 750 ppb, which is far below the established screening level of 8,300 ppb. Although some of the sample results show non-detect for phthalates, phthalates may have existed, but not be detected because of high detection limits. For example, the November 21, 1989 samples results' detection limit was 330 ppb, which is much higher than the 4.3 ppb detection level used to analyze the July 2, 2000 samples. Phthalates are a group of constituents in plastics and a common laboratory contaminate. They are used as plasticizers to make plastics flexible and are also used in vacuum pumps. Their probable source is plastic debris lost or thrown over board from boats using the rivers, bay and marinas.

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**Table C-1**
**Yaquina Bay and River**
**Dissolved Chemicals in Native Waters and Elutriates**

| Location | Sample | Date | Sample Type * | Organic Carbon (mg/l) | Nitrogen Ammonia (mg/l) | Phosphorus Ortho-phosphate | Phenols | Manganese | Barium | Beryllium | Cyanide |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Pacific Ocean | 1 | 06/11/1980 | NE1 | 6.4 | 0.1 | 14 | <1 | 30 | --- | --- | 1 |
| Yaquina Bay | 2 | 06/12/1980 | EE1 | 3.7 | 1.4 | 19 | 9 | 40 | --- | --- | --- |
| Yaquina Bay | 3 | 06/12/1980 | EE1 | 3.2 | 0.86 | 64 | <1 | 140 | --- | --- | --- |
| Yaquina Bay | 3 | 06/12/1980 | EH2 | 6.9 | 1.3 | 116 | 42 | 60 | --- | --- | --- |
| Yaquina Bay | 4 | 06/12/1980 | EE1 | 7.4 | 1.6 | 77 | 12 | 90 | <100 | 10 | 2 |
| Yaquina Bay | 4 | 06/12/1980 | EH2 | 15 | 1.4 | 76 | 51 | 40 | <100 | <10 | 2 |
| Yaquina Bay | 5 | 06/12/1980 | EE1 | 10 | 1.9 | 19 | 7 | 380 | --- | --- | --- |
| Yaquina Bay | 5 | 06/12/1980 | EH2 | 11 | 1.8 | 16 | <1 | 180 | --- | --- | <0.5 |
| Yaquina Bay | 6 | 06/12/1980 | EE1 | 19 | 5.3 | 67 | 190 | 410 | --- | --- | --- |
| Yaquina Bay | 6 | 06/12/1980 | EH2 | 27 | 4.1 | 87 | 200 | 160 | --- | --- | --- |
| Yaquina Bay | 7 | 06/12/1980 | EE1 | 4 | 0.41 | <10 | 10 | 200 | -- | --- | --- |
| Yaquina Bay | 7 | 06/13/1980 | EH2 | 5.3 | 0.42 | <10 | 11 | 80 | --- | --- | --- |
| Yaquina Bay | 8 | 06/13/1980 | EE1 | 3 | 0.38 | 12 | 17 | 230 | --- | --- | --- |
| Yaquina Bay | 8 | 06/13/1980 | EH2 | 3.4 | 0.23 | <10 | 1 | 110 | --- | --- | --- |
| Yaquina Bay | 9 | 06/10/1980 | EE1 | 4.5 | 1 | 38 | 170 | 485 | --- | --- | --- |
| Yaquina Bay | 9 | 06/10/1980 | EH2 | 5.9 | 0.67 | 43 | <1 | 194 | -- | --- | --- |
| Yaquina Bay | 10 | 06/10/1980 | EE1 | 14 | 14 | 19 | 190 | 3600 | 500 | <10 | 2 |
| Yaquina Bay | 10 | 06/10/1980 | EH2 | 12 | 9.1 | 18 | 95 | 1300 | --- | <10 | 2 |
| Yaquina Bay | 11 | 06/10/1980 | EE1 | 6.3 | 1.4 | 13 | 23 | 630 | --- | --- | --- |
| Yaquina Bay | 11 | 06/10/1980 | EH2 | 8.7 | 0.76 | 22 | 1 | 410 | --- | --- | --- |
| Yaquina Bay | 12 | 06/10/1980 | EE1 | 5.6 | 4.5 | 26 | 1 | 10000 | --- | --- | --- |
| Yaquina Bay | 13 | 06/10/1980 | EE1 | 0.5 | 1.3 | 28 | <1 | 5500 | -- | --- | --- |
| Yaquina Bay | 14 | 06/11/1980 | NH2 | 4.5 | 0.06 | 22 | <1 | 20 | <100 | <10 | 1 |

* NE= native water, NH= euryhaline water, NF= native fresh water, EE= elutriate with estuarine water, EH= elutriate with eurhaline, EF= elutriate with fresh water, EB= bottom material (see Table C-4). The number following the two-digit code indicates: for native water samples the number of samples analyzed and for elutriates the respective mixing water.

# TABLE C-2
# YAQUINA BAY AND RIVER
# DISSOLVED INSECTICIDES AND HERBICIDES
# IN NATIVE WATERS AND ELUTRIATES in ug/l

| Analyte | SITE 1 | SITE 4 | SITE 4 | SITE 10 | SITE 10 | SITE 14 |
|---|---|---|---|---|---|---|
| Sample Type* | NE1 | EE1 | EH2 | EE1 | EH2 | EH2 |
| Aldrin | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| Ametryne | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| Atratone | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| Atrazine | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| Chlordane | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| Cyanazine | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| Cyprazine | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| DDD | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| DDE | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| DDT | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| Dieldrin | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| Endosulfan | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| Endrin | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| Heptachlor | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| Heptachlor Epoxide | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| Lindane | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| Methoxychlor | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| Mirex | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| PCB | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| Naphthalenes, Polychlor. | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| Perthane | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| Prometone | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| Prometryne | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| Propazine | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| Silvex | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| Simazine | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| Simetone | <0.01 | <0.01 | <0.01 | <0.1 | <0.1 | <0.1 |
| Simetryne | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| Toxaphene | <1 | <1 | <1 | <1 | <1 | <1 |
| 2, 4-D | <0.01 | <0.01 | <0.01 | <0.01 | **0.04** | <0.01 |
| 2,4-DP | **0.01** | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| 2,4,5-T | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |

* NE= native water, NH= euryhaline water, NF= native fresh water; EE= elutriate with estuarine water, EH= elutriate with euryhaline, EF=elutriate with fresh water, EB= bottom material (See Table C-4). The number following the two digit code indicates: for native water samples, the number of samples analyzed and for elutriates, the respective mixing water.

## TABLE C-3
## YAQUINA BAY AND RIVER
## DISSOLVED METALS IN NATIVE WATERS AND ELUTRIATES in ug/l

| Location | Sample | Date | Sample Type | Arsenic | Cadmium | Chromium | Copper | Lead | Mercury | Nickel | Zinc | Iron |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Pacific Ocean | 1 | 6/11/80 | NE1 | 1 | 1.3 | --- | 2 | 2 | ND | ND | 11 | 100 |
| Yaquina Bay | 2 | 6/12/80 | EE1 | --- | 0.88 | ND | 1 | ND | ND | --- | 1.8 | 120 |
| Yaquina Bay | 3 | 6/12/80 | EH1 | --- | 0.09 | ND | 1 | ND | ND | --- | 1.2 | 120 |
| Yaquina Bay | 3 | 6/12/80 | EH2 | --- | 0.41 | ND | 2 | 2 | 0.1 | --- | 1.8 | 40 |
| Yaquina Bay | 4 | 6/12/80 | EE1 | 4 | 0.12 | --- | 3 | ND | ND | 4 | 1.8 | 130 |
| Yaquina Bay | 4 | 6/12/80 | EH2 | 5 | 0.41 | --- | 1 | ND | ND | 2 | 5.4 | 40 |
| Yaquina Bay | 5 | 6/12/80 | EE1 | --- | 0.32 | ND | 3 | ND | 0.2 | --- | 3.4 | 160 |
| Yaquina Bay | 5 | 6/12/80 | EH2 | --- | 0.05 | --- | 4 | ND | ND | --- | 2.6 | 60 |
| Yaquina Bay | 6 | 6/12/80 | EE1 | --- | 0.01 | --- | 2 | 1 | 0.2 | --- | 5.4 | 110 |
| Yaquina Bay | 6 | 6/12/80 | EH2 | --- | 0.25 | ND | 6 | ND | ND | --- | 1.7 | 40 |
| Yaquina Bay | 7 | 6/12/80 | EE1 | --- | 0.08 | ND | 3 | 1 | ND | --- | 8.3 | 120 |
| Yaquina Bay | 7 | 6/13/80 | EH2 | --- | 0.18 | ND | 1 | ND | ND | --- | 3.5 | 50 |
| Yaquina Bay | 8 | 6/13/80 | EE1 | --- | 0.11 | ND | 2 | ND | ND | --- | 4.8 | 110 |
| Yaquina Bay | 8 | 6/13/80 | EH2 | --- | 0.14 | ND | 2 | 2 | 0.1 | --- | 3.5 | 40 |
| Yaquina Bay | 9 | 6/10/80 | EE1 | --- | 0.05 | ND | 4 | ND | ND | --- | 2.7 | 126 |
| Yaquina Bay | 9 | 6/10/80 | EH2 | --- | 0.08 | ND | ND | ND | 0.1 | --- | 1.2 | 40 |
| Yaquina Bay | 10 | 6/10/80 | EE1 | 4 | 0.47 | ND | 2 | 2 | 0.2 | 3 | 12 | 4000 |
| Yaquina Bay | 10 | 6/10/80 | EH2 | 2 | 0.15 | --- | 3 | 3 | ND | 2 | 4.1 | 770 |
| Yaquina Bay | 11 | 6/10/80 | EE1 | --- | 0.01 | ND | ND | ND | ND | --- | 3.7 | 120 |
| Yaquina Bay | 11 | 6/10/80 | EH2 | --- | 0.06 | ND | 2 | ND | ND | --- | 1.3 | 70 |
| Yaquina Bay | 12 | 6/10/80 | EE1 | --- | 0.01 | ND | 11 | ND | 0.1 | --- | 2.7 | 110 |
| Yaquina Bay | 13 | 6/10/80 | EE1 | --- | 0.26 | ND | 1 | ND | ND | --- | 2.5 | 143 |
| Yaquina Bay | 14 | 6/11/80 | NH2 | ND | 0.11 | --- | 3 | ND | ND | 2 | 3.3 | 20 |
| Detection Limit | | | | 1 | — | 1 | 1 | 1 | 0.1 | 1 | — | — |

* NE= native water, NH= euryhaline water, NF= native fresh water; EE= elutriate with estuarine water, EH= elutriate with euryhaline, EF=elutriate with fresh water, EB= bottom material (See Table C-4). The number following the two digit code indicates: for native water samples, the number of samples analyzed and for elutriates, the respective mixing water.

## TABLE C-4
## YAQUINA ESTUARY
## TOTAL METALS ANALYSES OF SEDIMENTS in ppm

| Location | Sample | Date | Arsenic | Cadmium | Chromium | Copper | Lead | Mercury | Nickel | Zinc |
|---|---|---|---|---|---|---|---|---|---|---|
| **HARBOR** | | | | | | | | | | |
| Yaquina Bay* | SITE 4 | 6/12/80 | 6 | 1 | 10 | 8 | 10 | 0.02 | 10 | 40 |
| Yaquina Bay | EPA 2 | 4/4-5/1990 | 21.8 | 0.7 | 49.2 | 23.8 | 14.7 | 0.06 | 36 | 81.7 |
| Yaquina Bay | EPA 3 | 4/4-5/1990 | 8.7 | 0.46 | 32 | 14 | 6.73 | 0.03 | 22 | 52.1 |
| Yaquina Bay | EPA 6 | 4/4-5/1990 | 8.5 | 0.17 | 26 | 7.9 | 3.65 | 0.02 | 17 | 33.7 |
| Yaquina Bay | EPA 8 | 4/4-5/1990 | 11.5 | 0.33 | 32.3 | 12.7 | 4.46 | 0.03 | 23 | 58.7 |
| Yaquina Bay | EPA 9 | 4/4-5/1990 | 18.9 | 0.24 | 56.7 | 23.8 | 12.7 | 0.06 | 40 | 79.1 |
| Yaquina Bay | EPA 10 | 4/4-5/1990 | 8.1 | 0.14 | 29.4 | 9.4 | 5.23 | 0.02 | 20 | 44.2 |
| Yaquina Bay | EPA 11 | 4/4-5/1990 | 9.8 | 0.05 | 14.4 | 2.6 | 3.18 | 0.03 | 9 | 31.9 |
| Yaquina Bay | EPA 12 | 4/4-5/1990 | 27.5 | 0.2 | 44.9 | 20.3 | 14.7 | 0.06 | 30 | 76 |
| Yaquina Bay | EPA 13 | 4/4-5/1990 | 5.8 | 0.21 | 18.1 | 5.2 | 5.11 | 0.02 | 11 | 22.7 |
| Yaquina Bay | EPA 14 | 4/4-5/1990 | 16.1 | 0.14 | 41.4 | 14 | 7.8 | 0.04 | 30 | 59 |
| Yaquina Bay | BC 9 | 4/4-5/1990 | 9.4 | 0.14 | 41 | 14.3 | 4.4 | 0.05 | 29 | 55.6 |
| Yaquina Bay | BC 10 | 4/4-5/1990 | 6.1 | 0.07 | 16.8 | 4.3 | 1.57 | 0.02 | 11 | 22.1 |
| Yaq/Newport | YNMJ2 | 3/16/95 | 4.5 | 0.15 | 20.7 | 7.57 | 3.58 | ND | 16 | 29.8 |
| Yaq/Newport | YNMJ 1/3 | 3/16/95 | 2.8 | 0.34 | 11.5 | 2.2 | 1.78 | ND | 7.3 | 13.9 |
| Yaquina Bay | YSB-1 | 3/15/95 | 8.4 | 0.45 | 46.2 | 20.8 | 8.98 | 0.05 | 40.6 | 84.3 |
| Yaquina Bay | YSB-2 | 3/15/95 | 5.3 | 0.3 | 24.4 | 12.3 | 5.23 | 0.03 | 18.5 | 49.5 |
| Yaquina Bay | YB-1 | 3/15/95 | 9.1 | 0.27 | 45 | 21.8 | 9.17 | 0.06 | 40.2 | 65 |
| Yaquina Bay | YB-BC-05 | 6/1/00 | 11 | 0.44 | -- | 30 | 11 | ND | 47 | 88 |
| Yaquina Bay | YB-GC-07 | 6/1/00 | 5.9 | 0.92 | -- | 15 | 5.8 | ND | 31 | 54 |
| Yaquina Bay | YB-GC-08 | 6/1/00 | 6.6 | 0.52 | -- | 23 | 8.1 | ND | 38 | 83 |
| Yaquina Bay | YB-BC-09 | 6/1/00 | 9.3 | 0.86 | -- | 37 | 11 | ND | 50 | 110 |
| **RIVERINE** | | | | | | | | | | |
| Depots Slough* | SITE 10 | 6/10/80 | 12 | 1 | 30 | 39 | 40 | 0.03 | 20 | 120 |
| Depot Slough | #1 | 11/21/89 | 2 | ND | 13 | 11 | 5.5 | ND | 9 | 50.9 |
| Depot Slough | #2 | 11/21/89 | 1.8 | ND | 13 | 11 | 4.6 | ND | 8.3 | 41.6 |
| Depot Slough | #3 | 11/21/89 | ND | ND | 16 | 9.3 | 5 | ND | 9.7 | 43.7 |
| Depot Slough | #4 | 11/21/89 | 2.1 | ND | 18 | 12 | 12.8 | ND | 10 | 50.8 |
| Toledo | 1w.m.e | 11/21/89 | 2 | ND | 13 | 11 | 5.5 | ND | 9 | 50.9 |
| Toledo | 2w.m.e | 11/21/89 | 1.8 | ND | 13 | 11 | 4.6 | ND | 8.3 | 41.6 |
| Toledo | 3w.m.e | 11/21/89 | ND | ND | 16 | 9.3 | 5 | 0.06 | 9.7 | 43.7 |
| Toledo | 4w.m.e | 11/21/89 | 2.1 | ND | 18 | 12 | 12.8 | 0.06 | 10 | 50.8 |
| Depot Slough | T-DS-1 | 2/11/94 | 12.3 | 0.34 | 43.3 | 33.5 | 21.3 | 0.1 | 33.3 | 127 |
| Depot Slough | T-DS-2 | 2/11/94 | 12 | 0.32 | 46 | 34 | 21.8 | 0.11 | 33.2 | 130 |
| Depot Slough | T-DS-3 | 2/11/94 | 12.5 | 0.3 | 48.4 | 32.6 | 19.7 | 0.11 | 36 | 128 |
| Toledo | T-GC-1 | 2/11/94 | 9 | 0.28 | 43 | 29 | 18.5 | 0.07 | 26.7 | 108 |
| Toledo | T-GC-2 | 2/11/94 | 10.3 | 0.31 | 57 | 161 | 37.9 | 0.07 | 34 | 416 |
| Toledo | T-GC-3 | 2/11/94 | 9.4 | 0.3 | 62 | 75 | 28.6 | 0.08 | 33.3 | 157 |
| Toledo | T-GC1-3 | 2/11/94 | 10.4 | 0.27 | 83 | 97 | 24.1 | 0.07 | 40.7 | 156 |
| **Detection Limit** | | | **0.084- 0.4** | **0.029- 0.4** | **0.4** | **0.057- 0.8** | **0.0039-** | **0.023-0.08** | **0.05- 2.8** | **0.17-** |
| **Screening Levels** | | | **57** | **5.1** | | **390** | **450** | **0.41** | **140** | **410** |
| **Bioaccum. Trigger** | | | **507.1** | **—** | **—** | **—** | **—** | **1.5** | **370** | **—** |

* bottom material(EB) collected as part of elutriate testing. see table C-1 through C-3.

# TABLE C-5
# YAQUINA ODMDS SITES AND ESTUARY
# TOTAL METALS ANALYSES OF SEDIMENTS in ppm

| Location | Sample | Date | Arsenic | Cadmium | Chromium | Copper | Lead | Mercury | Nickel | Zinc | Silver |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **BASELINE** | | | | | | | | | | | |
| Yaquina Bay (North)** | YOC-BC-01 | 7/2/00 | 4.06 | 0.14 | --- | 2 | 1.7 | ND | 6.3 | 12 | 0.03 |
| Yaquina Bay (North)** | YOC-BC-02 | 7/2/00 | 3.3 | 0.17 | --- | 2.8 | 2 | ND | 10 | 16 | 0.04 |
| Yaquina Bay (Reference)** | YOC-BC-03 | 7/2/00 | 3.1 | 0.19 | --- | 2.5 | 1.9 | ND | 9.7 | 15 | 0.032 |
| Yaquina Bay (South)** | YOC-BC-04 | 7/2/00 | 3.3 | 0.14 | --- | 2.6 | 1.7 | ND | 9.2 | 14 | 0.025 |
| Yaquina Bay (South)** | YOC-BC-05 | 7/2/00 | 3.7 | 0.17 | --- | 2.3 | 1.8 | ND | 9.1 | 15 | 0.033 |
| **ODMDS MONITORING** | | | | | | | | | | | |
| Yaquina Section 103 | YB1 | 10/12/89 | 5.69 | 0.04 | 7.5 | 1.2 | 2.7 | ND | 3.1 | 5.4 | --- |
| Yaquina Section 103 | YB2 | 10/12/89 | 4.94 | 0.05 | 9.8 | 1.5 | 2.9 | ND | 5.7 | 7.8 | --- |
| Yaquina Section 103 | YB3 | 10/12/89 | 5.05 | 0.04 | 9 | 1.4 | 1.8 | ND | 4.7 | 6.1 | --- |
| Yaquina Section 103 | YB4 | 10/12/89 | 5.34 | 0.04 | 9 | 1.5 | 1.4 | ND | 4.8 | 7.8 | --- |
| Yaquina Section 103 | YB5 | 10/12/89 | 4.94 | 0.17 | 8.2 | 1.4 | 1.6 | ND | 4.7 | 13.1 | --- |
| Yaquina Section 103 | YB6 | 10/12/89 | 5.69 | 0.12 | 7.5 | 1.2 | 2.7 | ND | 3.5 | 6.1 | --- |
| Yaquina Section 103 | YB7 | 10/12/89 | 5.75 | 0.03 | 9.8 | 1.5 | 1.6 | ND | 6.6 | 9 | --- |
| Yaquina Section 103 | YB8 | 10/12/89 | 4.12 | 0.05 | 9.8 | 1.3 | 0.9 | ND | 5.2 | 8.7 | --- |
| Yaquina Section 103 | YB9 | 10/12/89 | 4.94 | 0.04 | 8.2 | 1.2 | 10.2 | ND | 4.7 | 6.8 | --- |
| Yaquina Section 103 | YB10 | 10/12/89 | 4.94 | 0.04 | 9 | 1.3 | 1.1 | ND | 5.4 | 8.1 | --- |
| Yaquina Section 103 | YB11 | 10/12/89 | 5.17 | 0.05 | 18 | 2.2 | 2.5 | ND | 11.4 | 10.7 | --- |
| Yaquina Section 103 | YB12 | 10/12/89 | 4.94 | 0.04 | 24 | 2.7 | 2.1 | ND | 12.8 | 11.9 | --- |
| **RIVERINE** | | | | | | | | | | | |
| Yaquina Bay* | YQA1 | 7/28/86 | 1.3 | 3.1 | --- | 3.3 | 21 | 0.052 | -- | 7.5 | --- |
| Yaquina Bay* | YQA 2/3 | 7/28/86 | 0.5 | 2.7 | --- | 1 | 21 | 0.042 | -- | 6.1 | --- |
| Yaquina Bay* | YQA7 | 7/28/86 | 0.55 | 3.3 | --- | 2.2 | 24 | 0.038 | -- | 13 | --- |
| Yaquina Bay* | YQA8 | 7/28/86 | 0.01 | 2.2 | --- | 4 | 24 | 0.051 | -- | 20 | --- |
| Yaquina Bay* | YQA9 | 7/28/86 | 0.83 | 4 | --- | 8.9 | 24 | 0.047 | -- | 27 | --- |
| Yaquina Bay* | YQA10 | 7/28/86 | 0.26 | 3.6 | --- | 2.2 | 24 | 0.078 | -- | 12 | --- |
| **Detection Limit** | | | **0.084-0.4** | **0.029-0.4** | **0.4** | **0.057-0.8** | **0.0039-0.4** | **0.023-0.06** | **0.05-2.8** | **0.17-1.2** | **0.008-0.0091** |
| **Screening Levels** | | | **57** | **5.1** | **---** | **390** | **450** | **0.41** | **140** | **410** | **---** |
| **Bioaccum. Trigger** | | | **507.1** | **---** | **---** | **---** | **---** | **1.5** | **370** | **---** | **---** |

* These samples were extracted using the 3030(1) method instead of current 3050A method. The originial lab results are not available to verify copies of data. Therefore, data is suspect.

Note: Antimony concentration was found at a few sites ranging from 0.03 to 0.62 ppm, far below the 150 ppm screening level.

** YOC-BC-01 is a composite of YQ23-25 YOC-BC-02 is a composite of YQ1-2 YOC-BC-03 is a composite of YQ5-6
YOC-BC-04 is a composite of YQ13-14 YOC-BC-05 is a composite of YQ16-18

# TABLE C-6
# YAQUINA ODMDS SITES
# PHYSICAL ANALYSES

| Location | Sample | Date | mm Median | % Gravel | % Sand | % Fines | TVS % | TOC % | Specific Gravity | Void Ratio |
|---|---|---|---|---|---|---|---|---|---|---|
| **BASELINE (Interim Site)** | | | | | | | | | | |
| Yaquina Bay | Y1 | 1984 | 0.19 | 0 | 99.8 | 0.2 | --- | 1 | --- | --- |
| Yaquina Bay | Y2 | 1984 | 0.18 | 0 | 99.9 | 0.1 | --- | 1.3 | --- | --- |
| Yaquina Bay | Y3 | 1984 | 0.18 | 0.1 | 99.8 | 0.2 | --- | 1.4 | --- | --- |
| Yaquina Bay | Y4 | 1984 | 0.16 | 0 | 97.9 | 2.1 | --- | 2.7 | --- | --- |
| Yaquina Bay | Y5 | 1984 | 0.2 | 0.6 | 99.1 | 0.3 | --- | 1.1 | --- | --- |
| Yaquina Bay | Y6 | 1984 | 0.21 | 0 | 99.7 | 0.3 | --- | 0.7 | --- | --- |
| Yaquina Bay | Y7 | 1984 | 0.21 | 0 | 99.9 | 0.1 | --- | 0.9 | --- | --- |
| Yaquina Bay | Y8 | 1984 | 0.2 | 0 | 99.8 | 0.2 | --- | 0.6 | --- | --- |
| Yaquina Bay | Y9 | 1984 | 0.19 | 0 | 99.5 | 0.5 | --- | 1.1 | --- | --- |
| Yaquina Bay | Y10 | 1984 | 0.18 | 0 | 99.2 | 0.8 | --- | 0.8 | | |
| Yaquina Bay | Y11 | 1984 | 0.17 | 0 | 99.2 | 0.8 | --- | 1.5 | --- | --- |
| Yaquina Bay | Y12 | 1984 | 0.19 | 0.8 | 98.9 | 0.3 | --- | 1.4 | --- | --- |
| Yaquina Bay | Y13 | 1984 | 0.2 | 0.8 | 98.7 | 0.5 | --- | 1.5 | --- | --- |
| Yaquina Bay | Y14 | 1984 | 0.2 | 0 | 99.8 | 0.2 | --- | 0.8 | --- | --- |
| Yaquina Bay | Y15 | 1984 | 0.2 | 0 | 99.9 | 0.1 | --- | 0.6 | --- | --- |
| Yaquina Bay | Y16 | 1984 | 0.21 | 0 | 99.7 | 0.3 | --- | 0.9 | --- | --- |
| **BASELINE (Section 103 Site)** | | | | | | | | | | |
| Yaquina Bay | 100-6 | 5/16/86 | 0.192 | 0 | 100 | 0 | --- | 0.8 | --- | --- |
| Yaquina Bay | 100-12 | 5/16/86 | 0.189 | 0 | 99.9 | 0.1 | --- | 0.7 | --- | --- |
| Yaquina Bay | 100-18 | 5/16/86 | 0.199 | 0 | 100 | 0 | --- | 0.7 | --- | --- |
| Yaquina Bay | 100-28 | 5/16/86 | 0.195 | 0 | 99.5 | 0.5 | --- | 0.4 | --- | --- |
| Yaquina Bay | 100-34 | 5/16/86 | 0.187 | 0 | 100 | 0 | --- | 1.1 | --- | --- |
| Yaquina Bay | 100-41 | 5/16/86 | 0.183 | 0 | 99.2 | 0.8 | --- | 0.9 | --- | --- |
| Yaquina Bay | 100-47 | 5/16/86 | 0.183 | 0 | 99.8 | 0.2 | --- | 0.8 | --- | --- |
| Yaquina Bay | 100-54 | 5/16/86 | 0.183 | 0 | 99.5 | 0.5 | --- | 0.7 | --- | --- |
| Yaquina Bay | 100-60 | 5/16/86 | 0.185 | 0 | 99.4 | 0.6 | --- | 0.9 | --- | --- |
| Yaquina Bay | 100-71 | 5/16/86 | 0.228 | 0 | 99.8 | 0.2 | --- | 0.6 | --- | --- |
| Yaquina Bay | 100-77 | 5/16/86 | 0.208 | 0 | 99.8 | 0.2 | --- | 0.7 | --- | --- |
| Yaquina Bay | 100-83 | 5/16/86 | 0.213 | 0 | 99.8 | 0.2 | --- | 0.6 | --- | --- |
| **BASELINE (North & South Sites)** | | | | | | | | | | |
| Yaquina Bay (North) | YQ1 | 7/2/00 | 0.18 | 0 | 97.7 | 2.3 | 0.78 | --- | 2.81 | 0.76 |
| Yaquina Bay (North) | YQ2 | 7/2/00 | 0.2 | 0 | 96.7 | 3.3. | 0.8 | --- | 2.57 | 0.59 |
| Yaquina Bay | YQ3 | 7/2/00 | 0.2 | 0 | 98.2 | 1.8 | 0.72 | --- | 2.63 | 0.47 |
| Yaquina Bay (Reference) | YQ5 | 7/2/00 | 0.18 | 0.3 | 97.6 | 2.1 | 0.79 | --- | 2.75 | 0.73 |
| Yaquina Bay (Reference) | YQ6 | 7/2/00 | 0.19 | 0 | 96.5 | 3.5 | 12.72 | --- | 2.64 | 0.67 |
| Yaquina Bay | YQ11 | 7/2/00 | 0.2 | 0 | 97.5 | 2.5 | 0.8 | --- | 2.65 | 0.7 |
| Yaquina Bay | YQ12 | 7/2/00 | 0.2 | 0 | 98.4 | 1.6 | 0.68 | --- | 2.63 | 0.67 |
| Yaquina Bay (South) | YQ13 | 7/2/00 | 0.19 | 0 | 97.4 | 2.6 | 0.73 | --- | 2.69 | 0.53 |
| Yaquina Bay (South) | YQ14 | 7/2/00 | 0.2 | 0 | 96.7 | 3.3 | 0.92 | --- | 2.64 | 0.7 |
| Yaquina Bay | YQ15 | 7/2/00 | 0.19 | 0 | 98.6 | 1.4 | 0.95 | --- | 2.69 | 0.78 |
| Yaquina Bay (South) | YQ16 | 7/2/00 | 0.2 | 1.5 | 97.6 | 0.9 | 0.7 | --- | 2.75 | 0.74 |
| Yaquina Bay (South) | YQ17 | 7/2/00 | 0.21 | 0 | 97.9 | 2.1 | 0.91 | --- | 2.72 | 0.76 |
| Yaquina Bay (South) | YQ18 | 7/2/00 | 0.2 | 0 | 100 | 0 | 0.84 | --- | 2.7 | 0.6 |
| Yaquina Bay | YQ19 | 7/2/00 | 0.2 | 0 | 100 | 0 | 0.84 | --- | 2.69 | 0.8 |
| Yaquina Bay | YQ20 | 7/2/00 | 0.19 | 0 | 99.9 | 0.1 | 0.87 | --- | 2.4 | 0.54 |
| Yaquina Bay | YQ21 | 7/2/00 | 0.3 | 0 | 100 | 0 | 0.78 | --- | 2.72 | 0.81 |
| Yaquina Bay | YQ22 | 7/2/00 | 0.28 | 0 | 99.3 | 0.7 | 0.84 | --- | 2.89 | 0.88 |
| Yaquina Bay (North) | YQ23 | 7/2/00 | 0.3 | 0 | 98.2 | 1.8 | 0.67 | --- | 2.59 | 0.49 |
| Yaquina Bay (North) | YQ24 | 7/2/00 | 0.23 | 0 | 99.8 | 0.2 | 0.69 | --- | 2.62 | 0.68 |
| Yaquina Bay (North) | YQ25 | 7/2/00 | 0.17 | 0 | 98.8 | 1.2 | 0.74 | --- | 2.84 | 0.71 |
| Yaquina Bay | YQ25Dup | 7/2/00 | 0.17 | 0 | 98.5 | 1.5 | 0.67 | --- | 2.96 | 0.77 |
| Yaquina Bay (North)* | YOC-BC-01 | 7/2/00 | --- | --- | --- | --- | --- | 400 | --- | --- |
| Yaquina Bay (North)* | YOC-BC-02 | 7/2/00 | --- | --- | --- | --- | --- | 560 | --- | --- |
| Yaquina Bay (Reference) * | YOC-BC-03 | 7/2/00 | --- | --- | --- | --- | --- | 520 | --- | --- |
| Yaquina Bay (South)* | YOC-BC-04 | 7/2/00 | --- | --- | --- | --- | --- | 560 | --- | --- |
| Yaquina Bay (South)* | YOC-BC-05 | 7/2/00 | --- | --- | --- | --- | --- | 460 | --- | --- |
| **Detection Limit** | | | | | | | | 0.05 | | |

*YOC-BC-01 is a composite of YQ23-25 YOC-BC-02 is a composite of YQ1-2 YOC-BC-03 is a composite of YQ5-6
YOC-BC-04 is a composite of YQ13-14 YOC-BC-05 is a composite of YQ16-18

Note: The 1984 data was take from The Yaquina Bay Interim Ocean Dredged Material Disposal Site Evaluation Study.

## TABLE C-7
## YAQUINA ESTUARY
## PHYSICAL ANALYSES

| Location | Sample | Date | (mm) Median | % Gravel | % Sand | % Silt | % Clay | TVS % | TOC % |
|---|---|---|---|---|---|---|---|---|---|
| **RIVERINE** | | | | | | | | | |
| Depot Slough | T-DS-1 | 2/8/94 | 0.011 | 0 | 7.9 | 65.5 | 26.6 | 13.1 | 4.78 |
| Depot Slough | T-DS-2 | 2/8/94 | 0.012 | 0 | 10 | 69.6 | 20.4 | 12 | 5.09 |
| Depot Slough | T-DS-3 | 2/8/94 | 0.014 | 0 | 10.7 | 65.7 | 23.6 | 11.8 | 4.67 |
| Toledo | T-GC-1 | 2/11/94 | 0.024 | 0 | 5.2 | 71.8 | 23 | --- | 5.13 |
| Toledo | T-GC-2 | 2/11/94 | 0.022 | 0.28 | 6.52 | 64.8 | 28.4 | --- | 4.47 |
| Toledo | T-GC-3 | 2/11/94 | 0.022 | 0.14 | 9.36 | 64.9 | 25.6 | --- | 4.96 |
| Toledo | T-GC-1-3 | 2/11/94 | 0.021 | 0.19 | 6.11 | 64.6 | 29.1 | --- | 4.45 |
| **HARBOR** | | | | | | | | | |
| S. Beach Marina | SBM-BC-1 | 5/7/91 | 0.1 | 0 | 72.9 | 21.5 | 5.6 | 5.7 | 2.27 |
| S. Beach Marina | SBM-BC-2 | 5/7/91 | 0.06 | 0 | 31 | 66.6 | 2.4 | 9.4 | 4.3 |
| S. Beach Marina | SBM-BC-3 | 5/7/91 | 0.089 | 0 | 55.6 | 37.3 | 7.1 | 8.4 | 2.56 |
| S. Beach Marina | SBM-BC-4 | 5/7/91 | 0.17 | 0 | 82.6 | 12.2 | 5.2 | 2.2 | --- |
| S. Beach Marina | SBM-BC-5 | 5/7/91 | 0.094 | 0 | 53.6 | 36.2 | 10.2 | 4.7 | --- |
| S. Beach Marina | SBM-BC-6 | 5/7/91 | 0.16 | 0 | 76.6 | 16.9 | 6.5 | 2.7 | --- |
| S. Beach Marina | SBM-BC-7 | 5/7/91 | 0.039 | 0 | 32.7 | 56.9 | 10.4 | 11.8 | --- |
| S. Beach Marina | SBM-BC-10 | 5/7/91 | ---- | --- | --- | --- | --- | --- | 2.14 |
| Yaquina Bay | YSB-1 | 3/15/95 | 0.074 | 0 | 49.5 | 50.5 | 0 | 8.5 | ---- |
| Yaquina Bay | YSB-2 | 3/15/95 | 0.15 | 0 | 73.3 | 26.7 | 0 | 3.6 | ---- |
| Yaquina Bay | YB-1 | 3/15/95 | 0.03 | 0 | 27.7 | 72.3 | 0 | 7.2 | ---- |
| Yaquina Bay | YB-2 | 3/15/95 | 0.18 | 0 | 98.7 | 1.3 | 0 | 0.7 | ---- |
| Yaquina Bay | YB-3 | 3/15/95 | 0.34 | 21 | 77 | 2 | 0 | 1.2 | ---- |
| Yaquina Bay | YB-4 | 3/15/95 | 0.2 | 17.2 | 81.8 | 1 | 0 | 0.7 | ---- |
| Yaquina Bay | YB-5 | 3/15/95 | 0.18 | 0 | 99.2 | 0.8 | 0 | 0.9 | ---- |
| Yaq/Newport NJ | YNMJ-1 | 3/16/95 | 0.18 | 0 | 97.4 | 2.6 | 0 | 0.8 | ---- |
| Yaq/Newport NJ | YNMJ-2 | 3/16/95 | 0.17 | 0 | 88.2 | 10 | 1.8 | 1.5 | 0.73 |
| Yaq/Newport NJ | YNMJ-3 | 3/16/95 | 0.18 | 0 | 97.9 | 2.1 | 0 | 0.8 | ---- |
| Newport(10-11.5ft) | DH-96-1/Sam. 4 | 7/15/96 | 0.19 | 0 | 92.3 | 7.7 | 0 | --- | ---- |
| Newport(20.0-21.5ft) | DH-96-1/Sam. 6 | 7/15/96 | 0.18 | 1.1 | 90 | 8.9 | 0 | --- | ---- |
| Newport(30.0-31.5ft) | DH-96-1/Sam. 8 | 7/15/96 | 0.16 | 8 | 52.6 | 39.5 | 0 | --- | ---- |
| Newport(0.0-11.5ft) | DH-96-1/Co.1-3 | 7/15/96 | 0.17 | 1.4 | 91.5 | 7.1 | 0 | 0.7 | ---- |
| Newport(5.0-6.5 ft) | DH-96-2/Sam. 2 | 7/15/96 | 0.17 | 0.7 | 92.3 | 7 | 0 | --- | ---- |
| Newport(10.0-11.5 ft) | DH-96-2/Sam. 3 | 7/15/96 | 0.19 | 0 | 90 | 9.6 | 0 | --- | ---- |
| Newport(12.0-13.5ft) | DH-96-2/Sam. 4 | 7/15/96 | 0.16 | 0 | 90 | 10 | 0 | --- | ---- |
| Newport (20.0-21.5ft) | DH-96-2/Sam. 6 | 7/15/96 | 0.17 | 0.3 | 90.1 | 9.6 | 0 | --- | ---- |
| Newport (25.0-26.5ft) | DH-96-2/Sam. 7 | 7/15/96 | 0.16 | 0 | 83 | 17 | 0 | --- | ---- |
| Newport(20.0-21.5 ft) | DH-96-3/Sam. 6 | 7/15/96 | 0.19 | 0 | 87.8 | 12.2 | 0 | --- | ---- |
| Newport (0.0 – 3.5ft) | DH-96-3/ Co.1-4 | 7/15/96 | 0.18 | 0.7 | 92.4 | 6.9 | 0 | 0.9 | ---- |
| Newport (20.0-21.5ft) | DH-96-4/Sam. 6 | 7/15/96 | 0.26 | 0 | 92.4 | 7.6 | 0 | --- | ---- |
| Newport(0.0 – 13.5 ft) | DH-96-4/Co. 1-4 | 7/15/96 | 0.18 | 0 | 94.9 | 5 | 0 | 0.5 | ---- |
| Yaquina Bay | YB-BC-01 | 6/1/00 | 0.19 | 0 | 99.6 | 0.4 | 0 | 0.58 | --- |
| Yaquina Bay | YB-BC-02 | 6/1/00 | 0.18 | 0 | 100 | 0 | 0 | 0.72 | --- |
| Yaquina Bay | YB-BC-03 | 6/1/00 | 0.19 | 0 | 96.5 | 3.5 | 0 | 0.7 | --- |
| Yaquina Bay | YB-BC-04 | 6/1/00 | 0.2 | 0 | 98.6 | 1.4 | 0 | 1 | --- |
| Yaquina Bay | YB-BC-05 | 6/1/00 | 0.05 | 0 | 46.9 | 53.1 | 0 | 12.7 | 5.2 |
| Yaquina Bay | YB-BC-06 | 6/1/00 | 0.19 | 0 | 99.2 | 0.8 | 0 | 3.54 | --- |
| Yaquina Bay | YB-GC-07 | 6/1/00 | 0.15 | 0 | 84.7 | 15.3 | 0 | 10.4 | 4.1 |
| Yaquina Bay | YB-GC-08 | 6/1/00 | 0.08 | 2.13 | 55.7 | 42.1 | 0 | 8.87 | 2.7 |
| Yaquina Bay | YB-BC-09 | 6/1/00 | 0.04 | 0 | 35.6 | 64.4 | 0 | 9.05 | 2.7 |

## TABLE C-8
## YAQUINA ESTUARY
## PHYSICAL ANALYSES

| Location | Sample | Date | (mm) Median | % Gravel | % Sand | % Fines | TVS % | TOC % |
|---|---|---|---|---|---|---|---|---|
| **HARBOR** | | | | | | | | |
| Yaquina Bay | YQA1 | 7/28/86 | 0.21 | 0 | 94.4 | 0.1 | 1 | 0 |
| Yaquina Bay | YQA 2/3 | 7/28/86 | 0.28 | 0 | 99.8 | 0.2 | 0.6 | 0 |
| Yaquina Bay | YQA4 | 7/28/86 | 0.17 | 0 | 100 | 0 | 1.1 | 6.8 |
| Yaquina Bay | YQA5 | 7/28/86 | 0.28 | 0 | 78 | 0.2 | 1.2 | 0 |
| Yaquina Bay | YQA6 | 7/28/86 | 1.2 | 0 | 63.3 | 0.4 | 1.1 | 0 |
| Yaquina Bay | YQA7 | 7/28/86 | 0.18 | 0 | 99.5 | 0.5 | 1.4 | 0 |
| Yaquina Bay | YQA8 | 7/28/86 | 0.18 | 0 | 99 | 1 | 2.8 | 0 |
| Yaquina Bay | YQA9 | 7/28/86 | 0.17 | 0 | 94.8 | 5.2 | 5.5 | 0 |
| Yaquina Bay | YQA10 | 7/28/86 | 0.3 | 0 | 99.5 | 0.5 | 1.3 | 0 |
| Yaquina Bay | YB1 | 10/12/89 | 0.19 | 0 | 99.5 | 0.5 | 0.6 | --- |
| Yaquina Bay | YB2 | 10/12/89 | 0.18 | 0 | 97.6 | 2.4 | 0.9 | --- |
| Yaquina Bay | YB3 | 10/12/89 | 0.19 | 2.4 | 96.9 | 0.8 | 1 | --- |
| Yaquina Bay | YB4 | 10/12/89 | 0.19 | 0 | 99.2 | 0.8 | 1.1 | --- |
| Yaquina Bay | YB5 | 10/12/89 | 0.19 | 0 | 99.1 | 0.9 | 0.9 | --- |
| Yaquina Bay | YB6 | 10/12/89 | 0.19 | 0 | 99.2 | 0.8 | 0.8 | --- |
| Yaquina Bay | YB7 | 10/12/89 | 0.18 | 0 | 99.4 | 0.6 | 0.6 | --- |
| Yaquina Bay | YB8 | 10/12/89 | 0.18 | 0 | 97.5 | 2.5 | 1 | --- |
| Yaquina Bay | YB9 | 10/12/89 | 0.2 | 0 | 99.1 | 0.9 | 0.8 | --- |
| Yaquina Bay | YB11 | 10/12/89 | 0.16 | 0 | 94.3 | 5.7 | 0.9 | --- |
| Yaquina Bay | YB12 | 10/12/89 | 0.17 | 0 | 95.4 | 4.6 | 0.7 | --- |
| Yaquina Bay | EPA-1 | 4/1/90 | 0.093 | 0 | 56.2 | 43.8 | 9.6 | --- |
| Yaquina Bay | EPA-2 | 4/1/90 | 0.091 | 0 | 46.4 | 53.6 | 17 | 6.62 |
| Yaquina Bay | EPA-3 | 4/1/90 | 0.128 | 0 | 71.9 | 28.1 | 3.2 | 1.19 |
| Yaquina Bay | EPA-4 | 4/1/90 | 0.151 | 0 | 83.5 | 16.5 | 2.4 | --- |
| Yaquina Bay | EPA-5 | 4/1/90 | 0.14 | 0 | 81.4 | 18.6 | 2.8 | --- |
| Yaquina Bay | EPA-6 | 4/1/90 | 0.141 | 0 | 81.9 | 18.1 | 3.4 | 0.58 |
| Yaquina Bay | EPA-7 | 4/1/90 | 5.48 | 53.6 | 43.1 | 3.3 | 2.4 | --- |
| Yaquina Bay | EPA-8 | 4/1/90 | 0.125 | 0 | 75.4 | 24.6 | 3.6 | 1.33 |
| Yaquina Bay | EPA-9 | 4/1/90 | 0.03 | 0 | 24.4 | 75.6 | 11.1 | 2.4 |
| Yaquina Bay | EPA-10 | 4/1/90 | 0.124 | 0 | 76.2 | 23.8 | 4 | 1.81 |
| Yaquina Bay | EPA-11 | 4/1/90 | 0.3 | 0 | 96.8 | 3.2 | 2.4 | 0.31 |
| Yaquina Bay | EPA-12 | 4/1/90 | 0.059 | 0 | 37.4 | 62.6 | 7.2 | 2.72 |
| Yaquina Bay | EPA-13 | 4/1/90 | 0.168 | 0 | 86.9 | 13.1 | 2 | 0.51 |
| Yaquina Bay | EPA-14 | 4/1/90 | 0.088 | 0 | 55.4 | 44.6 | 6.6 | 2.7 |
| Yaquina Bay | BC-1 | 4/1/90 | 0.187 | 0 | 99.8 | 0.2 | 0.6 | --- |
| Yaquina Bay | BC-2 | 4/1/90 | 0.187 | 0 | 99.7 | 0.3 | 0.7 | --- |
| Yaquina Bay | BC-3 | 4/1/90 | 0.283 | 0 | 98.9 | 0.8 | 0.6 | --- |
| Yaquina Bay | BC-7 | 4/1/90 | 0.23 | 0 | 98.4 | 1.6 | 0.5 | --- |
| Yaquina Bay | BC-8 | 4/1/90 | 0.22 | 0 | 98.2 | 1.8 | 0.5 | --- |
| Yaquina Bay | BC-9 | 4/1/90 | 0.097 | 0 | 61.8 | 38.2 | 5.1 | 2.57 |
| Yaquina Bay | BC-11 | 4/1/90 | 0.187 | 0 | 99 | 1 | 0.4 | 0.25 |
| Yaquina Bay | YR-1 | 2/8/94 | 0.39 | 1 | 96.1 | 2.9 | 7.3 | --- |
| Yaquina Bay | YR-2 | 2/8/94 | 0.36 | 0 | 97.5 | 2.5 | 1.3 | --- |
| Yaquina Bay | YR-3 | 2/8/94 | 0.27 | 0 | 95.9 | 4.1 | 1.7 | --- |
| Yaquina Bay | YR-4 | 2/8/94 | 0.18 | 0 | 95 | 5 | 2.1 | --- |
| Yaquina Bay | YR-5 | 2/8/94 | 0.28 | 0 | 96 | 3.9 | 3.7 | --- |
| Yaquina Bay | YR-6 | 2/8/94 | 0.24 | 0 | 79.9 | 20.1 | 3.5 | --- |

## TABLE C-9
## YAQUINA ESTUARY
## DREDGE TEST ANALYSES

| Location | Sample | Date | Resuspended Density | Void Ratio | Specific Gravity | Roundness Grade |
|---|---|---|---|---|---|---|
| **HARBOR** | | | | | | |
| S. Beach Marina | SBM-BC-1 | 5/7/91 | 1476 | 2.336 | 2.59 | A to SA |
| S. Beach Marina | SBM-BC-2 | 5/7/91 | 1348 | 3.297 | 2.5 | SA to SR |
| S. Beach Marina | SBM-BC-3 | 5/7/91 | 1361 | 3.289 | 2.55 | SA to SR |
| S. Beach Marina | SBM-BC-4 | 5/7/91 | 1628 | 1.684 | 2.69 | SA to SR |
| S. Beach Marina | SBM-BC-5 | 5/7/91 | 1403 | 3.037 | 2.63 | SA to SR |
| S. Beach Marina | SBM-BC-6 | 5/7/91 | 1587 | 1.892 | 2.7 | SA to SR |
| S. Beach Marina | SBM-BC-7 | 5/7/91 | --- | --- | --- | SA to SR |
| S. Beach Marina | SBM-BC-10 | 5/7/91 | --- | --- | --- | SA to SR |
| Yaquina Bay | YSB-1 | 3/15/95 | 1325 | 3.894 | 2.59 | A to SA |
| Yaquina Bay | YSB-2 | 3/15/95 | 1549 | 2.053 | 2.676 | SA to SR |
| Yaquina Bay | YB-1 | 3/15/95 | 1295 | 4.324 | 2.569 | A to SA |
| Yaquina Bay | YB-2 | 3/15/95 | 1901 | 0.906 | 2.716 | SA to SR |
| Yaquina Bay | YB-3 | 3/15/95 | 1810 | 1.157 | 2.748 | SA to SR |
| Newport(0.0-11.5ft) | DH-96-1/Comp.1-3 | 7/15/96 | 1829 | 1.039 | 2.687 | SA to SR |
| Newport(0.0-11.5ft) | DH-96-3/Comp.1-4 | 7/15/96 | 1857 | 0.949 | 2.671 | SA to SR |
| Newport(0.0-11.5ft) | DH-96-4/Comp.1-4 | 7/15/96 | 1919 | 0.839 | 2.69 | SA to SR |
| **RIVERINE** | | | | | | |
| Ocean | SITE 1 | 6/11/80 | --- | 0.596 | --- | SA to SR |
| Yaquina | SITE 2 | 6/12/80 | --- | 0.69 | --- | SA to SR |
| Yaquina | SITE 3 | 6/12/80 | --- | 0.684 | --- | SA to SR |
| Yaquina | SITE 4 | 6/11/80 | --- | 1.144 | --- | SA to SR |
| Yaquina | SITE 5 | 6/11/80 | --- | 0.762 | --- | SA to SR |
| Yaquina River | YQ-BC1 | 4/4-5/90 | 1902 | 0.83 | 2.65 | SA TO SR |
| Yaquina River | YQ-BC2 | 4/4-5/90 | 1923 | 0.8 | 2.66 | SA to SR |
| Yaquina River | YQ-BC3 | 4/4-5/90 | 1934 | 0.77 | 2.65 | SA to SR |
| Yaquina River | YQ-BC7 | 4/4-5/90 | 1912 | 0.84 | 2.68 | SA to SR |
| Yaquina River | YQ-BC8 | 4/4-5/90 | 1903 | 0.86 | 2.68 | SA to SR |
| Yaquina River | YQ-BC9 | 4/4-5/90 | 1518 | 2.15 | 2.63 | SA to SR |
| Yaquina River | YQ-BC10 | 4/4-5/90 | 1809 | 1.13 | 2.72 | SA to SR |
| Yaquina River | YQ-BC11 | 4/4-5/90 | 1922 | 0.86 | 2.72 | SA to SR |
| Yaquina River | YR-1 | 2/8/94 | 1,686 | 1.358 | 2.618 | SA to SR |
| Yaquina River | YR-2 | 2/8/94 | 1,722 | 1.252 | 2.628 | SA to SR |
| Yaquina River | YR-3 | 2/8/94 | 1,660 | 1.458 | 2.622 | SA to SR |
| Yaquina River | YR-4 | 2/8/94 | 1,634 | 1.58 | 2.636 | SA to SR |
| Yaquina River | YR-5 | 2/8/94 | 1,719 | 1.303 | 2.658 | SA to SR |
| Yaquina River | YR-6 | 2/8/94 | 1,501 | 2.202 | 2.604 | SA to SR |
| Depot Slough | T-DS-1 | 2/8/94 | 1136 | 9.306 | 2.401 | SA to SR |
| Depot Slough | T-DS-2 | 2/8/94 | 1163 | 7.675 | 2.418 | SA to SR |
| Depot Slough | T-DS-3 | 2/8/94 | 1160 | 7.955 | 2.442 | SA to SR |

## TABLE C10
## YAQUINA ESTUARY
## ORGANOTIN COMPOUNDS in ppb (dry weight)

| Location | Sample | Date | Tetrabutyltin | Tributyltin | Dibutyltin | Butyltin |
|---|---|---|---|---|---|---|
| **HARBOR** | | | | | | |
| Yaquina Bay | EPA 1 | 4/4-5/90 | --- | ND | --- | --- |
| Yaquina Bay | EPA 2 | 4/4-5/90 | --- | **278** | --- | --- |
| Yaquina Bay | EPA 3 | 4/4-5/90 | --- | **8.4** | --- | --- |
| Yaquina Bay | EPA 4 | 4/4-5/90 | --- | ND | --- | --- |
| Yaquina Bay | EPA 5 | 4/4-5/90 | --- | ND | --- | --- |
| Yaquina Bay | EPA 6 | 4/4-5/90 | --- | **3.8** | --- | --- |
| Yaquina Bay | EPA 7 | 4/4-5/90 | --- | ND | --- | --- |
| Yaquina Bay | EPA 8 | 4/4-5/90 | --- | **4.5** | --- | --- |
| Yaquina Bay | EPA 9 | 4/4-5/90 | --- | **5.6** | --- | --- |
| Yaquina Bay | EPA 10 | 4/4-5/90 | --- | **1.5** | --- | --- |
| Yaquina Bay | EPA 11 | 4/4-5/90 | --- | ND | --- | --- |
| Yaquina Bay | EPA 12 | 4/4-5/90 | --- | ND | --- | --- |
| Yaquina Bay | EPA 13 | 4/4-5/90 | --- | ND | --- | --- |
| Yaquina Bay | EPA 14 | 4/4-5/90 | --- | ND | --- | --- |
| Yaquina Bay | YQ-BC9 | 4/4-5/90 | --- | **5.6** | --- | --- |
| Yaquina Bay | YQ-BC10 | 4/4-5/90 | --- | **1.5** | --- | --- |
| S. Beach Marina | SBM-BC-1 | 5/7/91 | ND | ND | **10** | ND |
| S. Beach Marina | SBM-BC-2 | 5/7/91 | ND | ND | ND | ND |
| S. Beach Marina | SBM-BC-3 | 5/7/91 | ND | ND | ND | ND |
| S. Beach Marina | SBM-BC-10 | 5/7/91 | ND | **12** | **25** | ND |
| Yaq/Newport NJ | YNMJ-2 | 3/16/95 | --- | **3** | **3** | **3** |
| Yaq/Newport NJ | YNMJ-1/3 | 3/16/95 | --- | **3** | **3** | **3** |
| Yaquina Bay | YSB-1 | 3/15/95 | ND | ND | ND | ND |
| Yaquina Bay | YSB-2 | 3/15/95 | ND | **5** | **3** | ND |
| Yaquina Bay | YB-1 | 3/15/95 | ND | **10** | ND | ND |
| **RIVERINE** | | | | | | |
| Depot Slough | T-DS-1 | 2/8/94 | ND | ND | **9** | ND |
| Depot Slough | T-DS-2 | 2/8/94 | ND | **9** | **11** | ND |
| Depot Slough | T-DS-3 | 2/8/94 | ND | ND | **6** | ND |
| Toledo | T-GC-1 | 2/11/94 | | | | **21** |
| Toledo | T-GC-2 | 2/11/94 | ND | **24** | **30** | **24** |
| Toledo | T-GC-3 | 2/11/94 | ND | **120** | **170** | **66** |
| Toledo | T-GC-4 | 2/11/94 | ND | ND | **28** | **22** |
| Yaquina Bay | YB-GC-07 | 6/1/00 | ND | ND | ND | ND |
| Yaquina Bay | YB-GC-08 | 6/1/00 | ND | ND | ND | ND |
| Yaquina Bay | YB-BC-09 | 6/1/00 | ND | ND | ND | ND |
| **Detection Limit*** | | | **10.0 - 14.0** | **10.0 - 14.0** | **10.0 - 14.0** | **10.0 - 14.0** |
| **Screening level** | | | --- | **73** | --- | --- |
| **Bioacc.** | | | --- | **219** | --- | --- |

* Michelsen, 1998. This issue paper changed the extraction method and screening and bioaccumulation levels from dry weight to porewater.

## TABLE C-11
## YAQUINA ODMDS AND ESTUARY
## PHENOLS COMPOUNDS ANALYSES in ppb

| Location | Sample | Date | Phenol | 2-methylphenol | 4-methylphenol | 2,4-dimethylphenol | Pentachlorophenol |
|---|---|---|---|---|---|---|---|
| **HARBOR** | | | | | | | |
| Yaquina Bay | EPA2 | 4/4-5/90 | **480** | ND | **170** | ND | ND |
| Yaquina Bay | EPA 3 | 4/4-5/90 | **120** | ND | ND | ND | ND |
| Yaquina Bay | EPA 6 | 4/4-5/90 | **83** | ND | ND | ND | ND |
| Yaquina Bay | EPA 8 | 4/4-5/90 | **310** | ND | **190** | ND | ND |
| Yaquina Bay | EPA 9 | 4/4-5/90 | **170** | ND | ND | ND | ND |
| Yaquina Bay | EPA 10 | 4/4-5/90 | ND | ND | ND | ND | ND |
| Yaquina Bay | EPA 11 | 4/4-5/90 | ND | ND | ND | ND | ND |
| Yaquina Bay | EPA 12 | 4/4-5/90 | ND | ND | ND | ND | ND |
| Yaquina Bay | EPA 13 | 4/4-5/90 | ND | ND | ND | ND | ND |
| Yaquina Bay | EPA 14 | 4/4-5/90 | **260** | ND | **140** | ND | ND |
| Yaquina Bay | BC9 | 4/4-5/90 | ND | ND | ND | ND | ND |
| Yaquina Bay | BC10 | 4/4-5/90 | ND | ND | ND | ND | ND |
| S. Beach Marina | SBM-BC-1 | 5/7/91 | **50** | ND | **70** | ND | ND |
| S. Beach Marina | SBM-BC-2 | 5/7/91 | ND | ND | **60** | ND | ND |
| S. Beach Marina | SBM-BC-3 | 5/7/91 | ND | ND | ND | ND | ND |
| S. Beach Marina | SBM-BC-10 | 5/7/91 | **50** | ND | ND | ND | ND |
| Yaq/Newport NJ | YNMJ-2 | 3/16/95 | **33** | ND | ND | ND | ND |
| Yaq/Newport NJ | YNMJ-1/3 | 3/16/95 | ND | ND | ND | ND | ND |
| Yaquina Bay | YSB-1 | 3/15/95 | ND | ND | ND | ND | ND |
| Yaquina Bay | YSB-2 | 3/15/95 | **27** | ND | ND | ND | ND |
| Yaquina Bay | YB-1 | 3/15/95 | **34** | ND | ND | ND | ND |
| Yaquina Bay | YB-BC-05 | 6/1/00 | ND | ND | **42** | ND | ND |
| Yaquina Bay | YB-GC-07 | 6/1/00 | ND | ND | **13** | ND | ND |
| Yaquina Bay | YB-GC-08 | 6/1/00 | ND | ND | **12** | ND | ND |
| Yaquina Bay | YB-BC-09 | 6/1/00 | ND | ND | **66** | ND | ND |
| **RIVERINE** | | | | | | | |
| Depot Slough | Depot Slo 1 | 11/21/89 | ND | ND | ND | ND | ND |
| Depot Slough | Depot Slo 2 | 11/21/89 | ND | ND | ND | ND | ND |
| Depot Slough | Depot Slo 3 | 11/21/89 | ND | ND | ND | ND | ND |
| Depot Slough | Depot Slo 4 | 11/21/89 | ND | ND | ND | ND | ND |
| Toledo | 1W,1M,1E | 11/21/89 | ND | ND | ND | ND | ND |
| Toledo | 2W,2M,2E | 11/21/89 | ND | ND | ND | ND | ND |
| Toledo | 3W,3M,3E | 11/21/89 | ND | ND | ND | ND | ND |
| Toledo | 4W,4M,4E | 11/21/89 | ND | ND | ND | ND | ND |
| Depot Slough | T-DS-1 | 2/8/94 | ND | ND | ND | ND | ND |
| Depot Slough | T-DS-2 | 2/8/94 | ND | ND | ND | ND | ND |
| Depot Slough | T-DS-3 | 2/8/94 | ND | ND | ND | ND | ND |
| **BASELINE** | | | | | | | |
| Yaquina Bay (North)* | YOC-BC-01 | 7/2/00 | ND | ND | ND | ND | ND |
| Yaquina Bay (North)* | YOC-BC-02 | 7/2/00 | ND | ND | ND | ND | ND |
| Yaquina Bay (Reference) * | YOC-BC-03 | 7/2/00 | ND | ND | ND | ND | ND |
| Yaquina Bay (South)* | YOC-BC-04 | 7/2/00 | ND | ND | ND | ND | ND |
| Yaquina Bay (South)* | YOC-BC-05 | 7/2/00 | ND | ND | ND | ND | ND |
| **Detection Limit** | | | **4.1-330** | **2.1- 330** | **3.7-330** | **2.1-330** | **1.9-1600** |
| **Screening level** | | | 420 | 63 | 670 | 29 | 400 |
| **Bioacc. Trigger** | | | 876 | --- | --- | --- | 504 |

*YOC-BC-01 is a composite of YQ23-25 YOC-BC-02 is a composite of YQ1-2 YOC-BC-03 is a composite of YQ5-6
YOC-BC-04 is a composite of YQ13-14 YOC-BC-05 is a composite of YQ16-18

## TABLE C-12
## YAQUINA ODMDS AND ESTUARY
## PESTICIDES AND PCBs ANALYSES in ppb

| Location | Sample | Date | Total DDT [1] | Total BHC | Lindane g-BHC | Aldrin | Alpha-Chlordane | Dieldrin | Heptachlor & Heptachlor epoxide | Endrin & Endrin Aldehyde | Endosulfan (I+II+Sulfate) | Total PCB |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **BASELINE** | | | | | | | | | | | | |
| Yaquina Bay (North)* | YOC-BC-01 | 7/1/00 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| Yaquina Bay (North)* | YOC-BC-02 | 7/1/00 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| Yaquina Bay (Reference) * | YOC-BC-03 | 7/1/00 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| Yaquina Bay (South)* | YOC-BC-04 | 7/1/00 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| Yaquina Bay (South)* | YOC-BC-05 | 7/1/00 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| **HARBOR** | | | | | | | | | | | | |
| Yaquina Bay (Section 103) | YQA-1 | 7/1/86 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| Yaquina Bay (Section 103) | YQA-2/3 | 7/1/86 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| Yaquina Bay (Section 103) | YQA-7 | 7/1/86 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| Yaquina Bay (Section 103) | YQA-8 | 7/1/86 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| Yaquina Bay (Section 103) | YQA-9 | 7/1/86 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| Yaquina Bay (Section 103) | YQA-10 | 7/1/86 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| Yaq/Newport NJ | YNMJ-2 | 3/1/95 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| Yaq/Newport NJ | YNMJ-1/3 | 3/1/95 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| Yaquina Bay | YSB-1 | 3/1/95 | 4 | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| Yaquina Bay | YSB-2 | 3/1/95 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| Yaquina Bay | YB-1 | 3/1/95 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| Yaquina Bay | YB-BC-05 | 5/1/00 | ND | ND | 2.8 | ND | ND | ND | ND | ND | ND | ND |
| Yaquina Bay | YB-GC-07 | 5/1/00 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| Yaquina Bay | YB-GC-08 | 5/1/00 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| Yaquina Bay | YB-BC-09 | 5/1/00 | ND | 6.2 | ND | ND | ND | ND | ND | ND | ND | ND |
| **RIVERINE** | | | | | | | | | | | | |
| Depot Slough | T-DS-1 | 2/1/94 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| Depot Slough | T-DS-2 | 2/1/94 | ND | ND | ND | ND | ND | ND | ND | ND | ND | 20* |
| Depot Slough | T-DS-3 | 2/1/94 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| Toledo | T-GC-1 | 2/1/94 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| Toledo | T-GC-2 | 2/1/94 | ND | ND | ND | ND | ND | ND | ND | ND | ND | 70* |
| Toledo | T-GC-3 | 2/1/94 | ND | ND | ND | ND | ND | ND | ND | ND | ND | 70* |
| Toledo | T-GC-1,2,3 | 2/1/94 | ND | ND | ND | ND | ND | ND | ND | ND | ND | 100* |
| **Detection Limit** | | | 1.0 - 2 | .077- 330 | 0.22-270 | .090-270 | 3.1-330 | 0.09-130 | 0.1-200 | 0.12-2 | 0.17-0.32 | 12-Feb |
| **Screening level** | | | 6.9 | | 10 | 10 | 10 | 10 | 10 | | | 130 |
| **Bioacc. Trigger** | | | 50 | | --- | 37 | 37 | 37 | 37 | | | 38 [2] |

*YOC-BC-01 is a composite of YQ23-25 YOC-BC-02 is a composite of YQ1-2 YOC-BC-03 is a composite of YQ5-6
YOC-BC-04 is a composite of YQ13-14 YOC-BC-05 is a composite of YQ16-18

## TABLE C-13
## YAQUINA ESTUARY
## PESTICIDES AND PCBs ANALYSES in ppb

| Location | Sample | Date | Total DDT [1] | Total BHC | Lindane g-BHC | Aldrin | Alpha-Chlorda | Dieldrin | Heptachlor & Heptachlor epoxide | Endrin & Endrin Ketone | Endosulfan (I+II+Sulfate) | Total PCB |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **HARBOR** | | | | | | | | | | | | |
| Yaquina Bay | EPA2 | 4/1/90 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| Yaquina Bay | EPA 3 | 4/1/90 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| Yaquina Bay | EPA 6 | 4/1/90 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| Yaquina Bay | EPA 8 | 4/1/90 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| Yaquina Bay | EPA 9 | 4/1/90 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| Yaquina Bay | EPA 10 | 4/1/90 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| Yaquina Bay | EPA 11 | 4/1/90 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| Yaquina Bay | EPA 12 | 4/1/90 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| Yaquina Bay | EPA 13 | 4/1/90 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| Yaquina Bay | EPA 14 | 4/1/90 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| Yaquina Bay | BC9 | 4/1/90 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| Yaquina Bay | BC10 | 4/1/90 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| Yaquina* | SITE 4 | 6/1/80 | ND | ND | ND | ND | ND | ND | ND | ND | ND | 26 |
| **RIVERINE** | | | | | | | | | | | | |
| Depot Slough* | SITE 10 | 6/1/80 | ND | ND | ND | ND | ND | 0.5 | ND | ND | ND | 34 |
| Depot Slough | Depot Slo 1 | 11/1/89 | ND | --- | ND | ND | ND | ND | ND | --- | --- | ND |
| Depot Slough | Depot Slo 2 | 11/1/89 | ND | --- | ND | ND | ND | ND | ND | --- | --- | ND |
| Depot Slough | Depot Slo 3 | 11/1/89 | ND | --- | ND | ND | ND | ND | ND | --- | --- | ND |
| Depot Slough | Depot Slo 4 | 11/1/89 | ND | --- | ND | ND | ND | ND | ND | --- | --- | ND |
| Toledo | 1W,1M,1E | 11/1/89 | ND | ND | ND | ND | ND | ND | ND | --- | --- | ND |
| Toledo | 2W,2M,2E | 11/1/89 | ND | ND | ND | ND | ND | ND | ND | --- | --- | ND |
| Toledo | 3W,3M,3E | 11/1/89 | ND | ND | ND | ND | ND | ND | ND | --- | --- | ND |
| Toledo | 4W,4M,4E | 11/1/89 | ND | ND | ND | ND | ND | ND | ND | --- | --- | ND |
| **Detection Limit** | | | .17-800 | .077- 330 | 0.22-270 | .090-270 | 3.1-330 | 0.09-130 | 0.1-200 | 0.12-2 | 0.17-0.32 | 12-Feb |
| **Screening level** | | | 6.9 | | 10 | 10 | 10 | 10 | 10 | | | 130 |
| **Bioacc. Trigger** | | | 50 | | --- | 37 | 37 | 37 | 37 | | | 38 [2] |

## TABLE C-14
## YAQUINA ODMDS AND ESTUARY
## LOW POLYNUCLEAR AROMATIC HYDROCARBONS in ppb

| Location | Sample | Date | Naphthalene | Acenaphthylene | Acenaphthene | Fluorene | Phenanthrene | Anthracene | 2- Methyl-naphthalene | Total LPAHs |
|---|---|---|---|---|---|---|---|---|---|---|
| **BASELINE** | | | | | | | | | | |
| Yaquina Bay (North)* | YOC-BC-01 | 7/1/00 | ND | ND | ND | ND | ND | ND | ND | --- |
| Yaquina Bay (North)* | YOC-BC-02 | 7/1/00 | ND | ND | ND | ND | ND | ND | ND | --- |
| Yaquina Bay (Reference) * | YOC-BC-03 | 7/1/00 | ND | ND | ND | ND | ND | ND | ND | --- |
| Yaquina Bay (South)* | YOC-BC-04 | 7/1/00 | ND | ND | ND | ND | ND | ND | ND | --- |
| Yaquina Bay (South)* | YOC-BC-05 | 7/1/00 | ND | ND | ND | ND | ND | ND | ND | --- |
| **RIVERINE** | | | | | | | | | | |
| Toledo | 1W,1M,1E | 11/1/89 | ND | ND | ND | ND | ND | ND | ND | --- |
| Toledo | 2W,2M,2E | 11/1/89 | ND | ND | ND | ND | ND | ND | ND | --- |
| Toledo | 3W,3M,3E | 11/1/89 | ND | ND | ND | ND | ND | ND | ND | --- |
| Toledo | 4W,4M,4E | 11/1/89 | ND | ND | ND | ND | ND | ND | ND | --- |
| Depot Slough | Depot Slo 1 | 11/1/89 | ND | ND | ND | ND | ND | ND | ND | --- |
| Depot Slough | Depot Slo 2 | 11/1/89 | ND | ND | ND | ND | ND | ND | ND | --- |
| Depot Slough | Depot Slo 3 | 11/1/89 | ND | ND | ND | ND | ND | ND | ND | --- |
| Depot Slough | Depot Slo 4 | 11/1/89 | ND | ND | ND | ND | ND | ND | ND | --- |
| Depot Slough | T-DS-1 | 2/1/94 | ND | ND | ND | ND | **28** | ND | ND | **28** |
| Depot Slough | T-DS-2 | 2/1/94 | ND | ND | ND | ND | **35** | ND | ND | **35** |
| Depot Slough | T-DS-3 | 2/1/94 | ND | ND | ND | ND | **24** | ND | ND | **24** |
| **HARBOR** | | | | | | | | | | |
| Yaquina Bay | EPA2 | 4/1/90 | ND | ND | ND | ND | ND | ND | ND | --- |
| Yaquina Bay | EPA 3 | 4/1/90 | ND | ND | ND | ND | ND | ND | ND | --- |
| Yaquina Bay | EPA2 | 4/1/90 | ND | ND | ND | ND | ND | ND | ND | --- |
| Yaquina Bay | EPA 3 | 4/1/90 | ND | ND | ND | ND | ND | ND | ND | --- |
| Yaquina Bay | EPA 6 | 4/1/90 | ND | ND | ND | ND | ND | ND | ND | --- |
| Yaquina Bay | EPA 8 | 4/1/90 | ND | ND | ND | ND | **76** | ND | ND | **76** |
| Yaquina Bay | EPA 9 | 4/1/90 | ND | ND | ND | ND | ND | ND | ND | --- |
| Yaquina Bay | EPA 10 | 4/1/90 | ND | ND | ND | ND | ND | ND | ND | --- |
| Yaquina Bay | EPA 11 | 4/1/90 | ND | ND | ND | ND | ND | ND | ND | --- |
| Yaquina Bay | EPA 12 | 4/1/90 | ND | ND | ND | ND | ND | ND | ND | --- |
| Yaquina Bay | EPA 13 | 4/1/90 | ND | ND | ND | ND | ND | ND | ND | --- |
| Yaquina Bay | EPA 14 | 4/1/90 | ND | ND | ND | ND | ND | ND | ND | --- |
| Yaquina Bay | BC9 | 4/1/90 | ND | ND | ND | ND | **130** | ND | ND | **130** |
| Yaquina Bay | BC10 | 4/1/90 | ND | ND | ND | ND | ND | ND | ND | --- |
| Yaq/Newport NJ | YNMJ-2 | 3/1/95 | ND | ND | ND | ND | ND | ND | ND | --- |
| Yaq/Newport NJ | YNMJ-1/3 | 3/1/95 | ND | ND | ND | ND | ND | ND | ND | --- |
| Yaquina Bay | YSB-1 | 3/1/95 | ND | ND | ND | ND | **40** | ND | ND | **40** |
| Yaquina Bay | YSB-2 | 3/1/95 | ND | ND | ND | ND | **20** | ND | ND | **20** |
| Yaquina Bay | YB-1 | 3/1/95 | ND | ND | ND | ND | **28** | ND | ND | **28** |
| Yaquina Bay | YB-BC-05 | 6/1/00 | ND | ND | ND | ND | **22** | ND | ND | **22** |
| Yaquina Bay | YB-GC-07 | 6/1/00 | ND | **10** | ND | **5.1** | **51** | **12** | ND | **78.1** |
| Yaquina Bay | YB-GC-08 | 6/1/00 | ND | ND | ND | ND | **9.1** | ND | ND | **9.1** |
| Yaquina Bay | YB-BC-09 | 6/1/00 | ND | ND | ND | ND | ND | ND | ND | --- |
| **Detection limits** | | | **2.9-330** | **1.1 – 330** | **0.98-330** | **1.3-330** | **0.93-330** | **1.4-330** | **2.0-330** | |
| **Screening level** | | | **2,100** | **560** | **500** | **540** | **1,500** | **960** | **670** | **5,200** |
| **Bioacc. Trigger** | | | --- | --- | --- | --- | --- | --- | --- | --- |

*YOC-BC-01 is a composite of YQ23-25 YOC-BC-02 is a composite of YQ1-2 YOC-BC-03 is a composite of YQ5-6
YOC-BC-04 is a composite of YQ13-14 YOC-BC-05 is a composite of YQ16-18

## TABLE C-15
## YAQUINA ODMDS AND ESTUARY
## HIGH POLYNUCLEAR AROMATIC HYDROCARBONS in ppb

| Location | Sample | Date | Fluoranthene | Pyrene | benz(a)-anthracene | Chrysene | Benzofluor-anthenes (b+k) | Benzo (a)-pyrene | Indeno (1,2,3-c,d) pyrene | Dibenz(a,h) anthracene | Benzo(g,h,i) perylene | Total HPHAH |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **BASELINE** | | | | | | | | | | | | |
| Yaquina Bay (North)* | YOC-BC-01 | 7/1/00 | ND | ND | ND | ND | ND | ND | ND | ND | ND | --- |
| Yaquina Bay (North)* | YOC-BC-02 | 7/1/00 | ND | ND | ND | ND | ND | ND | ND | ND | ND | --- |
| Yaquina Bay (Reference) * | YOC-BC-03 | 7/1/00 | ND | ND | ND | ND | ND | ND | ND | ND | ND | --- |
| Yaquina Bay (South)* | YOC-BC-04 | 7/1/00 | ND | ND | ND | ND | ND | ND | ND | ND | ND | --- |
| Yaquina Bay (South)* | YOC-BC-05 | 7/1/00 | ND | ND | ND | ND | ND | ND | ND | ND | ND | --- |
| **RIVERINE** | | | | | | | | | | | | |
| Depot Slough | Depot Slo 1 | 11/1/89 | ND | ND | ND | ND | ND | ND | ND | ND | ND | --- |
| Depot Slough | Depot Slo 2 | 11/1/89 | ND | ND | ND | ND | ND | ND | ND | ND | ND | --- |
| Depot Slough | Depot Slo 3 | 11/1/89 | ND | ND | ND | ND | ND | ND | ND | ND | ND | --- |
| Depot Slough | Depot Slo 4 | 11/1/89 | 220 | 170 | ND | ND | ND | ND | ND | ND | ND | 390 |
| Toledo | 1W,1M,1E | 11/1/89 | ND | ND | ND | ND | ND | ND | ND | ND | ND | --- |
| Toledo | 2W,2M,2E | 11/1/89 | ND | ND | ND | ND | ND | ND | ND | ND | ND | --- |
| Toledo | 3W,3M,3E | 11/1/89 | ND | ND | ND | ND | ND | ND | ND | ND | ND | --- |
| Toledo | 4W,4M,4E | 11/1/89 | ND | ND | ND | ND | ND | ND | ND | ND | ND | --- |
| Depot Slough | T-DS-1 | 2/1/94 | 79 | 79 | 29 | 37 | 66 | 22 | 33 | ND | ND | 345 |
| Depot Slough | T-DS-2 | 2/1/94 | 120 | 120 | 30 | 41 | 70 | 22 | 37 | ND | ND | 440 |
| Depot Slough | T-DS-3 | 2/1/94 | 53 | 53 | ND | 36 | ND | ND | 21 | ND | ND | 163 |
| **HARBOR** | | | | | | | | | | | | |
| Yaq/Newport NJ | YNMJ-2 | 3/1/95 | 21 | ND | ND | ND | ND | ND | ND | ND | ND | 21 |
| Yaq/Newport NJ | YNMJ-1/3 | 3/1/95 | ND | ND | ND | ND | ND | ND | ND | ND | ND | --- |
| Yaquina Bay | YSB-1 | 3/1/95 | 160 | 97 | ND | 34 | ND | ND | ND | ND | ND | 291 |
| Yaquina Bay | YSB-2 | 3/1/95 | 74 | 52 | ND | 23 | ND | ND | ND | ND | ND | 149 |
| Yaquina Bay | YB-1 | 3/1/95 | 37 | 28 | ND | ND | ND | ND | ND | ND | ND | 65 |
| Yaquina Bay | EPA2 | 4/1/90 | 270 | 170 | ND | ND | ND | ND | ND | ND | ND | 440 |
| Yaquina Bay | EPA 3 | 4/1/90 | 130 | 94 | ND | ND | ND | ND | ND | ND | ND | 224 |
| Yaquina Bay | EPA 6 | 4/1/90 | ND | ND | ND | ND | ND | ND | ND | ND | ND | --- |
| Yaquina Bay | EPA 8 | 4/1/90 | 230 | 150 | ND | 76 | ND | ND | ND | ND | ND | 456 |
| Yaquina Bay | EPA 9 | 4/1/90 | ND | ND | ND | ND | ND | ND | ND | ND | ND | --- |
| Yaquina Bay | EPA 10 | 4/1/90 | ND | ND | ND | ND | ND | ND | ND | ND | ND | --- |
| Yaquina Bay | EPA 11 | 4/1/90 | ND | ND | ND | ND | ND | ND | ND | ND | ND | --- |
| Yaquina Bay | EPA 12 | 4/1/90 | ND | ND | ND | ND | ND | ND | ND | ND | ND | --- |
| Yaquina Bay | EPA 13 | 4/1/90 | ND | ND | ND | ND | ND | ND | ND | ND | ND | --- |
| Yaquina Bay | EPA 14 | 4/1/90 | ND | ND | ND | ND | ND | ND | ND | ND | ND | --- |
| Yaquina Bay | BC9 | 4/1/90 | 100 | 67 | ND | 95 | ND | ND | ND | ND | ND | 262 |
| Yaquina Bay | BC10 | 4/1/90 | ND | ND | ND | ND | ND | ND | ND | ND | ND | --- |
| Yaquina Bay | YB-BC-05 | 6/1/00 | 83 | 47 | 7.3 | 20 | 17 | ND | ND | ND | ND | 174.3 |
| Yaquina Bay | YB-GC-07 | 6/1/00 | 290 | 140 | 40 | 66 | 48 | 21 | 14 | ND | 22 | 641 |
| Yaquina Bay | YB-GC-08 | 6/1/00 | 41 | 27 | 6.4 | 14 | 9.1 | ND | ND | ND | ND | 97.5 |
| Yaquina Bay | YB-BC-09 | 6/1/00 | 43 | 26 | ND | 14 | ND | ND | ND | ND | ND | 83 |
| **Detection Limits** | | | 0.9-220 | 0.8-170 | 0.9-330 | 1.1-330 | 0.8-330 | 1.1-330 | 1.1-330 | 0.6-330 | 0.4-330 | |
| **Screening level** | | | 1,700 | 2,600 | 1,300 | 1,400 | 3,200 | 1,600 | 600 | 230 | 670 | 12,000 |
| **Bioacc. Trigger** | | | 4,600 | --- | --- | --- | --- | 3,600 | --- | --- | --- | --- |

*YOC-BC-01 is a composite of YQ23-25 YOC-BC-02 is a composite of YQ1-2 YOC-BC-03 is a composite of YQ5-6
YOC-BC-04 is a composite of YQ13-14 YOC-BC-05 is a composite of YQ16-18

# TABLE C-16
# YAQUINA ODMDS AND ESTUARY
# CHLORINATED HYDROCARBONS ANALYSES in ppb

| Location | Sample | Date | 1,3-Dichlorobenzene | 1,4-Dichlorobenzene | 1,2-Dichlorobenzene | 1,2,4-Trichlorobenzene | Hexachlorobenzene (HCB) |
|---|---|---|---|---|---|---|---|
| **BASELLINE** | | | | | | | |
| Yaquina Bay (North)* | YOC-BC-01 | 7/1/00 | ND | ND | ND | ND | ND |
| Yaquina Bay (North)* | YOC-BC-02 | 7/1/00 | ND | ND | ND | ND | ND |
| Yaquina Bay (Reference) | YOC-BC-03 | 7/1/00 | ND | ND | ND | ND | ND |
| Yaquina Bay (South)* | YOC-BC-04 | 7/1/00 | ND | ND | ND | ND | ND |
| Yaquina Bay (South)* | YOC-BC-05 | 7/1/00 | ND | ND | ND | ND | ND |
| **HARBOR** | | | | | | | |
| Yaquina Bay | YB-BC-05 | 6/1/00 | ND | ND | ND | ND | ND |
| Yaquina Bay | YB-GC-07 | 6/1/00 | ND | ND | ND | ND | ND |
| Yaquina Bay | YB-GC-08 | 6/1/00 | ND | ND | ND | ND | ND |
| Yaquina Bay | YB-BC-09 | 6/1/00 | ND | ND | ND | ND | ND |
| **RIVERINE** | | | | | | | |
| Depot Slough | Depot Slough 1 | 11/1/89 | ND | ND | ND | ND | ND |
| Depot Slough | Depot Slough 2 | 11/1/89 | ND | ND | ND | ND | ND |
| Depot Slough | Depot Slough 3 | 11/1/89 | ND | ND | ND | ND | ND |
| Depot Slough | Depot Slough 4 | 11/1/89 | ND | ND | ND | ND | ND |
| Toledo | 1W,1M,1E | 11/1/89 | ND | ND | ND | ND | ND |
| Toledo | 2W,2M,2E | 11/1/89 | ND | ND | ND | ND | ND |
| Toledo | 3W,3M,3E | 11/1/89 | ND | ND | ND | ND | ND |
| Toledo | 4W,4M,4E | 11/1/89 | ND | ND | ND | ND | ND |
| Toledo | T-GC-1 | 2/1/94 | ND | ND | ND | ND | ND |
| Toledo | T-GC-2 | 2/1/94 | ND | ND | ND | ND | ND |
| Toledo | T-GC-3 | 2/1/94 | ND | ND | ND | ND | ND |
| Toledo | T-GC-1,2,3 | 2/1/94 | ND | ND | ND | ND | ND |
| **Detection Limits** | | | **4 – 330** | **3 – 330** | **2.5 – 330** | **1.7 – 330** | **2 – 330** |
| **Screening level** | | | **170** | **110** | **35** | **31** | **22** |
| **Bioacc. Trigger** | | | **1,241** | **120** | **37** | **---** | **168** |

*YOC-BC-01 is a composite of YQ23-25 YOC-BC-02 is a composite of YQ1-2 YOC-BC-03 is a composite of YQ5-6
YOC-BC-04 is a composite of YQ13-14 YOC-BC-05 is a composite of YQ16-18

## TABLE C-17
## YAQUINA ODMDS AND ESTUARY
## PHTHALATES ANALYSES in ppb

| Location | Sample | Date | Dimethyl phthalate | Diethyl phthalate | Di-n-butyl phthalate | Butyl Benzyl | Dis(2-ethylhexyl) phthalate | Di-n-octyl |
|---|---|---|---|---|---|---|---|---|
| **BASELINE** | | | | | | | | |
| Yaquina Bay (North)* | YOC-BC-01 | 7/2/00 | ND | ND | ND | ND | 6.3 | ND |
| Yaquina Bay (North)* | YOC-BC-02 | 7/2/00 | ND | 3.8 | ND | ND | 5 | ND |
| Yaquina Bay (Reference) * | YOC-BC-03 | 7/2/00 | ND | ND | ND | ND | 4.5 | ND |
| Yaquina Bay (South)* | YOC-BC-04 | 7/2/00 | ND | ND | ND | ND | ND | ND |
| Yaquina Bay (South)* | YOC-BC-05 | 7/2/00 | ND | ND | ND | ND | ND | ND |
| **RIVERINE** | | | | | | | | |
| Depot Slough | Depot Slo 1 | 11/21/89 | ND | ND | ND | ND | ND | ND |
| Depot Slough | Depot Slo 2 | 11/21/89 | ND | ND | ND | ND | ND | ND |
| Depot Slough | Depot Slo 3 | 11/21/89 | ND | ND | ND | ND | ND | ND |
| Depot Slough | Depot Slo 4 | 11/21/89 | ND | ND | ND | ND | ND | ND |
| Toledo | 1W,1M,1E | 11/21/89 | ND | ND | ND | ND | ND | ND |
| Toledo | 2W,2M,2E | 11/21/89 | ND | ND | ND | ND | ND | ND |
| Toledo | 3W,3M,3E | 11/21/89 | ND | ND | ND | ND | ND | ND |
| Toledo | 4W,4M,4E | 11/21/89 | ND | ND | ND | ND | ND | ND |
| **HARBOR** | | | | | | | | |
| Yaquina Bay | EPA2 | 4/4-5/90 | ND | ND | ND | ND | 750 | ND |
| Yaquina Bay | EPA 3 | 4/4-5/90 | ND | ND | ND | ND | 340 | ND |
| Yaquina Bay | EPA 6 | 4/4-5/90 | ND | ND | ND | ND | 77 | ND |
| Yaquina Bay | EPA 8 | 4/4-5/90 | ND | ND | ND | ND | 150 | ND |
| Yaquina Bay | EPA 9 | 4/4-5/90 | ND | ND | ND | ND | ND | ND |
| Yaquina Bay | EPA 10 | 4/4-5/90 | ND | ND | ND | ND | 260 | ND |
| Yaquina Bay | EPA 11 | 4/4-5/90 | ND | ND | ND | ND | ND | ND |
| Yaquina Bay | EPA 12 | 4/4-5/90 | ND | ND | ND | ND | ND | ND |
| Yaquina Bay | EPA 13 | 4/4-5/90 | ND | ND | ND | ND | ND | ND |
| Yaquina Bay | EPA 14 | 4/4-5/90 | ND | ND | ND | ND | 110 | ND |
| Yaquina Bay | BC9 | 4/4-5/90 | ND | ND | ND | ND | ND | ND |
| Yaquina Bay | BC10 | 4/4-5/90 | ND | ND | ND | ND | ND | ND |
| Yaquina Bay | YB-BC-05 | 6/1/00 | ND | 15 | ND | ND | 18 | ND |
| Yaquina Bay | YB-GC-07 | 6/1/00 | ND | 8.2 | ND | ND | 54 | ND |
| Yaquina Bay | YB-GC-08 | 6/1/00 | ND | 8 | ND | 6.4 | 75 | ND |
| Yaquina Bay | YB-BC-09 | 6/1/00 | ND | 8.5 | ND | 7.8 | 23 | ND |
| **Detectioin Limits** | | | 4.6 – 330 | 3.1 – 330 | 18 - 330 | 2.1 – 330 | 4.3 – 330 | 3.6 – 330 |
| **Screening level** | | | 1,400 | 1,200 | 5,100 | 970 | 8,300 | 6,200 |
| **Bioacc. Trigger** | | | 1,400 | --- | 10,220 | --- | 13,870 | --- |

*YOC-BC-01 is a composite of YQ23-25 YOC-BC-02 is a composite of YQ1-2 YOC-BC-03 is a composite of YQ5-6
YOC-BC-04 is a composite of YQ13-14 YOC-BC-05 is a composite of YQ16-18

## TABLE C-18
## YAQUINA ODMDS AND ESTUARY
## MISCELLANEOUS EXTRACTABLES ANALYSES in ppb

| Location | Sample | Date | Benzyl alchohol | Benzoic Acid | Dibenzo furan | Hexachloro-ethane | Hexachloro-Butadiene | N-Nitrosodi-phenylamine |
|---|---|---|---|---|---|---|---|---|
| **BASELINE** | | | | | | | | |
| Yaquina Bay (North)* | YOC-BC-01 | 7/2/00 | ND | ND | ND | ND | ND | ND |
| Yaquina Bay (North)* | YOC-BC-02 | 7/2/00 | ND | ND | ND | ND | ND | ND |
| Yaquina Bay (Reference) | YOC-BC-03 | 7/2/00 | ND | ND | ND | ND | ND | ND |
| Yaquina Bay (South)* | YOC-BC-04 | 7/2/00 | ND | ND | ND | ND | ND | ND |
| Yaquina Bay (South)* | YOC-BC-05 | 7/2/00 | ND | ND | ND | ND | ND | ND |
| **RIVERINE** | | | | | | | | |
| Depot Slough | Depot Slo 1 | 11/1/89 | ND | ND | ND | ND | ND | --- |
| Depot Slough | Depot Slo 2 | 11/1/89 | ND | ND | ND | ND | ND | --- |
| Depot Slough | Depot Slo 3 | 11/1/89 | ND | ND | ND | ND | ND | --- |
| Depot Slough | Depot Slo 4 | 11/1/89 | ND | ND | ND | ND | ND | --- |
| Toledo | 1W,1M,1E | 11/1/89 | ND | ND | ND | ND | ND | ND |
| Toledo | 2W,2M,2E | 11/1/89 | ND | ND | ND | ND | ND | ND |
| Toledo | 3W,3M,3E | 11/1/89 | ND | ND | ND | ND | ND | ND |
| Toledo | 4W,4M,4E | 11/1/89 | ND | ND | ND | ND | ND | ND |
| **HARBOR** | | | | | | | | |
| Yaquina Bay | EPA2 | 4/4-5/90 | ND | ND | ND | ND | ND | ND |
| Yaquina Bay | EPA 3 | 4/4-5/90 | ND | ND | ND | ND | ND | ND |
| Yaquina Bay | EPA 6 | 4/4-5/90 | ND | ND | ND | ND | ND | ND |
| Yaquina Bay | EPA 8 | 4/4-5/90 | ND | ND | ND | ND | ND | ND |
| Yaquina Bay | EPA 9 | 4/4-5/90 | ND | ND | ND | ND | ND | ND |
| Yaquina Bay | EPA 10 | 4/4-5/90 | ND | ND | ND | ND | ND | ND |
| Yaquina Bay | EPA 11 | 4/4-5/90 | ND | ND | ND | ND | ND | ND |
| Yaquina Bay | EPA 12 | 4/4-5/90 | ND | ND | ND | ND | ND | ND |
| Yaquina Bay | EPA 13 | 4/4-5/90 | ND | ND | ND | ND | ND | ND |
| Yaquina Bay | EPA 14 | 4/4-5/90 | ND | ND | ND | ND | ND | ND |
| Yaquina Bay | BC9 | 4/4-5/90 | ND | ND | ND | ND | ND | ND |
| Yaquina Bay | BC10 | 4/4-5/90 | ND | ND | ND | ND | ND | ND |
| Yaquina Bay | YB-BC-05 | 6/1/00 | ND | ND | ND | ND | ND | ND |
| Yaquina Bay | YB-GC-07 | 6/1/00 | ND | 8.2 | ND | ND | ND | ND |
| Yaquina Bay | YB-GC-08 | 6/1/00 | ND | ND | ND | ND | ND | ND |
| Yaquina Bay | YB-BC-09 | 6/1/00 | ND | 11 | ND | ND | ND | ND |
| **Detection Limits** | | | 4.0 – 330 | 1.5 – 1600 | 2.6- 330 | 3.5 – 330 | 2.8 – 330 | 0.8 – 1.3 |
| **Screening level** | | | 57 | 650 | 540 | 1,400 | 29 | 28 |
| **Bioacc. Trigger** | | | --- | --- | --- | 10,220 | 212 | 130 |

*YOC-BC-01 is a composite of YQ23-25 YOC-BC-02 is a composite of YQ1-2 YOC-BC-03 is a composite of YQ5-6
YOC-BC-04 is a composite of YQ13-14 YOC-BC-05 is a composite of YQ16-18

## TABLE C-19
## YAQUINA BAY
## DIOXIN/FURAN CONGENERS in ppt

US EPA and USACE April 4-5, 1990 sediment sampling

| ANALYTES | TEF VALUES | EPA-2 | EPA-3 | EPA-6 | EPA-8 | EPA-9 | EPA-12 | EPA-13 | EPA-14 |
|---|---|---|---|---|---|---|---|---|---|
| **I. CDDS** | | | | | | | | | |
| 2378 TCDD | 1 | -0.46 | -0.84 | -0.41 | -0.36 | 0.38 | -1.9 | 0.29 | -0.64 |
| TOXIC EQUIVALENT CONC. | | 0.23 | 0.42 | 0.205 | 0.18 | 0.38 | 0.95 | 0.029 | 0.32 |
| 12378 PeCDD | 0.5 | 1.5 | 1.9 | -0.59 | 0.62 | 1.2 | -0.83 | 0.35 | 0.51 |
| TOXIC EQUIVALENT CONC. | | 0.75 | 0.95 | 0.15 | 0.31 | 0.6 | 0 | 0.175 | 0.255 |
| 123478 HxCDD | 0.1 | 2.2 | 3.5 | 0.47 | -0.89 | 0.97 | 0.74 | 0.32 | 0.86 |
| TOXIC EQUIVALENT CONC. | | 0.22 | 0.35 | 0.047 | 0.0445 | 0.097 | 0.074 | 0.032 | 0.086 |
| 123678 HxCDD | 0.1 | 11 | 19 | 1.5 | 3.1 | 3.9 | 3.2 | 0.78 | 0.86 |
| TOXIC EQUIVALENT CONC. | | 1.1 | 1.9 | 0.15 | 0.31 | 0.39 | 0.32 | 0.078 | 0.087 |
| 123789 HxCDD | 0.1 | 4 | 7.3 | 1 | 1.8 | 2.7 | 2.1 | 0.55 | 1.1 |
| TOXIC EQUIVALENT CONC. | | 0.4 | 0.73 | 0.1 | 0.18 | 0.27 | 0.21 | 0.055 | 0.11 |
| 1234678 HpCDD | 0.01 | 240 | 380 | 27 | 58 | 85 | 72 | 13 | 23 |
| TOXIC EQUIVALENT CONC. | | 2.4 | 3.8 | 0.27 | 0.58 | 0.85 | 0.72 | 0.13 | 0.23 |
| OCDD | 0.001 | 1400 | 2300 | 180 | 390 | 620 | 550 | 130 | 200 |
| TOXIC EQUIVALENT CONC. | | 1.4 | 2.3 | 0.18 | 0.39 | 0.62 | 0.55 | 0.13 | 0.2 |
| **II. CDFs** | | | | | | | | | |
| 2378TCDF | 0.1 | 1.4 | 0.95 | 0.61 | 0.97 | 1.3 | 1.5 | 0.59 | 0.52 |
| TOXIC EQUIVALENT CONC. | | 0.14 | 0.095 | 0.061 | 0.097 | 0.13 | 0.15 | 0.059 | 0.052 |
| 12378 PeCDF | 0.05 | 0.23 | 0.36 | 0.36 | 0.53 | 0.46 | 0.44 | 0.18 | 0.29 |
| TOXIC EQUIVALENT CONC. | | 0.0115 | 0.018 | 0.018 | 0.0265 | 0.023 | 0.022 | 0.009 | 0.0145 |
| 23478 PeCDF | 0.5 | -0.66 | 0.52 | 0.17 | 0.31 | 0.52 | 0.51 | -0.21 | 0.28 |
| TOXIC EQUIVALENT CONC. | | 0.16 | 0.26 | 0.085 | 0.155 | 0.26 | 0.26 | 0.05 | 0.14 |
| 123478 HxCDF | 0.1 | 1.5 | -7.9 | 0.41 | 0.79 | -15 | 1.1 | 0.32 | 0.61 |
| TOXIC EQUIVALENT CONC. | | 0.15 | 0.395 | 0.041 | 0.079 | 0 | 0.11 | 0.032 | 0.061 |
| 123678 HxCDF | 0.1 | -11 | 1.3 | 0.81 | 1 | -0.45 | -3.7 | 0.39 | 0.55 |
| TOXIC EQUIVALENT CONC. | | 0.55 | 0.13 | 0.081 | 0.1 | 0.0225 | 0.185 | 0.039 | 0.055 |
| 123789 HxCDF | 0.1 | 1.4 | 1.8 | 0.6 | 0.86 | 0.7 | 0.99 | 0.45 | 0.64 |
| TOXIC EQUIVALENT CONC. | | 0.14 | 0.18 | 0.06 | 0.086 | 0.07 | 0.099 | 0.045 | 0.064 |
| 234678 HxCDF | 0.1 | -0.41 | 0.2 | -0.52 | -0.29 | -0.16 | 0.44 | -0.33 | -0.24 |
| TOXIC EQUIVALENT CONC. | | 0.0205 | 0.02 | 0.026 | 0.0145 | 0.008 | 0.022 | 0.0165 | 0.012 |
| 1234678 HpCDF | 0.01 | 15 | 29 | 2.8 | 6.2 | 11 | 12 | 1.6 | 3.4 |
| TOXIC EQUIVALENT CONC. | | 0.15 | 0.29 | 0.028 | 0.062 | 0.11 | 0.12 | 0.016 | 0.034 |
| 1234789 HpCDF | 0.01 | 1.1 | 1.3 | 0.46 | -0.96 | 0.77 | 1.3 | -0.72 | -0.58 |
| TOXIC EQUIVALENT CONC. | | 0.011 | 0.013 | 0.0046 | 0.0048 | 0.0077 | 0.013 | 0.0036 | 0.0029 |
| OCDF | 0.001 | 34 | 51 | 7.2 | 21 | 32 | 43 | 4.7 | 10 |
| TOXIC EQUIVALENT CONC. | | 0.034 | 0.051 | 0.0072 | 0.021 | 0.032 | 0.043 | 0.0047 | 0.01 |
| TOTAL TOXIC EQUIVALENT CONC. | | 7.85 | 11.88 | 1.49 | 2.63 | 3.86 | 3.83 | 0.89 | 1.72 |
| GUIDANCE CRITERIA TOXIC EQ. CONC.(ng/kg) | | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 |

Figure C-1

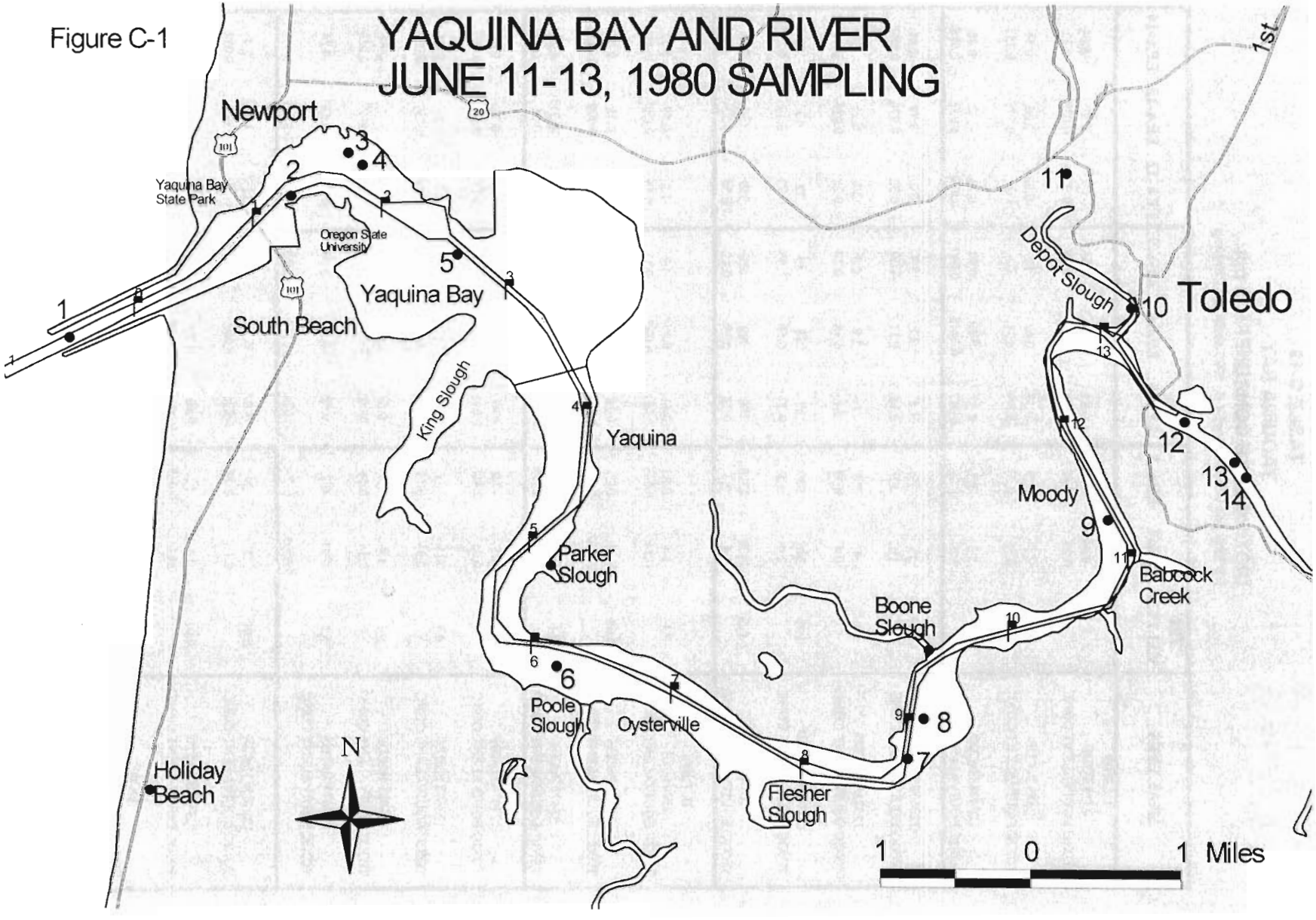

YAQUINA BAY AND RIVER
JUNE 11-13, 1980 SAMPLING
Newport
Yaquina Bay State Park
Oregon State University
South Beach
Yaquina Bay
King Slough
Yaquina
Parker Slough
Poole Slough
Oysterville
Flesher Slough
Boone Slough
Moody
Babcock Creek
Depot Slough
Toledo
1st
Holiday Beach
N
1 0 1 Miles

Figure C-2

# YAQUINA INTERIM SITE 1984 SAMPLING

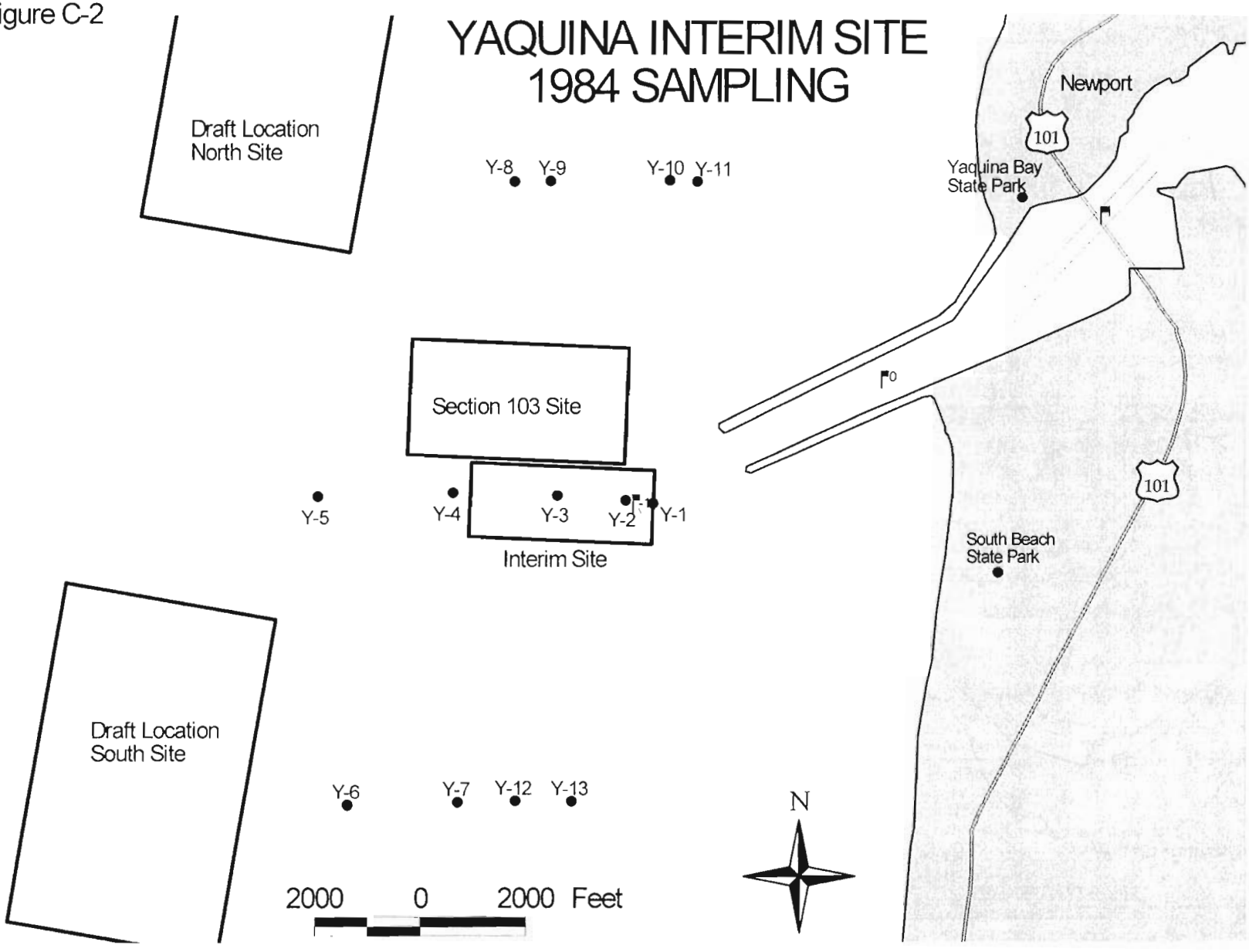


Figure C-3

# YAQUINA ODMDS
# MAY 16, 1986 SAMPLING

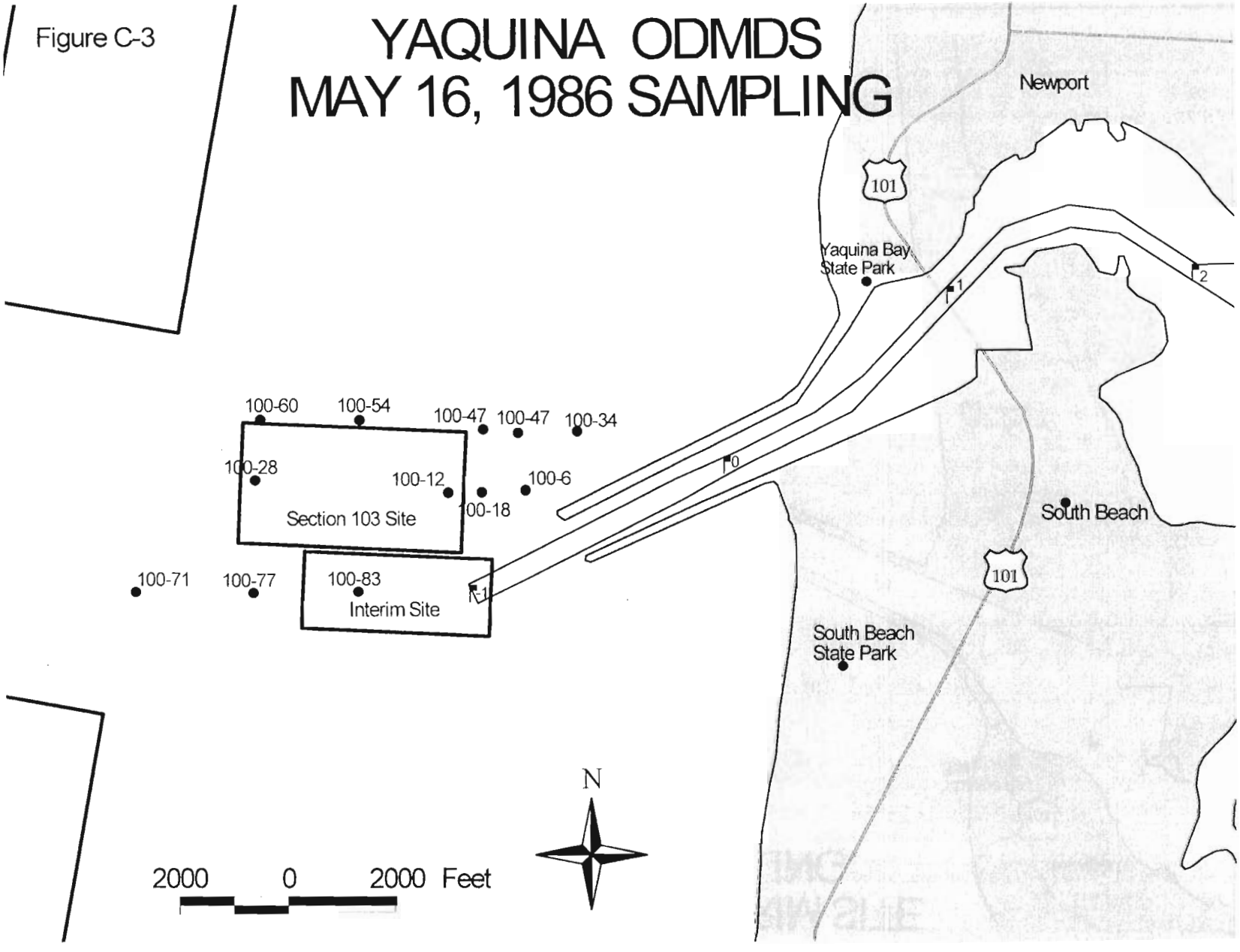


Figure C-4

# YAQUINA BAY
# JULY 28, 1986 SAMPLING

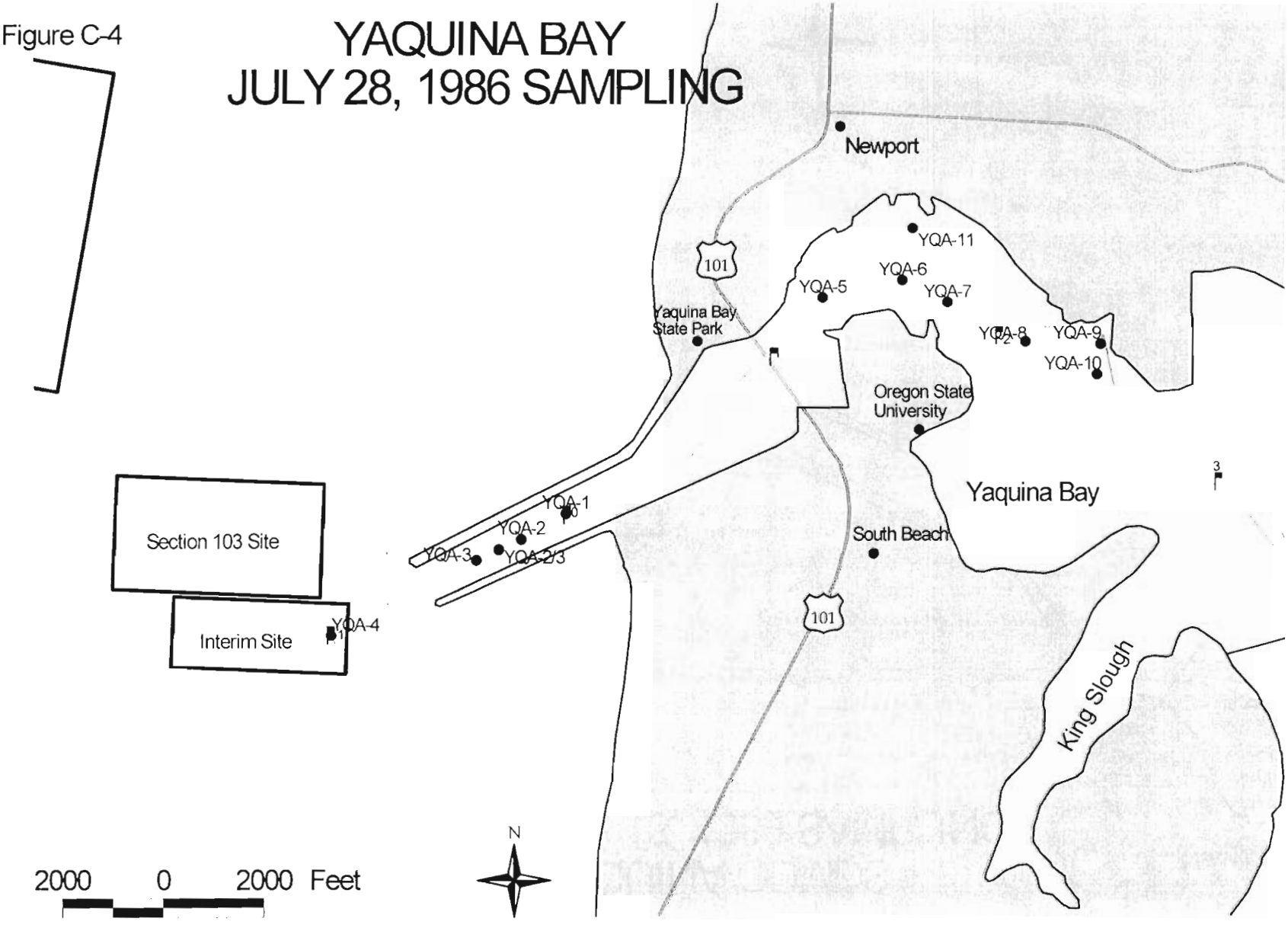


Figure C-5

# YAQUINA ODMDS
# OCTOBER 18, 1989 SAMPLING

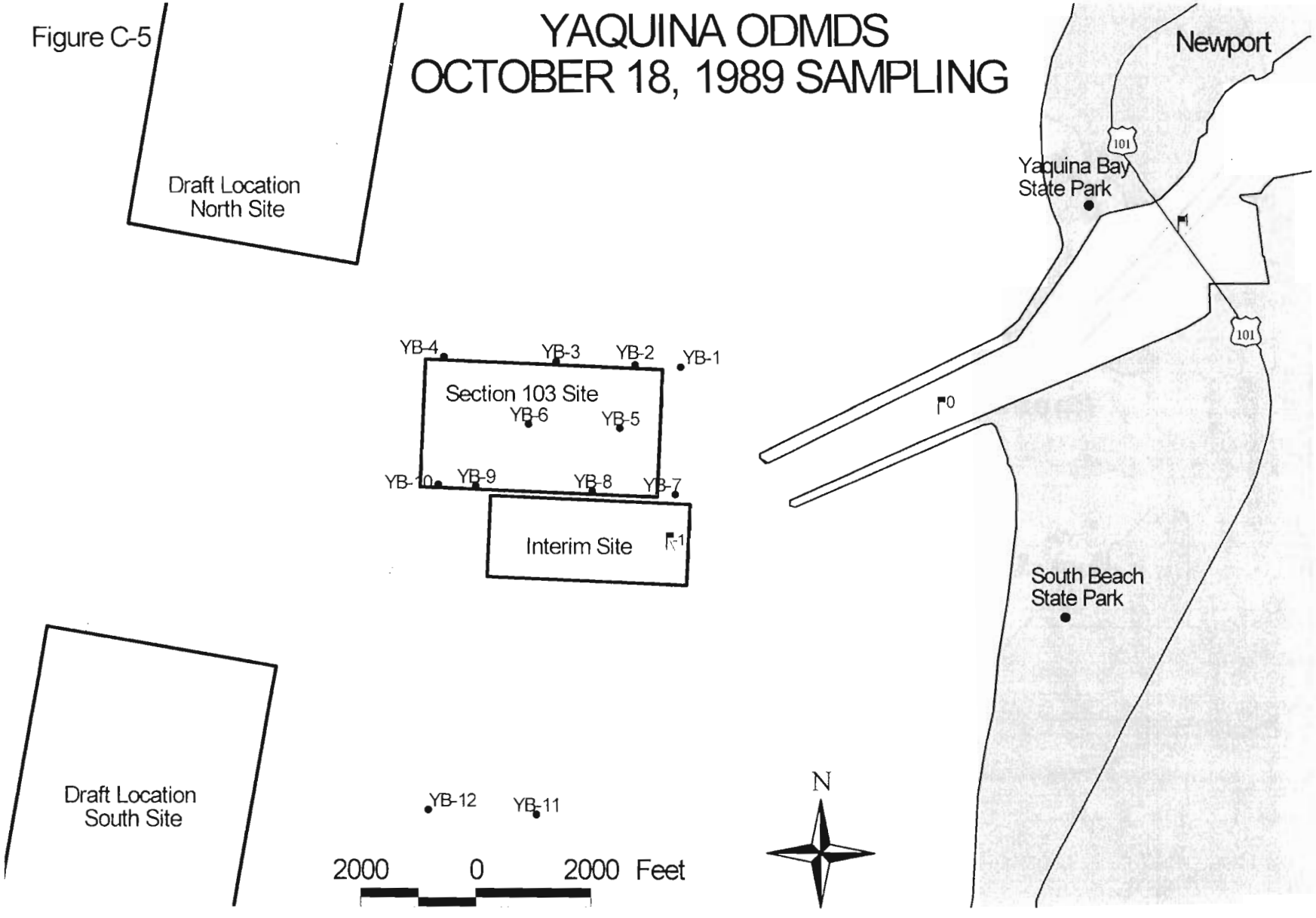


Figure C-6

# DEPOT SLOUGH
# NOVEMBER 21, 1989 SAMPLING

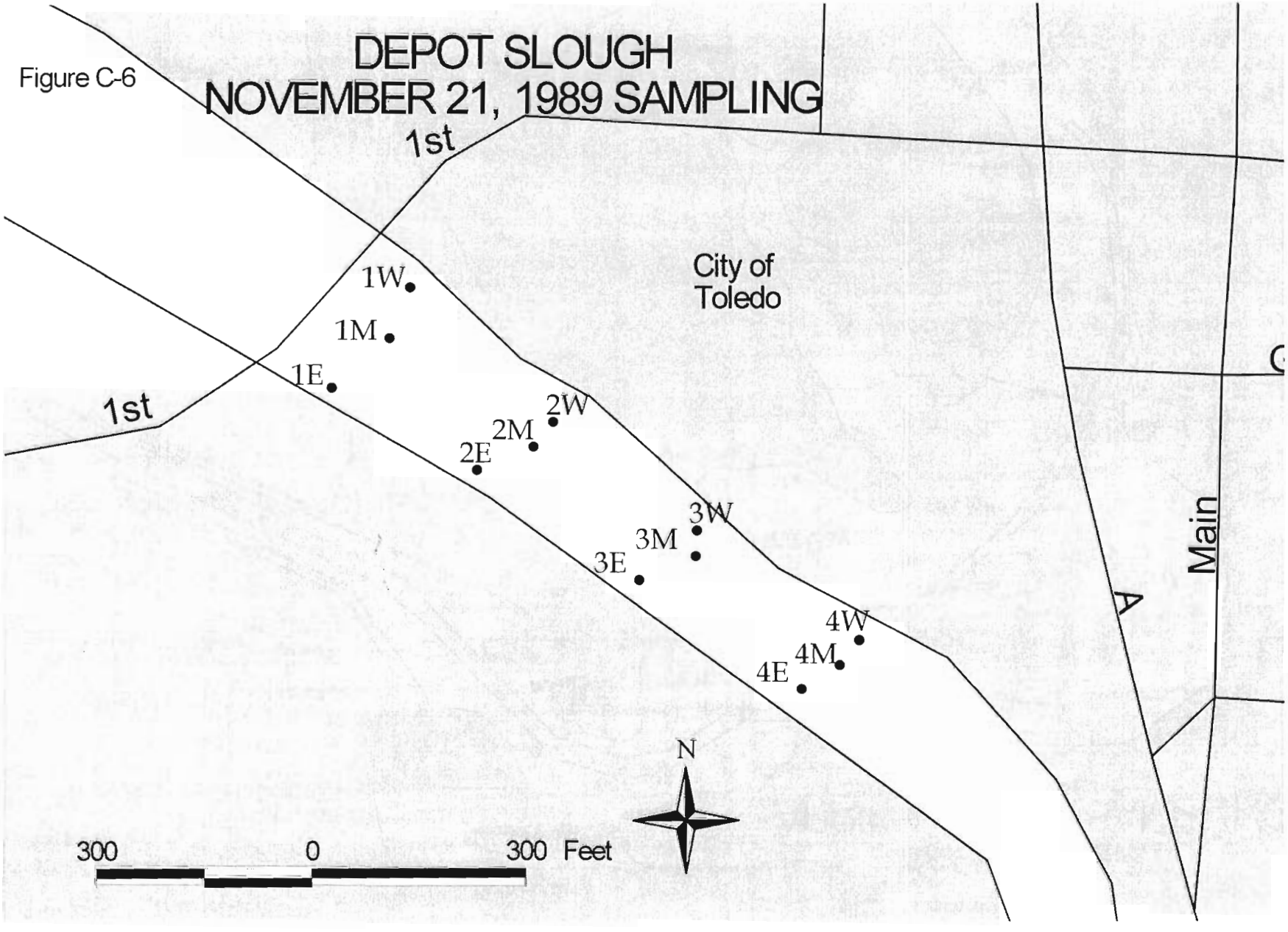


Figure C-7

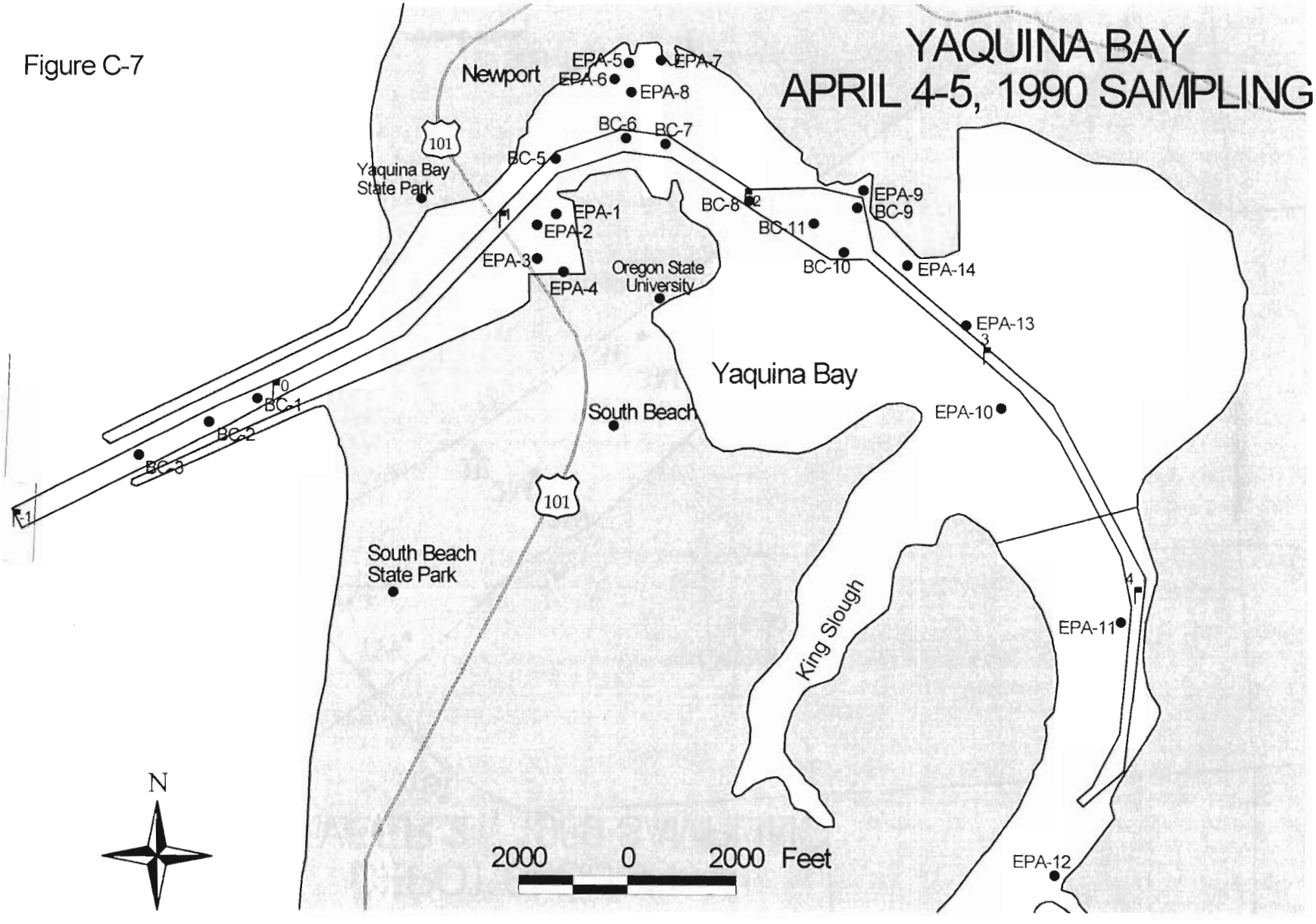

YAQUINA BAY
APRIL 4-5, 1990 SAMPLING
Newport
EPA-5
EPA-6
EPA-7
EPA-8
BC-6
BC-7
BC-5
101
Yaquina Bay
State Park
EPA-1
EPA-2
EPA-3
EPA-4
BC-8
BC-11
BC-10
EPA-9
BC-9
EPA-14
EPA-13
Oregon State
University
Yaquina Bay
South Beach
EPA-10
BC-1
BC-2
BC-3
South Beach
State Park
King Slough
EPA-11
EPA-12
N
2000 0 2000 Feet

Figure C-8

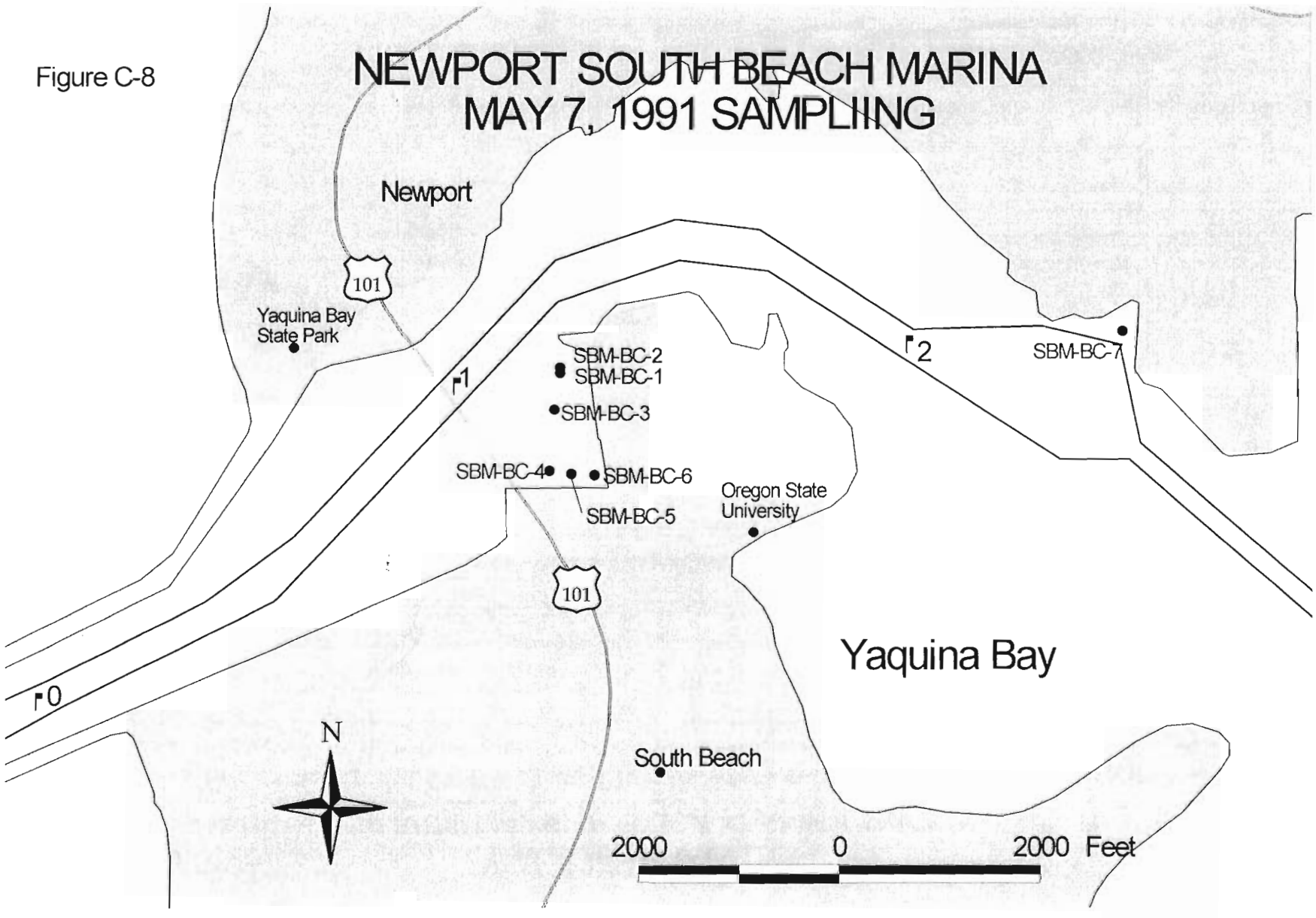
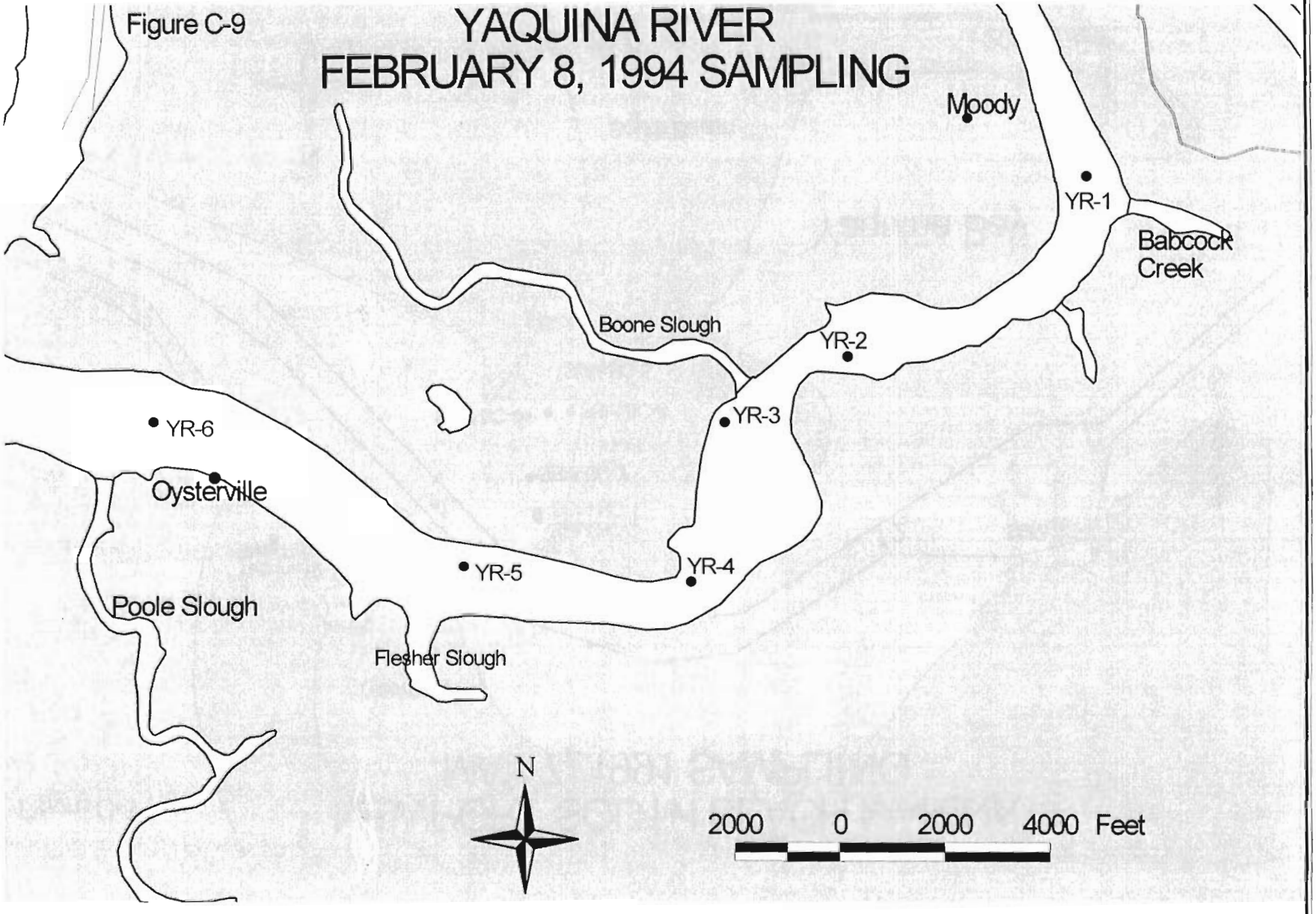

NEWPORT SOUTH BEACH MARINA
MAY 7, 1991 SAMPLING
Newport
101
Yaquina Bay
State Park
1
SBM-BC-2
SBM-BC-1
SBM-BC-3
SBM-BC-4
SBM-BC-6
SBM-BC-5
Oregon State
University
2
SBM-BC-7
101
Yaquina Bay
0
N
South Beach
2000
0
2000 Feet

Figure C-9

# YAQUINA RIVER
# FEBRUARY 8, 1994 SAMPLING



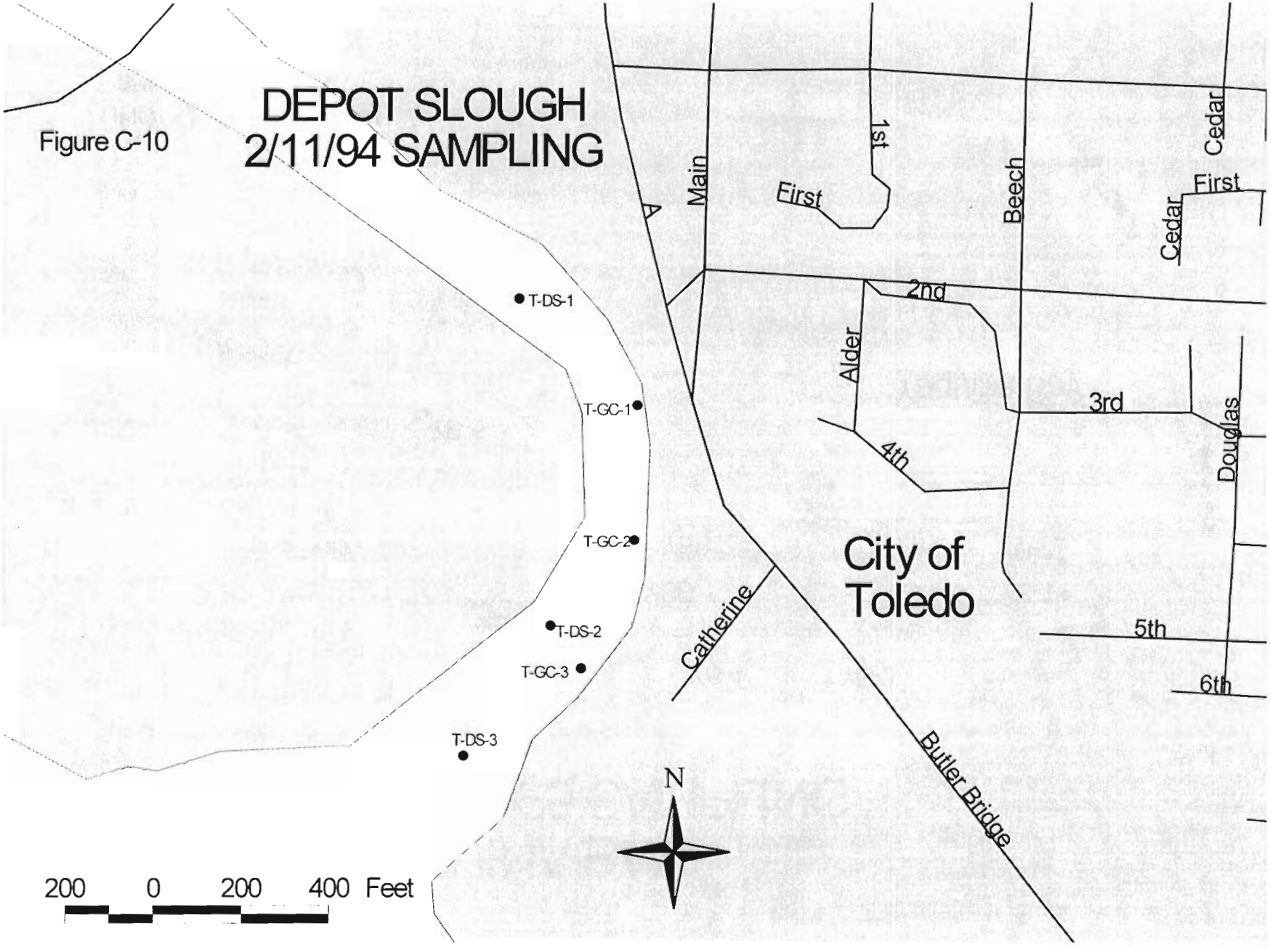

DEPOT SLOUGH
2/11/94 SAMPLING
Figure C-10
T-DS-1
T-GC-1
T-GC-2
T-DS-2
T-GC-3
T-DS-3
A
Main
First
1st
Beech
Cedar
First
Cedar
2nd
Alder
3rd
4th
Douglas
City of
Toledo
5th
6th
Catherine
Butler Bridge
N
200 0 200 400 Feet

FIGURE C-11

# YAQUINA BAY
# MARCH 15, 1995 SAMPLING

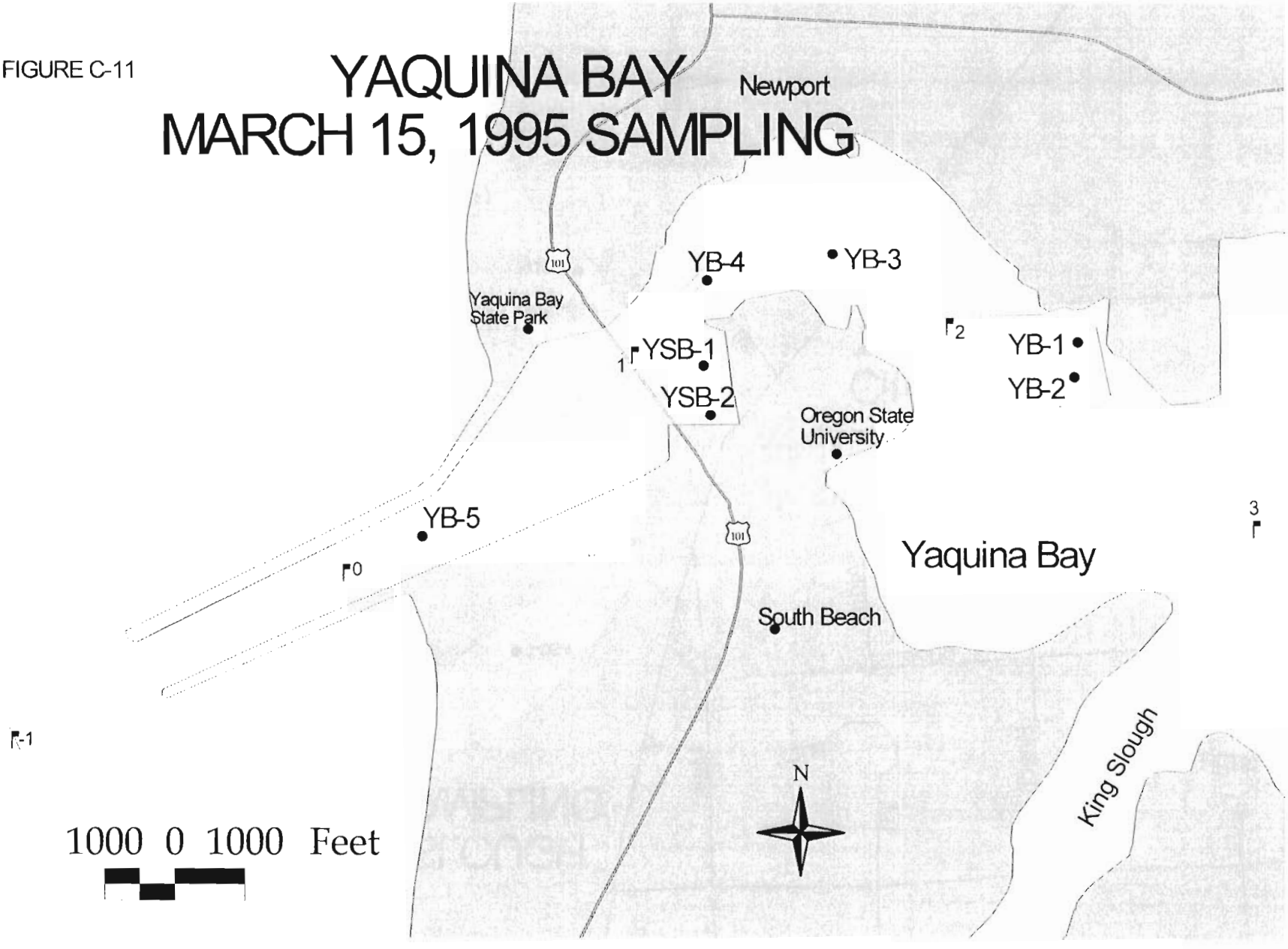


Figure C-12

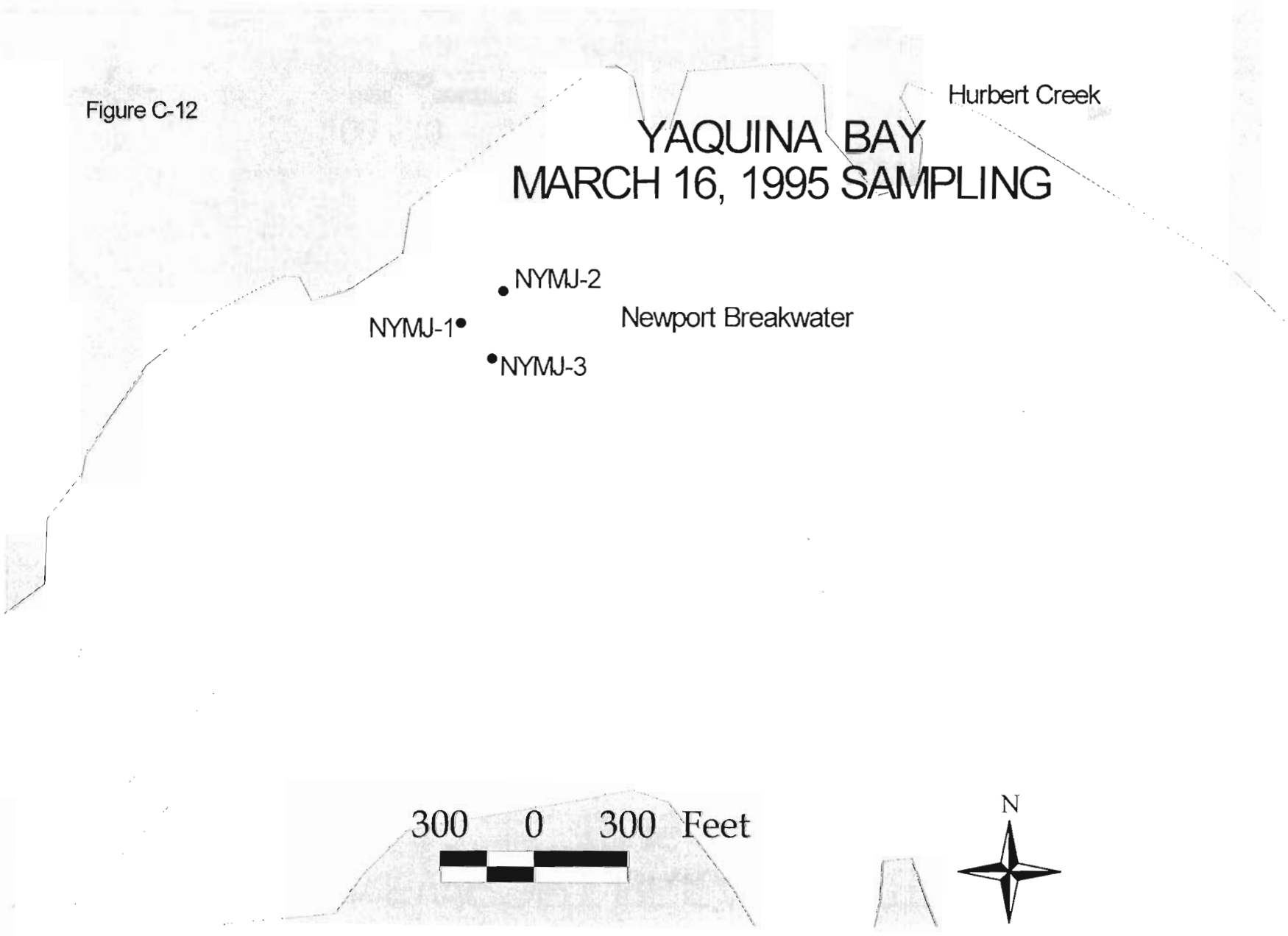

YAQUINA BAY
MARCH 16, 1995 SAMPLING
Hurbert Creek
NYMJ-2
NYMJ-1
Newport Breakwater
NYMJ-3
300 0 300 Feet
N

Figure C-13

# NEWPORT BREAKWATER
# JULY 15, 1996 SAMPLING

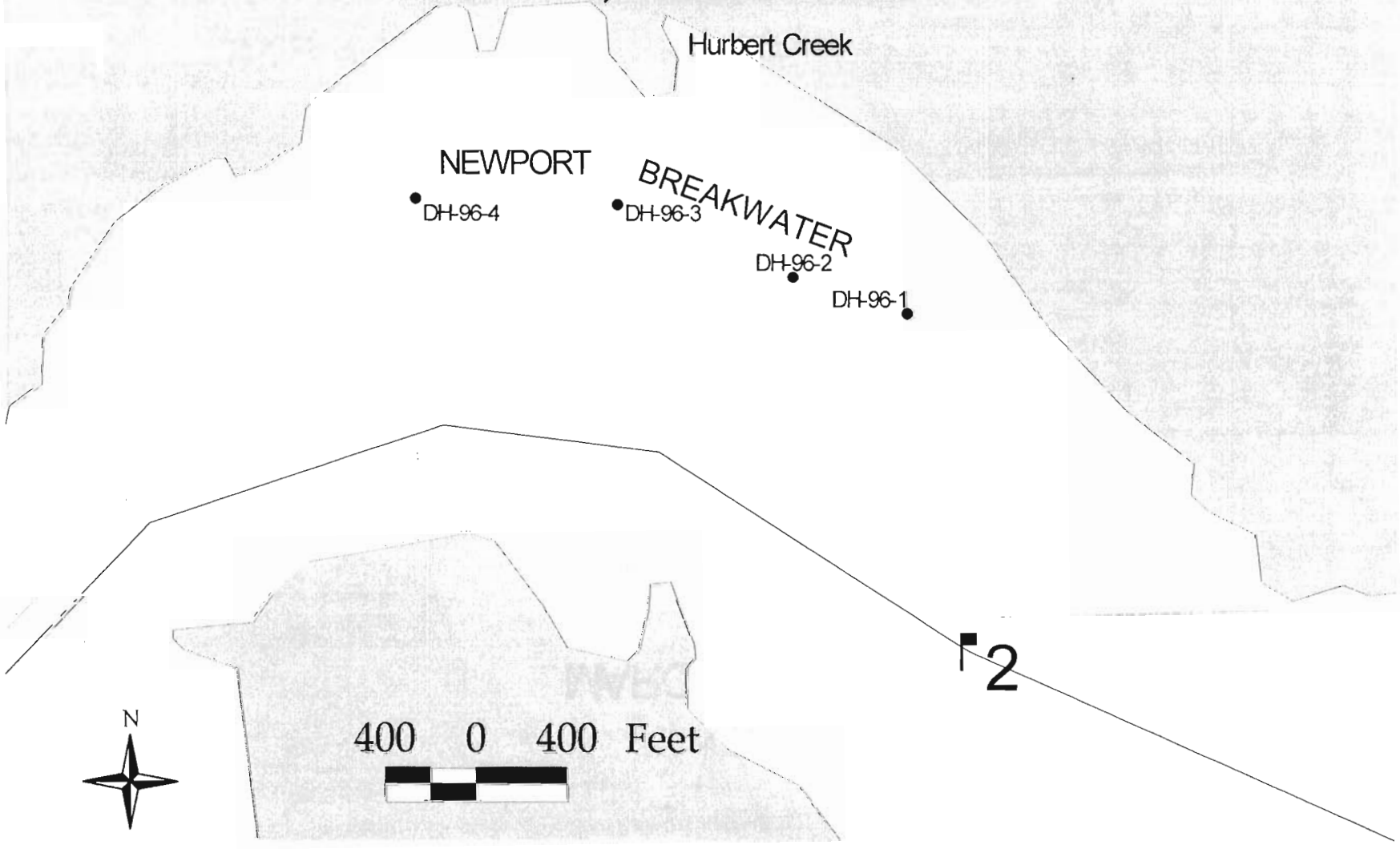


Figure C-14

# YAQUINA BAY AND SOUTH BEACH MARINA
# MAY 31, 2000 SAMPLING

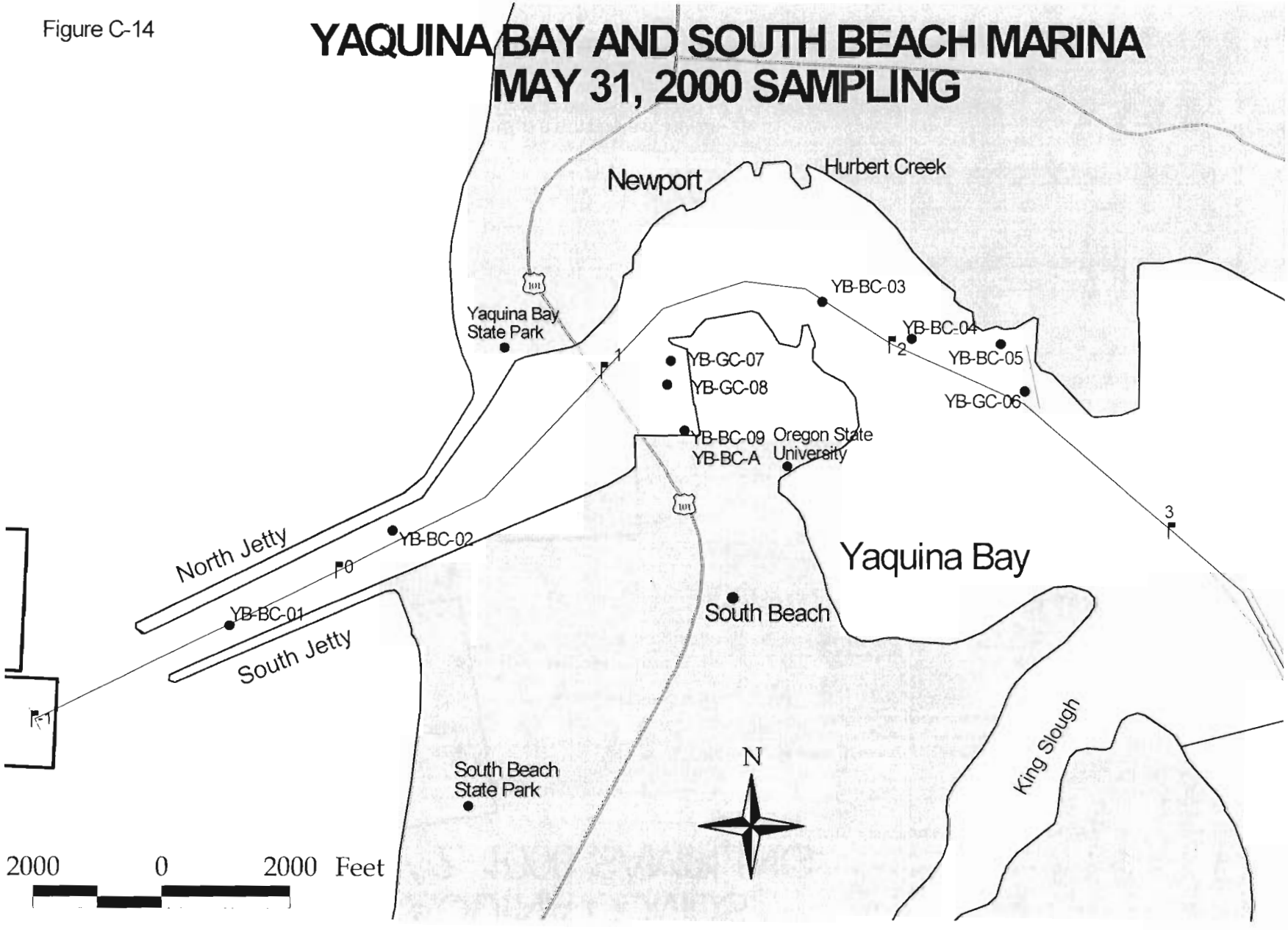
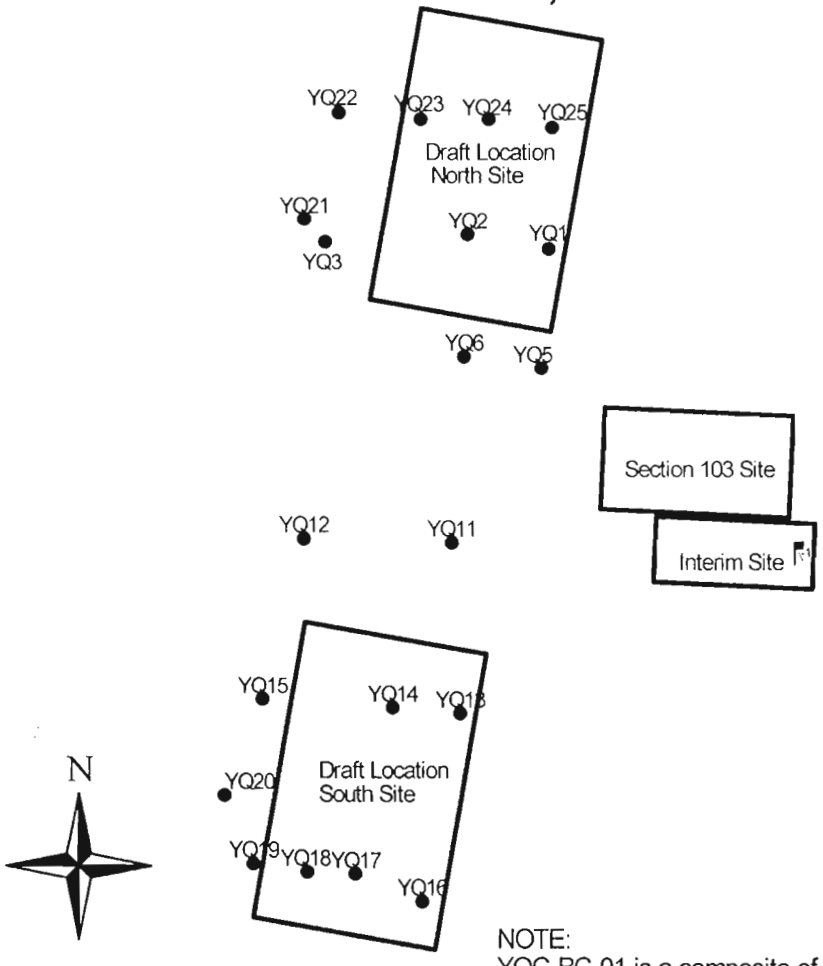
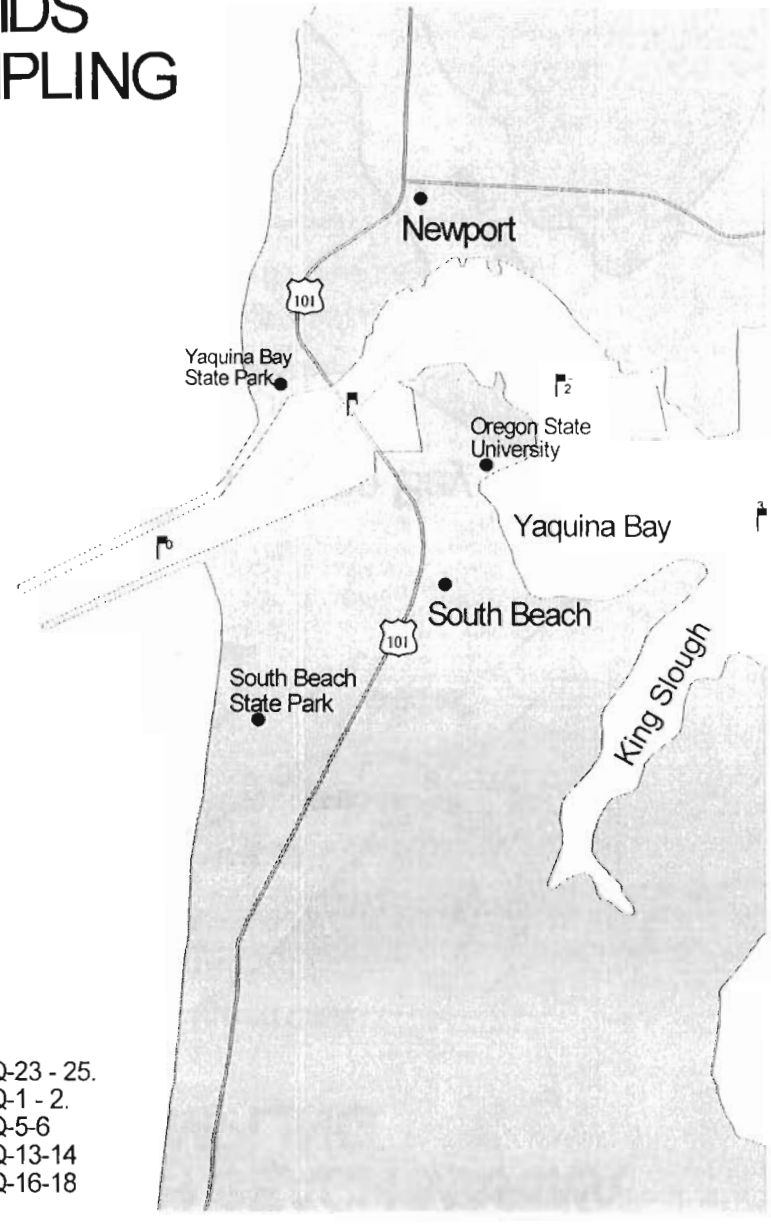


Figure C-15

# YAQUINA ODMDS
# JULY 2, 1000 SAMPLING




NOTE:
YOC-BC-01 is a composite of YQ-23 - 25.
YOC-BC-02 is a composite of YQ-1 - 2.
YOC-BC-03 is a composite of YQ-5-6
YOC-BC-04 is a composite of YQ-13-14
YOC-BC-05 is a composite of YQ-16-18



# APPENDIX D

# Yaquina Bay and Harbor

# ODMDS

# Management/Monitoring Plan

# Appendix D
# Yaquina Bay and Harbor
## ODMDS
# Management/Monitoring Plan
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# Purpose and Authorization

This Management and Monitoring Plan has been prepared jointly by the USEPA, Region 10, and the USACE, Portland District.

The purpose of this plan is to establish a coordinated program for the management and monitoring of the Yaquina Bay and Harbor Ocean Dredged Material Disposal Sites (ODMDSs) is environmentally sound and feasible from an engineering standpoint. This management/monitoring plan fully meets all criteria and factors set forth in Part 228, *Criteria for the Management of Disposal Sites for Ocean Dumping* (Title 40 CFR), and has been reviewed by the public. These regulations were promulgated in accordance with criteria set forth in Sections 102 and 103 of the Marine Protection, Research, and Sanctuaries Act (MPRSA) of 1972 (33 U.S.C. §1412 and §1413). Further, Section 506, *Site Designation*, of the Water Resources Development Act (WRDA) of 1992, further defined the roles, authorities, and responsibilities of the U.S. Army Corps of Engineers (Corps) and the U.S. Environmental Protection Agency (EPA) by amending Section 102(c) of the Marine Protection, Research, and Sanctuaries Act (33 U.S.C. §1412(c)).

MPRSA Section 102(c)(3), as amended by WRDA 92, sets forth a number of requirements regarding the content and development of site management plans, as follows:

In the case of dredged material disposal sites EPA in conjunction with the Corps of Engineers, shall develop a site management plan for each site designated pursuant to MPRSA Section 102(c)(3). Plans shall include, but not be limited to-

(A) a baseline assessment of conditions at the site;

(B) a program for monitoring the site;

(C) special management conditions or practices to be implemented at each site that are necessary for protection of the environment;

(D) consideration of the quantity of the material to be disposed of at the site, and the presence, nature, and bioavailability of the contaminants in the material;

(E) consideration of the anticipated use of the site over the long term, including the anticipated closure date for the site, if applicable, and any need for management of the site after the closure of the site; and

(F) a schedule for review and revision of the plan (which shall not be reviewed and revised less frequently than 10 years after adoption of the plan, and every 10 years thereafter).

Management of ODMDSs involves regulating the times, the quantity, and the physical/chemical characteristics of dredged material that is dumped at the site; establishing disposal controls, conditions, and requirements to avoid and minimize potential impacts to the marine environment; and monitoring the site environs to verify that unanticipated or significant adverse effects are not occurring from past or continued use of the disposal site and that permit terms are met.

Appropriate management of ODMDSs is aimed at assuring that disposal activities will not unreasonably degrade or endanger human health, welfare, the marine environment or economic potentialities (see MPRSA Section 103(a)). ODMDS management is a continuum that begins with site designation. At the site designation stage, the emphasis is on selecting a site where disposal will not have a significant adverse impact on various amenities such as fisheries, coral reefs, historic sites (e.g., shipwrecks), or endangered species, or on other uses of the marine environment.

ODMDSs are selected so as to minimize the risk of potentially adverse effects to human health and the marine environment.

## Objectives

The fundamental objectives of this management and monitoring plan are to provide for the safe and efficient disposal of dredged material while at the same time, minimizing the impacts to coastal resources. Specific objectives necessary for accomplishing this are:

1. Controlling mounding, to avoid potentially hazardous increases in wave heights,
2. Minimize impacts to marine resources,
3. Safe and efficient use of hopper dredges,
4. Minimize interference with other uses of the ocean, and
5. The practical beneficial use of dredged material.

**Controlling Mounding**. The height of the disposal would be limited to prevent adverse wave impacts. For example placement can be limited to produce a theoretical incident wave height increase of 10 percent or less. A 10 percent wave height increase was selected because it represents the threshold at which the increase becomes meaningful to wave dynamics and provides an adequate margin of safety for commercial and recreational navigation.

**Minimize Impacts To Marine Resources**. Sensitive and/or unique biological areas and important fishing areas have been avoided through the site selection process. However, timing and spatial restrictions can further reduce impacts to the marine resources in the proposed designated sites. Disposal can be managed to not

effect the same area more than once in a given year or to minimize the spatial extent of the disposal by repeated use of the same area. Material can be placed in a dispersive manner so that a given area receives a minimum thickness of material (non-repetitive placement).

**Safe and Efficient Use of Hopper Dredges**. The government is committed to the safe and efficient use of available hopper dredges. There are a limited number of dredges available on the West Coast to do routine annual maintenance work at Yaquina Bay and other coastal and river navigation projects. The time period for hopper dredges to safely work at entrance channels along the West Coast is generally limited to May through mid-October. Much of the shoaling occurs during the summer after river flows drop off, therefore most of the dredging occurs between July 1 and mid-October. The travel time to and from disposal areas is an important factor in determining hopper dredge production rates.

**Minimize Interference With Other Uses of The Ocean**. Disposal operations will be conducted in such a way as to minimize interference with other users. This is would be accomplished by controlling mounding within the sites, and continuing safe navigation practices for both government owned and contract dredges, by coordinating with other vessels, Coast Guard, and the local fishing industry.

**The Practical Beneficial Use of Dredged Material**. The only beneficial uses that are currently considered practical using available equipment and funds is keeping the sand within the littoral system. However with the proposed ODMDSs at Yaquina Bay sand will be moved further offshore and placed into deeper water. The presence of rock reefs limits the ability to place dredged material within the littoral system. Designation of the ODMDSs does not preclude such future beach nourishment provided a local sponsor agrees to provide easements, environmental clearances, and funding to cover cost increases if any.

## Site Management Roles and Responsibilities

The management and monitoring of ocean dredged material disposal sites are a federal responsibility shared between the EPA and the Corps of Engineers.

## Pre and Post Construction Assessment Studies

# Baseline Studies

MPRSA 102(c)(3)(A) requires that the management plan include a baseline of conditions at the site.

Sidescan sonar, bathymetric, and two seasons of benthic infaunal studies have been conducted in the offshore sandy area at Yaquina Bay. The benthic infaunal studies

were conducted in sandy areas identified by the sidescan sonar.

## Disposal Site Characterization

The two disposal sites covered by this management/monitoring plan are the new North and South ODMDSs off the mouth of Yaquina Bay (see Figure D-1). Neither of these two sites has been historically used for dredged material disposal. Between 1977 and 2000 material was placed in the EPA interim disposal site or the Corps' selected Section 103 site.

The SE corner of the North Site is located approximately 1.5 nmi. from the entrance to Yaquina Bay. Water depths range from 115 feet to 152 feet. The NW corner of the South Site is located approximately 1.75 nmi. from the entrance to Yaquina Bay also in water depths of 115 feet to 152 feet. Site coordinates for both the North and South Sites are provided in Table D-1.

*Table D-1. Coordinates (NAD 1983) and Dimensions of the Sites.*

| **North Site** | |
|---|---|
| *Corner Coordinates*: | *Dimensions*: |
| 44° 38' 17.98" N, 124° 07' 25.95" W | 4,000' wide |
| 44° 38' 12.86" N, 124° 06' 31.10" W | by 6,500' long |
| 44° 37' 14.33" N, 124° 07' 37.57" W | Azimuth (long axis): 10° T |
| 44° 37' 09.22" N, 124° 06' 42.73" W | Depth: 115'-152' |
| **South Site** | |
| *Corner Coordinates*: | *Dimensions*: |
| 44° 36' 04.50" N, 124° 07' 52.66" W | 4,000' wide |
| 44° 35' 59.39" N, 124° 06' 57.84" W | by 6,5000' long |
| 44° 35' 00.85" N, 124° 08' 04.27" W | Azimuth (long axis): 10° T |
| 44° 34' 55.75" N, 124° 07' 09.47" W | Depth: 115'-152' |

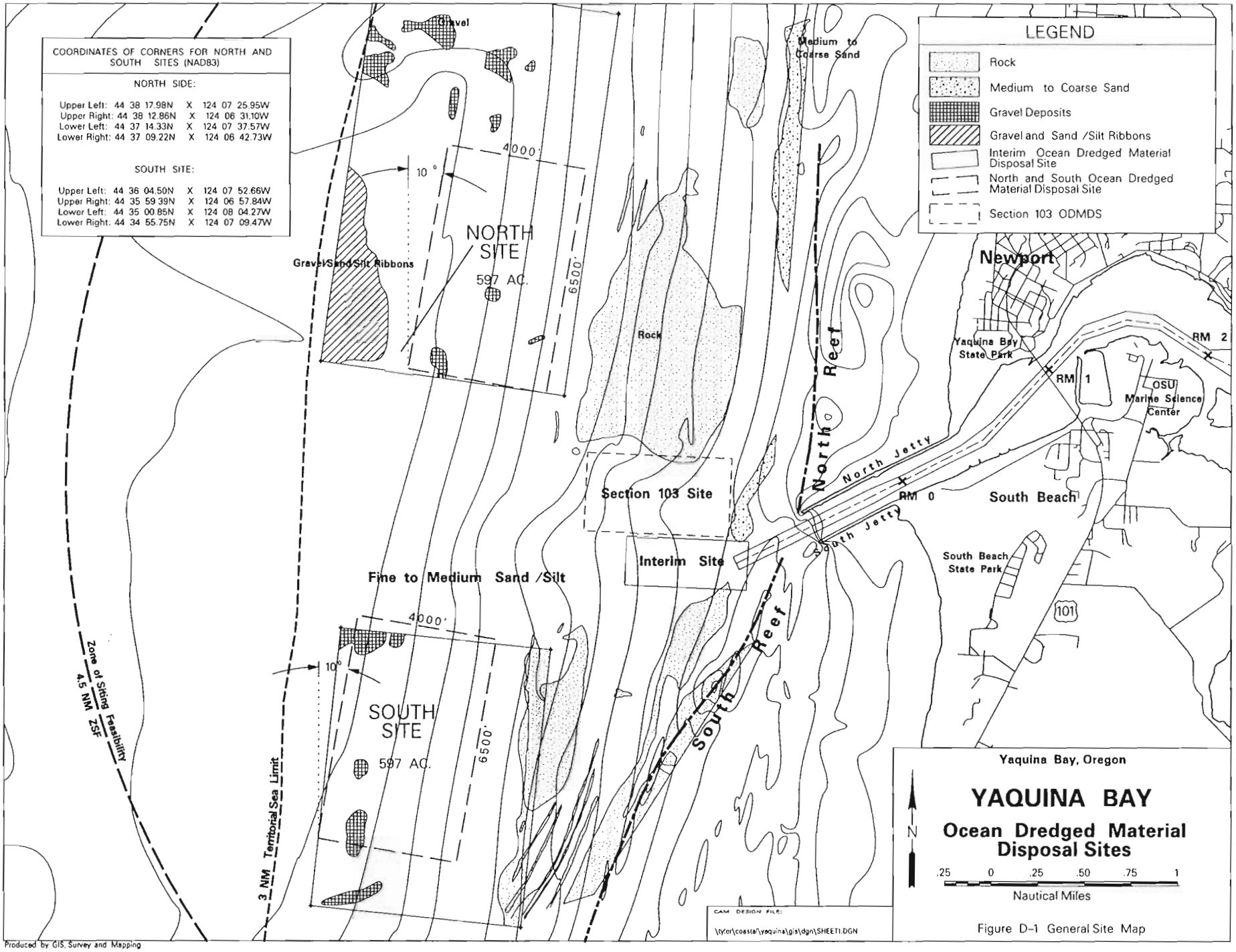



Figure D-1 General Site Map

# Disposal Site History

The North and South ODMDSs offshore of the entrance to Yaquina Bay have never received dredged material.

# Monitoring Program

MPRSA 102(c)(3)(B) requires that management plans include a program for monitoring the site.

## Site Monitoring

It is important to understand that disposal site monitoring is not a stand-alone activity; it is based on the site designation process, the characteristics of the dredged material, and compliance with permit or §103(e) authorization terms. Disposal site monitoring is a key component of site management. The main purpose of a disposal site monitoring program is to determine whether dredged material site management practices, including disposal operations, at the site need to be changed to avoid unreasonable degradation or endangerment of human health or welfare or the marine environment.

The 1996 Guidance Documentation (USACE/USEPA 1996) for developing management plans states that continuous monitoring of all physical, chemical, and biological parameters and resources in and around a typical disposal site is not necessary. Effective monitoring programs should be designed by the Corps of Engineers and EPA as a tiered series of investigations. The most effective monitoring programs for ocean disposal sites should:

- be integral components of site management;
- evaluate the fate and effect of dredged material disposal;
- use a tiered monitoring approach;
- link specific measured effects (action levels) with predetermined management actions; and
- support decision making

Monitoring plans are developed using a tiered approach: simple techniques for monitoring of physical characteristics occupies the lowest tier while more complex chemical monitoring techniques occupy higher tiers (Zeller and Wastler 1986). Biological effects testing of oceanic processes occupy the highest tier. Work at the higher tiers is undertaken only when the need is demonstrated by the results of monitoring techniques at the lower tiers. Therefore, only the level of monitoring needed to address specific management decisions is undertaken. Each monitoring plan addresses the specific or unique aspects of a particular site and contains

triggers, unacceptable impacts and indications for management action or additional testing depending on the management needs (Zeller and Wastler 1986).

According to Segar and Stamman (1986), the broad objectives of most monitoring plans are much the same:

- to ensure that there is no threat to human health or safety;
- to ensure that no unacceptable harm to the ecosystem or resources occurs;
- to ensure conditions that will lead to an unacceptable impact are not developing; and
- to make informed management decisions.

In the tiered approach, the decision rules indicating the need for further testing or remedial action are to be defined in advance (Fredette et al. 1986, Fredette et al. 1990, Segar and Stamman 1986). Specifying the decision rule alone is not enough. One should also specify potential actions to be taken for the specific outcomes of applying the decision rule to the monitoring results. In establishing tiers and triggers, concern for a resource is not sufficient. Quantitative changes in the resource or other variable that indicate an unacceptable impact are to be predefined and must be testable.

For the purpose of developing this plan, it is assumed that most of the benthic organisms living in the areas used for placement will be destroyed. The areas being used each year are therefore being limited to reduce the extent of the potential impact. In fact, based on past studies at ODMDSs and especially the type of organisms living in the high energy, nearshore areas, many organisms are likely to survive disposal, and affected areas are expected to recolonize following use. Given the large natural fluctuations in population composition and density, it would be very difficult to conclusively demonstrate this through studies. Therefore, the Corps is not proposing routine biological monitoring at the sites. Rather, we would consider special studies to try and answer specific questions, which could help in establishing future management objectives and practices.

Figure D-2 shows a generalized, tiered monitoring plan for a disposal site.

> Tier 1. Focus is on determining the physical behavior of the disposed material; generally by bathymetric survey and sometimes by periodic sediment characterization to determine whether the deposited material is behaving as expected
>
> Tier 2. Can include more intensive physical or sediment monitoring (limited chemistry and/or minimal biological monitoring) with the extent of each component determined by the outcome of the Tier 1 activities.

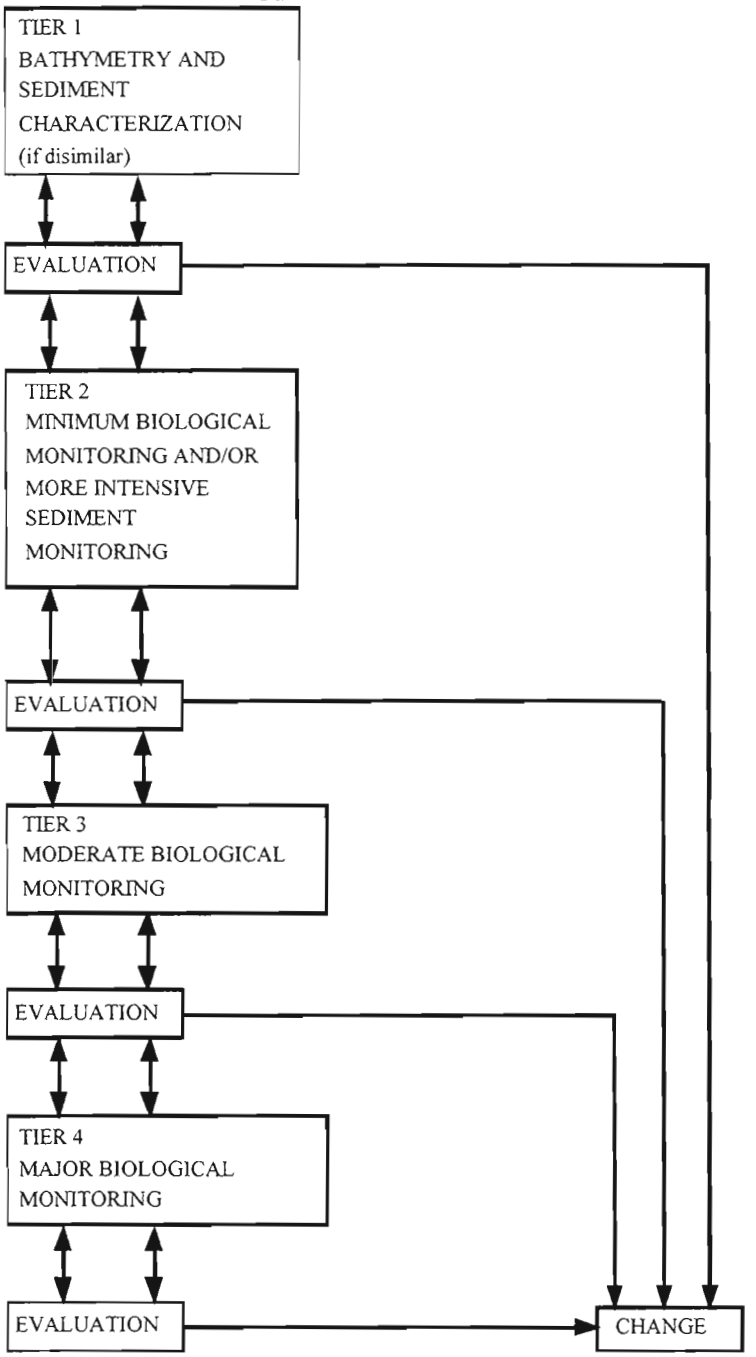
Tiers 3 and 4. Include intensive studies directed at specific problems.

An evaluation of the monitoring data takes place between each tier to determine whether there is any need for change, or whether more data, the next tier, will be required before determining a need for change.

Potential options concerning the disposal operations include the following:

- **No Change**
  - No Change Required: monitoring reveals no cause for concern; disposal and monitoring continue as planned
  - No Change Possible: (e.g. one-time use, thereby eliminating the possibility for subsequent change in disposal operations)

*Figure D- 2. Generalized, Tiered Approach to Monitoring ODMDSs*




- **Operational Change Required**

  Scheduling: adjust the schedule (time periods or rates) of the disposal to avoid a temporary situation

  Placement of Material Within The Site: place the material in a different portion of the site than originally planned or in a different manner

than originally planned (e.g. point dump vs. non-repetitive dump)
Restrict Type or Quantity of Material Placed

- **Change In Site Location**
  Where the impacts are found to be unavoidable and unacceptable over a large area or long time, a change in site location, including other areas within the same site, may be considered.

- **Discontinue Disposal At Site**
  Cessation of disposal if unavoidable and unacceptable conditions occur or persist at a site. This would require identification if a replacement site.

## Specific Monitoring Objectives

- Ensure that the dredged material is behaving as predicted and that dredged material does not create unacceptable mounds.
- Assess the significance of potential impacts of disposal operations on the public safety and resources or resource use.

## Predictions

- Unacceptable mounding can be avoided through proper dredged material disposal management.
- Dredged material is similar to existing sandy substrate. No significant impact to the habitat is anticipated.
- Areas outside the designated disposal areas will not be adversely affected by the disposal events.

## Evaluation Questions

- What is the distribution pattern of the dredged material? Is the material behaving as anticipated?
- Can the dredged material be identified as different from the existing substrate?
- Is mounding occurring? To what extent?
- How have the depth contours been affected?
- Do the depth contours change over time?
- Is erosion occurring? At what rate?
- Has the character of the site been significantly altered so as to cause alteration of adjoining habitat?
- Has the material moved and affected conditions (sediment type or depths) outside the site?

### Coordinated Management of North and South Sites

The Corps and EPA will coordinate decisions for site management. Decisions to increase the spacing between the dumping positions, or to shift disposal operations to an alternate site (South vs. North) or to other portions of a site will be part of the coordinated management strategy. Information regarding environmental impacts at the site, or changes in management strategy will be provided to the public for their information and consideration. Every effort will be made to coordinate before an action is initiated.

If Tier 1 monitoring indicates a potential problem, which cannot be readily corrected by management practices, Tier 2 monitoring will be employed or an alternate site or location within the site will be selected. If Tier 2 indicates a problem, or a previously unidentified concern is established, a coordinated Tier 3 plan for specific studies will be developed which focuses on the identified concerns, or an alternate site or location within the site will be used.

### Monitoring Data

Bathymetric surveys (Tier 1) are scheduled annually in the spring. Future bathymetric surveys will show cumulative changes based upon using the oldest most complete surveys available at the site as a baseline. The extent of coverage will be determined by EPA and the Corps of Engineers with input from the public, but will be limited to those areas likely to or potentially affected by disposal at the sites.

Data from the monitoring program will be compiled yearly and submitted to EPA, Region 10 Ocean Dumping Coordinator and the state. The information will be provided to other interested parties upon request. These findings will be evaluated and coordinated decisions will be made by EPA and the Corps of Engineers concerning the need for management changes. The disposal plan for a given dredging year will be based on the results of the previous year's monitoring and the spring, pre-dredging/disposal hydrographic surveys.

## Special Management Conditions or Practices (Disposal Methods)

MPRSA 102(c)(3)(C) requires that management plans include special management conditions or practices to be implemented at the site that are necessary for the protection of the environment.

## Alternative Placement Strategies

The placement strategy has a large influence on the overall impact of disposal in any site. Placement strategies vary on several scales, ranging from individual dumps to the long-term distribution of material. Each time a hopper dredge releases a load of sand it creates a low "mound" on the ocean floor. Individual mounds are broad and flat with the specific dimensions of those mounds depending on the volume of material, type of dredge, and depth of water at the ODMDS. Over the course of an average maintenance dredging season there would be numerous hopper dredge dumps. Those individual dumps could be spread over a large area (non-repetitive dumping) or they could be concentrated by repetitively dumping in a small area. The disposal area could be more concentrated in deep water than in shallow water because of the lower potential effects on wave heights. From year to year there would also be the option of switching placement between the North and South site or rotating the disposal areas or reusing the same areas within a site.

### Individual Dump Alternatives

Dredge Type. The type of hopper dredge used influences the dimensions of the individual dump mounds. At the same vessel speed, current and water depth, a multiple bottom-door hopper dredge produces a longer and thinner disposal mound than a split-hull hopper dredge. This difference occurs because it takes longer to discharge the material from the bottom-door dredge than from the split-hull dredge.

For the hopper dredges that commonly work at Yaquina Bay, the Corps' multiple bottom-door hopper dredge YAQUINA would produce a thinner deposit than the split-hull contract hopper dredges at any given water depth. As an example, in 100 feet of water with a one-foot per second (fps) current, the YAQUINA would produce a disposal mound that would have a maximum height of .12 feet (1 inch), however, 90 % of the mound area would be less than 0.07 feet (0.84 inches) thick. The area of the mound would be about 17 acres. The contract dredge WESTPORT would produce a mound with a maximum height of over .22 feet (2.64 inches), however, 90% of the mound area would be less than 0.10 feet (1.2 inches) thick. The area of the mound would be around 21 acres.

### Repetitive or Non-repetitive Disposal Placement

On an annual basis, the disposal alternatives include the options of concentrating or dispersing the dredged material. With the existing ODMDS configuration at Yaquina Bay disposal has been concentrated by repetitively dumping because there were no placement alternatives available.

By repetitively dumping in the same locations, dredged material could be concentrated in smaller areas. The maximum mound thickness would be limited to

avoid adversely impacting wave heights and could increase with water depth.

Non-repetitive placement could spread the dredged material over a larger area, but would limit the depth of accumulation. At the extreme, the disposal dumps could be spread so thinly that no two individual mounds would overlap. The area required for non-repetitive disposal would depend on the selected depth of accumulation.

### Year-to-Year Site Usage

Various local and state representatives including local fishermen have expressed a preference for placement of material in the North Site. How a disposal site could be used from year-to-year depends on the volume to be dredged, the movement of material away from the site, on the depth of water, and the potential impacts to navigation and marine resources. Waves and currents can move material away from the sites but in deep water this movement is limited. In some locations it may be better to provide an extended period of time between disposals in order to allow marine resources to recover.

Modeling could be used to evaluate whether there would be any compounding effects on wave heights from adjacent mounds. Dredged material could be point dumped or a non-repetitive disposal option could be employed. A non-repetitive disposal would raise a larger area slower than point dumping. Initial disposal could be in the north site and rates of accumulation and movement of material can be monitored and modeled. Present modeling indicates that movement would be to the WNW (300°) at 120 ft/yr.

## Quantity Restrictions and Weather Restrictions

The North and south Site are sized to allow multiple years of disposal without restrictions due to potential navigational safety (mounding). Adverse sea and weather conditions limit dredging and disposal at Yaquina Bay to a period typically from May to October. It may be possible to cross the bar for ocean disposal at other times of the year, but likely to incur time delays. Even during dredging season the dredges may experience storm events that restrict ocean disposal.

## Seasonal Restrictions

Adverse sea and weather conditions limit dredging and disposal at Yaquina Bay to a period typically from May to October.

## Equipment Requirements and Discharge Point

Dredges used at Yaquina Bay include Corps and contract dredges are required to meet all US Coast Guard requirements for safety. They are also required to use modern electronic positioning equipment capable of fixing their location within plus or minus 3 feet to ensure they place material within the designated disposal sites.

## Debris Removal Provisions

Debris is defined as material that could cause interference with particular uses of the ocean. Floatable debris comprises material such as logs, that could cause navigation hazards or solids, such as plastic or wood chunks that could foul beaches. Non-floatable debris comprises material that could reasonably be expected to cause conflicts with bottom-net or trawl fishing. As a general rule, non-sediment material that would pass through a 24-inch x 24-inch mesh is not considered debris if it is dredged as part of the sediment matrix.

Discharge of debris at ODMDSs is prohibited unless specifically allowed. Typically the planning or permitting process assesses the potential risks of any debris that could be encountered during dredging. Dredging contractors are required to maintain a record of the handling of debris encountered during dredging and disposal. Compliance inspectors may review these records.

The Corps or EPA may make dredging or disposal area inspections to ensure that the contractor is in compliance with the approved operating plans, and that debris is removed prior to discharge at ODMDSs. The need for such a requirement will be assessed during the planning or permitting process. Floatable debris must be either removed at the dredging area or picked out of the water at the disposal area. Sediments, which contain debris that is not easily removed, may require screening through a 24-inch x 24-inch mesh. The mesh must be periodically cleaned and the debris disposed of according to the approved dredging and disposal plan. Hopper and pipeline dredges are incapable of picking up large debris.

**Record-Keeping And Reporting Requirements**. Currently, daily records are required of dredges indicating where material was dredged and where material was placed. We can also require start and endpoint coordinates for each load placed to be provided to the Corps. An annual summary report of quantity dredged and placed at each site is prepared and provided to EPA and Oregon.

**Inspection And Surveillance Provisions**. Contract dredges have 24-hour inspection by Corps of Engineer personnel to ensure dredging and disposal in the correct locations. Corps of Engineers' dredges are responsible for ensuring proper positioning. USCG has surveillance role under MPRSA.

# Quantity of Material and Presence of Contamination

MPRSA 102(c)(3)(D) requires that management plans include consideration of the quantity of the material to be disposed of at the site, and the presence, nature, and bioavailability of the contaminants in the material.

The quantity of material allowable for disposal at a particular ODMDS is a function of the capacity of the site and the type of material. For non-dispersive sites, the site will eventually become "full". The concern, in such a case, usually will be that the material not impact amenities outside the ODMDS boundaries or cause a navigation hazard. There are also vertical limitations so as to avoid navigation hazards.

Sediment to be placed at the Yaquina Bay ODMDSs will be evaluated according to the Dredging Material Evaluation Framework for the Lower Columbia River Management Area (USACE et al., 1998). The information is used by the Portland District, Corps of Engineers and EPA Region 10 and the Oregon to evaluate the suitability of the dredged material for disposal at a given site. The evaluation procedures are intended to ensure that all dredged material disposals are consistent with the MPRSA.

## DISPOSAL MATERIAL

### Yaquina Bay and Harbor Navigation Project

The entrance channel, authorized at 400 feet wide and 40 feet deep, runs from deep water approximately one mile to RM 0.0. In the past, this area was dredged to a depth of 35 feet, but since the return of deeper draft vessels in 1988, dredging is to the authorized depth of 40 feet.

A cross channel shoal develops at the entrance to Yaquina Bay. The shoal builds off the ends of the jetties during the winter and spring, between RM -0.6 and 0.0. A hopper dredge removes the sediment from May through October. The entrance is dredged to between 42 and 44 feet to ensure that the full depth is available between dredging operations. Adverse sea and weather conditions typically prevent dredging during the rest of the year. The south side of the channel between RM 0+05 and RM 0+22 is not dredged deeper than 40 feet due to the presence of a rock outcropping.

From RM 0.0, the authorized channel is 30 feet deep and 300 feet wide to the turning basin at McClean Point at RM 2.0. The turning basin is authorized at 30 feet deep, 900 to 1,200 feet wide, and 1,400 feet long. The channel from the turning basin (RM 2.4) to Yaquina (RM 4.0) is 18 feet deep and 200 feet wide.

Shoaling occurs along the outside quarter of the channel between RM 1.3 and RM 1.6, and around the periphery of the turning basin. The shoals will be removed using hopper dredges or clamshell dredges and barges. The Corps does not currently maintain the channel from the turning basis to RM 4.0. Dredging to 32 to 33 feet ensures the needed year-round depths of 30 feet.

The project includes a small 10-foot-deep boat basin ("north basin") at Newport. East of the highway 101 bridges is the South Beach Marina with an authorized access channel 10 feet deep, 100 feet wide, and 2,035 feet long.

The authorized project in the Yaquina River consists of a channel 10 feet deep running from approximately RM 4.0 (at the town of Yaquina) to RM 14.0. Generally, the channel is 150 feet wide. At Toledo, the channel widens to 200 feet, and extends into Depot Slough. A turning basin at RM 14.0,350 feet wide and 500 feet long, completes the project.

The Yaquina area project sediments have been sampled and tested at various times including 1980, 1981,1986, 1990, 1991, 1996, and 2000. Testing has included physical, chemical and biological analyses. The material has been determined to be suitable for unconfined aquatic disposal without further testing. Future evaluation of material would be in accordance with the guidance and timing set forth in the *Dredged Material Evaluation Framework - Lower Columbia River Management Area*, November 1998.

## Anticipated Site Use

MPRSA 102(c)(3)(E) requires that the management plan include consideration of the anticipated use of the site.

The management plan must describe the anticipated use of the site over the long term, including the anticipated closure date for the site, if applicable, and any need for management of the site after the closure of the site. As indicated above, the anticipated use should be considered in developing site conditions and monitoring plan.

The ODMDSs are expected to be used in the following manner. The actual use of the sites will be reviewed annually and could be adjusted based on changing conditions, understanding, and priorities.

Placement priorities will be to fully use the North Site to the maximum extent practicable. Other priorities will include controlling mounding to avoid potentially hazardous increases in wave heights; minimize impacts to marine resources; safe use of hopper dredges; efficient use of available funds; minimize interference with

other uses such as crab fishing, recreational fishing, and commercial navigation; and the beneficial use of dredged material.

Placement may utilize multiple cells to ensure dispersal over the sites. Mound height will be limited to prevent increases in wave height by more than 10 percent, as predicted by models. Hydrographic surveys will be conducted annually to monitor accumulation to ensure the threshold is not exceeded and appropriate management action is taken.

The Corps proposes to use the ODMDSs to dispose of sediments dredged from the federally authorized navigation projects at Yaquina Bay. The ODMDSs could also be used for placement of material dredged during other federal or non-federal actions authorized in accordance with Section 103 of the MPRSA. These actions would require a Section 103 permit from the Corps, and coordinated through the public notice process.

## Site Management Plan Review and Revision

MPRSA 102(c)(3)(F) requires that the management plan include a schedule for review and revision of the plan which shall not be reviewed and revised less frequently than 10 years after adoption of the plan, and every 10 years thereafter.

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# APPENDIX E
# CULTURAL RESOURCES

APPENDIX E
CULTURAL RESOURCES
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# CULTURAL RESOURCES

## Introduction

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 areas of primary concern are two rectangular disposal sites located off the ship channel on the ocean side of the Yaquina Bar (see Figure E-l).

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

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 . 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, ethnographical known Native Americans[4],[5] (for comparison with the Coos Bay Indians see Simons)6.

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

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

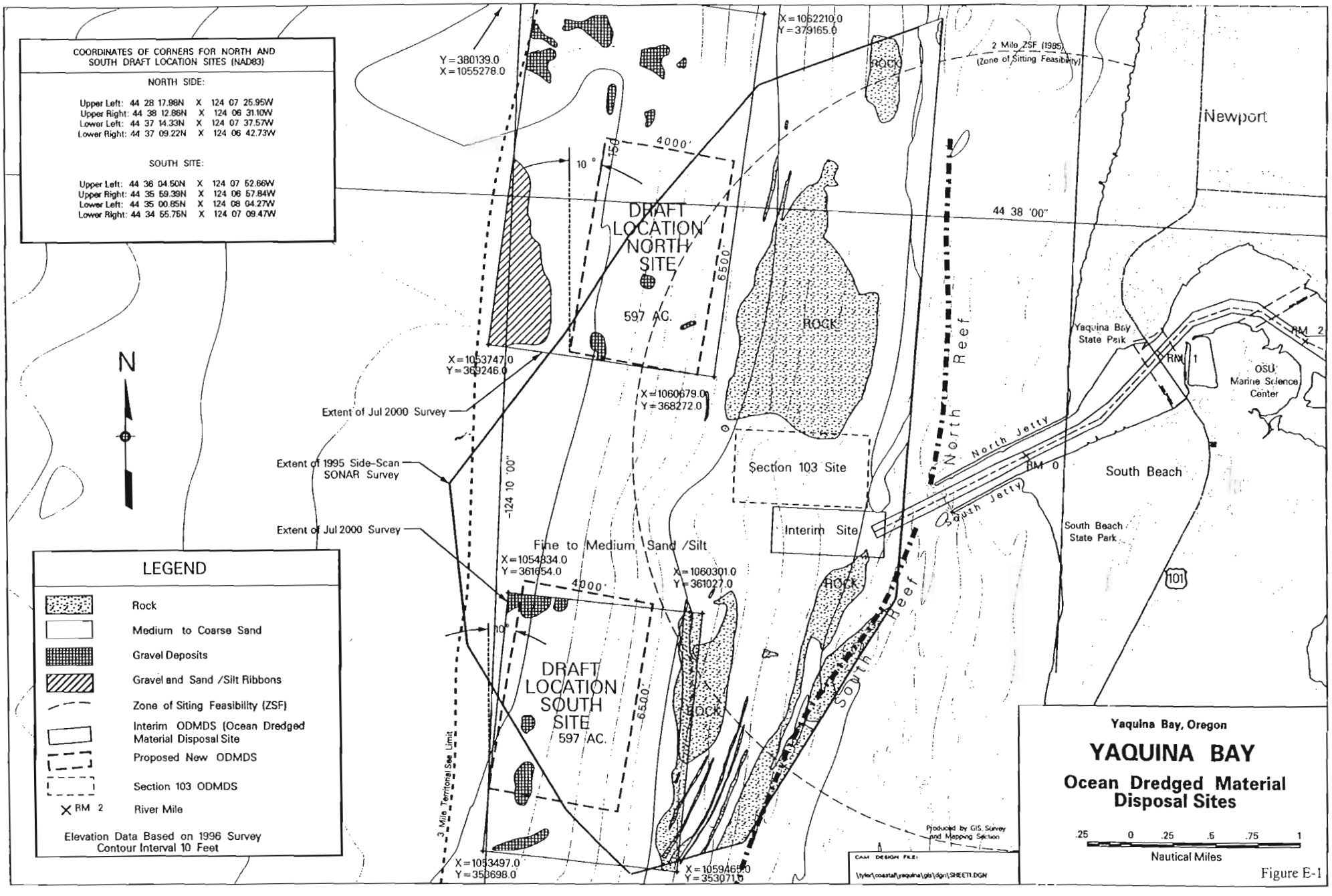
COORDINATES OF CORNERS FOR NORTH AND SOUTH DRAFT LOCATION SITES (NAD83)
NORTH SIDE:
Upper Left: 44 28 17.98N X 124 07 25.95W
Upper Right: 44 38 12.86N X 124 06 31.10W
Lower Left: 44 37 14.33N X 124 07 37.57W
Lower Right: 44 37 09.22N X 124 06 42.73W
SOUTH SITE:
Upper Left: 44 36 04.50N X 124 07 52.66W
Upper Right: 44 35 59.39N X 124 06 57.84W
Lower Left: 44 35 00.85N X 124 08 04.27W
Lower Right: 44 34 55.75N X 124 07 09.47W
N
LEGEND
Rock
Medium to Coarse Sand
Gravel Deposits
Gravel and Sand /Silt Ribbons
Zone of Siting Feasibility (ZSF)
Interim ODMDS (Ocean Dredged Material Disposal Site
Proposed New ODMDS
Section 103 ODMDS
RM 2 River Mile
Elevation Data Based on 1996 Survey
Contour Interval 10 Feet
Y=380139.0
X=1055278.0
X=1052210.0
Y=379165.0
2 Mile ZSF (1985)
(Zone of Sitting Feasibility)
Newport
DRAFT LOCATION NORTH SITE
597 AC.
4000'
6500'
150
10°
44 38 '00"
ROCK
North Reef
X=1053747.0
Y=369246.0
X=1060679.0
Y=368272.0
Extent of Jul 2000 Survey
Extent of 1995 Side-Scan SONAR Survey
Extent of Jul 2000 Survey
-124 10 '00"
Section 103 Site
Interim Site
Fine to Medium Sand /Silt
X=1054834.0
Y=361654.0
X=1060301.0
Y=361027.0
DRAFT LOCATION SOUTH SITE
597 AC.
South Reef
3 Mile Territorial Sea Limit
X=1053497.0
Y=353698.0
X=1059465.0
Y=353071.0
Yaquina Bay State Park
RM 2
RM 1
RM 0
OSU Marine Science Center
North Jetty
South Jetty
South Beach
South Beach State Park
101
Produced by GIS Survey and Mapping Section
CAM DESIGN FILE:
\tyler\coastal\yaquina\gis\dgn\SHEET1.DGN
Yaquina Bay, Oregon
YAQUINA BAY
Ocean Dredged Material Disposal Sites
.25 0 .25 .5 .75 1
Nautical Miles

Figure E-1

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.

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.

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.

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.

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.

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.

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.

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 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

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.

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 use of these disposal sites.

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; Fogary, 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 (Fate of Wreck) | Reference |
|---|---|---|---|---|
| Early 1849 | Unknown | Chinese silk-carg salvaged by India & 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. |

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ATTACHMENT E-A1

DEPARTMENT OF THE ARMY
PORTLAND DISTRICT, CORPS OF ENGINEERS
P.O. BOX 2946
PORTLAND, OREGON 97208-2946

Reply to
Attention of:

JAN 1 0 2001

Planning, Programs and Project Management Division

Dr. Leland Gilsen
State Historic Preservation Office
1115 Commercial St. NE, ste 2
Salem, OR 97301-1012

Dear Dr. Gilsen:

The Portland District Corps of Engineers is currently conducting a study to add new ocean disposal sites offshore Newport, Oregon in Yaquina Bay. The project area is illustrated in Enclosure 1. The **"Yaquina Bay Ocean Disposal Maintenance Dredging Evaluation Study"** proposes to add two disposal sites for placement of dredged material obtained from the jetty channel. This area is currently maintained annually by dredging approximately 300,000 cubic yards of material and disposing in two existing sites at the mouth of the jetty.

The proposed Northern and Southern Disposal sites measure approximately 6500 feet north-south by 4000 feet east-west and encompass 597 acres each. These sites are located approximately 2 miles offshore (west) of South Beach. As part of the Corps study, both proposed disposal sites were subjected to sidescan sonar survey during July 2000, by Williamson & Associates, Seattle, WA (Enclosure 2). This survey indicated minimal bottom features in homogenous sand and silt sediments. The authors concluded there were no obvious shipwreck signatures in their data. This general area was also studied by the Corps in 1985 for the **"Yaquina Bay Interim Ocean Disposal Site Evaluation Study"**. Historic research undertaken for the 1985 study indicated that 12 vessels wrecked in the project area, seven of which occurred on the bar with subsequent movement to South Beach (Enclosure 3). This same study concluded that the only high probability area for the location of historic shipwrecks is south of and adjacent to the south jetty. By letter dated April 24, 1985, your office concurred that this project would have no effect on sites eligible for inclusion on the National Register of Historic Places.

Given the conclusions of the current and past studies of the project area, it is our opinion that placement of dredged material in the proposed ocean disposal sites will have no effect on sites listed or eligible for listing in the National Register of Historic Places. We request your review and concurrence with our findings. Should you have questions or need additional information, please contact Ms. Gail Celmer of my staff at (503) 808-4762.

Sincerely,

Robert E. Willis
Chief, Environmental Resources
Branch

Enclosures

Copies Furnished:

CENWP-EC-HR (Siipola)

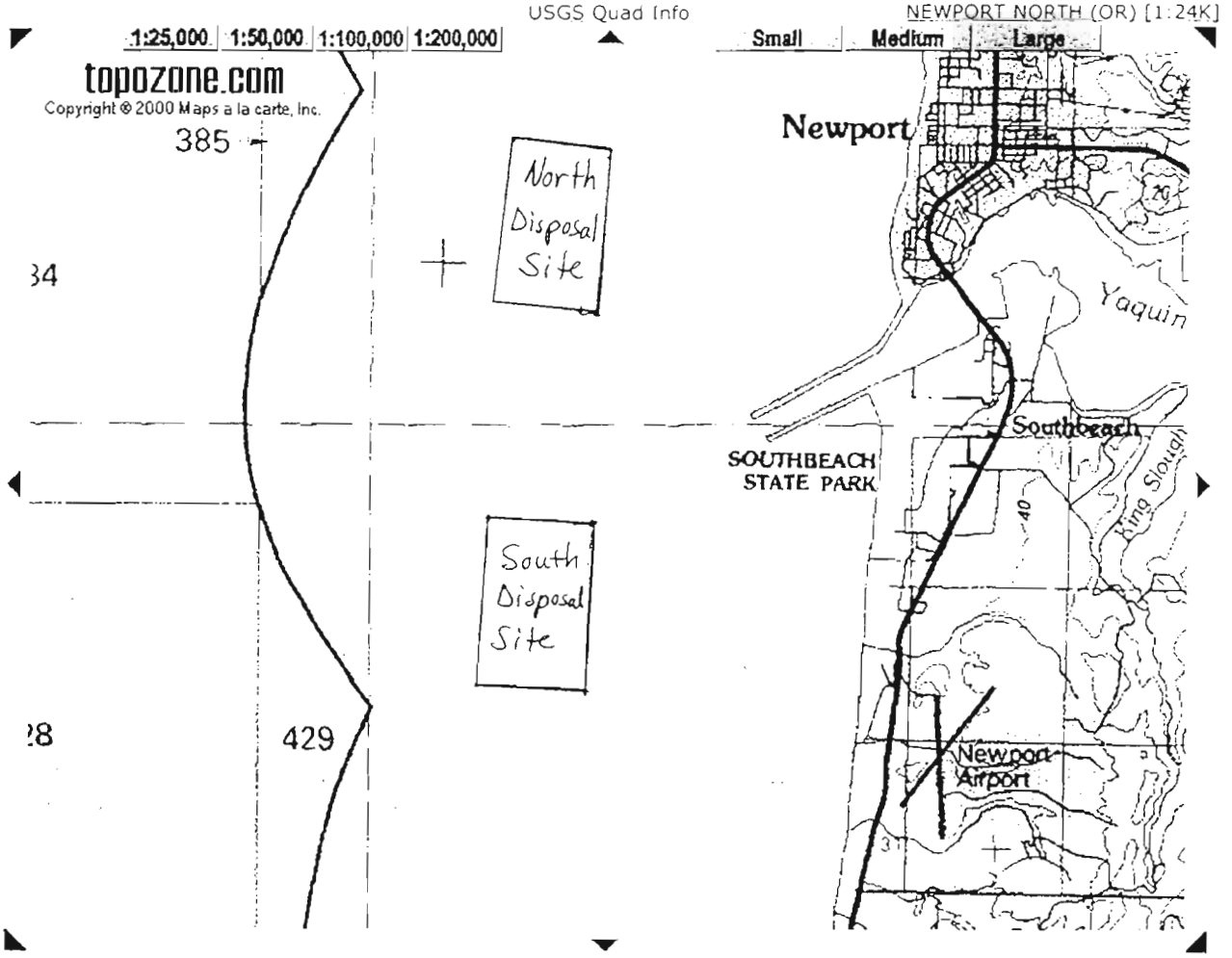
CENWP-PM-E Willis, Rader, Celmer)

**Map target is 44.6089°N, 124.1029°W - UTM Zone 10, N 4939880, E 412482**

Exact center of display is UTM Zone 10, N 4939284, E 412496

USGS Quad Info NEWPORT NORTH (OR) [1:24K]

1:25,000 | 1:50,000 | 1:100,000 | 1:200,000 | Small | Medium | Large




USGS Quad Info NEWPORT SOUTH (OR) [1:24K]

meters 0 2000 4000 6000 8000

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Take a look at our **Map Legend** for help with topographic map symbols

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Enclosure 1

# OFFSHORE DISPOSAL SITE INVESTIGATION
# NEWPORT, OREGON

## JULY 2000

Revision 1, September 11, 2000

PREPARED FOR:

US Army Corps of Engineers, Portland District
Portland, Oregon
Ph. (503) 808-4845

PREPARED BY:

WILLIAMSON & ASSOCIATES, INC.
4200 23RD Ave. W.
Seattle, WA 98199
Ph. (206) 285-8273

Enclosure 2

# OFFSHORE DISPOSAL SITE INVESTIGATION
# NEWPORT, OREGON

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Plate 6: Contemporary and Prior Survey Locations 1" = 1450' (1:17400)


## CD'S


CD 1: AutoCAD 14 DWGS for all plates
CD 2: TIFF images for all plates


WILLIAMSON

## 1.0 INTRODUCTION

The US Army Corps of Engineers contracted Williamson & Associates, Inc. to perform a sidescan sonar survey over two proposed disposal sites offshore of Yaquina Bay near Newport, Oregon. The objectives of the survey were to:

1. Conduct a sidescan sonar investigation of two offshore sites for possible disposal of material dredged from Yaquina Bay and associated entrance channel.
2. Interpret and identify the location and types of surface materials, geomorphologic features and cultural resources from the acquired Side Scan imagery.
3. Compare the contemporary survey to prior surveys

## 2.0 OPERATIONS

Prior to mobilization in Newport, the sidescan sonar equipment was delivered to Williamson's Seattle facility for testing and interfacing. The sonar would not operate properly on start-up and electrical technicians identified the problem to be a malfunctioning board in the surface unit and corrected the problem. Mobilization and fieldwork was conducted between July 17 and July 21, 2000. The EG&G sidescan sonar and ISIS acquisition equipment were installed on the ACOE survey vessel *HICKSON* at the South Beach Marina in Newport, Oregon on July 18, 2000. The EG&G surface unit for the EG&G 272-TD towfish and the ISIS image processing equipment were installed in the aft section of the pilot house. A 140 foot tow cable was supplied by the ACOE of which approximately 25 feet was required to run from the console to the tow point off the aft davit on the port side. The average water depth was 130 feet resulting in the total length of cable used for most of the survey for an average layback of 105.5 feet and an average sonar elevation of ~100 feet. The ACOE supplied sonar positioning using HYPACK 8.9 w/DGPS.

### 2.1 Survey Crew

The following personnel were present throughout all survey operations:

| | |
|---|---|
| Dick Gunsolus | Party Chief / ACOEPD |
| Mike Stecher | Survey Technician / Williamson & Associates, Inc. |
| Jim McElya | Intern / Williamson & Associates, Inc. |
| *HICKSON* Crew | ACOEPD |

### 2.2 Survey Equipment

The following is a list of all survey and navigation equipment used for this survey:

| | |
|---|---|
| EG&G Mark 1B (Model 260) | Sidescan sonar recorder/surface unit |
| EG&G 272-TD | 500/100 kHz sidescan towfish |
| Triton ISIS | Image Processing System |
| HyPAK 8.9 | Integrated Navigation System |
| Ashtech | DGPS |

## 3.0 SURVEY GRID

The two disposal site investigation areas to be surveyed were approximately three miles offshore of the Yaquina jetties. The following coordinates for the proposed disposal site locations are as follows:

Coordinates are in feet, State Plane, Oregon North Zone, NAD27:

| North Site | South Site |
|---|---|
| 1055278, 380139 | 1054334, 361654 |
| 1062210, 379165 | 1060301, 361027 |
| 1060679, 368272 | 1059465, 353071 |
| 1053747, 369246 | 1053497, 353698 |

Average water depth was calculated to be ~130 ft. with a gentle offshore slope trending east to west. Line plans were developed to parallel the N-S trending contours. The line plans were developed to provide a minimum of 100% coverage. An adequate line spacing to develop the two areas was determined to be 1000 ft. main scheme with 500 ft. splits at a 200m(656ft.) range scale setting.

## 4.0 INSTRUMENT SETTINGS

### 4.1 Sidescan Sonar

The EG&G 260 dual frequency sidescan sonar was supplied by the ACOEPD. The control settings of the sonar were set in the following manner:

| | |
|---|---|
| Frequncy | 100kHz |
| Port/Starboard Gain | 3 |
| Range Scale | 200m(656ft.) |

### 4.2 Triton ISIS

The analog sonar signals were input to a Triton ISIS image processing system where they were digitized as 16 bit pixels with 2048 pixels per channel. The ISIS also logged XY position sent over from the HyPak 8.9 navigation computer operated by ACOE personnel. All data logged on the ISIS system was stored on 1.2 GB optical disks.

### 4.4 HyPack

The navigation computer used Coastal Oceanographics HyPack 8.9 to log all positioning data. The system integrates DGPS and Digital Exchange Files (.DXF) developed in AutoCAD to display the vessel position relative to the survey area in real time. A helmsman monitor was used to display a left/right indicator to assist the coxswain in navigating the launch along the planned route. During post processing, sonar layback was calculated to be 105.5ft., which was applied to the imagery to correct positioning of the sonar location.

## 5.0 POSITIONING

### 5.1 Geodetic Parameters

-NAD 27, State plane, Oregon North Zone, US Survey feet

### 5.2 Differential Global Positioning System

-Supplied by ACOEPD

### 5.3 Tidal Corrections

N/A

## 6.0 DATA PROCESSING

The data sets were played back on the ISIS from the optical disks. The first step was to play each line and smooth the navigation using the "smooth-nav" feature of the mosaicking program in ISIS. Each line was then individually inspected and gridded to the proper datum at a resolution of 0.5 meters. Each image was then exported to Delphmap and converted into a GeoTiff format. Each line was imported and tiled in AutoCAD14 and corrected for the layback positioning. Charts were created using "real world coordinates" and scaled to a proper size.

## 7.0 DATA INTERPRETATION

The sonar data was processed and mosaicked to produce an acoustic image of the seafloor in the survey area. The image shows minimal features except along the eastern edge of the Southern site where the bedrock structure has been exposed from the overlying sediments. Some gravel deposits with a higher reflectivity (darker) are dispersed throughout both sites. The general seafloor characteristics consist of the fairly homogenous materials of unconsolidated sediments consisting of fine to medium sand/silt as found in the prior survey (Geo Recon International '95), and the contemporary survey.

Bedrock exposure in the surveyed area has been previously defined as the Astoria Formation (Geo Recon International '95), which consists of marine sandstones and sandy siltstones of the middle Miocene age. The bedrock exhibits a north-northeast trending strike defined by apparent channels of sand/silt and erosion resistant rock "ridges". These resistant rock ridges and sand channels probably correlate to the sandstones interbedded with the less resistant sandy siltstones found in the Astoria Formation.

The locations of exposed bedrock differ between the prior, and contemporary surveys in the Northern site. The Northern site investigation indicates no exposure of the underlying bedrock, whereas the prior investigations indicate exposure along the southeastern survey limit. This could be due to the shifting of sediments with seasonal variations in sea state and current velocity, or positioning errors related to the technology used at that time.

The Southern investigation site agrees with the prior survey depicting bedrock exposure on the eastern survey limit however, the extent of exposure appears greater on the contemporary survey. A corridor of approximately 1045 feet wide of exposed bedrock exists along the entire eastern limit.

The reflectivity of unconsolidated bottom sediments is used to determine whether or not the sediments are sands, silts or gravel. Fine sand/silt reflects far less acoustic energy than gravel for a given gain level. The difference in reflectivity appears on the mosaic as light (silt) to dark (gravel) bottom.

The depositional environment on the sea floor seems to be active, this is indicated by the changes in the bedrock exposure limits indicated from the prior Geo Recon '95, and this contemporary survey. Seasonal variations of sediment transport/accumulation are typical for near shore ocean environments as a result of longshore currents.

There were no obvious shipwrecks found in the data, either above bottom or partially buried in the unconsolidated sediments. No other cultural resources, other than the mooring block from a buoy located at the northern end of the Southern area, were identified during this survey.

# APPENDIX E
# CULTURAL RESOURCES

Enclosure 3

APPENDIX E
CULTURAL RESOURCES
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## Introduction

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 areas of primary concern are two rectangular disposal sites located off the ship channel on the ocean side of the Yaquina Bar (see Figure E-1). 4 E-2

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

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 . 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, ethnographical known Native Americans[4],[5] (for comparison with the Coos Bay Indians see Simons)6.

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

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

## 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.

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.

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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.

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.

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 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

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.

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 use of these disposal sites.

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; Fogary, 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 (Fate of Wreck) | Reference |
|---|---|---|---|---|
| Early 1849 | Unknown | Chinese silk-cargo salvaged by Indian & 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. |

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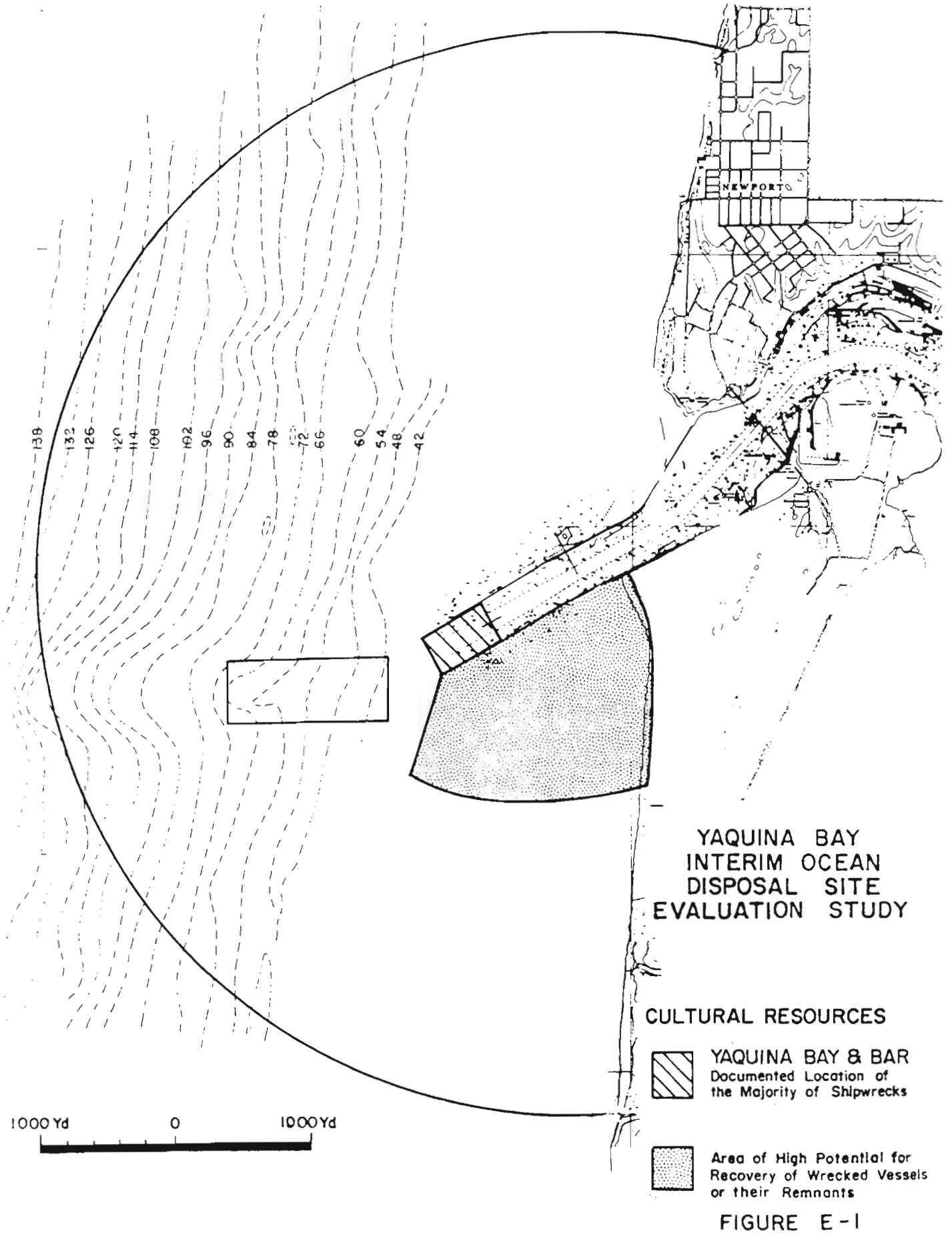
NEWPORT
138
132
126
120
114
108
102
96
90
84
78
72
66
60
54
48
42
YAQUINA BAY
INTERIM OCEAN
DISPOSAL SITE
EVALUATION STUDY
CULTURAL RESOURCES
YAQUINA BAY & BAR
Documented Location of
the Majority of Shipwrecks
Area of High Potential for
Recovery of Wrecked Vessels
or their Remnants
1000 Yd
0
1000 Yd

FIGURE E-1

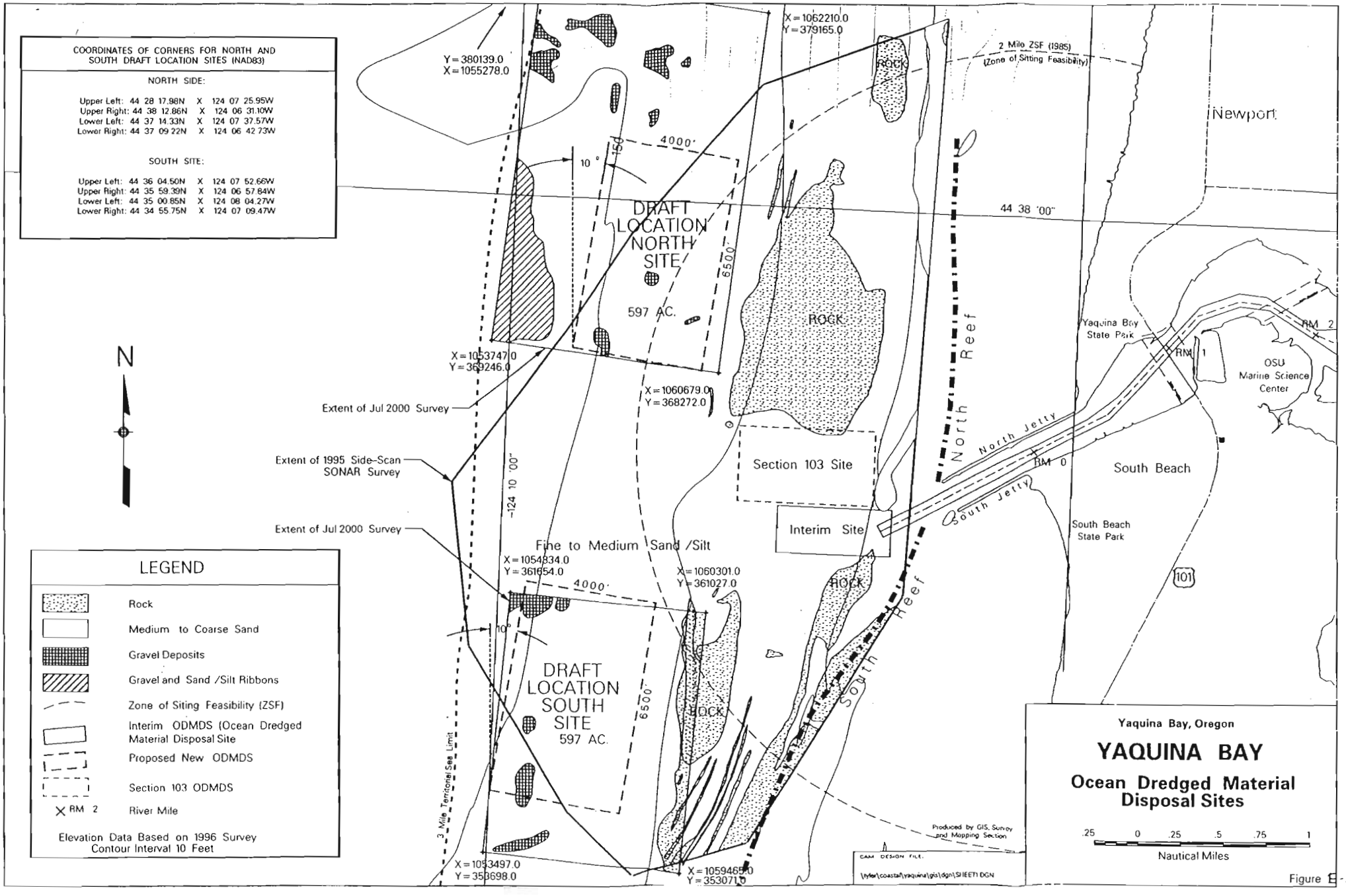
COORDINATES OF CORNERS FOR NORTH AND SOUTH DRAFT LOCATION SITES (NAD83)
NORTH SIDE:
Upper Left: 44 28 17.98N X 124 07 25.95W
Upper Right: 44 38 12.86N X 124 06 31.10W
Lower Left: 44 37 14.33N X 124 07 37.57W
Lower Right: 44 37 09.22N X 124 06 42.73W
SOUTH SITE:
Upper Left: 44 36 04.50N X 124 07 52.66W
Upper Right: 44 35 59.39N X 124 06 57.84W
Lower Left: 44 35 00.85N X 124 08 04.27W
Lower Right: 44 34 55.75N X 124 07 09.47W
N
LEGEND
Rock
Medium to Coarse Sand
Gravel Deposits
Gravel and Sand /Silt Ribbons
Zone of Siting Feasibility (ZSF)
Interim ODMDS (Ocean Dredged Material Disposal Site
Proposed New ODMDS
Section 103 ODMDS
RM 2 River Mile
Elevation Data Based on 1996 Survey
Contour Interval 10 Feet
Y=380139.0
X=1055278.0
X=1062210.0
Y=379165.0
2 Mile ZSF (1985)
(Zone of Siting Feasibility)
Newport
4000'
10°
150
DRAFT LOCATION NORTH SITE
597 AC.
6500'
ROCK
44 38 '00"
X=1053747.0
Y=369246.0
X=1060679.0
Y=368272.0
Extent of Jul 2000 Survey
Extent of 1995 Side-Scan SONAR Survey
Extent of Jul 2000 Survey
-124 10 '00"
Section 103 Site
Interim Site
North Reef
North Jetty
South Jetty
South Reef
Yaquina Bay State Park
RM 2
RM 1
RM 0
OSU Marine Science Center
South Beach
South Beach State Park
101
Fine to Medium Sand /Silt
X=1054834.0
Y=361654.0
X=1060301.0
Y=361027.0
DRAFT LOCATION SOUTH SITE
597 AC.
3 Mile Territorial Sea Limit
X=1053497.0
Y=353698.0
X=1059465.0
Y=353071.0
Produced by GIS, Survey and Mapping Section
CAM DESIGN FILE
\tyler\coastal\yaquina\gis\dgn\SHEET1.DGN
Yaquina Bay, Oregon
YAQUINA BAY
Ocean Dredged Material Disposal Sites
.25 0 .25 .5 .75 1
Nautical Miles

Figure E-2

ATTACHMENT E-A2

Oregon
John A. Kitzhaber, M.D., Governor

**Parks and Recreation Department**
State Historic Preservation Office
1115 Commercial St. NE
Salem, OR 97301-1012
(503) 378-4168
FAX (503) 378-6447

February 5, 2001

Robert E. Willis
Portland Corps of Engineers
P O Box 2946
Portland OR 97208-2946

RE: Yaquina Bay Ocean Disposal
Sidescan Sonar Record
Lincoln County

Dear Mr Willis:

Based on the negative sonar study done by Williamson & Associates, we concur that the proposed disposal areas of the project will have 'no effect" on sites on, or eligible for inclusion on, the National Register of Historic Places.

If you have any questions, you can contact me at (503) 378-4168 x 232.

Sincerely,

Leland Gilsen
SHPO Archeologist

# APPENDIX F

## Comments and Coordination

# APPENDIX F
## COMMENTS AND COORDINATION

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| Paragraph | Page No. |
|---|---|
| Comments | F-1 |
| Coordination | F-1 |

## Comments and Coordination

### Comments

This proposed federal action requires concurrence or consistency for the following federal laws from the responsible agencies as indicated below.

| | |
|---|---|
| * Marine Protection, Research and Sanctuaries Act | U.S. Environmental Protection Agency |
| * Endangered Species Act of 1973, as amended | U.S. Fish & Wildlife Service<br>National Marine Fisheries Service |
| * National Historic Preservation Act of 1966, as amended | State Historic Preservation Officer |
| * Coastal Zone Management Act of 1972, as amended | Oregon Department of Land Conservation and Development |
| * Clean Water Act of 1977, as amended | Oregon Dept. of Environmental Quality |

Consistency or concurrence letters from the above listed agencies are included in this appendix or will be obtained prior to use of the sites. State water quality certification, required by Section 401 of the Clean Water Act, will be obtained for individual disposal actions.

### Coordination

Procedures used in this evaluation and the proposed use of the adjusted new sites has been Coordinated with the following State and Federal agencies:

- Oregon Department of Fish and Wildlife
- Oregon Department of Environmental Quality
- Oregon Department of Land Conservation and Development
- Oregon Division of State Lands
- U.S. Fish and Wildlife Service
- National Marine Fisheries Service

This evaluation was issued to Federal, State, and local agencies, private groups, and individuals for a 30-day public review. No adverse comments were received in response to this public notice. Formal notice will also be carried out by the EPA during the final site designation process. Coordination letters received in response to the public notice are included in this appendix.

**Marine Protection, Research, and Sanctuaries Act of 1972, as amended**

**U.S. Environmental Protection Agency**

**Concurrence**

**UNITED STATES ENVIRONMENTAL PROTECTION AGENCY**
**REGION 10**
1200 Sixth Avenue
Seattle, Washington 98101

July 19, 2001

Reply To
Attn Of: ECO-083

Steven J. Stevens
U.S. Army Corps of Engineers
PO Box 2946
Portland, OR 97208-2946

RE: CENWP-PM-E-01-06, dated May 17, 2001, Yaquina Bay Ocean Disposal Site Selection and Use, Lincoln County, Oregon - Final Concurrence

Dear Mr. Stevens:

This letter supplements our letter of June 4, 2001 regarding the subject public notice for selection and use of Ocean Dredged Material Disposal Sites (ODMDS) offshore of Yaquina Bay, Oregon. In our June 4th letter, EPA requested that additional information be provided and requested that the Corps provide an extension for our concurrence. In subsequent conversations with the Corps, the Corps agreed that the extension was appropriate while the requested information was packaged. That package was provided to us June 28, 2001 and EPA considers the application package complete.

EPA has completed our review of the proposal, including letters commenting on the proposal, and hereby provide concurrence as required under the Marine Protection, Research, and Sanctuaries Act of 1972, as amended, (MPRSA). In the next several weeks, we and you will continue to coordinate closely to on EPA's Draft Rule for site designation pursuant to §102 of the MPRSA. EPA anticipates publication of the Draft Rule in the Federal Register in early August and publication of the Final Rule this fall. Official designation becomes effective 30-days after publication of the Final Rule. Our concurrence for this §103 action by the Corps will be effective until official designation of the ODMDS, at which time all conditions of site use will be governed by EPA's §102 action.

All coordination with regard to this matter should be referred to John Malek, Ocean Dumping Coordinator, telephone (206) 553-1286, e-mail: malek.john@epa.gov.

Sincerely,

John Malek

John Malek
Ocean Dumping Coordinator

# Endangered Species Act of 1973, as amended

## U.S. Fish and Wildlife Service

## Coordination

**DEPARTMENT OF THE ARMY**
PORTLAND DISTRICT, CORPS OF ENGINEERS
P.O. BOX 2946
PORTLAND, OREGON 97208-2946

Reply to
Attention of:

JUL 2 3 2001

Planning, Programs and Project Management Division

Mr. Kemper McMaster
Field Supervisor
U.S. Fish and Wildlife Service
2600 SE 98th, Suite 100
Portland, OR 97266

Dear Mr. McMaster:

Pursuant to the requirements of the Endangered Species Act, we are providing a biological assessment that addresses threatened and endangered species that may occur in the vicinity of two proposed sites for ocean disposal of materials dredged from Yaquina Bay near Newport, Oregon.

The proposed action involves selection and use of two 597-acre sites that are located approximately 2.5 miles offshore. The Service, per letter to the Corps dated March 14, 2001 listed Marbled Murrelet and Brown Pelican as threatened and endangered species that could potentially occur on the project site. Marine mammals and turtles that were on the list were addressed in a separate biological assessment submitted to the National Marine Fisheries Service.

We have determined that the proposed action may affect but would not likely adversely affect the listed species addressed in the biological assessment. We would appreciate a response from the Service regarding our determinations for our records. An e-mail would suffice.

If you have any questions, or need further information concerning this project, please contact Steve Helm of my staff at 503-808-4778 or e-mail at steve.r.helm@usace.army.mil.

Sincerely,

Robert E. Willis
Chief, Environmental Resources Branch

Enclosure

Copies Furnished:
CENWP-PM-E (Steve Stevens)
CENWP-PM-E (Steve Helm)

# BIOLOGICAL ASSESSMENT

# FOR

# MARBLED MURRELET AND BROWN PELICAN

# FOR

# SELECTION AND USE OF TWO DREDGED MATERIAL OCEAN DISPOSAL SITES

# NEWPORT, OREGON

## BACKGROUND AND PROJECT DESCRIPTION

Yaquina River enters the Pacific Ocean near the city of Newport, Oregon, approximately 115 miles south of the Columbia River. The Corps of Engineers, Portland District has been responsible for maintenance of navigable waterways of the North Pacific Coast since 1871. The need for improved navigation controls in the Yaquina Bay estuary began with the founding of a port city at Yaquina. Because of the navigation need, two jetties were constructed in 1896, and Congress authorized dredging in the Bay in 1919. Dredging was authorized to provide an entrance channel, decrease tide-caused delays for commercial ships crossing the bar, provide improved safety, provide mooring facilities, permit barge and small boat traffic upstream to river mile 14, and provide a harbor of refuge.

Rough seas encountered at the Yaquina Bay entrance preclude the safe and efficient operation of any dredge other than a hopper dredge. Upland disposal of dredged material from a hopper dredge operation is not economical due to the need to double handle the material and sufficient upland capacity is unavailable. Disposal of material dredged from Yaquina Bay, therefore, must occur at an in-water site. Before 1977, dredged material from Yaquina Bay was placed in the general vicinity of the proposed sites and sites used since 1977. Between 1977 and 1986, dredged material was disposed of at the EPA Interim disposal site (see attached map). Because of navigational safety concerns resulting from increased mounding at the Interim site, the Corps selected an alternate site under its Section 103 authority (see attached map) and most material dredged from the Bay since 1986 has been placed there.

The proposed project involves selection and use of two Ocean Dredged Material Disposal Sites (ODMDSs) (see attached map) for redistribution of sediments from the Yaquina Bay project. The availability of ODMDSs in the vicinity of Yaquina Bay is necessary to maintain safe deep-draft navigation through authorized federal channels. These sites each would have disposal capacity for approximately 20 years. The Corps and EPA have prepared a draft evaluation study and environmental assessment (USACOE 2001) to describes the conditions at the Interim, Section 103, and the two proposed ODMDSs.

This document also details compliance of the ODMDSs with the Marine Protection, Research and Sanctuaries Act of 1972, the National Environmental Policy Act of 1969, the Endangered Species Act of 1973, the National Historic Preservation Act of 1966, and the Coastal Zone Management Act of 1972 (all as amended).

Since 1986, an annual average of 313,600 cubic yards of material has been dredged from the Yaquina Bay Federal Navigation Project. Future volumes are expected to remain relatively constant. The existing Section 103 site has experienced mounding, generating a potentially hazardous navigation safety condition, and has limited capacity to receive future dredge material disposals. Commercial shippers, crab fishermen, and the U.S. Coast Guard expressed concern over this situation to both the Corps and EPA. Efforts were undertaken by the federal government to temporarily expand existing sites in 1998 and to manage distribution of the maintenance dredged material within the available site while seeking a more permanent management solution. Ocean dumping is necessary to maintain the Yaquina Bay project, thereby allowing continued commercial use of the existing navigation channel at its authorized depth.

The proposed disposal sites are located approximately 2.5 miles offshore and are characterized by water depths of 120-150 feet (see attached map). The coordinates of the corners of the north site are as follows:

| Latitude | | | Longitude | | |
|---|---|---|---|---|---|
| 44° | 38' | 17.98" N | 124° | 07' | 25.95" W |
| 44° | 38' | 12.86" N | 124° | 06' | 31.10" W |
| 44° | 37' | 14.33" N | 124° | 07' | 37.57" W |
| 44° | 37' | 09.22" N | 124° | 06' | 42.73" W |

The coordinates of the corners of the south site are as follows:

| Latitude | | | Longitude | | |
|---|---|---|---|---|---|
| 44° | 36' | 04.50" N | 124° | 07' | 52.66" W |
| 44° | 35' | 59.39" N | 124° | 06' | 57.84" W |
| 44° | 35' | 00.85" N | 124° | 08' | 04.27" W |
| 44° | 34' | 55.75" N | 124° | 07' | 09.47" W |

The two sites are of equal size, each with and area of 597 acres (4,000 feet by 6,500 feet).

## BIOLOGICAL ASSESSMENTS

### MARBLED MURRELETS

**Occurrence and Discussion:** The marbled murrelet (*Brachyramphus marmoratus*) (threatened) is a permanent resident in Oregon coastal waters and occur in the vicinity of the proposed project site. Strong et al. (1993) reported that murrelets tend to occur in patches that vary in location on a daily basis. Highest densities of murrelets were recorded off beach and mixed beach-rocky shoreline, but to a lesser extent off river

mouths. Murrelet abundance was most prevalent within 500 m of shore and abundance decreased by 50 percent beyond 500 m and was reduced to 10 percent of nearshore levels 1200 m offshore. Fledglings were never abundant in the 94-km reach of nearshore waters between Newport and Florence (Strong et. al 1993). Foraging typically occurs within 500 meters of shore (Marshall 1988). For these reasons, it is expected that marbled murrelet use of the proposed project site would be infrequent.

Strong et al. (1993) reported that marbled murrelets were sensitive to the presence of vessels and that almost all responses, i.e., flight or diving occurred less than 50 m from the vessel. Dredging vessels travelling to and from Yaquina Bay will pass through the nearshore area where marbled murrelets may occur but passage of vessels would probably have to be within 50 m of marbled murrelets to result in flight or diving by an individual bird and murrelets would be expected to return to their normal offshore activities quickly after passage of the vessel. Recreational and commercial boating traffic is common off Yaquina Bay.

Use of the site would result in entrainment of some sand lance, the primary food resource for marbled murrelets. Sand lance commonly burrow in unconsolidated sandy substrates and occur in waters less than 100 m deep (Trumble 1973 in Emmett et al. 1991). Offshore habitat and prey resources, however, are not considered limiting factors for marbled murrelet populations. Marbled murrelets nest in old growth coniferous forests and the low incidence of occurrence at coastal locations is thought to be related to the loss of old growth coniferous forests (Fed. Reg. 1991).

**Conclusion:** Because the proposed project site occurs farther offshore than murrelets typically forage and because the proposed project would not impact resources that are limiting factors to murrelet populations, the proposed action may affect but is not likely to adversely affect marbled murrelets.

**BROWN PELICAN**

**Occurrence and Discussion:** The brown pelican (*Pelicanus occidentalis*) (endangered) occur in the Yaquina River entrance and associated nearshore waters. Their presence at this location on the Oregon Coast occurs after nesting on islands off the coast of southern California and western Mexico and may occur from April through September with occasional birds staying well into the fall or early winter. Peak numbers occur from late August through October (Gilligan et al. 1994). Pelicans have been observed loafing on the jetties and nearby beaches and foraging in the Yaquina River entrance and nearshore waters. Observations indicate that the species has habituated to the intensive recreational and commercial boating use this area receives. They would be expected to occur as post-breeding dispersers in the vicinity of the proposed project site. The proposed action will not preclude foraging activities by this species in the project area as they are habituated to human activity at this location.

**Conclusion:** Because the project will not impact foraging activities of pelicans and because they would only occur as post-breeding dispersers, the proposed action may

affect but is not likely to adversely affect brown pelicans.

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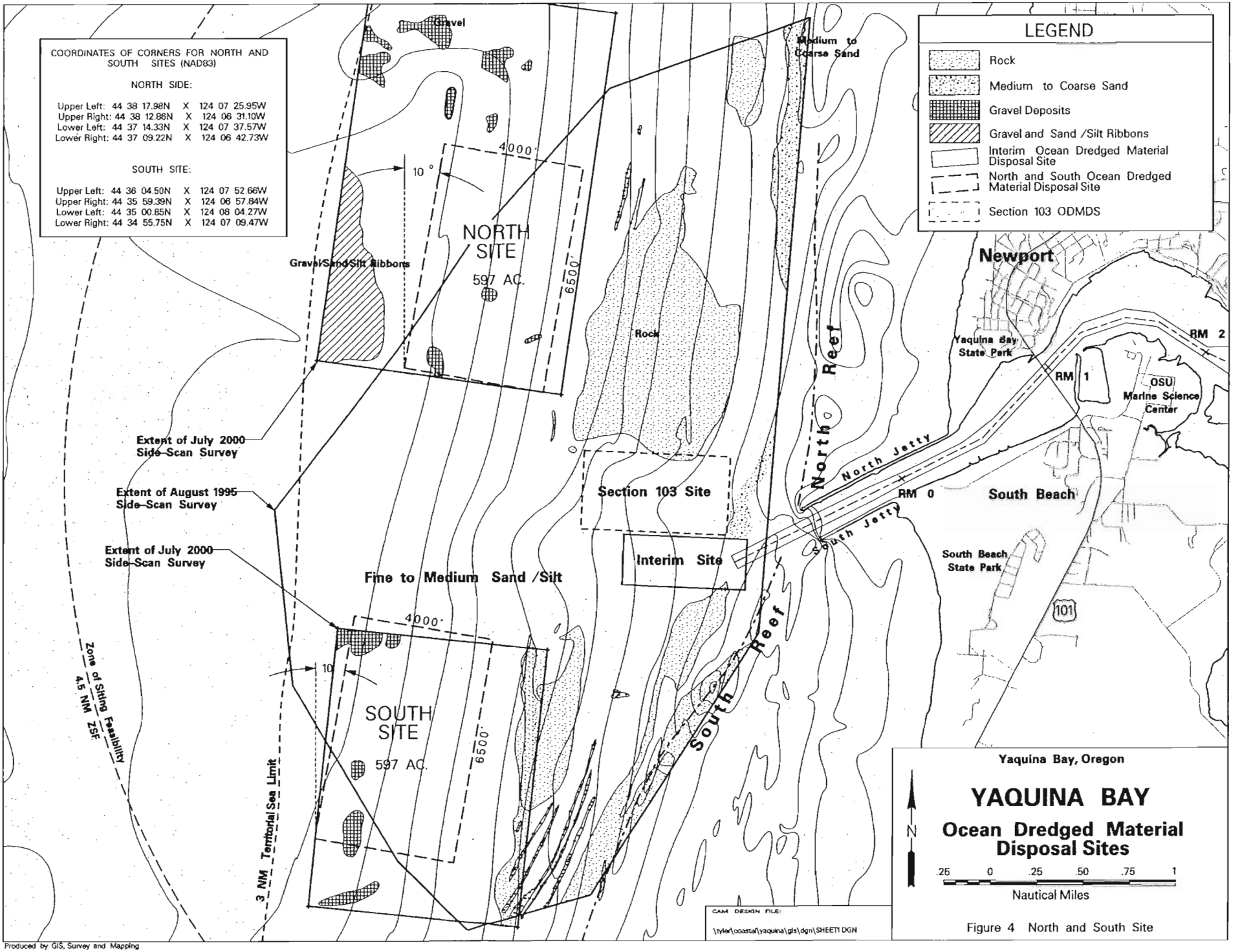


Figure 4 North and South Site

Produced by GIS, Survey and Mapping

# United States Department of the Interior

**FISH AND WILDLIFE SERVICE**
**Oregon Fish and Wildlife Office**
**2600 S.E. 98th Avenue, Suite 100**
**Portland, Oregon 97266**
**(503) 231-6179 FAX: (503) 231-6195**


Reply To: 8330.3001(01)
File Name: Sp300.wpd
OALS: 01-1167

March 14, 2001

Robert E. Willis
U.S. Army Corps of Engineers
P.O. Box 2946
Portland, OR 97208-2946

Subject: Yaquina Bay Dredge Spoils Sites Project (1-7-01-SP-300).

Dear Mr. Willis:

This is in response to your letter, dated February 7, 2001, requesting information on listed and proposed endangered and threatened species that may be present within the area of the Yaquina Bay Dredge Spoils Sites in Lincoln County. The U.S. Fish and Wildlife Service (Service) received your letter on February 13, 2001.

We have attached a list (Attachment A) of threatened and endangered species that may occur within the area of the Yaquina Bay Dredge Spoils Sites. The list fulfills the requirement of the Service under section 7(c) of the Endangered Species Act (Act) of 1973, as amended (16 U.S.C. 1531 *et seq.*). U.S. Army Corps of Engineers (COE) requirements under the Act are outlined in Attachment B.

The purpose of the Act is to provide a means whereby threatened and endangered species and the ecosystems on which they depend may be conserved. Under section 7(a)(1) and 7(a)(2) of the Act and pursuant to 50 CFR 402 *et seq.*, COE is required to utilize their authorities to carry out programs which further species conservation and to determine whether projects may affect threatened and endangered species, and/or critical habitat. A Biological Assessment is required for construction projects (or other undertakings having similar physical impacts) which are major Federal actions significantly affecting the quality of the human environment as defined in NEPA (42 U.S.C. 4332 (2)(c)). For projects other than major construction activities, the Service suggests that a biological evaluation similar to the Biological Assessment be prepared to determine whether they may affect listed and proposed species. Recommended contents of a Biological Assessment are described in Attachment B, as well as 50 CFR 401.12.

If COE determines, based on the Biological Assessment or evaluation, that threatened and endangered species and/or critical habitat may be affected by the project, COE is required to consult with the Service following the requirements of 50 CFR 402 which implement the Act.

Attachment A includes a list of candidate species under review for listing. The list reflects changes to the candidate species list published October 25, 1999, in the Federal Register (Vol. 64, No. 205, 57534) and the addition of "species of concern." Candidate species have no protection under the Act but are included for consideration as it is possible candidates could be listed prior to project completion. Species of concern are those taxa whose conservation status is of concern to the Service (many previously known as Category 2 candidates), but for which further information is still needed.

If a proposed project may affect candidate species or species of concern, COE is not required to perform a Biological Assessment or evaluation or consult with the Service. However, the Service recommends addressing potential impacts to these species in order to prevent future conflicts. Therefore, if early evaluation of the project indicates that it is likely to adversely impact a candidate species or species of concern, COE may wish to request technical assistance from this office.

Your interest in endangered species is appreciated. The Service encourages COE to investigate opportunities for incorporating conservation of threatened and endangered species into project planning processes as a means of complying with the Act. If you have questions regarding your responsibilities under the Act, please contact Cindy Bright or Laura Todd at (503) 231-6179. For questions regarding anadromous fish, please contact National Marine Fisheries Service, 525 NE Oregon Street, Suite 500, Portland, Oregon 97232, (503) 230-5400. All correspondence should include the above referenced file number.

Sincerely,

Nancy K. Lee

for Kemper M. McMaster
State Supervisor

Attachments
SP 300
cc: OFWO-ES
ODFW (nongame)

ATTACHMENT A

# FEDERALLY LISTED AND PROPOSED ENDANGERED AND THREATENED SPECIES, CANDIDATE SPECIES AND SPECIES OF CONCERN THAT MAY OCCUR WITHIN THE AREA OF THE YAQUINA BAY DREDGE SPOILS SITES 1-7-01-SP-300

## LISTED SPECIES[1/]

| | | |
|---|---|---|
| **Mammals** | | |
| Right whale | *Balaena (=Eubalaena) glacialis* | E** |
| Sei whale | *Balaenoptera borealis* | E** |
| Blue whale | *Balaenoptera musculus* | E** |
| Finback whale | *Balaenoptera physalus* | E** |
| Steller (=northern) sea lion | *Eumetopias jubatus* | T** |
| Sperm whale | *Physeter macrocephalus* | E** |
| **Birds** | | |
| Marbled murrelet | *Brachyramphus marmoratus* | CH T |
| Brown pelican | *Pelicanus occidentalis* | E |
| **Amphibians and Reptiles** | | |
| Loggerhead sea turtle | *Caretta caretta* | T** |
| Green sea turtle | *Chelonia mydas* | T** |
| Leatherback sea turtle | *Dermochelys coriacea* | CH E** |
| Olive (=Pacific) ridley sea turtle | *Lepidochelys olivacea* | T** |
| **Fish** | | |
| Coho salmon (Oregon Coast)[2/] | *Oncorhynchus kisutch* | **T |

## PROPOSED SPECIES

None

## CANDIDATE SPECIES

| | | |
|---|---|---|
| **Fish** | | |
| Steelhead (Oregon Coast)[3/] | *Oncorhynchus mykiss* | **CF |

## SPECIES OF CONCERN

| | |
|---|---|
| **Fish** | |
| Green sturgeon | *Acipenser medirostris* |
| River lamprey | *Lampetra ayresi* |
| Pacific lamprey | *Lampetra tridentata* |
| Coastal cutthroat trout (Oregon Coast) | *Oncorhynchus clarki clarki* |

*(E) - Listed Endangered* *(T) - Listed Threatened* *(CH) - Critical Habitat has been designated for this species*
*(PE) - Proposed Endangered* *(PT) - Proposed Threatened* *(PCH) - Critical Habitat has been proposed for this species*

*Species of Concern - Taxa whose conservation status is of concern to the Service (many previously known as Category 2 candidates), but for which further information is still needed.*

*(CF) - Candidate: National Marine Fisheries Service designation for any species being considered by the Secretary for listing for endangered or threatened species, but not yet the subject of a proposed rule.*

*** Consultation with National Marine Fisheries Service required.*

*1/ U. S. Department of Interior, Fish and Wildlife Service, December 31, 1999, Endangered and Threatened Wildlife and Plants, 50 CFR 17.11 and 17.12*

*2/ Federal Register Vol. 63, No. 153, August 10, 1998, Final Rule-Oregon Coast Coho Salmon*

*3/ Federal Register Vol. 63, No. 53, March 19, 1998, Final Rule-West Coast Steelhead*

ATTACHMENT B

FEDERAL AGENCIES RESPONSIBILITIES UNDER SECTION 7(a) and (c) OF THE ENDANGERED SPECIES ACT

**SECTION 7(a)-Consultation/Conference**

Requires:

1) Federal agencies to utilize their authorities to carry out programs to conserve endangered and threatened species;

2) Consultation with FWS when a Federal action may affect a listed endangered or threatened species to insure that any action authorized, funded or carried out by a Federal agency is not likely to jeopardize the continued existence of listed species or result in the destruction or adverse modification of Critical Habitat. The process is initiated by the Federal agency after they have determined if their action may affect (adversely or beneficially) a listed species; and

3) Conference with FWS when a Federal action is likely to jeopardize the continued existence of a proposed species or result in destruction or adverse modification of proposed Critical Habitat.

**SECTION 7(c)-Biological Assessment for Major Construction Projects**[1]

Requires Federal agencies or their designees to prepare a Biological Assessment (BA) for construction projects only. The purpose of the BA is to identify proposed and/or listed species which are/is likely to be affected by a construction project. The process is initiated by a Federal agency in requesting a list of proposed and listed threatened and endangered species (list attached). The BA should be completed within 180 days after its initiation (or within such a time period as is mutually agreeable). If the BA is not initiated within 90 days of receipt of the species list, the accuracy of the species list should be informally verified with our Service. No irreversible commitment of resources is to be made during the BA process which would foreclose reasonable and prudent alternatives to protect endangered species. Planning, design, and administrative actions may be taken; however, no construction may begin.

To complete the BA, your agency or its designee should: (1) conduct and on-site inspection of the area to be affected by the proposal which may include a detailed survey of the area to determine if the species is present and whether suitable habitat exists for either expanding the existing population or for potential reintroduction of the species; (2) review literature and scientific data to determine species distribution, habitat needs, and other biological requirements; (3) interview experts including those within FWS, National Marine Fisheries Service, State conservation departments, universities, and others who may have data not yet published in scientific literature; (4) review and analyze the effects of the proposal on the species in terms of individuals and populations, including consideration of cumulative effects of the proposal on the species and its habitat; (5) analyze alternative actions that may provide conservation measures and (6) prepare a report documenting the results, including a discussion of study methods used, nay problems encountered, and other relevant information. The BA should conclude whether or not a listed species will be affected. Upon completion, the report should be forwarded to our Portland Office.

---

[1]A construction project (or other undertaking having similar physical impacts) which is a major Federal action significantly affecting the quality of the human environment as referred to in NEPA (42 U.S.C. 4332. (2)c). On projects other that construction, it is suggested that a biological evaluation similar to the biological assessment be undertaken to conserve species influenced by the Endangered Species Act.

DEPARTMENT OF THE ARMY
PORTLAND DISTRICT, CORPS OF ENGINEERS
P.O. BOX 2946
PORTLAND, OREGON 97208-2946

Reply to
Attention of:

FEB 0 7 2001

Planning, Programs and Project Management Division

Mr. Kemper McMaster
Field Supervisor
U.S. Fish and Wildlife Service
2600 SE 98th, Suite 100
Portland, OR 97266

Dear Mr. McMaster:

Pursuant to the requirements of the Endangered Species Act, we are requesting a list of threatened and endangered species, which may occur approximately two miles offshore of Newport, Lincoln County, Oregon. The areas of interest are two 597-acre sites denoted as "Draft Location North Site" and "Draft Location South Site" on the enclosed map. Latitude and longitude coordinates for these sites are identified on the map.

The proposed work entails long-term periodic placement of dredge spoils from Yaquina Bay.

If you have any questions, or need further information concerning this project, please contact Steve Helm of my staff at 503-808-4778 or e-mail at steve.r.helm@usace.army.mil.

Sincerely,

Robert E. Willis
Chief, Environmental Resources
Branch

Enclosure

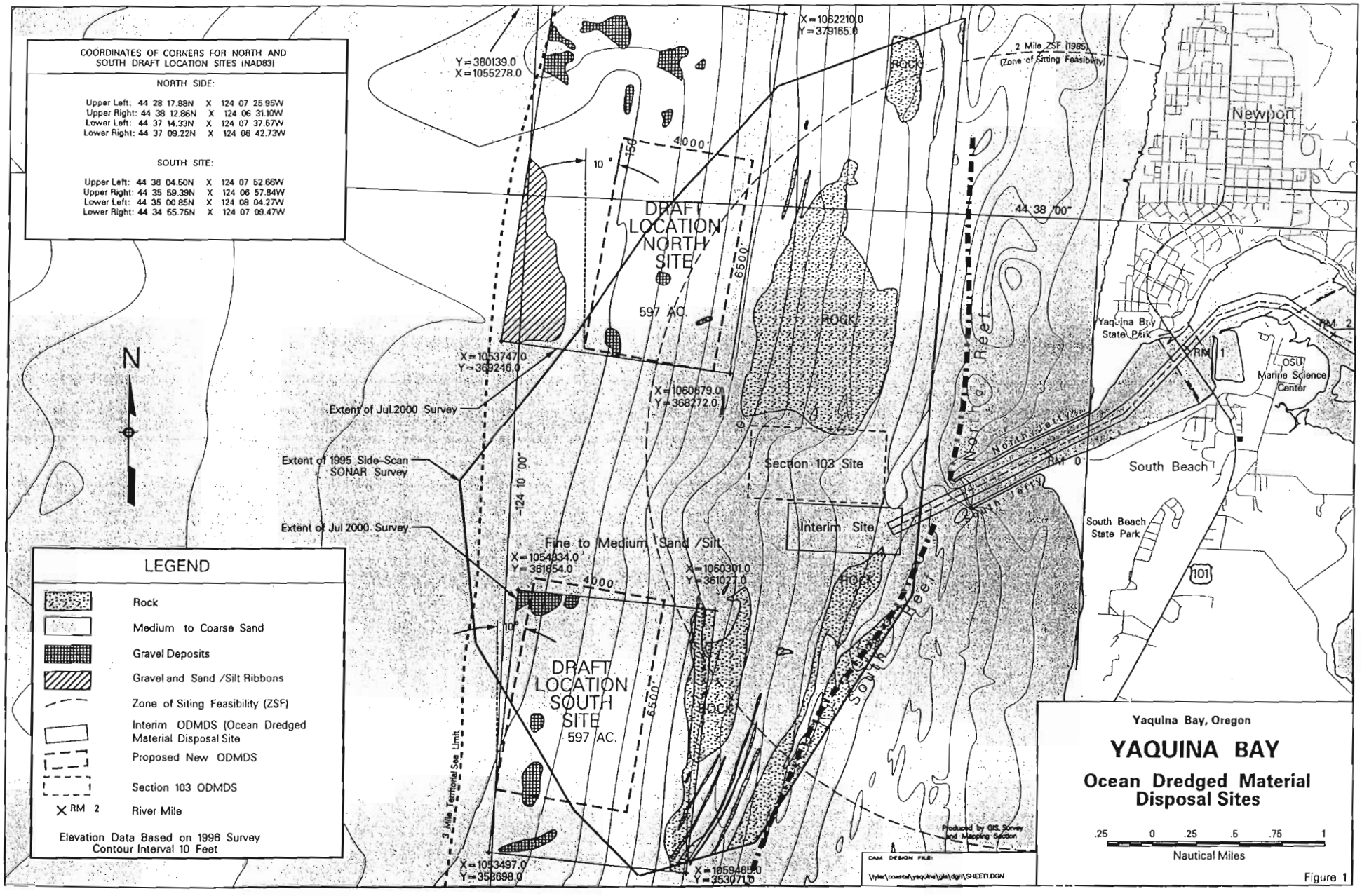
COORDINATES OF CORNERS FOR NORTH AND SOUTH DRAFT LOCATION SITES (NAD83)
NORTH SIDE:
Upper Left: 44 28 17.98N X 124 07 25.95W
Upper Right: 44 38 12.86N X 124 06 31.10W
Lower Left: 44 37 14.33N X 124 07 37.57W
Lower Right: 44 37 09.22N X 124 06 42.73W
SOUTH SITE:
Upper Left: 44 36 04.50N X 124 07 52.66W
Upper Right: 44 35 59.39N X 124 06 57.84W
Lower Left: 44 35 00.85N X 124 08 04.27W
Lower Right: 44 34 55.75N X 124 07 09.47W
N
LEGEND
Rock
Medium to Coarse Sand
Gravel Deposits
Gravel and Sand /Silt Ribbons
Zone of Siting Feasibility (ZSF)
Interim ODMDS (Ocean Dredged Material Disposal Site
Proposed New ODMDS
Section 103 ODMDS
RM 2 River Mile
Elevation Data Based on 1996 Survey
Contour Interval 10 Feet
Y=380139.0
X=1055278.0
X=1052210.0
Y=379165.0
2 Mile ZSF (1985)
(Zone of Siting Feasibility)
Newport
ROCK
4000'
10°
156
DRAFT LOCATION NORTH SITE
597 AC.
6500'
44 38 00"
X=1053747.0
Y=369246.0
X=1060679.0
Y=368272.0
Extent of Jul 2000 Survey
Extent of 1995 Side-Scan SONAR Survey
-124 10 00"
Section 103 Site
Interim Site
Extent of Jul 2000 Survey
Fine to Medium Sand /Silt
X=1054834.0
Y=361654.0
X=1060301.0
Y=361027.0
DRAFT LOCATION SOUTH SITE
597 AC.
3 Mile Territorial Sea Limit
X=1053497.0
Y=353698.0
X=1059465.0
Y=353071.0
North Reef
North Jetty
South Jetty
South Reef
Yaquina Bay State Park
RM 2
RM 1
RM 0
OSU Marine Science Center
South Beach
South Beach State Park
101
Produced by GIS, Survey and Mapping Section
CAD DESIGN FILE:
\tyler\coastal\yaquina\gis\dgn\SHEET1.DGN
Yaquina Bay, Oregon
YAQUINA BAY
Ocean Dredged Material Disposal Sites
.25 0 .25 .5 .75 1
Nautical Miles

Figure 1

# Endangered Species Act of 1973, as amended

## U.S. National Marine Fisheries Service

## Coordination

**DEPARTMENT OF THE ARMY**
PORTLAND DISTRICT, CORPS OF ENGINEERS
P.O. BOX 2946
PORTLAND, OREGON 97208-2946

Reply to
Attention of:

JUL 2 3 2001

Planning, Programs and Project Management Division

Mr. Brent Norberg
Regional Administrator, Northwest Region
National Marine Fisheries Service
7600 Sand Point Way, NE
Bin C15700, Bldg 1
Seattle, WA 98115-0070

Dear Mr. Norberg:

Pursuant to the requirements of the Endangered Species Act, we are providing a biological assessment that addresses threatened and endangered species that may occur in the vicinity of two proposed sites for ocean disposal of materials dredged from Yaquina Bay near Newport, Oregon. The proposed action involves selection and use of two 597-acre sites that are located approximately 2.5 miles offshore.

We have determined that the proposed action may affect but would not likely adversely affect listed species addressed in the biological assessment. We would appreciate a response from NMFS regarding our determinations for our records. An e-mail would suffice.

If you have any questions, or need further information concerning this project, please contact Steve Helm of my staff at 503-808-4778 or e-mail at steve.r.helm@usace.army.mil.

Sincerely,

Robert E. Willis
Chief, Environmental Resources Branch

Enclosure

Copies Furnished:
CENWP-PM-E (Steve Stevens)
CENWP-PM-E (Steve Helm)

# BIOLOGICAL ASSESSMENT

# FOR

# RIGHT, SEI, BLUE, FINBACK, AND SPERM WHALES

# STELLER SEA LION

# LOGGERHEAD, GREEN, LEATHERBACK, AND PACIFIC RIDLEY SEA TURTLES

# FOR

# SELECTION AND USE OF TWO DREDGED MATERIAL OCEAN DISPOSAL SITES

# NEWPORT, OREGON

## BACKGROUND AND PROJECT DESCRIPTION

Yaquina River enters the Pacific Ocean near the city of Newport, Oregon, approximately 115 miles south of the Columbia River. The Corps of Engineers, Portland District has been responsible for maintenance of navigable waterways of the North Pacific Coast since 1871. The need for improved navigation controls in the Yaquina Bay estuary began with the founding of a port city at Yaquina. Because of the navigation need, two jetties were constructed in 1896, and Congress authorized dredging in the Bay in 1919. Dredging was authorized to provide an entrance channel, decrease tide-caused delays for commercial ships crossing the bar, provide improved safety, provide mooring facilities, permit barge and small boat traffic upstream to river mile 14, and provide a harbor of refuge.

Rough seas encountered at the Yaquina Bay entrance preclude the safe and efficient operation of any dredge other than a hopper dredge. Upland disposal of dredged material from a hopper dredge operation is not economical due to the need to double handle the material and sufficient upland capacity is unavailable. Disposal of material dredged from Yaquina Bay, therefore, must occur at an in-water site. Before 1977, dredged material from Yaquina Bay was placed in the general vicinity of the proposed sites and sites used since 1977. Between 1977 and 1986, dredged material was disposed of at the EPA Interim disposal site (see attached map). Because of navigational safety concerns resulting from increased mounding at the Interim site, the Corps selected an alternate site under its Section 103 authority (see attached map) and most material dredged from the Bay since 1986 has been placed there.

The proposed project involves selection and use of two Ocean Dredged Material Disposal Sites (ODMDSs) (see attached map) for redistribution of sediments from the Yaquina

Bay project. The availability of ODMDSs in the vicinity of Yaquina Bay is necessary to maintain safe deep-draft navigation through authorized federal channels. These sites each would have disposal capacity for approximately 20 years. The Corps and EPA have prepared a draft evaluation study and environmental assessment (USACOE 2001) to describes the conditions at the Interim, Section 103, and the two proposed ODMDSs. This document also details compliance of the ODMDSs with the Marine Protection, Research and Sanctuaries Act of 1972, the National Environmental Policy Act of 1969, the Endangered Species Act of 1973, the National Historic Preservation Act of 1966, and the Coastal Zone Management Act of 1972 (all as amended).

Since 1986, an annual average of 313,600 cubic yards of material has been dredged from the Yaquina Bay Federal Navigation Project. Future volumes are expected to remain relatively constant. The existing Section 103 site has experienced mounding, generating a potentially hazardous navigation safety condition, and has limited capacity to receive future dredge material disposals. Commercial shippers, crab fishermen, and the U.S. Coast Guard expressed concern over this situation to both the Corps and EPA. Efforts were undertaken by the federal government to temporarily expand existing sites in 1998 and to manage distribution of the maintenance dredged material within the available site while seeking a more permanent management solution. Ocean dumping is necessary to maintain the Yaquina Bay project, thereby allowing continued commercial use of the existing navigation channel at its authorized depth.

The proposed disposal sites are located approximately 2.5 miles offshore and are characterized by water depths of 120-150 feet (see attached map). The coordinates of the corners of the north site are as follows:

| Latitude | | | Longitude | | |
|---|---|---|---|---|---|
| 44° | 38' | 17.98" N | 124° | 07' | 25.95" W |
| 44° | 38' | 12.86" N | 124° | 06' | 31.10" W |
| 44° | 37' | 14.33" N | 124° | 07' | 37.57" W |
| 44° | 37' | 09.22" N | 124° | 06' | 42.73" W |

The coordinates of the corners of the south site are as follows:

| Latitude | | | Longitude | | |
|---|---|---|---|---|---|
| 44° | 36' | 04.50" N | 124° | 07' | 52.66" W |
| 44° | 35' | 59.39" N | 124° | 06' | 57.84" W |
| 44° | 35' | 00.85" N | 124° | 08' | 04.27" W |
| 44° | 34' | 55.75" N | 124° | 07' | 09.47" W |

The two sites are of equal size, each with and area of 597 acres (4,000 feet by 6,500 feet).

## BIOLOGICAL ASSESSMENTS

### LOGGERHEAD, GREEN, LEATHERBACK, AND PACIFIC RIDLEY SEA TURTLES

**Occurrence and Discussion:** The loggerhead sea turtle (*Caretta caretta*) (threatened), the green sea *turtle (Chelonia mydas*) (threatened), the leatherback sea turtle (*Dermochelys coriacea*) (endangered), and the Pacific ridley sea turtle (*Lepidochelys olivacea*) (threatened) have all been recorded from strandings along the Oregon and Washington coastline since 1982 (J. Scordino, NMFS, pers. comm. cited in Green et al. 1992). Green et al. (1992) recorded 16 leatherback sea turtles during their survey of Oregon and Washington coastal waters and found that they were associated with warmer waters over the Pacific slope during summer (Green et al. 1992). Leatherback, loggerhead, green, and Pacific Ridley sea turtle occurrences off the Oregon Coast are associated with the appearance of albacore. Albacore occurrence is strongly associated with the warm waters of the Japanese Current that tends to approach the Oregon Coast in late summer. During El Nino events, warm water may occur closer to the Oregon coast than usual but typically, warm water associated with the Japanese Current does not closely approach the Oregon Coast, generally occurring 30-60+ miles offshore.

**Conclusion:** Because the marine turtles discussed above do not typically occur close to shore and would only occur in the vicinity of the proposed project site under unusual circumstances, the proposed action may affect but is not likely to adversely affect the four species of sea turtles discussed above.

### BLUE, FINBACK, SEI, SPERM, HUMPBACK AND RIGHT WHALES

**Occurrence and Discussion:** The blue whale (*Balaenopter musculus*), the finback whale (*Balaenoptera physalus*), the Sei whale (*Balaenoptera borealis*), the humpback whale (*Megaptera novaeangliae*), the sperm whale (*Physeter macrocephalus*), and the right whale (*Balaena glacialis*) are all listed as endangered and all occur as migrants in waters off the Oregon coast.

These species may occur in the project area but information on numbers, distribution, and feeding habits is lacking other than in a general sense. According to Maser et al. (1981), occurrence of blue whales off the Oregon coast is primarily in May and June and August through October. Blue whales typically occur offshore as individuals or in small groups and winter well south of Oregon. Finback whales also winter far south of Oregon and range off the Oregon Coast during summer. Whaling records indicate that finback whales were primarily harvested off Oregon from May to September. Sei whales also winter south of Oregon. Based upon information from central California, Sei whales probably occur in southward migration off the Oregon coast in late summer and early fall. Sperm

whales occur as migrants and some may summer off the Oregon coast. Sperm whales forage in waters much deeper than those in the vicinity of the proposed project. Strandings have occurred along the Oregon coast. Humpback whales primarily occur off the Oregon coast between April and October with peak numbers occurring during June, July, and August. Green et al. (1992) observed 35 humpback whales near Heceta Bank in June 1990. They noted that humpbacked whales were particularly concentrated in Oregon along the southern edge of Heceta Bank and found this species primarily on the continental shelf and slope. Right whales may occur off the Oregon coast during winter and summer distribution is in cool waters north of 50 degrees north latitude.

**Conclusion:** Because the whales discussed above generally occur farther from shore and would only occur in the vicinity of the proposed project site as migrants, the proposed action may affect but is not likely to adversely affect the five species of whales discussed above.

## STELLER SEA LION

**Occurrence and Discussion:** The Steller sea lion (*Eumetopias jubatus*) (threatened) breeds along the west coast of north America from California's Channel Islands, to the Kurile Islands and the Okshotsk Sea in the western north Pacific Ocean and are year long residents along the Oregon coast. They occur as migrants in the vicinity of the proposed project area.

Steller sea lions are known to haul out at ten sites off Oregon of which two of these sites, Rogue and Orford Reefs, are rookeries. Other important haul out sites include Ecola State Park, Sea Lion Caves, Columbia River South Jetty, Three Arch Rock, Cape Arago, and Seal Rock. No pupping or hauling out areas are present near the proposed project (USACOE 1985), the nearest haul out area being Seal Rock located approximately seven miles south of the North Jetty.

Steller sea lion population counts for Oregon have increased since 1976. Counts were relatively stable in the 1980's in Oregon and ranged from 2,000-3,000 Steller sea lions. The 1996 Steller sea lion count for the Oregon Coast was 3,990 (Hill and DeMaster 1998). In 1984 and 1985, year-round counts ranged from 769 to 2352. During this survey, peak counts (2352) were made on May 21 & 23, 1984 with haul out attendance greatest at Ecola State Park, Sea Lion Caves, Orford Reef, and Rogue Reef (Brown 1988). Peak attendance at the two Oregon rookeries occurs during May, June, and July. Sea lions begin to leave the rookeries in August. Males are the first to leave, followed by females within a few months (Gentry and Winthrow 1978). Seasonal shifts in the use of haul out sites are common among Steller sea lions. Steller sea lion numbers appear to be lower off Oregon in the winter than summer, though it is not known where these animals may be migrating to or wintering.

Steller sea lions forage at river mouths and nearshore areas along the coast. Roffe and Mate (1984) determined that proximity to the mouth of a river was the most important factor in determination of foraging areas. Foraging by this species would be expected to

occur in the project vicinity during migration although the extent of foraging activities at the immediate project site is unknown. Steller sea lion presence at the Yaquina Bay entrance is anticipated to be incidental because of intense recreational use.

**Conclusion:** Because the Steller sea lion is only migratory in the vicinity of the proposed project site, the proposed action may affect but is not likely to adversely affect Steller sea lions.

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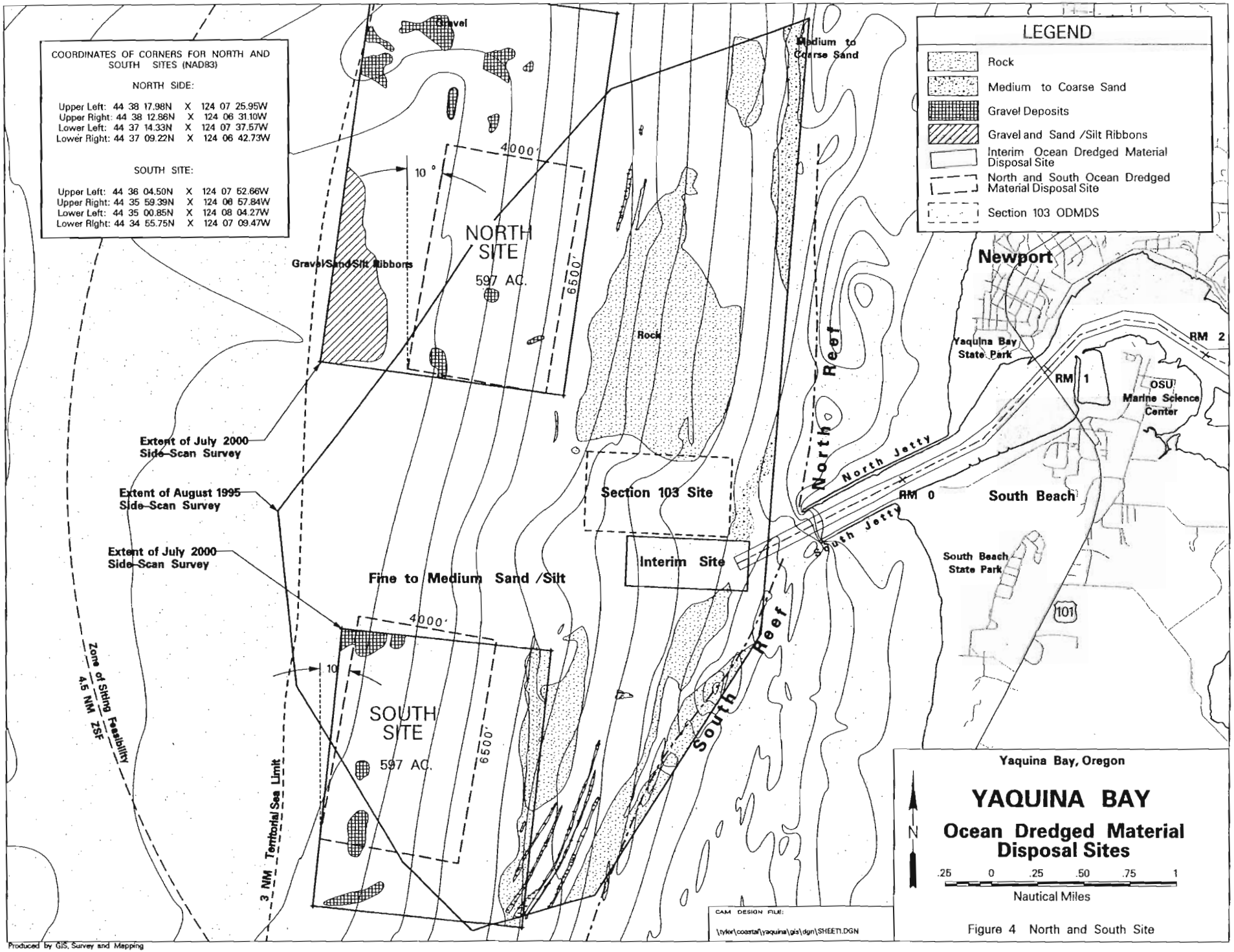


Figure 4 North and South Site

**DEPARTMENT OF THE ARMY**
PORTLAND DISTRICT, CORPS OF ENGINEERS
P.O. BOX 2946
PORTLAND, OREGON 97208-2946

Reply to
Attention of:

JUL 2 1999

Engineering and Construction Division

National Marine Fisheries Service
525 NE Oregon St.
Portland, OR 97232-2737

Dear Mr. Mike Tehan:

Enclosed is the biological assessment for the Operation and Maintenance program for the coastal dredging projects. This assessment is for Oregon Coast Coho and Southern Oregon/ Northern California Coast Coho stocks. It supercedes the assessment provided to your office in August 1998 for just the Southern Oregon/Northern California Coho. The consultation is for a five-year period. A determination has been made that this program is not likely to adversely effect the listed stocks of coho salmon.

If you have any questions or need any additional information, please contact Mr. Kim Larson, of my staff, at (503) 808-4776

Sincerely,

Howard B. Jones, P.E.
Chief, Engineering and Construction
Division

**Biological Assessment**
**for**
**Oregon Coast Coho (Threatened)**
**Southern Oregon/Northern California Coast Coho (Threatened)**
**For**
**U.S. Army Corps of Engineers, Portland District**
**Maintenance Dredging on the Oregon Coast**

## 1. PROJECT DESCRIPTION

The Portland District Corps of Engineers (COE) routinely dredges several waterways along the Oregon Coast to maintain federal navigation channels. This Biological Assessment evaluates the potential impacts of the COE 5-year routine dredging operations within the range of the threatened coho salmon (*Oncorhynchus kisutch*), excluding the Columbia River. Two Evolutionarily Significant Units (ESUs), the Southern Oregon/Northern California Coast ESU and the Oregon Coast ESU, encompass the following waterways that are subject to COE maintenance dredging: Tillamook Bay, Depoe Bay, Yaquina Bay, Harbor, and River, Siuslaw River, Umpqua River, Coos Bay, Coquille River, and Port Orford. The potential effects of maintenance dredging to threatened coho salmon in the Rogue and Chetco Rivers were addressed in an earlier consultation with National Marine Fisheries Service (August 1998), but are included herein for consistency.

The COE implements four dredging techniques on the Oregon Coast: hopper, pipeline, clamshell, and agitation. These techniques are described below. The COE Portland District contracts out approximately 40 percent of dredging along the Oregon Coast, and operates it's own fleet of three dredges for work in this area, the *Yaquina*, *Essayons*, and *Sandwick*.

Scheduling of maintenance dredging along the Oregon Coast considers numerous factors. Due to weather and ocean conditions, dredging is typically limited to the period from May to mid-October, but has been possible later or as early as April or March for emergencies. Shoaling patterns and needs change continually, so hydrographic surveys (depth) are frequently conducted to track channel conditions throughout the season. The need for dredging is determined by a combination of hydrographic surveys, level of traffic, Coast Guard or other safety concerns, and expressions of concern by local traffic or Ports. Typically, the areas of greatest shoaling are dredged first, but considerations such as commercial and seasonal demand are factored into justifications. To the extent possible, the COE concentrates on entrance bars first (whenever ocean conditions permit) and saves inside channel (protected) areas for later in the season (unless conditions restrict traffic). The COE ideally dredges projects to their full depth, including overdepth for advanced maintenance. There are times, however, when the COE must do minimal dredging to deal with emergency circumstances, then return at a later date to complete the work. Most dredging operations work 24 hours per day, depending upon weather, staffing, and other factors. The agitation dredge operates only during a single ebb tide per 24-hour period.

Hopper dredges are seagoing vessels designed to dredge and transport dredged material to open-water disposal areas. The working of a hopper dredge is similar to that of a home vacuum cleaner. Dragarms with dragheads extend from each side of the ship's hull. The dragheads are lowered to the channel bottom and are slowly drawn over or through the substrate. Pumps create suction in the dragarm and the material is drawn up through the arms

and deposited in hopper bins in the vessel's midsection. When the bins are full, the dredge sails to the designated disposal area and empties the dredged material through large hopper doors in the bottom of the hull, or in split-hull dredges, by opening the full length of the hopper. The COE *Yaquina* is a small (200 feet), shallow-draft hopper dredge. Because of its size, it is particularly well suited for dredging smaller, shallow coastal entrances, but is equally suited to work in deep draft waters. The COE *Essayons* is a medium-class hopper dredge designed for deep-draft projects. On the Oregon Coast, it is typically limited to Coos Bay and the Columbia River.

The pipeline dredge is a steel hull, cutter-head type of dredge, using a single cutter head at the end of a suction pipe. It is not self-propelled. The dredge is towed to it's initial position and generally anchored by retractable spuds on the stern, and swing anchors on the bow. Once on station, the discharge pipeline is attached. Pipeline length varies depending on disposal location and method. Once the pipeline is connected, the dredges cutter head, mounted on a lattice frame (ladder), is lowered to the river bottom. While digging, the cutter, rotating at around 24 rpm loosens up sediment, allowing it to be pumped with water (in a slurry form) to the disposal site.

Clamshell dredging is done using a bucket operated from a crane, derrick mounted on a barge, or from shore. Sediment removed by the bucket is usually placed on a barge for removal to an approved site. Material can be off-loaded to an upland site, or more commonly, placed in an acceptable in-water site. Bucket dredges are not self-propelled, so they are not typically used in high traffic areas. They are often used in tight quarters, such as around docks and piers. In addition, because they are usually barge-mounted, they can be used in shallow areas where draft restrictions limit other choices. Dredged material comes up virtually *in situ*, so clamshells are particularly good in silts or contaminated material, where water entrainment is a concern.

Channel flushing (agitation dredging) is an effective method for shallow areas (depths of up to 20 feet). The *Sandwick* is a small converted military landing craft that operates as a channel flusher. It typically operates in projects of less than 20 feet draft and small clean-up jobs. The *Sandwick* has been fitted with a large steel plate, and operates by deflecting propeller wash toward the shoal area. Sediments are put into suspension and subsequently transferred downstream during an ebb tide flow by a combination of propeller wash and tidal current. This type of dredge is used only on ebb tides. This process is similar to natural processes that distribute sediment throughout the channel, but at an accelerated rate. The Sandwick can move approximately 800 to 1000 cubic yards of material per day, depending on the project site.

Routine maintenance dredging for each location on the Oregon Coast is described below (from north to south), with dredging depths given in relation to mean lower low water (MLLW). The dredging in these waterways occurs in isolated areas only, that is, dredging rarely entails the full width of the authorized navigational channel. The COE Oregon Coast maintenance dredging is summarized in Table 1.

## 1.1 Tillamook Bay and Bar

Routine dredging is required every five to eight years in the access channel to the Garibaldi Boat Basin. This is necessary to remove shoals that interfere with navigation from approximately River Mile (RM) 3 to the Garibaldi Boat Basin that supports primarily commercial and recreational fishing vessels. Typically, 30,000 cubic yards of material will be removed to maintain a 12-foot deep channel that is 200 feet wide (less than 5 percent of the channel width

## Table 1. U.S. Army Corps of Engineers, Portland District, Annual Maintenance Sc

| Waterway | | January | February | March | April | May | June |
|---|---|---|---|---|---|---|---|
| Tillamook Bay | estimated coho presence | Adult upstream migration | | Smolt outmigration | | | |
| | ODFW preferred in-water work window | 1 November - 15 February | | | | | |
| | entrance (every 5 - 8 yrs) | | | | 17 days of pipeline dredging with upland dispos | | |
| Depoe Bay | estimated coho presence | | | | | | |
| | ODFW preferred in-water work window | | | | | | |
| | boat basin (every 5 - 8 yrs) | | | | | | 10 days of pipeli |
| | sediment check dam (every 5 - 8 yrs) | | | | | | 4 days of dragline |
| Yaquina Bay and Harbor | estimated coho presence | | | | Smolt outmigration | | |
| | ODFW preferred in-water work window | 1 Oct - 15 Feb (Yaquina Bay); 1 Oct - 31 Mar (Yaquina River) | 1 October - 31 March (Yaquina River) | | | | |
| | entrance to turn basin (annually) | | | | | | 32 days of hopper or clamsh |
| | South Beach Basin (every 5 - 8 yrs) | | | | | | |
| Siuslaw River | estimated coho presence | | | Smolt outmigration | | | |
| | ODFW preferred in-water work window | 1 October - 15 February | | | | | |
| | entrance (annually) | | | | 9 days of hopper dredging to ocea | | |
| Umpqua River | estimated coho presence | | | Smolt outmigration | | | |
| | ODFW preferred in-water work window | 1 November - 31 January | | | | | |
| | entrance (annually) | | | | | | 18 days of hopper dre |
| | upstream (to RM 11) (annually) | | | | | | |
| | Winchester Bay (annually) | | | | | | |
| Coos Bay | estimated coho presence | | | Smolt outmigration | | | |
| | ODFW preferred in-water work window | 1 October - 15 February | | | | | |
| | entrance (annually) | | | | | | 18 days of hopper dredging to oce |
| | channel to RM 12 (annually) | | | | | | 25 days of hopper dredging to ocean o |
| | RM 12 to RM 15 (every 2 yrs) | | | | | | 70 days of clamshell dredging to oc |
| | Charleston (annually) | | | | | | 18 days of agitation (Sandwick) dredging and 5 days of either hopper |

| | | |
|---|---|---|
| **Coquille River and Bandon Boat Basin** | estimated coho presence | Smolt outmigration |
| | ODFW preferred in-water work window | 1 October - 15 February |
| | entrance (annually) | 5 days of hopper dredging to oce |
| | side channel to boat basin (every 5 - 10 yrs) | 6 days of pipeline dredging to flowlane disposal (6,000 cu yd) |
| **Port Orford** | estimated coho presence | |
| | ODFW preferred in-water work window | |
| | boat basin (annually) | 16 days of pipeline dredging to upland disposal or disposal south of jetty (6,000 cu yd) / 46 days of |
| **Rogue River** | estimated coho presence | Smolt outmigration |
| | ODFW preferred in-water work window | 1 October - 31 May |
| | entrance (annually) | 16 days of hopper dredging to oce |
| | boat basin (annually) | 18 days of pipeline dredging to surf zone disposal (24,000 |
| **Chetco River** | estimatedcoho presence | Smolt outmigration |
| | ODFW preferred in-water work window | 1 October - 31 May |
| | entrance (annually) | 6 days of hopper dredging to ocean disposal (35,000 cu |

south of Miami Cove). An additional 2 feet of over-depth dredging can be performed for advanced maintenance and dredging tolerance. The material is primarily silty sand but grades to sandy clayey silt. Dredging will be undertaken either using a clamshell/bucket dredge with ocean disposal, or using a pipeline to an upland disposal site. The likely ocean disposal site is approximately 3.5 miles offshore (it would need to be selected through the Section 103 process). Approximately 17 days of dredging at Tillamook Bay is undertaken between 1 April and 31 October, depending upon weather conditions. The area was last dredged in Fiscal Year 1991 and dredging is planned next in Fiscal Year 2000.

The Wilson, Trask, Kilchis, Miami, and Tillamook Rivers feed into Tillamook Bay. These streams support populations of coho salmon, winter steelhead, summer steelhead (introduced/hatchery stock), spring and fall chinook salmon, and chum salmon (ODFW 1992, EPA 1998). These waterways are included among those proposed as critical habitat for the threatened Oregon Coast ESU coho salmon (64 FR 24998). Outmigration of juvenile coho typically extends from March through June, while upstream migration of adult coho salmon typically extends from September through January (Knutsen, personal communication) (see Table 1). The ODFW preferred in-water work window for Tillamook Bay is 1 November to 15 February (ODFW 1997).

## 1.2 Depoe Bay

Depoe Bay supports commercial, charter, and recreational fishing boats. Every five to eight years, dredging is required at the boat basin and for the removal of accumulated material in the sediment check dam (owned by the Port of Depoe Bay) at the mouth of Depoe Bay Creek. This 6-foot high dam was completed in 1950 (ODFW 1992).

The boat basin is maintained at 8 feet deep (plus an additional 1-foot of over-depth), in an area 750 feet long and averaging 390 feet wide (nearly the full extent of the boat basin). Pipeline dredging to a surf-zone disposal site is used to remove typically 15,000 cubic yards of accumulated silty sand at the boat basin. Either a dragline or a bucket dredge is used to move a maximum of 2,000 cubic yards of silty sand from behind the check dam to an upland disposal site. The dredging activities at Depoe Bay historically occur between 1 June and 15 September, depending upon weather. The boat basin dredging may take approximately 10 days, while the dredging behind the check dam may require approximately 4 days.

Approximately 3 miles of Depoe Bay Creek supports coho salmon and winter steelhead (ODFW 1992). Outmigration of juvenile coho typically ranges from mid-March to mid-June, with a peak from mid-April to mid-May (see Table 1). Upstream migration of adult coho salmon typically occurs during October, but may extend through December. There is a fish ladder at the check dam to provide for fish passage. Depoe Bay and Depoe Bay Creek are not identified among those proposed as critical habitat for the Oregon Coast ESU coho salmon (64 FR 24998). The ODFW listed in-water work window for "Other Coastal Tributaries" is 1 July to 15 September (ODFW 1997). Personal communication with ODFW staff indicates a preferred in-water work window for Depoe Bay of 1 October to 15 February.

## 1.3 Yaquina Bay and Harbor

The COE Yaquina Bay and Harbor project includes two high-tide, rubble mound jetties at the entrance. The North and South Jetties are 7,000 feet and 8,600 feet long, respectively, and are 1,000 feet apart at their outer ends. In addition, an 800-foot long spur jetty protects the south side of the channel. The COE must routinely dredge the federal navigation channel at Yaquina

Bay and Harbor. The Yaquina entrance channel is generally annually dredged between 1 April and 31 October, over a period of approximately 32 days. Within this reach, from the entrance to the turning basin, typically 340,000 cubic yards of sand will be removed. In this reach, dredging is typically undertaken using a hopper or clamshell dredge with ocean disposal (approximately 1 mile offshore). The one-mile segment, from deep water to RM 0+0, is authorized at 400 feet wide (approximately 43 percent of the distance between the jetties) and 40 feet deep (plus a 5-foot allowable over-depth). At RM 0+0, the channel is reduced to 300 feet wide and 30 feet deep (plus a 2-foot allowable over-depth). This channel segment comprises approximately 31 percent of the distance between the jetties and approximately 21 percent of the channel width upstream of the jetties. This channel configuration continues for another two miles upstream of the Highway 101 bridge, to a turning basin. The turning basin, at RM 2+00 to RM 2+40, is 30 feet deep and occupies an area 900 to 1,200 feet wide by 1,400 feet long.

The project also includes an access channel to the South Beach Basin Marina, just upstream of the Highway 101 bridge. This channel is 10 feet deep (plus a 1-foot allowable over-depth) by 100 feet wide, extending over a distance of 1,035 feet. Every five to eight years, typically 30,000 cubic yards of material will be removed using a pipeline dredge with the material disposed of at an upland site. Dredging is undertaken over an approximate 30-day period, between 15 September and 31 October. The Port of Newport maintains the rest of the boat basin.

The Yaquina River project includes a channel 10 feet deep and 150 feet wide extending from RM 4.0 upstream to RM 14.0, at Toledo, with a channel into Depot Slough. Depot Slough was dredged in 1995 but is not expected to require dredging in the foreseeable future. The Yaquina River channel itself is not maintained. If dredging were ever required, it would likely be done by clamshell dredge with material barged to the ocean disposal site.

Approximately 15 miles of the Yaquina River supports coho salmon, winter steelhead, and fall chinook (ODFW 1992). The project is within waters included among those proposed as critical habitat for the threatened Oregon Coast ESU coho salmon (64 FR 24998). Within the Yaquina River basin, upstream migration of adult coho peaks in October but may extend through December, while juvenile outmigration typically extends from late-March through August with a distinctive peak in May. The ODFW preferred in-water work window for Yaquina Bay is 1 October to 15 February, and for Yaquina River is 1 October to 31 March.

## 1.4 Siuslaw River

The Siuslaw River project includes two high-tide jetties, approximately 750 feet apart at their outer ends. The north and south jetties extend 9,690 feet and 6,000 feet, respectively. Each jetty includes a 400-foot long spur jetty on the outer side, approximately 900 feet shoreward of the jetty heads. To maintain the navigation channel of the Siuslaw River, restrictive shoals are annually removed downstream of RM 0.2. A 300-foot wide channel (approximately 40 percent of the channel width) is maintained to a depth of 18 feet (plus up to 5 feet over-depth). Typically, 180,000 cubic yards of poorly-graded sand with low organic content will be annually dredged from the entrance to the river using a hopper dredge with ocean disposal (approximately 1.2 miles offshore). Work is undertaken between 1 April and 31 October, typically over a period of 9 days.

Upstream to RM 5, a 200-foot wide channel (approximately 21 percent of the channel width) is authorized to a 16-foot depth. Between RM 5 and RM 16.5, a 120-foot wide channel is authorized to a 12-foot depth. This navigation channel comprises approximately 22 percent of channel width, ranging from 3 percent to 56 percent of channel width. A 400-foot by 600-foot turning basin at RM 5 at Florence is authorized at a 16-foot depth. These inner reaches are not currently maintained to their authorized depth, and are not frequently dredged.

The Siuslaw River and its tributaries support coho salmon, steelhead, and fall chinook salmon (ODFW 1992). It is included as proposed critical habitat for Oregon Coast ESA coho salmon (64 FR 24998). Peak upstream migration of adult coho salmon is typically in October (the range may extend through December), while a peak in juvenile outmigration is typically observed from early March through early April (with the range extending from early February through early June). The ODFW preferred in-water work window for the Siuslaw project area is 1 October to 15 February (ODFW 1997).

## 1.5 Umpqua River

The Umpqua River project includes two jetties at the river entrance. The north jetty is approximately 8,000 feet long, while the south jetty is approximately 4,200 feet long. The south jetty includes a training jetty on the north side. The Umpqua River is annually dredged to remove restrictive shoals in order to maintain the federal navigation channel. This channel extends from the mouth upriver to Reedsport at approximately RM 11+40.

The entrance channel, which extends from RM –1 to RM 0-10, is maintained to a depth of 26 feet, with up to five foot of over-depth for advanced maintenance, and a width of 400 feet (approximately 21 percent of the distance between the jetties). In the entrance channel, dredging is undertaken using a hopper dredge. Ocean disposal (approximately 1.5 miles offshore) is used for the 180,000 cubic yards of sand material typically removed annually from this portion of the channel. This work typically take place between 1 April and 31 October, over a period of approximately 18 days.

Beginning at RM 0-10 and extending to Reedsport at RM 11+40, Umpqua River maintenance dredging normally occurs between 15 September and 31 October, but can occur between 1 April and 31 October if critical shoaling occurs, or as a back-up dredging location for entrance dredging. This would be coordinated with the Oregon Department of Fish and Wildlife. Typically, 20 days are required to remove the anticipated 180,000 cubic yards of material from this reach of the Umpqua River to an in-bay or ocean disposal site (approximately 1.5 miles offshore). This channel is maintained to a depth of 22 feet, with up to two feet of over-depth for advanced maintenance and dredging tolerance, and a width of 200 feet. The authorized navigational channel comprises approximately 10 percent of the channel width (ranging from 3 percent to 27 percent).

At approximately RM 8, a side channel extends approximately 1.3 miles to Gardiner. This 200-foot wide side channel is authorized at a depth of 22 feet. This comprises approximately 15 percent of the channel width. While not maintained to the extent authorized, a 22-foot deep turning basin at Gardiner is 500 feet wide (approximately 35 percent of the channel width) by 800 feet long. On the Umpqua River, there is also a 600-foot wide (approximately 60 percent of channel width) by 1000-foot long turning basin at Reedsport (approximately RM 10) that is authorized to a depth of 22 feet, but has not been dredged for several years.

Winchester Bay is also dredged annually. This component of the Umpqua River project includes access channels to two man-made boat basins on the south end of Winchester Bay, west of Cornwall Point. The access channels to both the east and west boat basins are authorized to 16 feet deep and 100 feet wide, with the exception of the southern 950 feet of the east basin which is authorized to 12 feet deep and 75 feet wide. Up to two feet of advanced maintenance dredging is performed to ensure that the authorized depth is maintained between dredging operations. The *Sandwick*, an agitation dredge, will be used over a period of 10 to 20 days annually to redistribute some accumulated sediment. This work is generally conducted between 1 September and 31 October. A clamshell dredge with in-bay disposal or a pipeline dredge with upland (North Spit) disposal is also periodically used (every 5 to 8 years) to remove typically 30,000 cubic yards of sediment (primarily poorly-graded sand) from the bay.

Approximately 114 miles of the Umpqua River supports coho salmon, summer and winter steelhead, and spring and fall chinook salmon (ODFW 1992). It is included as proposed critical habitat for Oregon Coast ESA coho salmon (64 FR 24998). The ODFW preferred in-water work window for the Umpqua Bay and Smith River Estuary is 1 November to 31 January (ODFW 1997). Within the Umpqua River system, upstream migration of adult coho salmon extends from October through December, but a peak is apparent in October. Juvenile outmigration typically peaks in May, but may extend from March through July.

## 1.6 Coos Bay

The Coos Bay project includes two high-tide, rubble mound jetties approximately 2,000 feet apart at their outer ends. The north and south jetties are approximately 4,300 feet and 4,000 feet long, respectively. Annual dredging is required downstream of RM 12. However, between RM 12 and RM 15, dredging is necessary only every second year. Dredging operations in this area are typically undertaken between 1 April and 31 October, although the work above RM 12 has extended into December.

The navigation channel at the entrance to Coos Bay is annually dredged to maintain a 47-foot depth and 700-foot width. Between the jetties, the navigational channel comprises approximately 21 percent of the distance. Typically, 800,000 cubic yards of material is removed from the entrance, over a period of approximately 18 days, using a hopper dredge. An ocean disposal site, approximately 1.5 miles offshore, is used to dispose of the dredged material.

The channel gradually decreases to 37 feet deep and 300 feet wide at RM 1.0. These dimensions continue to RM 9. Between RM 1 and RM 9, the navigational channel comprises approximately 9 percent of the channel width (range 5 percent to 17 percent). Within this reach, approximately 300,000 cubic yards of material is typically removed over a period of approximately 25 days. A hopper dredge is used, with the material disposed of at either in-bay or ocean sites. At RM 9, the channel widens to 400 feet and continues to RM 15. Within this reach, the navigational channel comprises approximately 17 percent (range 4 percent to 71 percent). The navigational channel comprises the greatest proportion of the channel width (71 percent) near Coalbank Slough, at the east end of the Port of Coos Bay. From RM 12 and RM 15, 800,000 cubic yards of fine grained sediment is typically removed with a clamshell dredge every other year, and placed at an ocean disposal site.

Charleston Channel extends to the south off Coos Bay at RM 2. The Portland District Corps of Engineers annually dredges Charleston Channel to provide for a 17-foot deep channel 150-foot wide channel for 3,200 feet, then 16 feet deep to the highway bridge, at approximately

RM 1.15. The authorized navigational channel comprises approximately 9 percent of the channel width (range 3 percent to 16 percent). The COE typically conducts agitation dredging (only on ebb tides) over an average of 18 days per year. In addition, up to 40,000 cubic yards of sand has been removed some years using a hopper or clamshell dredge. This material has been disposed of in the ocean (approximately 1.5 miles offshore) or in "area G" at Coos Bay RM 1, between Coos Head and the North Spit.

Coos River supports coho salmon, winter steelhead, and fall chinook salmon (ODFW 1992). It is included as proposed critical habitat for Oregon Coast ESA coho salmon (64 FR 24998). Western brook lamprey, Pacific lamprey, American shad, cutthroat trout, rainbow trout, largscale sucker, rainbow trout, speckled dace, and striped bass are also found in the Coos River (ODFW 1992). The ODFW preferred in-water work window for Coos Bay up to Catching Slough is 1 October to 15 February (ODFW 1997). The preferred in-water work window for the Coos River, Millicoma River, and South Fork Coos River (tidewater) is 1 October to 31 March (ODFW 1997). Upstream migration of adult coho salmon appears to peak in October, but may extend through January. Outmigration of juvenile coho typically extends from March through June, but a peak is typically observed from mid-April to mid-May.

## 1.7 Coquille River and Bandon Boat Basin

The north and south jetties protecting the entrance to the Coquille River are 3,450 feet and 2,700 feet long, respectively. The entrance to the river is annually dredged to remove shoals at and maintain a navigation channel for commercial and recreational vessels. The authorized channel is 13 feet deep by approximately 200 feet wide up to RM 1.3. This comprises approximately 20 percent of the channel width (range approximately 7 percent to 44 percent). An additional two feet of over-depth will be dredged to ensure that the authorized depth is maintained between dredging operations. An additional five feet of over-depth will be dredged at the entrance. A hopper dredge would be used to remove typically 40,000 cubic yards of sand at the entrance to an ocean disposal site (approximately 1 mile offshore). The maintenance dredging is undertaken from 1 April to 31 October, typically requiring 5 days.

The channel to the Bandon Boat Basin is maintained every five to ten years. Using a pipeline dredge, typically 6,000 cubic yards of material is removed to the Coquille River flow lane. This dredging is conducted between 1 April and 31 October, typically requiring 6 days.

Approximately 35 miles of the Coquille River support anadromous salmonids including coho salmon, winter steelhead, and spring and fall chinook salmon (ODFW 1992). It is included as proposed critical habitat for Oregon Coast ESA coho salmon (64 FR 24998). Cutthroat trout, American shad, Coast Range sculpin, largescale sucker, Pacific lamprey, prickley sculpin, stickleback, striped bass, and green sturgeon are also documented in the Coquille River (ODFW 1992). The ODFW preferred in-water work window for the Coquille River in the project area is 1 October to 15 February (ODFW 1997). Upstream migration of adult coho salmon in the Coquille River appears to peak in October, but may extend through January. Outmigration of juvenile coho typically extends from March through June, but a peak is typically observed from mid-April to mid-May.

## 1.8 Port Orford

The Port Orford project includes a 550-foot long breakwater and dredging of a turning basin. A northerly littoral drift results in shoaling in the boat basin of Port Orford and along the end and

face of the dock. The boat basin at Port Orford is annually maintained using both agitation and pipeline dredging. The Sandwick operates during ebb tides only, from 45 to 50 days per year between 1 April and 31 October. Between 1 November and 31 March (approximately 16 days of dredging), typically up to 6,000 cubic yards of coarse-grained sand is piped to an upland (beach) disposal site or in-water south of the jetty. An area 100 feet wide and 340 feet long is maintained to a depth of 16 feet in summer. In winter, an area 30 feet wide and 120 feet along the dock face is maintained to a depth of 10 feet plus 2 feet of over depth. The dredged area appears to comprise less than five percent of the bay area.

No rivers, creeks, or other waterways flow into Port Orford. It is not specifically identified in designated critical habitat for the threatened Southern Oregon/Northern California Coast ESU coho salmon (64 FR 24049). The ODFW preferred in-water work window for Port Orford is 15 July to 31 October (ODFW 1997).

## 1.9 Rogue River

The COE maintains two jetties at the entrance to the Rogue River. Approximately 1,100 feet apart at their outer ends, the north jetty is approximately 2,700 feet long, while the south jetty is approximately 1,900 feet long. The COE also maintains an authorized navigational channel from deep water to the Gold Beach Boat Basin (a distance of 3,500 feet). This navigational channel is maintained at 300 feet wide by 13 feet deep (plus 3 to 5 feet of over-depth for advance maintenance). Between the two jetties, the navigational channel comprises approximately 32 percent of the channel width. However, the navigational channel occupies approximately 57 percent of the channel within a short (approximately 900-foot long) section near RM 0-0. A 8-foot depth (plus 2 feet additional over-depth) by 100-foot wide channel is maintained within the 2,000-foot long entrance to the boat basin.

Within the entrance channel, the COE mainly employs a hopper dredge with ocean disposal (approximately 2 miles offshore). Approximately 80,000 cubic yards of material is annually removed, requiring approximately 16 days. The dredged material is primarily sand, but some cobbles and gravels occur.

The entrance to the boat basin is maintained primarily by pipeline dredging (approximately 18 days), with the material disposed of in the surf zone south of the south jetty. This area typically yields 24,000 cubic yards of fine sand, silt, and clay. Dredging is supplemented by the use of the Sandwick agitation dredge, typically 24 days of operation between 1 April and 1 July (but may occur as late as 31 October).

The Rogue River supports anadromous salmonids including coho salmon, winter steelhead, and spring and fall chinook salmon (ODFW 1992). The Rogue River is included as designated critical habitat for the threatened Southern Oregon/Northern California Coast ESU coho salmon (64 FR 24049). The ODFW preferred in-water work window for the Rogue River in the project area is 1 October to 31 May (ODFW 1997). At the Rogue River, upstream migration of adult coho salmon typically ranges from October through December, but a distinctive peak is apparent in October. Juvenile outmigration extends from April through August, but peaks in June.

## 1.10 Chetco River

Two stone jetties protect the entrance to the Chetco River. The north jetty is approximately 1,270 feet long, while the south jetty is approximately 1,225 feet long. The COE maintains a 120-foot wide by 14-foot deep navigational channel between the ocean and Brookings Harbor turning basin (RM 0.0). This entrance channel comprises approximately 48 percent of the width between the jetties, and approximately 26 percent of the channel width further upstream. The 250-foot wide by 650-foot long turning basin, protected by a dike, is annually maintained to a depth of 14 feet. A hopper or rarely a clamshell dredge is annually used between 1 April and 31 October (approximately 6 days) to remove an average of 35,000 cubic yards of sand (with some gravels and cobbles) from the entrance channel. This is supplemented by use of the Sandwick agitation dredge (approximately 6 days).

The Chetco River support anadromous salmonids including coho salmon, winter steelhead, and spring and fall chinook salmon (ODFW 1992). It is included as designated critical habitat for the Southern Oregon/Northern California Coast ESU coho salmon (64 FR 24049). Cutthroat trout, Coast Range sculpin, prickley sculpin, reticulate sculpin, and stickleback are also documented in the Chetco River (ODFW 1992). The ODFW preferred in-water work window for the mouth of the Chetco River is 1 October to 31 May (ODFW 1997). In the Chetco River, upstream migration of adult coho salmon typically ranges from October through December, but a distinctive peak is apparent in October. Juvenile outmigration extends from April through August, but peaks in June.

# 2. LIFE HISTORY OF OREGON COAST COHO SALMON

Coho salmon were historically distributed throughout the North Pacific Ocean north of Central California. This anadromous salmonid exhibits a relatively short, 3-year life cycle. Adults typically enter fresh water in late-summer through fall, spawn by mid-winter, and die thereafter. Variation is exhibited between and within populations of coho salmon. Depending upon water temperature, incubation in river gravels requires 1.5 to 4 months. Juvenile coho salmon rear in fresh water up to 15 months after emergence, and smolts outmigrate to the ocean in the spring. For several months before they disperse, these smolts typically stay in nearshore areas close to their natal streams (Groot and Margolis 1991). Coho salmon from California to British Columbia typically migrate northward along the coast, generally remaining over the continental shelf, within sight of land, and at depths less than 90 - 150 meters (Groot and Margolis 1991). While in fresh water, juvenile coho salmon feed primarily on aquatic invertebrates, but fish become an important prey as coho grow larger (Groot and Margolis 1991). In estuarine and marine environments, chum and pink salmon fry, as well as larvae of pacific crab are important prey. Coho salmon may spend days to weeks in estuaries, using them primarily for migration and physiological transition between the marine and fresh-water environments (EPA 1998). The primary habitats used are mud flats, tidal channels, and open water; salt marsh and eelgrass habitats are not used (EPA 1998). Typically, coho salmon spend two growing seasons (approximately 18 months) in the ocean before returning to their natal streams to spawn. However, precocious males "Jacks' return after 6 months. Table 1 includes detail pertaining to typical seasonal use by coho salmon in the waterways proposed for dredging.

The Southern Oregon/Northern California Coast ESU coho salmon was listed threatened under ESA on 6 May 1997 (62 FR 24588). This ESU includes all coho salmon naturally reproduced in streams between Cape Blanco, Oregon and Punta Gorda, California. Critical habitat was

subsequently identified (final rule) on 5 May 1999 (64 FR 24049). In this final rule, designated critical habitat includes "...consists of the water, substrate, and adjacent riparian zone of estuarine and riverine reaches..." in specified hydrologic units of river reaches accessible to listed coho salmon within the listed ESU (64 FR 24049).

Coho salmon of the Oregon Coast ESU (i.e., between Cape Blanco and the Columbia River) were listed as threatened under the ESA on 10 August 1998 (63 FR 42587). Critical habitat was proposed on 10 May 1999 (64 FR 24988). In the proposed rule, critical habitat is defined as "the current fresh water and estuarine range inhabited by the ESU." In the rule, fresh water critical habitat includes all waterways and substrates below longstanding naturally impassable barriers (i.e., natural waterfalls in existence for at least several hundred years) and several dams that block access to former salmon habitats" (64 FR 24988).

Section 9 of the ESA prohibits the take of listed threatened or endangered species. Under this act, "take" includes to "harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct" (16 USC 1532(19)). Habitat destruction is included in the definition of take, as determined in Babbitt v. Sweet Home Capture of Communities for a Greater Oregon. With this in mind, the following section discusses the anticipated affect of coastal dredging by the COE to the threatened coho salmon.

## 3. IMPACTS TO LISTED SPECIES

The potential impacts to coho salmon anticipated to result from maintenance dredging along the Oregon Coast are discussed below. The potential impacts may include direct mortality, harassment, and habitat loss. Due to weather constraints on vessel operation, some dredging operations are anticipated to coincide with the peak time of adult river entry (i.e., October), and of outmigration of smolts (i.e., early to mid May).

### 3.1 Direct Mortality

Direct mortality to individual coho salmon is unlikely from hopper, clamshell, and pipeline dredging operations. While dredging operations have the potential to entrain coho salmon, no salmonids were entrained in 366 samples taken in a 1997-1998 study of salmonid entrainment during operation of the Corps of Engineers' *Yaquina* hopper dredge in the Yaquina, Siuslaw, Umpqua, Rogue, and Chetco Rivers (R2 Resouces 1999). Aquatic biota observed in the samples included flatfish, perch, lingcod, sandlance, sculpin, gunnel, smelt, Pacific sandfish, Dungeness crab (adult and juveniles), red cancer crab (adult and juvenile), kelp crab, hermit crabs, shrimp, razor clams, jellyfish, sea star, sand dollars, snails, and isopods (R2 Resources 1999). A slight risk to coho salmon, remains, however, when the dragheads or cutterheads are not in direct contact with the substrate, such as when the pumps are being primed, the lines and hoppers are being flushed, when vessels are being maneuvered.

The nature of the agitation dredge minimizes the potential for direct mortality to coho salmon from dredging operations. The underwater velocities and wavefront created in the path of this type of dredge would preclude entrainment and other potential direct mortality in the propeller.

### 3.2 Harassment

Vibration, noise, and turbidity from dredging operations may displace or otherwise harass both adult and juvenile coho salmon. Noise and vibration are expected in and proximal to the

navigational channel, and may displace or harass (e.g., stress) individual coho salmon even if they do not occupy the area being dredged. This type of potential harassment would be limited to coho salmon occupying the area during the time dredging is taking place. The extent of this potential take cannot be quantified.

Temporary increases in turbidity will result from dredging operations, particularly from agitation dredging. These increases will generally be limited to the navigational channel during the time dredging is taking place. Generally, the dredged material has little or no fine component and the material would quickly settle out from suspension. Displacement of adult and juvenile coho salmon is anticipated to result from the increased turbidity from dredging, but there is a risk of harm to individuals not displaced. The extent of this potential take cannot be quantified.

### 3.3 Loss of Modification of Critical Habitat

Habitat loss may result from the dredging operations. The activities, however, will be limited to areas routinely subject to dredging (i.e., navigation channels, turning basins, boat basins). Coho salmon use estuarine habitats (primarily tidal channels and open water) mainly for migration and for physiological transition prior to ocean residency. The dredged navigational channels are not suitable rearing or optimal foraging habitat for coho salmon. Most areas are dredged on an annual basis, therefore, it is unlikely that substantial benthic populations would be established.

### 3.4 Other

Sediments from the Federal navigation channels are evaluated to determine that they are acceptable for in-water disposal according to the requirements of the Clean Water Act and the Marine Protection, Research, and Sanctuaries Act. Chemical analyses include metals, polynuclear aeromatic hydrocarbons, total organic carbon, acid volatile sulfide, and pesticides/polychlorobiphenyls. Operation and maintenance project sediment testing is performed on a 5-year rotational cycle for projects dredged on a regular schedule. Projects dredged less frequently are sampled, tested, and evaluated as needed prior to dredging. Testing follows national guidance prepared jointly by the COE and U.S. Environmental Protection Agency, and is coordinated with the Oregon Department of Environmental Quality (DEQ).

## 4. CONSERVATION MEASURES

If captain or crew operating the dredges observe any kind of sheen or other indication of contaminants, he/she will immediately stop dredging and notify Corps of Engineers Environmental staff to determine appropriate action.

Should routine or other sediment sampling determine that dredged material is not acceptable for unconfined in-water placement, a suitable, alternative disposal plan will be developed in cooperation with the U.S. EPA and other agencies.

The Corps of Engineers will conduct sediment sampling at the Coos Bay project area, and will obtain the results of sampling currently being undertaken by the USFWS and DEQ near the site of the *New Carissa* grounding. If contaminants are detected, ocean disposal will not occur, and the Corps of Engineers will consult with NMFS regarding alternate sediment disposal.

To minimize the potential for entrainment of coho salmon, the dragheads and cutterheads will remain on the bottom of the water column to the greatest extent possible. Exceptions may include, but not be limited to, priming the pumps, clearing the lines, and turning the vessel.

## 5. DETERMINATION OF EFFECT

Based on the implementation of the conservation measures and other considerations outlined above, it is concluded that the Federal navigation projects (i.e., maintenance dredging) at Tillamook Bay, Depoe Bay, Yaquina Bay and Harbor, Siuslaw River, Umpqua River, Coos Bay, Coquille River and Bandon Boat Basin, Port Orford, Rogue River, and Chetco River may affect, but are not likely to adversely affect coho salmon. In addition, these projects will not result in loss or adverse modification of designated or proposed critical habitat.

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**DEPARTMENT OF THE ARMY**
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AUG 2 2000

Reply to
Attention of:
Planning, Programs and Project Management Division

Ms. Nora Berwick
Northwest Regional Coordinator, Essential Fisheries Habitat
National Marine Fisheries Service
525 NE Oregon Street Suite 500
Portland, OR 97232-2737

Dear Ms. Berwick:

Pursuant to the Magnuson-Stevens Fishery Conservation and Management Act and the 1996 Sustainable Fisheries Act an Essential Fish Habitat (EFH) consultation is necessary for any Federal action that has the potential to impact EFH. Essential fish habitat is defined by the Act in Section 3 (104-297) as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity". The estuaries and the Pacific Ocean off the mouth of these estuaries are designated as EFH for various ground fish and coastal pelagic species. A draft plan has also been prepared for salmon EFH and is in the process of being finalized. Attached is an assessment of the potential impacts to EFH by Portland District's maintenance dredging program for the Oregon Coastal Projects. The assessment is for ground fish, coastal pelagic and salmon species. Salmon EFH is included even though the salmon plan has not been finalized. This is done because it is likely that the plan will be finalized during the period of this consultation.

We are requesting that this EFH assessment be incorporated into the ongoing Endangered Species Act consultation that is also being done for the Coastal Dredging Program and that the EFH recommendations be provided in the Biological Opinion for the program. If you need any additional information please contact Mr. Kim Larson (503) 808-4776 of my staff.

Robert E. Willis
Chief, Environmental Resources
Branch

Enclosure

# ESSENTIAL FISH HABITAT ASSESSMENT FOR COASTAL DREGING PROJECTS

**Action Agency:** US Army Corps of Engineers, Portland District.

**Location:** Coast of Oregon at the following estuaries: Columbia River, Tillamook Bay, Depoe Bay, Yaquina Bay, Siuslaw River, Umpqua River, Coos Bay, Coquille River, Rogue River and Port Orford

**Project Name:** The Maintenance Dredging Program for the Oregon Coastal Projects.

**Project Description:** The Portland District Corps of Engineers (COE) routinely dredges several waterways along the Oregon Coast to maintain federal navigation channels. The COE uses four dredging techniques on the Oregon Coast: hopper, pipeline, clamshell, and agitation. These techniques are described below. The COE Portland District contracts out approximately 40 percent of dredging along the Oregon Coast, and operates it's own fleet of three dredges for work in this area, the hopper dredges *Yaquina*, *Essayons*, and the agitation dredge *Sandwick*.

Scheduling of maintenance dredging along the Oregon Coast considers numerous factors. Dredging is typically limited to the period from May to mid-October, because of adverse weather conditions in the winter. It has been possible depending upon weather to dredge later than October or as early as April or March for emergencies. Shoaling patterns and needs change continually, so hydrographic surveys (depth) are frequently conducted to track channel conditions throughout the season. The need for dredging is determined by a combination of hydrographic surveys, level of traffic, Coast Guard or other safety concerns, and expressions of concern by local traffic or Ports. Typically, the areas of greatest shoaling are dredged first, but considerations such as commercial and seasonal demand are factored into justifications. To the extent possible, the COE concentrates on entrance bars first (whenever ocean conditions permit) and saves inside channel (protected) areas for later in the season (unless conditions restrict traffic). The COE ideally dredges projects to their full-authorized depth, including up to three feet of overdepth for advanced maintenance. There are times, however, when the COE must do minimal dredging to deal with emergency circumstances, then return at a later date to complete the work.

Hopper dredges are seagoing vessels designed to dredge and transport dredged material to open-water disposal areas. The working of a hopper dredge is similar to that of a home vacuum cleaner. Dragarms with dragheads extend from each side of the ship's hull. The dragheads are lowered to the channel bottom and are slowly drawn over or through the substrate. Pumps create suction in the dragarm and the material is drawn up through the arms and deposited in hopper bins in the vessel's midsection. When the bins are full, the dredge sails to the designated disposal area and empties the dredged material through large hopper doors in the bottom of the hull, or in split-hull dredges, by opening the full length of the hopper. The COE *Yaquina* is a small (200 feet), shallow-draft hopper dredge. Because of its size, it is particularly well suited for dredging smaller, shallow coastal entrances, but is equally suited to work in deep draft waters. The COE *Essayons* is a medium-class hopper dredge designed for deep-draft projects. On the Oregon Coast, it is typically limited to Coos Bay and the Columbia River.

The pipeline dredge is a steel hull, cutter-head type of dredge, using a single cutter head at the end of a suction pipe. It is not self-propelled. The dredge is towed to its initial position and generally anchored by retractable spuds on the stern, and swing anchors on the bow. Once on station, the discharge pipeline is attached. Pipeline length varies depending on disposal location and method. Once the pipeline is connected, the dredge cutter head, mounted on a lattice frame (ladder), is lowered to the river bottom. While digging, the cutter, rotating at around 24 rpm loosens up sediment, allowing it to be pumped with water (in a slurry form) to the disposal site.

Clamshell dredging is done using a bucket operated from a crane, derrick mounted on a barge, or from shore. Sediment removed by the bucket is usually placed on a barge for removal to an approved site. Material can be off-loaded to an upland site, or more commonly, placed in an acceptable in-water site. Bucket dredges are not self-propelled, so they are not typically used in high traffic areas. They are often used in tight quarters, such as around docks and piers. In addition, because they are usually barge-mounted, they can be used in shallow areas where draft restrictions limit other choices. Dredged material comes up virtually *in situ*, so clamshells are particularly good in silts or contaminated material, where water entrainment is a concern.

Channel flushing (agitation dredging) is an effective method for shallow areas (depths of up to 20 feet). The *Sandwick* is a small converted military landing craft that operates as a channel flusher. It typically operates in projects of less than 20 feet draft and small clean-up jobs. The *Sandwick* has been fitted with a large steel plate, and operates by deflecting propeller wash toward the shoal area. Sediments are put into suspension and subsequently transferred downstream during an ebb tide flow by a combination of propeller wash and tidal current. This type of dredge is used only on ebb tides. This process is similar to natural processes that distribute sediment throughout the channel, but at an accelerated rate. The Sandwick can move approximately 800 to 1000 cubic yards of material per day, depending on the project site.

Most dredging operations are done 24 hours a day 6 days a week depending upon weather and dredge repair. The dredge is usually tied up on the seventh day to change crews and do minor maintenance. Agitation dredging is done only during the major ebb tide each day. Routine maintenance dredging for each location on the Oregon Coast is described below (from north to south), with dredging depths given in relation to mean lower low water (MLLW). The dredging in these waterways occurs in isolated areas only, that is, dredging rarely entails the full width of the authorized navigational channel.

Most of the estuaries have rubble mound jetties at the entrance. These jetties were constructed to direct the river flow to help maintain the entrance channel and reduce dredging requirements. These jetties are maintained on an irregular schedule when they have deteriorated to the point that they are no longer functioning as designed. Construction of the jetties has resulted in the loss of mobile sand habitat and the creation of rocky reef habitat. The mobile sand habitat lost was not generally very productive because it is in a high energy zone, while the rocky jetties provide habitat for a variety of ground fish species. Maintenance of the jetties is only done within the confines of the original jetty and will therefore have minimal impact on EFH.

### *1.1 Columbia River*

The Mouth of the Columbia River (MCR) project includes two rubble mound jetties and a spur jetty. The north jetty completed in 1917 is about 2.5 miles long. The south jetty was constructed in 1914 and is about 6.6 miles long. Major rehabs of the jetties were in 1962 and 1965 and again in 1982 for the south jetty and in 1939 and 1965 for the north jetty. Spur jetty A is on the north shore just inside the mouth. It is 0.3 miles long and was built to stabilize the main navigation channel. It was constructed during the first north jetty rehab in 1939.

The entrance channel extends from RM –2 to +3.0 and is dredged annually. The channel is 2640' wide with the northerly 2,000' maintained to a depth of 55' and the southern 640' to a depth of 48'. Approximately 6 million cubic yards are removed from the channel annually and disposed at an ocean disposal site. Four ocean disposal sites have been designated off the mouth of the Columbia River. In addition, one estuary site next to the north jetty is also used for MCR material. The four ocean sites are sites A, B, E, and F. Site A is 5,000' x 2,000' feet and is located to the south of the MCR in 65' feet of water. The site has experience sever mounding problems and is now no longer used. Site B is 5,000' x 2,000' and is located north of the MCR in 110' of water. The site was one of the principal disposal sites for the MCR material and has been used extensively. It has been expanded several times to increase it's capacity and reduce the potential for a mounding problem. The site is currently 12,000' x 24,000' and is in water depths from 60' to 150'. Site B has not been used since 1998 because of mounding problems and objections by the crab fisherman. It is not anticipated that the site will be used again in the near future. Site E is located at the tip of the north jetty and has been used annually since 1973. Site E is considered a dispersive site with the material placed in the site during the summer usually gone by the next summer. The site was normally used during early summer or fall when littoral transport was thought to be northward toward Peacock spit and away from the main navigation channel. Historically only 1,000,000 cubic yards of dredged material has been placed in the site in order not to exceed it's dispersive capacity. The site was expanded in 1997 to increase its capacity and hopefully provide more material for nourishment of the beaches to the north. The site is current triangular in shape and is approximately 2,000' at it's narrowest and 10,000' at the widest, with an average depth of 125'

Site F has been used on and off since the 1960's, but was not used to any extent until 1989. This was due primarily to a preference for use of the other sites and the fact that the site was located in the path of ships entering the Columbia River. In addition, it is in the vicinity of where the pilots transfer to and from vessels entering and leaving the river. Following the development of mounding problems at sites A and B it was decided that site F would have to be used more often. In order to minimize conflicts with shipping and provide adequate capacity the site was expanded 30 times in 1993 to a size of 10,000' x 10,000'. The expanded site was divided into 16 (2,000' x 2,000') cells with a 1,000' buffer strip. The cells are used to distribute the material through out the site so that mounding would not be a problem. The buffer strip is used to ensure that the material is not carried to areas outside the site. The site has been used almost ever year since 1993 and has a remaining capacity of approximately 10,000,000 yards. Disposal beyond this capacity will result in the development of mounds that could alter the wave climate on the approaches to the Columbia River. Disposal in Site F is expected to be extremely limited in the future.

As a result of the mounding that has occurred at most of the existing sites, locations of new sites are being investigated. The sites that have been proposed are described in the Environmental Impact Statement (EIS) for the Columbia River Channel Improvement Project. The sites proposed are south east of the entrance in 150' to 300' of water and the expanded site E. These sites have been designed to be large enough in capacity so that disposal operations can be managed to avoid mounding and have the capacity to last for 50 years. The EFH evaluation for these sites was included in the EFH evaluation for the channel deepening project and will not be covered in this evaluation.

### *1.2 Tillamook Bay and Bar*

The Tillamook project includes a north and south rubble mound jetties 5,700' and 8,000' long respectively. Dredging is required every five to eight years in the channel from RM 3.0 to the Garibaldi Boat Basin. Typically, 30,000 cubic yards of material is removed to maintain a 12-foot deep by 200 feet wide channel. An additional 2 feet of over-depth dredging can be performed for advanced maintenance and dredging tolerance. The material is primarily silty sand but grades to sandy clayey silt. Dredging is done using a clamshell/bucket dredge with ocean disposal, or by using a pipeline to an upland disposal site. The likely ocean disposal site is approximately 3.5 miles offshore. Approximately 17 days of dredging are done between 1 April and 31 October. Dredging with ocean disposal is dependent upon weather conditions. The area was last dredged in 1991 and is planned for 2000. Two ocean disposal sites have been designated offshore of Tillamook Bay. The interim site was designated in 1977 and is located 1.2 nautical miles offshore of the entrance to the jetties. The site is 3,500' x 1,500' in 90' of water. It was used between 1977 and 1979 and 53,000 cubic yards of material were deposited in the site. Sampling done in the site in 1985 as part of the final site designation process indicated the site had unusually high productivity. Consequently, it was decided to relocate the site to the south in an area of less biological productivity. The adjusted site is located south of the interim site and is 4000' x 2000' in water depths ranging from 60-100'. No dredge material has been deposited in either of the ocean disposal sites since 1979, because of the scouring action in the channel that occurred after the completion of the south jetty. There is some indication that a shoal near the south jetty will need to be dredged and that material would be placed in the ocean disposal site. Other material that could potential be placed in the ocean site are the material from RM 3+00 to 3+26 near Garibaldi, OR.

### *1.3 Depoe Bay*

Dredging is done in the Depoe Bay boat basin and at a check dam (owned by the Port of Depoe Bay) at the mouth of Depoe Bay Creek every five to eight years. The boat basin is maintained at 8 feet deep (plus an additional 1-foot of over-depth), in an area 750 feet long and averaging 390 feet wide (nearly the full extent of the boat basin). Pipeline dredging to a surf-zone disposal site is used to remove typically 15,000 cubic yards of accumulated silty sand at the boat basin. The 6-foot high check dam was completed in 1950 to reduce sediment input into the Bay. Either a dragline or a bucket dredge is used to move a maximum of 2,000 cubic yards of silty sand from behind the dam to an upland disposal site. The dredging activities at Depoe Bay historically occur between 1 June and 15 September, depending upon weather. The boat basin dredging may

take approximately 10 days, while the dredging behind the check dam may require approximately 4 days.

A interim ocean disposal site was designated off Depoe Bay in 1977. The site was 1,800' x 700' and was located in 90' of water. The site was never used because of logistics and has been de-designated.

*1.4 Yaquina Bay and Harbor*

The Yaquina Bay and Harbor project includes two rubble mound jetties at the entrance. The North and South Jetties are 7,000 feet and 8,600 feet long, respectively, and are 1,000 feet apart at their outer ends. In addition, an 800-foot long spur jetty protects the south side of the channel. The entrance channel is dredged annually, over a period of approximately 32 days, to remove approximately 340,000 cubic yards of sand a from the entrance to the turning basin using a hopper or clamshell dredge with ocean disposal. Two ocean disposal sites have existed off the mouth of the Yaquina River. The initial interim site was designated in 1977 and is directly off of the mouth of the estuary. This site was 3,600' x 1,400' in 60' of water. The site was used until 1986 when mounding became a problem and the site was adjusted to the north using 103 authority. The adjusted site was 2,200' x 4,070' and was in 70' of water. Mounding continued to a problem and a part of the original interim site (2,800' x 1,400') was redesignated for use in 1998. Mounding has continued to be a problem and Portland District and EPA are in the process of identify a new site that will be located away from the entrance to the bay. This site is anticipated to be available for use by 2001.

The one-mile segment of the main navigation channel, from deep water to RM 0+0, is authorized at 400 feet wide and 40 feet deep (plus a 5-foot allowable over-depth). At RM 0+0, the channel is reduced to 300 feet wide and 30 feet deep (plus a 2-foot allowable over-depth). This channel configuration continues for another two miles upstream of the Highway 101 bridge, to a turning basin. The turning basin, at RM 2+00 to RM 2+40, is 30 feet deep and occupies an area 900 to 1,200 feet wide by 1,400 feet long.

The project also includes an access channel to the South Beach Basin Marina, just upstream of the Highway 101 bridge. This channel is 10 feet deep (plus a 1-foot allowable over-depth) by 100 feet wide, extending over a distance of 1,035 feet. Every five to eight years, typically 30,000 cubic yards of material will be removed using a pipeline dredge with the material disposed of at an upland site. Dredging is undertaken over an approximate 30-day period, between 15 September and 31 October. The Port of Newport maintains the rest of the boat basin.
The Yaquina River project includes a channel 10 feet deep and 150 feet wide extending from RM 4.0 upstream to RM 14.0, at Toledo, with a channel into Depot Slough. Depot Slough was dredged in 1995 but is not expected to require dredging in the foreseeable future. The Yaquina River channel itself is not maintained. If dredging were ever required, it would likely be done by clamshell dredge with material barged to the ocean disposal site.

*1.5 Siuslaw River*

The Siuslaw River project includes two jetties, approximately 750 feet apart at their outer ends. The north and south jetties extend 9,690 feet and 6,000 feet, respectively. Each jetty includes a

400-foot long spur jetty on the outer side, approximately 900 feet shoreward of the jetty heads. The Siuslaw River entrance channel is dredged downstream of RM 0.2 to 300-foot wide by 18 feet deep (plus up to 5 feet over-depth). Typically, 180,000 cubic yards of poorly-graded sand with low organic content is removed annually using a hopper dredge with ocean disposal. Three ocean disposal sites have been used off the mouth of the Siuslaw River. Site A which is located just off the mouth of the estuary in 70' of water, was designated as an interim site in 1977. It is 3,000' x 900' and was used until mounding became a concern in the early 1990's. Two additional sites were designated under the Corps 103 authority sites B and C. Site B is an extension of Site A and extends further offshore in to area with a water depth of 90'. It is 3,000' x 2,000' and includes part of Site A. Site C is 3,000' x 2,000'and is located south of the channel in 78' of water about the same distance as Site A from the entrance channel. From 1994 until 1996 disposal was limited to the outer third of Site A because of mounding. No material has been placed in Site A since 1996. Dredging of the entrance channel typically occurs over a period of 9 days. The channel upstream to RM 5, is authorized to 200-foot wide by 16-foot deep. Between RM 5 and RM 16.5, a 120-foot wide channel is authorized to a 12-foot depth. A 400-foot by 600-foot turning basin at RM 5 at Florence is authorized at a 16-foot depth. These inner reaches are not currently maintained to their authorized depth, and are not frequently dredged.

### *1.6 Umpqua River*

The Umpqua River project includes two jetties at the river entrance. The north jetty is approximately 8,000 feet long, while the south jetty is approximately 4,200 feet long. The south jetty includes a training jetty on the north side. The Umpqua River navigation channel extends from the mouth upriver to Reedsport at approximately RM 11. The entrance channel, which extends from RM –1 to RM 0-10, is authorized to a depth of 26 feet, with up to five foot of over-depth for advanced maintenance, and a width of 400 feet. The entrance channel is maintained using a hopper dredge with ocean disposal. Two ocean disposal sites have been used off the mouth of the Umpqua River since 1977. The first site was designated in 1977 and was locate ½ mile offshore of the entrance. As a result of relocation of the channel and mounding in this site a new site was proposed to the north of the first site. This site has been used exclusively since 1991. The new site is located at a depth of approximately 105' and is 3,200' x 1,400' in size. Approximately, 180,000 cubic yards of sand material is typically removed annually from this portion of the channel over a period of 18 days. Since 1992 approximately 166,000 cubic yards of material have been placed in this site from the Umpqua River main navigation channel.

Beginning at RM 0-10 and extending to Reedsport at RM 11+40, Umpqua River maintenance dredging normally occurs between 15 September and 31 October. It can occur between 1 April and 31 October, however, if critical shoaling occurs, or as a back-up dredging location when weather conditions prevents dredging the entrance channel. Typically, 20 days are required to remove the anticipated 180,000 cubic yards of material from this reach of the Umpqua River to an in-bay or the ocean disposal site. This channel is maintained to a depth of 22 feet, with up to two feet of over-depth for advanced maintenance and dredging tolerance, and a width of 200 feet. At approximately RM 8, a side channel extends approximately 1.3 miles to Gardiner. This 200-foot wide side channel is authorized at a depth of 22 feet. While not maintained to the extent authorized, a 22-foot deep turning basin at Gardiner is 500 feet wide by 800 feet long. On the Umpqua River, there is also a 600-foot wide by 1000-foot long turning basin at Reedsport

(approximately RM 10) that is authorized to a depth of 22 feet, but has not been dredged for several years.

The access channels to the two boat basins in Winchester Bay are also dredged annually. The east and west boat basin channels are authorized to 16 feet deep and 100 feet wide, with the exception of the southern 950 feet of the east basin, which is authorized to 12 feet deep and 75 feet wide. Up to two feet of advanced maintenance dredging is performed to ensure that the authorized depth is maintained between dredging operations. The *Sandwick*, an agitation dredge, will be used over a period of 10 to 20 days annually to redistribute some accumulated sediment. This work is generally conducted between 1 September and 31 October. A clamshell dredge with in-bay disposal or a pipeline dredge with upland (North Spit) disposal is also periodically used (every 5 to 8 years) to remove typically 30,000 cubic yards of sediment (primarily poorly-graded sand) from the bay.

### *1.7 Coos Bay*

The Coos Bay project includes a north and south jetty approximately 4,300 feet and 4,000 feet long, respectively. The navigation channel at the entrance to Coos Bay is annually dredged to maintain a 47-foot depth and 700-foot width channel. Typically, 800,000 cubic yards of material is removed from the entrance, over a period of approximately 18 days. Dredging is done using a hopper dredge with ocean disposal. There are four ocean disposal sites offshore of Coos Bay, Sites H, E, F and a rock site. Site H is furthest offshore at a depth of 165 feet. It is in an area of primary fine grain sediment and is used primarily for disposal of fine grain material from above RM 12 in the Coos Bay channel. The site is approximately 3,300' x 1,200' and has been used since 1986. Sites E and F are closer inshore at depths of 51 feet and 72 feet respectively and are in an area of coarse grained material. Both sites are used for disposal of coarse grained material from the lower reaches of the navigation channel. Site E is 3,300' x 1,200' and is located directly off the mouth of the jetties. The original Site F was located north of site E and was the same size as site E. Concerns with mounding of dredge material and the desire to have a site big enough for it to managed to eliminate mounding resulted in it being ultimately expanded twice to a site approximately 13,000' x 7,500' in 1995. The rock site was a one time use site for placement of rock from the Coos Bay channel deepening project. The site is 1,800' x 500' and is located directly offshore of site E in approximately 100 feet of water. In 1997 180,000 cubic yards of rock were placed in the rock site. Sites E and F have been used on a regular basis since 1976. Use of site E was discontinued in 1990 when mounding problems became severe.

The channel gradually decreases from 47 to 37 feet deep and 300 feet wide at RM 1.0 and then continues to RM 9. Within this reach, approximately 300,000 cubic yards of material is typically removed over a period of approximately 25 days. A hopper dredge is used, with either in-bay or ocean disposal. At RM 9, the channel widens to 400 feet and continues to RM 15. From RM 12 to RM 15, 800,000 cubic yards of fine grained sediment is typically removed with a clamshell dredge every other year, and placed at an ocean disposal site. Dredging operations in this area are typically undertaken between 1 April and 31 October, although the work above RM 12 has extended into December.

Charleston Channel extends to the south off Coos Bay at RM 2 and is annually dredged to

provide for a 17-foot deep channel 150-foot wide channel for 3,200 feet, and then 16 feet deep to the highway bridge, at approximately RM 1.15. Agitation dredging (only on ebb tides) is done over an average of 18 days early in the dredging season to help clean out the entrance. In addition, up to 40,000 cubic yards of sand has been removed some years using a hopper or clamshell dredge. This material has been disposed of in the ocean (approximately 1.5 miles offshore) or in "area G" at Coos Bay RM 1, between Coos Head and the North Spit.

### *1.8 Coquille River and Bandon Boat Basin*

The north and south jetties at Coquille River are 3,450 feet and 2,700 feet long, respectively. The entrance to the river is annually dredged to an authorized depth of 13 feet (plus up to 5 feet advanced maintenance) by 200 feet wide up to RM 1.3. A hopper dredge is used to remove typically 40,000 cubic yards of sand annually at the entrance and take it to an ocean disposal site (approximately 1 mile offshore). Two ocean sites have been used offshore of the Coquille River. The original site is located south of the entrance in about 60 feet of water and is 3,600'x 1,400'. Concerns with mounding of dredge material and with the presence of rock pinnacles in area necessitated moving the site to an area north of the entrance. This site is in 60 feet of water and about the same size (3,500'x1,750'). Dredging the main navigation channel is done from 1 April to 31 October, typically requiring 5 days. The channel to the boat basin is maintained every five to ten years using a pipeline dredge. Typically 6,000 cubic yards of material is removed to a flow lane site in the main channel. This dredging is conducted between 1 April and 31 October, typically requiring 6 days.

### *1.9 Port Orford*

The Port Orford project includes a 550-foot long breakwater and dredging of a turning basin. A northerly littoral drift results in shoaling in the boat basin and along the end and face of the dock. The boat basin is annually maintained using both agitation and pipeline dredging. Agitation dredging occurs during ebb tides for 45 to 50 days per year between 1 April and 31 October. Pipeline dredging occurs between 1 November and 31 March for approximately 16 days of dredging. Typically up to 6,000 cubic yards of coarse-grained sand is piped to an upland (beach) disposal site or in-water south of the jetty. Along the face of the dock an area 100 feet wide and 340 feet long is maintained to a depth of 16 feet in summer. In winter, an area 30 feet wide and 120 feet along the dock face is maintained to a depth of 10 feet plus 2 feet of over depth. Port Orford also has an ocean disposal site located south of the boat basin in approximately 50 feet of water. It is 1,800 feet by 700 feet and has been used only once.

### *1.10 Rogue River*

The north jetty at the Rogue River is approximately 2,700 feet long, while the south jetty is approximately 1,900 feet long. The navigational channel extends from deep water to the Gold Beach Boat Basin (a distance of 3,500 feet) and is maintained to a width of 300 feet and a depth of 13 feet (plus 3 to 5 feet of over-depth for advance maintenance). The 2000-foot entrance channel to the boat basin is maintained to a depth of 8-foot depth (plus 2 feet additional over-depth) and a width of 100-foot.

The main navigation channel is maintained by a hopper dredge with ocean disposal. The existing ocean disposal site is located to the south of the entrance approximately 1.75 miles from in the

entrance in 60 feet of water. The site is currently 3,600 x 1,400 feet but is purposed to be doubled to 2,800 feet to the north because of concern with mounding of sediments that have occurred at other sites along the coast. Approximately 67,000 cubic yards of material have been placed in the site annually since 1987. Dredging of the main navigation channel takes approximately 16 days. The material dredged from the Rogue is primarily sand, but there is also some cobbles and gravel. The entrance to the boat basin is maintained primarily by pipeline dredging (approximately 18 days), with the material disposed of in the surf zone south of the south jetty. This area typically yields 24,000 cubic yards of fine sand, silt, and clay. Dredging is supplemented by agitation dredging, which typically takes 24 days of between 1 April and 1 July (but may occur as late as 31 October). A total of approximately 80,000 cubic yards are annually removed from the Rogue River project.

### *1.11 Chetco River*

The north jetty at the Chetco River is approximately 1,270 feet long, while the south jetty is approximately 1,225 feet long. The main navigation channel extends from the ocean to Brookings Harbor turning basin (RM 0.0). It is maintained to a width of 120-foot and a depth of 14 feet. The 250-foot wide by 650-foot long turning basin, protected by a dike, is annually maintained to a depth of 14 feet. A hopper or rarely a clamshell dredge is annually used between 1 April and 31 October, for approximately 6 days, to remove an average of 35,000 cubic yards of sand (with some gravel and cobbles) from the entrance channel. This is supplemented by use of an agitation dredge for approximately 6 days. Dredged material from the operation of the hopper dredge is normally placed in the ocean disposal site. The ocean disposal site is located approximately 1 mile offshore in water depths of 70 feet. The disposal site is 1800 feet on a side and has been used annually since 1972. Since 1996 disposal has been done in a near shore berm along the beach south of the south jetty rather than at the ocean disposal site. This is being done to reduce erosion of the beach near the Sporthaven county park. Erosion in this area is threatening the south jetty.

**Essential Fish Habitat Designations:** Pursuant to the Magnuson-Stevens Fishery Conservation and Management Act and the 1996 Sustainable Fisheries Act an Essential Fish Habitat (EFH) consultation is necessary for the above described maintenance actions. Essential fish habitat is defined by the Act in Section 3 (104-297) as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity". The estuaries and the Pacific Ocean off the mouth of these estuaries are designated as EFH for various ground fish and coastal pelagic species (PFMC 1998a and 1998b). A draft plan has also been prepared for salmon EFH and is in the process of being finalized. Salmon EFH is included in this evaluation because it is likely that the plan will be finalized during the period of this consultation. EFH for ground fish, coastal pelagic and salmon species and their life history stages that would be affected by the coastal operation and maintenance activities are listed in the table below.

A detailed discussion of EFH for the groundfish is provided in the Final Environmental Assessment/Regulatory Impact Review for Amendment 11 to The Pacific Coast Groundfish Fishery Management Plan [Pacific Fisheries Management Council (PFMC) 1998] and the NMFS (June 15, 1998), Essential Fish Habitat for West Coast Groundfish Appendix. A detailed discussion of EFH for Coastal Pelagic species is provided in Amendment 8 to the Coastal Pelagic

Species Fishery Management Plan (PFMC 1998). Salmon EFH is discussed in Appendix A of Amendment 14 to the Pacific Coast Salmon Plan (PFMC, 1999). Assessments of the impacts to these species' EFH from the coastal operations and maintenance program including the use of the designation of ocean disposal sites are based on this information.

| **Ground Fish Species** | Egg | Larvae | Young Juvenile | Juvenile | Adult | Spawning |
|---|---|---|---|---|---|---|
| Spiny Dogfish | | | X | X | X | |
| Ratfish | | | | X | X | |
| Lingcod | | X | | X | X | X |
| Cabezon | | X | | | | |
| Kelp Greenling | | X | | | | |
| Pacific Cod | | X | X | X | X | X |
| Pacific Whiting (Hake) | | | X | X | X | |
| Sablefish | | X | X | X | X | X |
| Jack Mackerel | | | | | X | |
| Darkblotched Rockfish | | | | X | X | |
| Greenstriped Rockfish | | | | X | X | |
| Thornyheads | | X | | | | |
| Pacific Ocean Perch | | | | X | X | |
| Widow Rockfish | | | X | X | | |
| Misc. Rockfish | | | | X | X | |
| Arrowtooth Flounder | | | | X | X | |
| Butter Sole | X | X | | | | |
| Curlfin Sole | X | | | | | |
| Dover Sole | X | | | X | X | |
| English Sole | X | X | X | X | X | X |
| Flathead Sole | | X | | X | X | X |
| Pacific Sanddab | | | | X | X | |
| Petrale Sole | | | X | X | X | |
| Rex Sole | X | X | | X | X | |
| Sand Sole | X | X | | | | |
| Starry Flounder | X | X | X | | | X |

| **Coastal Pelagic Species** | Egg | Larvae | Young Juvenile | Juvenile | Adult | Spawning |
|---|---|---|---|---|---|---|
| Northern anchovy | X | X | | X | X | |
| Pacific sardine | X | X | | X | X | |
| Pacific mackerel | X | X | | X | X | |
| Jack mackerel | | | | | X | |
| Market squid | ? | ? | ? | | X | ? |

| **Salmon** | | | | | | |
|---|---|---|---|---|---|---|
| Coho salmon | | | | X | X | |
| Chinook salmon | | | X | X | X | |

**Potential Effects of Dredging and Dredged Material Disposal on EFH:** The coastal operation and maintenance program would affect EFH for ground fish, coastal pelagic and salmon species by altering channel and bottom habitat by dredging and disposal. Dredging and disposal would affect EFH in the following ways: changing bottom topography, removing or covering benthic invertebrate populations, creating a temporary increase in turbidity and reducing migratory habitat by disturbance. Alteration of bottom habitat is likely to effect populations of managed species by reducing food sources through the reduction in benthic invertebrate populations. Reduced food sources and increased turbidities may reduce feeding success and consequently the overall value of the habitat to the managed species. Reduction in migratory habitat may delay salmon migration timing, which can reduce survival of juveniles and success of adults in reaching upriver spawning areas.

In general dredging and disposal impacts to managed species, however, are expected to be minimal. The channel bottom is not considered highly productive habitat because it is disturbed on a regular basis from dredging and ship traffic. The deeper channels also are below the photic zone, which is considered the more productive zone in the river because of increased light penetration. In addition the amount of habitat impacted in the channel areas is small compared to the total amount available for the managed species. Loss of migratory habitat will occur primarily as a result of disturbance created by dredging operations. This impact is not expected to be large since the dredge is only operating in a small portion of the total width of the river. In addition, hopper dredges only operate intermittently since once they are full they have to go to the disposal area to empty the hopper. During this time period disturbance would not be occurring from the dredge operations and any impact to fish migration that may be occurring would be minimal.

Use of the ocean disposal sites will involve covering of existing benthic populations and the loss of them as a food supply to the managed species. In addition, the bottom topography and sediment type may be changed such that recovery after disposal events may be to a different benthic community than what was there prior to disposal. This in turn may change the value of the habitat to the managed species. This is dependent upon where the disposal site is located and whether the type of material disposed of is similar to the natural sediment at the site. Cumulative impact of ocean disposal is the total impacts to the bottom from the use of all the ocean disposal sites at the different estuaries. Use of all of these sites has changed the topography and habitat in these areas and it's continued use will kept the sites from recovering. The total acreage of the existing disposal sites, however, is small compared to the total acres of habitat available off the coast.

Mitigation for the ocean disposal sites was done by selecting sites that avoid unique areas and areas of greater biological productivity and thereby minimizing impacts to the bottom habitat. A buffer zone was also established at some sites to prevent disposal material from occurring outside the site. Selection of most of the sites was done through an extensive coordination process with both federal and state agencies and private interest groups. In addition, in most cases both pre and post studies were done to further characterize the site and help in the management of disposal at the site. The Corps and EPA are continuing to conduct post disposal studies and use this information for the management of the sites.

Mitigation for dredging and disposal impacts are provided by the following measures that were incorporated into the project design to reduce impacts:

**Dredging**

1. Dredging will be done only in channel areas that are dredged on a regular basis and generally have a lower biological productivity than undisturbed areas.

2. Dredging in up river areas will be done during recommended in-water work periods to minimize impacts to managed species habitat.

3. Dredging will be done principally with hydraulic dredges to reduce turbidity levels in the water column.

4. Agitation dredging will be done only during ebb tide so that suspended sediments and resultant turbidity are carried downstream out of the estuary and do not settle into important habitat areas.

**Disposal**

1. Sediments have been tested and determined to be non-contaminated and suitable for in-water disposal.

2. In estuary disposal sites are located, when possible, in areas of high energy and lower biological productivity.

3. Ocean disposal sites are located, to the extent possible, in areas of low biological productivity.

4. Ocean disposal sites are located, to the extent possible, in areas that avoid impacts to commercial fishing operations.

5. Ocean disposal sites bathymetry is monitored on a regular basis to ensure that mounding is not happening and creating a navigation hazard.

6. Some ocean disposal sites have a buffer zone in order to ensure that disposal will not impact areas outside of the disposal site.

**EFH Assessment: Dredging:** Dredging in the main and side navigation channels of the coastal estuaries will have minimal impact on EFH. Most of these areas are dredged on a regular basis and consequently currently do not provide much valuable EFH. The deeper navigation channels are generally lower in productivity because of low light penetration and an unstable bottom. Benthic sampling taken in the channel areas in the Columbia River have shown benthic invertebrate densities a third less than in the areas less than 20 feet deep which are the more

productive areas.

*Ground Fish EFH*

The navigation channels and the estuaries are designated EFH for several species of flounder with the dominate ones being starry flounder and English sole. Most occur primarily as different age juveniles that may use the channel as a migratory corridor to rearing areas in the bays and intertidal areas which have large concentrations of food organisms such as the amphipod *Corophium salmonis*. The less than one-year-old juveniles occur throughout the estuary but are more concentrated in the freshwater and low salinity areas. They are generally not as abundant in the estuary as the older age classes. Age one to two year old juveniles occur throughout the estuary but are abundant year around in the side channels and bays and also in the main navigation channel. Two-year-old juveniles are less widespread and occur mostly in the higher salinity portions of the estuary.

*Coastal Pelagic EFH*

The water column over the navigation channels is designated EFH for the northern anchovy. Anchovies that occur in the estuaries are an extension of the coastal population and occur primarily in the lower estuary where salinity is high. Anchovies spawn in the ocean, but all life history stages can occur in the estuary with the eggs and larvae apparently swept into the estuary by flood tides. Individuals less than one year old, however, are not abundant in the estuary while anchovy one year or older can be abundant particularly during low river flow periods when salinity is higher. Anchovies are pelagic feeders feeding primarily on copepods. Dredging in the estuaries is expected to have a minimal impact on anchovy EFH, since hydraulic dredging and associated disposal will have only minimal impact on turbidity levels in the water column where anchovies occur.

*Salmon EFH*

The navigation and side channels are part of the estuary habitat designated as EFH for Chinook and coho salmon. Both adult and juvenile salmon use this habitat for migration to and from the ocean. The juveniles also use the shallow water portions of the estuary for rearing and acclimating to salt water. The maintenance dredging program along the Oregon Coast has the potential to impact both of these types of habitat. Migration habitat can be impacted by dredge operations. Vibration and noise from dredging operations may displace or otherwise harass both adult and juvenile salmon during their migration. The extent of this potential impact cannot be quantified, however, it is expected to small in the larger estuaries and greater in the smaller, shallower estuaries where there is less areas to avoid it.

Temporary increases in suspended sediment and resultant turbidity from dredging and disposal operations may also impact salmon migration. Agitation dredging in particular produces a large amount of suspended sediment. These increases in suspended sediment will generally be limited to the navigational channel during the time dredging is taking place and to the area around the disposal sites during disposal operations. Most of the dredged material is medium to fine grain

sand has little or no fines or silts and quickly settles out of suspension. Consequently, the impact is expected to be short term and localized. The extent of this potential impact, however, cannot be quantified but could again be worse in the smaller shallow channels since the fish would have fewer areas to avoid it.

Impacts to salmon rearing habitat may also result from dredging and disposal operations but is expected to be small. The dredged navigational channels or historic disposal sites are normally not highly productive rearing habitat for salmon since they are dredged or used for disposed on a fairly regular basis and therefore do not have highly productive benthic invertebrate populations, that juvenile salmon feed upon. As a result it is unlikely that continued dredging and disposal in these areas will have a significant impact on salmon EFH.

**EFH Assessment: Ocean Disposal Site Use:**

Benthic populations have been sampled at most of the ocean disposal sites. The sites are generally located inshore in a mobile sand community environment and are only low to moderately productive. Some of the sites such as the Coos Bay site H and the MCR deep water sites are located in deeper water which is generally more productive than the inshore sites.

*Ground Fish EFH*

All of the disposal sites are designated EFH for the ground fish species listed in Table 1. Most do not provide any unique habitat for ground fish species.

Spiny Dogfish- EFH for young juvenile, juvenile and adult spiny dogfish has the potential to be impacted by ocean disposal. Spiny dogfish are inner shelf-mesobenthal species that occur at depths from 0-900m, but most occur in depths less than 350m. Adult females move inshore to shallow waters in the spring to release their young. Young juveniles are neritic while juveniles and adults are sublittorial bathyal. Juveniles occur principally on mud bottoms when not in the water column while adults can occur from the intertidal to great depths. Based on the above description of habitat requirements for spiny dogfish, the coastal ocean disposal sites do not provide any unique habitat that is not available elsewhere and is only a small proportion of the total areal extent of the EFH described by NMFS (1998). Therefore, impact to the total EFH for this species is anticipated to be minimal.

Ratfish- EFH for juvenile and adult ratfish has the potential to be impacted by the ocean disposal sites. Ratfish are a middle shelf mesobenthal species that occur in depths from 0 to 913m. They are most abundant, however in depths from 100-150m. They also occur in the estuarine EFH complex during the winter and early spring to feed and mate. Ratfish are, however, generally a deep water species that prefer low relief rocky bottoms or exposed gravel or cobble. They are not common over sand or boulders. Based on the above description of Ratfish habitat requirements the disposal sites do not provide any unique habitat that is not available elsewhere and it is only a small proportion of the total areal extent of the EFH described by NMFS (1998). Therefore, impact to the total EFH for this species is anticipated to be minimal.

Lingcod- EFH for spawning, larval, juvenile and adult lingcod has the potential to be impacted by the ocean disposal sites. Lingcod are an estuarine-mesobenthal species that occurs in depths from 0 to 475m. Spawning occurs in 3-10m below mean lower low water over rocky reefs in areas of swift currents. Larvae occur in nearshore areas from winter to late spring. Larger larvae are epipelagic primarily found in the upper three meters of the water column. Juveniles settle in estuaries and shallow waters along the coast while older juveniles move offshore as they grow but are most common in waters greater than 150m. Adults prefer slopes of submerged banks 10-70m below the surface with sea weeds, kelp and eelgrass beds that form feeding grounds for small prey fish. They also prefer channels in rocky intertidal areas with swift currents that concentrate plankton and plankton feeding fish. Based on the habitat requirements for Lingcod, the most of the disposal sites do not provide any unique habitat that is not available elsewhere and is only a small proportion of the total areal extent of the EFH described by NMFS (1998). The sites off Yaqunia Bay are currently near the nertic reef and therefore may be used more than other sites by reef oriented species such as lingcod. These sites are located far enough from the reef to minimize these impacts and the new sites are proposed to be located even further from the reefs, which will further reduce the value of this habitat. Therefore, impact to the total EFH for this species is anticipated to be minimal.

Cabezon and Kelp Greenling- EFH for larval cabezon and kelp greenling has the potential to be impacted by ocean disposal. Both species are abundant all year in estuarine and subtidal areas. Larval and young juvenile cabezon and kelp greenling are pelagic and have been found offshore as far as 322 km. Juveniles settle to the bottom and are found primarily in the shallow water bays and estuaries. The disposal sites would provide minimal habitat for larval stage cabezon and kelp greenling. Impacts to these species from using the sites are expected to be minimal.

Pacific Cod- EFH for larval, young juvenile, juvenile, adult and spawning of Pacific cod has the potential to be impacted by ocean disposal. Pacific cod are a member of the inner shelf-mesobenthal community. The majority of Pacific cod are found at depths between 50-300m with spawning occurring at depths from 40-265m. The eggs are demersal, adhesive and are found sublittorally. Larvae and small juveniles are pelagic, with the highest abundance in the upper 15 to 30m of the water column. Larvae are found over the continental shelf from winter through summer. Small juveniles occur from 60 –150m gradually moving to deeper water with increased age. Larger juveniles and adults are parademersal occurring over mud, sand and clay and occasionally coarse sand and gravel bottoms. Based on the above habitat descriptions for Pacific cod, it is possible that disposal at the deeper water sites could have an impact on habitat used by some life stages of Pacific cod. Based on the habitat requirements described above for Pacific cod, the deep water sites do not provide any unique habitat that is not available elsewhere and is only a small proportion of the total areal extent of the EFH described by NMFS (1998). Therefore, impact to the total EFH for this species is anticipated to be minimal.

Pacific Whiting (Hake)- EFH for young juvenile, juvenile and adult Pacific whiting has the potential to be impacted by disposal at the deep water sites. Pacific hake is a migratory species that inhabits the continental slope and shelf from Baja California to British Columbia. Juvenile hake usually reside in shallow coastal waters, bays and estuaries with adults occurring further offshore, usually between depths of 50- 500m. Along the Pacific Coast from British Columbia to

California adults use a narrow band of feeding habitat near the shelf break for 6-8 months per year. Based on the habitat requirements described above for Pacific whiting, the deeper water sites do not provide any unique habitat that is not available elsewhere and is only a small proportion of the total areal extent of the EFH described by NMFS (1998). Therefore, impact to the total EFH for this species is anticipated to be minimal.

Sablefish- EFH for larval, young juvenile, juvenile, adult and spawning of sablefish has the potential to be impacted by disposal at the deep water sites. Sablefish are an inner shelf-bathybenthal species that occurs in deep water. Sablefish are most abundant from 200-1000m but have been reported to depths of 1900m. Spawning occurs at depths greater than 300m. Larvae and young juveniles are pelagic and may move inshore and remain there for up to four years to rear. Older juveniles and adults inhabit progressively deeper water and are benthopelagic on soft bottoms. Based on the habitat requirements described above for sablefish, the deeper water site does not provide any unique habitat that is not available elsewhere and is only a small proportion of the total areal extent of the EFH described by NMFS (1998). Therefore, impact to the total EFH for this species is anticipated to be minimal.

Jack mackerel- EFH for adult jack mackerel has been identified as having the potential to be impacted by disposal at the deep water sites. Adults occur in neritic and oceanic areas to depths as great as 402m. They are relatively uncommon below 75m. Since jack mackerel are pelagic and show no affinity to any type of bottom substrate, it is not expected that disposal at the deeper water sites would have any affect on jack mackerel EFH.

Rockfish species,Darkblotched, Greenstriped and Misc. Rockfish- EFH for juveniles and adults of these species have the potential to be impacted by disposal at deep water sites. These species are primarily mid- to deep water species. The inshore depth range of adults and juveniles of these species overlaps, to some extent, the depth of the deep water disposal sites. Based on the habitat requirements described above for rockfish species, the deep water sites do not provide any unique habitat that is not available elsewhere and is only a small proportion of the total areal extent of the EFH described by NMFS (1998). Therefore, impact to the total EFH for this species is anticipated to be minimal.

Thornyheads- EFH of larvae of the thornyhead has the potential to be effected by disposal in deep water sites. Thornyheads are deep water species occurring in depths from 400-1400m. Larvae and small juveniles are pelagic for 18-20 months before settling to the bottom. During this time they may occur at the outer edge of the deep water sites. Based on the habitat requirements described above for thornyhead, the deep water sites does not provide any unique habitat that is not available elsewhere and is only a small proportion of the total areal extent of the EFH described by NMFS (1998). Therefore, impact to the total EFH for this species is anticipated to be minimal.

Pacific Ocean Perch- Pacific Ocean Perch is a deep water species that does not occur to any extent in the area of the deep water disposal sites. Therefore there will be no impact to their habitat from the use of the deep water site.

Widow Rockfish- EFH of young juvenile and juvenile widow rock fish has the potential to be impacted by disposal in deep water sites. Both juvenile stages are pelagic. Young juveniles occur from near surface to 20m deep from the inshore out to 300km offshore. Juveniles occur near bottom inshore at depths of 9-37 meters. Off Oregon, widow rockfish are most abundant on the continental shelf. All life histories stages are associated with some type of bottom structure such as seamounts, rocks, and ridges near canyons and headlands. Based on the above habitat requirements for widow rockfish, and because the disposal sites are featureless and do not provide the preferred habitat complexity, no adverse impacts on widow rockfish EFH are anticipated.

Arrowtooth flounder- EFH for juvenile and adult arrowtooth flounder habitat has the potential to be impacted by ocean disposal. Juveniles and adults are sublittorial-bathyal and occur from depths of 18-900m. They prefer sand or sandy gravel bottoms. Arrowtooth flounder migrate from shallow water feeding areas in the summer to offshore spawning areas in the winter. Based on the habitat requirements described above for arrowtooth flounder, the ocean sites do not provide any unique habitat that is not available elsewhere and is only a small proportion of the total areal extent of the EFH described by NMFS (1998). Therefore, impact to the total EFH for this species is anticipated to be minimal.

Butter Sole- EFH for eggs and larvae of the butter sole has the potential to be impacted by ocean disposal. Spawning takes place in coastal areas, within 18 km of the shore. They utilize the shallow waters to rear and then move offshore, as they grow larger. Based on the habitat requirements described above for buttersole, the ocean sites do not provide any unique habitat that is not available elsewhere and is only a small proportion of the total areal extent of the EFH described by NMFS (1998). Therefore, impact to the total EFH for this species is anticipated to be minimal.

Curlfin Sole- EFH for eggs of the curlfin sole has the potential to be impacted by ocean disposal. Curlfin sole are an inshore coastal species that occur on soft bottom. Little information is available on their habitat requirements but it is possible that their eggs could occur in the area of the disposal sites. Any adverse impact to the EFH for eggs will be minimal considering the eggs are pelagic.

Dover Sole- EFH for egg, juvenile and adults of the Dover sole has the potential to be impacted by ocean disposal. Dover sole are a dominant meso-benthal species in the North Pacific. They occur primarily in off shore waters at depths less than 500m. Eggs are epi-pelagic and may occur in the water column over the deeper water sites. Juvenile and adults are demersal and may occur in the disposal sites during summer when they are inshore feeding. Based on the habitat requirements described above for Dover sole, the disposal sites do not provide any unique feeding habitat that is not available elsewhere and is only a small proportion of the total areal extent of the EFH described by NMFS (1998). Therefore, impact to the total EFH for this species is anticipated to be minimal.

English Sole- EFH for all life history stages of the English sole has the potential to be impacted by ocean disposal. English sole are an inner shelf-mesobenthal species that occurs to depth of

55m. Adults spawn in inshore waters and the eggs and larvae are pelagic settling to the bottom as young juveniles. Juveniles rear in the inshore areas and in the bays and estuaries. As they grow older they move offshore. English sole are distributed throughout the inshore area on soft bottom habitat. Based on the habitat requirements described above for English sole, the disposal sites do provide habitat but it is not unique habitat that is not available elsewhere and is only a small proportion of the total areal extent of the EFH described by NMFS (1998). Therefore, impact to the total EFH for this species is anticipated to be minimal.

Flathead Sole- EFH for spawning, larval, juvenile and adult flathead sole has the potential to be impacted by ocean disposal. Flathead sole are mesobenthic, occurring on the continental shelf to depths of 550m, but usually less than 366m. Spawning occurs at depths of 80 –140m. Eggs and larvae are generally buoyant in seawater. The juveniles settle to the bottom and rear in the inshore areas and bays and estuaries. Larger juveniles and adults are usually found further offshore on soft, silty or mud bottoms. Based on the habitat requirements described above for flathead sole, the disposal sites do not provide any unique habitat that is not available elsewhere and is only a small proportion of the total areal extent of the EFH described by NMFS (1998). Therefore, impact to the total EFH for this species is anticipated to be minimal.

Pacific Sanddab- EFH for juvenile and adult pacific sanddab has the potential to be impacted by ocean disposal at the deep water site. Pacific sanddab is an inshore sublittorial species that occurs between 0 and 306m, but are most abundant off Oregon from 37- 90m. Juvenile pacific sanddab occur in shallow water coastal areas, bays and estuaries on silty sand bottoms. Adults are found further offshore on coarser sandy areas. Based on the habitat requirements described above for Pacific sanddab, the disposal sites do not provide any unique habitat that is not available elsewhere and is only a small proportion of the total areal extent of the EFH described by NMFS (1998). Therefore, impact to the total EFH for this species is anticipated to be minimal.

Petrale Sole- EFH for young juvenile, juvenile and adult Petrale sole has the potential to be impacted by ocean disposal. Petrale sole is an inner shelf-mesobenthal species that occurs at depths up to 460m. Juveniles and adults are demersal with young juveniles found at depths of 18-82m and larger juveniles at depths of 25-145m. Adults occur from the surf line to 550m but are most abundant at depths less than 300m on sand and sandy mud bottoms. Adults migrate seasonally from winter spawning grounds in deep water to summer feeding areas in shallow water. Based on the habitat requirements described above for Petrale sole, the disposal sites do not provide any unique habitat that is not available elsewhere and is only a small proportion of the total areal extent of the EFH described by NMFS (1998). Therefore, impact to the total EFH for this species is anticipated to be minimal.

Rex Sole- EFH for egg, larvae, juvenile and adult for Rex sole have the potential to be impacted by ocean disposal. Rex sole is a middle shelf-mesobenthal species occurring at depths from 0 to 850m. It is one of the mostly widely distributed sole on the shelf and upper slope, occurring in a variety of depths and sediment types. Spawning occurs at depths from 100-300m. Larvae are pelagic and are widely distributed offshore with a peak of abundance at about 46km offshore. Rex sole settle to the bottom at the outer continental shelf and rear in the outer continental shelf. Intermediate sized Rex sole move inshore to depths of 55-150m. Adults are distributed

throughout the depth range but are more abundant inshore in the summer when they are feeding. Based on the habitat requirements described above for Rex sole, the disposal sites do not provide any unique habitat that is not available elsewhere and is only a small proportion of the total areal extent of the EFH described by NMFS (1998). Therefore, impact to the total EFH for this species is anticipated to be minimal.

Sand sole-EFH for egg and larvae of the sand sole will not be affected by ocean disposal at any off the sites. Sand sole eggs and larvae are pelagic and are generally found in the upper 10m of the water column at water depths greater than 200m which is deeper than the deep water site.

Starry Flounder- EFH of egg, larvae and young juvenile starry flounder have the potential to be impacted by dredged material disposal at the ocean sites. Eggs and larvae are epipelagic and occur near the surface over water 20-70m deep. Juveniles are demersal and occur in the estuaries or in the lower reaches of the major coastal rivers. Juveniles prefer sandy to muddy substrates and are found at depths less than 375m. Eggs and larvae may occur in the water column over the disposal sites and could be adversely impacted. Juveniles may occur on the bottom in the disposal areas and could also be adversely impacted. Based on the habitat requirements described above for starry flounder, the disposal sites do not provide any unique habitat that is not available elsewhere and is only a small proportion of the total areal extent of the EFH described by NMFS (1998). Therefore, impact to the total EFH for this species is anticipated to be minimal.

*Coastal Pelagic EFH*

EFH for the all the coastal pelagic species life history stages is the water column except for the market squid, which spawns in specific spawning grounds on the bottom. Squid spawn year around at various locations. Eggs are fertilized as the females extrude them into egg capsules. The female then attaches the egg capsules to the bottom substrate. As spawning continues, mounds of capsules can cover an area of 100 square meters.

Some individuals may be present in the water column during disposal and there would be a potential for some impact from disposal material. Since the dredged material settles rapidly, however, it is unlikely the impact would be very significant. Disposal on squid spawning EFH could have a major effect on the reproductive success of the squid population, since it is unlikely that the eggs would survive. Squid spawning areas have been identified off the Oregon coast and none have been found in the vicinity of the disposal sites. In the event that squid spawning grounds are identified in this area, the site would have to be adjusted or a timing restriction placed on its use to reduce impacts.

*Salmon EFH*

EFH for salmon in the vicinity of the ocean disposal sites is used primarily as a migratory area for both adults and juveniles and as a rearing area for juveniles as they enter the ocean. Disposal at these sites is expected to have only minimal impact on migratory salmon since the disposal sites represent only a small portion of the overall area used by salmon for migration and rearing.

**Conclusions:** The following conclusions can be drawn from the above EFH assessment:

1. Dredging and disposal in the coastal estuaries will have a minimal adverse effect on EFH for ground fish, coastal pelagic and salmon species. The navigation channels are the least productive of the designated estuarine EFH complex because they are generally in deeper areas with low light penetration that are disturbed regularly by dredging and ship traffic. Estuarine disposal sites are normally selected to be in areas of low productivity and are also disturbed on a regular basis by disposal. Consequently, neither the channels or disposal sites provide any significant amount of feeding or rearing areas for juveniles or adults and use of these areas will not significantly impact overall EFH for the managed species.

2. As indicated above, there is a potential to impact EFH for some of the ground fish and coastal pelagic species as well as the salmon species by use of the ocean disposal sites. The amount of the habitat impacted, however, is very small compared to the total EFH habitat identified for any of the species evaluated. In no case does the habitat provided by the disposal sites represent any unique habitat that is limited in distribution or is not available elsewhere. Because of the minimal impact to the total EFH available for a given species, it is unlikely that use of the ocean sites will reduce the total designated EFH to the point that the population levels for any species evaluated will be significantly adversely affected.

**National Historic Preservation Act of 1966, as amended**

**Oregon State Historic Preservation Office**

**(See Appendix E)**

# Coastal Zone Management Act of 1972, as amended

## Oregon Department of Land Conservation and Development

Oregon
John A. Kitzhaber, M.D., Governor

Department of Land Conservation and Development
635 Capitol St. NE, Suite 150
Salem, Oregon 97301-2540
Phone (503) 373-0050
Director's Fax (503) 378-5518
Main Fax (503) 378-6033
Rural/Coastal Fax (503) 378-5518
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Web Address: http://www.lcd.state.or.us

July 5, 2001

Mr. Robert Willis, Chief
Environmental Resources Branch
Corps of Engineers
Portland District
P.O. Box 2946
Portland, OR 97208-2946

Dear Mr. Willis,

Subject: Section 103 Designation of New Ocean Dredged Material Sites
Yaquina Bay Federal Navigation Project

The Department of Land Conservation and Development (DLCD), as Oregon's lead coastal zone management agency pursuant to the federal Coastal Zone Management Act (CZMA), has completed its review of proposed ocean disposal sites off Yaquina Bay. The proposed "North" and "South" sites are shown on "Figure 4" of the Corps of Engineers' submittal. The federal dredging project at Yaquina Bay is not the subject of this review.

The purpose of DLCD's coastal zone review has been to evaluate the consistency statement and supporting information submitted by the Corps of Engineers for the proposed ocean disposal sites against the enforceable policies of the approved Oregon Coastal Management Program (OCMP). The enforceable policies of the OCMP are: (1) the Statewide Planning Goals, as applicable; (2) the "acknowledged" (i.e., approved by the Land Conservation & Development Commission as being in compliance with the statewide planning goals) city or county comprehensive plan(s) for the project area; and (3) various state agency authorities. The consistency statement submitted by the Corps of Engineers indicates that the proposed federal action is consistent with the OCMP.

**Findings**

• Neither Goals 1-18 nor any city and county comprehensive plans apply to actions proposed in the territorial sea. Applicable enforceable policies include the standards of Goal 19-Ocean Resources and the associated Oregon Territorial Sea Plan (TSP), OAR 660-036. The paramount ocean policy of the State of Oregon is to ensure the long-term protection of renewable resources for the benefit of the state's citizens. The importance of maintaining safe navigation as well as Oregon's recreational and commercial fishing industries is also recognized by these state policies. Ocean disposal of dredged materials is anticipated under Oregon's ocean policies, specifically Goal 19. Ocean disposal sites and practices must not substantially interfere with commercial and recreational fishing, navigation, or the long-term protection of renewable resources. Goal 19 and the TSP also place a strong emphasis on ensuring that state and federal agencies have a clear understanding of the resource and use impacts of actions that affect ocean resources and uses.

• The Corps has provided the following documents in support of the proposed disposal sites: 1995 and 2000 sidescan sonar reports, 2000 benthic infauna evaluation report, and 2001 disposal site evaluation study and environmental assessment. The evaluation study/environmental assessment, from here on referred to as EA, includes a management and monitoring plan for the sites (Appendix D), as well as technical appendices on biological resources, physical processes and geological features, sediment and water quality, and cultural resources. The information provided in these documents is both current and thorough.

• The EA clearly explains the problems associated with existing ocean disposal sites off Yaquina Bay and the need for new disposal options in the area. Like the Corps, DLCD is aware of concerns raised by local fishermen, fishing associations, the Port of Newport, and the U.S. Coast Guard regarding navigation safety issues associated with transiting the existing disposal sites. The EA then lays out the process used to locate the new sites and the objectives for management and monitoring of the sites.

• The Corps has proposed two sites to accommodate the Yaquina dredging project. The designation of two sites leaves the Corps with greater flexibility regarding disposal management. DLCD is on record (e.g. Mouth of Columbia river ocean disposal sites) indicating a preference for disposal sites that encompass the smallest area possible to accommodate disposal needs, considering navigational safety, environmental, and economic factors. The concern is that the geographic extent of potential disposal impacts be minimized, thereby restricting the quantity of marine habitat and resources potentially at risk. Small disposal sites also seem to facilitate pre-disposal studies and post disposal monitoring while minimizing the likelihood of conflicts between dredges and other ocean users. However, DLCD notes that the management and monitoring plan (EA, p. D-16) states that "placement priorities will be to fully use the North Site to the maximum extent practicable." In any given year, use of the south site will be avoided or minimized. DLCD agrees with this prioritization as it addresses the concern that the geographic extent of potential disposal impacts be minimized.

• The disposal sites will be designated under the Corps §103 authority. We anticipate that an EPA §102 designation will ultimate occur for the new ODMD sites. Our understanding, based on review of new disposal sites for the Mouth of the Columbia River project, is that a §102 designation is a 50 year designation. While realizing that the Corps and EPA may be required to plan for disposal out to 50 years, DLCD does not believe that compliance with Oregon's ocean policies over a 50 year period can be ensured through a review at one point in time. Experience has shown that the effects of ODMD actions cannot always be predicted, and the cumulative impacts of disposal over long time periods remain a concern. Therefore, state participation in the implementation of the management and monitoring plan for the North and South sites will be necessary to address long-term impacts and compliance with state ocean policies.

• For the above reasons, the management and monitoring plan is of key importance to DLCD. Implementation of the plan is intended to minimize long-term impacts to ocean resources and uses associated with disposal. The management and monitoring objectives for the disposal sites appear to correlate well with requirements found in Goal 19 and the TSP. Objectives include

control of mounding to avoid impacts to navigation, minimizing impacts to marine resources, and minimizing interference with other ocean uses and users. Mounding will be limited by controlling dredged material placement volumes and locations, with a goal of no more than a 10% increase in wave height over the site (EA, p. D-2). The Corps states that impacts to marine resources and fishing areas have been avoided to the extent practicable through the site designation process and that that timing and spatial restrictions on dredged material placement will be used to further limit impacts (EA, p. D-2, 3). The Corps also indicates that all dredges will be required to follow safe navigation practices and that it will coordinate dredging/disposal activities with the local fishing industry and U.S. Coast Guard (EA, p. D-3).

• We note that state water quality laws also apply to the proposed disposal sites. The Department of Environmental Quality (DEQ) is reviewing the project for compliance with water quality requirements. DLCD defers to DEQ's determination in this regard.

**Decision**: Based on review of the Corps' consistency statement and supporting information and the above findings, DLCD hereby concurs with the Corps consistency statement for the new disposal sites with the following conditions:

(1) Only materials from maintenance of the federal dredging project at Yaquina Bay will be placed at ocean disposal sites. Use of the ocean disposal sites for dredged materials removed from other areas, such as another federal navigation project or a private dredging project, is not covered by this coastal zone decision; further consultation with DLCD would be required

(2) The Corps of Engineers will coordinate with the State of Oregon on an annual basis regarding site management and monitoring for the new disposal sites. Specifically, the Corps shall provide the following information on an annual basis:

(a) volume of material dredged and dumped for the year
(b) locations of individual dumps for the year
(c) results of bathymetric surveys scheduled to occur annually in Spring, along with any plots showing changes in bottom conditions between years.
(d) any other monitoring information available

(3) The Corps shall consult with the State of Oregon before changing the use priority established for the North Site in the Management and Monitoring Plan.

(4) The Corps shall immediately (i.e., within two weeks) inform the State of Oregon of any significant, unanticipated issues regarding site management and monitoring when and if such issues arise.

(5) The final Management and Monitoring Plan shall set as a priority "like on like" disposal within the sites (i.e., dredged materials placed in areas where the natural substrate has similar sediment characteristics) and require avoidance of disposal within 1000 ft. of any exposed bedrock areas.

For the record, DLCD reserves the right to re-examine this coastal zone decision in the event of new information suggesting that actual disposal impacts are significantly different than currently anticipated disposal impacts.

If the Corps of Engineers has a serious disagreement with DLCD's coastal zone decision, then please contact DLCD to discuss the matter further. We are also required to notify the Corps of the availability of Secretarial mediation from the U.S. Department of Commerce as described in 15 CFR 930 Subpart G. A copy of Oregon's decision has been sent to the Office of Ocean and Coastal Resource Management in the U.S. Department of Commerce in accordance with 15 CFR 930.42 (c).

If you have any questions about this coastal zone decision, I can be reached at 503-373-0050 X250 or by e-mail at christine.valentine@state.or.us. Thank you for coordinating with the OCMP.

Sincerely,

Christine Valentine
Coastal Agency Coordinator

cc. Tom Melville, DEQ
Dave Fox, ODFW-Newport
Don Mann, Port of Newport
John Malek, EPA

# COMMENT LETTERS

# United States Department of the Interior

**FISH AND WILDLIFE SERVICE**
**Oregon State Office**
**2600 S.E. 98th Avenue, Suite 100**
**Portland, Oregon 97266**
**(503) 231-6179 FAX: (503) 231-6195**


June 18, 2001

Colonel Randall J. Butler, District Engineer
Portland District, Corps of Engineers
ATTN: CENWP-PM-E-01-06 (Stevens)
P.O. Box 2946
Portland, Oregon 97208-2946

Dear Colonel Butler:

The U.S. Fish and Wildlife Service has reviewed the project plans to select two new ocean disposal sites offshore of Yaquina Bay, Oregon for permanent designation as Ocean Dredged Material Disposal Sites as advertised by the following public notice. No action will be taken by the Service at this time because of limited funding and staff. This letter does not fulfill the requirements of the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 et seq.). If the Corps of Engineers (Corps) determines, based on a Biological Assessment or evaluation, that threatened and endangered species and/or critical habitat may be affected by the project, the Corps is required to consult with the Service following the requirements of 50 CFR 402 which implement the Act. In addition, we may reexamine our position and provide supplementary comments if additional information becomes available that shows the project would adversely impact fish or wildlife.

We request that the applicant be required to adhere to all conditions and requirements specified by other Federal and State resource agencies.

Type of Permit: Section 102/103 of the Marine Protection, Research, and Sanctuaries Act of 1972

| Notice No./Date | Applicant Name | Due Date |
|---|---|---|
| CENWP-PM-E-01-06/May 17, 2001 | Corps of Engineers | June 18, 2001 |

Other Bureaus of the Department of the Interior do not expect to submit comments on this notice at this time.

Sincerely yours,

Ronald L Hart

for Kemper M. McMaster
State Supervisor
Acting for U.S. Department of
the Interior Coordinator

*printed on unbleached recycled paper*

Oregon
John A. Kitzhaber, M.D., Governor

**Department of Fish and Wildlife**
Marine Resources Program
2040 SE Marine Science Drive
Newport, OR 97365
(541) 867-4741
FAX (541) 867-0311

June 14, 2001

District Engineer
U.S. Army Corps of Engineer District, Portland
Attn: CENWP-PM-E
P.O. Box 2946
Portland, OR 97208-2946

Re: Yaquina Bay Ocean Disposal
CENWP-PM-E-01-06
issued May 17, 2001

Thank you for the opportunity to comment on the above-referenced public notice. As with others involved in this project, we have been concerned about the extreme hazard caused by shoaling and wave amplification problems in the current disposal site, and are relieved that the we are now in the final approval stages for new sites. We are pleased with the site survey and documentation process that has occurred to date. We have two comments that we would like to see incorporated into the management of the sites:

1) Site preference – ODFW prefers the north site over the south site because much of the south site lies in the primary navigation lane and disposal at the site may exacerbate winter shoaling in the nearby area to the north. Although I realize there are advantages to keeping options open by designating as many, and as large of, sites as possible, we still hold to the premise that the sites should be the minimum necessary to get the job done considering safety, environmental, and economic factors. If you feel that both sites are necessary to meet these requirements, the management plan for the sites should give preference to the north site, and allow use of the south site only if a problem arises with use of the north site.

2) Proximity to rocky substrate – The management plan for the sites should stipulate a 1,000 foot no-disposal buffer for any bedrock areas that occur near the sites.

Thank you again for the opportunity to comment and please feel free to call if you have any questions.

Sincerely,

David Fox
Marine Habitat Project Leader

cc: Christine Valentine, DLCD

# APPENDIX G

## Finding of no Significant Impact

# FINDING OF NO SIGNIFICANT IMPACT
# SELECTION AND USE OF NEW OCEAN DREDGED MATERIAL DISPOSAL SITES
# YAQUINA BAY NAVIGATION PROJECTS
# LINCOLN COUNTY, OREGON

The proposed action is the selection and use of two new ocean dredged material disposal sites (North and South) for placement of dredged material from maintenance of Federal navigation projects at Yaquina Bay and Yaquina River including South Beach Marina. The sites would also be available for disposal of dredged material by non-Federal entities under the Regulatory Permit program. Additional environmental compliance would be required for those actions. The need for the new sites has been determined since use of the existing Section 103 site is no longer feasible due to limited site capacity and continuing concerns over navigation safety. The U.S. Environmental Protection Agency and the Corps of Engineers propose to select the new ocean disposal sites and to use the new sites for the disposal of material dredged from the Yaquina Bay navigation channels.

In addition to assessment under the National Environmental Policy Act, the sites have been evaluated using the criteria of the Marine, Protection, Research and Sanctuaries Act of 1972 (MPRSA) and have been determined to be suitable disposal sites under the Act. The MPRSA requires evaluation of alternative disposal sites, including upland, estuarine and alternative ocean sites. Upland sites are either unavailable, limited in capacity, or reserved for dredging of port and marina facilities. No estuarine sites of sufficient capacity are available because of concerns for biological impacts. Other ocean sites were determined to be less suitable due to biological or economic concerns. The sites are also evaluated under the 5 general and 11 specific criteria required by the MPRSA. This evaluation was completed and concluded that, based on consideration of cultural, recreational, commercial, physical and biological effects, the selected North and South sites were the preferred disposal alternative and meet all of the required criteria. The no action alternative was also considered. This was determined to be unacceptable since use of the existing 103 site would only increase the potential for developing hazardous navigation conditions.

The use of the North and South sites has also been evaluated for compliance with other applicable statutes, including the Endangered Species Act, the National Historic Preservation Act and the Coastal Zone Management Act.

Since the selected disposal sites have been evaluated in terms of avoiding or minimizing environmental effects, no mitigation is required for the use of these sites. A monitoring plan has been developed as part of the MPRSA requirement that will evaluate bathymetric changes following each year's disposal action.

Having considered all of the above factors, including the Environmental Assessment and pertinent other environmental statutes and regulations, I find that the proposed action would not significantly affect the quality of the human environment and that an Environmental Impact Statement is not required.

Date: 30 Jul 01

RANDALL J. BUTLER
Colonel, EN
Commanding