Umpqua River, Oregon
Ocean Dredged Material Disposal Sites Evaluation Study and Environmental Assessment

U.S. Army Corps of Engineers, Portland District

U.S. Environmental Protection Agency, Region 10

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Abbreviations and Acronyms

CFR	Code of Federal Regulations
cfs	cubic feet per second
cy	cubic yard(s)
Corps	U.S. Army Corps of Engineers
DMEF	Dredge Material Evaluation Framework
DPS	Distinct Population Segment
EA	Environmental Assessment
EPA	U.S. Environmental Protection Agency
km	kilometers
m^3	cubic meter(s)
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
MDL	method detection limit
mm	millimeter(s)
MRL	method reporting limit
MLLW	mean lower low water
MPRSA	Marine Protection, Research and Sanctuaries Act
n mi	nautical mile(s)
NAD	North American Datum
NMFS	National Marine Fisheries Service
ODMDS	ocean dredged material disposal site(s)
ODFW	Oregon Department of Fish and Wildlife
OHV	off-highway vehicle
PAH	polynuclear aromatic hydrocarbon(s)
PCB	polychlorinated biphenyl(s)
ppb	parts per billion
ppm	parts per million
RM	river mile(s)
SEF	Sediment Evaluation Framework
SMMP	Site Management and Monitoring Plan
TOC	total organic carbon
TBT	tributyltin and other organotins
TVS	total volatile solids
ug/g	microgram per gram
ug/kg	micrograms per kilogram
ug/L	micrograms per liter
WIS	Wave Information Study
ZSF	Zone of Siting Feasibility

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PURPOSE AND NEED

This Ocean Dredged Material Disposal (ODMD) Site Evaluation and Environmental Assessment (EA) has been jointly prepared by the U.S. Army Corps of Engineers (Corps) and the U.S. Environmental Protection Agency (EPA). The purpose of this evaluation is to provide documentation in support of final designation by EPA of two ODMD Sites located offshore from the Umpqua River, Oregon (Figure 1). These sites are needed for long-term use by the Corps for the federally authorized Umpqua River navigation project and for use by others for the disposal of dredged material meeting ocean disposal criteria. This evaluation will assess the proposed final designation of two Umpqua River ODMD Sites against the statutory requirements set forth in the Marine Protection, Research and Sanctuaries Act, as amended, (MPRSA), 33 U.S.C. 1401 to 1445, and the regulations found in Part 228 of Title 40 of the Code of Federal Regulations (CFR). These regulations were promulgated in accordance with the criteria set out in Sections 102 and 103 of the MPRSA. This evaluation also outlines EPA's coordination under the National Environmental Policy Act of 1969 (NEPA), 42 U.S.C. Sections 4321 to 4370f, the Endangered Species Act of 1973 (ESA),16 U.S.C. Sections 1531 to 1544, the Magnuson-Stevens Fishery Conservation and Management Act of 1994, (MSA), 16 U.S.C. Sections 1801 to 1891d, the Marine Mammal Protection Act of 1972 (MMPA), 16 U.S.C. Sections 1361 to 1389, the National Historic Preservation Act of 1966 (NHPA), 16 U.S.C. Sections 470 to 470a-2, and the Coastal Zone Management Act of 1972 (CZMA), 16 U.S.C. Sections 1451 to 1465, all as amended.

Need for Disposal Site Designation

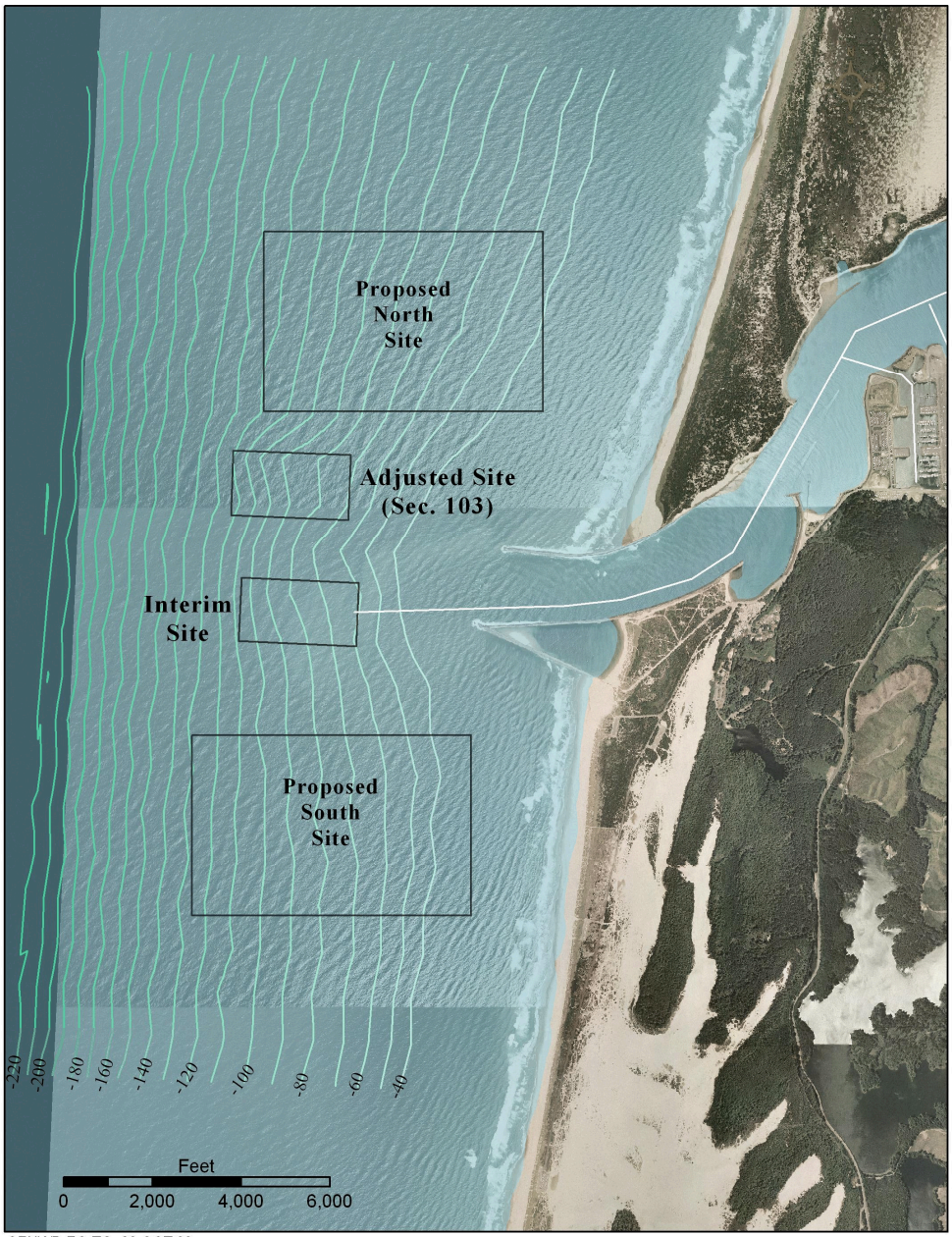
EPA undertook this evaluation to determine whether to designate any dredged material disposal site(s) near the mouth of the Umpqua River pursuant to its authority under the MPRSA at Section 102(c) in response to several factors. These factors included the following:

1. the prohibition on further use of the existing Umpqua Section 103 disposal site following the close of the 2008 dredging season pursuant to the Corps' site selection authority under the MPRSA at Section 103(b), which allows the Corps to designate a Section 103 site for a period of 5 years with a maximum 5 year extension, with EPA's concurrence;
2. the understanding that in the absence of an EPA-designated disposal site, or sites, any necessary open-water disposal would either be precluded or the Corps would have to undertake additional short-term site selections, perhaps a number of them, in the future;
3. the clear Congressional preference, expressed in the MPRSA at Section 103(b), that any open-water disposal of dredged material take place at EPA-designated sites, if feasible; and
4. the statutory preference to concentrate any open-water disposal at sites that have been used historically and at fewer sites, see 40 CFR 228.5(e).

EPA's evaluation considered whether there was a need for any disposal site designations for long-term dredged material disposal, including an assessment of whether other dredged material management methods and/or disposal options could reasonably be judged to

obviate the need for such designations. Having concluded that there was a need for open-water disposal sites, EPA then assessed whether there were sites that would satisfy the applicable environmental criteria to support a site designation under the MPRSA at Section 102(c).

Figure 1. Umpqua River ODMD Sites and Vicinity



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Background

The MPRSA was passed by Congress in recognition of the fact that the disposal of material into ocean waters could potentially result in unacceptable adverse environmental effects. Under the MPRSA, the EPA and the Corps were assigned responsibility to regulate the dumping of all types of material into ocean waters and to prevent or strictly limit the dumping into ocean waters of any material that would "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 permit program for ocean disposal of material other than dredged material and designates dredged material disposal sites. The Corps, with EPA's concurrence, issues permits for the disposal of dredged material for the purpose of ocean disposal where the Corps determines that dumping will not unreasonably degrade the environment or endanger human health, welfare, or amenities, or the marine environment, ecological systems, or economic potentialities. 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 disposed into ocean waters are the same as those where a permit would be issued.

EPA must consider statutory criteria and evaluate the five general regulatory criteria codified at 40 C.F.R.§ 228.5 and the eleven specific regulatory criteria at 40 C.F.R. § 228.6. Pursuant to Section 102(c) of the MPRSA, the EPA is responsible for designating sites for the disposal of dredged material. The Corps is allowed, with EPA's concurrence, to select a site for ocean disposal of dredged material pursuant to Section 103(b) of the MPRSA, when a feasible disposal site has not been designated by EPA, or when the continued use of an alternative site is necessary to maintain navigation and facilitate interstate or international commerce, and EPA has determined that the alternative site does not pose an unacceptable risk to human health, aquatic resources, or the environment. An EPA-designated site requires a site management and monitoring plan (SMMP). Use of a designated site is subject to the restrictions included in the SMMP and EPA's designation regulations. These restrictions are based on an in-depth evaluation of the site and potential disposal activity, as well as public review and comment. Designation of an ODMD Site 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 this involves evaluation of the specific disposal activity under the criteria (which can include multiple years of use), circulation of a public notice, and specific coordination with stakeholders, as well as concurrence by the appropriate EPA region.

EPA proposes to designate two new ODMD Sites, the proposed North Umpqua ODMD Site and South Umpqua ODMD Site, which are each approximately 4,000 feet northwest and southwest respectively, of the entrance to the Umpqua River (see Figure 1). Each proposed Umpqua River ODMD Site is 6,300 feet by 4,000 feet, with a depth ranging from 30 feet to 120 feet, and an average depth of 75 feet.

Offshore Disposal History

Umpqua River Ocean Disposal Before 1977

For the Umpqua River, offshore disposal of dredged material began in 1924. Since that time, more than 17 million cubic yards (cy) of dredged material have been placed in offshore disposal sites. Prior to formal designation of an Interim ODMD Site in 1977, the ocean dredged material disposal site offshore of the Umpqua River entrance was sited in terms of approximate location and areal configuration. Placement of dredged material within the offshore disposal site was governed by the need to minimize navigational impacts from dredged material being transported back into the navigation channel and to minimize haul distance for dredge vessels. Mounding of dredged material on the seabed did not appear to be a concern due to the spatial variability of dredged material placement within the disposal site. Site boundaries were not fixed and it was not required to place material strictly within the disposal site. The operational flexibility allowed the dredge vessel during material placement likely resulted in a higher rate of dispersion of dredged material than at present. Additionally, dredged material was placed over a wider areal expanse than the fixed configuration of the Interim site prior to 1977.

Umpqua River Ocean Disposal 1977 to 1986

From 1977 to 1986, management of an Interim ODMD Site offshore of the Umpqua River was characterized by the transition from unregulated dredged material disposal program to a regulated program. In January 1977, the active ocean disposal site at Umpqua River received interim designation when EPA issued the final Ocean Dumping Regulations (40 CFR Subchapter H). The Interim disposal site configuration was governed by the requirement to minimize the area of impact due to open-water disposal of dredged sediments. The areal size of the Interim ODMD Site was based on the following parameters:

- ODMD Site length: average dumping run to place one load of dredged material = (disposal vessel speed while dumping) x (time to empty disposal vessel).
- ODMD Site long axis orientation: preferential approach heading during dredged material disposal, which is determined in part by the predominate direction of incoming waves.
- ODMD Site width: average turn during one dump = disposal vessel turning radius while dumping.

The lineal dimensions and water depth variation for the Interim ODMD Site included: dimensions = 3,600 feet x 1,400 feet; azimuth = ~270°; average depth = 90 feet; and 1998 elevation variation = -113 to -55 mean lower low water (MLLW).

In contrast to the pre-1977 practice of placing material in larger unconfined areas, aiding rapid dispersion, fixing site boundaries at the Interim ODMD Site required the Corps to restrict disposal dredge material to within those boundaries. Material accumulated rapidly in the smaller Interim site, which caused mounding and potentially adverse impacts to navigation at the Umpqua River entrance. One potential explanation for dredged material mounding in the Interim ODMD Site was an increase in the average disposal volume from

1987 to 1991 (Table 1). The average annual volume of dredged material placed in the Interim ODMD Site from 1968-1986 was 141,000 cy/year, while the average annual volume from 1987 through 1991 was 188,000 cy/year. The use of a contractor operated, large capacity split-hull hopper dredge in 1990 also could have contributed to an increase in the vertical extent of dredged material placed in the disposal site.

Corps' specifications required contract dredges to place dredged material within the Interim ODMD Site boundaries. The Interim ODMD Site corner coordinates and a single disposal location coordinate were given as a reference for disposal position within the Interim Site. Importantly, uniform spreading of dredged material placed within the site was not a site management requirement. Thus, conceptually, placement of dredged material was done randomly, but within a fixed distance from a disposal buoy. Dredging contractors most likely placed dredged material on the extreme eastern, or channel side of the disposal area to shorten the haul distance and minimize the aerial extent of dispersal (referred to as point-dumping). This point-dumping likely accelerated the vertical accumulation of dredged material within the relatively small Interim ODMD Site. Except in 1990, the bulk of the sediment dredged from the Umpqua River and placed in the ODMDS was accomplished using government hopper dredges. Hopper dredges use 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 material is released from the vessel, resulting in a gradual release of material from the vessel. Contractor split-hull hopper dredges release their load of dredged material by opening the entire hull of the vessel. The split-hull method of disposal is much more rapid than disposal from bottom-door hopper dredges. The use of split-hull hopper dredges reduces the time required for material disposal, but also reduces the horizontal dispersal of dumped dredged material on the seabed while increasing the vertical accumulation of placed material during each dump cycle. 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 1987, the bottom-door hopper dredge *Yaquina* with a capacity of 1,000 cy has been used as the government dredge at the Umpqua River. In 1990, the much larger split-hull dredge *Padre Island* (capacity 2,600 cy) was used as the primary dredging/disposal vessel.

In 1988, mounding of dredged material at the Interim ODMDS began amplifying incoming ocean waves at the approaches to the Umpqua River entrance. Mariners and the Coast Guard reported the occurrence of shoaling and breaking of waves at the approach to the Umpqua entrance channel.

Umpqua River Ocean Disposal 1987 to Present

The Interim ODMD Site that was designated by EPA in 1977 did not receive final designation. A Portland District site evaluation report completed in 1989 (Corps 1989) recommended an "alternate" site to the north. Pending EPA designation, the Corps, under its Section 103 authority, selected this alternate site in 1991 and began site use in October 1991. The Section 103 ODMD Site is located 2,800 feet directly north of the former Interim ODMD Site in an average water depth of 105 feet (see Figure 1, "adjusted site"). The lineal dimensions, orientation, and water depth variation for the Section 103 ODMD Site include: the following planar dimension = 3,600 feet x 1,400 feet; azimuth = 270°;

average depth = 105 feet; and 1991 elevation variation = -130 to -64 mean lower low water level (MLLW). Since October 1991, all sediments dredged from the Umpqua River Project have been placed within the Section 103 ODMD Site. The Interim ODMD Site became unavailable for further use. [1]

Since 1979, annual bathymetric surveys have been conducted at the Umpqua sites and vicinity. Consistent monitoring is necessary to track bathymetric change at the sites, ensure that the Corps does not unintentionally worsen the mounding problem, or place dredged material outside of the active Section 103 ODMD Site boundaries. Based on the bathymetric monitoring of the Section 103 ODMD Site, the specified location of dredged material disposal has been shifted throughout the site on an annual basis to avoid dumping material on high spots created in previous years. Despite the effort to evenly distribute dredged material within the Section 103 ODMD Site, material has accumulated within this site to unacceptably high levels. Meanwhile, at the Interim ODMD site, monitoring showed that closure of this site since 1991 and exclusive utilization of the new Section 103 site for dredged material disposal between 1991 and 1998, allowed waves and currents within the Interim ODMD Site to disperse the mound to an elevation consistent with the ambient seabed.

Table 1. Umpqua River Project Dredging Volumes Placed in the ODMD sites

Year or Period	Dredging Vessel	Interim ODMD SITE (cy)	Section 103 ODMDS (cy)	Totals (cy)
1968-1986		2,678,849		2,678,849
1987	*Yaquina*	152,369		152,369
1988	*Yaquina*	330,163		330,163
1989	*Yaquina*	158,697		158,697
1990	*Padre Island*	180,285		180,285
1991	*Yaquina*	118,416		118,416
1992	*Yaquina*		209,072	209,072
1993	*Yaquina*		212,755	212,755
1994	*Yaquina*		204,000	204,000
1995	*Yaquina*		93,700	93,700
1996	*Yaquina*		116,799	116,799
1997	*Yaquina*		114,572	114,572
1998	*Yaquina*		196,300	196,300
1999	*Yaquina*		168,700	168,700
2000	*Yaquina*		68,600	68,600
2001	*Yaquina*		99,400	99,400
2002	*Yaquina*		246,200	246,200
2003	*Yaquina*/Clamshell		113,500	113,500
2004	*Yaquina*		93,200	93,200
2005	*Yaquina*		9,400	9,400
2006	*Yaquina*		62,000	62,000
2007	*Yaquina*/Clamshell		106,800	106,800
	Totals	3,618,779	2,114,998	5,733,777

[1] EPA's Interim Designations were superseded by later statutory changes to the MPRSA.

In 1996, shoaling and breaking waves associated with mounding at the Section 103 ODMD Site were reported. Subsequently, a site utilization study was conducted (Corps 1998). The study found that the size of the Section 103 ODMD Site mound in 1998 was sufficient to warrant serious concern regarding continual mound accumulation and further impact on the wave environment near the Umpqua River entrance. The average annual volume placed in the Section 103 site from 1992 to 1998 was 158,200 cy. Because of the concern for mounding, the volume of dredged material placed at the site was reduced. From 1999 to 2007, the average annual volume placed was 108,000 cy with 5 years having volumes below 100,000 cy (Table 1). In 2005 only 9,400 cy was placed.

AFFECTED ENVIRONMENT

Physical Resources

General

The Umpqua River estuary covers 6,430 acres. The estuary lies within the Heceta Head littoral cell, which extends for 90 kilometers (km) from Heceta Head south to Cape Arago. The estuary is fed by two rivers, the Umpqua River and the smaller Smith River. The coastal portion of the littoral cell consists of a 1- to 2-mile-wide plain covered by active and stabilized sand dunes backed by the mature upland topography of the Coast Range. The lower portion of the Umpqua River is bordered by broad alluvial flats. The continental shelf off the mouth of the Umpqua is about 30 km wide. Just to the north the continental shelf bulges outward forming Heceta Bank. Between Siuslaw and Yaquina the shelf is at its widest, extending over 70 km offshore. Sand covers the shelf at the Umpqua for about 3 km out from the shore. From there a thin layer of mud (1-3 centimeters thick) mantles the surface (Kulm, 1977).

The Heceta Head littoral cell is the largest on the Oregon Coast, stretching almost 80 km. Except for the headlands at both ends of the cell, the coast line is made of beach fronting sand dunes. Two major river systems, the Siuslaw and the Umpqua, and a large estuary, Coos Bay, occur within the cell. The Umpqua River is the major source for sediment in the littoral cell. The littoral cell is fed by the Umpqua and Smith rivers with a combined drainage basin of 5,042 square miles. Mean monthly discharge is highest in January at about 18,000 cubic feet per second (cfs) and lowest in September at about 1,200 cfs. Mean annual discharge is about 8,200 cfs.

The ocean bed in the vicinity of the mouth of the Umpqua River is characterized by a bulging outward of the bathymetric contours in front of the mouth of the Umpqua River, and an otherwise featureless slope that increases from the north to the south. A mile and a half north of the Umpqua's mouth the average slope is about 75 feet/mile between the 24 feet and 156 feet contours. Two miles south of the entrance the slope has increased to about 90 feet/mile. The slope also shows a general increase with distance offshore. The bulge in front of the mouth is evident to a depth of 130 feet, after which the contours are straight.

Umpqua River Sediments

The latest sampling and testing of sediments in the Umpqua River entrance channel and Gardiner/Winchester Bay access channels took place in 2006 (Abney 2006; see Appendix C). Eighteen samples were submitted for physical analyses (Table 6). The results of the physical analyses showed mean values of 0.37% gravel, 76.0% sand, and 23.7% silt/clay, with 6.82% volatile solids. This material is classified as silty sand in Gardiner channel and the Umpqua River main channel, and sandy silt in Winchester Bay.

Chemical analyses conducted on the samples included metals, total organic carbon (TOC), pesticides, polychlorinated biphenyls (PCBs), phenols, phthalates, miscellaneous extractables, and polynuclear aromatic hydrocarbons (PAHs). The chemical analyses indicated only very low levels of contamination in any of the samples, with all levels below their respective Dredge Material Evaluation Framework (DMEF 1986) or Sediment Evaluation Framework (SEF 2006) screening levels. No PCBs or chlorinated hydrocarbons were found at the method detection limits (MDLs) in any of the samples.

Table 2. Physical Analysis and Volatile Solids, 2006

Sample I.D.	Percent (%)				Location (RM)
	Gravel	Sand	Silt/Clay	Volatile Solids	
082906URGC-BC-01	0	86.7	13.3	3.59	Gardiner Channel (RM 8.1)
082906URGC-BC-02	1	93	6	8.51	Gardiner Channel (RM 9)
082906URMC-BC-01	0	75.7	24.3	--	Umpqua Channel (RM 8)
082906URMC-BC-02	0.2	96.2	3.6	--	Umpqua Channel (RM 8.5)
082906URMC-BC-03	0.2	87.6	12.2	--	Umpqua Channel (RM 10)
082906URMC-BC-04	0	93.9	6.1	2.54	Umpqua Channel (RM 11.5)
082906URMC-BC-05	0.1	96.3	3.6	1.67	Umpqua Channel (RM 11.4)
082906URMC-BC-06	0.9	96.3	2.8	--	Umpqua Channel (RM 5.1)
082906URMC-BC-07	0.1	95.4	4.5	--	Umpqua Channel (RM 4.2)
082906URMC-BC-08	0.3	96.2	3.5	--	Umpqua Channel (RM 2.9)
083006URMC-BC-09	1.2	97.5	1.3	--	Umpqua Channel (RM 0.9)
083006URMC-BC-10	0.1	98.4	1.5	--	Umpqua Channel (RM 1.1)
083006WBWC-BC-01	0.1	82.5	17.4	4.84	Winchester Bay West Channel
083006WBWC-GC-02	0	30.3	69.7	9.57	Winchester Bay West Channel
083006WBWC-GC-03	0.7	17.1	82.2	8.55	Winchester Bay West Channel
083006WBEC-GC-04	1.1	62.5	36.4	4.76	Winchester Bay East Channel
083006WBEC-GC-05	0.6	46.9	53.5	13.20	Winchester Bay East Channel
083006WBEC-GC-06	0.1	15	84.9	11.00	Winchester Bay East Channel

Several metals, organotins, pesticides, phthalates, miscellaneous extractables, phenols and low and high molecular weight PAHs were detected but at low levels. Detection levels were sufficiently low to evaluate material proposed for dredging and open water disposal. The analytical results of this characterization are consistent with historical data. Material represented by these samples was determined to be suitable for unconfined, in-water placement without further characterization.

Dredging of the Gardiner Channel during the summer of 1991 revealed a location where there was possible contamination at the fueling dock operated by Bunker C fuel oil. While

dredging to the authorized depth of 22 feet in the reach of the federal channel off the fueling dock (RM 8.4), an oily substance was seen bubbling to the surface. Dredging operations were stopped, two water samples were taken for analysis, and a video was taken of the surface where the oil was observed. Analysis of the water samples identified the oily substance as weathered Bunker C fuel oil. Subsequent dredging since 1991 was limited to 18 feet without encountering fuel oil-contaminated sediment. This indicates there is no contamination at shallower depths, although contamination might still be present in the deeper sediment at this location. The source of the oil remains unknown. Oil has not been detected during either dredging or sampling operations since the incident in 1991, consequently, there has been no further attempt to identify the source of the oil. However, the site is still considered a potential source of contaminants and sediments from the general vicinity of the fueling dock were sampled and analyzed during the 1996 and 2006 sediment quality evaluation.

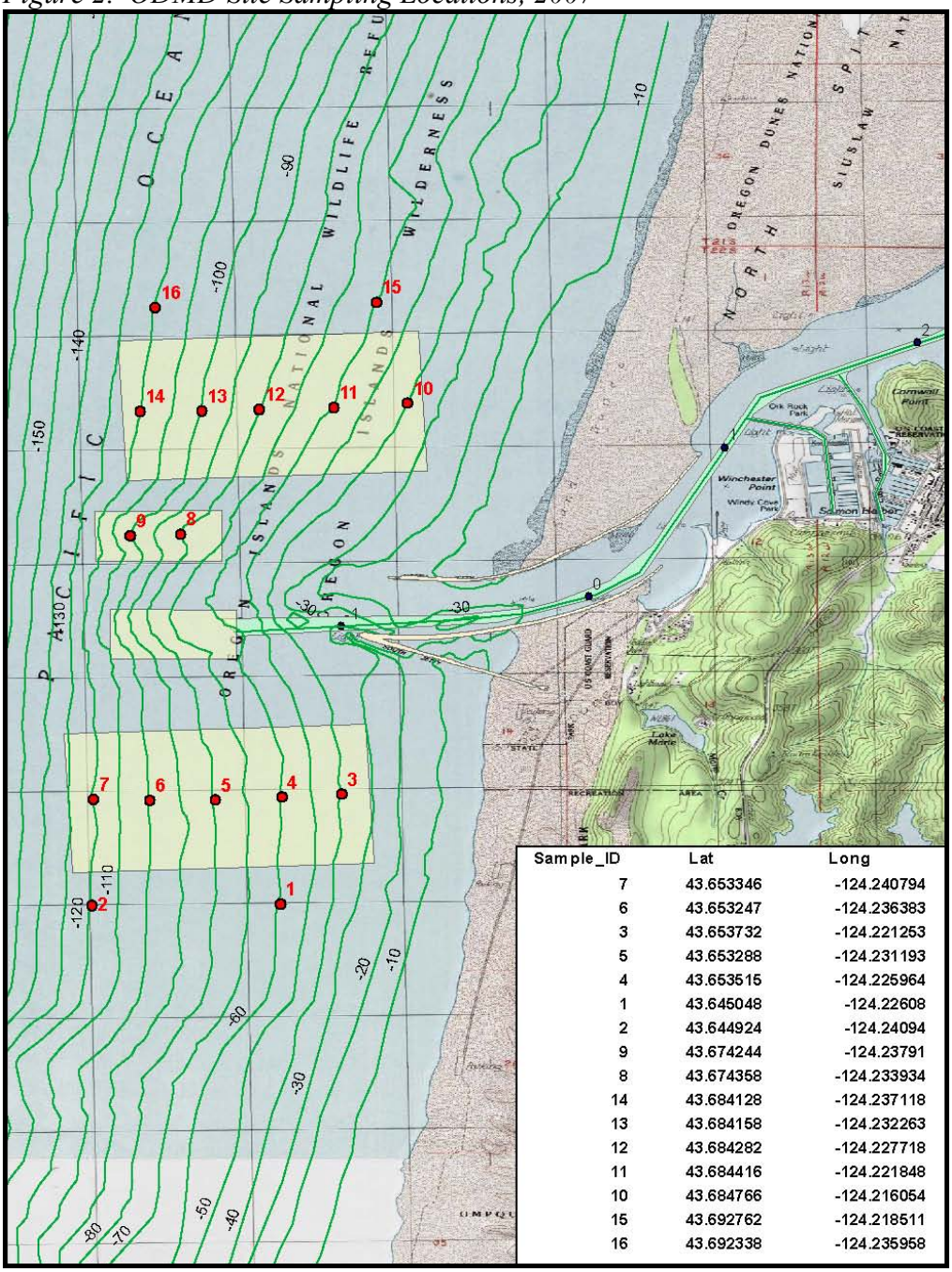
ODMD Site Sediments

Sediment samples from the existing Section 103 ODMD Site, the proposed North and South ODMD sites, and reference stations were collected by the Corps in June 2007 (Figure 6). Physical analysis of the samples showed the offshore area to be uniform in texture and characteristics (Table 7). The percent sand size and greater, including gravel, had a narrow range from 95% to 98%. Percent fines (percent passing through a 230 sieve, silt and clay) ranged from 1.98% to 4.97% with a mean of 3.18%. Organic content measured as percent total volatile solids (TVS) ranged from 1.0% to 1.88% with a mean of 1.33%. There was no discernable difference in stations located in the actively used Section 103 ODMD Sites and those areas which have not received dredged material from the Umpqua project.

Table 3. Physical Analysis, Volatile Solids, and Total Solids, June 2007

Sample I.D.	Percent (%)					Location (Depth)
	Gravel	Sand	Silt/Clay	Volatile Solids	Total Solids	
UMPO0707-BC-01	0.6	97.4	1.98	1.08	81.0	South Reference (61 feet)
UMPO0707-BC-02	11.6	84.6	3.76	1.59	76.9	South Reference (100 feet)
UMPO0707-BC-03	4.9	90.9	2.19	1.26	76.5	South Proposed (38 feet)
UMPO0707-BC-04	1.5	94.7	3.8	1.44	79.7	South Proposed (61 feet)
UMPO0707-BC-05	0.5	95.7	3.16	1.35	77.3	South Proposed (79 feet)
UMPO0707-BC-06	0.1	96.1	2.71	1.30	69.4	South Proposed (100 feet)
UMPO0707-BC-07	0.0	95.0	4.97	1.54	67.7	South Proposed (121 feet)
UMPO0707-BC-08	0.1	97.6	2.27	1.27	78.2	Section 103 (79 feet)
UMPO0707-BC-09	0.0	96.2	3.79	1.20	81.0	Section 103 (99 feet)
UMPO0707-BC-10	0.1	97.6	2.26	1.14	70.7	North Proposed (40 feet)
UMPO0707-BC-11	6.5	90.0	3.47	1.88	71.9	North Proposed (60 feet)
UMPO0707-BC-12	0.1	96.7	3.21	1.16	74.0	North Proposed (81 feet)
UMPO0707-BC-13	0.0	96.7	3.28	1.38	72.4	North Proposed (99 feet)
UMPO0707-BC-14	0.0	97.2	2.77	1.43	77.8	North Proposed (120 feet)
UMPO0707-BC-15	0.6	97.2	4.72	1.00	78.3	North Reference (60 feet)
UMPO0707-BC-16(1)	0.0	97.4	2.55	1.30	79.1	North Reference (122 feet)
UMPO0707-BC-16(2)	0.0	97.1	2.88	--	81.0	North Reference (122 feet)

Figure 2. ODMD Site Sampling Locations, 2007



Chemical analyses were conducted on sediments from the 16 offshore locations, see figure 2, and included analysis for metals (10 inorganic), TOC, pesticides, PCBs, phenols, phthalates, miscellaneous extractables, and PAHs. Metal analyses showed that the sediments are typical of clean marine sands. The organic analyses showed concentrations of most chemicals of concern to be below MDLs and well below established levels of concern. The one exception was for 4-methylphenol that was detected at a concentration of

1,000 ppb at station UMPO0707-BC-11 and detected at 190 ppb at station UMPO0707-BC-03. Station UMPO0707-BC-11 is located at a depth of 60 feet, while UMPO0707-BC-03 is at a depth of 30 feet. Neither location is associated with past dredged material placement. There are no known current or historical sources of 4-methylphenol in the Umpqua River basin, and no dredge material approved for disposal at the Umpqua site has contained this concentration of this chemical. The highest level found in the estuary in the round of sampling taken in 2006 was 20 ppb in the fine-grained material at a station in Winchester Bay east channel. These values for 4-methylphenol are therefore an anomaly for this location, environment, and sediment type, and do not warrant a re-sampling effort.

Oceanographic Circulation

Circulation of the coastal waters on the continental shelf (near the Umpqua River) results in an interaction of regional oceanic circulation, astronomical tides, local wind-generated surface waves and current, swell, and Umpqua River flow as affected by inland meteorological events. Times 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 along the shore and for offshore circulation along the Pacific Coast of Oregon was developed by the Corps. 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 (for example, flow through the Umpqua River jetties) tends to produce identifiable and relatively constant bathymetry features. Circulation that is highly variable (for example, flow along the open coast) tends to produce homogenous bathymetry having ephemeral features.

<u>Inner Continental Shelf</u>. 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-driven 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 the Umpqua River (for depths less than 120 feet) to produce the bathymetric conditions 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-grained sediments (silt size and smaller).

Surficial Geology

The geological data collected in 2007 from the proposed ODMD sites, and in 2006 from the navigation channel, showed that the properties of the sediments from the Umpqua navigation project and the offshore area are very similar. The average percent sand and gravel sized material from the lower 5 miles of the river was 97.3% based upon the 2006 sediment sampling. The average for all 16 offshore samples collected in June 2007 was 96.7%. Based on samples collected in 2006, sediments from Winchester Bay and the upper portion of Gardiner channel are fine-grained material dissimilar to the offshore sediments. Material dredged from Gardiner channel and Winchester Bay is limited in volume and historically has been placed upland or in estuarine disposal areas.

Water Quality

Water column chemistry and physical characteristics in the vicinity of the proposed Umpqua River ODMD sites were studied in the mid 1980s (Fuhrer and Rinella 1982). The water quality parameters fell within the normal ranges expected for nearshore ocean waters off the Oregon Coast.

Biological Resources

This section summarizes biological conditions in the ocean environment offshore of the Umpqua River. Additional information is provided in Appendix A. The proposed ODMD sites are located in the nearshore area and are typical of habitat common to the nearshore Pacific Coast off Oregon.

Plankton and Fish Larvae

No specific data is available for zooplankton in the Umpqua River offshore area. However, Keister and Peterson (2003) provided a discussion of the zooplankton community found off of the central Oregon Coast (along the Newport hydrographic line). They indicated that the zooplankton community is influenced strongly by seasonal variations in wind and current patterns. During late spring and summer, northwesterly winds set up flow towards the equator and coastal upwelling. Northwesterly winds dominate from April/May-September; periodic relaxations or southwesterly storms rapidly affect the hydrograph of nearshore areas. During this time period conditions about 30 kilometers (km) offshore are less variable. Boreal neritic copepods such as *Pseudocalanus mimus*, *Calanus marshallae*, *Centropages abdominalis*, *Acartia longiremis*, and *Acartia hudsonica* dominate the coastal plankton during summer (Peterson and Miller 1977). In early fall, winds reverse and upwelling ceases; during autumn and winter, winds are predominantly southwesterly, the Davidson Current flows toward the pole, and offshore surface waters are transported onshore. In winter, the coastal zooplankton is populated by warm-water species such as

Mesocalanus tenuicornis, *Paracalanus parvus*, *Ctenocalanus vanus*, *Clausocalanus spp.*, *Acartia tonsa*, and *Corycaeus anglicus* (Peterson and Miller 1977).

Auth and Brodeur (2006) examined ichthyoplankton off the central Oregon Coast (along the Newport hydrographic line). The dominant taxa collected were northern anchovy (*Engraulis mordax*), slender sole (*Lyopsetta exilis*), rockfishes (*Sebastes* spp.), northern lampfish (*Stenobrachius leucopsarus*), and blue lanternfish (*Tarletonbeania crenularis*). Total larval concentration increased from 49.3 per 1000 cubic meters (m^3) in 2000 to 72.0 per 1000 m^3 in 2002, with seasonal concentrations highest in August 2000 (90.3 per 1000 m^3) and April 2002 (151.2 per 1000 m^3). Relatively few larvae were found at depths greater than 100 meters, while highest larval concentrations generally were observed from depths of 0 to 50 meters. Larval diversity and concentration were higher offshore (46-84 km off the coast) than in nearshore areas (9-28 km off the coast). Highest concentrations were normally found at an intermediate station, approximately 65 km off the coast. Species designated as either coastal or offshore species by previous studies were predominantly found in their respective shelf regions. Most larval concentrations were positively correlated with temperature and negatively correlated with salinity.

Auth and others (2007) examined the ichthyoplankton assemblages from a single station 69 km off Heceta Head on the central Oregon Coast. The authors noted that the species composition, assemblages, and dominant taxa were similar to those found in other studies conducted in this area during summer (Richardson 1973; Richardson and Pearcy 1977; Brodeur et al., 1985; Auth and Brodeur 2006). This similarity provided evidence to support the hypothesis of Auth and Brodeur (2006) that past sampling along the Newport hydrographic line during summer is representative of ichthyoplankton assemblages elsewhere along the Oregon Coast.

Benthic Invertebrates

In September 1984 and January 1985, field sampling was conducted in water depths from 60 to 120 feet to collect data on benthic invertebrates in and adjacent to the Interim and Section 103 sites (Emmett et al., 1987; Corps 1989). The species composition of the area was found to be typical of nearshore high-energy environments. The benthic infaunal community was dominated by gammarid amphipods and polychaete worms.

Field surveys were conducted in July and September 2007, by Marine Taxonomic Services (2008), to provide current information about the benthic invertebrate species present in the vicinity of the proposed North and South ODMD sites. The benthic invertebrate fauna in the vicinity of the proposed ODMD sites was found to be typical of the nearshore, high-energy environment found along the Oregon Coast. The density distribution data represents juvenile recruitment of most species from spring spawning. This recruitment includes both opportunistic short-lived species (*Spiophanes bombyx*) and (*Owenia fusiformis*) and longer-lived species (*Siliqua* sp. juv. and *Dendraster excentricus*). The crustaceans show some population spikes throughout the sampling; however, the same species were not always the driving factors. Gammarid amphipods were often present but also present were *Diastylopsis dawsoni (Cumacea)* and barnacles (Cirripedia) which showed up on hard features such as snail shells and the occasional rock. The echinoderms were driven by

Dendraster sp. juveniles and *Dendraster excentricus* and the other miscellaneous groups were largely populated by Nemertinea and juvenile holothuroids.

The benthos in the area is typical of the communities found near other ocean disposal sites along the Oregon Coast, such as Coos Bay areas E and F, Rogue River, Siuslaw River, and Chetco River (Hancock et al., 1981; Corps 1985, 1988a, 1988b, 1989, 1990, 1999). This benthic community, largely dominated by very mobile organisms, provides an important link in the marine food web. These organisms serve as a direct food source for other benthic organisms and demersal fishes. They also play an active role in the breakdown of organic debris and the tube-building species that help stabilize the marine sediments. Many of the benthic species in the area are able to survive in this dynamic environment being either very mobile or being able to react both to natural or man made perturbations. The benthic community would be expected to re-colonize within a period of a few weeks to months after disposal (Corps, 1993).

Fish and Epibenthic Species

Commercially and recreationally important epibenthic species in the Umpqua inshore coastal area are shellfish and Dungeness crabs. Razor clam beds are located north of the Umpqua River jetty along the beach. Recruitment to the inshore beaches comes from the subtidal spawning areas. Gaper, softshell, butter, and bentnose clams are present in large numbers near the mouth of the Umpqua and upriver in the estuary proper. 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) has not identified any squid spawning areas off the Umpqua estuary. The nearshore area off the Umpqua River supports anadromous salmonids including coho salmon, steelhead, spring and fall Chinook salmon, and cutthroat trout, as well as a variety of other pelagic and demersal fish species. Trawl data collected in 2007 overall showed female Dungeness crab to be somewhat more numerous than males. Average size of 237 individuals in the July trawls approximately 92 mm, with size ranges from 63-163 mm. Average sizes of the 41 individuals in the September trawls were very close to those in the July trawls.

Commercial and Recreational Fisheries

Based on data from the National Marine Fisheries Service (NMFS 2006) for commercial fishing, in 2000 there were 57 vessels that delivered landings, i.e. market-sized fish caught and suitable for sale, to Winchester Bay; there were no landings in Reedsport. Data for landings in Winchester Bay are presented for the following West Coast fisheries (data shown represents landings in metric tons/value of total landings/number of vessels landing; NA = a data item was not available): coastal pelagic (NA/NA/1), crab (250.8/$1,170,610/23), groundfish (33.6/$129,193/20), highly migratory species (44.4/$105.495/10), salmon (44.1/$159,668/33), shellfish (NA/NA/3), shrimp (0.1/$711/4), and other species (30.8/$196,940/12). Recreational fishing takes place in the same general areas as the commercial fishery but usually closer to shore. For Winchester Bay, the 2000 recreational salmonid catch in the Ocean Boat Fishery was 4,432 Chinook salmon and 2,882 coho salmon (NMFS 2006). The recreational non-salmonid catch was 2,147 fish (NMFS 2006). The top species landed included yellowtail rockfish (*Sebastes flavidus*),

lingcod, canary rockfish (*S. pinniger*), yelloweye rockfish (*S. ruberrimus*), greenstriped rockfish (*S. elongatus*), and quillback rockfish (*S. maliger*).

Wildlife

Steller sea lions, harbor seals, and California sea lions are present most of the year in the Umpqua River coastal area. Steller sea lions forage at river mouths and nearshore areas along the Oregon Coast. Harbor seals breed in the estuary and on nearshore rocks. The Umpqua River nearshore area and shoreline provides important habitat for shorebirds, waterfowl, herons, bald eagles, hawks, and many other species of birds. Pelagic birds (e.g., murres, auklets, cormorants) are likely to use the area near the proposed Umpqua sites and adjacent waters for foraging.

Threatened and Endangered Species

Both the Oregon Coast coho salmon and the Southern Oregon/Northern California Coast (SONCC) coho are federally threatened Evolutionary Significant Units (ESUs) that may be present in the vicinity of the proposed Umpqua River ODMD sites. Although critical habitat has been designated for both ESUs, the ocean area off the Umpqua River is not included in that designated critical habitat. Coho salmon are present in the vicinity of the proposed ODMD Sites 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. Upstream migration of adult coho salmon generally takes place from August through November. Juvenile outmigration extends from April through June, but peaks in May.

The Southern Distinct Population Segment (DPS) of green sturgeon (*Acipenser medirostris*) is a federally threatened species. Southern DPS green sturgeon may occur at or near the Umpqua River ODMD sites as they migrate to northern estuaries during summer and early fall. Critical habitat for the Southern DPS green sturgeon proposed on September 8, 2008 (*73 Federal Register 52084*) included the proposed sites, but critical habitat has not yet been designated.. Green sturgeon that spawn to the north, primarily in the Klamath and Rogue rivers, constitute the Northern DPS, which is not federally listed. These two DPSs for sturgeon were established because they were genetically distinct.

Federally listed avian species that may be present in the Umpqua offshore area include the marbled murrelet, brown pelican, and short-tailed albatross. Threatened Marbled murrelets are observed in small flocks or as individuals in the ocean throughout the year. Endangered Brown pelicans are abundant from June to September along the coast and in the lower reach of the Umpqua River estuary. The endangered short-tailed albatross may forage in open ocean areas off the Oregon coast.

The blue, fin, sei, sperm, humpback, and southern resident killer whales are all federally endangered and have been observed as migrants off the coast in waters typically farther from shore than within the proposed Umpqua River ODMD sites. Threatened Steller sea lions are year-long residents along the Oregon Coast, and will occur as migrants in the vicinity of the proposed North and South Umpqua sites. Orford Reef and Rogue Reef, the nearest Steller sea lion rookeries and designated critical habitat, are located approximately

60 and 80 miles south of the proposed sites respectively. The loggerhead, green, leatherback, and olive ridley sea turtles have been recorded from strandings along the Oregon and Washington coasts. The occurrence of sea turtles off Oregon is associated with the appearance of albacore. Albacore occurrence is strongly associated with the warm waters of the Japanese Current. Because these warm waters generally occur 30 to 60+ miles offshore, these sea turtle species do not typically occur in the nearshore area.

Socio-Economic Resources

The community of Winchester Bay is located at the mouth of the Umpqua River, about 4 miles south of the City of Reedsport. The 2000 Census reported that Winchester Bay had a total population of 488 people, and Reedsport a population of 4,378 people. Based on the 2000 Census, the industries with highest employment in Winchester Bay were construction (14.7%), accommodation and food services (16.3%), and manufacturing (10.0%). The agriculture, forestry, fishing and hunting category represented 5.7% of the employed population. Approximately 27% of the labor force in 2000 was employed in government. For Reedsport, retail trade was the top occupational field (14.7%), followed by accommodation and food services (13.9%), and health care and social assistance (12.0%). The agriculture, forestry, fishing and hunting occupations represented 4.2% of the employed population. Approximately 18% of the labor force in 2000 was employed in government.

Cultural Resources

Appendix D provides detailed information concerning cultural resources in the Umpqua River offshore area. Prehistoric cultural resources are unlikely to be found within the Umpqua River offshore area. Shipwrecks are the most probable cultural resources to be expected within the offshore area. A review of the historical records indicates several recorded shipwrecks in the vicinity of the Umpqua River offshore area (see Appendix D). Side-scan sonar surveys were conducted within a 1.5 nm arc from the mouth of the Umpqua River channel. No shipwrecks or other historic remnants were detected from this survey.

Recreational Uses

Recreational resources in the area of the proposed Umpqua River ODMD sites are described in Appendix E. The Umpqua River and its associated offshore waters are known as one of the best salmon fishing areas along the Pacific Coast. Although the area receives recreational use year-round, the most popular months are from May through September. Primary activities include fishing, camping, beachcombing, off-highway vehicle use, and sightseeing.

The coastal land adjacent to the proposed Umpqua River ODMD sites is part of the Oregon Dunes National Recreational Area. The beach is open year round to motorized vehicles. Directly south of the Umpqua River, public land is administered by Douglas County. Camping and picnic facilities are provided for public use. The Oregon Dunes National Recreation Area continues south along the coast to Coos Bay. The most common activities taking place in the recreation area are off-highway vehicle use, hiking, photography, fishing, canoeing, horseback riding and camping. The southern portion of the national recreation area has developed access and receives much higher public use than the area

north of the river. The area directly south of the south jetty is utilized for wave-dependent near shore recreation, such as surfing, diving, kayaking, boogie-boarding, skim boarding, and body surfing.

The Umpqua River jetty fishery is well known and accounts for a high number of angler use days. The South Jetty is the primary fishing area because it is easily accessed. A popular place for fishing and crabbing in the entrance channel is off an old Coast Guard pier on the south side of the channel. Peak months of activity on the jetties and pier are June, July, and August. Most crabs are taken from the main entrance channel by individuals in boats, although some are taken directly off the Coast Guard pier. The most popular months for crabbing are June through September.

Commercial Uses

The Umpqua River offshore area supports a moderate commercial fishery primarily for salmon, Dungeness crabs, and bottom fish. Clams are commercially harvested in the estuary. The fishing and tourist industries are a primary source of income to the local economy. No significant mineral or petroleum deposits are known to exist in the vicinity of the proposed Umpqua River ODMD sites.

ANALYSIS OF ALTERNATIVES

EPA and the Corps considered several alternatives for disposal of dredged material generated from the Umpqua River navigation project and other projects with authorized users. Those alternatives included: no action, upland disposal, and estuarine disposal. The alternatives considered for ocean disposal included disposal off the continental shelf, continued use of the existing ODMD Site, and/or designation of a new ODMD Site. Although other users may require dredged material disposal options, the Corps navigation project is the largest and most regular source of dredged material in the vicinity. Since other potential, but smaller, users of the site would likely face many of the same constraints as the Corps in the disposal of dredged material, the discussion of alternatives focuses primarily on the Corps' navigational dredging.

No Action Alternative

Under the no action alternative, EPA would refrain from formal designation of any ODMD Site for the placement of dredged material by the Corps or other authorized persons or entities. If EPA did not designate sites, the Corps has the authority to select alternate sites under MPRSA Section 103. The substantive requirements for information and evaluation of a Section 103 site are similar to those of an EPA formal designation under Section 102, and site designation under Section 103 requires EPA concurrence. In addition, the use of a Section 103 site is limited to 5 years with one possible 5-year extension. The present site being used at Umpqua River is a Section 103 site. It will reach its 10-year use restriction at the end of the 2008 dredging season and will no longer be available for use. The no-action alternative would not meet the project purpose, which is to provide dredged material disposal capacity for long-term use by the Corps for the federally authorized Umpqua River navigation project and disposal capacity for other potential users. Therefore, the no action alternative was judged by both the Corps and EPA to be unacceptable and was dropped from further consideration.

Upland Disposal Alternative

Hopper dredges, self-propelled, seagoing vessels, are the only equipment that can be used to dredge the navigation channel because they can move quickly to minimize interference with navigation traffic and can adjust to rapidly changing weather and sea conditions. Because hopper dredges stockpile dredged material on-board and are designed to bottom dump that material, they are most efficiently utilized in conjunction with an in-water disposal area. Rehandling of material, moving it from the hopper dredge to another location for disposal, introduces an additional cost and logistical component to the process. To dispose of material from a hopper dredge to a land-based disposal site would necessitate dredging an in-water sump within the river estuary, bottom-dumping the dredged material from the hopper dredge into the in-water sump, then pumping the material ashore with a pipeline suction dredge. Aside from increased costs, this approach would have additional adverse environmental impacts associated with the dredging of an in-water estuarine site to be used as the sump. Estuarine sites are both highly valued and limited (see below for additional discussion). In addition, a significant adverse impact of upland disposal is that naturally-occurring sediments would be removed from the littoral system. Upland disposal of entrance material dredged from the Umpqua River project is not considered feasible due to the economic and environmental effects resulting from nearshore rehandling of dredged material.[2]

Estuarine Disposal Alternative

Estuarine habitat is limited and environmentally sensitive. Placement of dredged material in estuarine areas is generally only environmentally acceptable for specific beneficial uses, such as in areas where substrate is eroding and the dredged material would be suitable (e.g., fine grained and clean) to supplement existing substrate. In general, disposal of dredged material in estuaries would result in greater adverse environmental impacts than disposal in the ocean due to both the limited abundance and high productivity of estuaries relative to nearshore oceanic habitats. Disposal of material into the estuary would also increase the risk of the material eroding and reshoaling in the channel, potentially increasing dredging frequency and/or volumes.

There are operational constraints to estuarine disposal as well. Due to the narrowness and shallowness of the Umpqua River estuary, no suitable estuarine disposal areas were identified that could be accessed by a hopper dredge or accept the volume of material annually dredged from the Umpqua River entrance channel.

The Corps has historically placed dredged material from the Winchester Bay entrance and east and west boat basin access channels at an in-bay site located on the north side of the channel at RM 0.8. The site has a sand substrate with no vegetation and is dispersive. Estuarine disposal of dredged material from Winchester Bay entrance and boat basin is possible because of the relatively small quantity of material dredged from these specific locations and their proximity to this disposal site. However, owing to its limited capacity,

[2] Upland disposal of dredged material may be necessary if the material is characterized under the requirements of the Interim Final Northwest Regional Sediment Evaluation Framework (SEF) and found not suitable for open-water disposal (Corps of Engineers, 2006).

this site would not be suitable for the entire volume of material dredged from the navigation channel annually.

Ocean Disposal Alternatives

Ocean disposal alternatives include disposal of the material off the continental shelf, continued use, by designation, of the existing 103 ODMD Site, or designation of a new ODMD Site or Sites.

Disposal Off the Continental Shelf

The MPRSA directs EPA to utilize, whenever feasible, locations beyond the edge of the Continental Shelf. Section 102(a)(I), 33 U.S.C. § 1412(a)(I). This same directive is found in the regulations in the general criteria at 40 CFR § 228.5(e).

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 likely be less able to survive disturbance from the immediate impact of disposal and the long-term alteration of substrate type. 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 both downslope, through turbidity currents, and offshore, by near-bottom currents, potentially affecting organisms outside of any designated site.

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.

The limiting factor in considering a location beyond the edge of the continental shelf is feasibility. At, and in the vicinity of, the Umpqua River, potential disposal areas located off the continental shelf would be at least 15 nautical miles offshore in water depths of 600 feet or greater. This distance is well beyond the reasonable haul distance of hopper dredges working the Umpqua River project, which is discussed in greater detail in the discussion of the "Zone of Siting Feasibility". In addition, the feasibility of monitoring a site located off of the continental shelf is questionable, based on safety, cost, and time constraints correlated with increased distance from shore.

Given the currently unanswered environmental concerns, coupled with the cost/logistical issues of both disposal and monitoring, disposal off of the continental shelf is not currently a feasible alternative. Substantial additional investigation would be required in order to

determine the scope of the possible environmental impacts of this alternative. Such an investigation is not warranted unless there are no suitable sites closer to shore.

Continued Use of Existing Site

There is a preference towards using sites that have been used historically as expressed in the regulations at 40 CFR § 228.5(e). However, dredged material mounding and related navigation consequences have been documented and would be expected to continue despite existing limits placed on site use at either of the previously utilized sites. Excessively high dredged material mounds at the 103-selected Umpqua River ODMD Site can potentially increase the height of incident waves by 20% to 30% as compared with baseline (pre-mound) bathymetries. Due to the limited size, historical mounding, and navigational safety concerns, neither the interim site nor the Corps' 103-selected site is considered by the Corps or EPA to be suitable for long-term use.

Designation of New ODMD Sites

As discussed above in the evaluation of ocean disposal alternatives, the Corps and EPA concluded that designation of the existing 103-selected Umpqua River ODMD Site as an EPA site under Section 102 of the MPRSA does not have the capacity to meet the long-term disposal needs for the Umpqua River project.

Therefore, the Corps and EPA began an analysis of the ocean in the general vicinity of the Umpqua River mouth to explore the feasibility of designating a new ODMD site, or more than one site. A number of criteria listed below were developed to evaluate potential site locations.

- Provide ODMD site capacity for disposal of maintenance dredging material originating from the Umpqua River navigation project for a 20-year life-cycle. The annual disposal volume to be placed in an Umpqua River ODMD Site is expected to be approximately 188,000 cy. Over 20 years, the total volume to be placed at an ODMD Site would be approximately 3.8 million cy.
- Locate the new ODMDS so that average haul distance is within the Zone of Siting Feasibility (ZSF). The ZSF for hopper dredges is within a 3.15-mile radius from RM -1 (see Defining a Zone of Siting Feasibility section below).
- Avoid environmental and navigation impacts due to annual dredged material disposal operations. Prevent mound-induced wave shoaling. Enhance bathymetric dispersal of dredged material placed at ODMD Sites for split-hull vessels by using non-repetitive disposal to evenly distribute dredged material placement in sensitive areas.
- Where practical, enhance transport of suitable dredged material placed at ODMD Sites into the littoral zone. Locate new ODMD Sites such that the littoral transport of placed dredged material toward the entrance channel is minimized. Facilitate the littoral by-passing of dredged material around the Umpqua River jettied entrance.
- Minimize vertical accumulation (mounding) of placed dredged material, from multiple dredging disposal operations (enhance long-term use of ODMD Sites). Designate ODMD Sites with large areal configuration and use sub-regions of the ODMD Sites on an annual rotational basis. If necessary, use placement grid to enhance uniform distribution of dredged material.

- Ensure that new or expanded ODMD Sites conform to the five general and eleven specific criteria for the selection of ocean disposal sites (40 CFR 228.5 and 228.6).

These criteria were modeled and analyzed in depth in Appendix B, Physical Processes and Geologic Features, resulting in the development of two proposed new ODMD Sites. The remaining analysis considers the environmental impacts of designating these two sites in concordance with NEPA and their consistency with the general and specific criteria from 40 CFR 228.

ANALYSIS OF OCEAN DUMPING SITE DESIGNATION PROCESS AND ENVIRONMENTAL EFFECTS

Overview

Formal designation of ocean dumping sites is the responsibility of EPA as stated in the MPRSA. The process for site designation is found in the ocean dumping regulations at 40 CFR Part 228. The process followed by EPA, Region 10, and the Corps for the proposed Umpqua River ODMD Sites 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 and Corps, 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 to 228.6 are applied to the information assembled through this process, and a final site or sites are selected and proposed for formal designation.

Defining a Zone of Siting Feasibility

The MPRSA (33 U.S.C. 1401 to 1445) tasks EPA and the Corps with the joint obligation to ensure that ocean disposal will not "unreasonably degrade or endanger human health, welfare, or amenities, or the marine environment, ecological systems, or economic potentialities." EPA's site criteria and joint EPA/Corps guidance are intended to result in the designation of an environmentally acceptable site, oriented toward avoidance of unreasonable degradation or endangerment of human health, welfare, or amenities, or the marine environment, ecological systems, or economic potentialities, which is operationally efficient. At the outset, and pursuant to jointly developed guidance titled *General Approach to Designation Studies for Ocean Dredged Materials Disposal Sites* (EPA/Corps, 1984), a geographic area of consideration referred to as a Zone of Siting Feasibility (ZSF) is a first step towards designating a site. According to the guidance, a reasonable distance of haul from the dredge site to the disposal site is the determining factor in establishing the ZSF, and will be affected by available dredging equipment, energy use constraints, costs, and safety considerations. The initial ZSF, once established, is evaluated according to the

statutory and regulatory criteria under the MPRSA. Each of the criteria is overlain on the preliminary ZSF in sequence to eliminate unsuitable areas and determine the location and overall suitability of remaining sites, if any, within the ZSF that could be designated for the disposal of dredged material. If, based on that evaluation, a suitable site is not located within the initial ZSF, than the area of consideration must be expanded in order to ensure that a disposal site can be designated which will not unreasonably degrade or endanger human health, welfare, amenities, the marine environment, or ecological systems.

On the West coast, weather and ocean conditions are major considerations and act as significant limiting factors when assessing the reasonable distance of haul. Rough seas and adverse weather conditions are the norm from October through May on the Pacific Coast. These conditions act to limit ocean disposal of dredged material to a narrow window where it is generally safe to work from roughly the end of May to no later than mid-October, with a high probability of down time due to adverse weather at either end of that period.

The availability of dredging equipment is also a constraint that must be considered in the determination of a ZSF for a proposed ocean disposal site, but particularly so for sites on the West Coast of the United States. For most of the designated sites in Oregon, the Corps is the primary user and must confront equipment availability issues. For example, the Jones Act ,46 USC § 12106, precludes the Corps from contracting with foreign-owned vessels, which limits the accessible pool of vessels for Federal dredging and disposal projects to U.S. Government or privately owned (contract) equipment. The Corps evaluates the availability of Government or contract equipment annually and allocates the use of government dredges for the nation. Hopper dredges are mobile, can work in sea swell conditions up to 10 ft, and are self-propelled. Therefore, they are generally 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 U.S. are often committed to other work on the Atlantic and Gulf of Mexico coasts and are not available to be used elsewhere, except perhaps on an emergency basis. As a result, there are typically three hopper dredges working on the West Coast that can be used safely for dredging and disposal of dredged material in ocean disposal sites in Oregon and these dredges must also be shared along the coast with Washington, California, and occasionally Hawaii and Alaska.

Umpqua River ODMD Sites Zone of Siting Feasibility

Although an ODMD Site, once designated, may be used by any person or entity who has received a permit to dispose in the site, the primary anticipated user for the currently proposed Umpqua River ODMD Sites is the Corps. The Corps is expected to utilize the sites annually for disposal of dredged material from the Umpqua River Navigation Project. Potential users of the proposed Umpqua River ODMD Sites include the U.S. Coast Guard and others, but since no pending requests have been identified at this time, the discussion of the ZSF for the Umpqua River ODMD Sites below is based solely on the Corps' anticipated disposal activities.

Due to the limited work window resulting from weather/safety and equipment constraints, time is the limiting factor in calculation of the reasonable haul distance, and thus ZSF, for the proposed Umpqua River ODMD Sites. The amount of time necessary to maintain the Umpqua River Navigation 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 vary for each individual dredge. Loading time is essentially fixed based on the characteristics of the sediments being dredged, the dredge itself (e.g., pumps, size of hopper, and drag arms.), and the dredging site conditions. The time to discharge material also is basically fixed for a given dredge and the type of material, but may vary slightly depending on the disposal methodology outlined in the Site Management and Monitoring Plan (SMMP) for the site. The SMMP will generally direct disposal activities in such a manner as to minimize mounding or other environmental effects at the ODMD Site(s). Transport time depends primarily on the haul distance to the disposal site(s) as the speed of different hopper dredges when full is similar. Thus, a longer haul distance affects the total number of cycles per day, resulting in an impact on the total volume of material that can be dredged and disposed in one season.

In discerning a ZSF for the Umpqua River ODMD sites, certain factors are relatively fixed. The 5-year average (2002 to 2004, and 2006 to 2007) for dredging at the Corps' Umpqua River Navigation Project is 95,264 cy of material. 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 95,264 cy. Based upon work load, available funding and other constraints, the Government owned hopper dredge YAQUINA is typically available 6.7 days (according 5 year average) at the Umpqua River navigation project or a contract dredge is available for a similar length of time. This translates into a 13,860 cy per day average production requirement. The rated capacity for the YAQUINA is 1,034 cy. Load time typically is around 41 minutes for the Umpqua River navigation project. Dependent on the SMMP, environmental conditions, and characteristics of the dredged material, dump time could vary from 2 to 5 minutes. The dredge typically works 24 hours per day, except on Thursdays when crews are changed. The ZSF, as determined by haul distance, can be calculated as follows:

Assume 13.4 loads per day (13,860 cy ÷ 1034 cy/load = 13.4 loads)

Load time (.686 hr) + Dump time (0.055 hr) = .74 hr/load X (13.4 loads) or 9.92 hr/day

24 hr/day − 9.92 hr/day = 14.08 hr/day for transit to and from the disposal site

14.08 hr/day ÷ 13.4 loads/day = 1.05 hr transit time for one round trip

1.05 hr ÷ 2 = 0.525 hr transit one way

0.525 hr X 6kts (vessel speed) = 3.15 nm

Thus the outer limit of the ZSF for the Umpqua River ODMDS, as limited by the capacity of the available dredging equipment, average annual dredging quantity, and limited dredging time period, is 3.15 nautical miles (nm) from the Umpqua River navigation

project. This is the area within which potential sites will initially be evaluated according to the MPRSA statutory requirements and regulatory criteria.

Regulatory Criteria for Ocean Disposal Site Selection

EPA evaluated the five general (40 CFR 228.5) and 11 specific (40 CFR 228.6) regulatory criteria for site designation in reviewing the currently proposed Umpqua River ODMD sites. A conflict matrix format is utilized in Tables 4 through 7 to simplify and consolidate scoring for the general and specific site criteria review process for both of the historically utilized and both of the proposed sits. Each area of consideration on the conflict matrix addresses at least one general or specific criterion. A legend defining the matrix categories follows the tables.

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 *Umpqua Ocean Dredged Material Disposal Site Evaluation* (Corps 1989) and the more recent appendices prepared for this evaluation. The 1989 report presents the overlays on a base map, giving bathymetry and location of the ODMD sites and ZSF. 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 1989 selection of features to use for this determination was dependent on whether the resource was considered limited. 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 Resources;
4. Commercial and Sport Fishing Areas;
5. Geological Features; and
6. Cultural, Historically Significant Areas.

Figure 3 is a composite of all of the above areas and indicates, by various patterns, the relative amount of total usage within the Umpqua ZSF. The denser the pattern overlap, the more interactions between various limited resources exists and the more critical the overlap area is.

The proposed Umpqua River ODMD sites have been located away from the approach channel and are not likely to cause navigational hazards during disposal activities. As Figure 3 shows, the proposed Umpqua River ODMD sites are located mostly within an area of minimal conflict in the ZSF. Commercial salmon and crab fishing would potentially take place in the two proposed ocean disposal areas, but is not limited to those areas, occurring (as it does) over a wide nearshore area. Disposal operations and the salmon fishing season do overlap; however, coordination with ODFW personnel indicated no

Table 4. Original Interim Ocean Dredged Material Disposal Site Conflict Matrix

AREA OF CONSIDERATION	CONFLICT	POTENTIAL CONFLIC	NO CONFLICT	BENEFICIAL USE	COMMENTS	REVELANT SPECIFIC FACTORS (From Table 1 & 40CFR 228.6)	REVELANT GENERAL FACTORS (From Table 2 & 40CFR 228.5)
1. Unusual Topography			X			1, 6, 8, 11	a
2. Physical Sediment Compatibility		X			Potential Fines.	3, 4, 9	b, c, d
3. Chemical Sediment Compatibility			X		Material meets established concern levels.	3, 4, 7, 9	a, b, c, d
4. Influence of Past Disposal	X				Mounding due to past disposal.	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 w/ dredge during dredging.	2, 8	a, b
7. Recreational Fisheries		X			Interference w/ dredge during dredging.	2, 8	a, b
8.Breeding/Spawning Areas		X			Resident and migratory fish and bird use area.	2, 8	a, b
9. Nursery Areas		X			Juvenile flatfish and Big Skate.	2, 8	a, b
10. Feeding Areas		X			Resident and migretory fish and bird use area.	2, 8	a, b
11. Migration Routes		X			Anadromous fish/ birds/ 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			Burial short-term inpact to population.	2, 8, 10	a, b
14. Marine Mammals		X			Migration and feeding.	2, 8	a, b
15. Mineral Deposits			X			1, 8	a, b, c
16. Navigation Hazard	X				Site is located in direct line with the navigatiion channel, also see 6, 7, & 22.	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 Col. Chem./Phys. Characteristics		X			Temporary turbidity.	4, 6, 9	a, b, d
20. Recreational Uses		X			See 7.	2, 8, 11	a, b, c, d
21. Cultural/Historic Sites			X			11	b
22. Physical Oceanography: Waves/Circulation	X				Mounding induced wave increase.	1, 3, 6, 7	a, b, d
23. Direction of Transport/Potential for Settlement				X	Keep sand in active littoral zone.	1, 3, 6, 7	a, b, d
24. Monitoring			X			5	c
25. Shape/size of Site	X				Site too small for volumes placed.	1, 4, 7	d
26. Size of Buffer Zone			X			2, 3, 4, 7, 11	b, d
27. Potential for Cumulative Effects	X				See 22.	4, 7	c, d

Table 5. Existing Section 103 Ocean Dredged Material Disposal Site Conflict Matrix

AREA OF CONSIDERATION	CONFLICT	POTENTIAL CONFLIC	NO CONFLICT	BENEFICIAL USE	COMMENTS	REVELANT SPECIFIC FACTORS (From Table 1 & 40CFR 228.6)	REVELANT GENERAL FACTORS (From Table 2 & 40CFR 228.5)
1. Unusual Topography			X			1, 6, 8, 11	a
2. Physical Sediment Compatibility		X			Potential Fines.	3, 4, 9	b, c, d
3. Chemical Sediment Compatibility			X		Material meets established concern levels.	3, 4, 7, 9	a, b, c, d
4. Influence of Past Disposal	X				Mounding due to past disposal.	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 w/ dredge during dredging.	2, 8	a, b
7. Recreational Fisheries		X			Interference w/ dredge during dredging.	2, 8	a, b
8.Breeding/Spawning Areas		X			Resident and migratory fish and bird use area.	2, 8	a, b
9. Nursery Areas		X			Juvenile flatfish and Big Skate.	2, 8	a, b
10. Feeding Areas		X			Resident and migretory fish and bird use area.	2, 8	a, b
11. Migration Routes		X			Anadromous fish/ birds/ 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			Burial short-term inpact to population.	2, 8, 10	a, b
14. Marine Mammals		X			Migration and feeding.	2, 8	a, b
15. Mineral Deposits			X			1, 8	a, b, c
16. Navigation Hazard		X			See 6 & 7.	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 Col. Chem./Phys. Characteristics		X			Temporary turbidity.	4, 6, 9	a, b, d
20. Recreational Uses		X			See 7.	2, 8, 11	a, b, c, d
21. Cultural/Historic Sites			X			11	b
22. Physical Oceanography: Waves/Circulation	X				Mounding induced wave increase.	1, 3, 6, 7	a, b, d
23. Direction of Transport/Potential for Settlement				X	Keep sand in active littoral zone.	1, 3, 6, 7	a, b, d
24. Monitoring			X			5	c
25. Shape/size of Site	X				Site too small for volumes placed.	1, 4, 7	d
26. Size of Buffer Zone			X			2, 3, 4, 7, 11	b, d
27. Potential for Cumulative Effects	X				See 22.	4, 7	c, d

Table 6. Proposed South Umpqua River Ocean Dredged Material Disposal Site Conflict Matrix

AREA OF CONSIDERATION	CONFLICT	POTENTIAL CONFLICT	NO CONFLICT	BENEFICIAL USE	COMMENTS	REVELANT SPECIFIC FACTORS (From Table 1 & 40CFR 228.6)	REVELANT GENERAL FACTORS (From Table 2 & 40CFR 228.5)
1. Unusual Topography			X			1, 6, 8, 11	a
2. Physical Sediment Compatibility		X			Potential Fines.	3, 4, 9	b, c, d
3. Chemical Sediment Compatibility			X		Material meets established concern levels.	3, 4, 7, 9	a, b, c, d
4. Influence of Past Disposal			X		No past disposal.	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 w/ dredge during dredging.	2, 8	a, b
7. Recreational Fisheries		X			Interference w/ dredge during dredging.	2, 8	a, b
8.Breeding/Spawning Areas		X			Resident and migratory fish and bird use area.	2, 8	a, b
9. Nursery Areas		X			Juvenile flatfish and Big Skate.	2, 8	a, b
10. Feeding Areas		X			Resident and migratory fish and bird use area.	2, 8	a, b
11. Migration Routes		X			Anadromous fish/ birds/ 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			Mounding. Short-term inpact to population.	2, 8, 10	a, b
14. Marine Mammals		X			Migration and feeding.	2, 8	a, b
15. Mineral Deposits			X			1, 8	a, b, c
16. Navigation Hazard		X			See 6 & 7.	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 Col. Chem./Phys. Characteristics		X			Temporary turbidity.	4, 6, 9	a, b, d
20. Recreational Uses		X			See 7.	2, 8, 11	a, b, c, d
21. Cultural/Historic Sites			X			11	b
22. Physical Oceanography: Waves/Circulation		X			Mounding induced wave increase.	1, 3, 6, 7	a, b, d
23. Direction of Transport/Potential for Settlement				X	Keep sand in active littoral zone.	1, 3, 6, 7	a, b, d
24. Monitoring			X			5	c
25. Shape/size of 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			4, 7	c, d

Table 7. Proposed North Umpqua River Ocean Dredged Material Disposal Site Conflict Matrix

AREA OF CONSIDERATION	CONFLICT	POTENTIAL CONFLIC	NO CONFLICT	BENEFICIAL USE	COMMENTS	REVELANT SPECIFIC FACTORS (From Table 1 & 40CFR 228.6)	REVELANT GENERAL FACTORS (From Table 2 & 40CFR 228.5)
1. Unusual Topography			X			1, 6, 8, 11	a
2. Physical Sediment Compatibility		X			Potential Fines.	3, 4, 9	b, c, d
3. Chemical Sediment Compatibility			X		Material meets established concern levels.	3, 4, 7, 9	a, b, c, d
4. Influence of Past Disposal			X		No past disposal.	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 w/ dredge during dredging.	2, 8	a, b
7. Recreational Fisheries		X			Interference w/ dredge during dredging.	2, 8	a, b
8.Breeding/Spawning Areas		X			Resident and migratory fish and bird use area.	2, 8	a, b
9. Nursery Areas		X			Juvenile flatfish and Big Skate.	2, 8	a, b
10. Feeding Areas		X			Resident and migretory fish and bird use area.	2, 8	a, b
11. Migration Routes		X			Anadromous fish/ birds/ 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			Mounding. Short-term inpact to population.	2, 8, 10	a, b
14. Marine Mammals		X			Migration and feeding.	2, 8	a, b
15. Mineral Deposits			X			1, 8	a, b, c
16. Navigation Hazard		X			See 6 & 7.	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 Col. Chem./Phys. Characteristics		X			Temporary turbidity.	4, 6, 9	a, b, d
20. Recreational Uses		X			See 7.	2, 8, 11	a, b, c, d
21. Cultural/Historic Sites			X			11	b
22. Physical Oceanography: Waves/Circulation		X			Mounding induced wave increase.	1, 3, 6, 7	a, b, d
23. Direction of Transport/Potential for Settlement				X	Keep sand in active littoral zone.	1, 3, 6, 7	a, b, d
24. Monitoring			X			5	c
25. Shape/size of 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			4, 7	c, d

Conflict Matrix Tables 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-gain 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 and 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?
27. Potential for Cumulative Effects: Would placement of material contribute to cumulative affects from other activities?

Conflict Matrix Tables Legend (continued)

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.

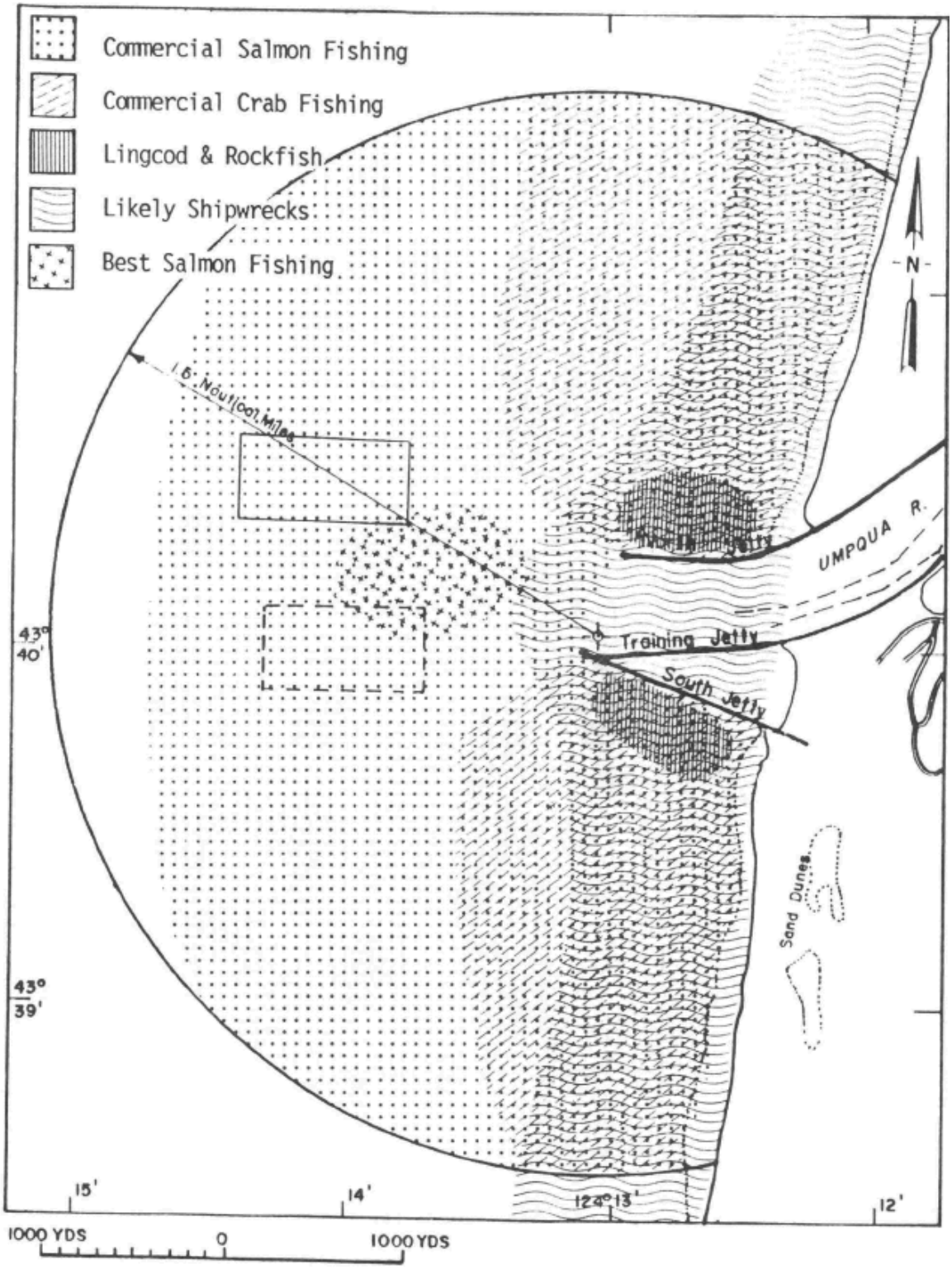
3/ Eleven Specific Factors for Ocean Disposal Site Selection

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 1 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/ Five 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. [Note: This criterion was eliminated after the draft EA was made available to the public by EPA's final rule published at 73 FR 74983 (December 10, 2008).]
d. The sizes of ocean disposal sites will be limited in order to localize, for identification and control, any single immediate adverse impact 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.

Figure 3. Overlay Evaluation of Individual Resources of Limited Distribution



observable conflicts between the two uses. Appendix A discusses all potential conflicts in the ZSF with living resources; it leads to the conclusion that there have been no major conflicts in the past, and no predictable conflicts are expected in the future.

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. The primary impact of disposal activities on water quality is expected to be the temporary turbidity caused by the physical movement of sediment through the water column. Based on modeling completed by the Corps and detailed in Appendix B, water column turbidity would be expected to dissipate within a few minutes for 97% of the dredged material disposed (sandier material), and within a half hour for finer grained sediments, which comprise about 3% of dredged material.

Based on an analysis of the sediment quality at both the proposed Umpqua River ODMD sites and within the Umpqua River Corps Navigation project detailed in Appendix C, no significant contaminant or suspended solids releases are expected. There would be no water quality perturbations to be concerned with moving toward any beach, shoreline, marine sanctuary, or known geographically limited fishery or shell fishery. Bottom movement of deposited material generally shows a net movement to the north, at the depth of the disposal site, but material appears to be quickly dispersed.

Interim Sites Which Do Not Meet Criteria (c). There are no interim disposal sites near the final Umpqua River sites. EPA's final rule published at 73 FR 74983 (December 10, 2008), after the draft EA was made available to the public, repealed obsolete regulations under the MPRSA regarding interim ocean dumping sites and interim ocean dumping criteria.

The historically used sites do not meet the criteria due to mounding and associated impacts to navigational safety. The data, which are more fully discussed below, show that the proposed North and South Umpqua River sites are environmentally acceptable for the types and quantities of dredged material they will receive and suitable for use as designated ODMD sites subject to site management pursuant to the SMMP.

Size of Sites (d). The fourth general criterion requires that the size, configuration, and location of the site(s) be evaluated as part of the study and that the size be limited. A detailed discussion of this criterion as it relates to the two proposed sites is located in Appendix B. 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-range impacts. The lineal dimensions, boundary coordinates, and water depth variation for the proposed Umpqua River ODMD sites are: lineal dimension of approximately 6,300 feet x 4,000 feet; axis azimuth is 270°; average depth is 75 feet; and 1998 elevation variation is -30 feet to -120 feet MLLW. The sites are of appropriate size to handle the volumes of material to be received annually over a minimum 20-year life cycle. Annual bathymetric surveys of the proposed ODMD sites

will be conducted in accordance with the SMMP. 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). At the Umpqua River, potential disposal areas located off the continental shelf would be at least 15 nautical miles offshore in water depths of 600 feet or greater. 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 by 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 may not 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 down slope as turbidity currents, and offshore, by near-bottom currents, making any long term monitoring and management challenging.

Disposal would also remove sediments from the nearshore littoral transport system, a system that functions with largely non-renewable quantities of sand in Oregon. Additional disruption in the mass balance of this system could contribute to the alteration of erosion/accretion patterns impacting beaches, spits, wetlands, and other shoreline habitats.

In addition, the haul distance to a site beyond the shelf is much greater than the 3.15 nm limit of the Umpqua River ZSF, making the site economically and logistically infeasible for the Corps navigation project, which is the primary expected user of the site. The additional cost/time associated with the increased haul distance, monitoring difficulties, and environmental concerns regarding disposal in such areas makes off-shelf disposal undesirable.

Application of Eleven Specific Factors (40 CFR 228.6)

Geographical Position, Depth of Water, Bottom Topography, and Distance from the Coast (1). The proposed North Umpqua ODMD Site is approximately 4,000 feet northwest of the entrance to the Umpqua River and the proposed South Umpqua ODMD Site is approximately 4,000 feet southwest from the entrance to the Umpqua River (see Figure 1). Appendix B contains a detailed discussion of the bottom topography of the proposed sites. The two designated sites would be used for disposal of dredged material from the Umpqua River navigation project and other permitted projects. The lineal dimensions, boundary coordinates, and water depth variation for the proposed Umpqua River ODMD sites are: lineal dimension of each site is approximately 6,300 feet x 4,000 feet; axis azimuth is 270°; average depth is 75 feet; and 1998 elevation variation is -30 feet to -120 feet MLLW. The corner coordinates (NAD 83) of the proposed sites are:

Proposed North Site	**Proposed South Site**
43° 41’ 23.09”N 124° 14’ 20.28”W	43° 39’ 32.31”N 124° 14’ 35.60”W
43° 41’ 25.86”N 124° 12’ 54.61”W	43° 39’ 35.23”N 124° 13’ 11.01”W
43° 40’ 43.62”N 124° 14’ 17.85”W	43° 38’ 53.08”N 124° 14’ 32.94”W
43° 40’ 46.37”N 124° 12’ 52.74”W	43° 38’ 55.82”N 124° 13’ 08.36”W

Based upon consideration of the location, depth of water, bottom topography, and distance from the coast, the proposed Umpqua River ODMD sites are expected to be suitable for the disposal of dredged material when the material is placed in accordance with the SMMP.

Location in Relation to Breeding, Spawning, Nursery, Feeding, or Passage Areas of Living Resources in Adult or Juvenile Phases (2). Aquatic resources of the oceanic region off the mouth of the Umpqua River are described in detail in Appendix A. In addition, EPA has evaluated possible impacts to species and critical habitat listed under the Endangered Species Act in the *Umpqua River, Oregon: Ocean Dredged Material Disposal Site Designation Biological Assessment* (BA), dated June 5, 2008. The proposed Umpqua River ODMD sites are located in the nearshore area and many nearshore pelagic organisms are found 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 in the oceanic region off of most of the Pacific Coast, those populations directly off the Umpqua River are small compared to the overall coastal populations. 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).

Benthic samples are discussed in detail in Appendix A. Based on the analysis of benthic samples collected from the area of the proposed Umpqua River ODMD sites, the sites contain benthic fauna common to nearshore, sandy, wave-influenced regions that exist along much of the Pacific Coast in Oregon and Washington.

Sediment in and near the proposed Umpqua River ODMD sites consists of well-sorted, fine sands typical of Pacific Northwest coastal areas (Appendix C). The infaunal community of the Umpqua River study area is dominated by gammarid amphipods and polychaete worms. The benthos in the area is typical of the communities found near other ocean disposal sites along the Oregon Coast, such as Coos Bay areas E and F, the Siuslaw River, and the Chetco River (Hancock et al., 1981; Corps 1985, 1988a, 1988b, 1990, 1999). This benthic community, largely dominated by very mobile organisms, provides an important link in the marine food web. These organisms serve as a direct food source for other benthic organisms and demersal fishes. They also play an active role in the breakdown of organic debris and the tube-building species help stabilize the marine sediments. Many of the benthic species in the area are able to survive in this dynamic environment since they are either very mobile or are able to react both to natural or human perturbations. They can readily recolonize in disturbed areas.

The area off the mouth of the Umpqua River also supports a variety of pelagic and demersal fish species, as well as shellfish, including Dungeness crab (*Cancer magister*). Many of these species have a reproductive strategy which includes releasing a large quantity of eggs so that some individuals will survive the substantial mortality common to the species during the larval and juvenile stages. 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 in the 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.

The nearshore area off the Umpqua River supports anadromous salmonids including coho salmon (*Oncorhynchus kisutch*), summer and winter steelhead (*Oncorhynchus mykiss*), and spring and fall Chinook salmon (*Oncorhynchus tshawytscha*), as well as a variety of other pelagic and demersal fish species. Common pelagic species include northern anchovy (*Engraulis mordax*) and smelts. Demersal species present in the inshore area are mostly residents and include sculpins and flatfish species occurring predominantly over open sandflats. Common flatfish species include English sole (*Parophrys vetulus*), sand sole (*Psettichthys melanostictus*), and sanddab (*Citharichthys* sp.). English sole and sand sole spawn in the inshore coastal area in the summer and juveniles of these, as well as other marine species, may rear in the estuary.

Three species of seals and sea lions inhabit the lower Umpqua River and coastal area. Steller sea lions (*Eumetopias jubatus*), a federally threatened species, and harbor seals (*Pusa vitulina*) are year-long residents, while California sea lions (*Zalophus californianus*) are present most of the year. Steller sea lions forage at river mouths and nearshore areas along the Oregon Coast. Harbor seals breed in the estuary and on nearshore rocks. The Umpqua River nearshore area and shoreline provides important habitat for shorebirds, waterfowl, herons, bald eagles (*Haliaeetus leucocephalus*), hawks, and many other species of birds. Pelagic birds (e.g., murres, auklets, cormorants) likely use the area for foraging.

Federally listed avian species that may be present in the Umpqua River offshore area include the marbled murrelet (*Brachyramphus marmoratus*, threatened), brown pelican (*Pelecanus occidentalis*, endangered), short-tailed albatross (*Phoebastria albatrus*, endangered). Marbled murrelets are observed in small flocks or as individuals in the ocean throughout the year. On October 2, 2008, the U.S. Fish and Wildlife Service announced that it will conduct a 12-month status review in response to a petition to delist the California/Oregon/Washington population of the marbled murrelet (73 *Federal Register* 57314). Brown pelicans are seasonally abundant (June to September) along the Oregon Coast and in the lower reaches of various estuaries, including the Umpqua River. On February 20, 2008, the U.S. Fish and Wildlife Service proposed to remove the brown pelican from the federal list of endangered and threatened wildlife due to recovery (73 *Federal Register* 9407). The short-tailed albatross may forage in open ocean areas off the Oregon Coast.

There are many whale species and sea turtles in Oregon's offshore coastal area that are listed under the Endangered Species Act. The blue whale (*Balaenoptera musculus*), fin whale (*Balaenoptera physalus*), sei whale (*Balaenoptera borealis*), sperm whale (*Physeter macrocephalus*), humpback whale (*Megaptera novaeangliae*), and southern resident killer whale (*Orcinus orca*) are all federally endangered species and occur as migrants off the Oregon Coast in waters typically farther from shore than within the proposed Umpqua River ODMD sites. Observations of the loggerhead sea turtle (*Caretta caretta*, threatened), green sea turtle (*Chelonia mydas*, threatened), leatherback sea turtle (*Dermochelys coriacea*, endangered), and olive ridley sea turtle (*Lepidochelys olivacea*, threatened) have been recorded from strandings along the Oregon and Washington coasts. The occurrence of sea turtles off the Oregon Coast is associated with the appearance of albacore. Albacore occurrence is strongly associated with the warm waters of the Japanese Current. Because these warm waters generally occur 30 to 60 or more miles offshore from the Oregon Coast, these sea turtle species do not typically occur in the nearshore area.

In general, the locations of the proposed ODMD sites do not provide unique breeding, spawning, nursery, feeding, or passage habitat. It is unlikely that any of the larger organisms (fish, marine mammals, turtles, etc.) would experience physiological effects as a consequence of disposal because the resulting turbidity plume and physical disturbance to the water column would likely cause them to avoid the area. Based on modeling completed by the Corps and detailed in Appendix B, water column turbidity would be expected to dissipate within a few minutes to half hour. Any avoidance behavior would be limited to the duration of this physical disturbance. Indirect impacts could occur if disposal operations changed the value of the habitat by burying the existing benthic community where dredged material is deposited. The benthic community would be expected to re-colonize within a period of a few weeks to months after disposal, limiting any effects to forage fish (Corps, 1993). Lastly, evaluation of past disposal activities has not indicated that any long-term adverse impacts to living resources have occurred. Therefore, EPA concluded in the BA that site designation was not likely to adversely affect any listed species or critical habitat.

Location in Relation to Beaches and other Amenity Areas (3). The proposed North ODMD Site would be located 3,100 feet from the north jetty and 3,000 feet from the nearest beach. The proposed South ODMD Site would be located 2,400 feet from the south jetty and 2,100 feet from the nearest beach. There are no rocks or pinnacles in the vicinity of either site. The Oregon Dunes National Recreation Area, a part of the Siuslaw National Forest, is located on the beach adjacent to the proposed South ODMD Site, but does not extend into the water. The dunes in the Recreation Area are used for off-highway vehicle use, hiking, photography, fishing, canoeing, horseback riding and camping. The U.S. Forest Services confirmed that the proposed designation of the Umpqua River ODMD sites would not expected to have any impact on the recreational uses of the adjacent upland areas within the Recreation Area.

It is possible that some of the wave-dependent near shore recreational uses near the south jetty may overlap with the proposed Umpqua River ODMD Sites, resulting in temporary

usage conflict during disposal activities. The proposed Umpqua River ODMD Sites were sized and located in order to provide long-term capacity without causing any impacts to the wave environment and the site monitoring and adaptive management outlined in the SMMP would address any possible future mounding. Therefore, the use of the proposed Umpqua River ODMD Sites is not expected to change the wave conditions for any of those recreational uses.

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. The 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 cy. This would be the likely volume range of dredged material deposited in any one dredging placement cycle. The estimated volume to be removed annually from the Umpqua River federal navigation project 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.

The majority of the dredged material disposed in the ocean traditionally comes from shoals in the Umpqua River entrance channel. These shoals consist primarily of marine sand transported into the entrance. The material contains no contaminants of concern in excess levels, is far removed from known sources of contaminants, and has been characterized under the Northwest Regional Sediment Evaluation Framework (SEF) as suitable for unconfined open-water disposal. Material proposed to be dredged from the boat basin access channel is finer but has been evaluated and found acceptable for unconfined open-water disposal. Material dredged from the boat basin access channels will be placed in either the proposed Umpqua River ODMD sites or at an in-bay site on the north side of the channel at approximately RM 1. The proposed Umpqua River ODMD sites have been sized to accommodate the quantity of material to be placed.

Feasibility of Surveillance and Monitoring (5). Monitoring and surveillance are both feasible within the ZSF and are included as requirements in the SMMP for these proposed sites, a draft of which is included in Appendix F. 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. The proposed Umpqua River ODMD sites are readily accessible. Most surveillance and monitoring work can be performed from small, surface research vessels at a reasonable cost or from the disposal vessel.

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 material dredged from the Umpqua River navigation channel is predominantly marine sands and fluvial gravels.

Although the Umpqua River delivers a large sediment load, the bottom contours suggest a rapid distribution away from the river mouth. The beaches seem to be in equilibrium, suggesting that littoral transport is in balance. From bottom current records, there appears to be a bias in transport to the north. During the spring-fall seasons and during La Nina years, the direction of littoral drift may have no net direction or may be towards the south. The constantly varying river outflow combines with tidal flows to produce a highly variable influence on the nearshore circulation.

Sediment movement in the littoral zone consists of two mechanisms depending upon the size of the sediment. Anything finer than sand-sized material remains in suspension in the water and is transported offshore relatively quickly. The almost total lack of silts and clays near the mouth of the Umpqua River attests to the efficiency of this mechanism. Sediments sand sized or coarser may occasionally be suspended by wave action near the bottom of the seafloor and moved by bottom currents or moved directly as bedload. Tidal, wind and wave forces contribute to generating bottom currents which act in relation to the sediment grain size and water depth to produce sediment transport.

Existence and Effects of Current and Previous Discharges and Dumping in the Area including Cumulative Effects (7). The two new ODMD sites are being proposed for the Umpqua River because of mounding problems associated with disposal at the previous Interim and 103-selected ocean disposal sites. Since there is a potential for coarser sediments to be deposited on finer sediments at the proposed disposal sites, there is a potential for mounding to occur. The proposed ocean disposal sites have been located and sized to minimize mounding. Periodic monitoring as outlined in the SMMP will evaluate potential mounding. A uniform disposal strategy as outlined in the SMMP will also be implemented to minimize mounding.

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. Two existing commercial fisheries occur in the inshore area: salmon trawling and Dungeness crab fishing (see Appendix A). The length of the salmon fishing season varies each year depending upon the established quota; however, it normally extends from July to September. During this period, the potential exists for conflicts between the dredge and fishing boats. The Coast Guard and the Oregon Department of Fish and Wildlife (ODFW) indicate that they are not aware of any instance where this has been a problem.

Based on data from the National Marine Fisheries Service (NMFS, 2006) for commercial fishing, in 2000 there were 57 vessels that delivered landings to Winchester Bay (there were no landings in Reedsport) in the following West Coast fisheries: coastal pelagic, crab, groundfish, highly migratory species, salmon, shellfish, shrimp, and other species. Recreational fishing occurs in the same areas as the commercial fishery but generally closer to shore. The top species landed in the recreational catch were Chinook salmon, coho salmon, yellowtail rockfish (*Sebastes flavidus*), lingcod, canary rockfish (*S.*

pinniger), yelloweye rockfish (*S. ruberrimus*), greenstriped rockfish (*S. elongatus*), and quillback rockfish (*S. maliger*). On May 1, 2008, U.S. Secretary of Commerce Carlos M. Gutierrez declared a commercial fishery failure for the West Coast salmon fishery because of historically low salmon returns and accordingly, NMFS closed the 2008 salmon fishery in Oregon south of Cape Falcon. The primary concern prompting the declaration was the decline in the Sacramento Chinook population.

Recreational salmon fishing is done by charter and private boats and occurs in the same areas as the commercial fishing, but generally closer to shore. Bottom fishing is done along the reef areas to the northwest by private charter boat. Recreational fishing boats have a potential for conflicting with dredging operations; however, no conflicts have been reported to date. It is unlikely that any significant conflict will develop in the near future.

The Dungeness crab season is from December 1 to August 15; however, most of the fishing is done prior to June and usually ends early because of the increase in unmarketable soft shell crabs in the catch. As a result, most crab fishing is done outside of the normal dredging season and it is unlikely that a conflict would result. There are no commercial fish or shellfish aquaculture operations that would currently be impacted by use of the proposed Umpqua River ODMD sites.

Mineral Extraction. There are no known metallic mineral deposits within the Umpqua ZSF. No exploratory oil/gas wells have been drilled offshore near the mouth of the Umpqua River and no development is expected in the future.

Desalination. There are no desalination plants in the area of the Umpqua River.

Wave Energy. With the increased interest in alternative energy sources, various wave energy projects have been proposed off the coast of Oregon. The Oregon State Governor, in a November 2007 news release to the Oregon Fishing Industry, stated that he was asking the Federal Energy Regulation Commission (FERC) to limit the permitting of wave energy to five to seven locations. Wave energy projects at those locations will involve numerous generating buoys moored offshore with transmission lines running to shore distribution facilities. One wave energy project, referred to as the Reedsport Wave Energy Project is proposed for installation approximately 5 miles north of the Umpqua River, which is north of the proposed North Umpqua River ODMD Site and use of the North site would not be expected to interfere with the project. Another project, the Douglas County Wave and Tidal Energy Project, would be located both in the ocean waters near the proposed North Umpqua ODMD site and on the South jetty structure at the mouth of the Umpqua River, just north of the proposed South Umpqua River ODMD Site. Final dimensions and configuration for the Douglas County project are not yet known, therefore, it is unknown whether usage conflicts with the proposed North or South Umpqua River ODMD Sites will result. Project proponents for both of these wave energy projects have received a preliminary permit and filed a notice of intent to file a license application with FERC.

Fish and Shellfish Culture. There are no fish or shellfish culture operations in the area of the proposed Umpqua River ODMD sites. Oysters are raised within the embayment of the south jetty.

Shipping and Other Legitimate Uses. No conflicts with commercial navigation traffic have been recorded in the long history of hopper dredging activity. The likely reason for this is the light commercial traffic in the Umpqua River channel.

Marine Reserves. The State of Oregon has initiated efforts to establish a network of state marine reserves as part of an overall strategy to manage its marine waters and submerged lands. The overall purpose would be to protect, sustain, or restore the nearshore marine ecosystem, its habitats, and species. A marine reserve is an area within Oregon's state territorial sea or adjacent intertidal area that is protected from all extractive activities including the removal or disturbance of living and non-living marine resources. Marine reserves are intended to provide lasting protection. Dredging and disposal are identified as disturbances and would be banned from areas designated as marine reserves. In November 2008, Oregon's Ocean Policy Advisory Council (OPAC) recommended to Governor Ted Kulongoski that two sites, Otter Rock near Depoe Bay, and Redfish Rocks near Port Orford, move forward as pilot marine reserves and identified three areas, Cape Falcon, Cascade Head, and Cape Perpetua, as deserving of further study and evaluation as sites for potential marine reserves. None of the sites identified by the OPAC are in or near the proposed ODMD sites.

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

General Discussion of Other Uses. There has not been a demonstrated conflict with any of the above listed uses at either of the historically used Umpqua disposal sites and no usage conflicts are expected at the two proposed Umpqua River ODMD sites. There is a low potential for future conflicts given that the area of the proposed sites has no unique value, is relatively small, and presents few potential conflicts with other uses in the vicinity. Since dredged material disposal sites in the vicinity have been in use for over 30 years, EPA's designation of the two proposed Umpqua River ODMD sites would not be expected to result in any change to the existing uses of the area, by any individuals or groups, or any associated economic benefit of those uses.

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, based mainly on fisheries and benthic data, is that of a mobile sand community. . Neither the pelagic or benthic communities should sustain any long-term impacts 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 any undesirable organism(s) not previously found at a disposal site. They are transported to, or recruited to, a site because the disposal of dredged materials creates an environment where they can establish. Materials to be dredged and transported to the proposed North and South Umpqua River ODMD sites historically have been classified as uncontaminated marine sands similar to the sediment present at the sites. Potential material dredged from the boat basin access channels may include fine-grained material. Limited quantities of fine-grained material from the boat basin access channels have been placed in the ocean. Any material proposed for ocean disposal would be subject to sediment quality evaluation. Therefore, it is highly unlikely that 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 cultural resources of the Umpqua River study area is described in detail in Appendix D. The cultural resource that has the greatest potential for impact by use of the proposed Umpqua River ODMD sites is shipwrecks. Potential shipwreck areas are evaluated in Appendix D. Historical records show that there are not any shipwrecks within the area of the proposed Umpqua River ODMD sites.

SUMMARY OF COORDINATION UNDER OTHER APPLICABLE FEDERAL STATUTES

Federal Action

The proposed federal action consists of designation of two ODMD sites at the mouth of the Umpqua River. Site designation does not create or confer rights on any person to use a designated site upon the effective date of site designation. Persons or entities who seek to use a site must first obtain a federal permit, or in the case of the Corps, meet the substantive permit requirements, in order to actually use a designated ocean dredged material disposal site. This process would include meeting the requirements of applicable statutes and regulations. EPA recognizes, however, that site designation is intended to have a practical result. When sites are designated, it is expected that such sites will be used by persons or entities meeting the statutory and regulatory criteria for ocean disposal of dredged material. Therefore, actual disposal is an indirect effect of site designation and is included in the evaluation of effects under the below listed statutes.

Public Involvement

A public meeting was held on December 3, 2008 at the Port of Umpqua. Corps and EPA staff presented information about the proposed Umpqua River North and South ODMD sites and the site designation process. Attendees included representatives of the Surfrider Foundation, the Umpqua Port Commission, the Salmon Harbor Marina, the Port of Umpqua, and the US Coast Guard. All attendees were encouraged to submit formal comments on the draft rule, which was out for public comment at the time of the meeting.

One comment was received in response to the federal register notice proposing the designation of the Umpqua River ODMD sites. An unidentified "american citizen" commented that nothing should be dumped in the ocean, but should be dumped on land to avoid "harming marine life." No project specific comments were provided. Upland disposal is evaluated in the alternatives analysis portion of this document and the EPA and Corps determined that generally, upland disposal is not feasible at the Umpqua River for economic and environmental reasons. No other comments were received in response to the federal register notice. A comment was received from the Confederated Tribes of the Coos, Lower Umpqua, and Siuslaw as part of the Tribal coordination process and is detailed in that section below.

Endangered Species Act

EPA's determination that the proposed action may affect, but is not likely to adversely affect listed species was documented in the *Umpqua River, Oregon: Ocean Dredged Material Disposal Site Designation Biological Assessment*, dated June 5, 2008. EPA initiated consultation under Section 7 of the Endangered Species Act of 1973, as amended (ESA), 16 U.S.C. Sections 1531 to 1544, based on this documentation with both the U.S. Fish and Wildlife Service (USFWS) and the National Marine Fisheries Service (NMFS) by letter dated June 5, 2008. The USFWS concurred with EPA's determination by letter dated July 29, 2008. The National Marine Fisheries Service (NMFS) did not concur on EPA's NLAA finding and subsequently prepared a Biological Opinion (BO), issued March 20, 2009.

NMFS concluded that EPA's site designation is not likely to jeopardize the continued existence of OC coho salmon or southern DPS green sturgeon and is not likely to destroy or adversely modify OC coho salmon designated critical habitat or proposed southern DPS green sturgeon habitat. However, NMFS found that the indirect effects of the Site designation related to the exposure fish could experience from the disposal of dredged material could have consequences for listed fish. Based on NMFS' estimate of ensuing indirect effects of the Site designation, NMFS estimated that injury and death of as many as 990 yearling OC coho salmon and an unquantified but small number of small subadult southern DPS green sturgeon could occur annually. For Steller sea lions, blue whales, fin whales, humpback whales, Southern Resident Killer whales, and SONCC coho salmon, NMFS concurred in the BO with EPA's determination of "may affect, not likely to adversely affect." For four species of sea turtles, sperm whales, and sei whales, NMFS found no effect because NMFS did not anticipate the species would be present in the action area.

NMFS acknowledged in the BO that EPA's action, the Site designation, does not authorize and will not itself result in disposal of dredged material. NMFS stated that any further analysis of the effects of disposal of dredged material at the disposal site and issuance of an incidental take statement with reasonable and prudent measures and non-discretionary terms and conditions to minimize take would be prepared when a disposal permit is requested by the action agency. NMFS did include one discretionary

conservation recommendation in the BO seeking a study of fish interactions with disposed material. Such recommendations are advisory in nature.

Magnuson-Stevens Fishery Conservation and Management Act

EPA's determination that the proposed action does not have the potential to cause substantial adverse effects on Essential Fish Habitat was documented in the *Umpqua River, Oregon: Ocean Dredged Material Disposal Site Designation Essential Fish Habitat Assessment*, dated June 5, 2008. EPA initiated consultation under the Magnuson-Stevens Fishery Conservation and Management Act (MSA) 16 U.S.C. Section 1855(b), based on this documentation with NMFS by letter dated June 5, 2008.

NMFS found that disposal of dredge material, an indirect effect of EPA's action to designate the Umpqua River ODMD Sites, will not alter the habitat value of the EFH. NMFS also concluded that impacts to forage base would be highly localized and any potential decrease in forage abundance is considered insignificant to the total food resources available to EFH management species. Finally, NMFS concluded that the safe passage of the EFH managed species will not be functionally changed by EPA's Site designation and the subsequent disposal of dredged material. Those findings are documented in the Magnuson-Stevens Fishery Conservation and Management Act section of the NMFS Biological Opinion.

NMFS included, as a "conservation recommendation," implementation of the measure to study fish behavior included in the ESA section of the BO. EPA responded to this recommendation in a separate response.

Marine Mammal Protection Act

EPA determined that the proposed action to designate the proposed Umpqua ODMD Sites would not result in take or incidental take of any protected marine mammal under the Marine Mammal Protection Act of 1972, as amended (MMPA), 16 U.S.C. Sections 1361 to 1389. The Biological Assessment, which evaluated the possible effects on ESA listed marine mammals including Stellar Sea Lion and whales, was provided the NMFS Office of Protected Resources for review on June 5, 2008. NMFS Regional Protected Resources Division staff responded via e-mail dated January 16, 2009, stating that Regional Offices do not provide written confirmation of project compliance with MMPA, but when reviewing projects under ESA, Regional Offices do recommend coordination with the NMFS Headquarters Office of Protected Resources in cases where they see a potential for disturbance or injury of non-listed marine mammals. The NMFS Regional Protected Resources Division did review EPA's proposed site designation under ESA and did not recommend that we contact the NMFS Headquarters Office of Protected Resources. NMFS found that all potential adverse effects to ESA-listed marine mammals are discountable or insignificant. Those findings are documented in Appendix A. Marine Mammal Determinations of the Biological Opinion issued by NMFS on March 20, 2009. Based on the review and this response provided by NMFS Regional Protected Resources Division, EPA has concluded that the requirements of the MMPA have been met.

Coastal Zone Management Act

EPA made a consistency determination pursuant to the Coastal Zone Management Act (CZMA), 16 U.S.C. Sections 1451 to 1465, and provided that determination to Oregon's Department of Land Conservation and Development (DLCD) by letter dated November 12, 2008. DLCD responded on January 16, 2009, providing a conditional concurrence with EPA's certification of consistency to the maximum extent practicable with the enforceable policies of the state's approved CZM program. DLCD's concurrence sought assurance in the SMMP that monitoring measures for the Rogue River Site would be reasonably likely to identify significant unanticipated adverse effects on renewable marine resources, biological diversity of marine life and the functional integrity of the marine ecosystem at the Site. In addition, DLCD sought inclusion in the SMMP of adaptive management measures to avoid significant impairment of the Site and significant decreases in abundance of commercial or recreational caught species from direct or indirect effects on important or essential habitat at the Site.

National Historic Preservation Act

National Historic Preservation Act, as amended (NHPA), 16 U.S.C. Sections 470 to 470a-2, which requires Federal agencies to take into account the effect of their actions on districts, sites, buildings, structures, or objects, included in, or eligible for inclusion in the National Register. EPA determined that no historic properties would be affected the proposed undertaking, the designation of the proposed Umpqua River ODMD sites. EPA provided that determination and supporting evaluation to the State Historic Preservation Officer in the Oregon Parks and Recreation Department by letter dated August 28, 2008. The Tribal Governments listed in the section below were copied on the letter as consulting parties. The SHPO responded via letter dated September 8, 2008, stating "while not having sufficient knowledge to predict the likelihood of cultural resources being within your project area, extreme caution is recommended during future ground disturbing activities." A follow-up e-mail with the State Archaeologist, Dennis Griffin, dated October 13, 2008, confirmed that the project could move forward without any further archaeological investigations.

Tribal Coordination

Coordination letters, dated August 28, 2008, were sent to the Coquille Indian Tribe, the Cow Creek Band of Umpqua Indians, the Confederated Tribes of the Grand Ronde Community of Oregon, the Confederated Tribes of the Siletz, and the Confederated Tribes of Coos, Lower Umpqua and Siuslaw. Tribal comments were also solicited during the NHPA process. The Confederated Tribes of the Coos, Lower Umpqua, and Siuslaw replied by letter dated September 12, 2008, stating that there are no known cultural resource sites in the area and that the Confederated Tribes had no objections to the proposed project. However, the letter went on to request that the Tribes be contacted immediately if any known or suspected cultural resources are encountered during the project. No further comments were received from any Tribe.

SELECTION OF OCEAN DISPOSAL SITES FOR FORMAL DESIGNATION

Based upon the evaluation of the criteria contained in 40 CFR Part 228, the Corps and EPA have determined that the North and South Umpqua River ODMD sites are suitable for designation. The designation of the ODMD sites by EPA will be finalized through formal rulemaking adopting this Environmental Assessment/MPRSA Criteria Evaluation and the appendices to support this action.

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Appendix A

Living Resources
Umpqua River, Oregon

April 2009

Appendix A
Living Resources
Umpqua River, Oregon

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Appendix A
Living Resources
Umpqua River, Oregon

Introduction

Information on living resources in the Umpqua River/Oregon Coast offshore areas was obtained from a variety of published and unpublished reports, thesis, and personal communications. Also, field sampling was conducted in 2007 to obtain benthic invertebrate, fish, and epibenthic data specifically in the proposed ocean dredged material disposal site area.

Plankton and Fish Larvae

No specific data is available for zooplankton in the Umpqua River offshore area. However, Keister and Peterson (2003) provided a discussion of the zooplankton community found off the central Oregon Coast (along the Newport hydrographic line). For the Umpqua offshore area, it is likely that zooplankton population dynamics would be similar to those found in the Newport area because of similar oceanographic conditions.

Keister and Peterson (2003) indicate that the zooplankton community is influenced strongly by seasonal variations in wind and current patterns. During late spring and summer, northwesterly winds set up equatorward flow and coastal upwelling. Northwesterly winds dominate from April/May-September; periodic relaxations or southwesterly storms rapidly affect the hydrography of nearshore areas, but offshore of about 30 kilometers, conditions are less variable. Boreal neritic copepods such as *Pseudocalanus mimus*, *Calanus marshallae*, *Centropages abdominalis*, *Acartia longiremis*, and *Acartia hudsonica* dominate the coastal plankton during summer (Peterson and Miller 1977). In early fall, winds reverse and upwelling ceases; during autumn and winter, winds are predominantly southwesterly, the Davidson Current flows poleward, and offshore surface waters are transported onshore. In winter, the coastal zooplankton is populated by warm-water species such as *Mesocalanus tenuicornis*, *Paracalanus parvus*, *Ctenocalanus vanus*, *Clausocalanus spp.*, *Acartia tonsa*, and *Corycaeus anglicus* (Peterson and Miller 1977).

Auth and Brodeur (2006) examined the species composition, distribution, and concentration of ichthyoplankton off the central Oregon coast (along the Newport hydrographic line) to investigate annual, seasonal, vertical, and cross-shelf variability. Larval concentrations were also analyzed in relation to water temperature and salinity. The 281 samples collected from 5 cruises along a historically sampled transect between April and September in 2000 and 2002 yielded 4,944 fish larvae comprising 72 taxa in 28 families. The dominant taxa collected were northern anchovy (*Engraulis mordax*), slender sole (*Lyopsetta exilis*), rockfishes (*Sebastes* spp.), northern lampfish (*Stenobrachius leucopsarus*), and blue lanternfish (*Tarletonbeania crenularis*). Total larval concentration increased from 49.3 per 1000 m^3 in 2000 to 72.0 per 1000 m^3 in 2002, with seasonal concentrations highest in August 2000 (90.3 per 1000 m^3) and April 2002 (151.2 per 1000 m^3). Relatively few larvae were found at depths greater than 100 meters, while highest larval concentrations generally occurred from depths of 0 to 50 meters. However, slender sole concentrations were highest from depths of 50 to 100 meters. Larval diversity and concentration were higher offshore (46-84 kilometers) than in coastal areas (9-28 kilometers). Highest concentrations were normally found at an intermediate station 65 kilometers off the coast. Species designated as either coastal or offshore species by previous studies were predominantly found in

their respective shelf regions. With the exception of slender sole, larval concentrations were positively correlated with temperature and negatively correlated with salinity.

Auth and others (2007) examined the diel vertical distribution, concentration, and community structure of ichthyoplankton from a single station 69 kilometers off Haceta Head on the central Oregon Coast. The depth-stratified samples yielded 1,571 fish larvae from 20 taxa, representing 11 families, and 128 fish eggs from 11 taxa within 9 families. Dominant larval taxa were rockfishes, northern lampfish, and blue lanternfish. The dominant egg taxa were Pacific sardine (*Sardinops sagax*), medusafish (*Icichthys lockingtoni*), Pacific viperfish (*Chauliodus macouni*), and Pacific jack mackerel (*Trachurus symmetricus*). Larval concentrations were found to generally increase from the surface to 50 meters and then decreased with depth. Larval concentrations were higher at night than during the day, and there was evidence of larval diel vertical migration. Depth stratum was found to be the most important factor explaining variability in larval and egg concentrations. The authors noted that the species composition, assemblages, and dominant taxa were similar to those found in other studies conducted during the summer off the central Oregon Coast (Richardson 1973; Richardson and Pearcy 1977; Brodeur et al., 1985; Auth and Brodeur 2006). This similarity provides evidence to support the hypothesis of Auth and Brodeur (2006) that past ichthyoplankton sampling along the Newport hydrographic line during the summer is representative of ichthyoplankton assemblages elsewhere along the Oregon Coast.

Benthic Invertebrates

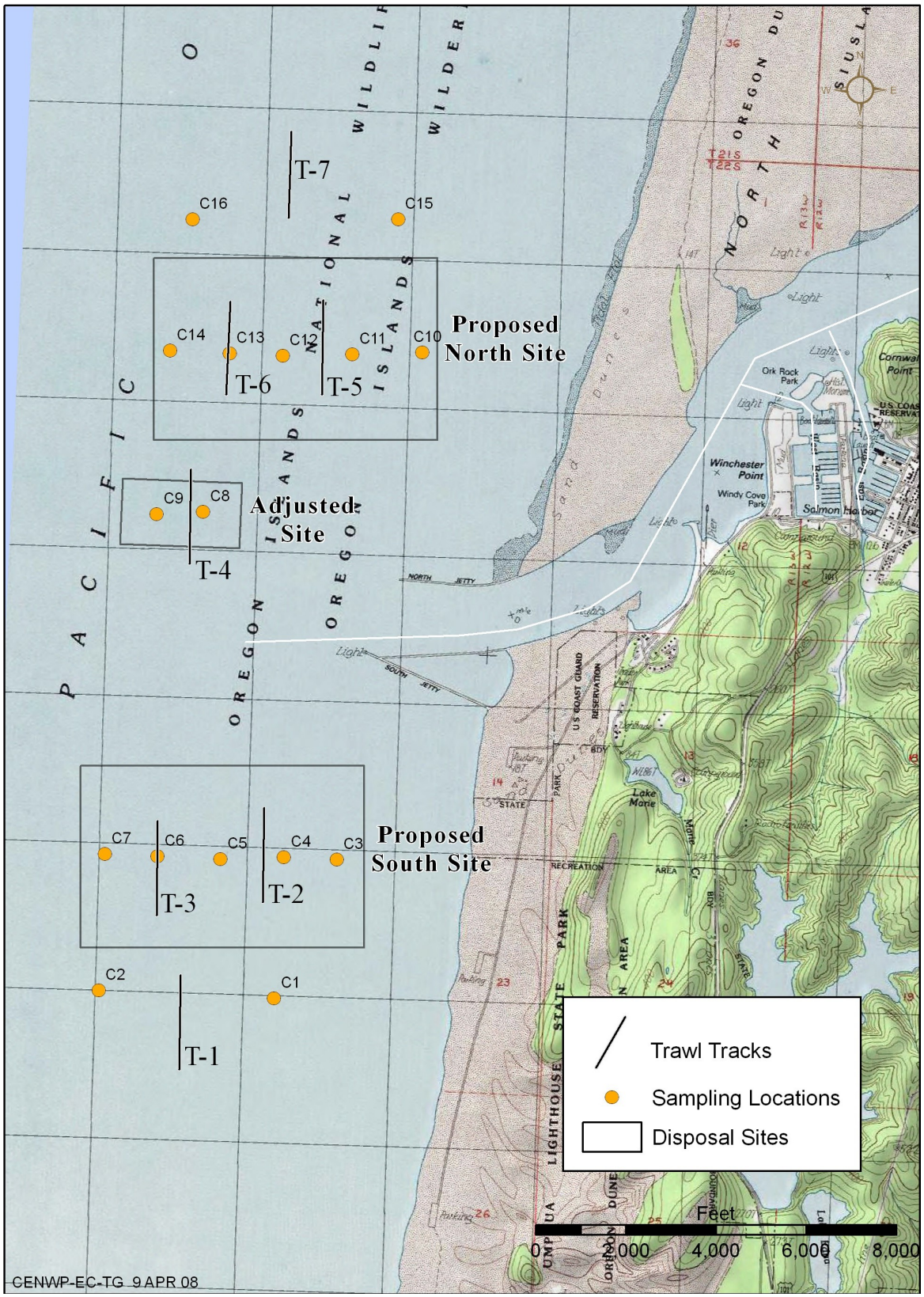
Benthic invertebrates play an important role in secondary productivity in nearshore marine systems. They are not only a direct source of food for many demersal fishes but play an active part in the shredding and breakdown of organic material and in sediment reworking.

In September 1984 and January 1985, field sampling was conducted in water depths from 60 to 120 feet to collect data on benthic invertebrates in and adjacent to the Interim and Section 103 ODMD Sites (Emmett et al., 1987; Corps 1989). The species composition of the area was found to be typical of nearshore high-energy environments. The benthic infaunal community was dominated by gammarid amphipods and polychaete worms.

Field surveys were conducted in July and September 2007 by Marine Taxonomic Services (2008) to provide current information about the benthic invertebrate species present in the vicinity of the proposed North and South ODMD Sites. The benthic infaunal study (Task I) used a 0.096 m^2 modified Gray-O'Hara box core to take 5 biological cores and 1 geological core at each of the 16 sampling sites (Figure A-1).

The benthic invertebrate fauna in the vicinity of the proposed ODMD Sites was found to be typical of the nearshore, high-energy environment found along the Oregon Coast. The density distribution data represents juvenile recruitment of most species from spring spawning. This recruitment includes both opportunistic short-lived species (*Spiophanes bombyx*) and (*Owenia fusiformis*) and longer-lived species (*Siliqua* sp. juv. and *Dendraster excentricus*). The crustaceans show some population spikes throughout the sampling; however, the same species were not always the driving factors. Gammarid amphipods were often present but also present were *Diastylopsis dawsoni (Cumacea)* and barnacles (Cirripedia) which showed up on hard features such as snail shells and the occasional rock. The echinoderms were driven by *Dendraster* sp. juveniles and *Dendraster excentricus* and the other miscellaneous groups were largely populated by Nemertinea and juvenile holothuroids.

Figure A-1. Umpqua River 2007 Sampling Locations



The benthos in the area is typical of the communities found near other ocean disposal sites along the Oregon Coast, such as Coos Bay areas E and F, Rogue River, Siuslaw River, and Chetco River (Hancock et al., 1981; Corps 1985, 1988a, 1988b, 1989, 1990, 1999). This benthic community, largely dominated by very mobile organisms, provides an important link in the marine food web. These organisms serve as a direct food source for other benthic organisms and demersal fishes. They also play an active role in the breakdown of organic debris and the tube-building species help stabilize the marine sediments. Many of the benthic species in this study are able to survive in this dynamic environment being either very mobile or being able to react both to natural or man made perturbations. They readily recolonize in disturbed areas.

Tables A-1 and A-2 show a summary comparing diversity (H' and SDV), evenness (J') and species richness (SR) at the stations sampled in July and September 2007, respectively (also see Figures A-2 to A-5). The tables also include the number of organisms, the calculated number per meter squared (m^2), and the number of species. Table A-3 shows the relative densities of the major taxa at each station. Figure A-6 shows the density of benthic invertebrates at each station. Figures A-7 and A-8 show the density of benthic species for July 2007 and September 2007, respectively, overlayed on the proposed ocean disposal sites.

Table A-1. Densities and Diversity Indices, Benthic Invertebrates, July 2007

Station	# Organisms	# per m^2	# Species	H'	SDV	J'	SR
1	556	1,156.48	42	2.39	0.7993	0.6394	6.4866
2	1,837	3,820.96	79	3.21	0.9253	0.7346	10.3780
3	435	904.80	32	2.04	0.7820	0.5886	5.1026
4	2,101	4,370.08	50	1.28	0.4334	0.3272	6.4051
5	1,461	3,038.88	67	2.97	0.9146	0.7064	9.0574
6	3,074	6,393.92	93	2.86	0.8998	0.6310	11.4560
7	1,987	4,132.96	81	3.10	0.9275	0.7054	10.5341
8	1,076	2,238.08	53	2.67	0.8805	0.6725	7.4488
9	2,470	5,137.60	65	1.83	0.6105	0.4384	8.1926
10	825	1,716.00	45	2.79	0.8983	0.7329	6.5521
11	717	1,491.36	50	2.77	0.8632	0.7081	7.4524
12	824	1,713.92	52	3.23	0.9415	0.8175	7.5959
13	23,853	49,614.24	79	1.63	0.6731	0.3730	7.7384
14	9,491	19,741.28	92	2.24	0.8159	0.4954	9.9366
15	1,554	3,232.32	59	1.37	0.4632	0.3360	7.8927
16	9,994	20,787.52	84	2.61	0.8488	0.5891	9.0122

Key: Species diversity (H' and SDV), evenness (J') and species richness (SR).

Table A-2. Densities and Diversity Indices, Benthic Invertebrates, September 2007

Station	# Organisms	# per m^2	# Species	H'	SDV	J'	SR
1	397	825.76	25	2.50	0.5368	0.7767	4.0107
2	1,340	2,787.20	87	3.57	0.9493	0.7994	11.9437
3	560	1,164.80	37	1.96	0.7491	0.5428	5.6891
4	896	1,863.68	47	2.01	0.6724	0.5221	6.7668
5	1,547	3,217.76	71	2.49	0.8001	0.5841	9.5315
6	1,976	4,110.08	71	2.90	0.9076	0.6803	9.2241
7	1,688	3,511.04	78	3.14	0.9393	0.7207	10.3616
8	2,785	5,792.80	58	2.92	0.9124	0.7191	7.1861
9	5,977	12,432.16	49	2.10	0.7943	0.5396	5.5200
10	2,649	5,509.92	53	1.62	0.6086	0.4080	6.5974
11	1,153	2,398.24	24	2.81	0.8862	0.6920	8.0850
12	5,277	10,976.16	68	1.27	0.4256	0.3010	7.8170
13	12,115	25,199.20	76	2.29	0.8345	0.5288	7.9769
14	6,755	14,050.40	98	2.73	0.8881	0.5954	11.0002
15	1,258	2,616.64	48	2.40	0.8174	0.6200	6.5851
16	3,947	8,209.76	86	2.70	0.8759	0.6061	10.2648

Key: Species diversity (H' and SDV), evenness (J') and species richness (SR).

Table A-3. Relative Density of Major Benthic Invertebrate Taxa

POLYCHAETA July 2007			POLYCHAETA September 2007		
Sta.	# Of Org.	#/m^2	Sta.	# Of Org.	#/m^2
1	105	218.4	1	9	18.7
2	1,032	2,146.6	2	619	1,287.5
3	27	56.2	3	28	58.2
4	83	172.6	4	103	214.2
5	776	1,614.1	5	469	975.5
6	1,454	3,024.3	6	897	1,865.8
7	870	1,809.6	7	680	1,414.4
8	490	1,019.2	8	1,327	2,760.2
9	1,906	3,964.5	9	2,095	4,357.6
10	241	501.3	10	206	428.5
11	133	276.6	11	155	322.4
12	311	646.9	12	610	1,268.8
13	7,554	15,712.3	13	4,372	9,093.8
14	4,737	9,853.0	14	2,672	5,557.8
15	132	274.6	15	158	328.6
16	5,003	10,406.2	16	1,023	2,127.8

MOLLUSCA July 2007			MOLLUSCA September 2007		
Sta.	# Of Org.	#/m^2	Sta.	# Of Org.	#/m^2
1	34	70.7	1	5	10.4
2	197	409.8	2	153	318.2
3	13	27.1	3	34	70.7
4	48	99.8	4	128	266.2
5	270	561.6	5	728	1,514.2
6	892	1,855.4	6	594	1,235.5
7	418	869.4	7	500	1040
8	161	334.9	8	636	1,322.9
9	169	351.5	9	943	1,961.4
10	82	170.6	10	1,669	3,471.5
11	62	129.0	11	231	480.5
12	137	285.0	12	4,110	8,548.8
13	13,307	27,678.6	13	3,484	7,246.7
14	1,396	2,903.7	14	1,438	2,991.1
15	60	124.8	15	411	854.9
16	1,178	2,450.2	16	872	1,813.8

Table A-3 (continued). Relative Density of Major Benthic Invertebrate Taxa

CRUSTACEA July 2007			CRUSTACEA September 2007		
Sta.	# Of Org.	#/m^2	Sta.	# Of Org.	#/m^2
1	380	790.4	1	203	422.2
2	531	1,104.5	2	463	963
3	141	293.3	3	287	597
4	360	748.8	4	128	266.2
5	318	661.4	5	237	493
6	411	854.9	6	243	505.4
7	435	904.8	7	238	495
8	207	430.6	8	544	1,131.5
9	178	370.2	9	2,678	5,570.2
10	434	902.7	10	615	1,279.2
11	242	503.4	11	440	915.2
12	304	632.3	12	426	886.1
13	1,701	3,538.1	13	999	2,077.9
14	921	1,915.7	14	638	1,327
15	194	403.5	15	278	578.2
16	1,743	3,625.4	16	365	759.2

ECHINODERMATA July 2007			ECHINODERMATA September 2007		
Sta.	# Of Org.	#/m^2	Sta.	# Of Org.	#/m^2
1	10	20.8	1	180	374.4
2	2	4.2	2	16	33.3
3	253	526.2	3	207	430.6
4	1,573	3,271.8	4	504	1,048.3
5	22	45.8	5	12	25.0
6	258	536.6	6	157	326.6
7	217	451.4	7	220	457.6
8	171	355.7	8	81	168.5
9	131	272.5	9	88	183.0
10	45	93.6	10	151	314.1
11	238	495	11	290	603.2
12	7	14.6	12	15	31.2
13	850	1,768	13	1,535	3,192.8
14	1,617	3,363.4	14	1,111	2,310.9
15	1,136	2,362.9	15	372	773.8
16	1,216	2,529.3	16	1,201	2,498.1

Figure A-2. Diversity (H') of Benthic Invertebrates at ODMD Site Sampling Stations

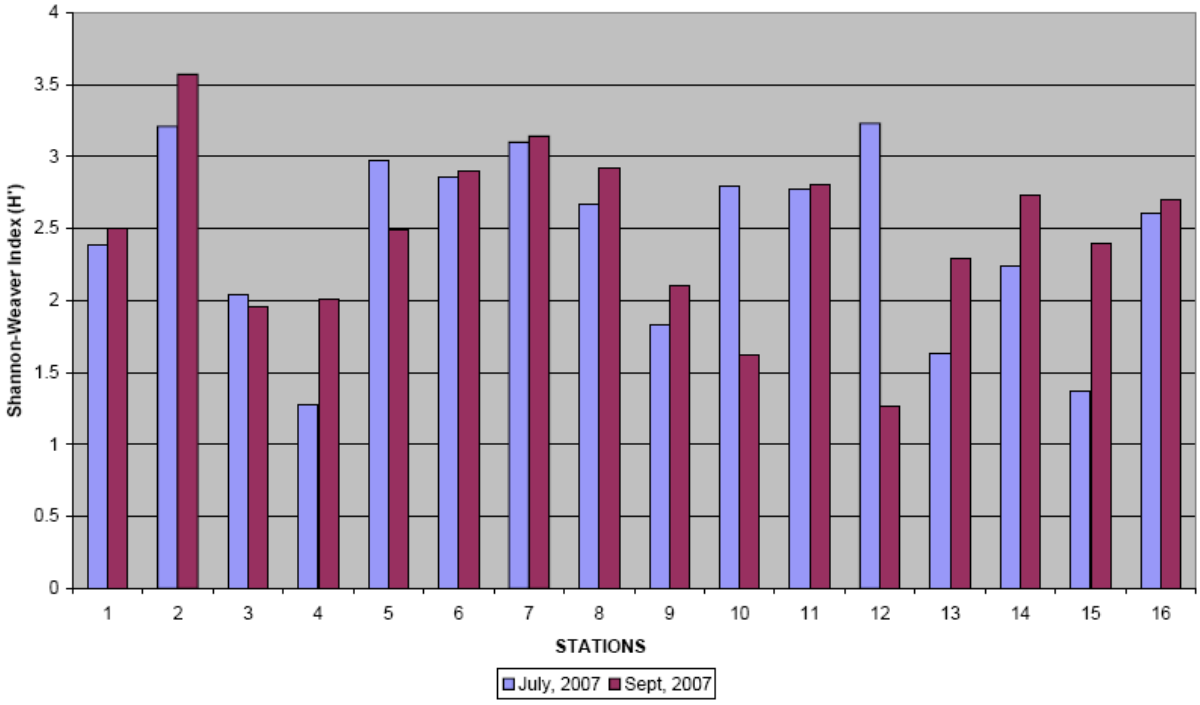


Figure A-3. Diversity (SDV) of Benthic Invertebrates at ODMD Site Sampling Stations

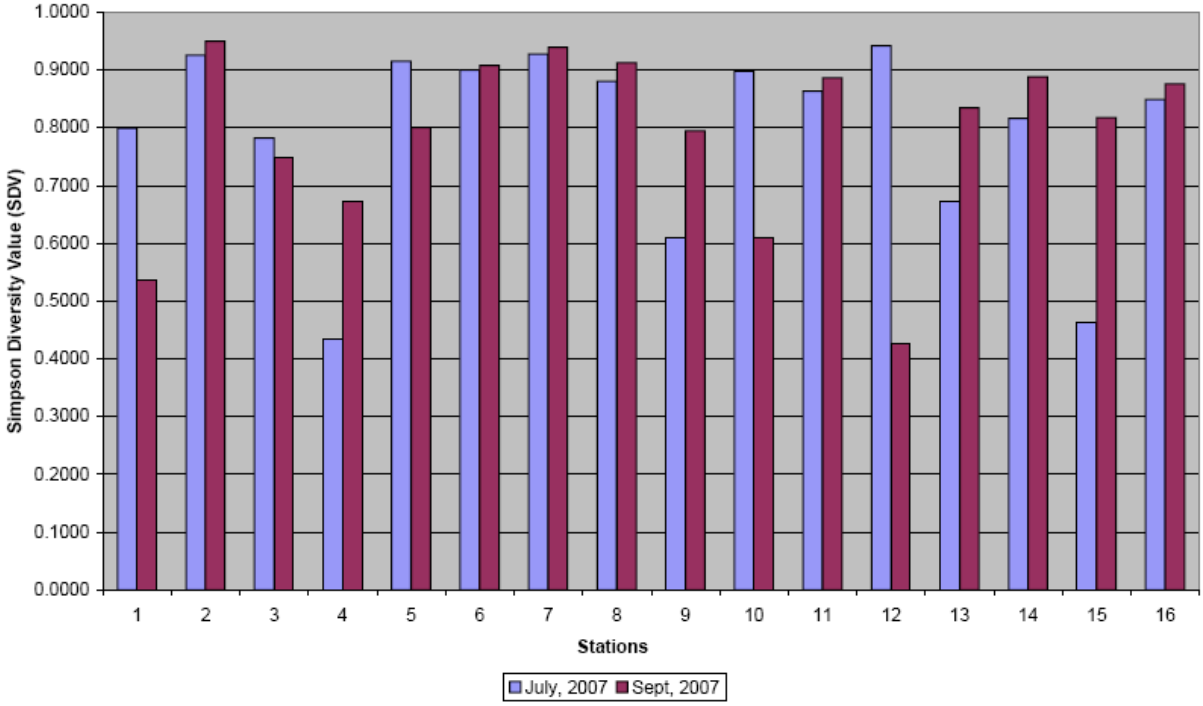


Figure A-4. Evenness (J') of Benthic Invertebrates at ODMD Site Sampling Stations

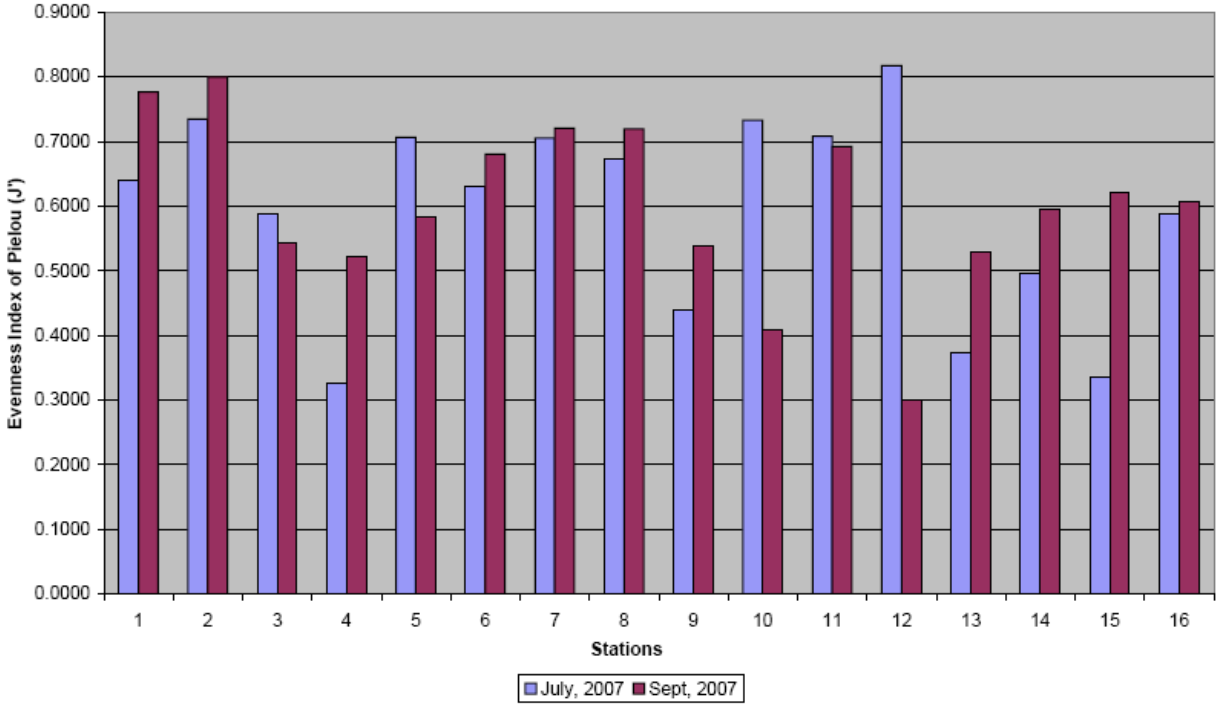


Figure A-5. Species Richness (SR) of Benthic Invertebrates at ODMD Site Sampling Stations

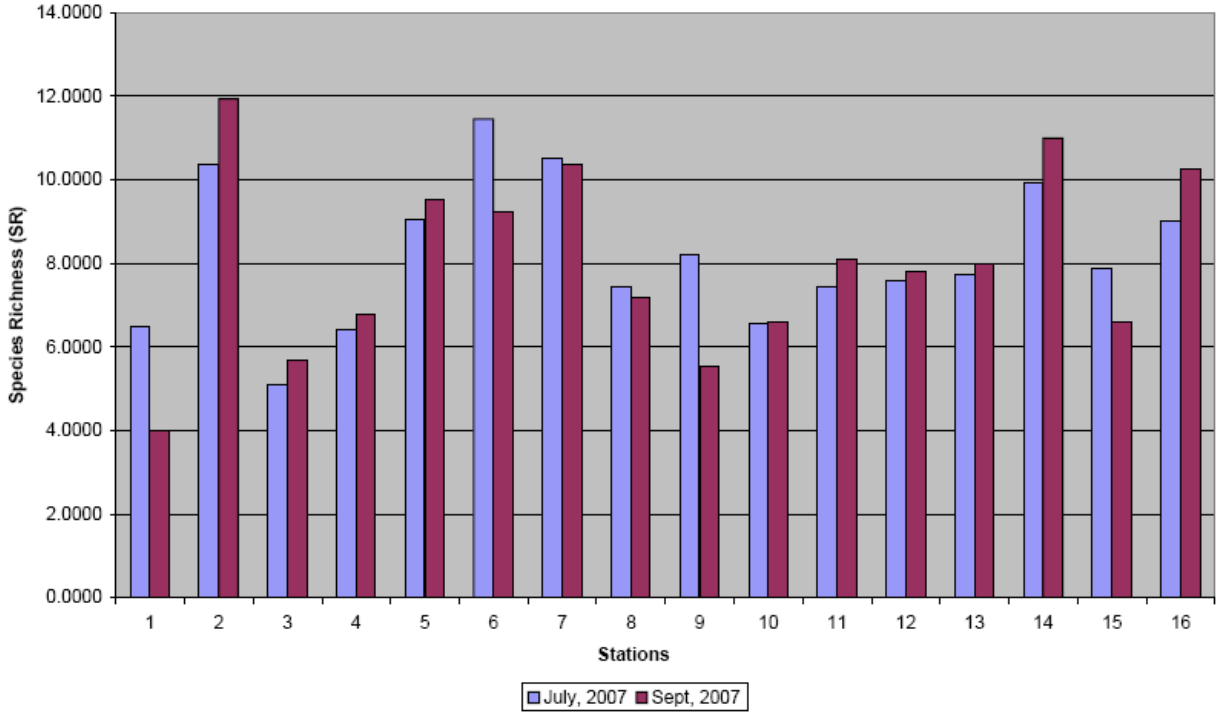


Figure A-6. Density of Benthic Invertebrates at ODMD Site Sampling Stations

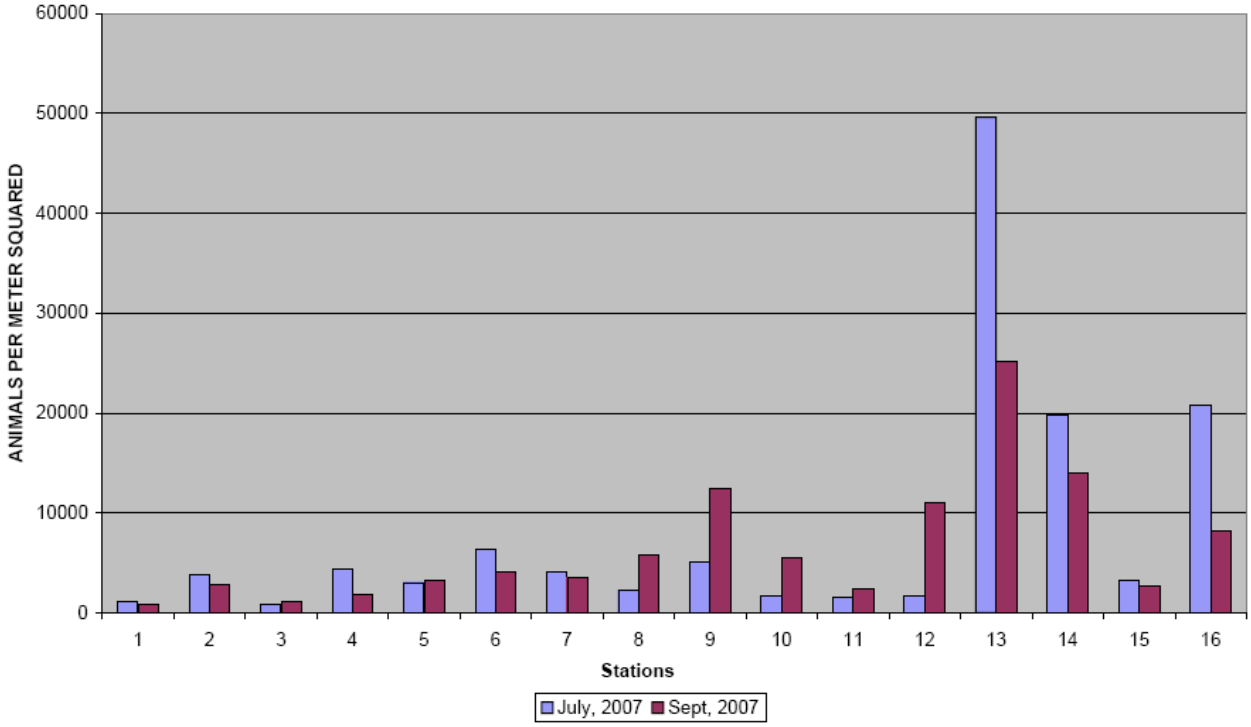


Figure A-7. Density of Benthic Species, July 2007

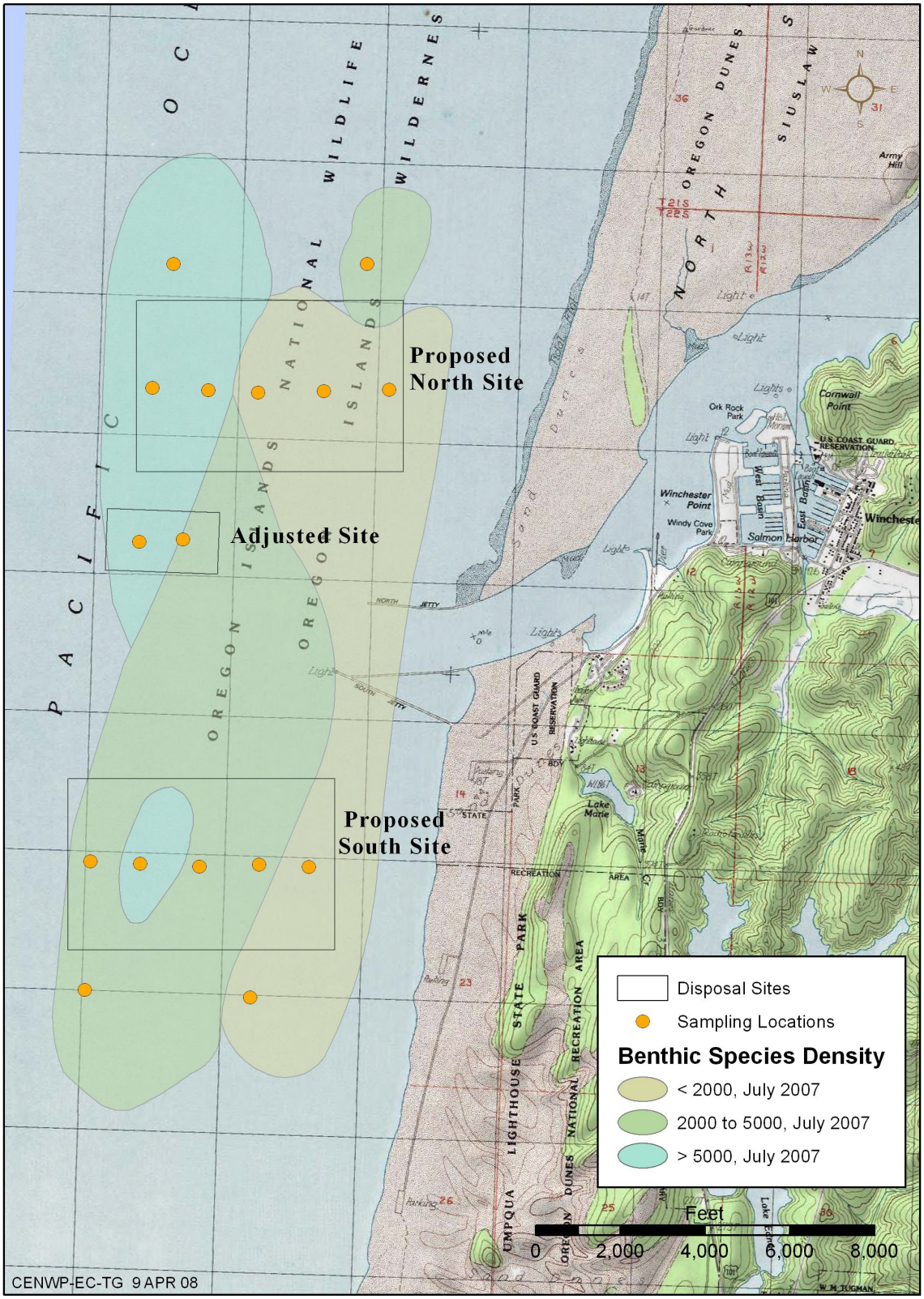
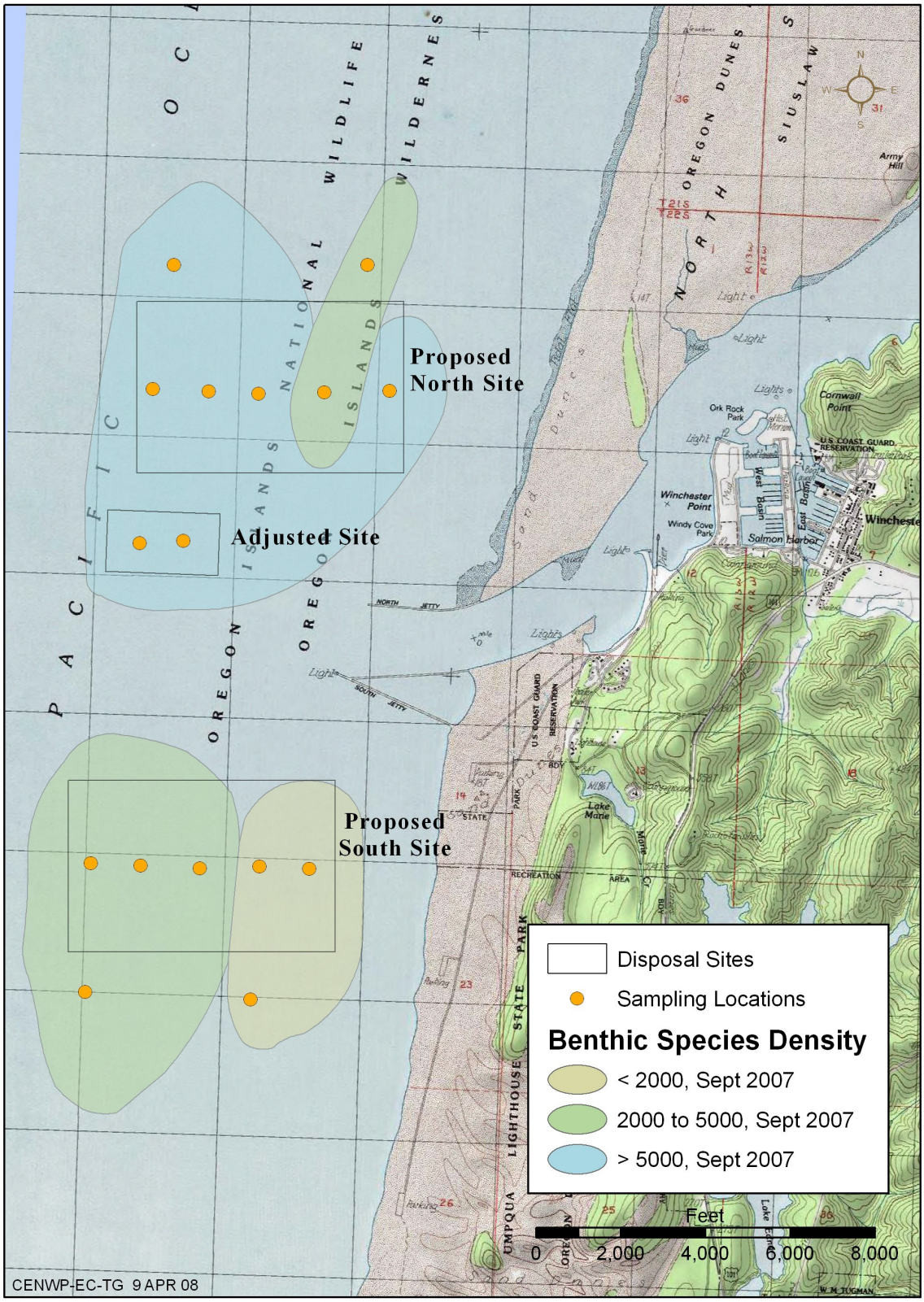


Figure A-8. Density of Benthic Species, September 2007



Fish and Epibenthic Species

Commercially and recreationally important epibenthic species in the Umpqua inshore coastal area are shellfish and Dungeness crabs. Razor clam beds are located north of the jetty along the beach. Recruitment to the inshore beaches comes from the subtidal spawning areas. Gaper, softshell, butter, and bentnose clams are present in large numbers near the mouth and upriver in the estuary proper. 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) has not identified any squid spawning areas off the Umpqua estuary.

The nearshore area off the Umpqua River supports anadromous salmonids including coho salmon (*Oncorhynchus kisutch*), summer and winter steelhead (*Oncorhynchus mykiss*), spring and fall Chinook salmon (*Oncorhynchus tshawytscha*), and cutthroat trout (*Oncorhynchus clarki*), as well as a variety of other pelagic and demersal fish species. Table A-4 shows the periods of occurrence for the various life stages of anadromous salmonids in Umpqua Bay and the Smith Estuary.

In September 1984 and January 1985, field sampling was conducted in water depths from 60 to 120 feet to collect data on demersal fish in the area of the Interim and Section 103 ODMD Sites (Emmett et al., 1987; Corps 1989). The dominant demersal fish species collected included night smelt (*Spirinchus starksi*), Pacific tomcod (*Microgadus proximus*), sand lance (*Ammodytes hexapterus*), pricklebreast poacher (*Stellerina xyosterna*), speckled sanddab (*Citharichthys stigmaeus*), and sand sole (*Psettichthys melanostictus*). The mean density of fish and crabs collected was significantly greater in January than in September, with more individuals collected in the shallower depths (60 to 70 feet). Length frequency data indicated that most fish collected were juveniles. Dungeness crab (*Cancer magister*) collected in September 1984 were primarily young-of-year [<25 millimeters (mm)], while in January 1985 they were larger and probably adults (>100 mm).

Field surveys were conducted in July and September 2007 by Marine Taxonomic Services (2008) to provide data on fish and epibenthic species present in the area of the proposed ODMD Sites. The demersal fish and epibenthic study (Task II) used a 26-foot semi-balloon otter trawl with a 0.25-inch mesh liner. Ten minute (bottom time) trawls were taken along each of seven trawl tracks (see Figure A-1). Tables A-5 and A-6 show the species captured by otter trawl.

The trawl samples denote the nearshore area as a nursery ground with an abundant food source. Most of the species encountered in the trawl samples were benthic feeders that tend to utilize the shallower areas because of the abundant food and fewer predators. The majority of the fish and crabs captured in the trawls were juveniles and young-of-the-year. However, larger crabs and fish have the ability to avoid the trawl net.

Table A-4. Periods of Occurrence for Anadromous Salmonids, Umpqua Bay and Smith Estuary

Life Stage/Activity/Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Upstream Adult Migration												
Winter Steelhead	■	■	■	▨							▨	▨
Summer Steelhead				▨	■	■	■	▨	▨	▨		
Spring Chinook salmon		▨	■	■	▨	▨						
Cutthroat Trout - Searun				▨	■	■	■	■	■	■	▨	
Fall Chinook salmon							▨	▨	■	■	▨	
Coho salmon									▨	■	■	▨
Adult Holding												
Winter Steelhead	■	■	■	▨								▨
Summer Steelhead				▨	■	■	■	▨	▨	▨		
Spring Chinook salmon		▨	■	■	▨	▨						
Cutthroat Trout - Searun				▨	■	■	■	■	■	■	▨	
Fall Chinook salmon							▨	▨	■	■	▨	
Coho salmon									▨	■	■	▨
Juvenile Rearing												
Winter Steelhead												
Summer Steelhead												
Spring Chinook salmon						▒	▒	▒	▒	▒		
Cutthroat Trout - Searun												
Fall Chinook salmon					▨	■	■	■	■	▨		
Coho salmon												
Downstream Juvenile Migration												
Winter Steelhead		▒	▒	▒	▒							
Summer Steelhead		▒	▒	▒	▒							
Spring Chinook salmon						▒	▒	▒	▒	▒		
Cutthroat Trout - Searun		▒	▒	▒	▒							
Fall Chinook salmon					▨	■	■	■	■	▨		
Coho salmon		▒	▒	▒	▒							

■ Represents periods of peak use based on professional opinion.
▨ Represents lesser level of use based on professional opinion.
▒ Represents periods of presence, either with no level of use OR uniformly distributed level of use indicated.

Based on professional opinion, 90% of the life-stage activity occurs during the time frame shown as the peak use period.
Based on professional opinion, 10% of the life-stage activity occurs during the time frame shown as the lesser use period.

Source: ODFW (http://nrimp.dfw.state.or.us/nrimp/default.aspx?p=259)

Table A-5. Trawl Data, Fish and Epibenthic Species, July 2007

Species	Parameter	Trawl #1	Trawl #2	Trawl #3	Trawl #4	Trawl #5	Trawl #6	Trawl #7
Cancer magister - female Dungeness Crab	number of individuals	11	20	2	2	41	--	24
	size range (mm)	94-125	81-106	94-100	106-106	63-119	--	75-113
	average size (mm)	107	96	97	106	90	--	92
Cancer magister - male Dungeness Crab	number of individuals	6	13	4	10	40	2	21
	size range (mm)	75-134	81-150	88-113	75-119	63-163	150-163	81-136
	average size (mm)	99	109	98	99	96	156	97
Bothidae juvenile	number of individuals	8	5	4	4	4	--	--
	size range (mm)	30-49	29-44	35-54	31-46	31-44	--	--
	average size (mm)	40	38	44	39	36	--	--
Citharichthys sp. Sanddab	number of individuals	29	13	13	6	12	--	11
	size range (mm)	80-130	40-111	35-161	31-148	46-122	--	42-115
	average size (mm)	110	87	93	69	91	--	82
Dendraster sp. juv Sand Dollar	number of individuals	--	714	64	2	--	--	50
	size range (mm)	--	10-20	10-20	10-20	--	--	10-20
	average size (mm)	--	--	--	--	--	--	--
Eopsetta jordani Petrale Sole	number of individuals	5	1	--	--	12	--	--
	size range (mm)	55-152	177	--	--	55-225	--	--
	average size (mm)	108	177	--	--	157	--	--
Gadidae Cod	number of individuals	9	2	--	25	19	--	--
	size range (mm)	41-59	57-67	--	42-91	45-76	--	--
	average size (mm)	52	62	--	59	56	--	--
Isopsetta isolepis Butter Sole	number of individuals	5	3	7	6	7	2	13
	size range (mm)	105-210	97-230	42-164	104-120	105-178	43-131	36-235
	average size (mm)	148	161	111	113	138	87	140
Leptocottus armatus Staghorn Sculpin	number of individuals	1	2	2	2	10	2	4
	size range (mm)	94	107-127	115-135	109-128	105-165	120-154	99-128
	average size (mm)	94	117	125	119	122	137	109

Note: Size range and average size = standard length of fish and carapace width of crabs.

Table A-5 (continued). Trawl Data, Fish and Epibenthic Species, July 2007

Species	Parameter	Trawl #1	Trawl #2	Trawl #3	Trawl #4	Trawl #5	Trawl #6	Trawl #7
Liparis pulchellus Showy Snailfish	number of individuals	--	--	--	6	--	--	1
	size range (mm)	--	--	--	15-35	--	--	22
	average size (mm)	--	--	--	21	--	--	22
Ophiodon elongatus Lingcod	number of individuals	--	1	2	--	--	--	--
	size range (mm)	--	98	115-115	--	--	--	--
	average size (mm)	--	98	115	--	--	--	--
Osmeridae Smelts	number of individuals	87	6	--	1	--	--	--
	size range (mm)	37-61	51-60	--	81	--	--	--
	average size (mm)	56	56	--	81	--	--	--
Pallasina barbata Tubenose Poacher	number of individuals	--	--	--	--	3	--	--
	size range (mm)	--	--	--	--	69-88	--	--
	average size (mm)	--	--	--	--	82	--	--
Parophrys vetulus English Sole	number of individuals	141	37	3	23	44	--	31
	size range (mm)	28-145	28-166	63-89	31-385	30-186	--	27-85
	average size (mm)	41	43	78	80	59	--	42
Pleurenectidae juvenile Flounders	number of individuals	12	9	1	--	11	--	7
	size range (mm)	20-29	26-42	41	--	19-35	--	21-29
	average size (mm)	25	31	41	--	26	--	25
Psettichthys mjelanostictus Sand Sole	number of individuals	14	1	--	--	--	--	--
	size range (mm)	40-330	372	--	--	--	--	--
	average size (mm)	156	372	--	--	--	--	--
Raja binoculata Big Skate	number of individuals	--	--	1	1	--	--	1
	size range (mm)	--	--	241	260	--	--	460
	average size (mm)	--	--	241	260	--	--	460
Stellerina xyosterna Pricklebreast Poacher	number of individuals	1	--	--	--	37	--	38
	size range (mm)	32	--	--	--	27-125	--	25-108
	average size (mm)	32	--	--	--	46	--	41

Note: Size range and average size = standard length of fish and carapace width of crabs.

Table A-6. Trawl Data, Fish and Epibenthic Species, September 2007

Species	Parameter	Trawl #1	Trawl #2	Trawl #3	Trawl #4	Trawl #5	Trawl #6	Trawl #7
Cancer magister - female Dungeness Crab	number of individuals	3	1	--	2	10	2	14
	size range (mm)	81-131	86	--	94-106	81-113	86-100	63-106
	average size (mm)	108	86	--	96	96	94	93
Cancer magister - male Dungeness Crab	number of individuals	2	1	1	--	1	2	2
	size range (mm)	88-94	106	100	--	106	75-86	81-94
	average size (mm)	91	106	100	--	106	81	88
Cancer productus – male Rock Crab	number of individuals	--	--	--	1	--	--	--
	size range (mm)	--	--	--	56	--	--	--
	average size (mm)	--	--	--	56	--	--	--
Citharichthys sp. Sanddab	number of individuals	16	45	5	4	4	5	6
	size range (mm)	25-130	28-131	30-128	40-100	40-68	28-60	50-120
	average size (mm)	87	82	81	83	53	58	86
Cottidae Sculpins	number of individuals	--	--	--	1	--	--	--
	size range (mm)	--	--	--	104	--	--	--
	average size (mm)	--	--	--	104	--	--	--
Engraulis mordax Northern Anchovy	number of individuals	28	4	--	--	--	--	--
	size range (mm)	38-56	41-50	--	--	--	--	--
	average size (mm)	45	46	--	--	--	--	--
Eopsetta jordani Petrale Sole	number of individuals	3	1	--	--	--	--	--
	size range (mm)	112-138	128	--	--	--	--	--
	average size (mm)	126	128	--	--	--	--	--
Gadidae Cod	number of individuals	4	2	--	--	4	--	18
	size range (mm)	55-80	40-49	--	--	53-120	--	82-50
	average size (mm)	66	45	--	--	78	--	69
Isopsetta isolepis Butter Sole	number of individuals	1	4	--	1	7	2	7
	size range (mm)	120	115-235	--	195	86-220	150-178	120-194
	average size (mm)	120	173	--	195	169	164	156

Note: Size range and average size = standard length of fish and carapace width of crabs.

Table A-6 (continued). Trawl Data, Fish and Epibenthic Species, September 2007

Species	Parameter	Trawl #1	Trawl #2	Trawl #3	Trawl #4	Trawl #5	Trawl #6	Trawl #7
Leptocottus armatus Staghorn Sculpin	number of individuals	4	4	--	--	1	--	1
	size range (mm)	110-135	110-170	--	--	100	--	102
	average size (mm)	123	135	--	--	100	--	102
Liparis pulchellus Showy Snailfish	number of individuals	--	--	--	1	1	--	--
	size range (mm)	--	--	--	19	16	--	--
	average size (mm)	--	--	--	19	16	--	--
Ophiodon elongatus Lingcod	number of individuals	1	--	--	--	--	--	--
	size range (mm)	148	--	--	--	--	--	--
	average size (mm)	148	--	--	--	--	--	--
Osmeridae Smelts	number of individuals	40	3	--	--	73	14	196
	size range (mm)	42-111	54-100	--	--	45-82	48-66	35-107
	average size (mm)	65	83	--	--	57	56	57
Parophrys vetulus English Sole	number of individuals	24	57	9	8	29	20	8
	size range (mm)	38-65	35-185	42-55	47-78	35-98	42-80	55-105
	average size (mm)	47	50	49	63	56	56	75
Pleurenectidae juvenile Flounders	number of individuals	--	3	--	--	--	2	--
	size range (mm)	--	30-60	--	--	--	45-52	--
	average size (mm)	--	49	--	--	--	--	--
Psettichthys mjelanostictus Sand Sole	number of individuals	5	11	--	--	1	1	1
	size range (mm)	147-180	105-225	--	--	242	400	320
	average size (mm)	166	161	--	--	242	400	320
Raja binoculata Big Skate	number of individuals	1	--	--	--	--	--	1
	size range (mm)	265	--	--	--	--	--	270
	average size (mm)	265	--	--	--	--	--	270
Stellerina xyosterna Pricklebreast Poacher	number of individuals	3	4	--	1	8	1	8
	size range (mm)	40-134	48-134	--	68	22-90	35	15-151
	average size (mm)	85	81	--	68	44	35	71

Note: Size range and average size = standard length of fish and carapace width of crabs.

Threatened and Endangered Fish Species

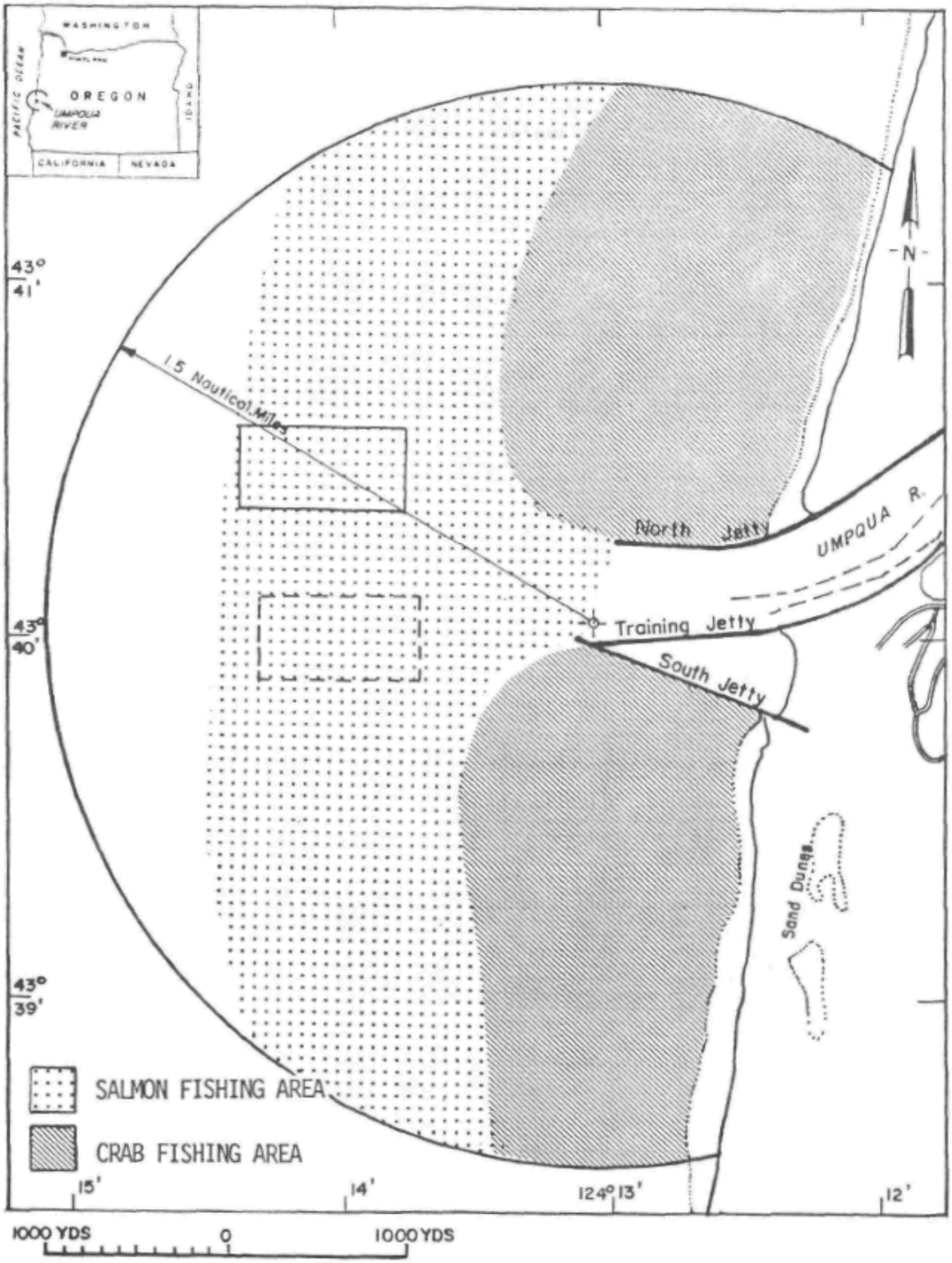
Both the Oregon Coast coho salmon and the Southern Oregon/Northern California Coast (SONCC) coho are federally threatened Evolutionary Significant Units (ESUs) that may be present in the vicinity of the proposed Umpqua River ODMD sites. Although critical habitat has been designated for both ESUs, the ocean area off the Umpqua River is not included in that designated critical habitat. Coho salmon are present in the vicinity of the proposed ODMD Sites 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. Upstream migration of adult coho salmon generally takes place from August through November. Juvenile outmigration extends from April through June, but peaks in May.

The Southern Distinct Population Segment (DPS) of green sturgeon (*Acipenser medirostris*) was listed as threatened on April 7, 2006 (71 *Federal Register* 17757). Critical habitat for the Southern DPS green sturgeon proposed on September 8, 2008 (*73 Federal Register 52084*) included the proposed sites, but critical habitat has not yet been designated. Green sturgeon that spawn to the north primarily in the Klamath and Rogue rivers constitute the Northern DPS, which is not federally listed. These two DPSs were established because they were found to be genetically distinct. Southern DPS green sturgeon may occur in the proposed ODMD Sites and areas offshore of the Umpqua River as they migrate to northern estuaries during summer and early fall.

Commercial and Recreational Fisheries

The community of Winchester Bay is located on the central Oregon Coast at the mouth of the Umpqua River about 4 miles south of the City of Reedsport. The major commercial fishing areas in the vicinity of the proposed Umpqua River ODMD Sites are shown in Figure A-9. Based on data from the National Marine Fisheries Service (NMFS 2006) for commercial fishing, in 2000 there were 57 vessels that delivered landings to Winchester Bay (there were no landings in Reedsport). Landings in Winchester Bay were in the following West Coast fisheries (data shown represents landings in metric tons/value of said landings/number of vessels landing/NA = not available): coastal pelagic (NA/NA/1), crab (250.8/$1,170,610/23), groundfish (33.6/$129,193/20), highly migratory species (44.4/$105.495/10), salmon (44.1/$159,668/33), shellfish (NA/NA/3), shrimp (0.1/$711/4), and other species (30.8/$196,940/12). There are two processors located in Winchester Bay. Winchester Bay residents owned 17 vessels in 2000 that participated in West Coast fisheries, 7 of which participated in the federal groundfish fishery. Reedsport residents owned 19 vessels in 2000 that participated in West Coast fisheries, including 9 vessels that participated in the federal groundfish fishery.

Figure A-9. Commercial Fishing Areas in the Vicinity of the Proposed Umpqua River ODMD Sites



Recreational fishing occurs in the same areas as the commercial fishery but generally closer to shore. Based on data from the NMFS (2006), Winchester Bay had at least one outfitter guide business in 2003. Five licensed charter vessel businesses were located in the community in the same year. There was one licensing vendor. In 2003, Reedsport had at least four registered outfitter guide businesses and four licensed charter vessel businesses. Reedsport had three sport fishing license vendors. In 2000, the number of licenses sold by active agents was 2,059 at a value of $34,525. For Winchester Bay, the 2000 recreational salmonid catch in the Ocean Boat Fishery was 4,432 Chinook salmon and 2,882 coho salmon. The recreational non-salmonid catch was 2,147 fish. The top species landed included yellowtail rockfish (*Sebastes flavidus*), lingcod, canary rockfish (*S. pinniger*), yelloweye rockfish (*S. ruberrimus*), greenstriped rockfish (*S. elongatus*), and quillback rockfish (*S. maliger*).

Wildlife

Three species of seals and sea lions inhabit the lower Umpqua River and coastal area. Steller sea lions (*Eumetopias jubatus*), a federally threatened species, and harbor seals (*Pusa vitulina*) are year-long residents, while California sea lions (*Zalophus californianus*) are present most of the year. Steller sea lions forage at river mouths and nearshore areas along the Oregon Coast. Harbor seals breed in the estuary and on nearshore rocks. The Umpqua River nearshore area and shoreline provides important habitat for shorebirds, waterfowl, herons, bald eagles (*Haliaeetus leucocephalus*), hawks, and many other species of birds. Pelagic birds (e.g., murres, auklets, cormorants) likely use the area for foraging.

Federally listed avian species that may be present in the Umpqua River offshore area include the marbled murrelet (*Brachyramphus marmoratus*, threatened), brown pelican (*Pelecanus occidentalis*, endangered), short-tailed albatross (*Phoebastria albatrus*, endangered). Marbled murrelets are observed in small flocks or as individuals in the ocean throughout the year. Brown pelicans are seasonally abundant (June to September) along the Oregon Coast and in the lower reaches of various estuaries, including the Umpqua River. On February 20, 2008, the U.S. Fish and Wildlife Service proposed to remove the brown pelican from the federal list of endangered and threatened wildlife due to recovery (73 *Federal Register* 9407). The short-tailed albatross may forage in open ocean areas off the Oregon Coast.

There are many whale species and sea turtles in Oregon's offshore coastal area that are listed under the Endangered Species Act. The blue whale (*Balaenoptera musculus*), fin whale (*Balaenoptera physalus*), sei whale (*Balaenoptera borealis*), sperm whale (*Physeter macrocephalus*), humpback whale (*Megaptera novaeangliae*), and southern resident killer whale (*Orcinus orca*) are all federally endangered species and occur as migrants off the Oregon Coast in waters typically farther from shore than within the proposed Umpqua River ODMD Sites.

Blue whales occur off the Oregon Coast in May and June, as well as from August through October. Blue whales typically occur offshore as individuals or in small groups and winter well south of Oregon. Fin whales also winter far south of Oregon and range off the coast during summer. Sei whales also winter south of Oregon and 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; they forage in waters much deeper than those in the nearshore area. Humpback whales primarily occur off the Oregon Coast from April to October with peak numbers from June through August. Humpback whales are particularly concentrated in Oregon along the southern edge of Heceta Bank and are found primarily on the continental shelf and slope. The range of the southern resident killer whale during the spring, summer, and fall includes the inland

waterways of Puget Sound, Strait of Juan de Fuca, and Southern Georgia Strait. Their occurrence in the coastal waters off Oregon has been documented. Little is known about the winter movements and range.

The loggerhead sea turtle (*Caretta caretta*, threatened), green sea turtle (*Chelonia mydas*, threatened), leatherback sea turtle (*Dermochelys coriacea*, endangered), and olive ridley sea turtle (*Lepidochelys olivacea*, threatened) are all federally listed species and have been recorded from strandings along the Oregon and Washington coasts. The occurrence of sea turtles off the Oregon Coast is associated with the appearance of albacore. Albacore occurrence is strongly associated with the warm waters of the Japanese current. Because these warm waters generally occur 30 to 60+ miles offshore from the Oregon Coast, these sea turtle species do not typically occur in the nearshore area.

Marine Reserves

The State of Oregon has initiated efforts to establish a network of marine reserves as part of an overall strategy to manage its marine waters and submerged lands. The overall purpose would be to protect, sustain, or restore the nearshore marine ecosystem, its habitats, and species. A marine reserve is an area within Oregon's state territorial sea or adjacent intertidal area that is protected from all extractive activities including the removal or disturbance of living and non-living marine resources. Marine reserves are intended to provide lasting protection. Dredging and disposal are identified as disturbances and would be banned from areas designated as marine reserves. In November 2008, Oregon's Ocean Policy Advisory Council (OPAC) recommended to Governor Ted Kulongoski that two sites, Otter Rock near Depoe Bay, and Redfish Rocks near Port Orford, move forward as pilot marine reserves and identified three areas, Cape Falcon, Cascade Head, and Cape Perpetua, as deserving of further study and evaluation as sites for potential marine reserves. None of the sites identified by the OPAC are in or near the proposed ODMD sites.

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Appendix B

Physical Processes and Geologic Features
Umpqua River, Oregon

April 2009

Appendix B
Physical Processes and Geologic Features
Umpqua River, Oregon

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Appendix B
Physical Processes and Geologic Features
Umpqua River, Oregon

EXECUTIVE SUMMARY

Geographic Location:	Northwest Pacific Coast of continental United States, maintained ocean entrance to Umpqua River along south-central Oregon.
Organizational Oversight:	U.S. Army Corps of Engineers, Portland District and U.S. Environmental Protection Agency, Region 10
Project Features Addressed:	Ocean Dredged Material Disposal Sites located 1 mile offshore of the jettied entrance to Umpqua River.

In April 1989 the U.S. Army Corps of Engineers, Portland District issued a report to Environmental Protection Agency, Region 10 titled, *Umpqua Ocean Dredged Material Disposal Site Evaluation*. The Corps' report recommended that a new ocean dredged material disposal (ODMD) site, known as the Section 103 site, be located north of the existing disposal site (known as the Interim ODMD Site). Both disposal sites were located about 0.5-mile offshore of the jettied entrance to Umpqua River (see Figure B-1). Subsequently, EPA used the 1989 Corps report for the preparation of a 1991 draft Environmental Impact Statement (EIS) entitled, *Umpqua, Oregon Dredged Material Disposal Site Designation*. The 1991 draft EIS recommended that the Corps' proposed Section 103 site be officially designated as an ODMD Site. Since the initial publication of the 1989 Corps' report and the 1991 draft EIS, additional information has been collected at the Umpqua ocean disposal sites and at the offshore approaches to the Umpqua River. The additional data has been assessed and the results are presented in this appendix.

Present and past seabed conditions at the Umpqua Interim ODMD Site and the Section 103 site are described in this appendix. This evaluation of the Section 103 site is the first formal assessment of this site's response to dredged material disposal. The impact of dredged material disposal on both the Interim and Section 103 sites, since the completion of the 1989 Corps' report, is also described in this appendix. Observed impacts with respect to changes in seabed conditions at the Interim and Section 103 sites (the formation of large high-relief dredged material mounds) have led to a reevaluation of some of the recommendations presented in the 1989 report.

Some statements and paragraphs from the Corps' 1989 report have been revised. The revisions are described in Section 1 of this appendix and are based on the additional data and information collected at the Interim and Section 103 sites since the 1989 report was completed. The principal design recommendation presented in this appendix (which differs from the recommendation presented in the 1989 report) is to change the location for the recommended ODMD site and increase the size/number of recommended ODMD sites offshore of the Umpqua River. The rationale and supporting calculations for this design change are presented Sections 4, 5, and 6 of this appendix.

SECTION 1. MANAGEMENT OF THE UMPQUA RIVER ODMD SITES

Two ocean dredged material disposal (ODMD) sites have been used by the U.S. Army Corps of Engineers (Corps) for disposal of sediments dredged from the Umpqua River navigation project (Figure B-1 and Table B-1). Prior to 1991 only the Interim ODMD Site or the area in the immediate vicinity was used for disposal of material removed from the Umpqua River project. In 1991 a Section 103 ODMD Site was selected by the Corps and was used in place of the Interim ODMD Site. This action was intended to reduce potential hazards associated with the rapid mounding of dredged material at the Interim ODMD Site and to increase long-term disposal site capacity.

Table B-1. Volume of Dredged Material Placed at Umpqua River ODMD Sites (1968-2007)

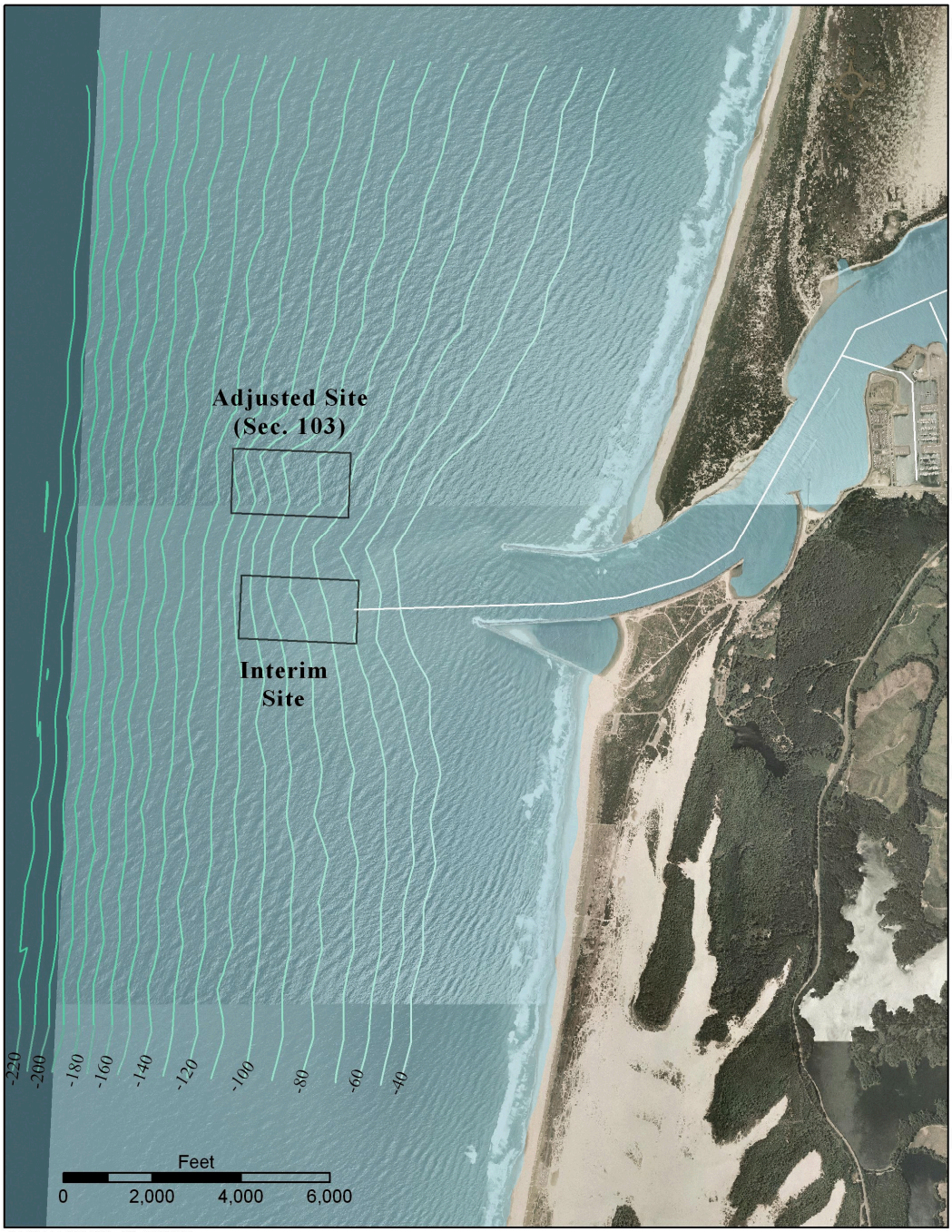
Year or Period	Dredging Vessel	Interim ODMD Site (cy)	Section 103 ODMD Site (cy)	Totals (cy)
1968-1977	---	961,000	---	961,916
1978-1986	---	1,718,849	---	1,717,933
1987	*Yaquina*	152,369	---	152,369
1988	*Yaquina*	330,163	---	330,163
1989	*Yaquina*	158,697	---	158,697
1990	*Padre Island*	180,285	---	180,285
1991	*Yaquina*	118,416	---	118,416
1992	*Yaquina*	---	209,072	209,072
1993	*Yaquina*	---	212,755	212,755
1994	*Yaquina*	---	204,000	204,000
1995	*Yaquina*	---	93,700	93,700
1996	*Yaquina*	---	116,799	116,799
1997	*Yaquina*	---	114,572	114,572
1998	*Yaquina*	---	196,300	196,300
1999	*Yaquina*	---	168,700	168,700
2000	*Yaquina*	---	68,600	68,600
2001	*Yaquina*	---	99,400	99,400
2002	*Yaquina*	---	246,200	246,200
2003	*Yaquina*/Clamshell	---	113,500	113,500
2004	*Yaquina*	---	93,200	93,200
2005	*Yaquina*	---	9,400	9,400
2006	*Yaquina*	---	62,000	62,000
2007	*Yaquina*/Clamshell	---	106,800	106,800
	Totals	3,618,779	2,114,998	5,733,777

The rational for disposal site management has changed significantly since the initiation of consistent dredging (and associated disposal) at the Umpqua River project. The transition in dredged material disposal site management at Umpqua River is characterized by three important shifts in Corps and EPA policy as discussed below.

Umpqua River Ocean Disposal Before 1977

Offshore disposal of dredge material at Umpqua began in 1924. Since then, more than 17 million cy have been dumped at sea. Prior to formal designation of the Interim ODMD Site in 1977, the ocean dredged material disposal site offshore of the Umpqua River entrance was sited in terms of approximate location and areal configuration.

Figure B-1. Umpqua River Ocean Disposal Sites



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Placement of dredged material within the offshore disposal site was governed by the need to minimize navigational impacts from dumped dredged material being transported back into the navigation channel and to minimize haul distance for dredge vessels. Mounding of dredged material on the seabed did not appear to be a concern due to the spatial variability of dredged material disposal within the disposal site. Site boundaries were not fixed and it was not required to place material strictly within the disposal site. The operational flexibility allowed dredge vessel during material placement likely resulted in a higher rate of dispersion of dredged material than at present. Additionally, dredged material was placed over a wider areal expanse than the fixed configuration of the designated ODMD Sites prior to 1977.

Umpqua River Ocean Disposal 1977 to 1986

From 1977 to 1986, management of the Interim ODMD Site offshore of the Umpqua River was characterized by the transition from unregulated dredged material disposal to a regulated program. In January 1977, the active ocean disposal site at Umpqua River received interim designation when EPA issued the final Ocean Dumping Regulations (40 CFR 228). The disposal site configuration was governed by the requirement to minimize the area of impact due to open-water disposal of dredged sediments. The areal size of the Interim ODMD Site was based on the following criteria:

- ODMD Site length: average dumping run to place one load of dredged material = (disposal vessel speed while dumping) x (time to empty disposal vessel).
- ODMD Site long axis orientation: preferential approach heading during dredged material disposal, which is determined in part by the predominate direction of incoming waves.
- ODMD Site width: average turn during one dump = disposal vessel turning radius while dumping.

The lineal dimensions and water depth variation for the Interim ODMD Site include dimension = 3,600 feet x 1,400 feet; azimuth = ~270°; average depth = 90 feet; and 1998 elevation variation = -113 to -55 MLLW.

A consequence of restrictive use of the Interim ODMD Site was the creation of potentially adverse impacts to navigation at the Umpqua River entrance by mounding of placed dredged material. One possible explanation for dredged material mounding in the Interim ODMD Site is an increase in the average disposal volume from 1987 to 1991 (Table B-1). The average annual volume of dredged material placed in the Interim ODMD Site from 1968-1986 was 141,000 cy/year, while the average annual volume from 1987 through 1991 was 188,000 cy/year. However, a more likely reason for rapid accumulation of dredged material in the Interim ODMD Site was the requirement for material disposal within small EPA-designated ODMD Sites, rather than the past practice of placing material in larger unconfined areas where the manner of placement allows for greater dispersion. The use of a contractor operated, large capacity split-hull hopper dredge in 1990 also could have contributed to an increase in the vertical extent of dredged material placed in the disposal site.

Corps' specifications required contract dredges to place dredged material within the Interim ODMD Site boundaries. The ODMD Site corner coordinates and a single disposal location coordinate were given as a reference for disposal position within the ODMD Site. No reference was made regarding uniform spreading of dredged material placed within the ODMD Sites. Conceptually, placement of dredged material was done randomly, but within a fixed distance from the disposal buoy. Dredging contractors most likely placed dredged material on the extreme channel-side of the disposal area to shorten the haul distance and minimize the aerial extent of dispersal (referred to as point-dumping). Point-dumping likely accelerated the vertical accumulation of dredged material within a small area such as the Interim ODMD Site. Except in 1990, the bulk of the sediment dredged from the Umpqua River and placed in the ODMD Site was accomplished using government hopper dredges. These

hopper dredges use 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 material is released from the vessel, resulting in a gradual release of material from the vessel. Contractor split-hull hopper dredges release their load of dredged material by opening the entire hull of the vessel. The split-hull method of disposal is much more rapid than disposal from bottom-door hopper dredges. The use of split-hull hopper dredges reduces the time required for material disposal, but also reduces the horizontal dispersal of dumped dredged material on the seabed while increasing the vertical accumulation of placed material during each dump cycle. 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 1987, the bottom-door hopper dredge Yaquina with a capacity of 1,000 cy has been used as the government dredge at Umpqua River. In 1990, the much larger split-hull dredge *Padre Island* (capacity 2,600 cy) was used as the primary dredging/disposal vessel.

In 1988, mounding of dredged material at the Interim ODMD Site began amplifying incoming ocean waves at the approaches to the Umpqua River entrance. Mariners and the Coast Guard reported the occurrence of shoaling and breaking of waves at the approach to the Umpqua entrance channel.

Umpqua River Ocean Disposal 1987 to Present

The Interim ODMD Site that was designated by EPA in 1977 did not receive final designation. A Portland District site evaluation report compiled in 1989 (Corps 1989) recommended an "Alternate Site" to the north. Pending EPA designation, the Corps selected this alternate site under its Section 103 authority in 1991, and began site use in 1992. The Section 103 ODMD Site is located 2,800 feet directly north of the Interim ODMD Site in an average water depth of 105 feet (Figure B-1). The lineal dimensions and water depth variation for the Section 103 ODMD Site include dimension = 3,600 feet x 1,400 feet; azimuth = 270°; average depth = 105 feet; and 1991 elevation variation = -130 to -64 MLLW. In October 1991, all sediments dredged from the Umpqua River Project were placed within the Section 103 ODMD Site. The Interim ODMD Site became unavailable for further use.

Annual bathymetric surveys have been conducted at Umpqua ODMD Sites and vicinity since 1979. Consistent monitoring is necessary to track bathymetric change at the ODMD Sites, ensure that the Corps of Engineers does not unintentionally worsen the mounding problem, or place dredged material outside of the active ODMD Site boundaries. Based on the bathymetric monitoring of the Section 103 ODMD Site, the specified location of dredged material disposal has been shifted throughout the site on an annual basis to avoid dumping material on high spots created in previous years. Despite the effort to evenly distribute dredged material within the Section 103 ODMD Site, dredged material has accumulated within this site since 1991 when it was designated and first used. While exclusively utilizing the Section 103 site for dredged material disposal between 1991 and 1998, the mound within the Interim ODMD Site was for the most part dispersed by waves and currents to an elevation consistent with the ambient seabed.

In 1996, shoaling and breaking waves associated with mounding at the Section 103 ODMD Site were reported. Subsequently a site utilization study was conducted (Corps 1998). The study found that size of the Section 103 ODMD Site mound in 1998 was sufficient to warrant serious concern regarding continual mound accumulation and further impact on the wave environment near Umpqua River entrance. The average annual volume placed in the Section 103 site from 1992 to 1998 was 158,200 cy. Because of the concern for mounding, the volume of dredged material placed at the site was reduced. From 1999 to 2007, the average annual volume placed was 108,000 cy with 5 years having volumes below 100,000 cy (Table B-1). In 2005 only 9,400 cy was placed.

SECTION 2. PAST BATHYMETRIC CHANGE AND RELATED IMPACTS AT THE UMPQUA RIVER ODMD SITES

Bathymetric change at the ODMD Sites, in terms of the mounding of placed dredged material, is discussed below. The change in wave conditions at the Umpqua River entrance due to dredged material mounding is also discussed.

1977 Interim ODMD Site

In 1977, the EPA designated the area just west of the entrance to the Umpqua River as an interim disposal site. From 1968 to 1977, approximately 962,000 cy of dredged sediment had been placed in or in the vicinity of the Interim ODMD Site. Between 1977 and 1987, approximately 1.7 million cy of dredged material was placed within the boundaries of the Interim ODMD Site (this is twice the volume that was placed at Interim ODMD Site during the previous 10-year period). With the exception of 1990, the dredged material was placed using bottom-door hopper dredges. Prior to 1981, no mounding of dredged material was reported or observed within the Interim ODMD Site boundary.

The baseline condition bathymetry for the ODMD Site and vicinity are shown and discussed in the 1989 Corps site evaluation report (Corps 1989). Some accumulation of placed dredged material was noted in the Interim ODMD Site after 1981. The accumulation of dredged material between 1981 and 1987 is shown graphically in Figure B-2. Figures B-2 and B-3 are difference plots generated by subtracting seabed surfaces developed from bathymetric survey data for the Interim ODMD Site.

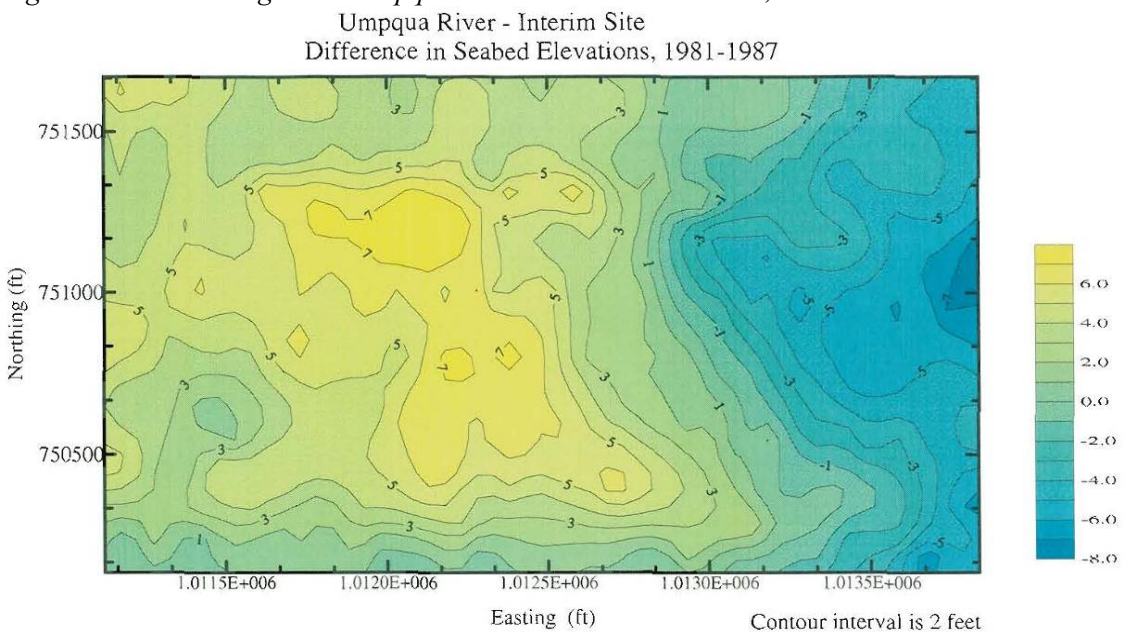
In 1988, significant mounding of dredged material was observed within the boundaries of the Interim ODMD Site and is shown in Figure 2(b). The occurrence of the Interim ODMD Site mound is also reported and shown in the 1989 Corps report. The mound feature associated with a two-year accumulation (1987-1988) of dredged material disposal was 18-feet high and about 1,600-feet (490 m) wide at the base with respect to the 1987 site bathymetry. Approximately 483,000 cy was contained within the 18-foot high mound, this represents most of the dredged material placed between 1987 and 1988. Rates of material erosion at the Interim ODMD Site during 1987 through 1998 varied from high to negligible, and aggradation from sources other than ocean disposal may have occurred during this period. Material volumes placed at the Interim ODMD Site and estimated dispersion rates for the years 1981 through May 1998 are presented in Table B-2.

As shown in Figure B-2(a), the Interim ODMD Site mound persisted through 1991 although its height was diminished from 1988 despite continued disposal of dredged material through 1991. As seen in Figure B-2(b), the mound had for the most part dispersed and scour of the seabed was occurring within the Interim ODMD Site boundaries. The rapid bottom accumulation of material placed within the Interim ODMD Site from 1987-1998 has been partially attributed to the mild wave climate during that time (Corps 1989). The rate of dispersion over the 17.5-year period (from 1981 through spring of 1998) varied from a high of 125,000 cy/year to a low of zero. The average rate of dispersion for the period is 71,000 cy/year or about 38% of the annual volume of material placed at the Interim ODMD Site. Disposal at the Interim ODMD Site was stopped at the end of the 1991 dredging season.

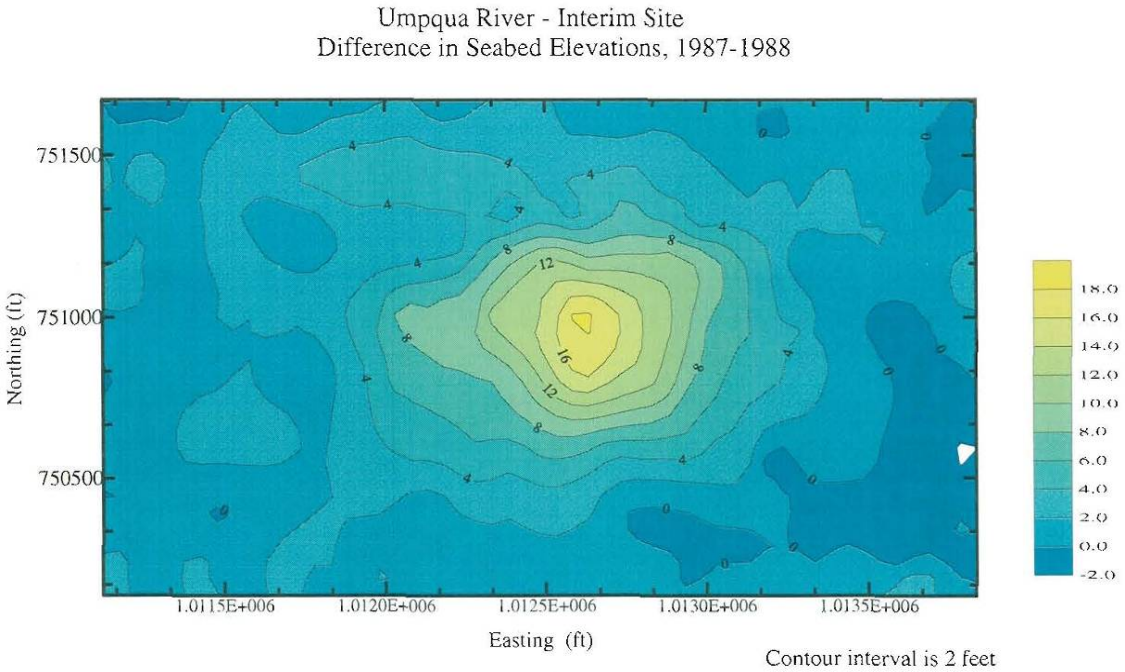
The moderate dispersion rate of the Interim ODMD Site is likely due to localized currents generated by the Umpqua River estuary and jetties. The Interim ODMD Site is inline with the main channel of the Umpqua River and estuarine flow (ebb and flood tide) is probably directed over the Interim

ODMD Site. Additionally, the jetties act on the littoral current redirecting the littoral current oceanward over the Interim ODMD Site.

Figure B-2. Mounding at the Umpqua River Interim ODMD Site, 1981-1988



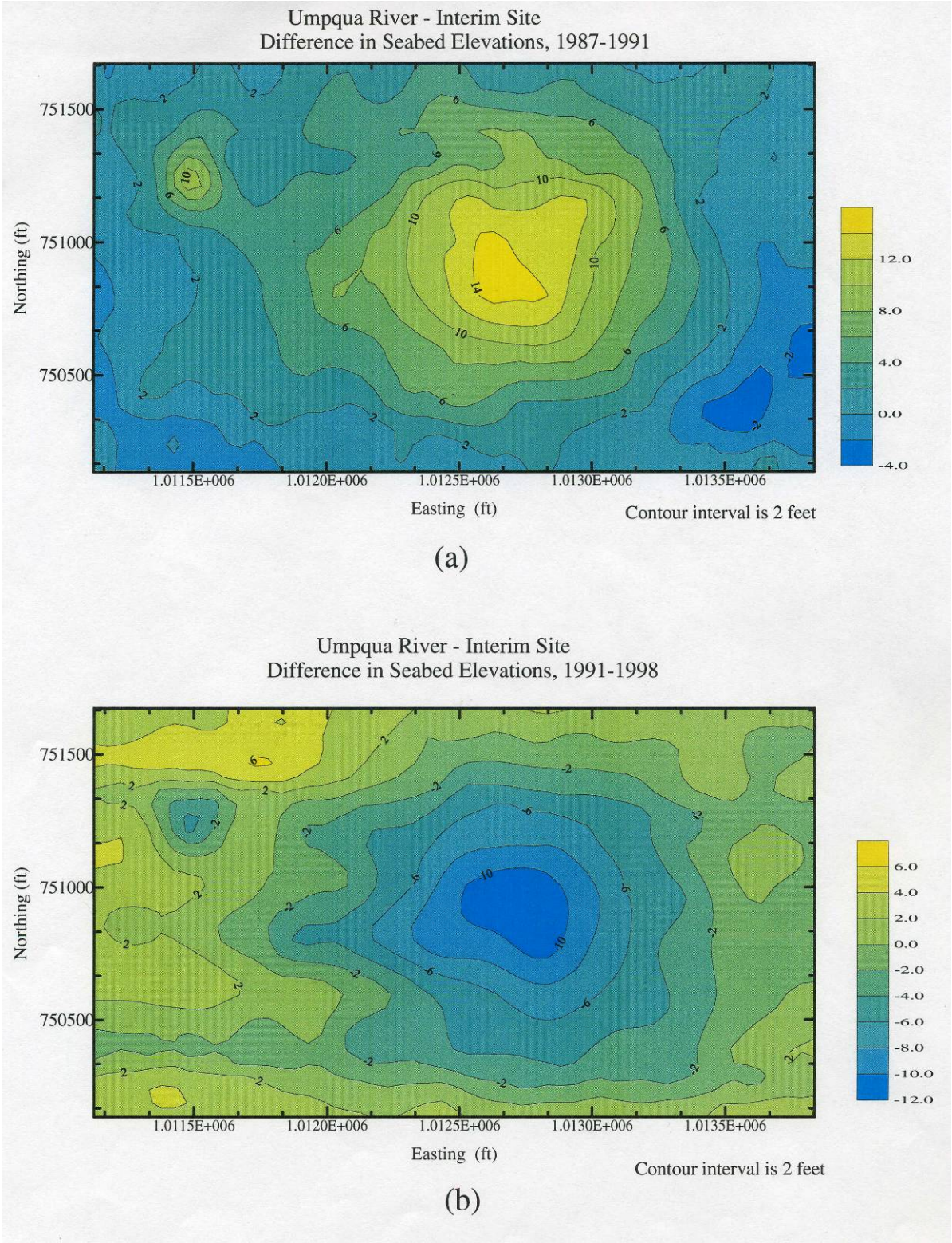
(a)



(b)

(a) Bathymetric changes at Umpqua River Interim ODMD Site between 1981 and 1987.
(b) Bathymetric changes at Umpqua River Interim ODMD Site between 1987 and 1988.
Note site boundaries represented by heavy axes lines.

Figure B-3. Mounding at the Umpqua River Interim ODMD Site, 1987 to 1998



(a) Bathymetric changes at Umpqua River Interim ODMD Site from 1987 to 1991.
(b) Bathymetric changes at Umpqua River Interim ODMD Site from 1991 to 1998.
Note site boundaries are represented by heavy axes lines.

Table B-2. Reported and Calculated Material Values and Rate of Dispersal at Interim ODMD Site

Years	Volume Placed (cy)	Volume Estimated on Seabed* (cy)	Rate of Dispersal (cy/year)
1981-1987	1,158,800	+286,100	-125,000
1987-1988	482,500	+483,600	negligible
1987-1991	939,900	+648,700	-58,200
1991-1998	0	-221,800	-29,800
1981-1998	1,946,400	+713,100	-70,500

*Volume determined by difference between bathymetric surveys. Negative values indicate loss of dredged material from disposal site due to long-term dispersion.

Section 103 ODMD Site

After the 1991 dredging season, use of the Interim ODMD Site was discontinued and only the Section 103 ODMD Site was used for disposal of sediments dredged from the Umpqua River project. From 1992 through May 1998, approximately 951,000 cy of dredged sediment was placed in the Section 103 ODMD Site. Only the bottom-door hopper dredge *Yaquina* has been used to place dredged material in the Section 103 ODMD Site. Progressive accumulation of placed dredged material has occurred at the Section 103 ODMD Site, despite the use of the bottom-door type of hopper dredge, and avoidance point-dumping to ensure a uniform distribution of material on the seabed.

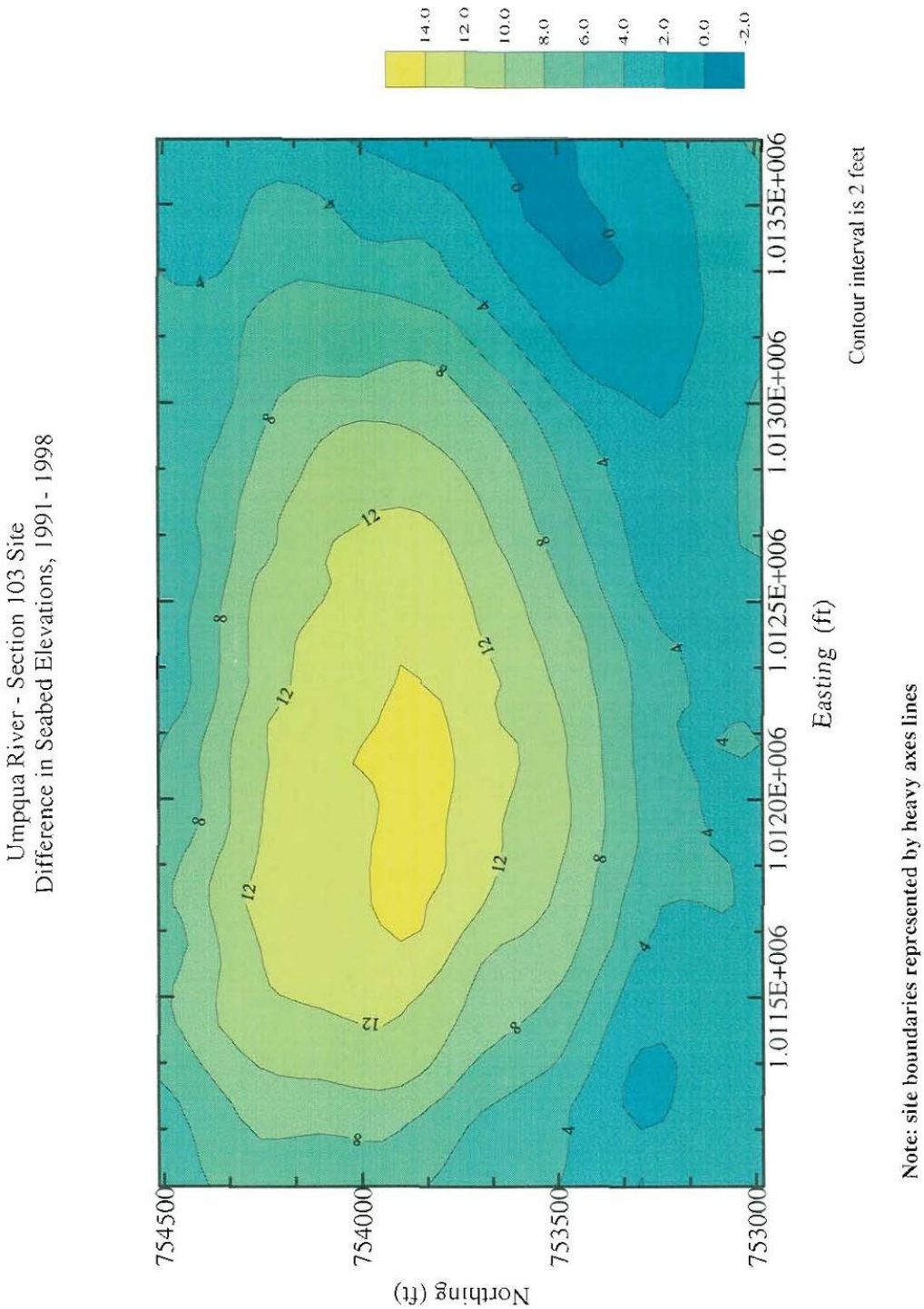
The mounding of dredged material that has occurred in the Section 103 site from 1991 to 1998 is shown in Figure B-4. This graphic is a difference plot that was obtained by subtracting the 1991 approach bathymetry from the 1998 approach bathymetry. The mound feature associated with 7 years (1991-1998) accumulation of dredged material disposal was 14 feet high and 2,300 feet long x 1,400 feet wide at the base with respect to the 1991 seabed elevations. Approximately 1.05 million cy is estimated to be contained within the 14-foot high mound or about 102,000 cy more material than was reportedly placed at the Section 103 site during 1991-1998. Since the seasonally averaged direction of sediment movement appears to be northward, some of the material placed at the Interim ODMD Site may have been transported northward to the Section 103 site. However little, if any, of the dredged material placed at the Section 103 site has been transported beyond the site's boundaries. It was assumed that the influence of along-shore currents and estuarine flow from the Umpqua River was minimal at the Section 103 site during 1991-1998. Material volumes placed at the Section 103 site and estimated dispersion rates for the years 1991 through May 1998 are presented in Table B-3.

Table B-3. Reported and Calculated Material Values and Rate of Dispersal at the Umpqua Section 103 ODMD Site

Period	Volume Placed (cy)	Volume Estimated on the Seabed* (cy)	Rate of Dispersal (cy/year)
1991-1998	950,900	+1,053,000	+13,600

*Volume determined by difference between bathymetric surveys. Negative values indicate loss of dredged material from disposal site due to long-term dispersion.

Figure B-4. Bathymetric Changes at Umpqua Section 103 ODMD Site from 1991-1998



The absence of sediment transport within and beyond the boundaries of the 103 site can be explained by the following conditions.

- The Section 103 site is north of the main channel of the Umpqua River and is not influenced by tidal currents and high flow from the estuary.
- The Section 103 site is deeper than the Interim ODMD Site and little sand movement occurs at depths greater than 100 feet. The average depth at the Section 103 site is 105 feet and the depth across the site varied from 64 feet to 130 feet below MLLW (pre-disposal bathymetry). Some movement of sand might be expected at the shallower depth of the eastern half to third of the site, however.

Capacity Limitations for Present ODMD Site

Based on assessments presented in the 1985 Corps report, the Umpqua River Interim ODMD Site was considered to be a moderately dispersive site. Capacity is defined as that quantity of material that can be placed within the legally designated disposal site without accumulating beyond the site boundaries, or interfering with navigation (Poindexter-Rollings 1990). Exceeding the capacity of the ODMD Sites at the Umpqua River creates a serious operational problem for the Corps and users of the deep-draft navigation channels and approaches.

Dredged material within the Interim ODMD Site accumulated to such an areal and vertical extent that adverse sea conditions were created. In some cases mounds rose 18 feet above ambient bathymetry and amplified incoming ocean wave heights. These wave conditions are hazardous to navigation at the entrance to the Umpqua River. Present and past wave amplification near the Umpqua River entrance due to mound formation is illustrated in Figures B-5 and B-6.

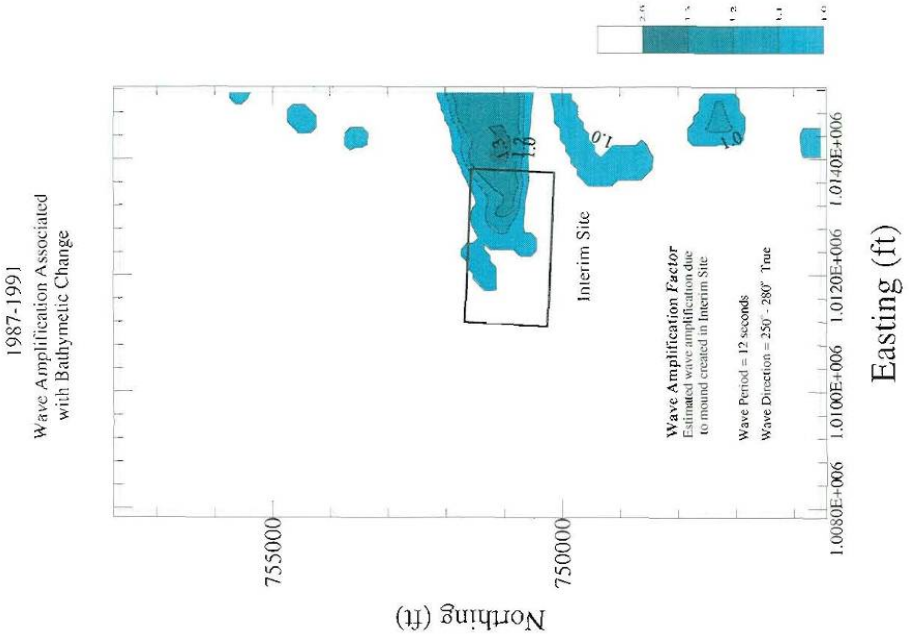
The potential amplification of ocean waves due to the change in bathymetry at the Interim ODMD Site between 1987 and 1991 is shown in Figure B-5. The placement of dredged material and associated change in bathymetry within the Interim ODMD Site is shown on Figure B-5(a). The corresponding potential increase in wave height, in terms of an amplification factor, due to the bathymetric change within the Interim ODMD Site is presented on Figure B-5(b).

Depictions of mound formation and associated wave amplification at the 103 ODMD Site between 1991 and 1998 are shown on Figure B-6(a) and B-6(b), respectively. Note that the dredged material mound which formed at the Interim ODMD Site from 1987 to 1991 is not present in 1998 (see Figure B-4(a). Based on the above observations, excessively high dredged material mounds at the Interim or Section 103 ODMD Site can potentially increase the height of incident waves by 20% to 30% for waves (having a period of 12-seconds) as compared with baseline (pre-mound) bathymetries.

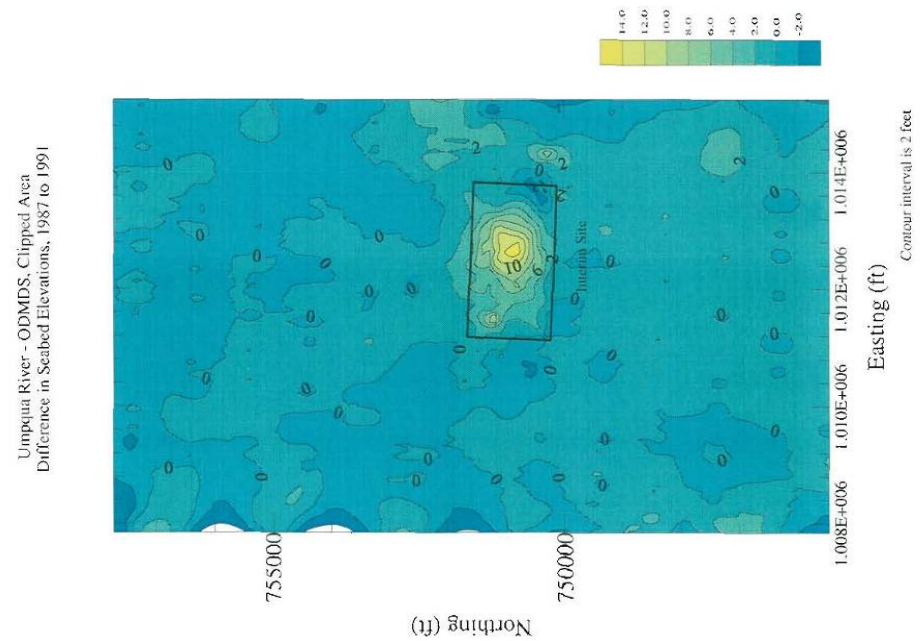
The issue of dredged material accumulating at the Interim ODMD Site and creating potentially hazardous wave conditions for navigation was resolved by coordinating regulatory agency approval for selection of the Section 103 ODMD Site. However, subsequent mounding at the Section 103 site has been documented and is expected to continue despite existing limits placed on site use.

To avert additional mounding and related navigation consequences at the Section 103 site, new or greatly expanded Umpqua River ODMD Sites must be designated. Based on past experiences with the Interim and Section 103 sites, the new ODMD Sites should be much larger without creating high mounds and providing site management flexibility.

Figure B-5. Mounding at the Umpqua River Interim ODMD Site



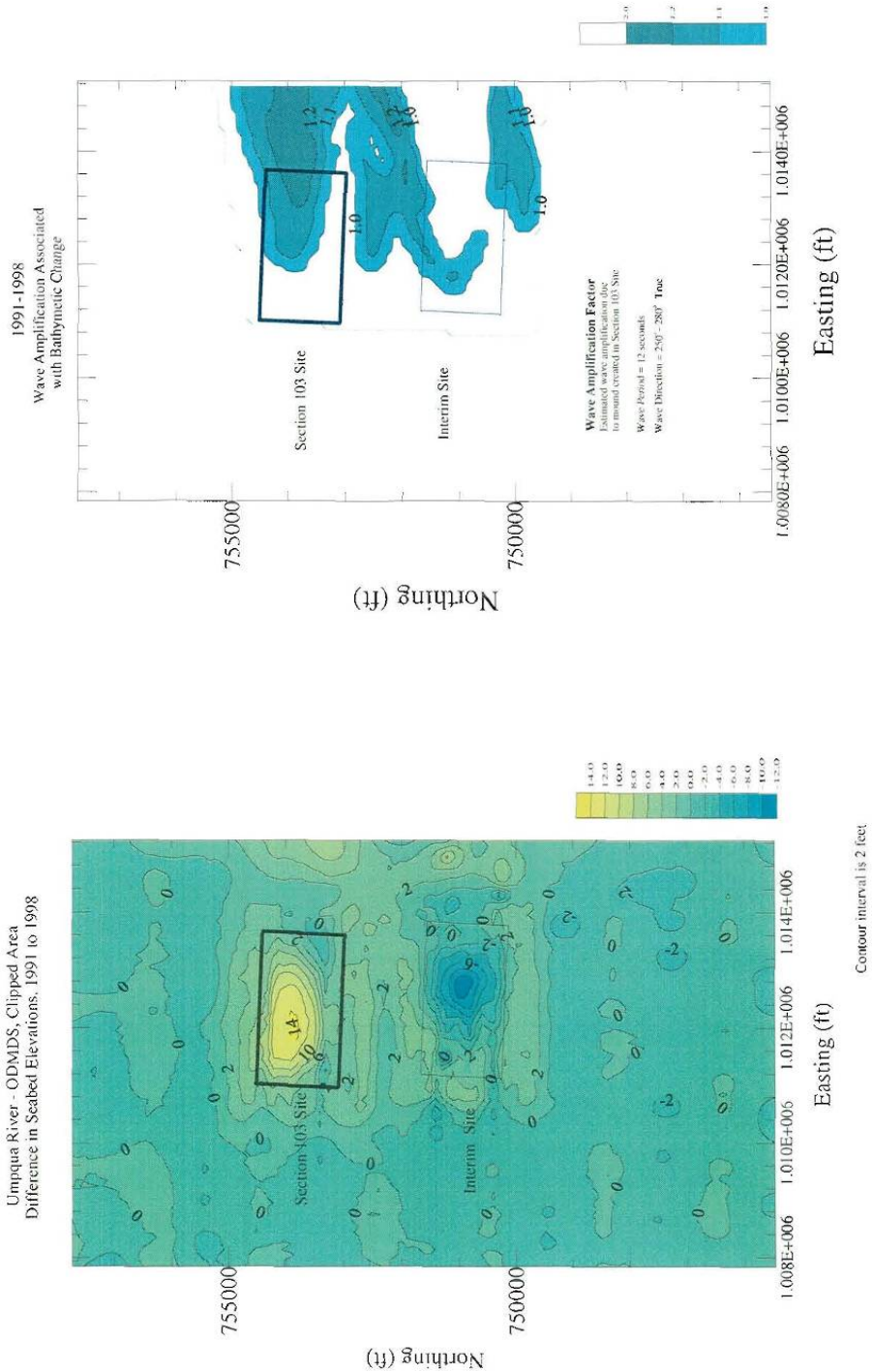
(b)



(a)

(a) Mounded bathymetry in 1991 – last year site was used.
(b) Wave amplification due to mound formation at the Interim ODMD Site.

Figure B-6. Mounding at the Umpqua River Section 103 ODMD Site



(a) Mounded bathymetry in 1998.
(b) Wave amplification due to mound formation at Section 103 site.

SECTION 3. REQUIREMENTS FOR THE NEW UMPQUA RIVER ODMD SITE(S)

The operational performance of the ODMD Sites at Umpqua River indicates that the key to successful ODMD Site designation and long-term management is reliably predicting the fate of dredged material placed in the ODMD Site. This is especially true if new ODMD Sites are required to have the minimum dimensions necessary to provide adequate site capacity. To meet this need at the Umpqua River, numerical models were used for the analysis of dredged material to be placed at new or expanded ODMD Sites. Results from the numerical modeling of dredged material fate will guide proposed ODMD Site expansion, re-designation, or relocation and ensure that long-term management of the sites meets operational requirements.

Specific ODMD Site Criteria

For design purposes the operational requirements for future ODMD Site use will be assessed to ensure that recommended (new) ODMD Sites have a minimum life-cycle of 20 years. The volume per year of dredged material to be placed within ODMD Sites for the next 20 years is based on the present running average of sediment dredged from the Umpqua River federal navigation project. Site capacity must be sufficient to handle the expected volume of placed dredged material without unacceptable adverse impacts to the environment at or near the recommended locations for candidate ODMD Sites. Requirements for successful ODMD Site designation and management at Umpqua River will:

- Provide ODMD Site capacity for disposal of maintenance dredging material originating from the Umpqua River navigation project for a 20-year life-cycle. The annual disposal volume to be placed in an Umpqua River ODMD Site is expected to be approximately 188,000 cy. Over 20 years, the total volume to be placed at an ODMD Site would be approximately 3.8 million cy.
- Locate the new ODMD Site so that average haul distance is within the Zone of Siting Feasibility (ZSF). The ZSF for hopper dredges is within a 3.15-natuical mile radius from RM -1 (see Figure B-1).
- Avoid environmental and navigation impacts due to annual dredged material disposal operations. Prevent mound-induced wave shoaling. Enhance bathymetric dispersal of dredged material placed at ODMD Sites for split-hull vessels by using non-repetitive disposal to evenly distribute dredged material placement in sensitive areas.
- Where practical, enhance transport of suitable dredged material placed at ODMD Sites into the littoral zone. Locate new ODMD Sites such that the littoral transport of placed dredged material toward the entrance channel is minimized. Facilitate the littoral by-passing of dredged material around the Umpqua River jettied entrance.
- Minimize vertical accumulation (mounding) of placed dredged material, from multiple dredging disposal operations (enhance long-term use of ODMD Site). Designate ODMD Sites with large areal configuration and use sub-regions of the ODMD Site on an annual rotational basis. If necessary, use placement grid to enhance uniform distribution of dredged material.
- Ensure that new or expanded ODMD Sites conform to the five general and eleven specific criteria for the selection of ocean disposal sites (40 CFR 228.5 and 228.6), also specified in the report entitled, *Umpqua Ocean Dredged Material Disposal Site Evaluation* (Corps 1989).

Candidate ODMD Site Selection

The principal considerations governing the selection of a new ODMD Site include the avoidance of mound-induced wave shoaling, avoidance of impacts on sensitive benthic areas, and locating the ODMD Site within the ZSF. The Interim and Section 103 sites should not be included within the recommended (new) ODMD Site boundaries because of the mounded bathymetry and wave shoaling that has occurred or is occurring within and adjacent to these existing sites. The recommended (new) ODMD Site must be large enough to permit the distribution of 20 years of sandy dredged material disposal (20 years x 188,000 cy/year = 3.8 million cy) without allowing the accumulated material to exceed a height that could potentially cause wave shoaling. Determination of the size for the recommended ODMD Site is discussed below.

Calculated Capacity for the Existing Section 103 ODMD Site

The volume capacity of the existing Umpqua Section 103 site can be determined given water depth and the perimeter dimensions. The estimated total capacity of the site is based on 1991 seabed (pre-disposal elevations) and an allowable mound height. At any given location within the recommended new ODMD Site, mounding of dredged material is be controlled so that incident waves are not amplified by more than 10% over the baseline (pre-disposal) condition. The allowable height of the mound is estimated from the curves presented on Figure B-7.

Given :

Water depth at candidate ODMDS = D = 105 ft

Areal dimensions of candidate ODMDS = Ls = 3600 ft, Ws = 1400 ft (equivalent square dimension = 2245 ft)

Side slope for accumulated dredged material = θ = 1.1 ^{o} = 1V : 50H = 0.020

H_m = maximum mound height to satisfy the 10% wave amplication critia

= 10 ft (obtained from Figure 9, using most conservative height, i.e. lowest curve)

Required :

Static Capacity of ODMDS (V_s), in terms of allowable mound volume, based on Hm = 10 *ft*

Solution :

$$V_s = \frac{1}{6} \times H_m \times (A + 4B + C), \qquad \text{where } A = (L_s - 2 \times \frac{H_m}{\theta}) \times (W_s - 2 \times \frac{H_m}{\theta})$$

= volume of a prismatoid

$$B = \left[(L_s - 2 \times \frac{H_m}{\theta}) + L_s \right] \times \left[(Ws - 2 \times \frac{H_m}{\theta}) + W_s \right] \Big/ 4$$

$$C = L_s \times W_s$$

$$V_s \approx 0.95 \times \text{ Volume of a trapezoid}$$

$$\text{Volume of a trapezoid} = \frac{1}{2} \times H_m \left[W_s + (W_s - 2 \times \frac{H_m}{\theta}) \right] \times L_s$$

$$V_s \approx 0.95 \times \left\{ \frac{1}{2} \times H_m \left[W_s + (W_s - 2 \times \frac{H_m}{\theta}) \right] \times L_s \right\} \quad \text{since } L_s = W_s$$

$$V_s \approx 0.95 \times \left\{ L_s^{\,2} \times H_m - H_m^{\,2} \times \frac{H_m}{\theta} \right\}$$

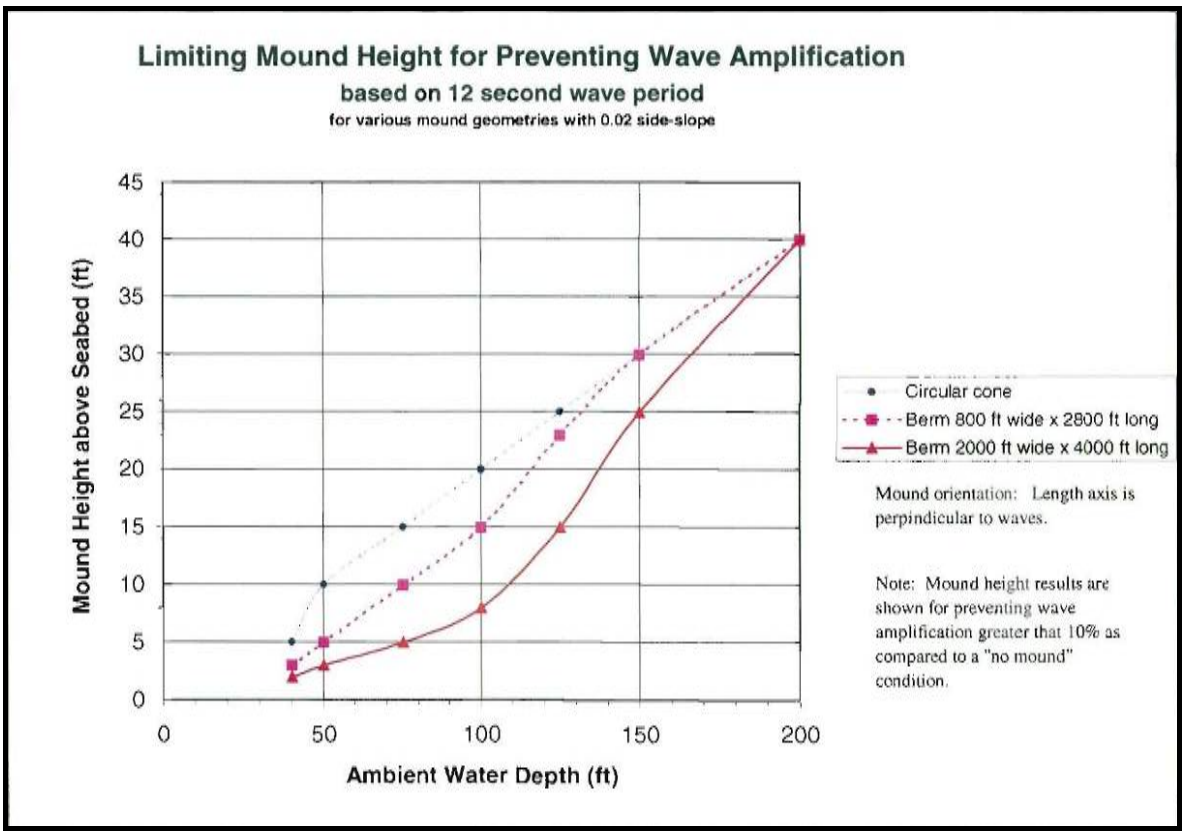
Total static capacity for the 103 site:

$$V_s \approx 0.95 \times \left\{ 2245^2 \times 10 - 10^2 \times \frac{2245}{.020} \right\}$$

$$V_s \approx 37{,}216{,}488\ ft^3 \times \frac{yd^3}{27\ ft^3}$$

$$V_s \approx 1.38\ million\ \ cy$$

Figure B-7. RCPWAVE Estimates for Maximum Limiting Mound Height



Approximately 951,000 cy of dredged material was placed at Section 103 site between 1991 and 1998. Based on the May 1998 bathymetric survey, all the material placed at the site remains on the seabed within the site boundaries. Thus, the Section 103 site is not dispersive. As shown above, the total static capacity for the Section 103 site has been calculated to be 1.38 million cy. As of 1998 about one million cy was already present within the Section 103 site after 7.5 years of operation, it was calculated that the capacity of the Section 103 site at historic placement rates would be exceeded within 3 years. Exceeding the Section 103 site capacity of 1.38 million cy may impact navigation at the approaches to the Umpqua River by amplifying the height of incident ocean waves. As a management tool, subsequent annual volumes placed were reduced at the Umpqua River.

Estimating the Size for the Proposed Umpqua River ODMD Site(s)

The location and dimensions required for new recommended ODMD Sites are based on the need to provide volume capacity for a 20-year life cycle. This means that the new Umpqua ODMD Site must provide site capacity to receive 3.8 million cy of sandy dredged material over a 20-year period. The dimensions of the recommended (new) ODMD Site will be based on the calculated site capacity with consideration given to the assumptions described below.

- The proposed new ODMD Sites should facilitate disposal of dredged material within the littoral zone and down-drift (with respect to the net littoral current direction) of the jetty entrance.

- One hundred feet is the approximate depth limit for littoral transport and 30-foot water depth is the shallowest open-coast operating depth for hopper dredges, most of the areal extent for the recommended new ODMD Sites should be located between water depth of 30 to 100 feet.

- The net direction (seasonally averaged) of littoral transport along the south central Oregon Coast has been observed to be toward the north (Scheidegger et al., 1971). In order to successfully by-pass dredged material around the jettied entrance of Umpqua River, a proposed new ODMD Site should be located north of the jetty entrance. It must be noted that during the spring-fall seasons and during certain La Nina years, the direction of littoral drift along the central Oregon Coast may have no net direction (north or south) or may be toward the south. To adequately address the potential bi-directional nature of littoral current at the Umpqua River entrance, an additional ODMD Site is recommended to be located south of the entrance.

- To ensure that the proposed new ODMD Sites provide adequate life-cycle capacity, the seabed condition of the site(s) is assumed to be non-dispersive. Thus, the capacity of the site(s) will be calculated using the static volume calculation method shown in the previous section.

- To minimize accumulation of placed dredged material because of previous disposal operations at the Interim and Section 103 sites, the new recommended ODMD Sites should be located at least 1,000 feet away from the existing disposal sites.

Based on the above assumptions, consideration will be given to a recommended (new) ODMD Site that is located north of the Umpqua River jetty entrance in water depth from 30 to 120 feet, and within the 3.15 nautical mile ZSF. The proposed new Umpqua ODMD Site will provide a 20-year life-cycle capacity of over 3.8 million cy. To address the inter-annual variation of the littoral current (direction of transport), additional consideration will be given to a second recommended ODMD Site located south of the Umpqua River jetty entrance and conforming to the same siting considerations as the north site. The static volume calculation for the recommended (new) ODMD Sites is presented below.

Given :

Average water depth at recommended ODMDS = D = 70 ft (average between 30 and 100 ft depth)

Required static capacity volume for the new ODMDS location = Vs = 3.8 million cy = 103 million cubic feet

Side slope for accumulated dredged material = θ = 1.2 = 1V : 50H = 0.020

Required :

Maximum limiting mound height for each ODMDS = Hm

Areal Dimensions for the ODMDS (for computaion - assume square site boundaries) $L_s = W_s$

Solution :

$H_m = 5$ ft for depth = 70 ft (obtained from Figure 9, lower curve using 70 ft water depth)

$$L_s = H_m/0.020 + \left[(H_m/0.020)^2 + 4 \times V_s/(0.95 \times H_m)\right]^{1/2}/2 = \text{required square dimension for ODMDS (feet)}$$

$$L_s = 5/0.020 + \left[(5/0.020)^2 + 4 \times 103{,}000{,}000/(0.95 \times H_m)\right]^{1/2}/2$$

$$W_s = L_s = 4{,}800 \text{ feet} = \text{minimum site dimension for 20-year life-cycle capacity}$$

Thus, a minimum area of 22 million square feet (505 acres) is required for the recommended new ODMD Site. A rectangular site with dimensions of 5,800 feet by 4,000 feet should provide adequate ODMD Site capacity for a 20-year design life for disposal of dredged material.

SECTION 4. SIMULATING THE FATE OF DREDGED MATERIAL PLACED AT THE NEW UMPQUA RIVER ODMD SITE(S)

Coupled Strategy for Numerical Modeling and ODMD Site Management

A prerequisite for successful ODMD Site designation and management is reliably predicting the fate of dredged material placed at the ODMD Site. The MPRSA requires that established and reliable procedures be used for the assessment of possible physical impacts due to the operation of proposed ODMD Sites.

During the Corps' Dredging Research Program, several sediment fate (FATE) numerical models were developed or enhanced in order to improve the reliability of ODMD Site management. These FATE models incorporate algorithms for simulating the behavior of dredged material placed in open water and accounting for a variety of disposal operations and environmental conditions. Results from FATE model application at the Umpqua River were used to guide site selection of a new recommended ODMD Site and ensure that life-cycle management of the proposed site would meet operational requirements. Site impact assessments focused on the following considerations:

- Wave conditions – the use of new or expanded ODMD Sites would not increase (worsen) the wave environment in the ODMD Site boundary and at the jetty approaches and adjacent areas.
- Impacts to benthic in-fauna – the use of expanded ODMD Sites would minimize potential impacts to benthic in-fauna. The ODMD Sites were located to avoid placement of dredged material on a seabed substrate significantly different from that dredged from the navigation channel.
- Littoral placement of dredged material – with placement in water depths from -30 to -100 feet, dredged material should be actively transported by waves and currents in the littoral zone where it can replenish eroded breaker areas and beaches. Placement of dredged material within new ODMD Sites should be such that littoral transport is maximized, and impacts to navigation (such as increased wave height) and impacts to the benthic community are minimized.

The FATE model results used to assess the long-term suitability of the proposed Umpqua River ODMD Site are described in Section 5, *Fate Modeling Results and Impact Assessment for the Proposed ODMD Sites*. The following paragraphs describe FATE model components and the strategy for using the FATE models in this ODMD Site assessment.

Fate of Dredged Sediment Placed in Open Water

The physical processes affecting dredged material placed in open water include gravity, waves, and currents. At the point of release from the disposal vessel, dredged material falls through the water column in the form of a plume and is transported laterally by convection and diffusion. Eventually, dredged material settles to the seabed. 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. Processes affecting the fate of placed dredged material during and immediately after the disposal operation occur within a time period of minutes to hours. This scenario characterizes the short-term fate of dredged material placed in open water.

After dredged material has come to rest on the seabed, waves and currents can erode it. If the dredged material is cohesive, it can experience consolidation. If many loads of dredged material are placed one on top of another such that a steep aggregate mound develops on ambient bathymetry, the slope of the mound can fail and material can be transported down slope. These processes, in aggregate, account for 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 from days to years after the disposal operation.

Predictive Methods – Applicable Numerical Models

The STFATE, LTFATE, and MDFATE numerical models incorporate physics-based algorithms for simulating short- and long-term bathymetric change resulting from dredging disposal operations and environmental processes. The models were developed at the Corps' Waterways Experiment Station (WES) and are briefly described below.

Short-term FATE predicts the distribution of dredged material through the water column and bathymetric distribution of dredged material on the seabed after it has passed through the water column, on an individual dump basis. The period simulated by the model is during dredged material disposal and from minutes to hours after disposal. The model accounts for various disposal vessel, water column, and material parameters.

Long-term FATE simulates bathymetric change due to 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.

Multiple-dump FATE predicts the change in bathymetry at an ODMD Site 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 that 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 it simulates processes during and immediately after dredged material disposal. MDFATE uses the same parameters as used in STFATE and LTFATE.

Predictions of dredged sediment behavior when it is placed into the ocean can only be reliable if wave, current, and tidal conditions are estimated accurately. To address the 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 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 to assess the effect of bathymetry change (dredged material mounds) upon the wave environment at candidate Umpqua ODMD Site. RCPWAVE is a 2-D numerical model that simulates the behavior of monochromatic waves as they are refracted and diffracted by the bathymetry that the waves pass over.

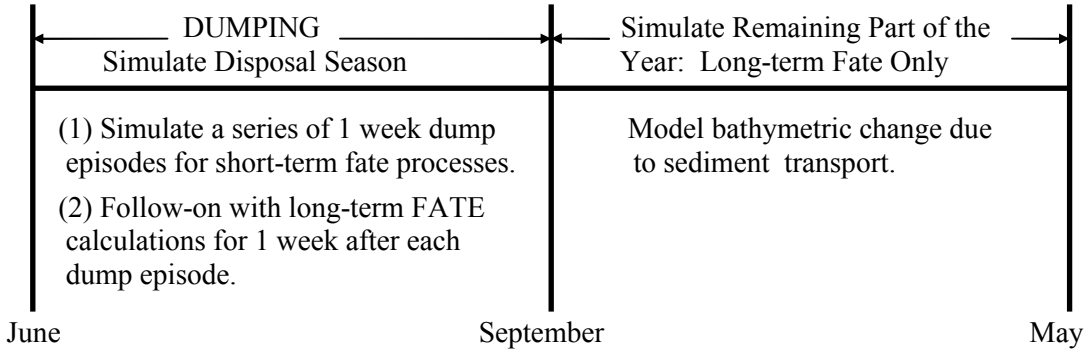
The above models have been successfully applied at several locations within and outside the Portland District (Scheffner 1992; Mortiz and Randall 1995; Corps 1995, 1998) prior to this investigation. Collectively, the above numerical models were used to resolve future ODMD Site management issues at Umpqua River related to physical aspects.

ODMD Site Modeling Strategy

As a first step toward modeling sediment fate at the ODMD Sites, existing oceanographic information was consolidated for use in the modeling effort. Because the most recent survey of the Umpqua River sites and approaches was performed in May 1998, bathymetry from that year was selected as the baseline condition for simulating behavior of dredged material (Corps 1998).

For modeling purposes, the annual dredging and disposal season at Umpqua River was broken into two discrete time periods. Dredging disposal at the Umpqua River ODMD Site normally begins during June and continues throughout the summer until September. After September, the ODMD Site is not used for dredged material disposal. Between September and June the energetic wave and current environment affects acts on the placed dredged material. The schematic shown below describes how the MDFATE model was applied to simulate dredged material disposal and long-term bathymetric change at the proposed new Umpqua River ODMD Sites.

Modeling of the Annual Dredged Material Disposal Cycle at Umpqua ODMD Sites



During a given ODMD Site year, short-term fate processes were simulated for a 4-month period (June-September). Long-term fate processes were then simulated for an 8-month period until the following year when the annual cycle was repeated.

Short-term FATE

The STFATE model was used to estimate the geometry (thickness and areal coverage) 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. The above estimates were performed for the Yaquina, Westport, and Newport dredging vessels. These dredges (or similar vessels) have been the most frequently used Umpqua River. Results are described in Section 6 of this appendix. STFATE results were used to optimize ODMD Site 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 FATE models were used to estimate the capacity of the recommended new ODMD Sites for a 20-year life-cycle. The site capacity of a given ODMD Site consists of two components: static site capacity and dynamic site capacity.

ODMD Site capacity = dynamic site capacity + static site capacity

Dynamic ODMD Site capacity is defined as the volume of placed dredged material that is transported out of an ODMD Site boundary or off a given bathymetric feature by waves and currents before commencement of the following dredging operational season. The time of a disposal cycle was taken as one year. The shallower a given ODMD Site location, the greater the potential for dispersing placed dredged sediments and the higher its dynamic capacity. Generally the deeper a given site, the lower the dynamic capacity.

Dynamic capacity is specified in terms of a volumetric rate (cy per year) at which sediment leaves a given site. Dynamic capacity at a given site can change with time based on changes in site bathymetry or changes in waves and currents. Results of dynamic capacity estimates are presented in Section 6 of this appendix.

Static ODMD Site capacity is defined as the limiting volume of dredged material that can be placed within a given area before the resultant mound feature begins to have a negative impact on navigation, or harm 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 shoal, steepen, or break. Environmental impacts associated with static capacity, include exceeding a pre-determined burial depth over the site's pre-disposal substrate or promoting down slope distribution of placed material onto areas beyond the designated ODMD Site boundaries.

For the case of Umpqua River ODMD Site, static site capacity is governed by the need to avoid navigation impacts. The constraints are vessel keel clearance and wave shoaling—and the most restrictive constraint applies. To meet keel clearance requirements, the highest elevation that an ODMD Site mound can attain is -55 feet MLLW. To meet wave shoaling constraints, a given ODMD Site mound must not amplify incident waves by more than 10%. The shoaling criteria are usually more restrictive. Generally the shallower a given ODMD Site location, the lower the static capacity and vice-versa. Results of static capacity estimates are presented in Section 6 of this appendix.

The MDFATE model was used to simulate the long-term accumulation of dredged material placed at various locations within candidate ODMD Sites. MDFATE results were used to optimize ODMD Site utilization based on the need to distribute dredged material within a given site, in terms of accumulation thickness and areal extent per year. The end result verified the feasibility of placing dredged material at candidate ODMD Sites over a long period of time (20-year life cycle). Results from STFATE and MDFATE were used to determine the ODMD Site dimensions required for 20-year operational design life.

Estimating Potential Wave Amplification

Management of Umpqua River ODMD Sites will prevent the amplification of incident waves due to the formation of new dredged material mounds by limiting the size of new dredged material mounds. Dredged material mound accumulation will be restricted based on a 1.10 (10%) wave amplification limit. The RCPWAVE model was used to assess wave shoaling characteristics of various dredged material mound sizes as a function of water depth and wave parameters. The 1.10 wave amplification criterion was used for purposes of minimizing hazardous wave conditions due to excessive accumulation of dredged material mounds. Results are described in Section 6 of this appendix.

Analytical Methods for Calculating Sediment Transport Potential

The calculation of closure depths (Hallermeier 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 of the limiting depth of sediment transport but do not define how much sediment transport will occur.

Hallermeier Sediment Transport Limits

The near-shore region of the seabed can be divided into different transport zones based upon relative rates and direction of sediment transport. Two water depth zonal limits, dl and ds are typically used to describe the transportability of sediment at the seabed due to shoaling waves (Hallermeier 1981). These depth values are referred to as closure depths. The water depth corresponding to dl gives a seaward limit for littoral (alongshore) sediment transport associated with highly turbulent surf-related effects. This depth is a function of the annual mean significant wave height (H1/3) and defines the littoral zone for which all significant along-shore, and cross-shore transport occurs. Algebraically, the littoral closure depth (dl) for typical nearshore sand is defined as:

$$dl = 2H1/3 + 11\sigma$$

where H1/3 = average annual nearshore significant wave height, feet
σ = annual standard deviation of H1/3, feet

The water depth corresponding to ds gives the extreme seaward limit of wave-induced sediment motion (occurring in the cross-shore direction) due to extreme waves 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 dl and landward of ds defines the shoal zone. Within the shoal zone between dl and ds is a buffer area where waves have neither a strong nor negligible effect on the bottom sediment transport during a typical year of wave action (Hallemeier 1981).

$$ds = (H1/3 - 0.3\sigma)Ts(g/5000D50)1/2$$

where Ts = wave period (associated with H1/3), seconds
g = 32.2 feet/sec^2
D50 = median sediment grain size, feet

Using the WIS-Phase III data for Station 39 (Jensen et al., 1989), the mean significant wave height and period are determined to be 10.8 feet and 10.9 seconds. The standard deviation of the mean significant wave height is 4.9 feet. The median grain size for dredged material to be placed at Umpqua River ODMD Sites is estimated to be 0.25 mm, and the grain size for in situ material at existing ODMD Sites was estimated to be 0.30 mm. The corresponding values for closure depths are:

dl = seaward limit of active littoral zone at Umpqua River (all sediments) = -76 feet MSL

ds = extreme seaward limit for wave-induced sediment motion (0.25 mm) = -285 feet MSL
ds = extreme seaward limit for wave-induced sediment motion (0.30 mm) = -260 feet MSL

In terms of closure depth, the Interim and 103 ODMD Sites should experience pronounced sediment transport when dredged material is placed at locations shallower than dl = -76 feet MSL. Although the Interim and 103 ODMD Sites are located at dl, dredged material dispersal rates have not kept up with the volume of material placed. The closure depth criterion (dl) does not describe the dispersal rate of sediment.

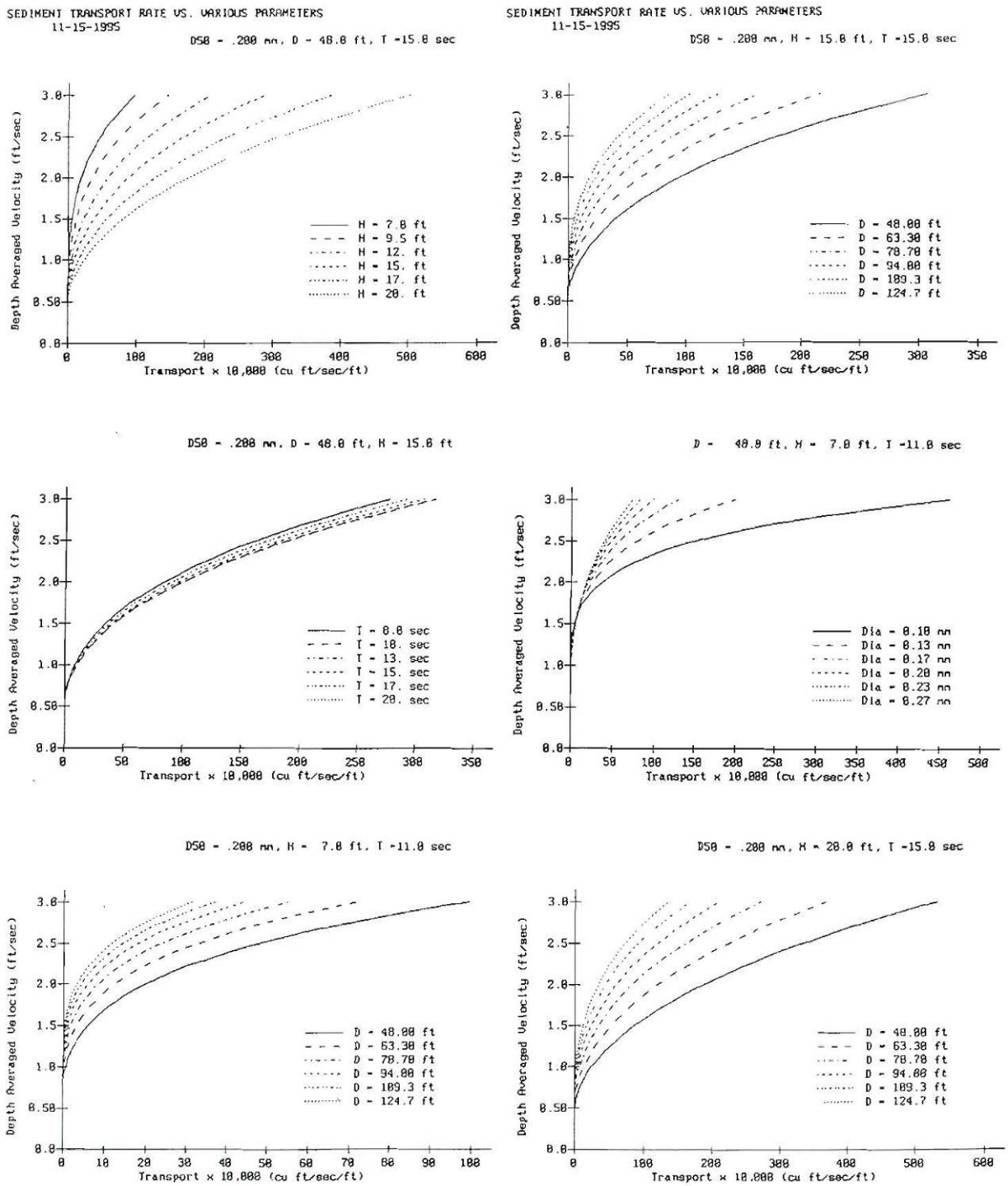
Ackers-White Sediment Transport Estimates

To obtain a more detailed description of sediment behavior, other relationships have been developed to quantitatively estimate sediment transport rates (Ackers and White 1973). The LTFATE model uses the Ackers and White (1973) equations as the basis for the non-cohesive sediment transport model. The equations are applicable for uniformly graded non-cohesive sediment in the range of 0.04 to 0.40 mm. The net direction of sediment transport is governed by current direction only. Wave direction has no effect on sediment transport direction. However, because ODMD Sites typically are located in relatively shallow water (less than 200 feet), 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).

Several 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 Ackers-White tests are shown in Figure B-8 (six graphs). Wave height and current are governing parameters for sediment transport (upper left and bottom two graphs). If wave height is increased from 7 to 20 feet in 48-foot water depth, sediment transport potential increases by a factor of 10 for a current of 1.5 feet/second. For water depth less than 125 feet, 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 55 feet (high point of Interim ODMD Site mound in 1988) and current of 1.5 feet/second, the sediment transport rate is about 5 times higher than at 125-foot depth. Note that regardless of wave height or water depth, if the depth-averaged current is lower than a threshold value of 0.5 feet/second, there is no net sediment transport.

Sediment grain size has an effect upon sediment mobility (middle right graph, Figure B-8), but only at high values of depth-averaged current. Since the range in sediment grain size for dredged material at Umpqua River is 0.2 to 0.3 mm, the transport rate could be significantly higher for the finer dredged materials placed in the shallow areas of existing ODMD Sites. The variability in wave period (middle left graph, Figure B-8) does not appear to have an appreciable effect upon sediment transport rates.

Figure B-8. Results from Ackers-White Patch-test of Point Values for Sediment Transport Potential



Limitations of Simple Analytical 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 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 ODMD Site designation efforts do not provide an efficiently dispersive disposal site. The Ackers-White and other equations relating physical processes are solved in two dimensions within the FATE sediment fate numerical models. Application of the FATE numerical models should provide the needed predictive means to reliably select a new site, or expand an existing ODMD Site. The FATE models can also be used to optimize management at existing ODMD Sites.

FATE Model Data Requirements

Before reliable modeling of dredged material fate could be conducted, the environmental processes that govern sediment transport at Umpqua River ODMD Sites had to be defined. The following prioritization of various environmental parameters is given 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, yearlong data record with 3-hour record interval.
- Third Priority: Characteristic physical properties for dredged sediment and ambient bottom sediments at ODMD Sites.
- Fourth Priority: Wave period time series, year-long data record with 3-hour record interval.

Section 6 of this appendix, *Measured Oceanographic Data*, quantitatively describes site specific parameters relevant to FATE modeling.

SECTION 5. FATE MODELING RESULTS AND IMPACT ASSESSMENT FOR THE PROPOSED ODMD SITES

Allowable Dredged Material Mound Height for the Proposed ODMD Sites

As discussed in Section 4, the areal size of a recommended new ODMD Site was determined based upon the site requirement to provide static capacity for 3.8 million cy of dredged material over a 20-year life-cycle without affecting present wave conditions. The RCPWAVE model was used to determine the maximum limiting height of a (dredged material) mound feature for various conditions. Figure B-7 summarizes the RCPWAVE results from estimating limiting mound height for several mound configurations in water depths from 40 to 200 feet. The lower bold solid line applies to a large mound feature (2,000-feet wide x 4,000-feet long with 1V:50H side slopes) and was used to determine to maximum mound height applicable for the recommended new ODMD Sites located offshore of the Umpqua River entrance.

Specification of the average water depth for a given ODMD Site permitted determination of the limiting mound height for the site (from Figure B-7). Once the limiting mound height was determined, the required ODMD Site size was calculated from geometry (assuming characteristic mound dimensions). All that was needed to begin the ODMD Site size calculation was to estimate the location (average water depth) of where to place the recommended new ODMD Sites. These calculations are shown in the later part of Section 4.

Recommended ODMD Site Size and Location

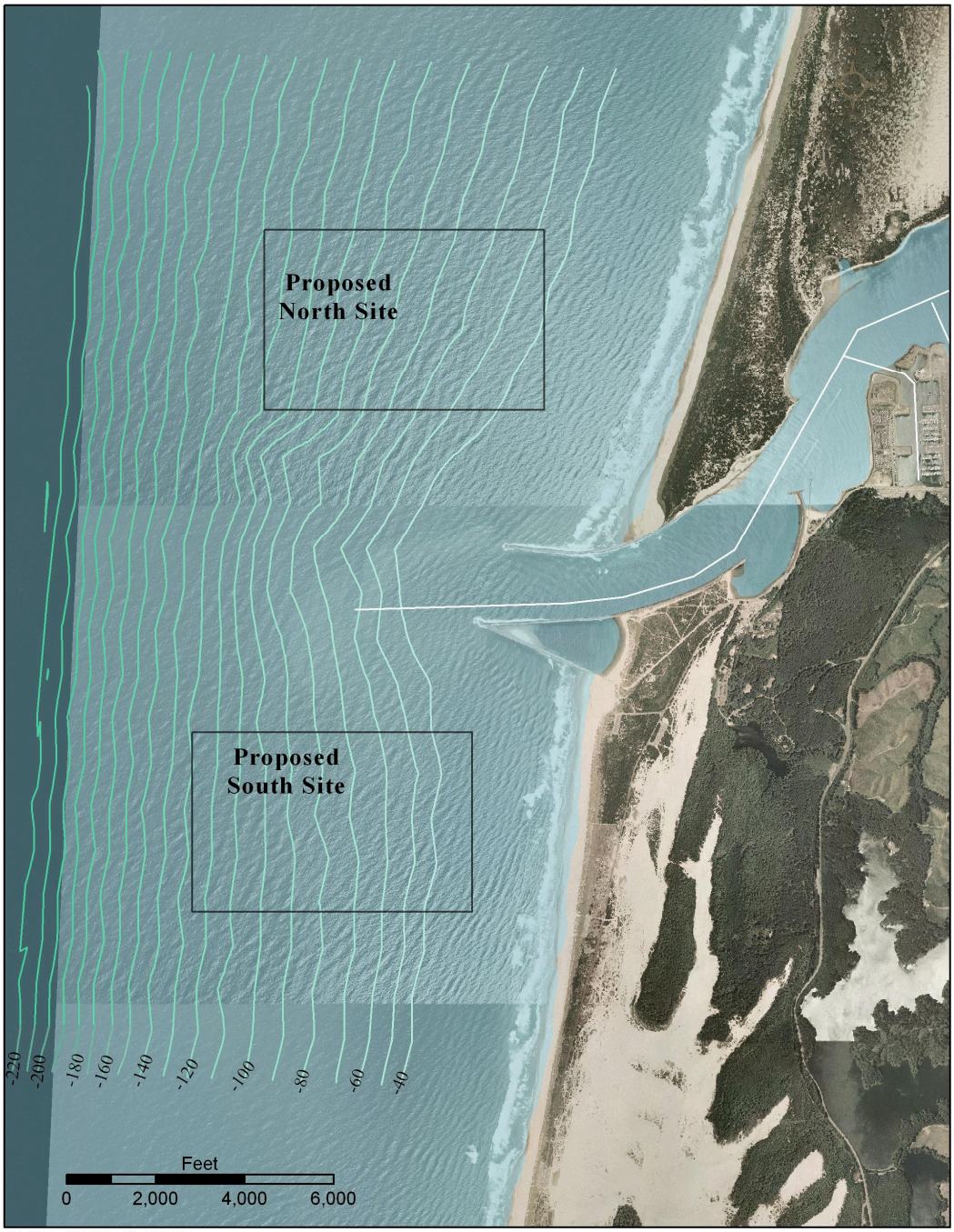
Locating two new ODMD Sites within the 3.15 nautical mile Umpqua ZSF was accomplished by a method of overlay. For example, new ODMD Sites should not be located within or adjacent to existing ODMD Site affected bathymetry. The above restrictions required that new ODMD Sites be located either north of the existing Section 103 site or south of the Interim ODMD Site. The average water depth of the sandy-bottom areas noted above is about 75 feet.

Based on an average water depth of 75 feet and the limiting mound height criteria shown in Figure B-7, the maximum limiting mound height for the new ODMD Site was determined to be 5 feet. The width (east-west) and length (north-south) dimensions of the new ODMD Sites were set so that the ODMD Sites are almost entirely within the ZSF. The lineal dimensions, boundary coordinates, and water depth variation for the new ODMD Sites are: lineal dimension = 6,300 feet x 4,000 feet; axis azimuth = 270°; average depth = 75 feet; and 1998 elevation variation = -30 feet to -120 feet MLLW. These boundaries apply to the two new ODMD Sites configurations shown in Figure B-9.

The available static site capacity within the one of the recommended new ODMD Sites is expected to be meet the 20-year life-cycle requirement of 3.8 million cy for Umpqua River dredging while providing sufficient area to promote evenly distribution of dredged material and prevent excessive mounding. This assessment is verified (via modeling) later in this section.

To address the issue dredged material disposal in context of potential littoral current variability (in term of direction), it is recommended that an additional new ODMD Site be located south of the Interim ODMD Site. This new ODMD Site (South Site) would have the same dimensions as the new ODMD Site located north of the Section 103 site (North Site). The recommended new South Site would be located within the seabed contours of -30 feet to -120 feet MLLW.

Figure B-9. Proposed New ODMD Sites for Umpqua River



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Short-Term Fate Modeling: Bathymetry Impact Assessment

The STFATE model (Johnson 1990, Johnson and Fong 1995) was used to predict the bathymetric distribution of dredged material after it has been placed at a disposal site and has passed through the water column, on an individual dump (disposal vessel load) basis. The STFATE model accounts for various disposal vessels, water column, and dredged material parameters. The objectives of the short-term fate assessment were to:

- Determine the disposal footprint geometry (per dump) in terms of thickness and areal extent. This data provides insight to potential bathymetric impacts in the immediate vicinity of disposal.
- Determine the distance that placed dredged material is displaced away from the point of release. This parameter describes the ODMD Site drop zone setback needed to keep material within the formal disposal site boundary while the placed material is falling through the water column.

Short-term fate simulations were conducted for the disposal of dredged material from two types of hopper dredges: (1) two sizes of a split-hull hopper dredge – *Padre Island* and the *Westport*; and (2) a multiple bottom door hopper dredge – *Yaquina*. Since 1987, the *Yaquina* has performed nearly all dredging disposal at the Umpqua River ODMD Site. The *Padre Island* performed all dredge material disposal in 1990. Should the *Yaquina* be taken out of service, the likely dredge to be used at Umpqua River entrance would be similar in character to the *Westport* or the *Padre Island*. Operating parameters for each dredge are shown in Table B-4.

Table B-4. Dredge Vessels Typically Used at the Umpqua River

Dredge	Overall Dimensions			Average Capacity for Disposal (cy)	Vessel Speed (knots)	No. Doors/ Size of Each	Disposal Duration (minutes)
	Length (ft.)	Beam (ft.)	Draft (ft.) Loaded/empty				
Padre Island (Newport)	281	52	19/8	2,600	2 to 6	split-hull 190 x 30 ft.	4 to 6
Westport	270	50	14/8	1,000	2 to 6	split-hull 160 x 25 ft.	2 to 6
Yaquina	200	58	14/10	1,000	2 to 8	bottom doors (6) 4 x 4 ft.	2 to 6

Note: The *Yaquina* has been used almost exclusively since 1987. For STFATE modeling purposes, results obtained for the dredge *Newport* were used in place of the *Padre Island*. The *Newport* has similar operating characteristics and working volume is 15% larger.

For simulation purposes, the vessel speed during disposal was varied from 1 to 10 feet/second (0.6 to 6 knots) for all three dredges. The duration of placement for an individual load of dredged material was assumed to be 5 minutes for the *Padre Island* and 3 minutes for the *Yaquina* and *Westport*. Short-term fate simulations were conducted for disposal water depths ranging from 40 to 200 feet. Three types of current conditions were also tested: no current, 1 feet/second, and 4 feet/second. Currents were modeled as being oriented 45° into the heading of the disposal vessel. The current regime at the Umpqua ODMD Sites ranges from 0.5 to 3 feet/second. The characteristics of sediment dredged from the Umpqua River navigation project and placed at the ODMD Sites are described in Section 7 of this appendix.

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. 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 Umpqua River ODMD Sites, approximately 97% of dredged material placed is composed of sand and 3% 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 (for the same scenario) is approximately 2,000 seconds. The above results were obtained for 100-foot water depth with no current. Short-term fate (STFATE) modeling results are summarized graphically in Figures B-10 and B-11 and are described below for parameters governing mound height, mound width, and displacement distance.

Mound thickness is directly related to dredge vessel speed during disposal (Figure B-10). For normal operating conditions in water depth of 70 feet, the *Yaquina* and *Westport* produce a footprint that is 0.2- to 0.05-feet or 0.3- to 0.1-feet thick for vessel speeds ranging from 1 to 10 feet/second, respectively. For the same variation in operating parameters, *Padre Island* produces a dump that is footprint 1.05- to 0.2-feet thick for vessel speeds ranging from 1 to 10 feet/second, respectively.

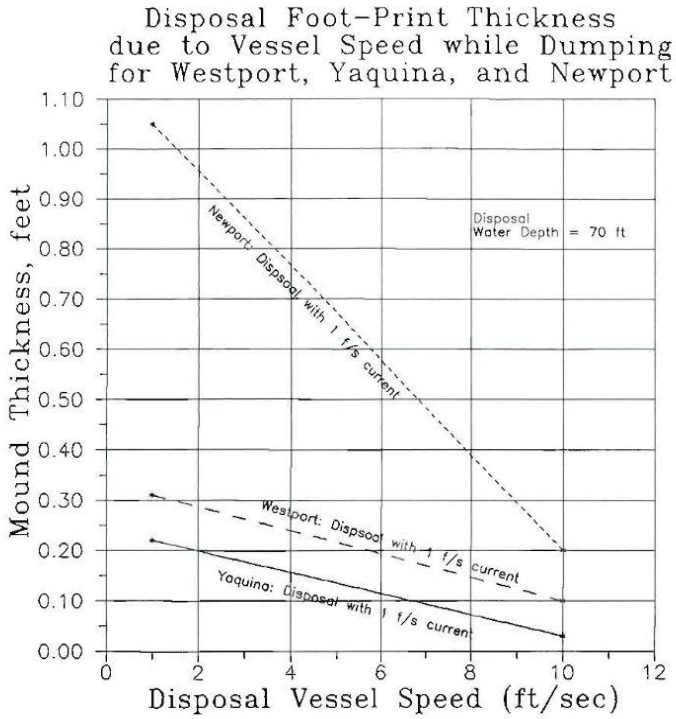
For similar operating conditions (vessel speed, vessel capacity, water depth, and currents), split-hull hopper dredges produce a thicker resultant mound footprint than multiple bottom-door hopper dredges (see Figure B-11). For average operating conditions in 100 feet of water without a current, the *Yaquina* will produce a deposition mound with maximum height of 0.17 feet. The *Westport* will produce a mound with maximum height of 0.3 feet. The *Padre Island*, which carries 2.5 times more volume than the *Westport*, will produce a mound with maximum height of 0.95 feet (Figure B-10). The most significant parameter affecting height is water depth. Increasing the water depth by a factor of three will decrease disposal mound height for a single dump by a factor of three for all three hopper dredges. This applies to dredges disposing in all current conditions tested.

Increasing current speed from 1 to 4 feet/second in 100 feet of water reduces mound height by a factor of three for both dredges (see Figures B-10 and B-11). The current acts to displace placed dredged material away from the location of release before the material impacts the seabed. For disposal in a water depth of 100 feet, a 1 foot/second current will displace dredged material 400 feet from the site of disposal before most of the material hits the seabed. For the same water depth, a 4 feet/second current will displace dredged material 1,500 feet from the site of disposal before most of the material hits the seabed.

The estimated areal coverage of a mound resulting from a single load placed by the Westport in 100 feet water depth is about 21 acres with maximum mound height of 0.22 feet; however, 90% of the mounded area is less than 0.10 feet (1.2 inches). The estimated areal coverage of a mound resulting from a single load placed by the *Yaquina* in 100 feet water depth is about 17 acres with maximum mound height of 0.12 feet; however, 90% of the mounded area is less than 0.07 feet (0.84 inches). The *Westport's* dump footprint is larger aerially and thicker than the *Yaquina's* dump footprint. The *Yaquina's* footprint is more uniform in terms of depositional thickness.

The estimated areal coverage of a mound resulting from a single load placed by the *Padre Island* in 100 feet water depth is about 20 acres with maximum mound height of 0.48 feet; however, 90% of the mounded area is less than 0.25 feet (3 inches). This is significantly greater than the *Yaquina* or *Westport* due to the large per dump volume of the *Padre Island*.

Figure B-10. Predicted Disposal Footprint Geometry as a Function of Vessel Speed and Predicted Disposal Footprint Thickness for Dredge Newport



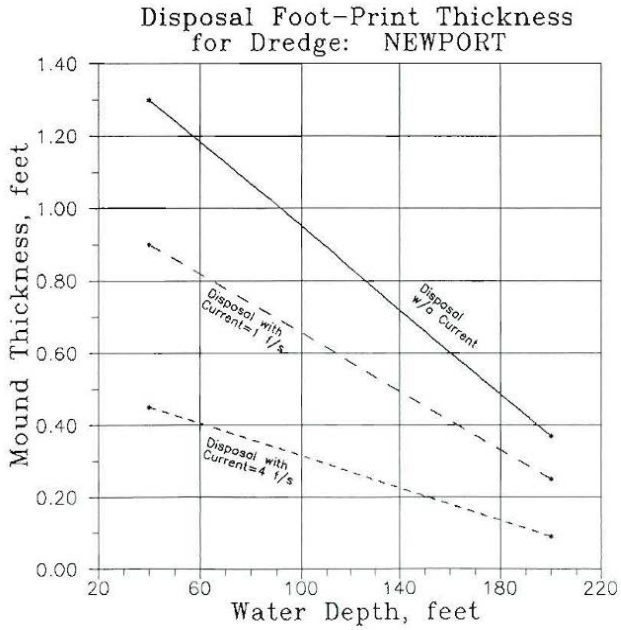
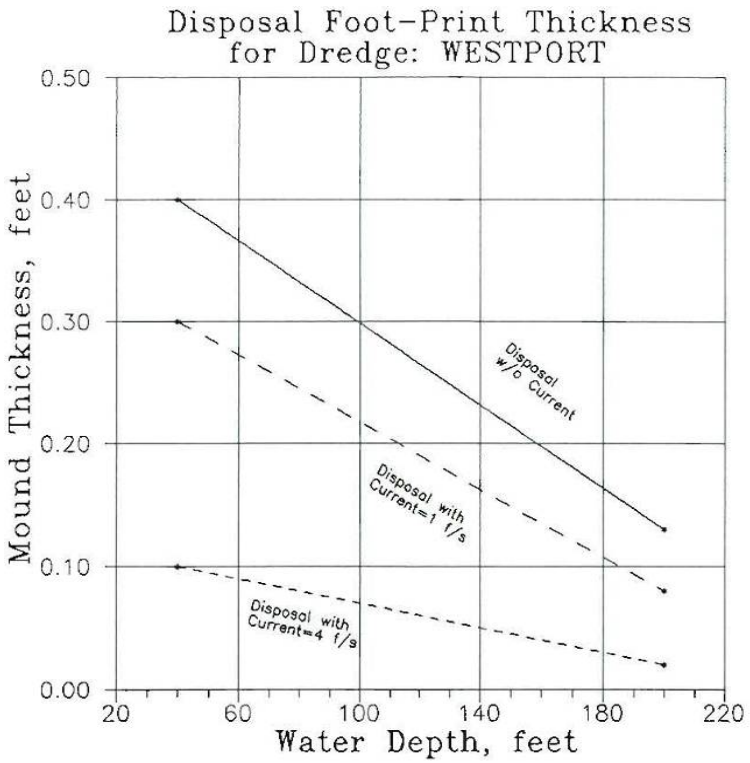
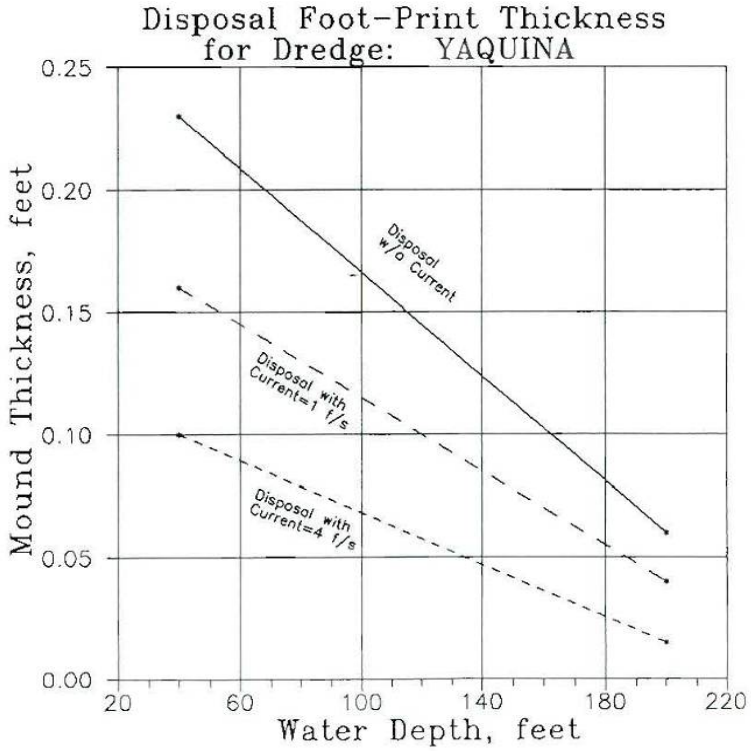


Figure B-11. Predicted Disposal Footprint Thickness for the Dredges Westport and Yaquina





For locations offshore where water depths range from 40 to 120 feet (assuming currents are 1 foot/second), the dredged material mound resulting from a single dump from either the *Yaquina* or *Westport* could be expected to have the following configuration:

Mound length: 1,200 to 2,400 feet.
Mound width: 400 to 1,300 feet.
Maximum mound thickness: 0.1 to 0.3 feet.
Displacement of mound during disposal: 200 to 700 feet.

Corresponding results obtained for the *Padre Island* would produce a significantly larger mound configuration in terms of height (3 times higher) and length (1.5 to 2 times longer).

STFATE Conclusions

Based on the dredging vessels used at the Umpqua River, the larger split-hull hopper dredges (e.g., *Padre Island*) would produce a disposal footprint per dump that is 60% to 150% higher than multiple bottom-door hopper dredges (e.g., *Yaquina*). If the larger split-hull dredges are consistently used for dredging the entrance of Umpqua River, special management actions should be employed during dredged material disposal operations (such as non-repetitive "grid dumping") to minimize rapid accumulation of placed 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 60% by increasing the speed of the disposal vessel from 3.5 feet/second (2 knots) to 8 feet/second (5 knots). Based on the above results, a 500-foot ODMD Site drop zone setback is recommended to prevent inadvertent placement of dredged material onto sensitive seabed areas.

Long-Term Fate Modeling: Typical Disposal Year

The accumulation of placed dredged material due to a year-long sequence of disposal at the proposed north ODMD Site was estimated using the MDFATE model (Moritz 1994, 1995). MDFATE can predict the bathymetric distribution of dredged material in response to a year-long disposal cycle. The focus of this effort was to estimate how dispersive the dredged material would be when dumped from the multiple-door hopper dredge *Yaquina*. Although the *Yaquina* has been used almost exclusively at the Umpqua River since 1986, a split-hull dredge vessel such as the *Padre Island* may be occasionally used in the future. Factors under consideration include the areal extent of placed dredged material and the maximum mound height attained after a given yearlong disposal cycle. Disposal parameters assumed for the Yaquina included:

- Volume placed = 188,000 cy/year.
- The ODMD Site was partitioned into 190 cells with each cell dimension to 300 feet x 300 feet. For each year of disposal simulation, one load of dredged material was placed randomly about the centroid of each of the 190 cells using a maximum placement radius of 500 feet from the centroid. This disposal scenario simulated uniform distribution of dredged material throughout the placement area of the new ODMD Site. The placement area is shown in Figure B-12.
- Dredges approach the disposal release point from the southwest, south, or southeast for each dump placed.

Results from the simulation are shown in Figures B-12 and B-13 in terms of accumulated placed dredged material. As it may not be possible to prevent accumulation of dredged material to heights

less than 5 feet during a 20-year life cycle, conventional (repetitive-with respect to on disposal location) disposal methods may not be sufficiently dispersive for the successful long-term management of site capacity within the proposed ODMD Site. To avert future site capacity problems at the proposed ODMD Site, it is recommended that a pro-active approach be used to enhance the uniform distribution of dredged material during disposal. This process entails the use of a placement grid to evenly distribute starting point for each dump. This method of dredged material disposal is discussed below.

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

The static capacity of the proposed ODMD Site was assessed for a design 20-year life cycle by conducting 20 back-to-back, year-long disposal operations. The MDFATE model was used for this series of simulations. The contour map shown on Figure B-12 is the 1998 pre-disposal condition of the proposed ODMD Site. The blue line shown on Figure B-12 is the site boundary and the inner red line is the placement (disposal) area.

ODMD Site Drop Zone Setback

To reduce the risk of dredged material being placed outside of the ODMD Site boundaries during disposal, a drop zone with a 500-foot setback was inscribed within the ODMD Site boundary. The setback functions to keep material within the ODMD Site while the placed material is falling through the water column. The setback foreshortens the permissible disposal area by 1,000 feet per side, from 6,300-feet long x 4,000-feet wide to 5,300-feet long x 3,000-feet wide.

ODMD Site Disposal Placement Grid

Uniform thin-layer placement of dredged material is accomplished by using a grid of 190 cells with dimensions of 300 feet by 300 feet to establish the release point for each load of dredged material. The placement grid was contained inside of the ODMD Site placement (disposal) area. The placement grid is used to guide the distribution of dredged material disposal for each year.

Approximately one dump per grid cell was used for the *Yaquina* to place 188,000 cy of dredged material within the site per year. The selection of each simulated dump location was chosen randomly based on 250- to 500-foot radii from the center coordinate for each cell.

Year One of 20-Year Disposal Sequence

The first year of the 20-year static capacity assessment was simulated based on the dredge *Yaquina* performing dredged material disposal within the proposed ODMD Site (see Figure B-12). The placement grid described above was used to control the disposal of 190 loads of dredged material within the proposed ODMD Site boundaries. The resultant dredged material accumulation, after one year of disposal, is shown on Figure B-12. The maximum height of dredged material accumulation is 0.6 feet and all placed dredged material is contained within the ODMD Site boundaries. Due to the low relief of the dredged material mound, waves and currents affected very little material during the first year of simulation.

Figure B-12. Current Bathymetry at the Proposed ODMD Site and Bottom Accumulation after One Year of Dredged Material Disposal

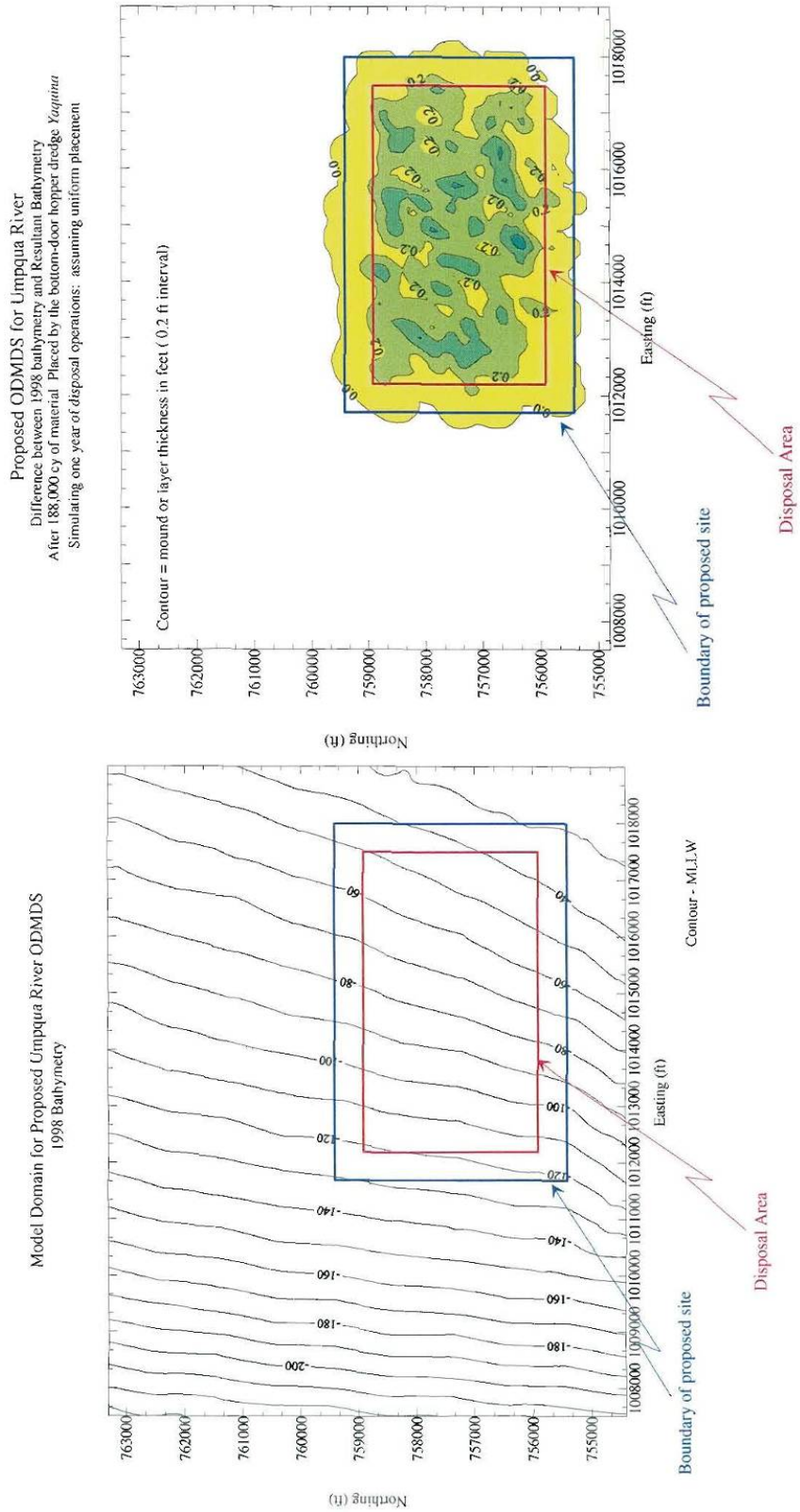
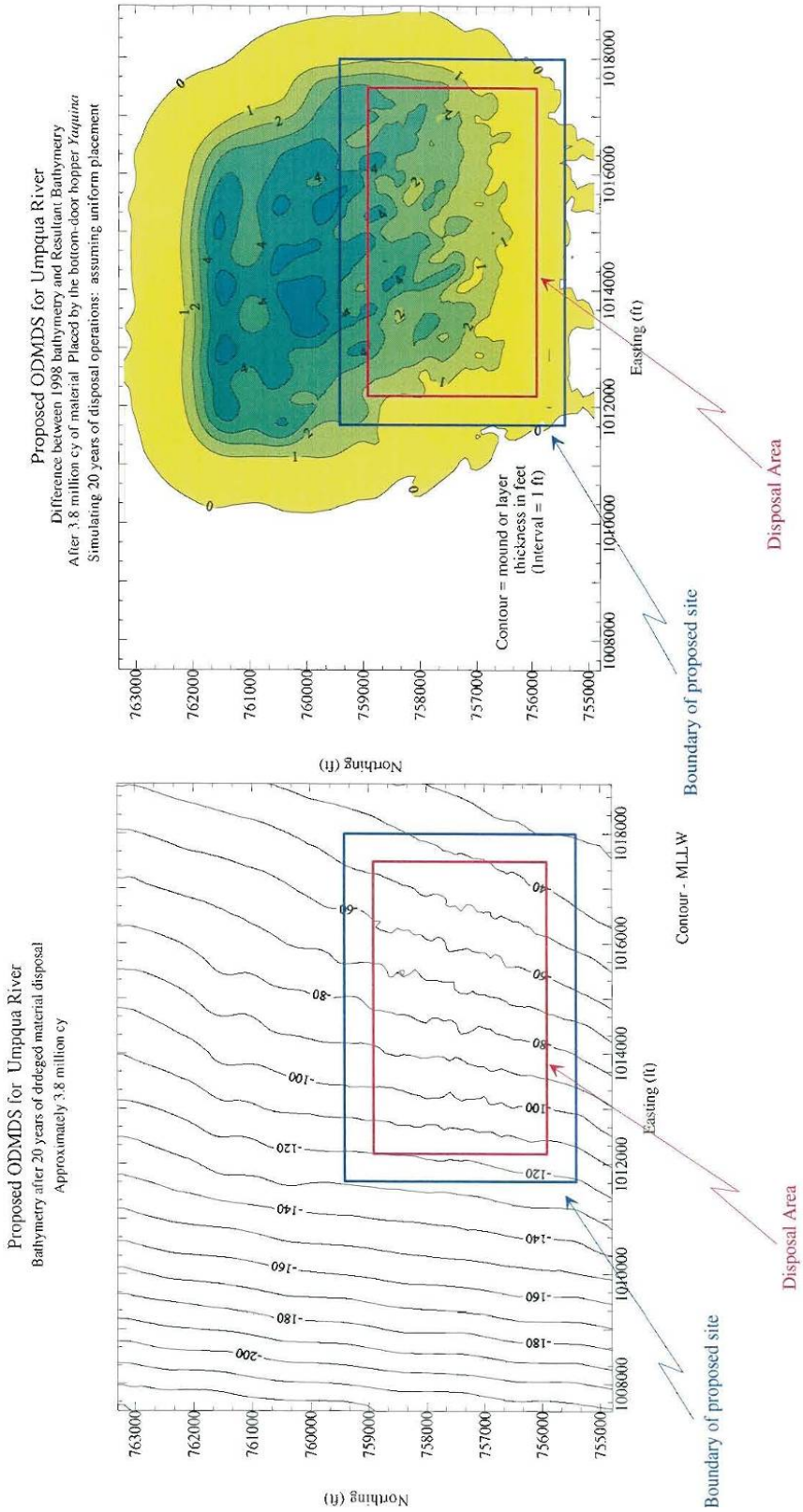


Figure B-13. Predicted Bathymetry at the Proposed ODMD Site after 20 Years of Dredged Material Disposal and Corresponding Dredged Material Bottom Accumulation



Complete 20-year Disposal Sequence

A 20-year period of disposal operations was simulated using MDFATE. For the simulations, about 3.8 million cy of dredged material was dumped using disposal parameters for the *Yaquina*. Results of the 20-year disposal sequence are shown in Figure B-13. The left graphic of the figure shows the predicted 20-year bathymetry within the proposed ODMD Site. The depth contours are displaced northward and seaward from the 1998 pre-disposal condition. The right graphic shows the extent of the dredged material mound resulting from 3.8 million cy of disposal, and was obtained by subtracting the 1998 bathymetry from 20-year bathymetry. Although a few small 5-foot high mounds occur at the northern boundary of the site, the average height of the resultant dredged material mound within the disposal area is about 3 feet. After 20 years of operation, the average height of material within the disposal area is expected to be about 4 feet, or 1-foot lower than the required maximum mound height of 5 feet.

Based on the above long-term simulation results, the proposed ODMD Site is expected to provide sufficient static capacity for a 20-year life-cycle without amplifying waves at the site. The dynamic capacity of the proposed ODMD Site after 20 years of dredged material accumulation is estimated to be 150,000 cy/year. Dynamic capacity is the volume of dredged material eroded off the mound feature per year. The net direction of sediment movement off of the mound is estimated to be toward the north (with periods of onshore and offshore movement) at 250 feet/year. The rate of dispersal of material beyond the site boundaries is 66,000 cy/year for a net loss of material (or 35% of the volume placed) per year.

Summary of Fate Modeling Results

Split-hull hopper dredges such as the *Westport* or *Padre Island* produce a more compact disposal mound on the seabed than do multiple bottom-door hopper dredges (e.g., *Yaquina*) assuming both dredges are of equivalent displacement. For a typical year-long disposal scenario, a split-hull dredge will produce an aggregate disposal mound feature 30% higher than a multiple bottom-door hopper dredge.

The proposed ODMD Site (North Site) shown in Figure B-9 is capable of receiving 188,000 cy/year of dredged material disposal for a period of 20 years (3.8 million cy total) without impacting the present wave climate.

The 20-year capacity of the proposed ODMD Site can only be met if a placement grid method of disposal control is used to evenly distribute dredged material within the site during disposal. The placement grid will consist of 64 cells with dimensions of 500 feet x 500 feet to establish the release point for each load of dredged material.

Net long-term movement of the dredged material placed at the proposed ODMD Site would be toward the north with some onshore and offshore movement. A 500-foot placement area setback should be inscribed within the proposed ODMD Site boundaries to keep material within the site while the placed material is falling through the water column.

SECTION 6: UTILIZATION OF THE PROPOSED NEW ODMD SITES

Two new ocean dredged material disposal sites are recommended, based on the need to achieve an optimal site location (to beneficially manage dredged material as a resource), and prescribed size (to ensure efficient disposal site capacity utilization). The size (offshore and along shore dimensions) of each proposed ODMD Site was selected to accommodate the ability of a hopper dredge (or other dredged material disposal vessel) to manage the prevailing set of waves during the disposal sequence and to avoid point dumping, which leads to rapid mounding of paced dredged material. Two ODMD Sites, featuring an *offshore area* and *a nearshore area*, are needed to balance dredged material placement on each side of the inlet for maintaining the littoral budget while not creating adverse effects of excessive dredged material accumulation in the nearshore. Two ODMD Sites (each located on opposite sides of the inlet), are needed to manage the long term and short term uncertainties of evolving site capacity as affected by the ambient environment and site utilization effects. The following describes specific attributes of each proposed ODMD Site, how each site would be utilized over time, and additional rationale for proposing two ODMD Sites; one site on each side of the Umpqua Coastal inlet.

The physical environment affecting each of the proposed ODMD Site is similar in terms of water depth, waves, currents, morphology, transport of native bottom sediment, and proximity to the Umpqua River inlet. The relative proximity of each proposed site to the inlet is desirable from the standpoint of locating ODMD Sites in an area that exhibits similar environmental effects, as compared to the process dredged material disposal. The energetic nature of the inlet's wave and current environment constantly churns (perturbs) the in-situ bottom sediments through much of each proposed ODMD Site, emulating the process of placing dredged material on the seabed.

Because each proposed ODMD Site is located within a similar environmental setting, each site would be utilized similarly, in context of dredged material placement, to take advantage of specific zonal attributes. Each site would be split into two zones, an *offshore zone* and a *nearshore zone* (demarked by the present pre-disposal "baseline" water depth of each site). The *nearshore zone* of each proposed ODMD Site would extend westward from the eastern-most boundary of each site (approximately -25 ft MLLW), to a seabed elevation of approximately -60 ft MLLW. The *offshore zone* would extend westward from western boundary of the nearshore zone (-60 ft MLLW) to the western boundary of each site (approximately -130 ft MLLW). The 60-ft depth elevation defines the approximate depth limit where fine-medium sand (dredged material) would be routinely transported on an intra-annual basis. Inshore of 60 ft water depth, the environmental forces acting on the seabed (waves and currents) are very energetic. This littoral transport effect is enhanced by the proximity of each site with respect to the Umpqua River inlet: Tidal currents and interaction of jetties with the ambient coastal current regime can significantly increase the transport potential of sediment within the proposed ODMD Sites. The seabed substrate of the nearshore area at Umpqua inlet is composed of sand and small gravel. Sandwaves 1-3 feet high commonly form in response to the vigorous sediment transport environment. Fine grain material (silt and smaller) does not persist inshore of -60 ft MLLW. This area constitutes the littoral zone in the Pacific Northwest. Sediment dredged from the Umpqua River entrance channel (fine-medium sand) and placed inshore of 60-ft water depth would be very similar to the insitu seabed sediment and quickly be re-worked by waves and currents to become part of the active littoral budget. As one moves progressively offshore of the 60-ft depth counter, sand sized sediment is affected progressively less by waves and currents. Offshore of the -80 to -100 ft MLLW contours, the seabed substrate is not considered part of the active intra-annual littoral budget.

The purpose of splitting each site into *a nearshore* and *offshore* zone is to place the dredged material preferentially within each site's nearshore zone when possible. Preferential use of each site's nearshore zone will allow for the re-introduction of dredged sand into the littoral zone north and south of the Umpqua River Inlet to maintain the littoral budget at and adjacent to the inlet, effectively maintaining the nearshore coastal morphology of the area. Maintaining the sediment budget adjacent to the inlet is an important longterm consideration for protecting the Umpqua jetties from destabilizing foundation scour and managing the risk of littoral sediment supply reduction with respect to the present littoral budget and related shoreline change (potential effects associated with not placing any dredged material within the nearshore areas). Having the option to place dredged material in nearshore areas north and south of the Umpqua inlet is required to address the constantly varying direction of littoral transport affecting the inlet and adjacent shorelands.

The direction of littoral transport along the Oregon Coast is generally along shore and bi-directional, on a seasonal basis, as motivated by the by bi-directional nature of the coastal ocean wave environment. In the winter, the direction of the most powerful storm waves can be from the northwest or the southwest, producing significant swings in littoral transport direction between storm events. For northwest waves, the littoral transport direction is motivated along shore toward the south and for southwest waves, the littoral transport is directed alongshore toward the north. The bi-directional aspect of the storm wave environment in the Pacific Northwest can be muted during inter-annual climate shifts such as La Nina, El Nino, and the Pacific Decadal Oscillation. During these regional climate shifts, the littoral transport direction during winter can be sustained in one direction without significant reversal. During the summer, long period swell and locally generated wind seas generally approach the Oregon Coast from the north-northwest, producing a weak but sustained littoral drift toward the south. The net littoral direction (and subsequent long term morphology change) is usually dictated by the winter forcing environment. During times when the littoral budget has shifted preferentially in one direction (ie toward the north) , use of the South Site nearshore area would be curtailed to avoid having placed dredged material be transported northward, back into the inlet's navigation channel. The same would occur for a sustained southern littoral drift regime. The inter-annual shifts would be observable through the observed wave record at Coastal Data Information program (CDIP) and National Data Buoy Center (NDBC) wave buoys. Under some conditions, the prevailing transport of seabed sediment may be in the cross-shore direction (onshore versus offshore). A significant degree of offshore transport may occur during intense winter storms, and can be enhanced by the presence of shore structures such as jetties. Onshore transport can occur at any time, but is persistent during summer conditions when the nearshore wave field is dominated by a low wave height swell. The implications of unexpected episodes of cross shore transport may enhance or diminish the capacity of each proposed ODMD Site to accept additional material. For the above reasons, each ODMD Site would be adaptively managed to account for these and other limiting oceanographic effects; hence the need for two new ODMD Sites.

The nearshore zone of each site would be managed such that the total vertical accumulation of placed dredged material (on the site's seabed), would not exceed a prescribed operational limit with respect to each site's baseline condition. The baseline condition for a given ODMD Site is based on the pre-disposal condition and may be revised throughout the ODMD Site life-cycle as prescribed in the SMMP. The mound height restriction for the nearshore zone of each ODMD Site would be based on the criteria (described in Section 3) to limit wave shoaling associated with dredged material mounding. For a baseline water depth of 40 ft, the total vertical accumulation of placed dredged material (with respect to the site's baseline condition) would be 3-4 ft. In areas where the baseline bathymetry is 60 ft, the limiting mound height would be 5-6 ft. Each ODMD Site would be managed to limit the vertical extent of dredged material accumulation with respect to the baseline bathymetry. The littoral transport of dredged material placed within the *nearshore zone* of each site is expected to mitigate the cumulative effect of mounding. After dredged material is placed within the *nearshore*

zone of an ODMD Site (the material deposits on the seabed and accumulates), the material is expected to be transported by waves and currents out of the site and into the ambient littoral zone. Long term use of the nearshore areas will be based on the capacity of each site to receive additional dredged material, as balanced by the rate of material transport out of the site boundaries. The operational objective of each ODMD Site will be to not exceed the prescribed vertical limits and management protocols for dredged material accumulation.

The *offshore areas* of each proposed ODMD Sites will be managed according to the same general mound restriction protocols as the nearshore sites, with respect to the limiting mound height and water depth criteria described in Section 3. The offshore areas will likely exhibit little transport of placed dredged material resulting in a continuous accumulation of placed dredged material. If designated for dredged material disposal, the bathymetry for each site will be actively monitored to assess site capacity and adaptively develop dredged material disposal plans. This procedure has been used for various EPA-USACE jointly managed ODMD Sites with a high rate of performance. However, because these proposed sites are located near an inlet within a large littoral cell, there is a potential for in situ sediment (adjacent to the sites) to be transported into each site, effectively reducing its capacity to receive additional dredged material. For this reason, it is advantageous to designate both proposed ODMD Sites to mitigate the risk of unexpected site capacity loss within a given site.

Overall utilization of the proposed ODMD Sites would be prescribed by a procedure of site rotation: Each site could be used on an alternating yearly schedule, This would ensure that material placed within the nearshore zone of each site has time be transported out of the site before the site is used again. Annual site rotation would be modified as appropriate, to allow management to adapt to changing site or climate conditions, or for other reasons as determined through site monitoring. For example, it may be advantageous to schedule the use of each ODMD Site on a 2- or 3-year rotational basis.

SECTION 7. MEASURED OCEANOGRAPHIC DATA

Predictions of future ODMD Site capacity requirements are dependent upon the quality of oceanographic data available. Analyses of the fate of dredged material placed in open water can only be reliable if tide, current, and wave data are accurate. Relevant oceanographic data used in this appendix to simulate dredged material disposal at Umpqua River include:

- Bathymetric surveys at existing and proposed ODMD Site locations.
- Physical/textural properties for native seabed sediments at ODMD Sites and dredged materials to be placed at ODMD Sites.
- 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 Umpqua River entrance approach and ODMD Site have been digitally recorded since 1983. Areal coverage of the approach surveys is from the entrance of the Umpqua River to 2 nautical miles (n mi) offshore and 2 n mi north and south of the navigation channel. Surveys were performed irregularly with intervals between them varying from 4 to 7 years. Areal

coverage of each disposal site survey typically extends 500 feet beyond the site's formal boundary, and the frequency of surveys varies from 1 to 7 years. Elevation (z) values for the hydrosurvey data are recorded in feet MLLW, which is -4.15 NGVD at Fort Stevens - 1947 adjustment. The horizontal datum (x,y) is Oregon State Plane, north zone, NAD 27.

Survey Error Assessment

Horizontal control for the surveys is ±3.3 feet (±10 feet 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 feet. The accuracy for vertical data (z), corrected for heave-pitch-roll, at 100-foot water depth is ±1.5 feet. This represents the random error inherent in the depth data for hydrosurveys. In summary, the estimated accuracy statistics for the hydrographic surveys are:

Random error for horizontal points = ±3.3 feet (±10 feet before 1987)
Random error for vertical points = ±1.5 feet

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

Sediments at Umpqua River ODMD Sites

The material that is dredged from the channel entrance closely resembles the ambient seafloor sediments in the vicinity of the ODMD Sites. The average grain size (D50) of the seafloor sediment samples was 0.25 mm (Corps 1989).

Dredged Sediment Characteristics

The type of the sediment dredged from the Umpqua River navigation project depends on the location. The majority of dredged materials historically placed at the ODMD Site have been poorly graded sand (SP sand, ASTM D 2487) with an average grain size of 0.2 to 0.3 mm. A small amount of finer-grained material is dredged from Winchester Bay and is placed in the ODMD Site.

Based on an analysis of sediments from the channel entrance, the material is of uniform grain size and contains very little silts and clays (less than 2%). This sediment is composed of fine to medium sand having a mean grain size of 0.22 mm. The sediment is also low in organic content as measured by volatile solids varying from 0.4% to 0.8% (Corps 1989).

Physical Properties of Dredged Material Placed at ODMD Sites

The specific gravity of the material dredged from the Umpqua River entrance channel is estimated to be 2.70 and the resuspended density is 1,850 g/l. The resulting resuspended void ratio (e_{ss}) for fine-sand dredged from the entrance channel was calculated to be 1.03 using a volumetric method presented below:

$V_t = V_s + V_v$, assume $V_t = 1.0$ unit

where V_v = volume of voids in sample

$V_s = 1 V_v V_s$ = volume of solids (sediment constituent) in sample

V_t = total unit volume of sediment in sample

Relating volume (V) to mass (M),

$M_t = M_s + M_v$, M_v is due to entrained water $= \rho_v \times V_v$

$\rho_t V_t = \rho_s V_s + \rho_v V_v$ $\rho_t = \rho_{ss} = 1850\ g/l$

$\rho_t = \rho_s V_s + \rho_v V_v$ $\rho_v = 1024\ g/l$, $\rho_s = 2700\ g/l$ ($S.G = 2.70$)

$\rho_t / \rho_s = (1 - V_v) + \rho_v V_v / \rho_s$ $= S.G. \times 1{,}000\ g/l$

$0.6852 = (1 - V_v) + 0.3793 \times V_v$

$V_v = 0.5072$

$V_s = 1.0 - 0.5072 = 0.4928$

$e_{ss} = V_v / V_s$

$e_{ss} = 1.03$

The in situ void ratio for loose to dense uniform dry sand typically ranges from 0.85 to 0.51. The higher value calculated for Umpqua River sediments (1.03) is due to the sediment being resuspended in a subaqueous environment.

Dredged Material Solids Content and Void Ratio

Normally material that is dredged hydraulically has a low solids content. The concentration of solids for hydraulically dredged sediments (Cs, by volume) varies from 0.18 to 0.35. Because hydraulic dredges are used to remove channel sediments from the Umpqua River entrance, the solids content for each load of dredged material placed at the ODMD Site is likely less than 0.35. However, the operating practice of overflow dredging is used at Umpqua. This method allows for water to be drained out of the hopper bins as dredged sediment is pumped in. Overflow dredging can substantially increase the solids content of each load of dredged material placed at an ODMD Site. The concentration of solids for sand in the hopper dredges operating at Umpqua is assumed to be the same as for the resuspended sediment tests (ρss = 1,850 g/l and e_{ss} = 1.03) and was calculated by:

C_s in dredge $= V_s$ in dredge$/V_t$ in dredge $=$ concentration of solids by volume in the hopper dredge

$e_{ss} = V_v/V_s = 1.03$, V_v in dredge $= V_s$ in dredge $\times$ 1.03

e_{ss} = resuspended void ratio

e_{insitu} = insitu void ratio at site of dredging in channel

$= (0.85 + 0.51)/2 = 0.68$ (assumed value based on typical range)

in a volumetric analysis, $V_t = V_s + V_v$ assume $V_t = 1.0$ units

$V_t = V_v$ in dredge $+ V_s$ in dredge

$= 1.03 \times V_s$ in dredge $+ V_s$ in dredge

$= V_s$ in dredge $\times (1 + 1.03)$

since $V_t = 1.0$, V_s in dredge $= 1.0/(1 + 1.03) = .493$

C_s in dredge $= V_s$ in dredge $/V_t = 0.493/1.0 = 0.493$ similarly, $C_{s(insitu)} = 0.595$ ($e_{insitu} = 0.68$)

Usually the volume of sediment placed at an ODMD Site is different from the volume of sediment removed from the site of dredging. The difference between volume removed and volume placed is related to the following conditions: (1) the in situ void ratio of the sediment before dredging, 0.51 to 0.85; (2) the resuspended void ratio of the dredged sediment after being placed into the disposal vessel, 1.03 in this case; and (3) the depositional void ratio of the dredged sediment after placement at an ODMD Site. The change in specific volume of dredged material from the dredging site to the disposal is commonly referred to as a bulking factor. The bulking factor for dredged sediments placed at the Umpqua ODMD Site can be calculated by noting the relationship between the volume of sediment removed from the channel (V in situ), the volume of dredged material in the disposal vessel (V in dredge), and volume deposited on the seabed (Vd).

The depositional void ratio for dredged material placed on the seabed (ed) for sand-based dredged material placed at the ODMD Sites was assumed to be equivalent to the resuspended case (ed = e_{ss}).

$Vt_{ss} = C_{s(insitu)} \times V_t$ (insitu) $(1 + e_{ss}) = V_t$ (in dredge)

V_t (in dredge) $= C_{s(in\ dredge)} \times V_t$ in dredge $(1 + e_d)$

$= C_{s(insitu)} \times C_s$ (in dredge) $\times V_t$ (insitu) $\times (1 + e_d) = (0.595)(0.493)\ V_t$ (insitu)$(1+1.03)^2$

$= 1.209 \times V_t$ (insitu)

where, e_d = depositional void ratio

Bulking Factor from dredging site to disposal vessel = 1.209

Bulking Factor from disposal vessel to disposal site = 1.000, or $V_{seabed} = V_{disposal}$

The volume of dredged material hauled to the ODMD Site 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 (V disposal). This variable is not equivalent to the undisturbed volume of in situ sediment (V in situ). The volume recorded in dredge logs is equal to the volume of material placed on the seabed at the ODMD Site. Therefore, the dredging volume statistics presented in Table B-1 are actual volumes of dredged material placed at the ODMD Site.

Subaqueous Angle of Repose – Slope Failure of Dredged Sediments

As dredged sediments are continually placed within a specific open-water area, the material accumulates laterally and vertically. Geometrically the extent to which material accumulates is limited by the steepest angle the material can attain before gravity and other forces cause the material to collapse or slump and redistribute downslope. The slumped sediment comes to rest when some equilibrium angle is reached. The limiting angle of repose (shearing angle, ϕs) for subaqueous dredged sediments is steepest angle the material can attain before slope failure occurs. The post-sheared angle (ϕps) defines the slope of the dredged material after is has come to rest (Allen 1970, Larson and Krause 1989). Thus, the areal and vertical configuration of aggregate mounds at an ODMD Site is controlled by the shearing angle and post-sheared angle of the dredged material.

Depending on the type of material and the environment where material is placed, slope failure angles can vary considerably. The angle of repose for dry loose sand is 26°-30° from a horizontal reference plane (Hough 1957). Reported values for the subaqueous angle of repose or shearing angle for sand placed on the seabed range from 1.8°- 8° (Corps 1995, Johnson and Fong 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°.

At the Umpqua ODMD Site, the angle at which sandy dredged material begins to fail or its shearing angle, ϕs) is estimated to 1.5° ($\tan \phi = \Delta z/\Delta x = \Delta z/\Delta y$). This value is based upon the assessment of recent bathymetric surveys of the dredged material mound at the Section 103 ODMD Site. The angle at which avalanching stops (post-sheared angle, ϕps) once it has begun is estimated to be 1.4°. These values will define the steepness at which dredged material is permitted to accumulate during the MDFATE simulation.

Summary of Umpqua Dredged Material Parameters

The following dredged material parameters will be used in the Dredging Research Program FATE models when simulation activities are pursued in later phases of this investigation:

Dredged material type = fine to medium poorly-graded sand, USC Classification - SP
D75 (material dredged from channel) = 0.35 mm
D25 (material dredged from channel) = 0.18 mm
Fines content (D<0.0625 mm) = 2 % (silt)
S.G. of dredged material solids = 2.70
Cs (disposal) = concentration of solids by volume in the disposal vessel = 0.493
ed = depositional void ratio = 1.03
ϕs = subaqueous shearing angle = 1.5°, ϕps = subaqueous post-shearing angle = 1.4°

Surface Waves - Simulated Data

A synthetic time series for the annualized wave environment offshore of Umpqua River was generated using HPDSIM, a PC-program developed under the Dredging Research Program (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 that 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 39 - Phase II database (Corson et al., 1987). Station 39 is located 30 miles

offshore from the mouth of the Umpqua River. The summary statistics for Station 39 are shown below.

Mean WIS Parameters

Water depth at WIS II-39 = 1800 feet
H1/3 = average annual significant wave height = 10.8 feet
σH = annual standard deviation of H1/3 = 4.9 feet
Ts = wave period (associated with H1/3) = 10.9 second
σH = annual standard deviation of Ts = 2.4 second
Most frequent wave direction band = 292.5°(T)
Wave direction for largest wave height = 216°(T)

An example of the simulated wave environment for wave height (H1/3) and wave period (Ts) for a 1-year duration (time = 0 corresponds to January 1) is shown in Figure B-14. The waves are more severe during the late fall, winter, and early spring than during other times of the year. The maximum and minimum significant wave heights (H1/3) from the synthetic wave field were about 29 feet and 2 feet.

Based on favorable comparisons of synthetically generated wave data (WIS) and observed wave data for other locations on the Oregon Coast (Corps 1995), the WIS data were considered adequate for simulating the wave environment at Umpqua River and for use as input for sediment fate modeling.

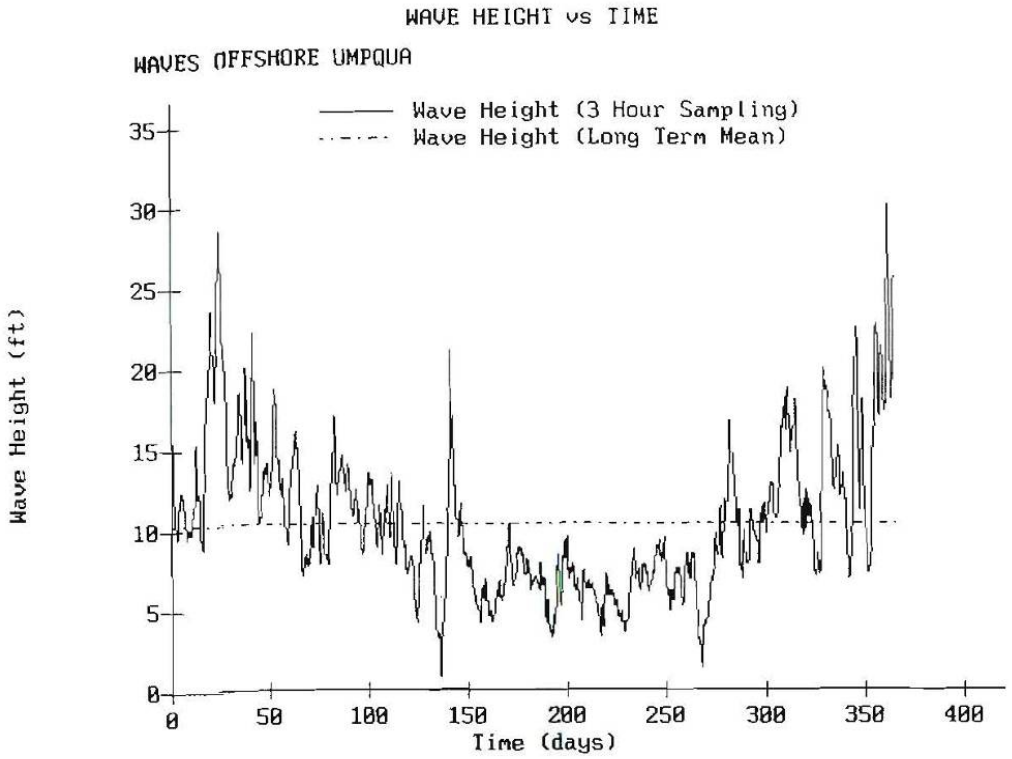
Wave Energy

With the increased interest in alternative energy sources, various wave energy projects have been proposed off the Oregon Coast. In a November 2007 news release to the Oregon fishing industry, the Governor of Oregon stated that he was asking the Federal Energy Regulation Commission to limit the permitting of wave energy to 5-7 sites. These projects will involve numerous generating buoys moored offshore with transmission lines running to shore distribution facilities. At present all proposed projects are north of Cape Blanco. The closest if permitted would be located offshore of Bandon, Oregon. No wave energy projects are currently proposed off the Umpqua River.

Simulated Shelf Tidal Elevations and Currents

The shelf tidal environment at the Umpqua River ODMD Site was simulated using the five primary tidal constituents generated from the ADCIRC-derived database for the eastern north Pacific Coast (Hench et al., 1994; Luettich 1995). ADCIRC (Advanced CIRCulation) is a two-dimensional finite-element model developed that simulates tidal circulation along shelves and coasts. The time series shown in the top of Figure B-15 represents a simulated equilibrium shelf tide 5 miles offshore of the Umpqua River for 2 months. 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 B-15 is 10 to 11 feet, which agrees with the observed range for the Umpqua River entrance bar. The phasing of the simulated tidal cycle also compared favorably with observed tidal data measurements.

Figure B-14. Wave Environment Offshore of Umpqua Simulated from WIS II Data



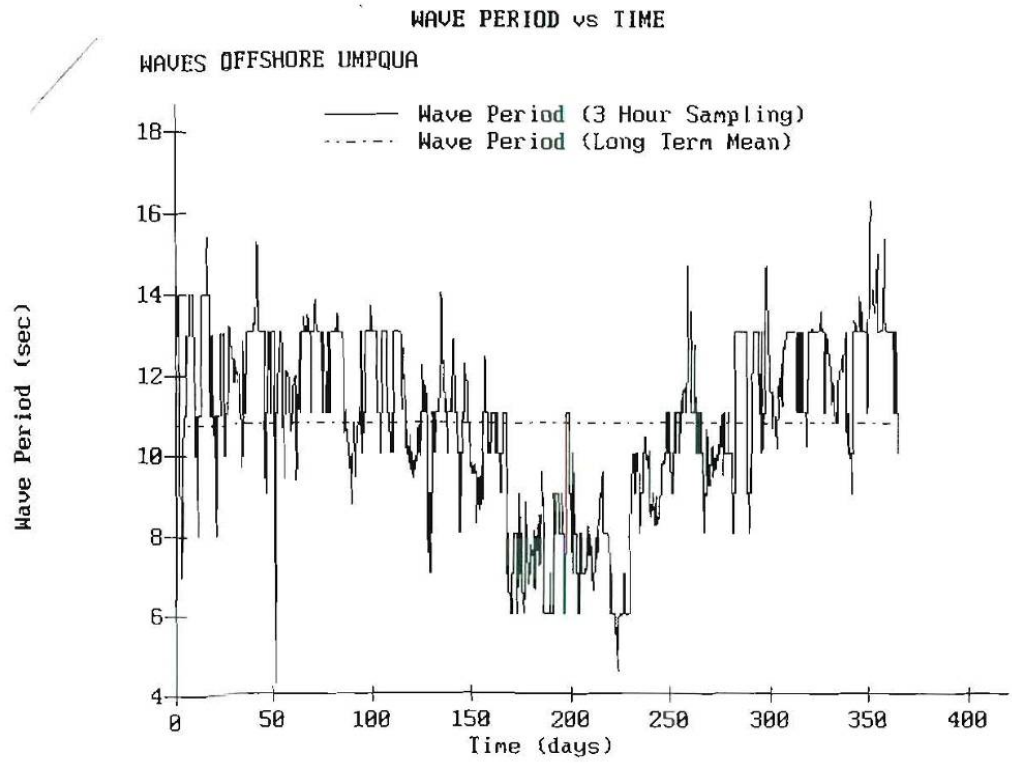
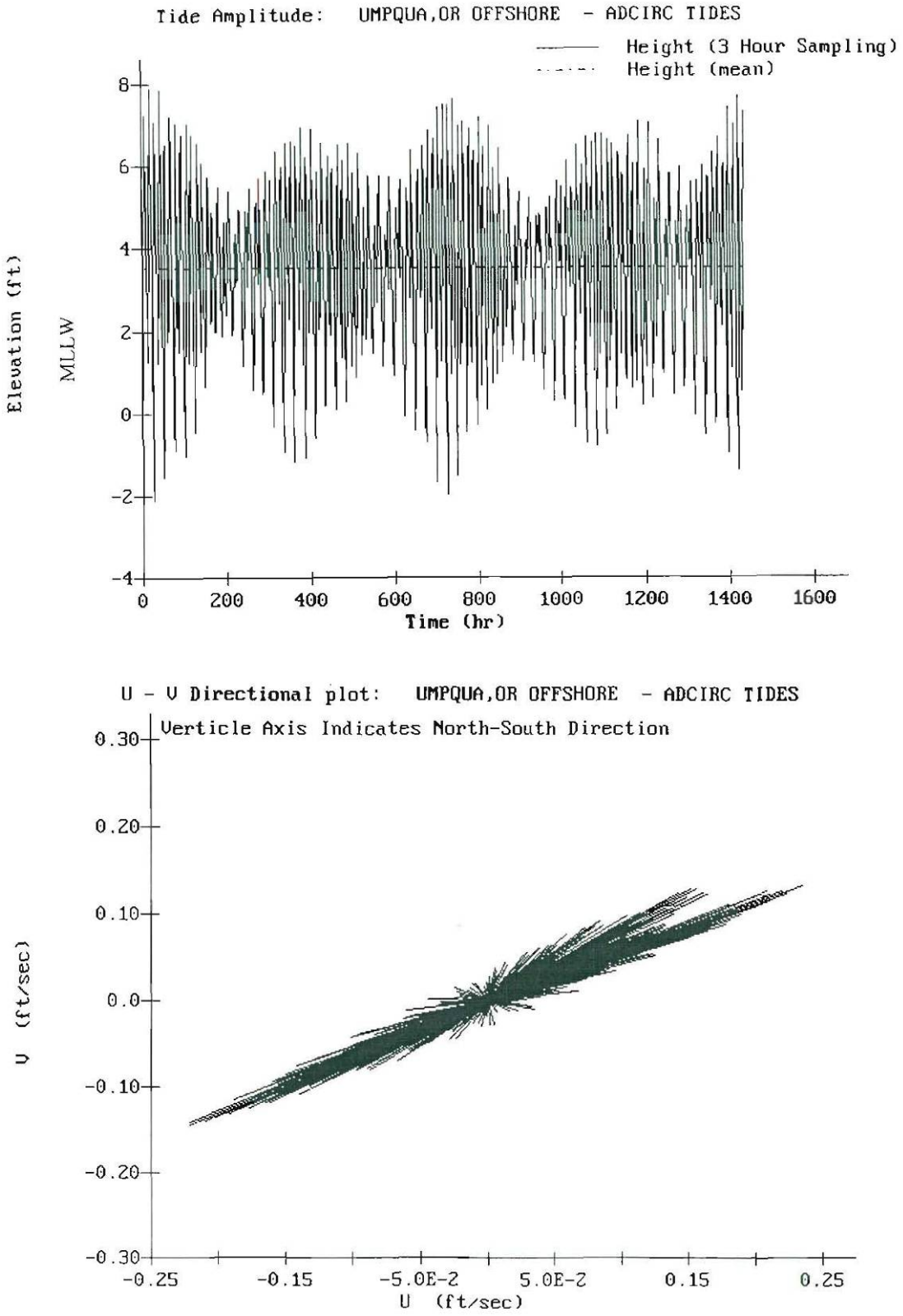


Figure B-14. ADCIRC-Simulated Tidal Elevation and Current at Umpqua ODMD Sites



Depth-averaged tidal currents (U,V) applicable for the Umpqua bar are shown in the bottom of Figure B-15 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 Umpqua River estuary is not included in the ADCIRC generated tidal current.

Based on favorable comparisons of synthetically-generated shelf tidal data (ADCIRC) and observed tidal data for other locations on the Oregon Coast (Corps 1995), the ADCIRC data were considered adequate for simulating the wave environment at Umpqua River and for use as input for sediment fate modeling.

Measured Currents Applicable for Umpqua River ODMD Sites

Currents significantly affect the short-term fate and completely control the long-term fate of dredged material. For inner-shelf waters (depths <120 feet), the residual current regime is influenced by wind-stress, waves, tidal, and estuarine processes. The term "residual" refers to a gross parameter that is the result of averaging current direction and velocity over many days, or months, or years. Short-term variations in current – changes measured in hours or a few days – are not accounted for in the gross parameter. A residual currents describes the net direction and speed of flow for a given location during a given time interval and does not include shelf tidal currents, storm-induced currents, and other episodic events.

Bottom Currents at the ODMD Sites

Current meters were deployed near the Umpqua ODMD Site in 1985 and 1986. The meters were attached to anchors at depth of 78 to 95 feet. Bottom currents were obtained for the periods from April 12 to May 9 and from July 11 to August 14 in 1985, and from July 11 to August 14 and March 27 to May 5 in 1986. The current roses presented in the 1989 Corps' report are used to generate the direction and magnitude of the residual bottom current at the Umpqua disposal sites (Corps 1989).

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 from 1959 to 1963 (Burt and Wyatt 1964). The inferred surface currents are summarized below.

November – February: Vreef = 0.82 feet/second @ 0° (T)
March – October: Vreef = 0.82 feet/second @ 180° (T)

Geostrophic Currents

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

June – September: VG70 = 0.6 feet/second @ 187° (T) water depth = 70 feet
VG150 = 0.2 feet/second @ 202° (T) water depth = 150 feet
VG200 = 0.2 feet/second @ 63° (T) water depth = 150 feet

Currents Observed at a Similar Nearshore Location – Coos Bay

Detailed current measurements have been obtained from other similarly situated Oregon nearshore ODMD Sites. The most thorough study was conducted at Coos Bay, Oregon (Sollitt et al., 1984). The entrance to the Umpqua River is 22 n mi north of Coos Bay. Seasonal measurements were made over two-week periods are summarized below.

November – March: VCoos = 0.75 feet/second @ 30° (T)
April – July: VCoos = 0.75 feet/second @ 210° (T)
August – October: VCoos = 0.50 feet/second @ 205° (T)

Calculation of Residual Current for Umpqua River ODMD Sites

To consistently represent the residual current at Umpqua River ODMD Sites, an annualized residual current was developed based on a two-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. The annualized residual current, applicable for locations within the 1.5-mile ZSF for water depths at 100 feet, is described below.

May – October: Vresidual = 0.45 feet/second @ 192° (T)
November – April: Vresidual = 1.1 feet/second @ 298° (T)

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

SECTION 8. GEOLOGICAL RESOURCES

Regional Setting

The estuary of the Umpqua River opens into the Pacific Ocean about 180 miles south of the mouth of the Columbia River. It lies within the Heceta Head littoral cell, which extends for 90 kilometers (km) from Heceta Head south to Cape Arago. Figure B-16 shows the location of the Umpqua littoral cell. The estuary is fed by two rivers, the Umpqua, and the smaller Smith. The watershed encompasses part of the Coast Range, with the Umpqua River extending into the Cascades. The coastal zone of the littoral cell consists of a 1- to 2-mile-wide plain covered by active and stabilized sand dunes backed by the mature upland topography of the Coast Range. The lower portion of the Umpqua River is bordered by broad alluvial flats. The continental shelf off the mouth of the Umpqua is about 30 km wide. Just to the north it bulges outward forming the Heceta Bank. Between Siuslaw and Yaquina the shelf is at its widest, extending over 70 km offshore. Sand covers the shelf at the Umpqua for about 3 km out from the shore. From there a thin layer of mud (1-3 centimeters thick) mantles the surface (Kulm 1977).

The Heceta Head littoral cell is the largest on the Oregon Coast. Except for the headlands at both ends of the cell, the entire coast line is made of beach fronting sand dunes. Three major river systems enter the cell. From north to south these are the Siuslaw, the Umpqua, which is the largest of the three, and Coos River.

Regional Geology

The Heceta Head littoral cell and the larger part of the Umpqua River are in the southern portion of the Coast Range. The rocks of the Coast Range are marine and deltaic sediments, and volcanic rocks, mostly from the earlier half of the Cenozoic. During the Eocene the area was part of a large embayment of the ocean with a volcanic island arc to the west. The sea gradually withdrew to the west and north, so by the end of the Oligocene the southern portion was emergent. In the Miocene uplift began that transformed the area into the mountains present today. Figure B-17 shows the coastal geology near the Umpqua River.

During the Pliocene and Pleistocene periodic ice ages and warmer interglacial periods caused major fluctuations in the sea level. Terraces were cut that, in conjunction with tectonic uplift, are now raised above sea level. Low stand of sea level allowed streams to cut below today's sea level. With the sea level rise that came with the end of the last glaciation, these valleys were drowned and formed large estuaries, including the Umpqua. Along the coast of the Heceta Head littoral cell, the Flournoy Formation was eroded into a low coastal plain. The combination of favorable terrain and ample sediment supply allowed extensive dune fields to form (Coos Bay dune sheet). The sheet had its origin at the end of the last ice age. Its advance and growth is associated with the subsequent period of submergence (Cooper 1958, Lund 1973).

Figure B-16. Umpqua Littoral Cell Location

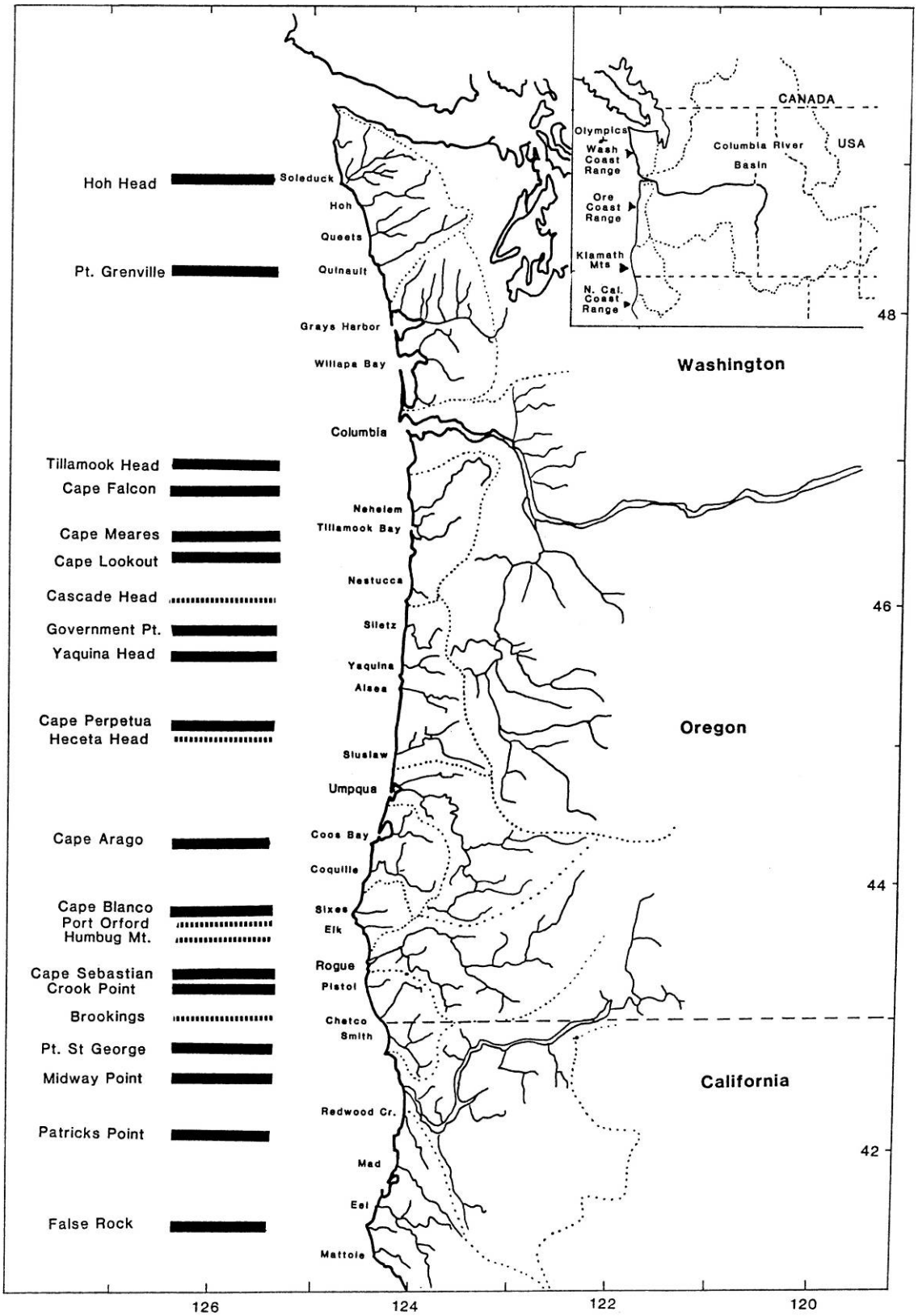
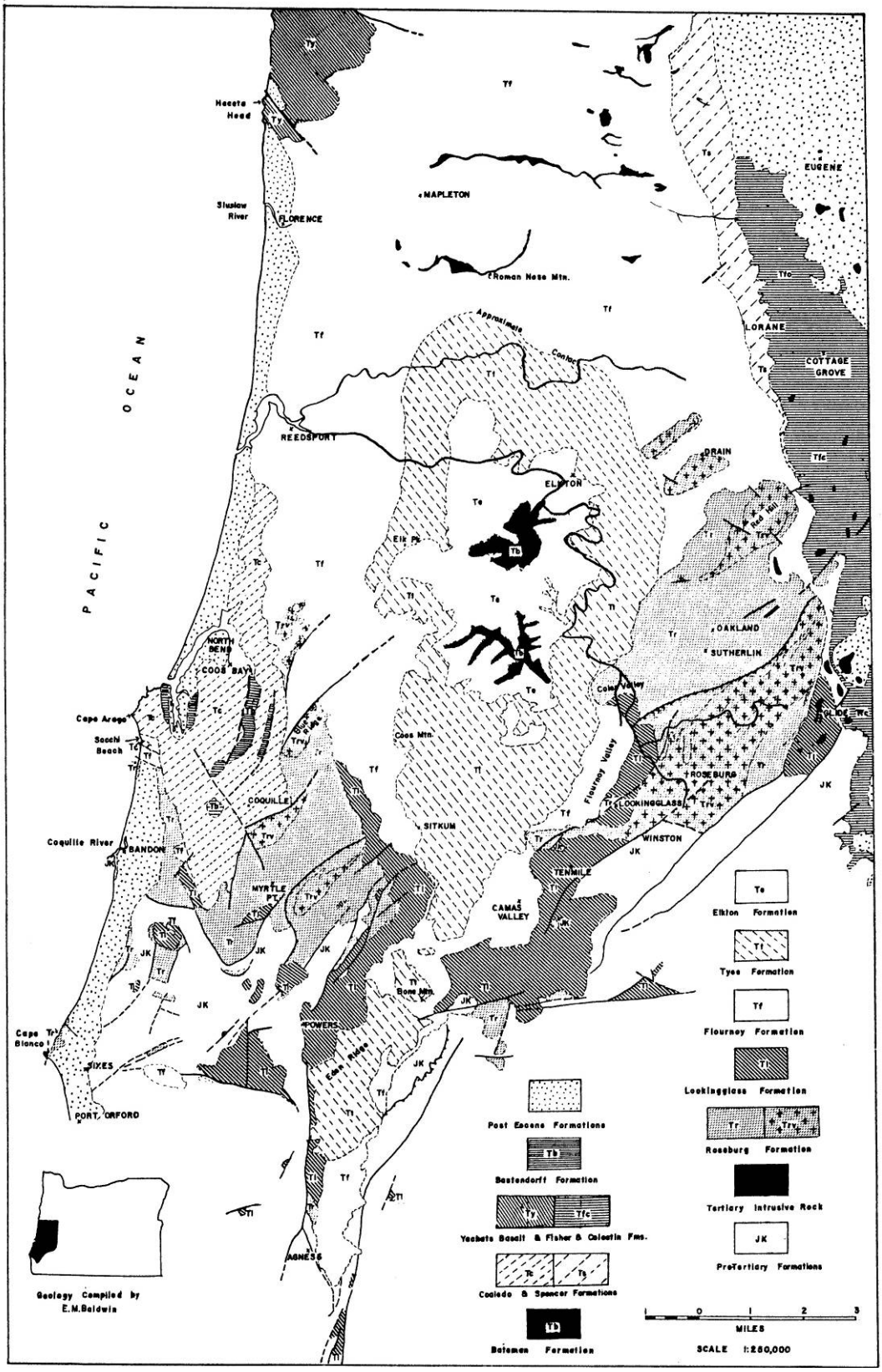


Figure B-17. Coastal Geology near the Umpqua River



The Umpqua River rises in the Cascade Range and the upper reaches pass through Mesozoic rocks of the northwest corner of the Klamath Mountains. For the most part it flows through Eocene formations of the Coast Range. The most important of these are the Roseburg formation to the east, the Flournoy Formation, the Tyee Formation, and the Elkton Formation. The Roseburg Formation was deposited in the early Eocene, and folded and thrust by subduction at the end of the Eocene. It consists of volcanics and interbedded sediments. The Flournoy Formation is probably middle Eocene in age, and is primarily composed of rhythmically bedded sandstone with thin layers of siltstone. The Tyee Formation, of late middle Eocene age, unconformably overlies the Flournoy. It is made of rhythmic graded bedding with micaceous sand grading upward into siltstone. The Elkton Formation is also from the late middle Eocene, though younger than the Tyee. It consists of siltstone with minor amounts of sandstone (Baldwin and Beaulieu 1973, Baldwin 1981).

Economic Geology

There are no accumulations of heavy minerals or gravel along the coast in the vicinity of the mouth of the Umpqua River. While there have been exploratory oil and gas wells bored both to the north and south on the continental shelf, as well as inland of the entrance of the Umpqua, no significant quantities of oil and gas has been found (Gray and Kulm 1985).

Sediments

The Umpqua River is the major source for sediment in the littoral cell. It is fed by the Umpqua and Smith rivers, with a combined drainage basin of 5,042 square miles. Mean monthly discharge is highest in January at about 18,000 cubic feet per second (cfs) and lowest in September at about 1,200 cfs. Mean annual discharge is about 8,200 cfs, which gives a 6 hour mean discharge of 1.77×10^8 cf. The estuary of the Umpqua River covers 6,430 acres. The diurnal tidal prism is 16×10^8 cf, which divided by the 6-hour discharge gives a hydrographic ratio of 9. This means that the estuary is fluvially dominated and that a large portion of the fluvial sediments will be transported out the mouth and into the sea. The Siuslaw River estuary has a hydrographic ratio of 6, so it too is fluvially dominated and should be a contributor of sediment to the cell. Coos Bay has a hydrographic ratio of 20, making it tidally dominated and a net sediment trap.

Coastal erosion does not seem to be a significant source of sediment for the Heceta Head littoral cell. The coastline of the cell is generally stable. Only at Cape Arago and Heceta Head are there slowly retreating cliffs (Corps 1971, Stembridge 1976). The extensive sand dune fields along the coast constitute a large sediment sink. Sand is transported off the beach by wind and deposited on the dunes; ironically however, the stabilization of sand dunes by vegetation may leave them vulnerable to undercutting by waves (USDA 1975). Still, the coast of the Heceta Head cell must be considered a net sediment sink. Rates and quantities of the material involved in either erosion or migration onto the land are not available.

Within the Heceta Head littoral cell there are three offshore dredge disposal projects. These are Coos Bay, which involves the largest quantities, Umpqua, and Siuslaw. The type of material contributed by dredging depends on both the location and hydrologic conditions. Dredging during or just after high flows is more likely to pick up fluvial sediments than dredging done during periods of low flow, when marine sediments have intruded into the mouth. By the same token the further upstream dredging is done the more likely it is that fluvial sediments will be encountered. Judging by the size of the material dredged from the Umpqua River, it seems that it is primarily fluvial in origin. Because the Umpqua is fluvially dominated, most of the Umpqua's sediment load should

eventually be carried out into the ocean. This means that the net contribution of dredging to the sediment budget is much smaller than the amount naturally carried offshore.

In determining the importance of the various potential sources the mineral assemblages of the sediments and the sources can be useful. The Heceta Head littoral cell is differentiated from the neighboring cells by its orthopyroxene to clinopyroxene ratio of about 1:1. Of the rivers entering the cell, only the Umpqua has a similar ratio, indicating that it is the major source of sediment for the cell. A slight increase in the ratio around the mouth of the Siuslaw River shows that it contributes minor amounts of material. Coos bay, in contrast, seems to be a sediment sink, trapping marine sands as well as fluvial sediments (Chesser and Peterson 1987).

Conditions in the ZSF

Bedrock is not exposed within the Umpqua River study area. However, the geologic map of the Reedsport Quadrangle (Beaulieu and Hughes 1975) indicates that the study area is underlain by the Flournoy Formation of middle Eocene age, which consists of rhythmically bedded hard sandstone and siltstone. The sub-bottom profiles indicate these layers dip to the west beneath the study area. No faults have been mapped or projected into the study area from onshore mapping. Clarke and others (1981) recognized three acoustic units separated by unconformities in seismic reflection profiles across the continental shelf of Oregon. They are, in order of increasing age, Pleistocene deposits (Unit l), late Miocene to late Pliocene (Unit 2), and Eocene to middle Miocene (Unit 3). The offshore mapping of Clarke and others (1981) extends to within 3 miles of the ZSF. By extrapolation, it appears that Unit 1 overlies Unit 3 in the study area. A breached anticline trending N12W can be projected into the western edge of the study area. No faults identified in either onshore or offshore mapping are projected into the ZSF (from Corps 1986).

The ocean bed in the vicinity of the Umpqua ZSF is characterized by a bulging outward of the bathymetric contours in front of the mouth of the Umpqua River, and an otherwise featureless slope that increases from the north to the south. A mile and a half north of the Umpqua's mouth the average slope is about 75 feet/mile between the 24 feet and 156 feet contours. Two miles south of the entrance the slope has increased to about 90 feet/mile. The slope also shows a general increase with distance offshore. The bulge in front of the mouth is evident to a depth of 130 feet, after which the contours are straight.

Figure B-18 shows the results of the 1984 sidescan sonar survey of the Umpqua ZSF. The area surveyed by sidescan sonar is primarily fine sand. Sand waves were observed extending from a couple of thousand feet north of the Umpqua's mouth to about a mile south, and to a depth of about 48 feet. A thin band of what is interpreted as "coarse sand/or gravel" is found both north and south of the mouth. No samples have been taken from these bands to confirm the interpretation, and the band may instead be sand dollar beds. Abundant sand dollar beds were identified in the 2007 benthic survey.

Figure B-19 shows two seismic profiles which cross the study area from ENE to WSW, essentially parallel with the slope. The layer of unconsolidated sediment is quite thick, varying between 120 to over 150 feet thick. About halfway down to bedrock there is an intermediate reflector. This layer may represent a temporary change in the depositional environment, a thin layer of denser material such as ash, or over consolidation of sediments by desiccation during a low stand of sea level. The bedrock surface is fairly irregular.

Figure B-18. 1984 Sidescan Sonar Survey of the Umpqua ZSF

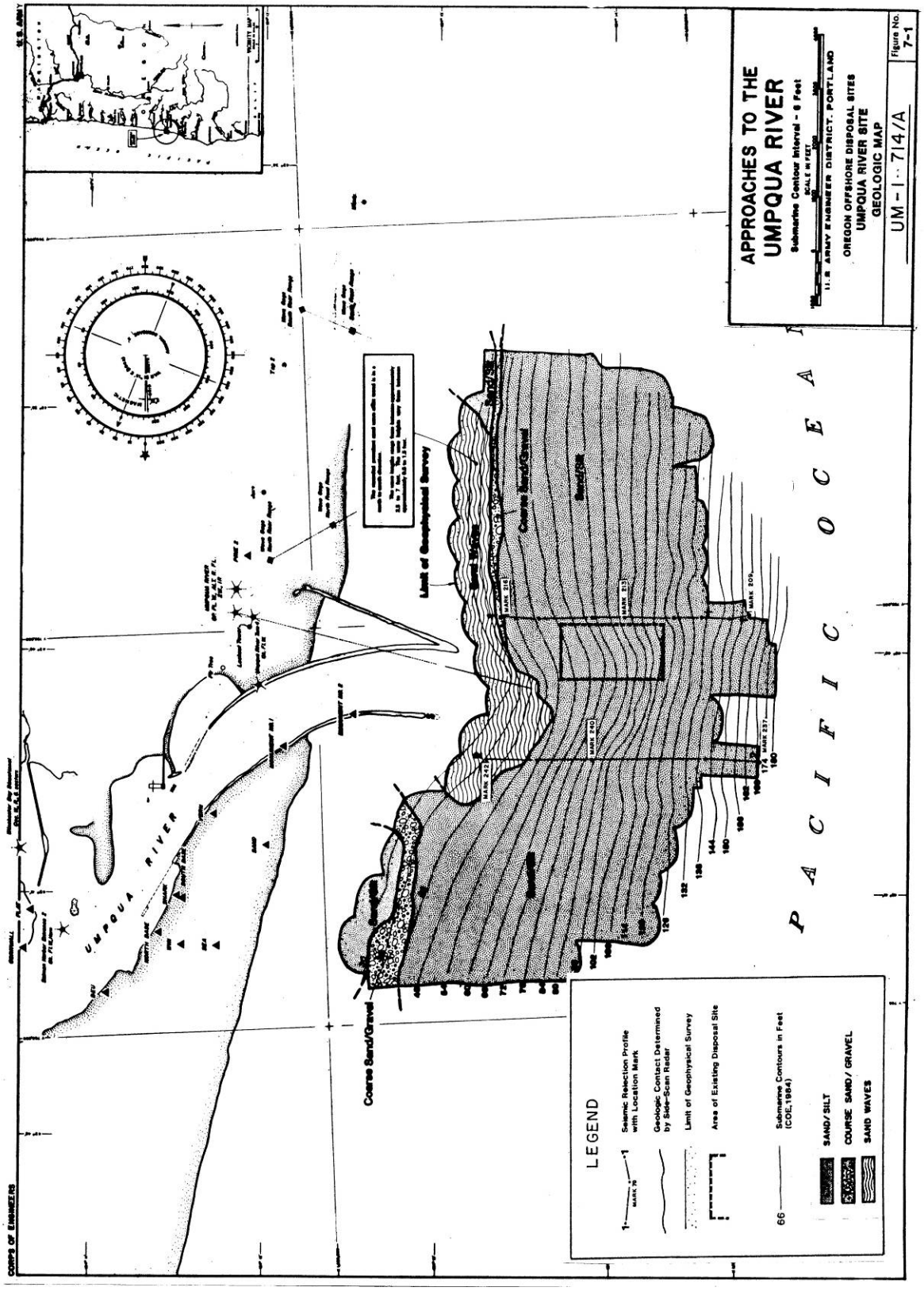
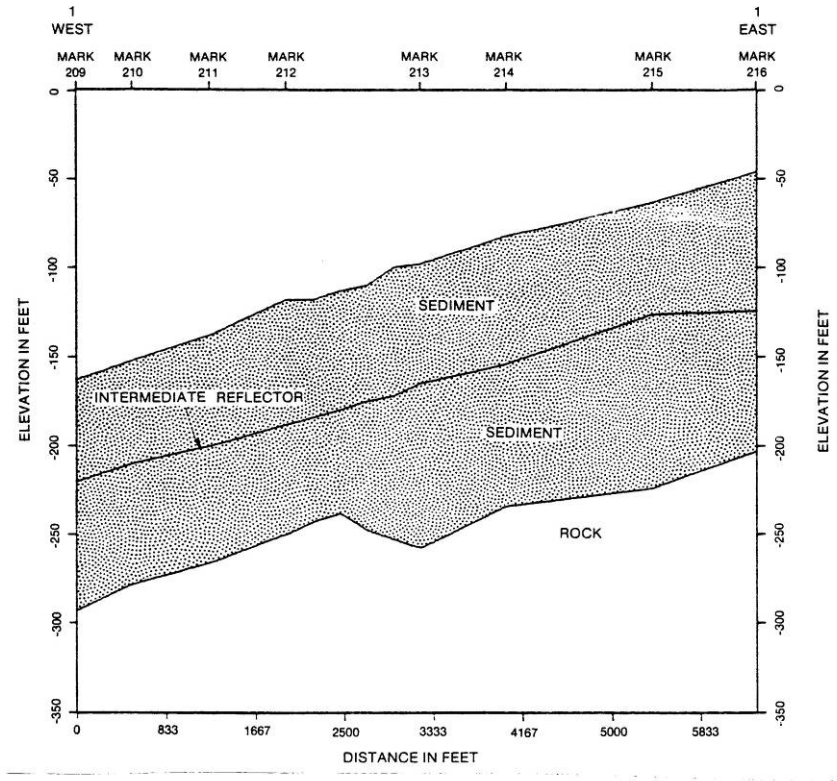
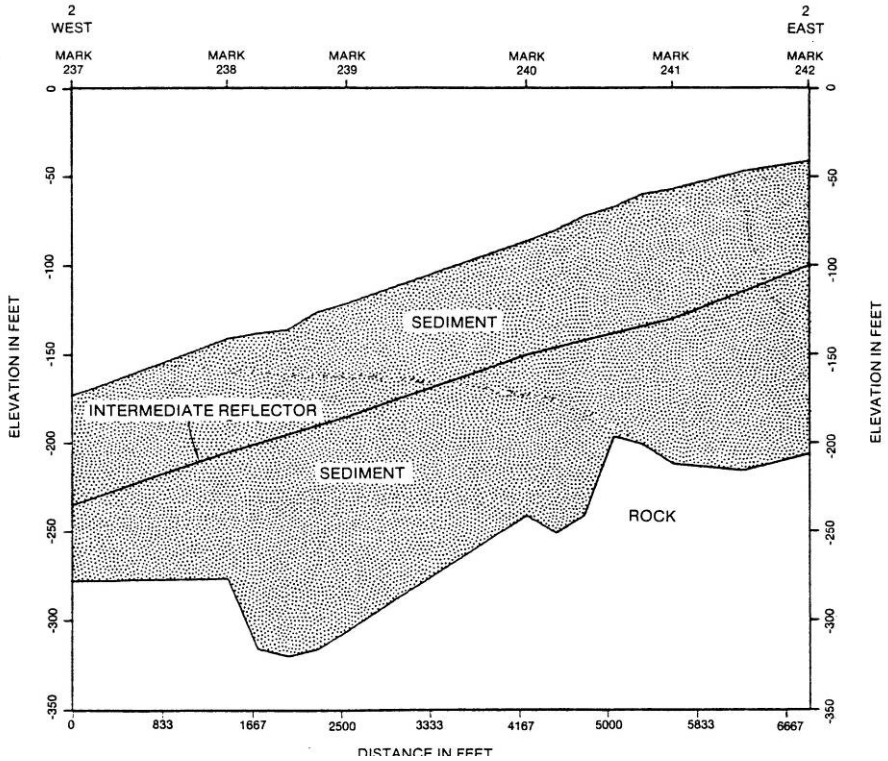


Figure B-19. Two Seismic Profiles Which Cross the Study Area from ENE to WSW





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Appendix C

Sediment and Water Quality
Umpqua River, Oregon

April 2009

Appendix C
Sediment and Water Quality
Umpqua River, Oregon

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Appendix C
Sediment and Water Quality
Umpqua River, Oregon

General

Two ocean dredged material disposal (ODMD) sites have been used by the U.S. Army Corps of Engineers' (Corps) Portland District for disposal of sediments dredged from the Umpqua River navigation project. Prior to 1991, only the Interim (1977) ODMD Site or the area in the immediate vicinity was used for disposal of dredged material. In 1991 the Corps, under its Section 103 authority, selected an alternate disposal site (Section 103 ODMD Site) that was used in place of the Interim ODMD Site. Currently two new ODMD Sites are being considered for designation and are located north and south of the Section 103 ODMD Site (proposed North and South ODMD Sites). This latest action is intended to reduce potential hazards associated with mounding and to increase long-term disposal site capacity.

The Marine Protection, Research and Sanctuaries Act (MPRSA) requires that 5 general criteria and 11 specific factors be addressed during the designation process (40 CFR 228.5 and 228.6). General criterion (b) and specific factors 4, 9, and 10 require sediment and water quality analyses indicative of both the dredging areas and disposal sites. Dredged materials placed in ODMD Sites along the Oregon Coast usually consist of medium to fine sands taken from entrance bar shoals and deposited on slightly finer continental shelf sands. The bulk of the sediments to be dredged at the Umpqua River navigation project are similar in grain size to those at the proposed ocean disposal sites. Because of their coarse nature, similarity to ocean disposal site sediments, isolation from known existing or historical contaminant sources, and the presence of strong hydraulic regimes, dredged sands from entrance bar shoals meet criteria for exemption from further testing according to provisions in 40 CFR 227.13(b). Data from navigation channel sands and fines in the Umpqua estuary and offshore at historic and proposed ODMD Sites are presented in this appendix.

The 5 general criteria and 11 specific factors be addressed during the designation process (40 CFR 228.5 and 228.6) have been interpreted as 27 different "areas of consideration" that cover the proposed ODMD Sites and the dredged material received. These areas of consideration are listed in a conflict matrix that is used to evaluate each proposed disposal site on its compliance with the requirements for designation (see Evaluation Study/Environmental Assessment). The results from the conflict matrix evaluation are used to select the best ODMD Site. The areas of consideration involving sediment quality include:

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 these seven areas of consideration is provided in this appendix.

Umpqua River Project Sediment and Water Quality

Summary information on sediment quality for the Umpqua River navigation project is provided below for data collected in 1980, 1981, 1986, 1987, 1989, 1991, 1992, 1996, and 2001. Detailed information including specific sample locations, as well as physical and chemical data, is provided for the sediment quality assessments conducted in 2006 (Abney 2006). Project sediments are routinely collected and subjected to physical and chemical analysis typically on a 5-year schedule or as specific sediment quality issues are raised. This is more frequent than required by regional testing guidance (DMEF 1998, SEF 2006). Information and specific data regarding sediment quality evaluations are available from the Portland District (https://www.nwp.usace.army.mil/ec/sqer.asp).

1980 Sediment Quality

Sediment samples from the main channel of the Umpqua River navigation project were collected in October 1980 as part of a coastal evaluation of authorized federal navigation channels. Physical sediment, bulk sediment chemistry, and elutriate analyses were performed on the samples for several organic and inorganic parameters. Details of the sampling, lab analysis, and procedures can be found in Fuhrer and Rinella (1982). Basic water quality parameters were taken in the field during sediment sample collection at Umpqua river mile (RM) 0.0. The water quality parameters fell within the normal ranges expected for nearshore ocean waters off the Oregon Coast.

Dredged materials deposited at the 1977 Interim ODMD Site historically came from the entrance bar, the entrance to the Winchester boat basin, and from the main channel up to RM 11. The grain size distribution curves for Umpqua River sediments from these areas showed well-sorted fine sands with median grain sizes between 0.2 and 0.3 millimeters (mm). Interim disposal site sediments were also found to be well-sorted fine sands with median grain size of approximately 0.3 mm. Thus, Umpqua River dredged sediments were very similar to the Interim ODMD Site sediments. Sediments in offshore areas not associated with the Interim ODMD Site were finer with a mean grain size about 0.16 mm.

The percentage of volatile solids in the Umpqua River channel was within the range exhibited by offshore sediments. However, the percentages of volatile solids in the Interim ODMD Site samples were all less than 0.8%, which were less than that in reference transects. The difference in volatile solids was assumed to be related to the coarser grain size of the sediments at the Interim ODMD Site and those dredged from the channel. Sediments from both the channel and the Interim ODMD Site were similar to those from reference areas. Sediment and elutriate analyses showed sediments dredged from the channel to be clean sand and well within the background range expected.

1981 Bioassays

Biological and chemical testing was conducted on fine sediments from the Winchester Bay boat basin channel to evaluate potential toxicity at the 1977 Interim ODMD Site. From April to August 1981, liquid, suspended particulate, and solid phase bioassays and bioaccumulation tests were conducted by Ecological Analysts Inc. (1981). Surface sediments were collected by ponar grab from five locations in the Salmon Harbor and Winchester Bay boat basins. A single composite of the 5 stations was used as the test sediment as agreed by the Corps and U.S. Environmental Protection Agency (EPA), Region 10. Reference sediments were collected from three stations immediately inshore of the Interim ODMD Site. Test species included: (1) liquid and suspended particulate phases – *Calanus pacifica* (copepod), *Crannon franciscorum* (bay shrimp), *Parophrvs vetulus* (juvenile English sole); (2) solid phase – *Rhepoxvnius abronius* (burrowing amphipod), *Macoma*

inequinata (filter-feeding infaunal bivalve), *Abarenicola pacifica* (deposit-feeding polychaete); and (3) bioaccumulation – *Abarenicola pacifica*.

Liquid and suspended particulate tests were conducted for 96 hours under static, aerated conditions. Significant mortality occurred for *C. franciscorum* exposed to 100% liquid phase test sediments. Survival percentages were reference control 85%, liquid phase test 45%, and suspended particulate phase test 82% survival. This mortality was attributed to a lack of food for test animals in the liquid phase, which is filtered, rather than to contaminant effects. It was estimated that, "The limiting permissible concentration of the liquid phase after initial mixing at the disposal site would not be exceeded." No other mortality was observed in the two phases (Ecological Analysts Inc. 1981).

Significant mortality was observed in flow-through, 10-day solid phase tests for *R. abronius* (Ecological Analysts Inc. 1981). Reference survival was 91% while test sediment survival was 69%, averaged over the 20 replicates run for each condition. The net decrease in survival was 22% and this mortality was attributed to a combination of contaminants and physical incompatibility of the fine-grained test sediments, since *R. abronius* prefers sandy substrates. No other significant solid phase mortality occurred. In the *A. pacifica* bioaccumulation tests, tissue accumulation showed no significant elevations of any contaminants tested.

1986 Sediment Quality

In 1986 the hopper dredge *Yaquina* found pockets of a black "emulsified" sediment in Gardiner channel. Dredging was suspended. Sediment samples were collected and no oil or other contaminants were detected. Sediments in Gardiner channel were tested again in 1989 and found acceptable for unconfined in-water disposal. Maintenance of the channel by hopper dredge was resumed in 1990. In October 1991 *Yaquina* again encountered oil in the vicinity of the fueling dock while dredging the Gardiner channel. Dredging was discontinued and water/oil samples collected for analysis. Analyses conducted by the Corps' Materials Laboratory showed the water/oil samples to contain weathered bunker oil (diesel fuel). Subsequently the Gardiner channel was maintained to a depth of -18 feet mean lower low water (MLLW; project depth is -22 feet MLLW) to avoid and remaining contaminated sediment. Industry served by the Gardiner channel closed in the 1990s and the Gardiner channel has not been maintained since then.

1987 Sediment Quality

Sediment physical and chemical analyses were completed in July 1987 for samples from 12 stations in the Winchester Bay boat basins. Results showed a mixture of sediment types with coarser sediments located near the basin entrances and fine sediments inside. Some of the fine sediments have high organic and clay content, with several stations showing ranges of 7% to 15% organics and 8% to 24% clays. Bulk and elutriate chemical analysis results showed that sediments did not have high contaminant levels. The mercury value for a sample in the west boat basin was somewhat elevated at 0.134 micrograms per gram (ug/g). However, toxicity effects for mercury at this level would not be expected at the ocean disposal site. Chromium values for all samples were elevated and ranged from 36.5 to 75.2 ug/g, but showed no relationship with sediment type or proximity to moorage areas. Some Oregon estuaries have high background chromium levels and these data indicated a similar phenomenon at Umpqua River. The same samples and composites were analyzed for organic contaminants including pesticides, polychlorinated biphenyls (PCB), and polynuclear aromatic hydrocarbons (PAH). None were detected in any samples.

1989 Sediment Quality

On February 23, 1989, sediment samples for physical and bulk chemical analyses were collected at four locations along the Gardiner channel and in the turning basin. A vibra-core was use to collect the samples. A 5-inch thick clay layer between 36- to 41-inches deep was sampled (UR-VC-1,U) for both physical and chemical analysis. At sample UR-VC-2, a fine-grained layer between 16 and 27 inches deep was sampled for physical and chemical analyses. At samples UR-VC-3 and UR-VC-4, the vibra-corer yielded recovery of 32 inches and 54 inches of sandy material, respectively; only physical analyses were conducted on these two samples. The two layers of fines sampled showed percent fines in these layers to be 64.7% and 52.2%. The percent fines in the bulk of the material ranged from a high of 13.2% to a low of 6.4%. The percent volatile solids for the clay layers was 5.2% and 5.7% while that of the bulk of the material ranged from 2.0% to 3.7%. No organic compounds for which analyses were preformed were detected in the samples tested. The concentrations of metals, oil and grease, total organic carbon (TOC), and ammonia were also typical of clean estuarine sediments with a moderate level of organic matter.

1991 Sediment Quality

Samples were collected in September 1991 from shoals in the main channel and from the turning basins in Gardiner channel and near Reedsport docks. Physical and chemical (one sample) analyses were conducted. All material was determined to be suitable for in-water disposal. Sediment samples were also collected from various locations from the Winchester Bay access channel to evaluate the suitability of the bay sediment for the beneficial development of wetland habitat on the North Spit.

1992 Sediment Quality

In April 1992, sediment from Winchester Bay was proposed for use as liner material in ponds to be constructed in the sand dunes of the north spit (Britton 1992). The sediment would “seal” the ponds helping them hold water and would retain soil moisture longer than the existing sand substrate. These ponds would provide aquatic habitat for a longer period of time during the year. The mean levels for heavy metals concentrations for all the sediment samples were found to be below Corps and EPA Region 10 screening levels. Also, individual samples did not exceed screening levels. As in the 1987 study, no pesticides or PCBs were detected. However, the detection limits for pesticides, PCBs, and PAHs were above guidelines. In view of this, the Corps recommended that the sediment be sampled again and reanalyzed to determine PAH concentration.

1996 Sediment Quality

Nine samples were collected using a box corer on July 30, 1996 and were subjected to physical tests. Sample UQR-BC-3 was taken from the Reedsport turning basin, samples UQR-BC-4, -7, and -8 were taken from the Gardiner channel and turning basin, and sample UQR-BC-9 was taken immediately downstream of the confluence of the Gardiner and main channels. All samples were silty and subjected to chemical analysis. Volatile solids in the Gardiner channel was the highest of all samples analyzed, ranging from 4.8% to 5.9%; the remaining samples had volatile solids ranging from 0.7% to 2.8%. All metal concentrations were below screening levels. Four of five samples analyzed yielded low levels of 4,4’ DDE; however, the values were estimated since each analyte was below the laboratory reporting limits of 10 parts per billion (ppb) but above the method detection level (MDL) of 0.3 ppb. There were no PCBs found in any of the samples. All sediment samples contained PAHs; however, total PAHs in all samples were far below established concern levels. Organotins were detected in all samples in or near the Gardiner turning basin; however, each analyte was below the laboratory reporting limits of 3 ppb but above the MDL of 0.3 ppb. All material was determined to be suitable of unconfined in-water disposal without further characterization.

2001 Sediment Quality

In February 2001, eight surface grab sediment samples were collected from the Umpqua River and six samples from Winchester Bay. All samples were submitted for physical analyses (mean 0.18 mm, with 77.59% sand and 22.28% fines), with six samples analyzed for metals, TOC, pesticides, PCBs, phenols, phthalates, miscellaneous extractables, PAHs, and organotin (TBT). Sediment represented by samples collected during this sampling event exceeded the DMEF (1998) Tier II guidelines screening level in one sample (WB-BC-03) for benzoic acid (1.2 times the DMEF screening level). Because benzoic acid is found in many natural forms and because neither Winchester Bay nor the sample in question have any known source of benzoic acid in the vicinity, the benzoic acid detected is thought to be an isolated, most likely a natural source of benzoic acid. In light of this determination all sediment represented by this sampling event was considered to be suitable for unconfined, in-water placement without further characterization.

2006 Sediment Quality

Physical and Volatile Solids (ASTM methods). Eighteen samples were submitted for testing, with data presented in Table C-1. The physical analyses resulted in mean values of 0.37% gravel (shell hash - 0.0%-1.2% range), 76.0% sand (15.0%-98.4% range), and 23.7% silt/clay (1.3%-84.9% range), with 6.82% volatile solids (1.67%-13.2% range only measured on 10 of the 18 samples).

Metals (EPA method 6010/7471), Total Organic Carbon (EPA method 9060). Seven samples were submitted for metals testing, with data presented in Table C-2. All samples were analyzed for TOC, which ranged from 0.78% to 2.17% in Gardiner channel, 0.02% to 1.81% in the Umpqua River main channel, and 2.5% to 4.86% in Winchester Bay. Low levels of all metals were detected in the three sampling areas. No sample concentrations approached their respective DMEF (1986) or SEF (2006) screening criteria.

Table C-1. Sediment Physical Analysis and Volatile Solids, 2006

Sample I.D.	Percent (%)				Location (RM)
	Gravel	Sand	Silt/Clay	Volatile Solids	
082906URGC-BC-01	0	86.7	13.3	3.59	Gardiner Channel (RM 8.1)
082906URGC-BC-02	1	93	6	8.51	Gardiner Channel (RM 9)
082906URMC-BC-01	0	75.7	24.3	--	Umpqua Channel (RM 8)
082906URMC-BC-02	0.2	96.2	3.6	--	Umpqua Channel (RM 8.5)
082906URMC-BC-03	0.2	87.6	12.2	--	Umpqua Channel (RM 10)
082906URMC-BC-04	0	93.9	6.1	2.54	Umpqua Channel (RM 11.5)
082906URMC-BC-05	0.1	96.3	3.6	1.67	Umpqua Channel (RM 11.4)
082906URMC-BC-06	0.9	96.3	2.8	--	Umpqua Channel (RM 5.1)
082906URMC-BC-07	0.1	95.4	4.5	--	Umpqua Channel (RM 4.2)
082906URMC-BC-08	0.3	96.2	3.5	--	Umpqua Channel (RM 2.9)
083006URMC-BC-09	1.2	97.5	1.3	--	Umpqua Channel (RM 0.9)
083006URMC-BC-10	0.1	98.4	1.5	--	Umpqua Channel (RM 1.1)
083006WBWC-BC-01	0.1	82.5	17.4	4.84	Winchester Bay West Channel
083006WBWC-GC-02	0	30.3	69.7	9.57	Winchester Bay West Channel
083006WBWC-GC-03	0.7	17.1	82.2	8.55	Winchester Bay West Channel
083006WBEC-GC-04	1.1	62.5	36.4	4.76	Winchester Bay East Channel
083006WBEC-GC-05	0.6	46.9	53.5	13.20	Winchester Bay East Channel
083006WBEC-GC-06	0.1	15	84.9	11.00	Winchester Bay East Channel

Table C-2. Inorganic Metals and TOC, 2006 (mg/kg)

Sample I.D.	Sb	As	Cd	Cr	Cu	Pb	Ni	Ag	Zn	Hg	Sulfide	TOC (%)
082906URGC-BC-01	0.09	4.56	0.07	35.6	16.4	5.37	32.3	0.05	49.3	0.025	1.6	0.78
082906URGC-BC-02	0.1	6.68	0.1	18.7	9.67	3.89	20.8	0.027	27.9	0.02	4	2.17
082906URMC-BC-01	--	--	--	--	--	--	--	--	--	--	3.3	0.89
082906URMC-BC-02	--	--	--	--	--	--	--	--	--	--	<0.5	0.1
082906URMC-BC-03	--	--	--	--	--	--	--	--	--	--	<0.5	0.35
082906URMC-BC-04	--	--	--	--	--	--	--	--	--	--	<0.5	0.31
082906URMC-BC-05	--	--	--	--	--	--	--	--	--	--	<0.5	0.12
082906URMC-BC-06	--	--	--	--	--	--	--	--	--	--	<0.5	0.06
082906URMC-BC-07	--	--	--	--	--	--	--	--	--	--	<0.5	0.14
082906URMC-BC-08	--	--	--	--	--	--	--	--	--	--	<0.5	0.05
083006URMC-BC-09	--	--	--	--	--	--	--	--	--	--	<0.5	<0.02
083006URMC-BC-10	--	--	--	--	--	--	--	--	--	--	0.80 J	0.02 J
083006WBWC-BC-01	--	--	--	--	--	--	--	--	--	--	300	1.81
083006WBWC-GC-02	0.09	6.1	0.27	52.7	29.8	7.74	50.5	0.095	61.4	0.072	996	2.95
083006WBWC-GC-03	0.11	6.19	0.28	64.2	36.2	9.9	62.5	0.15	70.1	0.075	1790	2.5
083006WBEC-GC-04	0.06	4.58	0.26	40.9	21.8	6.25	40.9	0.061	44.1	0.055	308	3.79
083006WBEC-GC-05	0.07	5.32	0.3	43	21.3	6.31	38.8	0.07	47.7	0.062	2250	4.86
083006WBEC-GC-06	0.06	6.09	0.27	53.6	32.5	9.42	50.7	0.113	66.9	0.069	2770	3.06
Minimum	0.06	4.56	0.07	18.7	9.67	3.89	20.8	0.027	27.9	0.02	1.6	0.05
Maximum	0.11	6.68	0.3	64.2	36.2	9.9	62.5	0.15	70.1	0.075	2770	4.86
Average	0.08	5.65	0.22	44.10	23.95	6.98	42.36	0.08	52.49	0.05	936	1.50
SEF 2006	150	57	5.1	260	390	450	---	6.1	410	0.41		NA

-- = Parameter not analyzed for this sample. Symbol (<) = Non-detect at the value listed (MDL).
mg/kg = milligrams per kilogram

Tributyltin [total (bulk) and pore-water]. Six samples were submitted for testing of bulk and pore-water organotin compounds. Due to insufficient pore-water recovery, only bulk analyses were performed. The data for the analyses is presented in Table C-3. Tetrabutyltin was not detected above detection limits in any samples. Mono-, di- and tri-butyltins were detected at less than 5 ppb, substantially below screening levels.

Table C-3. Total Organotin, 2006

Sample I.D.	Total (Bulk) ug/kg			
	Monobutyltin	Dibutyltin	Tributyltin	Tetrabutyltin
082906URGC-BC-01	0.24 J	<0.19	<0.087	<0.11
083006WBWC-GC-02	1.6 J	2.1 P	4.9	<0.13
083006WBWC-GC-03	1.9	2.5	2.2	<0.14
083006WBEC-GC-04	0.24 J	0.54 JP	<0.28	<0.11
083006WBEC-GC-05	1.7 J	1.9 J	2.6	<0.16
083006WBEC-GC-06	1.9 J	1.9 J	1.9 J	<0.16
Screening Level SEF 2006	75			

Symbol (<) = Non-detect at the value listed (MDL). ug/kg = micrograms per kilogram

Pesticides/PCBs (EPA method 8080), Phenols, Phthalates, Miscellaneous Extractables, Chlorinated Hydrocarbons and Phenols (EPA method 8270). Seven samples were submitted for testing, with data presented in Tables C-4 to C-9. No PCBs were found at the MDL in any of the samples. Most pesticides were not detected above MDLs in any of the samples. The pesticides 4,4'-DDD and 4,4'-DDT were detected in four samples at estimated levels below laboratory reporting limits and below DMEF (1986) and SEF (2006) screening levels. Di-n-butyl phthalate and bis(2-ethylhexyl) phthalate were detected in six samples at estimated levels below laboratory reporting limits. Di-n-butyl phthalate was detected above laboratory reporting limits in one sample. All phthalate concentrations were orders of magnitude below the DMEF and SEF screening levels. Of the miscellaneous extractable compounds, only dibenzofuran was detected at estimated levels in one sample. The concentration was well below DMEF and SEF screening levels. No chlorinated hydrocarbons were found at the MDL in any samples. The phenols 4-methylphenol and phenol were each detected above laboratory reporting limits in separate samples. Phenol was detected at estimated levels in all other samples. All concentrations of phenols detected were below DMEF and SEF screening levels.

Table C-4. PCBs 2006 (ug/kg)

Sample I.D.	PCBs Aroclors							
	1016	**1221**	**1232**	**1242**	**1248**	**1254**	**1260**	**Sum**
082906URGC-BC-01	<2.7	<2.7	<2.7	<2.7	<2.7	<2.7	<2.7	<2.7
082906URGC-BC-02	<3.2	<3.2	<3.2	<3.2	<3.2	<3.2	<3.2	<3.2
083006WBWC-GC-02	<15	<28	<10	<3.2	<3.2	<3.8	<3.2	<28
083006WBWC-GC-03	<5.6	<32	<13	<7.0	<9.2	<8.5	<3.3	<32
083006WBEC-GC-04	<10	<26	<2.6	<2.6	<2.6	<2.6	<2.6	<26
083006WBEC-GC-05	<27	<84	<120	<120	<10	<7.4	<3.8	<120
083006WBEC-GC-06	<3.7	<14	<3.7	<3.7	<3.7	<6.4	<5.1	<14
DMEF 1998 Screening level	Total PCBs							130/130
Symbol (<) = Non-detect at the value listed (MDL)								

Table C-5. Pesticides 2006 (ug/kg)

Sample I.D.	Pesticides								
	Aldrin	**Chlordane**	**Dieldrin**	**Heptachlor**	**Gamma-BHC (Lindane)**	**4,4'-DDD**	**4,4'-DDE**	**4,4'-DDT**	**Sum DDTs**
082906URGC-BC-01	<0.24	<8.3	<0.45	<1.1	<1.0	<0.19	<0.65	0.51 J	0.51
082906URGC-BC-02	<0.28	<5.2	<0.54	<0.15	<0.28	<0.22	<0.19	0.44 J	0.44
083006WBWC-GC-02	<1.4	<16	<2.7	<0.74	<1.4	<1.3	<0.92	<0.59	<1.3
083006WBWC-GC-03	<1.5	<41	<2.8	<0.76	<1.5	2.2 JD	<0.95	<0.61	2.2
083006WBEC-GC-04	<1.2	<19	<2.2	<1.1	<1.2	<0.9	<0.75	<0.49	<0.9
083006WBEC-GC-05	<1.7	<39	<3.3	<0.89	<1.7	<1.4	<1.2	2.9 JPD	2.9
083006WBEC-GC-06	<1.7	<28	<3.2	<1.4	<1.7	<1.4	<1.1	<0.7	<1.4
Screening Levels DMEF 1998/SEF 2006	10/9.5	10/2.8	10/1.9	10/1.5	10/--	--/16	--/9.0	--/12	6.9/--
Symbol (<) = Non-detect at the value listed (MDL). i = The MRL/MDL has been elevated due to matrix interference.									

Table C-6. Chlorinated Hydrocarbons 2006 (ug/kg)

Sample I.D.	1,3-Dichloro-benzene	1,4-Dichloro-benzene	1,2-Dichloro-benzene	1,2,4-Trichloro-benzene	Hexachloro-benzene
082906URGC-BC-01	<2.5	<3.0	<2.0	<2.4	<3.3
082906URGC-BC-02	<3.0	<3.5	<2.4	<2.8	<3.9
083006WBWC-GC-02	<3.0	<3.5	<2.4	<2.8	<3.9
083006WBWC-GC-03	<3.1	<3.6	<2.5	<2.9	<4.0
083006WBEC-GC-04	<2.4	<2.9	<2.0	<2.3	<3.2
083006WBEC-GC-05	<3.6	<4.2	<2.9	<3.4	<4.7
083006WBEC-GC-06	<3.5	<4.2	<2.9	<3.3	<4.6
Screening Levels DMEF 1998 / SEF 2006	170/--	110/110	35/35	31/31	22/22
Symbol (<) = Non-detect at the value listed (MDL).					

Table C-7. Miscellaneous Extractables 2006 (ug/kg)

Sample I.D.	Benzyl-alcohol	Benzoic Acid	Dibenzo-furan	Hexachloro-ethane	Hexachloro-butadiene	N-Nitroso diphenylamine
082906URGC-BC-01	<5.7	<150	<2.0	<3.4	<2.2	<3.4
082906URGC-BC-02	<6.8	<180	<2.4	<4.1	<2.6	<4.1
083006WBWC-GC-02	<6.9	<1180	<2.4	<4.1	<2.6	<4.1
083006WBWC-GC-03	<7.1	<190	<2.5	<4.2	<2.7	<4.2
083006WBEC-GC-04	<5.6	<150	<2.0	<3.3	<2.1	<3.3
083006WBEC-GC-05	<8.2	<220	<2.9	<4.9	<3.1	<4.9
083006WBEC-GC-06	<8.1	<210	3.1 J	<4.8	<3.1	<4.8
Screening Levels DMEF 1998/SEF 2006	57/57	650/650	540/540	1400/--	29/11	28/28
Symbol (<) = Non-detect at the value listed (MDL).						

Table C-8. Phthalates 2006 (ug/kg)

Sample I.D.	Phthalates					
	Dimethyl phthalate	Diethyl phthalate	Di-n-butyl phthalate	Butyl benzyl phthalate	Bis(2-ethylhexyl) phthalate	Di-n-octyl phthalate
082906URGC-BC-01	<2.8	<5.4	<4.0	<2.4	3.3 J	<1.9
082906URGC-BC-02	<3.3	<6.4	10	<2.8	<3.2	<2.2
083006WBWC-GC-02	<3.4	<6.5	7.6 J	<2.8	12 J	<2.3
083006WBWC-GC-03	<3.5	<6.7	8 J	<2.9	12 J	<2.3
083006WBEC-GC-04	<2.7	<5.3	4.1 J	<2.3	3.5 J	<1.8
083006WBEC-GC-05	<4	<7.8	11 J	<3.4	8.6 J	<2.7
083006WBEC-GC-06	<4	<7.7	8.6 J	<3.3	8 J	<2.7
Screening Levels DMEF 1998 / SEF 2006	1400/71	1200/200	5100/1400	970/63	8300/1300	6200/6200
Symbol (<) = Non-detect at the value listed (MDL).						

Table C-9. Phenols 2006 (ug/kg)

Sample I.D.	Phenols				
	Phenol	2-Methylphenol	4-Methylphenol	2,4-Dimethylphenol	Pentachlorophenol
082906URGC-BC-01	20 J	<5.3	<4.5	<8.5	<14
082906URGC-BC-02	14 J	<6.3	<5.4	<11	<16
083006WBWC-GC-02	23 J	<6.3	<5.4	<11	<16
083006WBWC-GC-03	24 J	<6.5	<5.5	<11	<17
083006WBEC-GC-04	23 J	<5.1	<4.4	<8.3	<13
083006WBEC-GC-05	38	<7.6	<6.5	<13	<19
083006WBEC-GC-06	28 J	<7.4	20	<12	<19
Screening Levels DMEF 1998 / SEF 2006	420/420	63/63	670/670	29/29	400/400
Symbol (<) = Non-detect at the value listed (MDL).					

Polynuclear Aromatic Hydrocarbons (EPA method 8270C). Seven samples were submitted for testing, with data presented in Tables C-10 and C-11. Most samples contained estimated low levels of some of the low molecular weight PAHs and high molecular weight PAHs. Three of the samples from Winchester Bay contained measurable quantities of chrysene, pyrene, and fluoranthene. The highest concentration of any high molecular weight PAH in any samples was 33 ug/kg. All PAH concentrations were well below DMEF (1986) and SEF (2006) screening levels.

Table C-10. Low Molecular Weight PAHs, 2006 (ug/kg)

Sample I.D.	Ace naphthene	Ace naphthylene	Anthracene	Fluorene	2-Methyl naphthalene	Naphthalene	Phenanthrene	Total Low PAHs
082906URGC-BC-01	<1.6	<2.2	<2.2	<2.7	<1.9	<2.0	<2.0	<2.7
082906URGC-BC-02	<1.9	<2.6	<2.6	<3.2	<2.2	<2.4	<2.4	<3.2
083006WBWC-GC-02	<1.9	<2.6	7.0 J	<3.2	2.3 J	<2.4	5.9 J	15.2
083006WBWC-GC-03	<1.9	<2.7	<2.7	<3.3	<2.3	2.7 J	4.2 J	6.9
083006WBEC-GC-04	<1.5	<2.1	<2.1	<2.6	2.6 J	5.4 J	6.9 J	14.9
083006WBEC-GC-05	<2.3	<3.1	<3.1	<3.8	<2.7	<2.9	5.0 J	5.0
083006WBEC-GC-06	2.4 J	<3.1	5.0 J	3.7 J	<2.7	4.6 J	6.7 J	22.4
Screening Levels DMEF 1998/SEF 2006	500/500	560/560	960/960	540/540	670/670	2100/2100	1500/1500	5200/5200
Symbol (<) = Non-detect at the value listed (MDL).								

2006 Sediment Quality Discussion

The physical analyses resulted in mean values of 0.37% gravel, 76.0% sand, and 23.7% silt/clay, with 6.82% volatile solids. This material is classified as silty sand in Gardiner channel and the Umpqua River main channel, and sandy silt in Winchester Bay. The chemical analyses indicated only very low levels of contamination in any of the samples, with all levels below their respective DMEF and SEF screening levels. No PCBs or chlorinated hydrocarbons were found at the MDLs in any of the samples. Several metals, organotins, pesticides, phthalates, miscellaneous extractables, phenols and low and high molecular weight PAHs were detected but at low levels. Detection levels were sufficient to evaluate material proposed for dredging. The analytical results of this characterization are consistent with historical data. Material represented by these samples was determined to be suitable for unconfined, in-water placement without further characterization.

Table C-11. High Molecular Weight PAHs, 2006 (ug/kg)

Sample I.D.	Benzo(a)-anthracene	Benzo-fluro-anthenes	Benzo-(g,h,i)-perylene	Chrysene	Pyrene	Benzo(a)-pyrene	Indeno-(1,2,3cd)-pyrene	Dibenzo (a,h) anthracene	Fluor-anthene	Total High PAHs
082906URGC-BC-01	2.3 J	<3.9	<3.6	<2.2	4.8 J	<2.5	<3.0	<3.4	5.3 J	12.4
082906URGC-BC-02	<2.6	<4.6	<4.3	<2.6	<2.4	<3.0	<3.5	<4.1	<4.1	<4.1
083006WBWC-GC-02	3.7 J	7.9 J	<4.3	23	18	3.2 J	<3.5	<4.1	22	77.8
083006WBWC-GC-03	5.0 J	8.4 J	<4.4	10	14	4.5 J	<3.6	<4.2	13	62.9
083006WBEC-GC-04	2.8 J	<3.8	<3.5	3.9 J	8.7 J	<2.4	<2.9	<3.3	11	26.4
083006WBEC-GC-05	7.3 J	9.2 J	<5.1	9.8 J	22	<3.6	<4.2	<4.9	14	62.3
083006WBEC-GC-06	9.6 J	11 J	<5.0	15	25	<3.5	<4.2	<4.8	33	93.6
Screening Levels DMEF 1998/ SEF 2006	1300/1300	3200/3200	670/670	1400/1400	2600/2600	1600/1600	600/600	230/230	1700/1700	12000/12000
Symbol (<) = Non-detect at the value listed (MDL).										

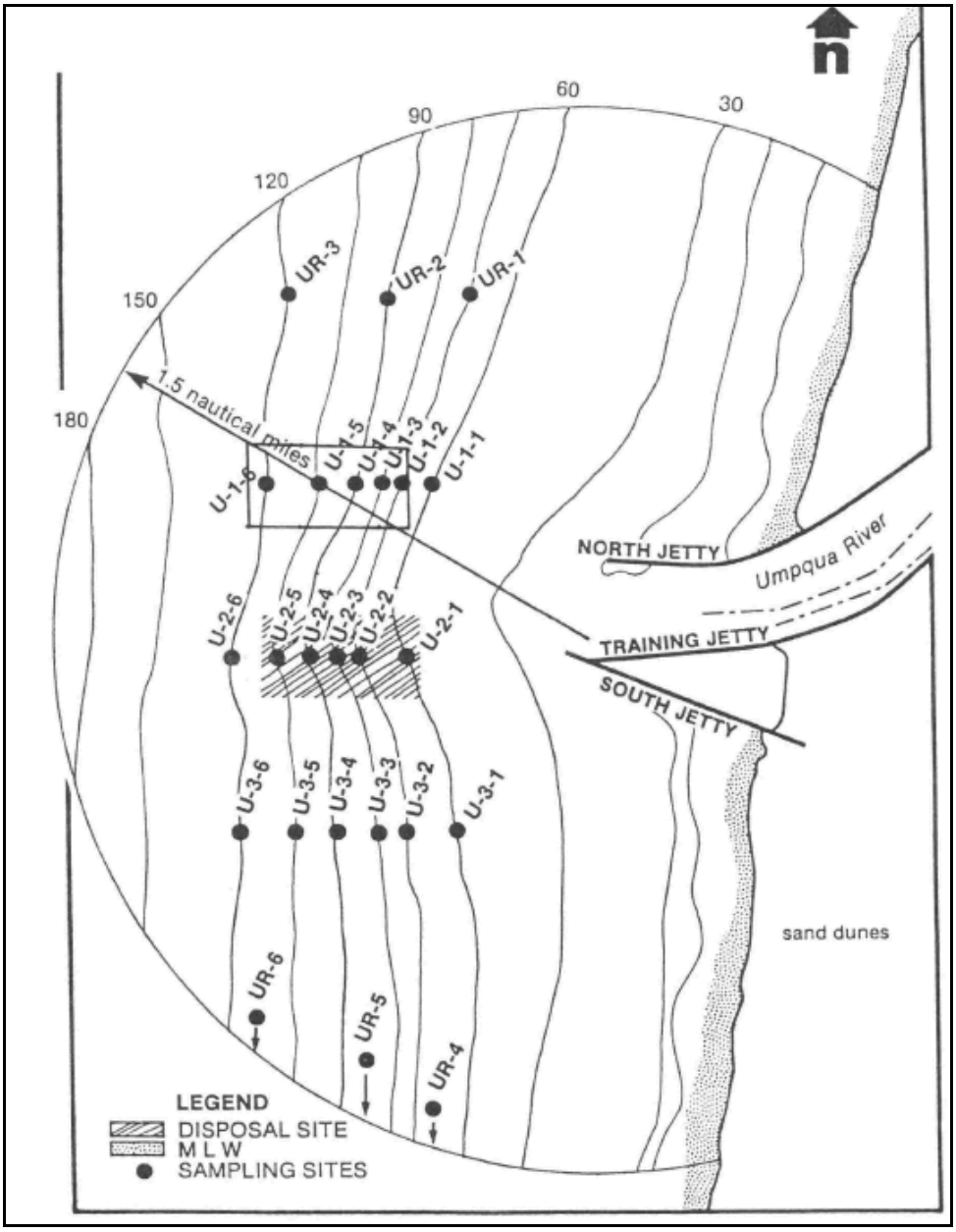
ODMD Site Baseline Sediment Quality

1984-1985 ODMD Site Sampling

Samples located in the study area of the proposed Umpqua River ODMD Sites, which encompassed a 1.5 nm arc from the channel entrance, were collected in September 1984 and January 1985. Sampling stations were located on the 60-, 70-, 80-, 90-, 100- and 110-foot depth contours as part of the baseline survey. Figure C-1 shows the location of the sampling sites and transects. Two reference transects were also sampled north and south of the study area. The reference transects were located far enough north and south to be out of the influence of past disposal offshore at Umpqua River, and are labeled UR-3 and 4 on Figure C-1. Six replicate bottom samples were taken from each of the 24 stations using a modified Gray-O'Hara box corer that sampled a 0.096-square meter area of the bottom. Samples were sent to the Corps' Materials Testing Laboratory for determination of sediment grain size and organic content. No chemical analyses were conducted.

Sediments from all stations sampled in the study area consisted of medium- to fine-grained sand inside the Interim (1977) ODMD Site (median 0.3 mm), and fine-grained sand outside of the Interim ODMD Site (median 0.16 mm). The Section 103 ODMD Site contained fine-grained sand (median 0.17 mm). Change in the grain size between the two surveys was not consistent within the study area. Thirteen of the 18 stations outside of the Interim ODMD Site showed a decrease in grain size, while 4 of the 6 Interim ODMD Site stations increased in grain size. For the most part the change in grain size was inconsequential, with 11 of the external stations showing a change less than or equal to 0.1 phi. Only two changed more than 0.3 phi. Within the disposal site the change was usually greater. Two stations increased by more that 0.35 phi. Increased grain size outside the disposal site was located in the deeper half of the study area adjacent to the site. In no case did a change in grain size bring the sediment outside the disposal site as close as 0.6 phi to the dredge material. It was not possible to infer movement of dredge material from the disposal site. Conversely, blanketing of the disposal site by native sediments did not seem to have occurred. The material placed at the Interim ODMD Site was dredged from the outer channel bar and the Umpqua River entrance. Samples taken from these areas in January 1979 had median grain sizes of 0.30 mm and 0.225 mm. This was coarser than the native offshore sediment, a difference that was also seen in the Interim ODMD Site.

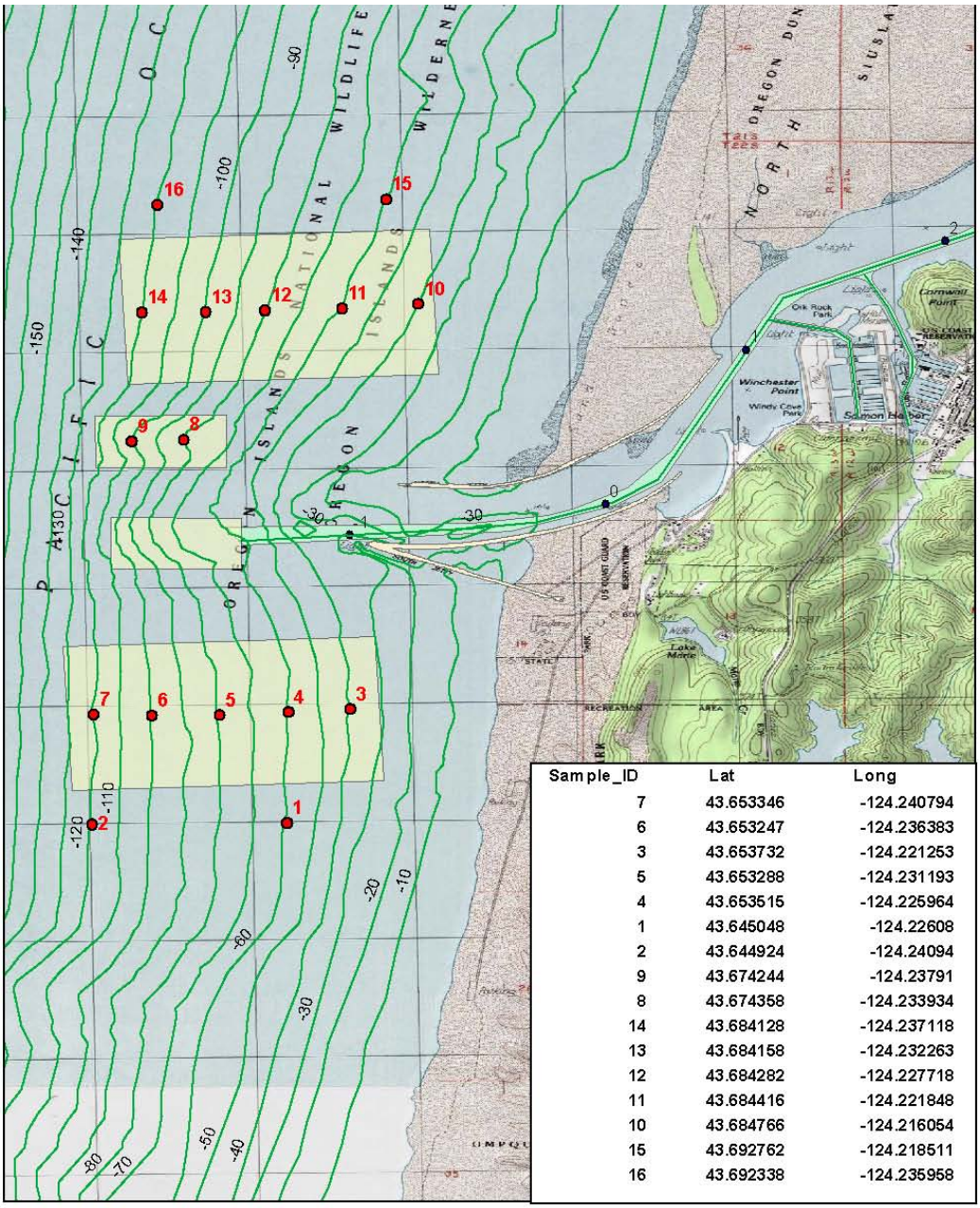
Figure C-1. Umpqua Study Area Sampling Locations, 1984-1985



2007 ODMD Site Sampling

At the Section 103 and proposed North and South ODMD Sites, a Gray-O'Hara modified 0.96-m^2 box core was used by the Corps to collect benthic infauna and sediment samples at 16 stations (Figure C-2) in June 2007. No sediment samples were collected at the historic Interim (1977) ODMD Site. Two samples (#8 and #9) were collected along the centerline of the Section 103 ODMD Site at depths of 90 and 110 feet. Five samples were collected from each of the proposed ODMD Sites at depths of 40, 60, 80, 100, and 120 feet. Two sites located north and south of the proposed ODMD Sites were selected as reference stations. Two grab samples were collected from each reference station at a depth from 60 to 120 feet. All samples were subjected to physical and chemical analysis.

Figure C-2. ODMD Site Sampling Locations, 2007



Sample_ID	Lat	Long
7	43.653346	-124.240794
6	43.653247	-124.236383
3	43.653732	-124.221253
5	43.653288	-124.231193
4	43.653515	-124.225964
1	43.645048	-124.22608
2	43.644924	-124.24094
9	43.674244	-124.23791
8	43.674358	-124.233934
14	43.684128	-124.237118
13	43.684158	-124.232263
12	43.684282	-124.227718
11	43.684416	-124.221848
10	43.684766	-124.216054
15	43.692762	-124.218511
16	43.692338	-124.235958

The 2007 sediment samples show the offshore area in the vicinity of the Section 103 ODMD Site, the proposed North and South ODMD Sites, and reference areas to be uniform in texture and characteristics (Table C-12). The percent sand size and greater, including gravel, had a narrow range from 95% to 98%. Percent fines (percent passing a 230 sieve, silt and clay) ranged from 1.98% to 4.97% with a mean of 3.18%. Organic content measured as percent total volatile solids (TVS) ranged from 1.0% to 1.88% with a mean of 1.33%. There was no discernable difference in stations

located in the actively used Section 103 ODMD Site and those areas which have not received dredged material from the Umpqua River navigation project.

Table C-12. Physical Analysis and Volatile and Total Solids, 2007

Sample I.D.	Percent (%)					Location (Depth)
	Gravel	Sand	Silt/Clay	Volatile Solids	Total Solids	
UMPO0707-BC-01	0.6	97.4	1.98	1.08	81.0	South Reference (61 feet)
UMPO0707-BC-02	11.6	84.6	3.76	1.59	76.9	South Reference (100 feet)
UMPO0707-BC-03	4.9	90.9	2.19	1.26	76.5	South Proposed (38 feet)
UMPO0707-BC-04	1.5	94.7	3.8	1.44	79.7	South Proposed (61 feet)
UMPO0707-BC-05	0.5	95.7	3.16	1.35	77.3	South Proposed (79 feet)
UMPO0707-BC-06	0.1	96.1	2.71	1.3	69.4	South Proposed (100 feet)
UMPO0707-BC-07	0.0	95	4.97	1.54	67.7	South Proposed (121 feet)
UMPO0707-BC-08	0.1	97.6	2.27	1.27	78.2	Section 103 (79 feet)
UMPO0707-BC-09	0.0	96.2	3.79	1.20	81.0	Section 103 (99 feet)
UMPO0707-BC-10	0.1	97.6	2.26	1.14	70.7	North Proposed (40 feet)
UMPO0707-BC-11	6.5	90.0	3.47	1.88	71.9	North Proposed (60 feet)
UMPO0707-BC-12	0.1	96.7	3.21	1.16	74.0	North Proposed (81 feet)
UMPO0707-BC-13	0.0	96.7	3.28	1.38	72.4	North Proposed (99 feet)
UMPO0707-BC-14	0.0	97.2	2.77	1.43	77.8	North Proposed (120 feet)
UMPO0707-BC-15	0.6	97.2	4.72	1.0	78.3	North Reference (60 feet)
UMPO0707-BC-16(1)	0.0	97.4	2.55	1.3	79.1	North Reference (122 feet)
UMPO0707-BC-16(2)	0.0	97.1	2.88	--	81.0	North Reference (122 feet)

Bulk chemical analyses were conducted on sediments from the 16 offshore locations. Analyses were conducted in accordance with the 2006 SEF similar to the analyses conducted for the Umpqua River navigation project. This included analyses for metals (10 inorganic), TOC, pesticides, PCBs, phenols, phthalates, miscellaneous extractables, and PAHs.

Metals (EPA method 6010/7471), Total Organic Carbon (EPA method 9060). All 16 samples were submitted for metals testing and data is presented in Table C-13. All sixteen samples were analyzed for TOC which ranged from 0.06% to 0.59% with an average of 0.15%. Low levels of metals were detected in all sampling areas. No sample had detectable silver (Ag) or mercury (Hg) above their respective MDL of 0.02 ppm or 0.005 ppm. Minimum, maximum, and average metal concentrations are shown in Table C-13. Maximum metal concentrations are Antimony (Sb) 0.05 ppm at UMPO070-BC-14, arsenic (As) 3.73 ppm at UMPO070-BC-08, cadmium (Cd) 0.07 ppm at UMPO070-BC-11, and UMPO070-BC-13, chromium (Cr) 23.3 ppm at UMPO070-BC-15, copper (Cu) 5.9 ppm at UMPO070-BC-11, lead (Pb) 2.35 ppm at UMPO070-BC-13, nickel (Ni) 17.9 ppm at UMPO070-BC-11 and zinc (Zn) 22.0 ppm at UMPO070-BC-15. All metal concentrations were well below their respective SEF 2006 screening criteria and are considered typical background levels.

Pesticides/PCBs (EPA method 8080). All 16 samples were submitted for pesticide and PCB analysis and data is presented in Tables C-14 and C-15. Three sediment samples had detectable levels below method reporting limits (MRLs) but above MDLs. Sample UMPO0700-BC-11 had detectable levels of aldrin (0.30 ppb) and gamma-chlordane (0.39 ppb). Samples UMPO0700-BC-02 and UMPO0700-BC-03 had detectable levels below MRLs but above MDLs of 4,4'-DDT and 0.22 ppb and 0.15 ppb, respectively. No PCBs were found at the MDL in any of the samples.

Table C-13. Metal Analysis and Total Organic Carbon, 2007

Sample I.D.	Sb	As	Cd	Cr	Cu	Pb	Ni	Ag	Zn	Hg	TOC (%)
UMPO0707-BC-01(1)	0.05	2.79	0.04	15.7	2.1	1.6	12.1	<0.02	14.6	<0.005	0.06
UMPO0707-BC-01(2)	<0.02	2.83	0.04	16.9	2.2	1.6	12.7	<0.02	15.4	<0.005	--
UMPO0707-BC-02	0.03	2.56	0.05	16.2	2.5	1.6	12.3	<0.02	15.1	<0.006	0.20
UMPO0707-BC-03	0.03	3.61	0.05	11.5	1.8	1.8	7.9	<0.02	12.7	<0.006	0.11
UMPO0707-BC-04	0.04	3.15	0.05	19.0	3.1	2.1	15.6	<0.02	18.5	<0.006	0.12
UMPO0707-BC-05	0.04	2.66	0.06	16.8	2.9	1.9	13.1	<0.02	17.5	<0.005	0.59
UMPO0707-BC-06	0.02	2.94	0.05	18.6	3.0	2.0	13.8	<0.02	18.3	<0.006	0.13
UMPO0707-BC -07	0.03	3.18	0.06	20.3	3.3	1.9	14.8	<0.02	19.0	<0.006	0.25
UMPO0707-BC -08	0.03	3.73	0.05	12.8	2.8	2.1	9.8	<0.02	16.8	<0.006	0.13
UMPO0707-BC -09	0.03	3.59	0.05	14.0	2.5	1.9	8.9	<0.02	14.8	<0.005	0.14
UMPO0707-BC -10	0.03	3.15	0.05	17.3	2.7	1.9	13.0	<0.02	17.2	<0.006	0.06
UMPO0707-BC -11	0.03	3.07	0.07	16.6	5.9	2.0	17.9	<0.02	18.4	<0.006	0.15
UMPO0707-BC -12	0.04	2.88	0.06	17.2	2.9	1.9	12.9	<0.02	18.6	<0.006	0.07
UMPO0707-BC -13	0.04	3.32	0.07	19.3	3.7	2.4	15.3	<0.02	21.7	<0.006	0.11
UMPO0707-BC -14	0.05	3.32	0.05	19.5	3.6	2.2	15.8	<0.02	21.0	<0.006	0.09
UMPO0707-BC -15	0.04	3.11	0.05	23.3	3.3	2.1	15.1	<0.02	22.0	<0.005	0.06
UMPO0707-BC -16	0.05	3.14	0.05	18.7	3.4	2.2	15.2	<0.02	20.3	<0.005	0.10
Minimum	0.02	2.56	0.04	11.50	1.80	1.57	7.87	0.00	12.70	0.00	0.06
Maximum	0.05	3.73	0.07	23.30	5.90	2.35	17.90	0.00	22.00	0.00	0.59
Average	0.04	3.12	0.05	17.28	3.04	1.94	13.30	0.00	17.76	0.00	0.15
SEF 2006 Screening Levels	150	57	5.1	260	390	450	---	6.1	410	0.41	NA

-- = Parameter not analyzed for this sample. Symbol (<) = Non-detect at the value listed (MDL).

Table C-14. Pesticides 2007 (ug/kg)

Sample I.D.	Pesticides								
	Aldrin	Alpha-Chlordane	Gamma-Chlordane	Dieldrin	Hepta-chlor	Gamma-BHC (Lindane)	4,4'-DDD	4,4'-DDE	4,4'-DDT
UMPO0707-BC-01	<0.19	<0.29	<0.08	<0.36	<0.1	<0.19	<0.15	<0.13	<0.08
UMPO0707-BC-02	<0.20	<0.3	<0.084	<0.38	<1.0	<0.2	<0.16	<0.14	0.22JT
UMPO0707-BC-03	<0.20	<0.31	<0.084	<0.38	<0.11	<0.2	<0.16	<1.0	0.15JT
UMPO0707-BC-04	<0.19	<0.29	<0.081	<0.37	<0.11	<0.19	<0.16	<0.13	<0.08
UMPO0707-BC-05	<0.20	<0.30	<0.51	<0.38	<0.11	<0.2	<0.16	<0.13	<0.08
UMPO0707-BC-06	<0.22	<0.34	<0.093	<0.42	<0.12	<0.22	<0.18	<0.15	<0.09
UMPO0707-BC-07	<0.23	<0.34	<0.21	<0.43	<0.12	<0.23	<0.18	<0.15	<0.10
UMPO0707-BC-08	<0.20	<0.3	<0.082	<0.38	<0.11	<0.2	<0.16	<0.13	<0.08
UMPO0707-BC-09	<0.19	<0.29	<0.08	<0.36	<0.10	<0.19	<0.15	<0.13	<0.08
UMPO0707-BC-10	<0.22	<0.33	<0.091	<0.42	<0.21	<0.22	<0.17	<0.15	<0.09
UMPO0707-BC-11	0.30JT	<1.1	0.39JT	<0.41	<0.12	<0.21	<0.17	<0.14	<0.09
UMPO0707-BC-12	<0.21	<.032	<0.087	<0.40	<0.18	<0.21	<0.17	<0.14	<0.09
UMPO0707-BC-13	<0.21	<0.32	<0.089	<0.41	<0.12	<0.21	<0.17	<0.14	<0.09
UMPO0707-BC-14	<0.20	<0.3	<0.083	<0.38	<0.11	<0.2	<0.16	<0.13	<0.08
UMPO0707-BC-15	<0.20	<0.3	<0.082	<0.38	<0.11	<0.2	<0.16	<0.13	<0.08
UMPO0707-BC-16	<0.19	<0.3	<0.081	<0.37	<0.11	<0.19	<0.16	<0.13	<0.08
SEF 2006	9.5	2.8	2.8	1.9	1.5	--	16	9	12

Symbol (<) = Non-detect at the value listed (MDL).
JT =The result is an estimated concentration that is less than the MRL but greater than or equal to the MDL.

Table C-15. PCBs 2007 (ug/kg)

Sample I.D.	PCB Aroclors						
	1016	1221	1232	1242	1248	1254	1260
UMPO0707-BC-01	<2.1	<2.1	<2.1	<2.1	<2.1	<2.1	<2.1
UMPO0707-BC-02	<2.3	<2.3	<2.3	<2.3	<2.3	<2.3	<2.3
UMPO0707-BC-03	<2.3	<2.3	<2.3	<2.3	<2.3	<2.3	<2.3
UMPO0707-BC-04	<2.2	<2.2	<2.2	<2.2	<2.2	<2.2	<2.2
UMPO0707-BC-05	<2.2	<2.2	<2.2	<2.2	<2.2	<2.2	<2.2
UMPO0707-BC-06	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5
UMPO0707-BC-07	<2.6	<2.6	<2.6	<2.6	<2.6	<2.6	<2.6
UMPO0707-BC-08	<2.2	<2.2	<2.2	<2.2	<2.2	<2.2	<2.2
UMPO0707-BC-09	<2.1	<2.1	<2.1	<2.1	<2.1	<2.1	<2.1
UMPO0707-BC-10	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5
UMPO0707-BC-11	<2.4	<2.4	<2.4	<2.4	<2.4	<2.4	<2.4
UMPO0707-BC-12	<2.3	<2.3	<2.3	<2.3	<2.3	<2.3	<2.3
UMPO0707-BC-13	<2.4	<2.4	<2.4	<2.4	<2.4	<2.4	<2.4
UMPO0707-BC-14	<2.2	<2.2	<2.2	<2.2	<2.2	<2.2	<2.2
UMPO0707-BC-15	<2.2	<2.2	<2.2	<2.2	<2.2	<2.2	<2.2
UMPO0707-BC-16	<2.2	<2.2	<2.2	<2.2	<2.2	<2.2	<2.2
SEF 2006 (Screening level 130 ppb sum of PCB Aroclors)							
Symbol (<) = Non-detect at the value listed (MDL).							

Phenols, Phthalates, Miscellaneous Extractables, and Chlorinated Hydrocarbons (EPA method 8270). Phenol was detected above laboratory reporting limits in all 16 samples (Table C-16). Phenol was detected at estimated levels (JT) in all samples except UMPO0707-BC-11 which had a level of 43 ppb. All concentrations of phenol detected were below DMEF and SEF screening levels. The chemical 4-methylphenol was detected in five samples. Three samples were low estimated values but two, UMPO0707-BC-03 and UMPO0707-BC-11, had values of 190 ppb and 1,000 ppb, respectively. Sample UMPO0707-BC-11 exceeds the SEF screening level for 4-methylphenol (670 ppb). Stations UMPO0707-BC-03 and UMPO0707-BC-11 are located in areas not affected by past dredged material disposal (see Figure C-2).

Di-n-butyl phthalate was detected in all sixteen samples at estimated levels below laboratory reporting limits (Table C-17). Concentrations ranged from 16JT to 37 ppb. Note that Di-n-butyl phthalate is a common laboratory contaminate and was detected at 19 ppb in the method blank. All phthalate concentrations were orders of magnitude below the SEF 2006 screening levels. No miscellaneous extractable compounds except for low levels of benzyl alcohol (ranging from 2.7 to 6.9 ppb) were detected. No chlorinated hydrocarbons were found at the MDL in any samples.

Polynuclear Aromatic Hydrocarbons (EPA method 8270C). All 16 samples were submitted for testing and data is presented in Tables C-18 and C-19. No PAHs were detected above the MDL in any sample.

Table C-16. Phenols 2007 (ug/kg)

Sample I.D.	*Phenol	2-Methyl-phenol	4-Methyl-phenol	2,4-Dimethyl-phenol	Pentachloro-phenol
UMPO0707-BC-01	13JT	<1.9	<1.9	<6.8	<25.0
UMPO0707-BC-02	25JT	<2.0	<2.0	<7.2	<27.0
UMPO0707-BC-03	24JT	<2.0	190	<7.2	<27.0
UMPO0707-BC-04	17JT	<1.9	4.7JT	<7.0	<26.0
UMPO0707-BC-05	22JT	<2.0	8.4JT	<7.2	<26.0
UMPO0707-BC-06	14JT	<2.2	<2.2	<8.0	<29.0
UMPO0707-BC-07	21JT	<2.3	<2.3	<8.2	<30.0
UMPO0707-BC-08	7JT	<2.0	<2.0	<7.1	<26.0
UMPO0707-BC-09	19JT	<1.9	1.9JT	<6.8	<25.0
UMPO0707-BC-10	13JT	<2.2	<2.2	<7.8	<29.0
UMPO0707-BC-11	43	<2.1	1,000	<7.7	<28.0
UMPO0707-BC-12	8.4JT	<2.1	<2.1	<7.5	<28.0
UMPO0707-BC-13	8.5JT	<2.1	<2.1	<7.6	<28.0
UMPO0707-BC-14	8.3JT	<2.0	<2.0	<7.1	<26.0
UMPO0707-BC-15	15JT	<2.0	<2.0	<7.1	<26.0
UMPO0707-BC-16	14JT	<1.9	<1.9	<7.0	<26.0
SEF 2006	420	63	670	29	400

Symbol (<) = Non-detect at the value listed (MDL).
JT =The result is an estimated concentration that is less than the MRL but greater than or equal to the MDL.
* Phenol was detected at 6.2 ppb in the laboratory method blank.

Table C-17. Phthalates 2007 (ug/kg)

Sample I.D.	Dimethyl Phthalate	Diethyl Phthalate	*Di-n-butyl phthalate	Butyl benzyl phthalate	Bis(2-ethylhexyl) phthalate	Di-n-octyl phthalate
UMPO0707-BC-01	<1.3	5.1JT	37	<4.0	<8.7	<2.1
UMPO0707-BC-02	<1.4	<1.7	25	<4.2	<9.2	<2.3
UMPO0707-BC-03	<1.4	<1.7	25	27	<9.2	<2.3
UMPO0707-BC-04	<1.3	<1.7	35	<4.1	<8.8	<2.2
UMPO0707-BC-05	<1.3	<1.7	35	<4.2	<9.1	<2.2
UMPO0707-BC-06	<1.5	<1.9	57	<4.7	<11.0	<2.5
UMPO0707-BC-07	<1.5	<2.0	16JT	<4.8	<11.0	<2.6
UMPO0707-BC-08	<1.3	<1.7	16JT	<4.1	<9.0	>2.2
UMPO0707-BC-09	<1.3	<1.7	17JT	<4.0	<8.7	<2.1
UMPO0707-BC-10	<1.5	<1.9	20	5.1JT	<10.0	<2.5
UMPO0707-BC-11	<1.4	<1.9	27	<4.5	12.0JT	<2.4
UMPO0707-BC-12	<1.4	<1.8	21	<4.4	<9.5	<2.3
UMPO0707-BC-13	<1.4	<1.8	37	<4.5	<9.7	<2.4
UMPO0707-BC-14	<1.3	<1.7	37	<4.2	<9.0	<2.2
UMPO0707-BC-15	<1.3	<1.7	37	<4.1	<9.0	<2.2
UMPO0707-BC-16	<1.3	<1.7	29	<4.1	<8.9	<2.2
SEF 2006	71	200	1400	63	1300	6200

Symbol (<) = Non-detect at the value listed (MDL).
JT =The result is an estimated concentration that is less than the MRL but greater than or equal to the MDL.
* Di-n-butyl phthalate was detected at 19 ppb in the laboratory method blank.

Table C-18. Low Molecular Weight PAHs, 2007 (ug/kg)

Sample I.D.	Ace naphthene	Ace naphthylene	Anthracene	Fluorene	2-Methyl naphthalene	Naph-thalene	Phen-anthrene	Total Low PAHs
UMPO0707-BC-01	<1.8	<1.5	<2.0	<1.4	<2.8	<2.9	<1.8	ND
UMPO0707-BC-02	<1.9	<1.6	<2.1	<1.5	<2.9	<3.0	<1.9	ND
UMPO0707-BC-03	<1.9	<1.6	<2.1	<1.5	<2.9	<3.1	<1.9	ND
UMPO0707-BC-04	<1.8	<1.6	<2.1	<1.4	<2.8	<2.9	<1.8	ND
UMPO0707-BC-05	<1.9	<1.6	<2.1	<1.5	<2.9	<3.0	<1.9	ND
UMPO0707-BC-06	<2.1	<1.8	<2.4	<1.6	<3.2	<3.4	<2.1	ND
UMPO0707-BC-07	<2.1	<1.8	<2.4	<1.7	<3.3	<3.4	<2.1	ND
UMPO0707-BC-08	<1.8	<1.6	<2.1	<1.5	<2.9	<3.0	<1.8	ND
UMPO0707-BC-09	<1.8	<1.5	<2.0	<1.4	<2.8	<2.9	<1.8	ND
UMPO0707-BC-10	<2.0	<1.7	<2.3	<1.6	<3.2	<3.3	<2.0	ND
UMPO0707-BC-11	<2	<1.7	<2.3	<1.6	<3.1	<3.2	<2.0	ND
UMPO0707-BC-12	<1.9	<1.7	<2.2	<1.5	<3.0	<3.2	<1.9	ND
UMPO0707-BC-13	<2.0	<1.7	<2.3	<1.6	<3.1	<3.2	<2.0	ND
UMPO0707-BC-14	<1.8	<1.6	<2.1	<1.5	<2.9	<3.0	<1.8	ND
UMPO0707-BC-15	<1.8	<1.6	<2.1	<1.5	<2.9	<3.0	<1.8	ND
UMPO0707-BC-16	<1.8	<1.6	<2.1	<1.4	<2.8	<3.0	<1.8	ND
SEF 2006	500	560	960	540	670	2100	1500	5200
Symbol (<) = Non-detect (ND) at the value listed (MDL).								

Table C-19. High Molecular Weight PAHs, 2007 (ug/kg)

Sample I.D.	Benzo(a)-anthracene	Benzo-fluroanthenes	Benzo-(g,h,i) perylene	Chrysene	Pyrene
UMPO0707-BC-01	<2.1	<1.8	<1.9	<1.9	<1.9
UMPO0707-BC-02	<2.3	<1.9	<2.0	<2.0	<2.0
UMPO0707-BC-03	<2.3	<1.9	<2.0	<2.0	<2.0
UMPO0707-BC-04	<2.2	<1.8	<1.9	<1.9	<1.9
UMPO0707-BC-05	<2.2	<1.9	<2.0	<2.0	<2.0
UMPO0707-BC-06	<2.5	<2.1	<2.2	<2.2	<2.2
UMPO0707-BC-07	<2.6	<2.1	<2.3	<2.3	<2.3
UMPO0707-BC-08	<2.2	<1.8	<2.0	<2.0	<2.0
UMPO0707-BC-09	<2.1	<1.8	<1.9	<1.9	<1.9
UMPO0707-BC-10	<2.5	<2.0	<2.2	<2.2	<2.2
UMPO0707-BC-11	<2.4	<2.0	<2.1	<2.1	<2.1
UMPO0707-BC-12	<2.3	<1.9	<2.1	<2.1	<2.1
UMPO0707-BC-13	<2.4	<2.0	<2.1	<2.1	<2.1
UMPO0707-BC-14	<2.2	<1.8	<2.0	<2.0	<2.0
UMPO0707-BC-15	<2.2	<1.8	<2.0	<2.0	<2.0
UMPO0707-BC-16	<2.2	<1.8	<1.9	<1.9	<1.9
SEF 2006	1300	3200	670	1400	2600

Symbol (<) = Non-detect (ND) at the value listed (MDL).

Table C-19 (continued). High Molecular Weight PAHs, 2007 (ug/kg)

Sample I.D.	Benzo(a)-pyrene	Indeno-(1,2,3cd) pyrene	Dibenzo (a,h) anthracene	Fluor-anthene	Total High PAHs
UMPO0707-BC-01	<2.1	<1.9	<1.9	<2.0	ND
UMPO0707-BC-02	<2.3	<2.0	<2.0	<2.1	ND
UMPO0707-BC-03	<2.3	<2.0	<2.0	<2.1	ND
UMPO0707-BC-04	<2.2	<1.9	<1.9	<2.1	ND
UMPO0707-BC-05	<2.2	<2.0	<2.0	<2.1	ND
UMPO0707-BC-06	<2.5	<2.2	<2.2	<2.4	ND
UMPO0707-BC-07	<2.6	<2.3	<2.3	<2.4	ND
UMPO0707-BC-08	<2.2	<2.0	<2.0	<2.1	ND
UMPO0707-BC-09	<2.1	<1.9	<1.9	<2.0	ND
UMPO0707-BC-10	<2.5	<2.2	<2.2	<2.3	ND
UMPO0707-BC-11	<2.4	<2.1	<2.1	<2.3	ND
UMPO0707-BC-12	<2.3	<2.1	<2.1	<2.2	ND
UMPO0707-BC-13	<2.4	<2.1	<2.1	<2.3	ND
UMPO0707-BC-14	<2.2	<2.0	<2.0	<2.1	ND
UMPO0707-BC-15	<2.2	<2.0	<2.0	<2.1	ND
UMPO0707-BC-16	<2.2	<1.9	<1.9	<2.1	ND
SEF 2006	1600	600	230	1700	12000

Symbol (<) = Non-detect (ND) at the value listed (MDL).

Discussion and Conclusions

The physical and chemical properties of the Umpqua River navigation project and the offshore area are very similar. The average percent sand and gravel sized material from the lower 5 miles of the river was 97.3 % based upon the 2006 sediment sampling. The average for all 16 offshore samples collected in June 2007 was 96.7%. The 2006 Umpqua River survey did not run chemical analyses on the sandy material from the mainstem navigation channel. This material meets the exclusionary criteria from testing based upon its physical character, physical environment, and lack of potential sources. Sediments from Winchester Bay and the upper portion of Gardiner channel are fine-grained material dissimilar to the offshore sediments. Seven samples collected in 2006 from areas of low energy (with high fines and organic content) were chemically tested. This included sediments for Gardiner channel and both the east and west boat basins at Winchester Bay. All chemicals of concern were well below established levels of concern (SEF 2006). Material dredged from Gardiner channel and Winchester Bay is limited in volume and historically has been placed upland or in estuarine disposal areas.

Water column chemistry and physical characteristics of the Umpqua study area were studied in the mid 1980s (Fuhrer and Rinella 1982). The water quality parameters fell within the normal ranges expected for nearshore ocean waters off the Oregon Coast.

Physical and bulk chemical analyses were conducted on sediments from the 16 offshore locations. Analyses were conducted in accordance with the 2006 SEF similar to the analyses conducted on the Umpqua River navigation project. This included analyzed for metals (10 inorganic), TOC, pesticides, PCBs, phenols, phthalates, miscellaneous extractables, and PAHs. Metal analyses showed that the sediments in the study area are typical of clean marine sands. The organic analyses

showed concentrations of most chemicals of concern to be below MDLs and well below established levels of concern. The one exception was for 4-methylphenol that was detected at 1,000 ppb at station UMPO0707-BC-11. It was also detected at 190 ppb at station UMPO0707-BC-03. Station UMPO0707-BC-11 is located at a depth of 60 feet while UMPO0707-BC-03 is at 30 feet. Both areas are not associated with past dredged material placement. The highest level found in the estuary in 2006 was 20 ppb in the fine-grained material at one station in Winchester Bay east channel. These values for 4-methylphenol are an anomaly for this location, environment, and sediment type, and do not warrant a resampling effort.

Dredged material was placed at the Interim ODMD Site in 1977. The Interim site was used through 1991 when the Corps, under its Section 103 authority, selected an alternate disposal site (Section 103 ODMD Site). From 1986 to 1991, a total of about 1 million cy of dredged material was placed in the Interim ODMD Site. Use of the Section 103 ODMD Site began in 1992; as of the end of the dredging season in 2007, this site had received about 3.1 million cy of dredged material. Studies in 1984 and 1985 in the study area showed that the material in the Interim ODMD Site was coarser grained and had a lower organic content than the surrounding sea floor. There is no such difference in the offshore sediment samples collected in June 2007 and the actively used Section 103 site. No samples were collected in the Interim ODMD Site in 2007 because it is not being considered for future use.

It has been documented in other locations, such as at the mouth of the Columbia River, that winter sea conditions neutralize any impacts in sediment character at ODMD Sites. Storm waves redistribute the sandy substrate and erase differences in texture that might be discernable if samples were collected directly after the dredged material placement. There does not appear to be any long-term impact based upon characteristics of dredged material placed. The Interim ODMD Site and Section 103 ODMD Site have experienced mounding of material. Mounding at the Interim ODMD Site and a shift in the alignment of the navigation channel necessitated the need for the Section 103 ODMD Site. A site utilization study completed in 1998 by the Portland District documented the mounding conditions at the Section 103 site. This study recommended two new ODMD Sites located to the north and south and of sufficient size to alleviate the concern for future mounding of dredged material. While the quality of dredged material has caused mounding, no impacts due to sediment quality have been apparent.

The Interim and Section 103 ODMD Sites were small and were shaped based upon the operating parameters of the hopper dredges that perform the dredging and disposal. Rectangular in shape, their length was based upon the distance a hopper dredge would travel during disposal. The width was based upon the turning radius of a typical hopper dredge to be used at the Umpqua project. Orientation allows the dredge to head into the prevailing wave direction. The small size of the sites resulted in mounding of the dredged material. The proposed North and South ODMD Sites are larger to allow more flexibility in dredged material placement, thereby avoiding future mounding. Because of the shallow nature of the proposed sites, the dynamics of the ocean climate in the area, and the similarity of the dredged material and native sediments, no buffer zone has been designated.

Areas of limited or unique habitat such as rock outcrops have not been identified in the study area. No degraded areas have been identified in the study area. Mounding has the only potential for a cumulative effect due to the placement of dredged material offshore of the Umpqua River. The proposed North and South ODMD Sites are designed to reduce this potential by providing dredged material management flexibility.

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Appendix D

Cultural Resources
Umpqua River, Oregon

April 2009

Appendix D
Cultural Resources
Umpqua River, Oregon

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Appendix D
Cultural Resources
Umpqua River, Oregon

Introduction

This appendix evaluates the cultural resource potential of the Umpqua River study area. The study area was set as an arc transcribed 1.5 nautical miles out from the mouth of the Umpqua River and ends both north and south at the beach (Figure D-1). The proposed action consists of final designation of two proposed ocean disposal sites situated in approximately 30 to 130 feet of water located to the north and south of the entrance to the Umpqua River (see Figure D-1). The recommended dimensions of the proposed ocean disposal sites are 6,300 feet by 1,400 feet. The corner coordinates of the proposed sites are:

Proposed North Site	**Proposed South Site**
43° 41’ 23.09”N 124° 14’ 20.28”W	43° 39’ 32.31”N 124° 14’ 35.60”W
43° 41’ 25.86”N 124° 12’ 54.61”W	43° 39’ 35.23”N 124° 13’ 11.01”W
43° 40’ 43.62”N 124° 14’ 17.85”W	43° 38’ 53.08”N 124° 14’ 32.94”W
43° 40’ 46.37”N 124° 12’ 52.74”W	43° 38’ 55.82”N 124° 13’ 08.36”W

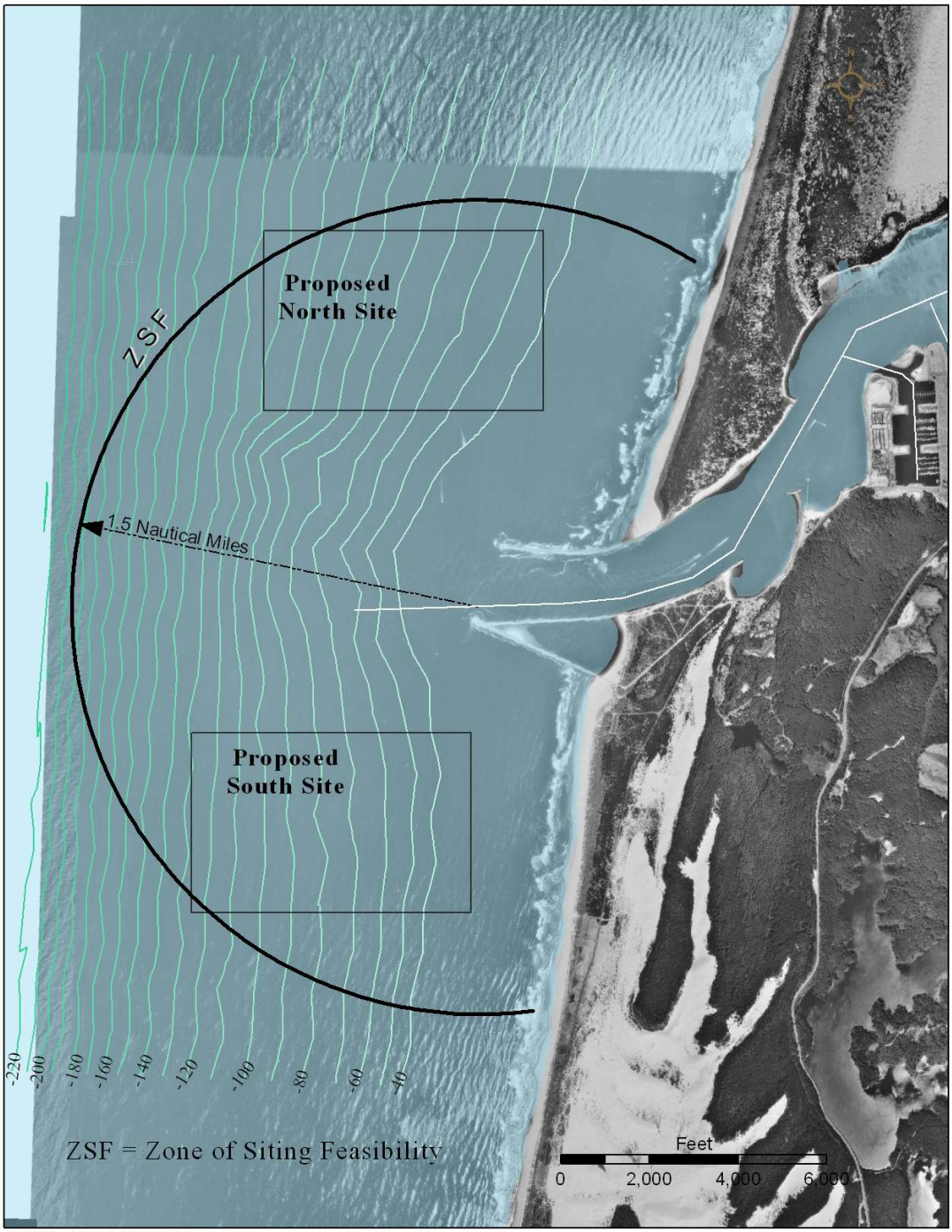
Prehistoric Potential

Analysis of the prehistoric cultural resource potential suggests two possibilities: (1) sites from the early colonization of the “new world” by the antecedents of the American Indians; and (2) sites or artifacts reflecting the procurement of food resources by more recent Indians in the shallow near-shore environments.

The initial colonization of the North American continent is thought to have occurred during the last phases of the Pleistocene. During this time, approximately 12,000 to 60,000 years ago, the sea levels ranged from 60 to 300 meters lower than their present position, a consequence of the glacial phases of the Pleistocene. Lowering of the sea level left a broad exposed coastal plain which in many places extended miles beyond the present coastline. Archeologists concerned with the problem of the arrival of humans in the North American continent point to a coastal route as a likely path for these early migrants (Fladmark 1983). It is possible that some of the earliest prehistoric sites maybe present on the seabed within the nearshore environment of the Oregon coastline.

The archeological characteristics (artifacts, features, site location in reference to topographic features, and chronology) of these sites are uncertain. They may include the tools and sites of wandering bands of big game hunters exploiting the resources of a broad coastal plain or members of a maritime based cultural group moving down the coast in boats with a technology oriented toward hunting sea mammals and procuring the other resources of the nearshore environment.

Figure D-1. Umpqua River Study Area



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A recent review of early prehistoric cultural resources suggest that on land sites from near the end of this period (ca. 12,000 years ago) occupy small surface areas which are widely dispersed and have low artifact densities (Kelley and Todd 1988). Sites with these characteristics are difficult to locate on dry ground and would be extremely difficult to locate in an inundated environment in which the ground surface of that occupation is buried under relatively recent deposits of sand and silts. Thus, not only are there the basic archeological questions of identifying who these people were and speculating on their technology, but also identifying stable land areas from this period which would have survived both the rise in sea level, and the present regime of wave and current energy. Although the issue of submerged early prehistoric sites cannot be dismissed, at the present, demonstration of the presence of an early site in an offshore area is necessary before large scale survey work can be justified.

Evidence gathered from archaeological sites located on coastal shorelines indicates that prehistoric Native Americans occupying the Oregon coastline concentrated their subsistence activities within the estuaries and the nearshore ocean environments. There is little evidence that these Indians engaged in an offshore fishery. Within the Umpqua estuary, a prehistoric archeological site, the Umpqua-Eden, provides evidence of this use. Bone fishhooks, harpoons, and barbs from fishing spears, and a netweight were recovered during testing. Faunal remains from the site included whale, stellar sea lion, harbor seal, and sea otter, while fish included salmon and starry flounder; shellfish made up a large percentage of the midden deposit itself. (Aikens 1984). Unlike the Indians of northwest Washington and some further north, the Indians of the Oregon Coast did not hunt whales. The presence of whale remains in archeological sites is likely from scavenged beached whales (Lewis and Clark 1969).

A number of places occupied by the historic lower Umpqua Indians are present within the estuary. Closest to the project area are two sites in the Winchester Bay vicinity. One of the sites is reported in Winchester Bay and the other near the outlet in the vicinity of the lighthouse (Dorsey 1890). The lower Umpqua Indians participated in a resource procurement strategy that emphasized the same resources as those recovered in the Umpqua-Eden site. These included clams, flounder, mussels, chitons, barnacles, crabs, and salmon caught in fixed fish traps, weirs, where the fish were speared, clubbed, or netted (Beckham 1986); whales were also scavenged when they drifted onto the beaches (Beckham 1986).

It is very unlikely that prehistoric sites of more recent periods (4000 BP) or from the ethnographic/historic period are present within the project area. Subsistence activities within the study area were limited to procurement, and would not produce archeological deposits. It is possible that fishhooks, stone weights, and other non perishable elements of a nearshore procurement technology are present.

Historic Cultural Resources

The majority of background research has been directed at documenting the presence of historic cultural resources, specifically shipwrecks within the ODMD Site study area. This documentary effort forms the essential background for evaluating potential project effects on cultural resources by defining the most likely cultural resource(s) within the area. Based on investigations of Ports along the Oregon Coast including studies at the mouth of the Columbia River, Yaquina Bay, Coquille River, and the Chetco River, historic shipwrecks are the most likely cultural resources present in the area's offshore location (Corps 1985, 1987).

A shipwreck database has been developed from the information compiled during background research. This database contains records of shipwrecks from each coastal project area as they come under review and the Oregon coastline in general. The database includes information on vessel type, size, and cargoes. This information can be used as supporting evidence to confirm whether a wreck site is the vessel identified as wrecked in that location. In addition to the information on shipwrecks, the reports also include brief discussions on the historic communities that supported vessel use. This information is important for defining the broader context of vessels use and will support statements of significance should any shipwrecks be discovered in coastal project areas.

Shipwreck Predictive Model

In addition to developing a database of known wreck sites, wreck site data was used to develop a general model predicting the likely location of wrecks along the Oregon Coast (Figure D-2). Compiling information on the seasonality of wrecks and analyzing specific wreck sites has produced the following wreck site distributions:

1. The areas with the highest likelihood of historic wrecks are beaches and past surf zones. In some cases historic surf zones can be distant from their current positions. For example, in the Astoria area the wreck sites of two vessels are considerably inland from the present surf zone.
2. The next most likely areas are located in the shallow near-shore environments, e.g., the present surf zones and the vicinity of navigation hazards such as reefs and areas of shoaling.
3. The least likely areas are those beyond the nearshore environment in areas of increasing water depth.

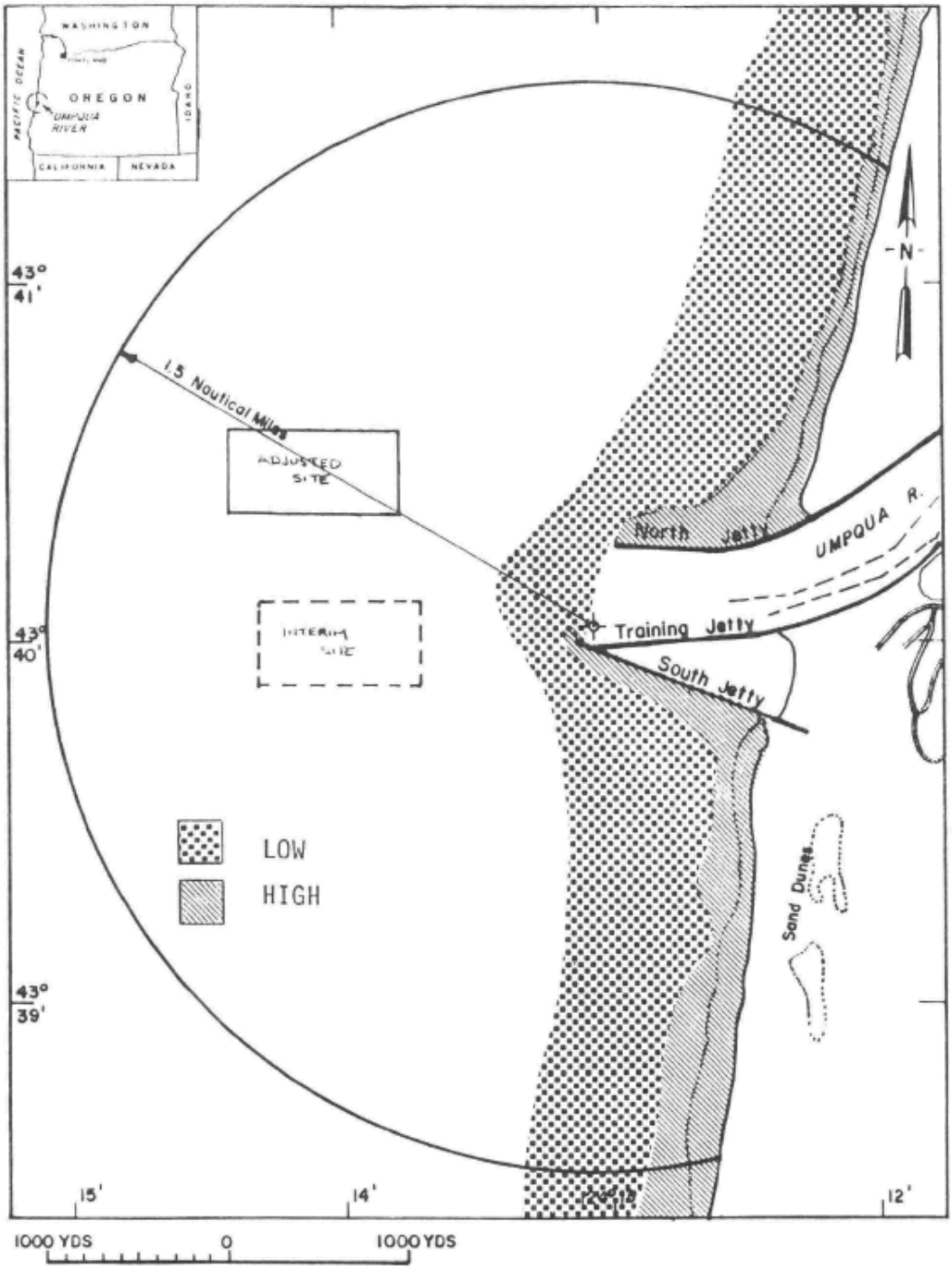
Analysis of the distribution of shipwrecks suggests that wreck sites are a product of natural forces that operate on a vessel after it has been damaged, looses power, and/or steerage. The majority of shipwrecks occur during the late fall-winter-early spring storm season. Research suggests that vessels are typically damaged while approaching the entrances of river Ports and landings along beaches. When vessels are damaged or loose power near the shoreline they are trapped by nearshore ocean currents and pushed by the predominantly onshore winds of the late fall, winter, and early spring storm period into the coast and toward the beaches.

These causal factors also operate on that small set of special cases, the derelict vessels that drift from their point of damage whether it is along the coastal waters of Japan or along the ocean trade routes miles off the coast. Though the absolute number of derelict vessels cannot be determined, when these vessels appear along the Oregon Coast during the storm season, they too drift towards the shore carried by coastal ocean currents and are brought into the beaches and surf zones by the on shore winds of the storm season. It is estimated that the majority of derelicts are beached during the late fall/winter or early spring storm seasons rather than being randomly distributed throughout the year.

Modeling shipwreck distributions and defining the causes is important for identifying the probable sites of undocumented wrecks. Though it is likely that the majority of wrecks sites are reported in the historic literature, it is certain that unidentified wreck sites are also present. The history of early exploration, fur trade and the colonization period indicates that many vessels operated under a set of conditions that did not always leave documentation of there presence in a specific area. As examples:

1. Early exploring/fur trading expeditions operated along an unknown coast line. There may have been occurrences where these vessels, reconnoitering an unknown coast line, were wrecked and lost without witnesses or records.
2. In some cases fur traders pursuing profits operated illegally in other countries territorial waters or without proper authorization from their own countries. Little if any documentation would be available to demonstrate the presence or loss of these vessels.
3. In other cases treasure vessels moved secretly along shipping lanes carrying their cargoes; when lost no record of their final position is available (Beales and Steele 1981).
4. In some cases vessels are lost along shorelines of their own coastal areas, become derelict hulks and drift on ocean currents to foreign coastlines and beaches (Brooks 1875).

Figure D-2. Umpqua River Shipwreck Frequencies



Based on the locations of known wreck sites, the shipwreck model predicts a similar wreck pattern for undocumented wreck sites. In the case of undocumented shipwrecks the model assumes that the basic natural forces of ocean currents and winds as determined by the season are the primary causes of wreck distributions along the Oregon Coast. This pattern is probably a constant throughout the maritime history of the Pacific Northwest Coast.

Uses of the Shipwreck Predictive Model

The shipwreck model has two purposes. As a planning tool for the ODMD Site projects or similar civil works projects, the model can be used to guide the evaluations of work areas by excluding the high probability locations from planning studies. Used in this manner, the model can help reduce project costs by orienting work toward low probability areas and preserve cultural resources by avoiding them. In addition, the model can be used as a probability parameter establishing device to focus historical archeological investigations in areas where wrecks are likely to occur, or if a researcher desires to locate wrecks with the densest level of information, to areas further offshore from the typical wreck site.

The model, however, cannot be used to avoid cultural resource investigations. Basically, the model predicts a general shipwreck distribution within each project area. However, each place has its own unique historic potential despite the fact that wrecks cluster on beaches and within shallow nearshore environments. Historic preservation legislation acknowledges the uniqueness of historic events by requiring evaluation of all project areas, not just the most likely areas. This requirement is important for the preservation of historical archeological resources. For example, shipwreck events are not as frequent as many popular accounts lead one to believe, especially when compared to the number of successful voyages. Commercial shipping was a very successful operation with thousands of tons of goods reaching their destinations; the benefits clearly offset the small number of vessels that were lost. For preservation values, the absolute number of potentially significant shipwrecks is probably small.

In addition, the likelihood that wrecks will be preserved and will be available for future study is not necessarily assured. Wrecks are not only preyed upon by professional salvagers, treasure hunters, and pioneers who saw wrecks as a source of "raw" materials, but are also lost to marine organisms and broken apart by the mechanical forces of wave energy and ocean currents. Most shipwrecks on beaches and in near shore environments are probably reduced to remnants of major structural elements (keels, frames), although it is possible that artifacts are present, distributed around the wreck buried under beach sands. At a minimum these wreck sites are significant as part of a comparative study collection with each wreck providing information on construction details of vessels of various classes. The offshore wrecks, however, maybe in a class by themselves. These wrecks, relatively fewer in number are generally beyond easy accessibility and maybe in a preservation environment superior to those wrecks in more exposed locations. Archeological data at these sites will probably be richer, including a higher density of artifacts and possibly, better of a vessels wooden structure.

A Sketch of Umpqua River History

From the 1820s to 1850s the Hudson Bay Company established and operated a major fur trading base, Fort Vancouver, on the middle Columbia River. The operation also included smaller posts. One post, Fort Umpqua, was located a t the confluence of Elk Creek and the Umpqua River. The labor of the trapping brigades was supplemented by a minor trade with the Indians.

In 1828, American trapper and explorer Jediah Smith crossed the lower Umpqua River and camped near present day Scottsburg. The party incited the Indians over attempts to recover an ax stolen by an Indian from one of Smith's men. The lower Umpqua Indians attacked the party of 22 men leaving only Smith and two partners as survivors. The attack initiated a period of increasing hostilities and conflicts aggravated by growing numbers of white settlers and miners that ended in the late 1850s with the establishment of the U.S. Army's Fort Umpqua near the

mouth of the river (Beckham 1969). Indians from Umpqua River, Coos Bay, and the Siuslaw were kept on a reserve in the vicinity of the fort (Douthit 1986). Sailing vessels and steamers carried supplies and personnel to man the post. Fort Umpqua was abandoned in the early 1860s. The Indians were moved to reservations up the coast.

Settlement began along then shorelines of the Umpqua estuary during the late 1840s and 1850s. The Klamath Exploring Expedition entered the Umpqua estuary aboard the chartered schooner *Samuel Roberts* (Schofield 1916). Members of the expedition platted the settlements of Winchester, Umpqua City, Scottsburg, and Elkton. The Expedition explored the Umpqua River and some of its tributaries noting the presence of small pioneering settlements and homesteads along Elk Creek (Beckham 1986).

With the platting of the towns, settlement slowly emerged. One of the first commercial structures, the Gardiner Mill Company's saw mill at Gardiner, was built in 1863 from timbers salvaged from the abandoned blockhouse at Fort Umpqua (Douthit 1986). The local economy developed and expanded primarily around the timber resources of the region. In addition, mining, the commercial salmon canning industry, and agricultural products provided some diversity within the regional economy (Beckham 1986). These products were transported to their various markets by vessels of the coastal trade. Numerous shipwrecks from this period are distributed along the coastline.

The Corps of Engineers entered the history of the Umpqua coastal area with its historic mission to promote regional development by providing and improving the commercial navigational system. In the 1870s the Corps, at the urging of local concerns, attempted to improve the navigability of the Umpqua River by removing rock obstructions from the streambed. The work was undertaken to make it possible to operate steamboats from Scottsburg (head of tide water) to Roseburg. However, even with these improvements the river was too swift and shallow for commercial shipping. The next set of improvements involved the construction of the North Jetty (1930) and the South Jetty (1930) and a 22-foot deep ship channel to Reedsport (1933). The ship channel supported shipping lumber from the mills in Gardiner and Reedsport (Willingham 1983).

From the early maritime fur trade, the exploration period, the establishment of Fort Umpqua, the early settlement period, and the period of regional development, the principal means of moving people and commodities was by ocean going vessels. Ships, schooners and vessels of the coastal trade, carried explorers, traders, and supplies for the settlements, pioneer communities, and the loggers/miners of the Umpqua region. In turn, these vessels carried out the furs that were taken in trade with the Indians, information on the areas settlement potential from the exploring expeditions, and later the goods produced in the region: the sawn lumber, canned salmon, gold, and agricultural produce of the settlement to the outside markets.

Umpqua River Shipwrecks

The shipwreck database for the Umpqua River covers an area extending 2 miles south, 9 miles north, and 20 miles west of the mouth of the river; in addition, some wreck sites in the interior estuary of the Umpqua River are also included. Fifty-one documented shipwrecks have occurred within this area (Table D-1). These wrecks have the following distribution: 28 wrecks (55%) deposited on beaches; 2 wrecks (3%) in surf zones; 8 wrecks (16%) on the bar at the mouth of the river; 5 (10%) offshore; 6 (12%) in the estuary; 1 on the jetty; and 1 (the *Oregon*, 1854), has an unknown wreck province. Of the wrecks that have occurred within the Umpqua study area, 26 wrecks (55%) have occurred on beaches; 2 wrecks (4%) in the surf zone; 8 wrecks (17%) on the bar; 3 wrecks (6%) offshore; and 1 wreck of unknown province.

Table D-1. Shipwrecks of the Umpqua River

Name of Vessel	Date of Wreck	Site of Wreck	Status	Sources
Admiral Nicholson	5/16/1924	bar	salvaged	Oregonian 5/17/1924
Cabeb Curtis	2/20/1851	bar	abandoned	Gibbs 1957; West Vol. 1, n.d.
Columbia	11/8/1858	bar	salvaged	West Vol. 1, n.d.
Gleaner	12/30/1917	bar	refloated	West Vol. 3, n.d.
Hunter	11/7/1902	bar	salvaged	West Vol. 2, n.d.
Ralph	10/5/1899	bar	salvaged	Coos Bay Times 2/12/1907; West Vol. 1, n.d.
San Gabriel	1/1/1913	bar?	refloated	West Vol. 3, n.d.
Adel	2/19/1949	bar?	refloated	Port Umpqua Courier
Almira	1/9/1852	beach	abandoned	Marshall 1982, Wright 1967
Bobolink	10/?/1873	beach	salvaged	West Vol. 1, n.d., Wright 1967
Enterprice	5/23/1873	beach	salvaged	West Vol. 1, n.d.
Eva	11/07/1915	beach	refloated	West Vol. 3, n.d.
Fearless	11/20/1889	beach	abandoned	West Vol. 1, n.d., Wright 1967
G.C. Lindauer	5/16/1924	beach	abandoned	Oregonian 5/17/1924
Gazelle	7/3/1922	beach	salvaged	Port Umpqua Courier 7/7/1922, 7/28/1922
Lily	10/21/1909	beach	salvaged	West Vol. 2, n.d.
Loo Choo	7/15/1855	beach	abandoned	Gibbs 1957, Wright 1967
Louise	4/14/1903	beach	refloated	West Vol. 2, n.d., Coos Bay Times 2/12/1907
Lucy	4/14/1903	beach	refloated	West Vol. 2, n.d., Coos Bay Times 2/12/1907
Mary and Ida	5/11/1893	beach	refloated	West Vol. 2, n.d.
Nassau	7/22/1852	beach	abandoned	West Vol. 1, n.d., Wright 1967
Peerless	2/12/1882	beach	salvaged	West Vol. 1, n.d.
Roanoke	2/12/1853	beach	abandoned	West Vol. 1, n.d., Wright 1967
Sadie	2/18/1906	beach	salvaged	West Vol. 2, n.d.
Sea Otter	8/22/1808	beach	abandoned	Gibbs 1957
Sparrow	12/4/1875	beach	salvaged	West Vol. 1, n.d., Wright 1967
Tacoma	1/29/1883	beach	abandoned	West Vol. 1, n.d., Wright 1967
Truckee	11/18/1897	beach	abandoned	Oregonian 11/19/1897
Una	3/27/1892	beach	refloated	Coos Bay Times 2/12/1907, West Vol. 1, n.d.
Una	1/21/1893	beach	refloated	West Vol. 1, n.d.
Washougal	8/?/1936	beach	abandoned	West Vol. 4, n.d.
Washtucna	7/4/1922	beach	refloated	Port Umpqua Courier7/7/1922, 8/18/1922
Wilhemina	1/22/1911	beach	salvaged	West Vol. 3, n.d., Marshall 1982
Zampa	11/11/1891	beach	refloated	West Vol. 1, n.d., Coos Bay Times 2/12/1907
Alpha	2/3/1907	beach	refloated	Marshall 1982
Meldon	3/16/1873	beach/bar	abandoned	Wright 1967, Marshall 1982
Adel	2/10/1920	interior	abandoned	West Vol. 3, n.d.
Juno	10/31/1906	interior	refloated	West Vol. 2, n.d.
Marie Joan	8/18/1936	interior	salvaged	Port Umpqua Courier 8/21/1936
Ork	11/24/1864	interior	abandoned	Gibbs 1957, Marshall 1982
Washtunca	8/18/1922	interior	abandoned	Port Umpqua Courier 8/18/1922
Bostonian	10/01/1850	interior?	abandoned	West, n.d., Marshall 1982

Further analysis of the wrecks showed that at least 21 of them have been salvaged or refloated. One vessel, the *Cabeb Curtis*, was reported wrecked and abandoned on the bar. Given that the bar has been the site of jetty construction, maintenance dredging, and increased scouring through channelization of the current, this vessel is unlikely to have survived within the vicinity of the bar. In addition, two of the offshore wrecks are located a substantial distance from the project area. The *Phil Sheridan* was reported sunk 15 miles off the mouth of the Umpqua and the *Florance* was reported sunk 20 miles off the mouth. Three other offshore wrecks are too recent to be important cultural resources.

Although there are 18 potentially significant wrecks or remnants of wrecks within the Umpqua study area, none of these wrecks are within the area that will be directly affected by disposal of material dredged from the Umpqua River navigation project. These wrecks have the following distribution:

Beach 11	Surf Zone 2
Interior 4	Unknown 1

These wrecks range in age from the wreck of the *Sea Otter* in 1808, through a group of vessels wrecked in the 1850s, to vessels wrecked in the 1980s. Wreck sites include good preservation contexts, the beach and surf zone. Wrecks in similar settings have included major structural elements, such as keels, frames, cargo hold(s), and associated cargo. Discovery of these features and artifacts will provide significant information on the fur trade, and the historic development of the Umpqua River region.

Testing the Shipwreck Predictive Model

The shipwreck model predicts that shipwrecks will be distributed with the following frequency: the majority of wrecks will be concentrated on the beaches and in the historic surf zones. The area with the next most frequent number of wreck sites will be the near shore environment, including the present surf zones and those areas with shallow or exposed navigation hazards such as, reefs and areas of shoaling. The areas with the least frequent number of shipwrecks are the deeper offshore areas. The database for the Umpqua River supports these assumptions.

Project Site Evaluation

Side scan sonar surveys were conducted within the Umpqua ODMD Site study area to determine if evidence of shipwrecks was present. Evidence may include the presence of structural remains of ships, sediment mounding indicating the burial of vessels, and/or ballast or cargo remnants marking the site of a decayed vessel. No shipwreck signature or other evidence of a shipwreck was recorded by the sonar investigation (Earth Science Assoc. and GeoRecon International 1985).

Though the presence of a shipwreck within the proposed ODMD Sites is unlikely, there is a strong likelihood that remnants of wrecks may be present north of the North Jetty. This area, formerly a surf zone and beach is the location of numerous wrecks. In addition, the preservation context of this area has been enhanced by the construction of the North Jetty; a substantial amount of sand has accreted in this area as a consequence of the construction of the jetty. The area that is now beach includes both former beach lines and surf zones.

Summary for Cultural Resources

The 2007 edition of the Northern Shipwrecks Database (Northern Maritime Research 2007) was reviewed for any entries within the Umpqua River study area. This database includes information compiled from the annual reports of Merchant Vessels of the United States, containing shipwreck reports dating from 1868 to 1968 (these reports were the basis of Bruce D. Berman's 1972 book *Encyclopedia of American Shipwrecks*), the National Oceanic and Atmospheric Administration's Automated Wrecks and Obstructions Information System, the United States Non-Submarine Contact List, war losses from World Wars I and II and the Civil War, and directories such as Lloyd's Register of Shipping. No new information was found to augment the list of known wrecks in the Umpqua River area.

While information on formerly coastal terrestrial archaeological sites remains limited and the locations of historic shipwrecks are unknown or imprecise, it is unlikely that there would be any effect on any extant cultural resources that would differ from existing conditions.

National Historic Preservation Act Compliance

It was concluded that there would be no effect on any historic properties that would differ from existing conditions for the proposed action to designate two new ocean disposal sites for the Umpqua River. A letter with a determination of "No Historic Properties Affected" has been sent to the Oregon State Historic Preservation Office (SHPO) for concurrence. The SHPO responded via letter dated September 8, 2008, stating "while not having sufficient knowledge to predict the likelihood of cultural resources being within your project area, extreme caution is recommended during future ground disturbing activities." A follow-up e-mail with the State Archaeologist, Dennis Griffin, dated October 13, 2008, confirmed that the project could move forward without any further archaeological investigations.

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Appendix E

Recreational Resources
Umpqua River, Oregon

April 2009

Appendix E
Recreational Resources
Umpqua River, Oregon

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Appendix E
Recreational Resources
Umpqua River, Oregon

Introduction

This appendix identifies the major recreational use areas within the Umpqua River study area, which encompassed an area within a 1.5 nautical mile radius from the mouth of the Umpqua River. Figure E-1 shows major recreational use areas within the Umpqua study area. The information was compiled to determine the potential impacts of disposal operations on recreation.

Recreational Use Areas

All ocean frontage within the Umpqua study area is publicly owned, making this area popular with recreationists. The Umpqua River and its associated offshore waters are known as one of the best salmon fishing areas along the Pacific Coast. Although the area receives recreational use year-round, the most popular months are from May through September. Primary activities include fishing, camping, beachcombing, off-highway vehicle (OHV) use, and sightseeing.

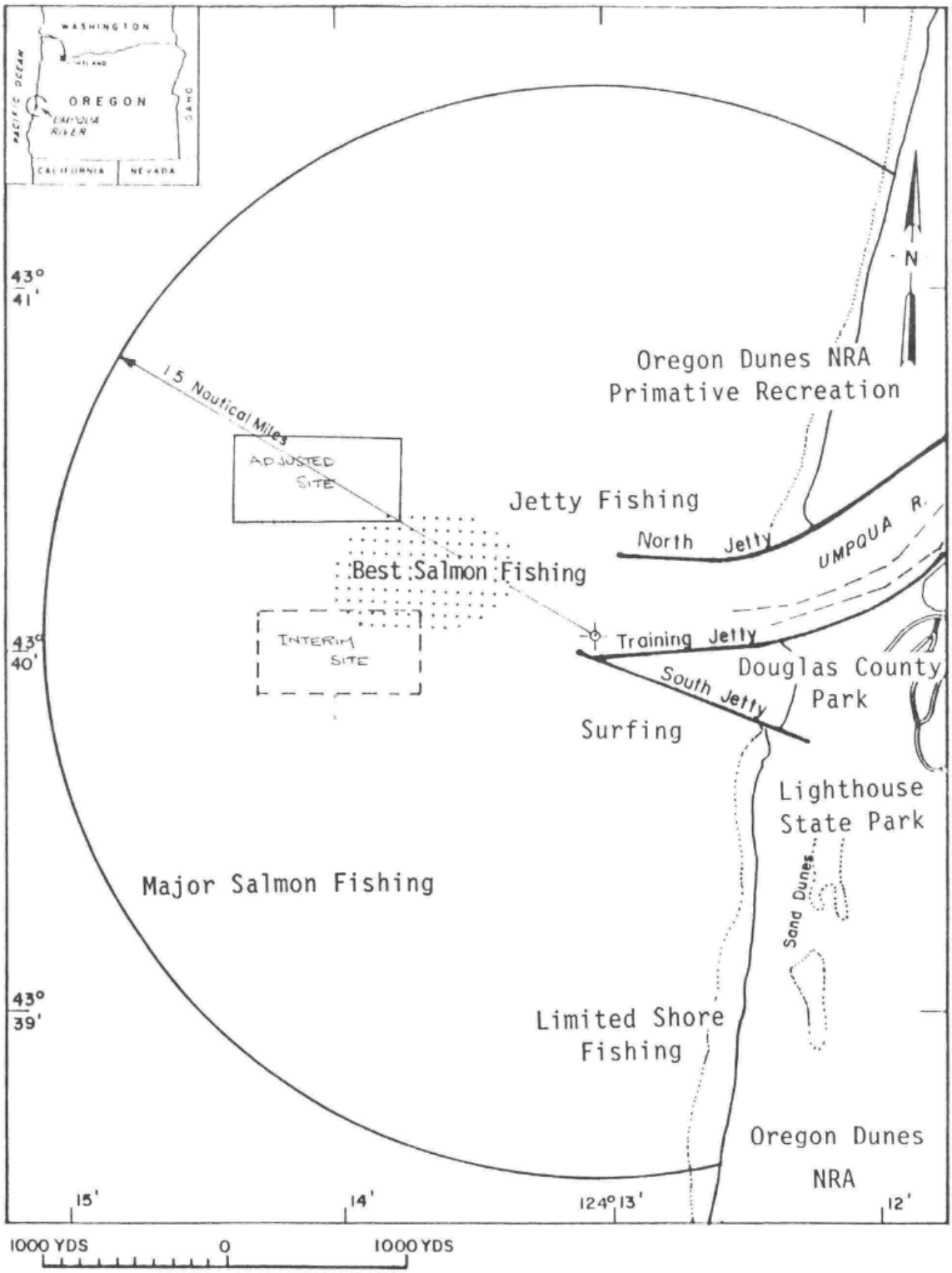
The coastal land north of the Umpqua River is part of the Oregon Dunes National Recreational Area. This portion of the Oregon Dunes has limited access and has no developed recreational facilities. The beach is open year round to motorized vehicles and OHV use is a popular activity. The dune area behind the beach is popular among hikers who enjoy a more primitive hiking experience.

Directly south of the Umpqua River, the public land is administered by Douglas County. Camping and picnic facilities are provided for public use. In addition, the county maintains a road which parallels the beach and provides access to the Umpqua Lighthouse State Park and sand dunes within the Oregon Dunes National Recreation Area. All of the recreation facilities at the state park are located inland away from the study area beach front.

Oregon Dunes National Recreation Area borders the state land and continues south along the coast to Coos Bay. There are no developed recreational facilities in the national recreation area within the Umpqua study area boundary. Unlike the beach area in the northern half of the study area, the entire length of the beach in the southern half of the study area is closed to motorized vehicles. The most common activities occurring in this portion of the study area are fishing, beachcombing, sightseeing, and hiking. The southern portion of the national recreation area has developed access and receives much higher public use than the area north of the river. The area directly south of the south jetty is utilized for wave-dependent near shore recreation, such as surfing, diving, kayaking, boogie-boarding, skim boarding, and body surfing.

The Umpqua River jetty fishery is well known and accounts for a high number of angler use days. The South Jetty is the primary fishing area because of the easy access. A popular place for fishing and crabbing the entrance channel is off the old U.S. Coast Guard pier on the south side of the channel. Peak months of activity on the jetties are June, July and August. Most crabs are taken from the main channel by individuals in boats, although some are taken directly off the U.S. Coast Guard pier. The most popular months for crabbing are June through September.

Figure E-1. Umpqua River Study Area Recreational Resources



Salmon fishing is the most popular type of offshore recreation. Both private and charter boats fish the waters throughout the western third of the Umpqua study area. A well known area lies just beyond the mouth of the river where salmon fishing is productive. Bottom fishing is also popular but is limited to areas outside of the study area. Sport angling occurs primarily during summer months when salmon are feeding nearshore before beginning the fall spawning migrations.

Impacts of Disposal Operations

The historical disposal sites shown on Figure E-1 were located directly adjacent to one of the most popular and productive salmon fishing areas offshore of the Umpqua River. The two proposed disposal sites are further north and south of this fishing area but are still located within areas identified for major salmon fishing. Any conflicts between disposal operations and recreation sites would occur as the dredging vessel was in route to the disposal site. These conflicts could include time delays for recreational boaters caused by the passing of the dredge, an increase in navigation hazards during congested periods and disruption of fishing activity as the dredge passed through popular fishing areas. Most of these conflicts could be considered an inconvenience rather than a threat to the recreational activity. The only serious threat is the potential for collision between recreational boaters and dredge traffic. Confrontations of this type are rare because the dredge moves at a slow speed. Unless there is significant change in equipment or operational procedures, the potential for collisions will remain low.

When the dredged material is deposited at the disposal site, the surrounding turbidity will increase. This would result in reduced visual quality of the area and could possibly disrupt the feeding patterns of sport fish. Both of these situations would be temporary and normal conditions would return as soon as the disposed material settles.

It is possible that some of the wave-dependent near shore recreational uses near the south jetty may overlap with the proposed South Umpqua River ODMD Site, resulting in temporary usage conflict during disposal activities. The proposed Umpqua River ODMD Sites were sized and located in order to provide long-term capacity without causing any impacts to the wave environment and the site monitoring and adaptive management outlined in the SMMP would address any possible future mounding. Therefore, the use of the proposed South Umpqua River ODMD Site is not expected to change the wave conditions for any of those recreational uses.

Sediment deposition along the beach is another possible consequence of dredged material disposal that could affect recreational activity. If the dredge material had a different color or texture than the existing material, the results could be a reduction in the visual quality of the area. There has not been any accumulation of dredged material on the beaches from past or present offshore disposal activities, nor have there been any adverse effects to recreational activities.

Conclusion

Use of the two proposed ocean disposal sites at the Umpqua River should have little impact on existing recreation. During disposal operations, water turbidity will increase. Any impact this may have on recreational fishing or visual quality of the area will only be temporary. Some inconveniences will be experienced by recreational boaters and anglers, but overall disposal operations appear to cause no serious threat to recreation.

If future studies indicate the disposal operations are either detrimental to ocean fauna or disrupt sediment deposition along the coast line, further information should be collected to determine more specifically what extent the impacts have on recreation. However, until any of these impacts are observed, future disposal of dredged material at the proposed sites is not expected to have any substantial effects on recreation.

Appendix F

Site Management and Monitoring Plan
Umpqua River, Oregon

April 2009

Final

Site Management/Monitoring Plan for the Umpqua River Ocean Dredged Material Disposal Sites, Oregon

Section 102 of the Marine Protection, Research and Sanctuaries Act
Ocean Dredge Material Disposal (ODMD) Sites
April 2009

ABSTRACT

This Site Management/Monitoring Plan (SMMP) has been prepared jointly by the Environmental Protection Agency (EPA), Region 10, and the U.S. Army Corps of Engineers (USACE), Portland District, and describes management and monitoring requirements for EPA-designated ODMD Sites located offshore from the Umpqua River, Oregon. Periodic review and updating of the SMMP will occur no less than 10 years from the date this SMMP is effective. All permits or other authorizations to use Umpqua River ODMD Sites shall be conditioned as necessary to assure consistency with this SMMP.

Umpqua River ODMD Sites
Site Management/Monitoring Plan

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Introduction

This Site Management/Monitoring Plan (SMMP) was prepared jointly by the U.S. Environmental Protection Agency, Region 10 (EPA), and U.S. Army Corps of Engineers, Portland District (USACE), and describes management and monitoring requirements for the two EPA-designated Sites, a North Site and a South Site, located offshore from the Umpqua River, Oregon (figure 1). The SMMP becomes effective upon the effective date of the designation of the Sites and supersedes and replaces any previous SMMP for this location.

It is the responsibility of the EPA and USACE to manage and monitor dredge material disposal sites designated by EPA pursuant to Section 102 of the Marine Protection, Research, and Sanctuaries Act (MPRSA). EPA has final authority over site management. SMMP provisions establish requirements for all dredged material disposal activities at the Sites. All Section 103 ocean disposal permits or evaluations will be conditioned as necessary to assure consistency with the SMMP. The USACE shall ensure that use of the Site is consistent with this SMMP.

Guidance for the preparation of SMMPs for disposal sites in accordance with the MPRSA, as amended, is provided in the joint EPA/USACE Guidance Document for *Development of Site Management Plans for Ocean Dredged Material Disposal Sites* (USACE/EPA 1996). This guidance document lays out a recommended framework for site management plan development and content.

Each SMMP is required, pursuant to the MPRSA, to include: a baseline assessment of conditions at the site; a program for monitoring the site; special management conditions or practices to be implemented at each site that are necessary for protection of the environment; consideration of the quantity of material to be disposed of at the site, and the presence, nature, and bioavailability of the contaminants in the material; 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 closure; and a schedule for review and revision of the plan which must be no less frequently than10 years after adoption of the plan and every 10 years thereafter.

Specific management of designated sites involves regulating the times of use, the quantity and the physical/chemical characteristics of dredged material that is dumped at the sites; and establishing disposal controls, conditions, and requirements to avoid and minimize potential impacts to the marine environment. Appropriate management is aimed at assuring that disposal activities comply with permit requirements, site management objectives and conditions, and do not unreasonably degrade or endanger human health, welfare, the marine environment or economic potentialities. Monitoring the site and adjacent environs is a critical component of management to verify compliance with requirements, objectives, and conditions to ensure that unanticipated or significantly adverse effects are not occurring from past or continued use of the disposal sites, and to ensure that permit terms are met.

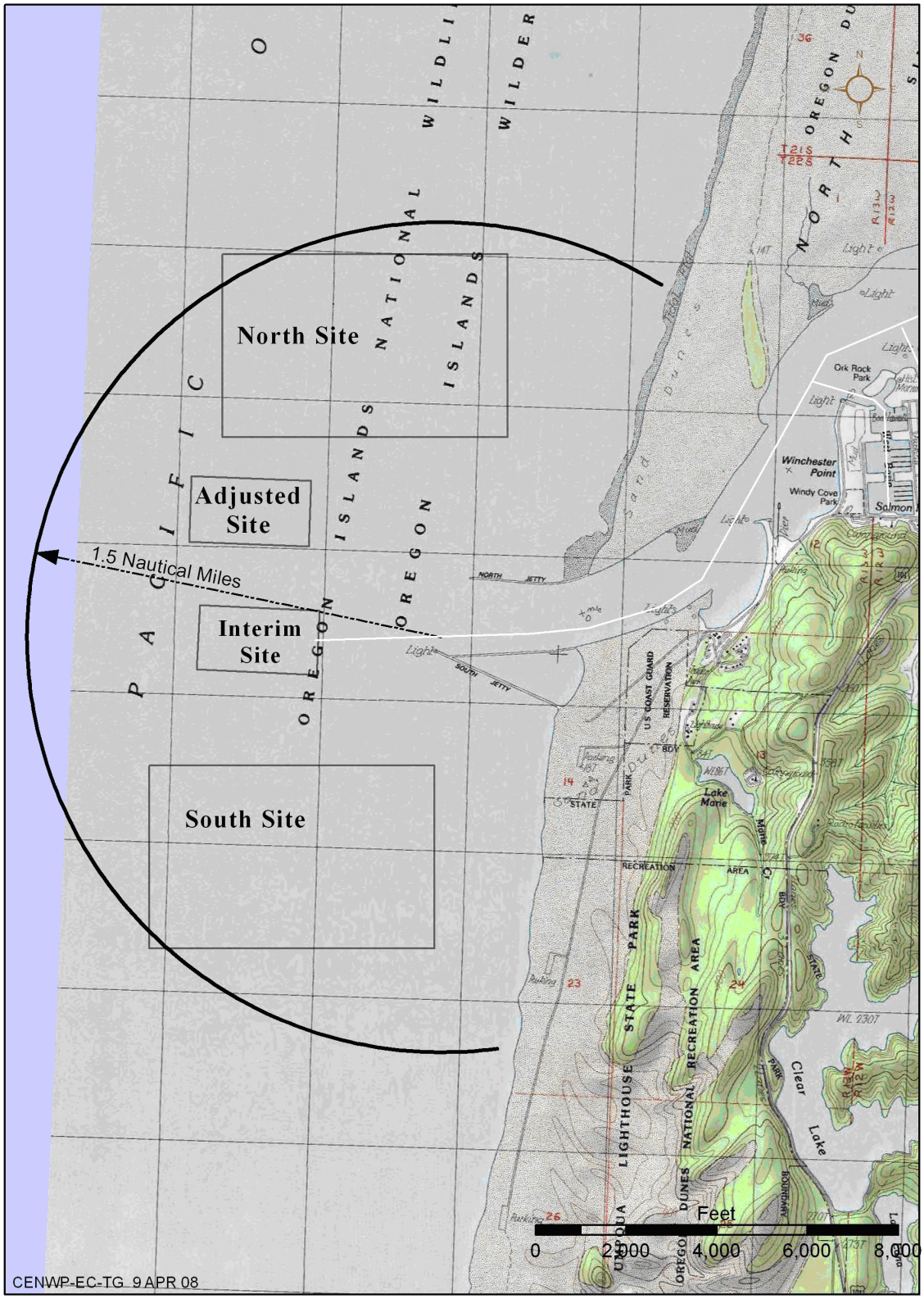

Figure 1 : Umpqua River ODMD Sites and Vicinity.

Site Management Roles and Responsibilities

The designation of ocean dredged material disposal sites and the issuance of permits for such sites are components of the federal, non-delegable, ocean dumping program. Site designation and management are federal responsibilities. Owing to the interactive nature of regulating ocean disposal of dredged material, the functional management of ocean dredged material disposal sites along the coast of Oregon is shared between EPA, Region 10, and the USACE, Portland District. The EPA and USACE will routinely consult on all decisions regarding site use and management. The primary mechanism for pre-disposal consultation will be the annual Umpqua River ODMD Sites monitoring update prepared by the Portland District.

The EPA may condition, terminate or restrict site use with cause. Region 10 is responsible for ocean disposal in ocean waters off the States of Alaska, Washington, and Oregon, which includes the Umpqua River ODMD Sites addressed in this SMMP.

The USACE is expected to be the primary user of the ODMD Sites for dredged material from federal navigation projects. The USACE also issues the permits for transportation of dredged material for the purpose of ocean disposal, after consultation with and concurrence from the EPA in compliance with these criteria. The USACE is responsible for meeting substantive permit requirements for its own use of these Sites and EPA concurs on site use by the USACE.

Baseline Definition

Section 102(c)(3)(A) of the MPRSA requires that the SMMP include a baseline assessment of conditions at the Sites. The record for the Pacific Ocean off the Umpqua River includes over thirty years of studies and surveys which are pertinent to dredged material management. Assessments of physical, chemical and biological characteristics of the section of the north Pacific Ocean encompassing the Umpqua River ODMD Sites is described in two EPA environmental studies (a 1991 draft environmental impact statement and a 2008 environmental assessment), for ODMD site designation, technical studies, and annual monitoring surveys. The bathymetric baseline for the Umpqua River ODMD Sites was established in 2008. There is no rare, unique, or critical habitat at or in the vicinity of the ODMD Sites. The Sites are situated within sight of land in an open and dynamic ocean environment. The seafloor is characterized as relatively uniform and featureless with highly active shifting sands grading westward into deeper water. The Sites have not been used for disposal of dredged material at any the time before designation.

In general, Pacific Northwest ODMDS sites are dispersive. However, mounds (and potential navigation hazards) develop when more material is placed in discrete locations within sites than the ocean has capability to disperse between disposal events. Current understanding and experience indicate generally slow dispersion from mounds takes place at ocean depths greater than 18 meters (approximately 60 feet), with dispersion steadily decreasing with increasing depth. Much higher dispersion rates have been observed within nearshore areas with depths shallower than 18 meters.

Site Definitions and Description

Disposal Site Definitions

For the purposes of management and monitoring of designated sites the following definitions are applicable:

Disposal Site: The sea bottom and overlying water column that is described in the applicable *Federal Register* Final Rule designating the individual site. A disposal site can consist of a placement area, appropriate drop zones(s), and a buffer (if applicable).

Placement Area (also can be called disposal area): The area of the sea bottom that will be immediately occupied by disposed dredged material released at the water surface (1) on an annual use basis, and/or (2) over the anticipated life of the disposal site. Generally, the placement area for dispersive sites is designated and managed on a seasonal or annual cycle. Material disposed and accumulating in the placement area during the active disposal season is expected to be transported out of the site and redistributed by natural forces (e.g., tides, currents, waves) leaving the placement area with near its original capacity. The placement area for non-dispersive sites are designed and managed for an ultimate accumulated volume capacity or for a specific number of years. Material disposed and accumulating in non-dispersive placement areas is not expected to be transported outside the boundaries of the disposal site, although natural forces may redistribute placed material on-site immediately or over several years.

Drop Zone (also can be called target zone, release zone): A drop zone is a defined area at the water surface within the placement area and within which dredged material disposal may occur. Drop zones are a management tool employed for the purpose of controlling where material disposed at the surface will fall and accumulate on the bottom. Drop zones are typically smaller than the placement area or are offset within the placement area to account for the spread of material as it descends through the water column and impacts on the bottom. The Drop Zone may be further subdivided into “cells” for more specific placement control.

Disposal Site History

An EPA designated Interim ODMD Site, located approximately one-half mile from the entrance to the Umpqua River, was initially used for disposal after its Interim designation in 1977 (Figure 1). However, due to a later realignment of the entrance channel, the approaches to the Umpqua River lay over the Interim Site. Mounding was observed at this Site in 1988, which raised the concern of potential problems for navigation. The Portland District recommended a new Adjusted Site in 1989, approximately 2,800 feet north of the Interim Site, for final site designation by EPA.

The Portland District stopped disposal at the Interim Site in October 1991. EPA has since repealed regulations under MPRSA regarding interim ocean dumping sites. (See 73 FR 74983, December 2008). The Portland District used the Adjusted Site under its authority pursuant to Section 103 of the MPRSA until the end of the 2008 dredging season, disposing over 2 million cubic yards there. The Adjusted Site also experienced mounding and was not considered suitable for long-term use. Site use under Section 103 expired at the end of the 2008 dredging season.

Disposal Site Descriptions

Two new ODMD Sites are designated by EPA, Region 10. The North ODMD Site is approximately 4,000 feet northwest of the entrance to the mouth of the Umpqua River and the South ODMD Site is approximately 4,000 feet southwest from the entrance to the Umpqua River (see Figure 1). The lineal dimensions, boundary coordinates, and water depth variation for the proposed ODMD Sites are:

lineal dimension = 6,300 feet x 4,000 feet;

axis azimuth = 270°;

average depth = 75 feet;

elevation variation = -30 feet to -120 feet Mean Lower Low Water (MLLW). The corner coordinates (NAD 83) of the Sites are:

North Site	**South Site**
43° 41’ 23.09”N 124° 14’ 20.28”W	43° 39’ 32.31”N 124° 14’ 35.60”W
43° 41’ 25.86”N 124° 12’ 54.61”W	43° 39’ 35.23”N 124° 13’ 11.01”W
43° 40’ 43.62”N 124° 14’ 17.85”W	43° 38’ 53.08”N 124° 14’ 32.94”W
43° 40’ 46.37”N 124° 12’ 52.74”W	43° 38’ 55.82”N 124° 13’ 08.36”W

Components of the Disposal Sites: The Umpqua River ODMD Sites each contain a drop zone set back 500’ from the site boundaries. Disposal must occur within the drop zone. There will be no buffer zone.

Disposal Capacity: Based on sediment fate modeling conducted in 1998, each Site is expected to have the capacity to receive approximately 188,000 cy of dredged material per year for 20 years (or 3.8 million cubic yards (mcy) each) without impacting the present wave climate.

The Sites are primarily intended to receive suitable dredged material from the USACE Umpqua River navigation project, other local USACE projects, and appropriately permitted dredged material from non-USACE projects. All dredged material to be disposed of in the ocean including Corps’ permits is subject to the EPA site management requirements in this SMMP.

Anticipated Site Use

Section 102(c)(3)(E) of the MPRSA requires that the SMMP include consideration of the anticipated use of the site. Primary and regular use of the Umpqua River ODMD Sites is expected by the Portland District, Corps of Engineers, for maintenance material removed from the federal navigation project. A summary of the Umpqua River federal project is included in this SMMP. Recent maintenance volumes dredged by the Corps from the Umpqua River navigation channel and entrance channel have averaged 104,000 cy with a range from 246,200 cy in 2002 to 9,400 cy in 2005. Only material from Corps federal projects has been placed in the ocean. It is expected that the ODMD Sites may be used in the future for disposal of material dredged by other public or private entities (e.g., the U.S. Coast Guard or Port of Umpqua) in accordance with Section 103 of the MPRSA. These disposals would require Section 103 permits (which could be multiple-year authorizations up to 7 years) from the Regulatory Branch of the USACE upon EPA concurrence. Individual permits are typically public noticed and require other federal consultations (e.g., Endangered Species Act, Magnuson-Stevens Act) and authorizations.

Umpqua River Navigation Project Description

The Umpqua River federal navigation project is located at the community of Winchester Bay and near the City of Reedsport in Douglas County, Oregon. The authorized project includes two jetties at the entrance. The north jetty is 8,000-feet long and the south jetty is 4,200-feet long. The authorized channel at the entrance is 26-feet deep and 400-feet wide. The river channel, which is 22-feet deep and 200-feet wide, extends from the entrance upstream to Reedsport at RM 11.4. There are also several adjacent channels, boat basins and turning basins A channel and turning basin at Gardiner is authorized but is not currently maintained.

The Umpqua River federal navigation project was authorized for the following purposes:

- Decrease waiting times for vessels crossing the bar;
- Provide a protected entrance for tugs, barges, and commercial fishing vessels;
- Provide mooring facilities for small boats which take advantage of project facilities;
- Permit barge and small boat traffic upstream to RM 11.7;
- Provide a harbor of refuge; and
- Maintain stable channel depths throughout the year.

Site Management Objectives

The primary objective of this SMMP is to provide for the safe and efficient disposal of dredged material at the Umpqua River ODMD Sites while minimizing adverse impacts on the environment, including, but not limited to, coastal and marine resources, to the greatest extent practicable. General site management objectives for accomplishing this primary objective are:

1. Avoid the creation of persistent mounds;
2. Minimize impacts on coastal sediment circulation by keeping sediment in the

littoral zone;
3. Minimize long-term adverse effects to marine resources;
4. Minimize interference with other uses of the ocean;
5. Maintain safe navigation and commerce;
6. Promote safe and efficient dredge operations; and
7. Document disposal and monitoring activities at the ODMD Sites.

All these general site management objectives are applicable to the Sites and additional specific management restriction may be imposed as necessary. Specific individual site objectives and restrictions will be periodically reassessed and/or revised in the future.

To minimize the creation and persistence of mounds, the sites will be managed to maximize the dispersal capability of the shallower portions of the disposal sites. Generally, there will be a preference for the use of areas shallower than -60 ft. MLLW if capacity remains in these locations.

- Site Management may include establishing cells along the nearshore portion of each Site to ensure uniform placement, minimize the accumulation of material, maximize dispersal out of the site, and avoid excessive or persistent mounding. Dump plans will be developed and may be adjusted during each disposal season to utilize different portions or cells within the shallower portion of the Sites to achieve uniform placement and minimize mounding.
- Disposal may be alternated as necessary between the two Sites to allow for maximum dispersal and minimal impact. The North Site is anticipated to receive more frequent use initially but this may change as conditions warrant.

Site Monitoring and Special Studies

Site monitoring is a key component of site management. The main purpose of a disposal site monitoring program is to determine compliance with site use requirements or conditions and 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. Monitoring of these activities is referred to as “Routine Monitoring” throughout the SMMP. Routine monitoring events may be triggered annually or at some other time interval (e.g., five years), when a set volume of material has been disposed at the Site(s), or when a combination of volume and chronology provide a logical trigger. Special Studies will be undertaken as necessary to address specific questions or issues that are not covered by routine monitoring events. Such situations could include follow-up after an accident (e.g., spill of a material) or in advance of use of a new type of equipment, or a different type of dredged material (e.g., rocks) at the Site(s). The results of these Special Studies are intended to refine future management objectives and practices, modify routine monitoring requirements or reset Baseline conditions.

Potential decision outcomes resulting from routine monitoring of disposal at one or both of the ODMD Sites include the following:

No Change:

No Change *Required* (e.g., routine monitoring reveals no cause for concern; disposal and monitoring continue as planned)

No Change *Possible* (e.g., one-time event or accident; while there may be no change in disposal operations, other actions may be appropriate)

Additional Information Required:

Adjust routine monitoring (e.g., go to a higher intensity tier)
Special Study

Operational Change Required:

Scheduling (e.g., adjust time periods or rates of disposal)

Adjust Placement of Material within Site (e.g., place material in a different Drop Zone or in a different manner)

Restrict Type or Quantity of Material Placed

Change Sites:

Relocate disposal activities from one Site to another site for a few days to a few weeks; follow-up with monitoring to determine if additional attention is warranted.

Discontinue Disposal Site Use:

Cease Disposal--Short-Term (e.g., 1 season) (A known temporary condition takes place which merits discontinued use for a short period of time; follow-up with monitoring to determine if additional attention warranted).

Cease Disposal--Long-Term. Typically this would occur when routine monitoring or a Special Study confirms an unacceptable condition persists. This would require site modification or identification and designation of a new site(s).

Umpqua River ODMD Sites - Routine Monitoring

Routine monitoring will generally consist of annual bathymetric monitoring of the dredged material disposed at the Sites, typically in the spring. The first annual bathymetry monitoring will be compared to the baseline survey from spring 2009. In subsequent years, bathymetry monitoring will be compared to the previous year's survey. More intensive monitoring is employed when annual bathymetry or direct field observation reveal persistent mounding. Only the level of monitoring sufficient to address the specific management questions at hand would be undertaken.

The following Specific Monitoring Objectives are identified for the Umpqua River ODMD Sites:

- Ensure that dredged material is being placed as required by this SMMP and the provisions as codified in the Federal Register for the Sites;
- Ensure that the dredged material is behaving as predicted during placement (e.g., monitoring v. modeling);
- Ensure that placement of dredged material does not create persistent and adverse wave-generating mounds (principally a shallow water concern);
- Assess the significance of potential impacts of disposal operations on the public safety and resources or resource use; and
- Verify that material is moving out of the Sites over time, as predicted, providing long-term capacity without adverse effects.

For management purposes, routine monitoring will concentrate on how the disposed dredged material is behaving within and in the vicinity of the Sites, and determining how to distribute material. Bathymetric surveys of the Sites will be conducted annually. The number and length of transects required for annual assessment will be sufficient to encompass the area impacted by dredge material disposal. The survey area will extend at least one survey transect beyond the area impacted. Bathymetric surveys will be used to monitor the disposal mound(s) to assist in verification of material placement, to monitor bathymetric changes and trends and to ensure that the site capacity is not exceeded (eg., that the dredged material footprint does not exceed the site boundaries). The area where material is disposed will be surveyed to assess the potential capacity of the sites for the next dredging season and for future years (e.g., determining how much of the previous year's disposed material has dispersed from the Sites). Annual bathymetric profiles are evaluated for cumulative changes based upon comparison of the Baseline and most complete surveys available with the then-current survey results. Bathymetric surveys and difference plots will be provided to EPA as part of the annual assessment report.

If mound heights appear to be increasing over time, more intensive monitoring and/or management action will be taken. Such action may consist of restricting placement to

only certain portions of the ODMD Sites or some other similar disposal or management action. If placement restriction or similar management actions do not sufficiently control mound height, the Site(s) or portions thereof, may be temporarily, or the instance of extreme mounding, permanently closed to use.

Monitoring the use of the ODMD Sites and surrounding area for biological resources, and confirmatory characterization of sediment, physical, biological, and chemical studies as deemed to be necessary are expected to occur on an approximate 7 to 9 year schedule, with the first monitoring event to occur by 2016. This schedule can be adjusted as necessary (see below Section on Adaptive Management and Monitoring). It is anticipated that such reassessments will be documented as stand-alone reports to directly support monitoring efforts at the Umpqua ODMD Sites.

Adaptive Management and Monitoring

The Sites will be adaptively managed to avoid unreasonable degradation or endangerment of human health or welfare or the marine environment. Site management and monitoring will be adjusted at any time as conditions warrant, and if EPA has reason to believe the marine environment at the Sites may be at an increased risk of degradation, additional testing may be required, and site use may be restricted or terminated while assessment is underway. The Corps and EPA may also from time to time, discuss ODMD Site monitoring with Federal and State agencies.

Special Studies

Special Studies are non-routine studies of specified duration that are intended to address specific questions or issues that are not covered by routine monitoring events or that arise from routine monitoring. The obvious need for a Special Study would be following an accident or spill. However, other circumstances may warrant special studies. Under such circumstances, the EPA and USACE would mutually scope and conduct appropriate studies to determine the effect of the incident on the Sites and to ascertain whether specific contingency or possible enforcement action would be necessary. The results of any Special Studies would be used to refine future management objectives and practices, modify routine monitoring requirements, or reset baseline conditions. Depending on the objective of the study, technical assistance or advice would be sought from other public agencies, and entities. It is anticipated that special studies would be coordinated with the Northwestern Regional Dredging Team.

Restrictions and Requirements

- Only clean dredged material can be placed into the ocean under current statutes and regulations. Sediment suitability must be documented prior to disposal at the Sites following procedures approved by the Regional Sediment Evaluation Team;
- The EPA may condition, terminate or restrict site use with cause.

Annual Summary Assessment Requirement

The operational mechanism for use and monitoring of the Sites on an annual basis as well as management decision-making will be the annual summary report updates. The annual summary report for a given dredging year is based on the results of the previous year's monitoring, the pre-dredging/disposal hydrographic surveys (typically conducted in the spring), and dredge operating parameters. The summary will focus on any operational adjustments which should be implemented. It is expected that the primary user of the ODMD Sites will be the USACE for material dredged from federal projects. The summary will identify the capacities of the ODMD Sites, expected volumes to be disposed, dredging and disposal techniques, timings and locations, routine monitoring or special studies, and other considerations drawing on the then-current site use conditions and SMMP. The USACE, either as user of the Sites or as permitting authority, will take the lead to draft the summary and provide it to EPA. Once reviewed by EPA, the summary will constitute the template for that year's disposal. EPA recognizes that the summary cannot anticipate every operational situation and that day-to-day flexibility in dredging and disposal decisions will be necessary. However, the user will make every effort to consult with EPA and seek their concurrence before changes are initiated, for example, decisions to increase the spacing between the dumping positions, to shift disposal operations to different portions of the Site(s), to redistribute material at a Site, or to make other significant changes in site use or management.

Record-Keeping and Reporting Requirements

Daily records are required of dredging and disposal activities, indicating where material was dredged and where and how material was disposed. Also required to be recorded are start and endpoint coordinates for each load disposed. An annual summary report of quantities dredged and disposed at each of the Sites will be prepared and provided to EPA.

Data from any routine monitoring or special studies will be compiled and submitted to the EPA (ATTN: Region 10, Ocean Dumping Coordinator). These results will be evaluated by EPA and the USACE. EPA has final authority over site management decisions. In addition, the USACE is expected to notify EPA 15 days prior to the beginning of a dredging cycle or project disposal. Holders of Section 103 permits who have received EPA concurrence for use, will notify EPA not less than 20 days prior to disposing at the Umpqua River ODMD Sites.

Inspection and Surveillance Provisions

EPA will typically utilize the inspection and surveillance capabilities of the USACE and the U.S. Coast Guard (USCG); however, EPA may choose to implement its own inspection and surveillance requirements using EPA personnel and/or contractors. It is expected that EPA may coordinate with the USACE on any special inspections and surveillance.

Special Management Conditions or Practices

The following Special Management Conditions will be implemented at the Umpqua River ODMD Sites:

Placement Strategy

The placement strategy has a large influence on the consequences of disposal in any site. Placement strategies vary, ranging from individual dumps to the long-term distribution of material. Both EPA and USACE policy establishes a preference for beneficial use of dredged material when practical. The intermediate and particularly the shallow nearshore portions of the North and South Sites are judged to have greater potential to provide a positive benefit as dispersion of sediments is inshore toward the beaches as well as along existing bathymetric contours. Accordingly, any sandy material going to the ocean must preferentially use the nearshore area. Exceptions to this requirement may include: (1) material or equipment incompatibility; (2) weather or navigation safety (e.g., use of multiple dredges) conflicts; (3) expected volumes exceed annual capacity in any year; (4) conflict with non-federal conditions; and/or (5) specific restriction or direction by EPA.

A Uniform Placement Strategy will be applied to both Sites; however, the specific manner in which this strategy will be applied at each Site may differ due to the greater dispersive or less-dispersive characteristics of different depth zones. Application of "uniform placement" is most critical to each annual disposal series, and particularly for the nearshore zone. Application of "uniform placement" is an expected outcome over the long-term and multiple-year disposals, rather than a placement regime to be achieved during each dredging season, particularly in the offshore zones where dispersal is very slow.

Equipment Considerations

The type of dredge used for disposal influences the dimensions of the individual and cumulative dump mound. No specific disposal technique is required at the Umpqua River ODMD Sites. For the hopper dredges that commonly work at Umpqua River, such as the USACE's multiple bottom-door hopper dredge Yaquina, each load would produce a thinner deposit than the split-hull contract hopper dredges at any given water depth. Material disposed from a split-hull barge is typically more consolidated than material disposed from a multiple bottom-door hopper dredge. Only hopper dredges can be used at the Umpqua River entrance channel due to waves and currents. Clam shell dredges with barges can be used at estuary sites such as Winchester Bay and harbor.

Equipment Requirements

Hopper dredges or clamshell and barge operations could include USACE and private contract dredges. All such operations are required to meet all USCG requirements for

safety. They are also required to use modern global positioning equipment capable of fixing their location within plus or minus 3 feet to ensure that material is placed within the designated disposal Sites.

Quantity, Seasonal and Weather and Environmental Restrictions

Dredging and disposal actions are generally concurrent activities. Quantities placed at the Sites will vary year-to-year depending on shoaling of the project and will be monitored. Disposal volumes and placement will be closely monitored and documented, to verify uniform placement, and to assess dispersive capability. Seasonal restrictions due to adverse sea and weather conditions limit dredging and disposal to a period typically from June through October. Even during the dredging season, storm events can restrict disposal events. Environmental restrictions may be imposed on dredging and / or disposal. In the event monitoring results reveal the need for additional time restrictions, disposal activities will be scheduled so as to avoid unacceptable adverse impacts.

Debris Removal Provisions

Debris is 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-floatable, non-sediment materials 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.

The USACE 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 disposal at the ODMD Sites. 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.

Disposal of debris at ODMD Sites is prohibited. Typically the planning or permitting process assesses the potential risks of any debris that could be encountered during dredging. Dredging contractors and USACE dredge captains are required to maintain a record of the handling of debris encountered during dredging and disposal. Compliance inspectors may review these records. Copies of these records may be required as part of annual reporting.

Quantity of Material and Presence of Contamination

Section 102(c)(3)(D) of the MPRSA requires that management plans include consideration of the quantity of the material to be disposed of at a disposal site, and the presence, nature, and bioavailability of the contaminants in the material.

Portions of the dredged material disposed at the Sites are expected to move across the boundaries of the Umpqua River ODMD Sites after disposal. The rate and direction of movement of disposed dredge material across the ODMD Site boundaries is determined by physical transport mechanisms. Depending on these transport mechanisms and the nature of the material, transport may be rapid and continuous, or may occur only during episodic events, such as storms or seasonal changes in transport mechanisms.

Only clean dredged material can be placed into the ocean under current statutes and regulations; there is no need for further restriction on material suitability. Material suitability must be documented prior to disposal at the Site. This is typically completed as part of regulatory permitting (non-Corps) or the Corps' substantive review process. All sediments to be disposed at the ODMD Sites will first be evaluated according to then-current requirements of the MPRSA, national guidance, and local/regional manual and determined to be suitable for ocean disposal. Representatives of the USACE Portland District, EPA Region 10, other federal agencies and the States of Oregon and Washington comprise the Regional Sediment Evaluation Team (RSET), which has developed a comprehensive Sediment Evaluation Framework (SEF - 2006) for the Pacific Northwest under the direction of the Northwestern Regional Dredging Team (RDT). It is expected that the interagency RDT through the local Portland Project Review Group (PRG) will be used to evaluate the suitability of sediments using the SEF. The current and future SEF evaluation procedures are designed to be consistent with the MPRSA.

Characterization records of dredged material approved to be disposed at any portion of the Umpqua River ODMD Sites will typically be retained by the USACE, either as the entity responsible for the dredging and disposal (Planning and/or O&M program) or the permitting agency (regulatory permits). USACE O&M projects sediment evaluation report are to be posted upon the web at https://www.nwp.usace.army.mil/ec/dme.asp . Ultimately, all sediment data will be routinely entered into the Northwestern RDT sediment database where it would be publicly available. Secondary copies of characterizations will be retained by EPA.

Site Management Plan Review and Revision

Section 102(c)(3)(F) of the MPRSA requires that the management plan include a schedule for review and revision of the plan. Revisions to the SMMP will be made as determined necessary by EPA. Should the results of monitoring or special studies indicate that the continued use of any ODMD Sites would lead to unacceptable effects, this SMMP will be modified as necessary to mitigate such effects. At least every 10 years after this SMMP is finalized and throughout the life of the Site, EPA is required to conduct a substantive review of the SMMP. These reviews will involve coordination with other agencies, technical experts, and stakeholders.

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